Construction & Operations Plan

Revolution Wind Farm

Volume I

Executive Summary, Introduction, Project Siting and Design Development, Description of Proposed Activity, Site Characterization and Assessment of Potential Impacts, and References

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Submitted to

BOEM
Bureau of Ocean Energy Management

Submitted by

Revolution Wind | Powered by Ørsted & Eversource

Prepared by

vhb

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
μg/L	micrograms per liter
μg/m^3	microgram(s) per cubic meter
μPa	micropascal(s)
μT	microtesla(s)
ac	acres
AC	alternating current
ACCSP	Atlantic Coastal Cooperative Statistics Program
ACS	American Community Survey
ADLS	Aircraft Detection Lighting System
AGL	above ground level
AIS	Automatic Identification System
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMI	area of mutual interest
AMSL	above mean sea level
AP	Assessor's Plat
APE	Area of Potential Effects
ASCE	American Society of Civil Engineers
ASSF	Area Subject to Stormwater Flowage
ASMFC	Atlantic States Marine Fisheries Commission
ATON	Aids to Navigation
AWEA	American Wind Energy Association
AWOIS	Automated Wreck and Obstruction Information System
BACT	best available control technology
BCC	Birds of Conservation Concern
BEA	Bureau of Economic Analysis
bgs	below ground surface
BIWF	Block Island Wind Farm

BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BP	before present
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CBI	Chlorophyll Bloom Index
CEC	chemical contaminants of emerging concern
CEQ	Council on Environmental Quality
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
CFSR	Climate Forecast System Reanalysis
CH_4	methane
CHIRP	Compressed High Impact Radar Pulse
cm	Centimeter(s)
cm/s	centimeter(s) per second
CMECS	Coastal and Marine Ecological Classification Standard
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	corresponding onshore area (air quality) or Conservation Opportunity Area (habitat)
COLREGs	International Regulations for Preventing Collisions at Sea 1972
COP	Construction and Operations Plan
CRMP	Coastal Resource Management Program
CT DEEP	Connecticut Department of Energy and Environmental Protection
CTV	crew transfer vessel
CVA	Certified Verification Agent
CWA	Clean Water Act of 1972
cy	cubic yard(s)
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
dB	decibel

dBA	A-weighted decibel
DDT	dichlorodiphenyltrichloroethane
DEQ	Virginia Department of Environmental Quality
DO	dissolved oxygen
DoD	United States Department of Defense
DP	dynamic positioning
DPS	distinct population segment
DSM	digital surface model
DTM	digital terrain model
DWT	dead-weight tonnage
EA	Environmental Assessment
EC4	Executive Climate Change Coordinating Council
EFH	essential fish habitat
EG	Estimated Gust
EIS	Environmental Impact Statement
EMF	electric and magnetic fields
EMS	emergency medical services
ENC	Electronic Navigation Charts
EO	Executive Order
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Right-to-Know Act
ERM	effects range median (water quality) or RIDEM Environmental Resource Map
ERP/OSRP	Emergency Response Plan/Oil Spill Response Plan
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
FAB/HAB	Fishermen's Advisory Board and Habitat Advisory Board
FDR	Facility Design Report
FEMA	Federal Emergency Management Agency
FIR	Fabrication and Installation Report or Fishing Industry Representatives
FIRM	Flood Insurance Rate Map
FHWA	Federal Highway Administration
FMP	Fishery Management Plan

FPM	flashes per minute
ft/s	foot (feet) per second
ft^2	square foot (feet)
FWRAM	Full Wave Range Dependent Acoustic Model
g C m^{-2} day^{-1}	grams of carbon per meter squared per day
G&G	geophysical and geotechnical
gal	gallon
GARFO	Greater Atlantic Regional Fisheries Office (National Oceanic and Atmospheric Administration)
GBS	gravity base structure
GDP	gross domestic product
GGRA	Greenhouse Gas Emissions Reduction Act
GHG	greenhouse gas
GIS	geographic information system
GLD	Geographic Location Description
GMWD	Global Maritime Wrecks Database
GW	gigawatt(s)
GWSA	Global Warming Solutions Act
ha	hectare
HAP	hazardous air pollutant
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HF	High frequency
HRSA	Historic Resources Study Area
HRVEA	Historic Resources Visual Effects Analysis
HVAC	High voltage alternating current
HYCOM	Hybrid Coordinate Ocean Model
Hz	hertz
IAC	Inter-Array Cable
IBTrACS	International Best Track Archive for Climate Stewardship
ICF	Interconnection Facility
IEEE	Institute of Electrical and Electronics Engineers

IHA	Incidental Harassment Authorization
IMO	International Maritime Organization
IPF	impact-producing factor
ITA	Incidental Take Authorization
kJ	kilojoule
km	kilometer(s)
KOP	key observation point
kV	kilovolt(s)
kW	kilowatt(s)
L	liter
LAER	lowest achievable emission rate
lbs	pounds
Ldn	Day-night average sound level
LEC	LEC Environmental Consultants, Inc.
Leg	Energy-average sound level
LF	Low frequency
LGM	Last Glacial Maximum
LiDAR	light detection and ranging
LNM	Local Notice to Mariners
LOA	Letter of Authorization or length overall
LOW	limit of work
LSZ	landscape similarity zone
m	meter(s)
μM	micromoles
MA	Massachusetts
m/s	meter(s) per second
m^2	square meter(s)
m^3	cubic meter(s)
MACEC	Massachusetts Clean Energy Center
MACZM	Massachusetts Office of Coastal Zone Management
MARA	Marine Archaeological Resources Assessment

MARPOL	International Convention for the Prevention of Pollution from Ships MARPOL)
MassDEP	Massachusetts Department of Environment Protection
MBTA	Migratory Bird Treaty Act
MA WEA	Massachusetts Wind Energy Area
MDE	Maryland Department of the Environment
MF	mid-frequency
Mft^3	million cubic feet
MG	Measured Gust
mG	milligauss
mg/L	milligram(s) per liter
MHWL	mean high water line
mm	millimeter(s)
Mm^3	million cubic meters
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MNL	Marine Navigation Lighting
MONM	Marine Operations Noise model
MoUs	Memorandum of Understandings
MRE	Marine Renewable Energy
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	mean sea level
MEC	Munitions and Explosives of Concern
mV/m	millivolt(s)/meter
MVP	Monitor Values Report
MW	megawatt(s)
MWA	Maximum Work Area
N_2O	nitrous oxide
NAA	nonattainment area
NAAQS	National Ambient Air Quality Standards
NARW	North Atlantic right whale
NAVD88	North American Vertical Datum of 1988
NBC	Narragansett Bay Commission
NBEP	Narragansett Bay Estuary Program

NBFSMN	Narragansett Bay Fixed Site Monitoring Network
NBNERR	Narragansett Bay National Estuarine Research Reserve
NBWTR	State of Narragansett Bay and Its Watershed Technical Report
NCCA	National Coastal Condition Assessment
NCCR	National Coastal Condition Report
NCEIFSD	National Centers for Environmental Information Storm Events Database
NCDC	National Climatic Data Center
NCEP	National Centers for Environmental Prediction
NCODA	Navy Coupled Ocean Data Assimilation
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center (National Oceanic and Atmospheric Administration)
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NESEC	Northeast States Emergency Consortium
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGEO	Non-governmental environmental organization
ng/L	nanograms per liter
NH_3	Ammonia
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NJDEP	New Jersey Department of Environmental Protection
NLCD	National Landcover Dataset
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NMS	noise mitigation systems
NO_2	nitrogen dioxide or nitrite
NO_3	nitrate
NOA	nearest onshore area
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxide(s)
NPCC	Northeast Power Coordinating Council, Inc.
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places

NSRA	navigational safety risk assessment
NSR	new source review or noise-sensitive receptor
NTL	Notice to Lessee
NTSC	National Transportation Safety Council
NVIC	Navigation and Vessel Inspection Circular
NWR	National Wildlife Refuge
NWS	National Weather Service
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
O_3	Ozone
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCS Lands Act	Outer Continental Shelf Lands Act
OFD	One Federal Decision
OH	Overhead
OnSS	Onshore Substation
OPAREA	Special Operating Area
OSAMP	Ocean Special Area Management Plan
OSRP	Oil Spill Response Plan
OSS	offshore substation
OW	otariid pinnipeds in water
PAL	The Public Archaeology Laboratory, Inc.
PAPE	Preliminary Area of Potential Effects
PATON	Private Aids to Navigation
Pb	lead
PBR	potential biological removal
PCB	polychlorinated biphenyl
PDE	Project Design Envelope
PLGR	pre-lay grapnel run
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in aerodynamic diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in aerodynamic diameter

PO_4	orthophosphate
POI	Point of Interconnection
PPA	Power Purchase Agreement
ppb	Part(s) per billion
ppm	part(s) per million
PPW	phocid pinnipeds in water
Project	Revolution Wind Farm Project
PSO	Protected Species Observer
PTS	permanent threshold shift
PV	Plan View
QBPD	Quonset Business Park District
QDC	Quonset Development Corporation
QMA	Qualified Marine Archaeologist
RHA	Rivers and Harbors Appropriation Act of 1899
RI	Rhode Island
RICR	Rhode Island Code of Regulations
RI CRMC	Rhode Island Coastal Resources Management Council
RI CRMP	Rhode Island Coastal Resources Management Program
RIDEM	Rhode Island Department of Environmental Management
RIDOT	Rhode Island Department of Transportation
RI EFSB	Rhode Island Energy Facility Siting Board
RIGL	Rhode Island General Law
RIGIS	Rhode Island Geographic Information System
RIHPHC	Rhode Island Historical Preservation and Heritage Commission
RI-MA WEA	Rhode Island/Massachusetts Wind Energy Area
RIPDES	Rhode Island Pollutant Discharge Elimination System
RISDISM	Rhode Island Stormwater Design and Installation Manual
RI WAP	Rhode Island Wildlife Action Plan
rms	root mean square
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
ROI	region of influence

ROW	right(s)-of-way
RSZ	Rotor Swept Zone
RTE	rare, threatened, and endangered species
RV	recreational vehicle
RWEC	Revolution Wind Export Cable
RWEC-OCS	Revolution Wind Export Cable-Outer Continental Shelf
RWEC-RI	Revolution Wind Export Cable-Rhode Island Waters
RWF	Revolution Wind Farm
SAMP	Special Area Management Plan
SAP	Site Assessment Plan
SAV	submerged aquatic vegetation
SCADA	Supervisory Control and Data Acquisition
SEL	sound exposure limit
SEL_{cum}	cumulative sound exposure level
SER	Site Evaluation Report
SERDP-SDSS	Strategic Environmental Research and Development Program spatial decision support system
SES	Surface Effects Ship
SESC	Soil Erosion and Sediment Control
SF_6	Sulfur hexafluoride
SFWF	South Fork Wind Farm
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SOV	services operations vessel
SPCC	spill prevention, control, and countermeasure
SPI	Sediment Profile Imaging
SPL	sound pressure level
$SPL_{0\text{-}pk}$	peak sound pressure level
SPL_{rms}	root-mean-square sound pressure level
SSFATE	Suspended Sediment FATE
TCP	Traditional Cultural Property
THPO	Tribal Historic Preservation Office(r)

TJB	Transition joint bay
TNEC	The Narragansett Electric Company d/b/a National Grid
TP	transition piece
tpy	tons per year
TSS	total suspended solids
TTS	temporary threshold shift
U.S.C.	*United States Code*
UDP	unanticipated discovery plan
UME	Unusual Mortality Event
URI	University of Rhode Island
USACE	United States Army Corps of Engineers
USCB	United States Census Bureau
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USDOC	United States Department of Commerce
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTC	Coordinated Universal Time
UXO	unexploded ordnance
VHB	Vanasse Hangen Brustlin, Inc.
VIA	Visual Impact Assessment
VOC	volatile organic compound
VRAP	Visual Resource Assessment Procedure
VSA	Visual Study Area
VSR	Visually Sensitive Resources
VTR	Vessel Trip Report
W-3	Port/Maritime Industrial Waterfront District
WEA	Wind Energy Area
WTG	wind turbine generator
WTS	Waterson Terminal Services
WWTF	wastewater treatment facility

XLPE	cross-linked polyethylene

Glossary and Terms

Term	Definition
Bundle	Two or more wires joined together to operate as a single phase.
Cable	A fully insulated conductor installed underground.
Circuit Breaker	A switch that automatically disconnects power to the circuit in the event of a fault condition. Located in substations.
Circuit	A system of conductors (three conductors or three bundles of conductors) through which an electric current is intended to flow, and which may be supported above ground by transmission structures or placed underground.
Conductor	A metallic wire or cable which serves as a path for electric current to flow.
Conduit	Pipes, typically encased in concrete to house and protect underground power cables or other subsurface utilities.
Certified Verification Agent (CVA)	An individual or organization, experienced in the design, fabrication, and installation of offshore marine facilities or structures, who will conduct specified third-party reviews, inspections, and verifications in accordance with 30 CFR 585.705.
Day-Night Average Sound Level (Ldn)	Single value that represents the same acoustic energy as fluctuating levels that exist over a 24-hour period. The Ldn considers how loud sound events are, how long they last, how many times they occur over a 24-hour period, and whether they occur during the day (7:00 AM to 10:00 PM) or night (10:00 PM to 7:00 AM).
Decibel (dB)	A logarithmic unit of measurement that can be used to express the magnitude of a sound.
Decibel, on the A-weighted scale (dB(A))	A decibel weighted to emphasize the range of frequencies where human hearing is most sensitive.
Demand	The total amount of electric power required at any given time by an electric supplier’s customers.
Double-Circuit	Two circuits on one structure.
Duct	Pipe for underground power cables (see also Conduit).
Duct Bank	A group of ducts or conduit usually encased in concrete in a trench.
Electric Field	A field produced as a result of voltages applied to electrical conductors and equipment; usually measured in units of kilovolts per meter.
Electric Transmission Facilities	The facilities (≥69 kV) that transmit electrical energy from generating plants to substations.

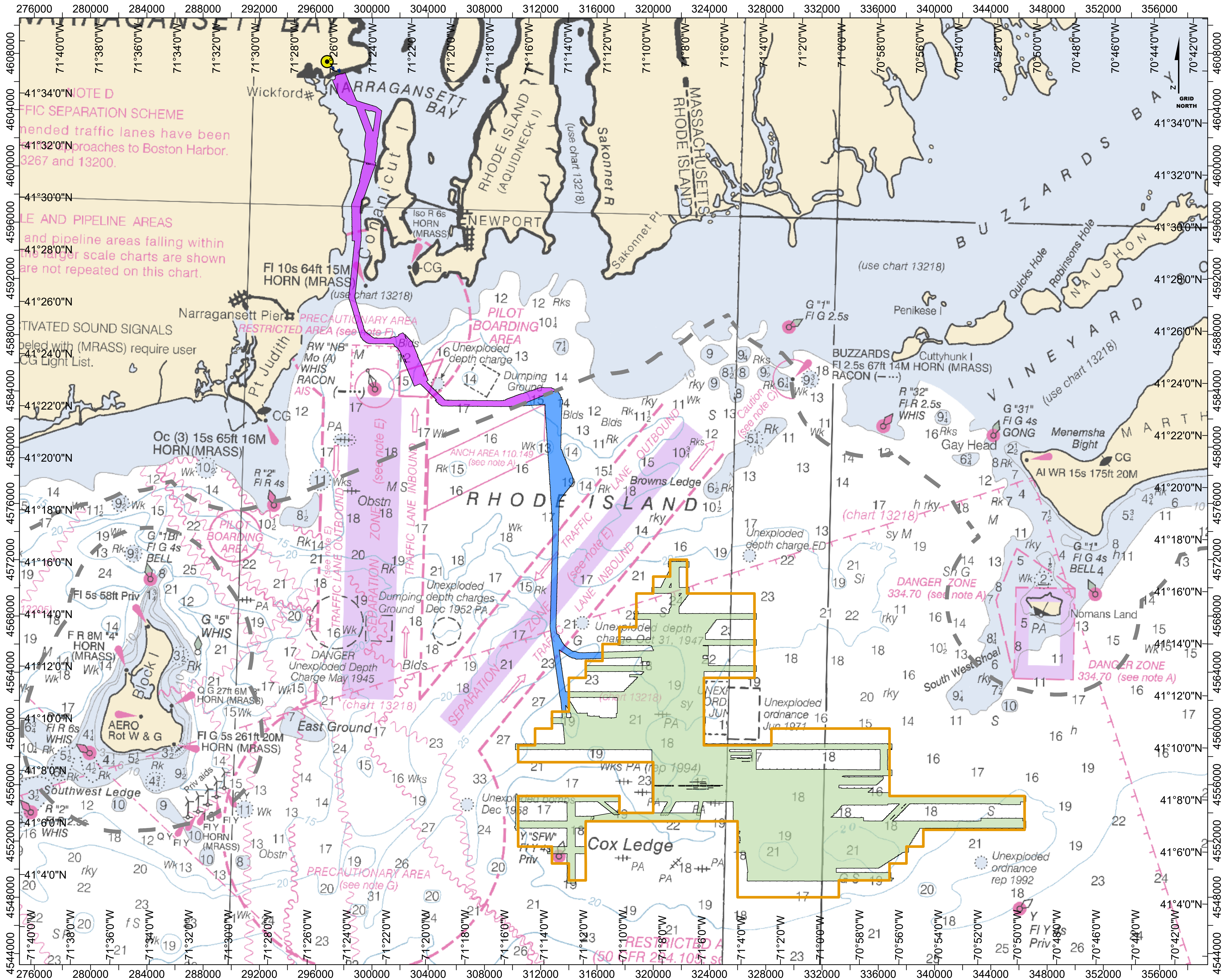
Term	Definition
Energy-Average Sound Level (Leq)	Leq is a single value that represents the same acoustic energy as the fluctuating levels that exists over a given period. The Leq considers how loud noise events are during the period, how long they last, and how many times they occur. Leq is commonly used to describe environmental noise and relates well to human annoyance.
Environmental Protection Measure (EPM)	Measure proposed to avoid or minimize potential impacts.
Fault	A failure or interruption in an electrical circuit (a.k.a. short circuit).
Facility Design Report and Fabrication and Installation Report (FDR/ FIR)	The FDR provides specific details of the design of any facilities, including cables and pipelines that are outlined in a BOEM-approved Construction and Operations Plan. The FIR demonstrates how the facilities will be fabricated and installed in a manner that conforms to developer responsibilities listed in CFR §585.105(a).
Foundation	The bases to which the wind turbine generators (WTGs) and Offshore Substations (OSSs) are installed on the seabed. Three types of foundations have been considered and reviewed for the Project: jacket, monopile, or gravity base structure (GBS). Monopile is the selected foundation type for the Project.
Freshwater Wetland Rules	CRMC Rules and Regulations Governing the Protection and Management of Freshwater Wetlands in the Vicinity of the Coast (650-RICR-20-00-02)
Gauss (G)	A unit of measure for magnetic fields. 1G equals 1,000 milliGauss.
Glacial till	Type of surficial geologic deposit that consists of boulders, gravel, sand silt, and clay mixed in various proportions. These deposits are predominantly nonsorted, nonstratified sediment and are deposited directly by glaciers.
Hertz (Hz)	A measure of the frequency of alternating current; expressed in units of cycles per second.
Horizontal Directional Drill (HDD)	Subsurface installation technique that will create an underground conduit through which an export cable may be installed through the intertidal zone.
Impact determinations	Direct or indirect; and short-term or long-term (further defined in Section 4.0).
Impact-Producing Factor (IPF)	Project activities and infrastructure that could impact resources were identified as IPFs.
Inter-Array Cable (IAC)	Cables that connects individual WTGs and transfers power between the WTGs and the OSS.
Interconnection Facility (ICF)	The TNEC Davisville Substation serves as the point of interconnection for the Project. The ICF is a modification of the Davisville Substation to facilitate the interconnection.
Interconnection ROW	ROW (right of way) of underground transmission lines between the OnSS and the ICF.
ISO New England, Inc.	The independent system operator of the electric transmission system in New England.
Landfall Envelope	The spatial onshore area at Quonset Point in North Kingstown, Rhode Island where landfall of the Project’s submarine export cables will be sited within.

Term	Definition
Landfall Work Area	Location on the shore in Quonset Business Park of Quonset Point in North Kingstown, Rhode Island, considered for a sea-to-shore export cable transition
Mechanical cutter	Method of submarine cable installation equipment that involves a cutting wheel or excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor.
Mechanical plow	Method of submarine cable installation equipment that involves pulling a plow along the cable route to lay and bury the cable. The plow's share cuts into the soil, opening a temporary trench which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. Some plows may use additional jets to fluidize the soil in front of the share.
Offshore Envelope	The area within which all offshore Project infrastructure will be sited within, further divided into the RWF Envelope, RWEC-OCS Envelope, and RWEC-RI State Waters Envelope. All associated seabed disturbance (e.g., vessel anchoring) associated with construction and operation and maintenance of the Project's infrastructure will be confined to the Offshore Envelope.
Offshore Substation (OSS)	Substation facility that collects electric energy generated by the WTG through the IACs for transmission through the RWEC. Mounted on dedicated foundation or co-located on one foundation with a WTG. The Project will include up to two Offshore Substations (OSSs).
Onshore Facilities	Landfall Work Area, Onshore Transmission Cable, Onshore Substation, Interconnection ROW, ICF and overhead ROW.
Onshore Substation (OnSS)	New substation facility to be located adjacent to the existing TNEC Davisville substation.
Onshore Transmission Cable	New onshore transmission cable between the TJBs and the OnSS.
OSS-Link Cable	Submarine transmission cable connecting the two OSSs (presuming two OSSs).
Operations and Maintenance (O&M) Facility	An ancillary facility of the Project that may be located at an existing port facility as outlined in Table 3.3-24. The O&M facility will support remote monitoring of the wind farm and offshore maintenance activities.
Overhead (OH)	Electrical facilities carried above-ground on supporting structures.
Power Purchase Agreement (PPA)	A financial agreement between two parties. This Project has three PPAs with the States of Connecticut and Rhode Island
Power Transformer:	A device used to transform voltage levels to facilitate the efficient transfer of power from the generating plant to the customer. A step-up transformer increases the voltage while a step-down transformer decreases it. Power transformers have a high voltage and a low voltage winding for each phase.
Pre-lay grapnel run (PLGR)	Process to remove possible obstructions and debris (such as abandoned fishing nets, wires, and hawsers) by pulling a grapnel along the proposed routes of the inter-array and –export cables.

Term	Definition
Revolution Wind, LLC	Owner and future operator of the Project and the Project Applicant.
Revolution Wind Export Cable (RWEC)	Comprised of an alternating current (AC) electric cable that will connect the RWF to the existing onshore regional electric transmission grid in North Kingstown, Rhode Island. The export cable located in both federal waters (RWEC-OCS) and Rhode Island State Waters (RWEC-RI) › RWEC-OCS: the submarine segment of the export cable buried beneath the seabed within federal waters on the OCS from the OSS to the boundary of Rhode Island State Waters. › RWEC-RI: the submarine segment of the export cable buried beneath the seabed within state territorial waters from the boundary of Rhode Island State Waters to the onshore transition joint bay at Quonset Point.
Revolution Wind Farm (RWF)	Comprised of up to 100 wind turbine generators (WTGs), IACs, OSS-Link Cable and up to two OSSs, all of which will be located within federal waters on the outer continental shelf (OCS).
Right-of-way (ROW)	Right-of-way. Corridor of land within which a utility company holds legal rights necessary to build, operate and maintain power lines.
Scour protection	Consists of engineered rock that may be placed at the base of each foundation to prevent undesirable seabed erosion.
Substation	A fenced-in yard containing switches, power transformers, line terminal structures, and other equipment enclosures and structures. Voltage change, adjustments of voltage, monitoring of circuits and other service functions take place in this installation.
Supervisory Control and Data Acquisition (SCADA)	Fiber optic system embedded in the Project cables that provides remote wind farm monitoring and control between the WTG, substations, and remote operation center(s). The SCADA provides a live status of environmental conditions within the RWF, as well as mechanical and electrical state of each WTG.
TNEC ROW	ROW containing overhead transmission lines including the Davisville Transmission Tap lines and the overhead lines connecting the ICF to the Davisville Substation.
Total Maximum Daily Load (TMDL)	Maximum allowed pollutant load to a water body without exceeding water quality standards.
Transmission Line	An electric power line operating at 69,000 or more volts.
Wetland	Land, including submerged land, which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial or floodplain by the USDA, Natural Resources Conservation Service. Wetlands include federally jurisdictional wetlands of the U.S. and navigable waters, freshwater wetlands or coastal resources regulated by a state or local regulatory authority. Jurisdictional wetlands are classified based on a combination of soil type, wetland plants, and hydrologic regime, or state-defined wetland types.
Wind Turbine Generator (WTG)	Electricity-generating wind turbine made of a tower, nacelle, rotor, and blades, with a nameplate capacity of 8 to 12 megawatts (MW) per turbine.

Executive Summary

This Revolution Wind Farm and Revolution Wind Export Cable Construction and Operations Plan (COP) is being submitted by Revolution Wind, LLC (Revolution Wind)(formerly DWW Rev I, LLC), a 50/50 joint venture between Orsted North America Inc. and Eversource Investment LLC, to support the siting and development of the Revolution Wind Farm and the Revolution Wind Export Cable (collectively, the Project). The wind farm portion of the Project (referred to as the Revolution Wind Farm [RWF]) will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area). The Lease Area's closest edge is approximately 15 statute miles (mi) (13 nautical miles [nm], 24.1 kilometers [km]) southeast of the Rhode Island coast. The Project also includes up to two submarine export cables (referred to as the Revolution Wind Export Cable [RWEC]), generally co-located within a single corridor through both federal waters and state waters of Rhode Island. The RWEC will make landfall at Quonset Point in North Kingstown, Rhode Island and will interconnect to the existing electric transmission system via the Davisville Substation, which is owned and operated by The Narragansett Electric Company (TNEC), located in North Kingstown, Rhode Island. The locations of the RWF and RWEC are shown on Figure ES-1; the onshore portions of the Project are shown on Figure ES-2.



Revolution Wind
Figure ES-1
Offshore Project Location

Legend

- OnSS

Offshore Envelope

- RWF Envelope
- RWEC-OCS Envelope
- RWEC-RI State Waters Envelope
- RWF Boundary Lease Area OCS-A 0486
- 3-Nautical Mile State Water Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
NOAA Raster Nautical Charts (RNC): NOAA Office of Coast Survey
Rhode Island Aerial Photographs (Spring 2018; State Plane):

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2500 5000 7500 Meters

0 9,000 18,000 27,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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ES-2

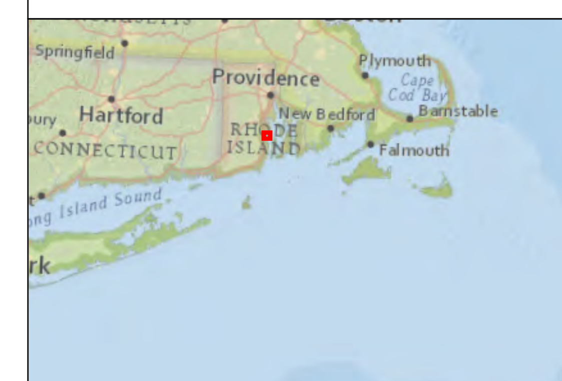
Onshore Project Location

NORTH KINGSTOWN, RI

Legend

- Onshore Transmission Cable
- Substation Limit of Work
- ICF Limit of Work
- Landfall Envelope
- RWEC-RI State Waters
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 60 120 180 Meters

0 225 450 675 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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The Project is defined in this COP using a Project Design Envelope (PDE) approach. The PDE defines "a reasonable range of project designs" associated with various components of a project (e.g., foundation and WTG options) (BOEM 2018). The PDE is used to assess the potential impacts on key environmental and human use resources (e.g., marine mammals, fish, benthic habitats, commercial fisheries, navigation, etc.), focusing on the design parameter (within the defined range) that represents the greatest potential impact (i.e., the maximum design scenario). The PDE for the Project is based on a maximum operating capacity ranging between 704 and 880 megawatts (MW) and includes the following primary assumptions: up to 100 wind turbine generators (WTGs) connected by a network of Inter-Array Cables measuring up to 155 mi (250 km) in total length; up to two Offshore Substations, connected by an up to 9-mi (15-km)-long OSS-Link Cable; up to two export cables (i.e., the RWEC) measuring up to 50 mi (80 km) in length; up to two underground transmission circuits (referred to as the Onshore Transmission Cable) located onshore and measuring up to 1 mi (1.6 km); and a new Onshore Substation and Interconnection Facility (ICF) and associated interconnection circuits. Based on stakeholder feedback, Revolution Wind is committed to a Project layout with WTGs situated in an approximate 1.15 mi (1 nm, 1.8 km) by 1.15 mi (1 nm, 1.8 km) grid, aligned with layouts proposed for other projects in the Rhode Island/Massachusetts Wind Energy Area (RI-MA WEA) and Massachusetts Wind Energy Area (MA WEA). While this layout reduces the overall efficiency and energy production of the Project, it satisfies the concerns of the regulatory agencies and the maritime community, and still allows for commercially feasible development of the Lease Area.

Revolution Wind assumes that all state and federal permits will be issued between Q1 and Q3 2023. Construction will begin as early as Q1 2023, beginning with the installation of the onshore components and initiation of seabed preparation activities (clearing of debris and obstructions).

The Project components and locations presented in this COP have been selected based on environmental and engineering site characterization studies completed to date and will be refined in the Facility Design Report (FDR) and Fabrication and Installation Report (FIR), which will be reviewed by BOEM pursuant to Title 30 of the Code of Federal Regulations (CFR) Parts 585.700-702 before the commencement of installation. In addition, a Certified Verification Agent (CVA), approved by BOEM, will conduct an independent assessment and verify that the Project components are fabricated and installed in accordance with both this COP and the FIR.

The purpose of the Project is to provide clean, reliable offshore wind energy that will increase the amount and availability of renewable energy to New England consumers while creating the opportunity to displace electricity generated by fossil fuel-powered plants and offering substantial economic and environmental benefits to the New England region. Massachusetts, Rhode Island, Connecticut, and New York, have adopted substantial renewable portfolio standards and clean energy targets to address issues associated with climate change, highlighting the current and future demand for this Project. In response to this expressed need and demand, Rhode Island and Connecticut have awarded Revolution Wind five Power Purchase Agreements (PPAs) to-date, totaling 704 MW of generation capacity. The Project will fulfill Revolution Wind's obligations to both Connecticut and Rhode Island in accordance with the PPAs and provide substantial environmental and economic benefits.

This COP includes the following information:

- An overview of the Project, including details on the regulatory framework in which the Project will be reviewed, a description of the agency and stakeholder outreach, a tentative schedule and other key Project information requested by BOEM (Section 1);
- A summary of the siting and route selection processes for the Project, including a siting history, details on steps taken to identify and evaluate potential cable routes, and description of technologies and installation methods considered (Section 2);
- A description of all planned facilities, including onshore and support facilities; and all proposed activities, including construction activities, commercial O&M, and conceptual decommissioning plans (Section 3); and
- A characterization and assessment of potential impacts during construction, O&M, and decommissioning activities, which will support relevant Project reviews and consultations (Section 4).

This COP was prepared in accordance with 30 CFR § 585. BOEM is expected to be the lead federal agency under the National Environmental Policy Act (NEPA). For activities in Rhode Island State Waters and onshore, the Rhode Island Energy Facility Siting Board (RI EFSB) will review Project activities as defined under the RI EFSB Rules of Practice and Procedure (445-RICR-00-00-1). State and local agencies will issue Advisory Opinions to the RI EFSB for consideration, as designated by the RI EFSB. The Rhode Island Coastal Resources Management Council (RI CRMC) will issue a Category B Assent and Submerged Lands License pursuant to RI CRMC Management Procedures (the "Red Book") (650-RICR-20-00-1 *et seq.*), a License to Alter Freshwater Wetlands (650-RICR-20-00-2), and a Federal Consistency Certification Letter of Concurrence pursuant to the Section 307 of the Coastal Zone Management Act (CZMA) (16 U.S.C. § 1456) and § 11.10 of RI Ocean Special Area Management Plan [Ocean SAMP] (650-RICR-20-05-2.1 *et seq.*). The Rhode Island Department of Environmental Management (RIDEM) will issue a Water Quality Certification RIGL § 46-12-3 and 250-RICR-150-05-1.1 *et seq.* (federal authority delegated to the State pursuant the Clean Water Act [CWA], 33 U.S.C. §§ 1341-1342), Authorization under the Rhode Island Pollutant Discharge Elimination System (RIPDES), and a Dredge Permit pursuant to the Rules and Regulations for Dredging and the Management of Dredged Materials (250-RICR-150-05-2.1 *et seq.*).

In addition to the federal and state level permits, the Project must also comply with applicable provisions of the Marine Mammals Protection Act (MMPA), the Migratory Bird Treaty Act (MBTA), the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), the National Historic Preservation Act (NHPA), the Clean Air Act (CAA), and the Rivers and Harbors Act (RHA).

Project activities that could impact resources were identified as Impact-Producing Factors (IPFs), which include seafloor and land disturbance; habitat alteration; sediment suspension and deposition; noise; electric and magnetic fields(EMF); discharges and releases; trash and debris; traffic; air emissions; visible structures; and lighting. The type and degree of potential impacts from Project activities vary based on the characteristics of the resource and the IPF that may affect each resource. Potential impacts were identified as either direct or indirect; and either short term or long term. These terms are defined in Section 4 of the COP. If measures are proposed to avoid and minimize potential impacts, the impact evaluation included consideration of these environmental protection measures. Table ES-1 summarizes the potential impacts expected from the implementation of the activities described in this COP and the environmental protection measures that Revolution Wind will implement to minimize these potential impacts.

Table ES-1 Summary of Potential Impacts and Environmental Protection Measures, by Resource

Resources	Potential Impacts by IPF	Environmental Protection Measures
Air Quality	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: No Impact › Air Emissions: Potential Impact › Visible Structures: No Impact › Lighting: No Impact	› Vessels providing construction or maintenance services will use low sulfur fuel, where possible. › Vessel engines will meet the appropriate Environmental Protection Agency (EPA) air emission standards for nitrogen oxide (NO_X) emissions when operating within Emission Controls Areas. › Onshore Facilities equipment and fuel suppliers will provide equipment and fuels that comply with the applicable EPA or equivalent emission standards. › Marine engines with a model year of 2007 or later and non-road engines complying with the Tier 3 standards (in 40 CFR 89 or 1039) or better will be used to satisfy best available control technology (BACT) or lowest achievable emission rate (LAER).
Water Quality	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: No Impact	› To the extent feasible, installation of the Inter-array cables (IACs), OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the Oil Spill Response Plan (OSRP). › All vessels will comply with United States Coast Guard (USCG) and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent

Resources	Potential Impacts by IPF	Environmental Protection Measures
		accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › At the landfall location, drilling fluids will be managed within a contained system to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids. › A Soil Erosion and Sediment Control (SESC) Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
Geological Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: No Impact	› IAC, OSS-Link Cable, and RWEC will avoid identified shallow hazards to the extent practicable. › To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › Dynamic positioning (DP) vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent possible. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Physical Oceanographic and Meteorological Conditions	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: No Impact	› No environmental protection measures to address physical oceanographic and meteorological conditions are proposed.
Coastal and Terrestrial Habitat	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: No Impact	› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › At the landfall location, drilling fluids will be managed within a contained system to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids. › Compliance with the RIPDES General Permit for Stormwater Discharges associated with Construction Activities which requires the implementation of a SESC Plan and spill prevention and control measures. › The operator must implement the site-specific SESC Plan and maintain it during the entire construction process until the entire worksite is permanently stabilized by vegetation or other means. The measures employed in the SESC Plan use best management practices (BMPs) to minimize the opportunity for turbid discharges leaving a construction work area. › The spill prevention and control measures mandate that the operator identify all areas where spills can occur and their accompanying drainage points. The operator must also establish spill prevention and control measures to reduce the chance of spills, stop the source

Resources	Potential Impacts by IPF	Environmental Protection Measures
		of spills, contain and clean-up spills, and dispose of materials contaminated by spills. Spill prevention and control training will be provided for relevant personnel. › The perimeter surrounding Onshore Facilities will be managed to encourage the growth of native grasses, ferns, and low growing shrubs. The management strategy will include the removal of invasive plants in compliance with state and federal regulations (e.g. herbicide use will not be permitted within regulated wetlands). › In accordance with Section 2.9(B)(1)(d) of the Freshwater Wetland Rules, the Onshore Facilities will be designed to avoid and minimize impacts to freshwater wetlands to the maximum extent practicable. Any wetlands that will be impacted as a result of the Project will be mitigated via the federal and state permitting process in accordance with Section 404 of the CWA and the Freshwater Wetland Rules. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities. › The documented sickle-leaved golden aster population on the OnSS parcel will be protected during construction.
Benthic and Shellfish Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: Potential Impact	› The RWF and RWEC will be sited to avoid and minimize impacts to sensitive habitats (e.g., hard bottom habitats) to the extent practicable. › To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel

Resources	Potential Impacts by IPF	Environmental Protection Measures
		anchors, and a site-specific Cable Burial Risk Assessment. › DP vessels will be used for installation of the IACs, OSS-Link Cable, and RWEC to the extent practicable. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › A preconstruction submerged aquatic vegetation (SAV) survey will be completed to identify any new or expanded SAV beds. The Project design will be refined to avoid impacts to SAV to the greatest extent practicable. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials will be managed through the OSRP. › All vessels will comply with United States Coast Guard (USCG) and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates

Resources	Potential Impacts by IPF	Environmental Protection Measures
		a yearly marine trash and debris awareness training and certification process. › A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities. › Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations.
Finfish and Essential Fish Habitat (EFH)	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impacts › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: Potential Impact	› To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. › DP vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent practicable. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts

Resources	Potential Impacts by IPF	Environmental Protection Measures
		being conducted by affiliates of Revolution Wind at other wind farms in the region. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities. › Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.

Marine Mammals	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and vibratory pile driving activities. › Environmental protection measures will be implemented for impact and vibratory pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, marine mammal and sea turtle monitoring protocols, the use of qualified and National Oceanic and Atmospheric Administration (NOAA)-approved protected species observers, and noise attenuation systems such as bubble curtains, as appropriate. › Vessels will follow NOAA guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions. › All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness. › Revolution Wind will require all construction and operation vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external

Resources	Potential Impacts by IPF	Environmental Protection Measures
		hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
Sea Turtles	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emission: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and vibratory pile driving activities. › Mitigation measures will be implemented for impact and vibratory pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, marine mammal and sea turtle monitoring protocols, the use of qualified and NOAA-approved protected species observers, and noise attenuation systems such as bubble curtains, as appropriate. › Vessels will follow NOAA guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions. › All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness. › Revolution Wind will require all construction and operation vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target

Resources	Potential Impacts by IPF	Environmental Protection Measures
		burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
Avian Species	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› To the extent feasible, tree and shrub removal for Onshore Facilities will occur outside the avian nesting and bat roosting period; May 1 through August 15. If tree and shrub removal cannot be avoided during this season, Revolution Wind will coordinate with appropriate agencies to determine appropriate course of action. › Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian species to avoid individual WTGs and minimize risk of potential collision. › Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations. › Revolution Wind will comply with Federal Aviation Administration (FAA) and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimizes impacts on avian species. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates

Resources	Potential Impacts by IPF	Environmental Protection Measures
		a yearly marine trash and debris awareness training and certification process. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities. › Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › The Onshore Transmission Cables will be buried; therefore, avoiding the risk to avian and bat species associated with overhead lines. › Revolution Wind is developing an Avian Post-Construction Monitoring Plan for the Project that will summarize the approach to monitoring; describe overarching monitoring goals and objectives; identify the key avian species, priority questions, and data gaps unique to the region and Project Area that will be addressed through monitoring; and describe methods and time frames for data collection, analysis, and reporting. Post-construction monitoring will assess impacts of the Project with the purpose of filling select information gaps and supporting validation of the Project's Avian Risk Assessment. Focus may be placed on improving knowledge of ESA-listed species occurrence and movements offshore, avian collision risk, species/species-group displacement, or similar topics. Where possible, monitoring conducted by Revolution Wind will build on and align with post-construction monitoring conducted by the other Orsted/Eversource offshore wind projects in the Northeast region. Revolution Wind will engage with federal and state agencies and environmental groups (eNGOs) to identify appropriate monitoring options and technologies, and to facilitate acceptance of the final plan. › Revolution Wind will document any dead (or injured) birds/bats found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and United States Fish and Wildlife Service (USFWS).

Resources	Potential Impacts by IPF	Environmental Protection Measures
Bat Species	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. › To the extent feasible, tree and shrub removal for Onshore Facilities will occur outside the avian nesting and bat roosting period; May 1 through August 15. If tree and shrub removal cannot be avoided during this season, Revolution Wind will coordinate with appropriate agencies to determine appropriate course of action. › Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian and bat species to avoid individual WTGs and minimize risk of potential collision. › Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian and bat species. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities. › Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › The Onshore Transmission Cables will be buried; therefore, avoiding the risk to avian and bat species associated with overhead lines. › Revolution Wind will document any dead (or injured) birds/bats found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and USFWS.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Above-Ground Historic Properties	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Negligible › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Revolution Wind will use Aircraft Detection Lighting System (ADLS) (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. › RWF WTGs will have uniform design, speed, height, and rotor diameter, thereby mitigating visual clutter. › The WTGs will be painted Pure White (RAL 9010) to Light Grey (RAL 7035) as recommended by BOEM and the FAA. This color white of the turbines generally blends well with the sky at the horizon and eliminates the need for daytime warning lights or red paint marking of the blade tips. › The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties. › The Onshore Facilities will be located adjacent to an existing substation on a parcel zoned for commercial and industrial/utility use. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise.
Marine Archaeological Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: No Impact › Lighting: No Impact	› The RWF and RWEC will be sited to avoid or minimize impacts to potential submerged cultural sites and paleo landforms, to the extent practicable. › Native American Tribal representatives were involved, and will continue to be involved, in marine survey protocol design, execution of the surveys, and interpretation of the results. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › An Unanticipated Discovery Plan (UDP) will be implemented that will include stop-work and notification procedures to be followed if a potentially significant archaeological resource is encountered during construction.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Terrestrial Archaeological Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact (Traditional Cultural Properties [TCPs] only) › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact (TCPs only) › Air Emissions: No Impact › Visible Structures: Potential Impact (TCPs only) › Lighting: No Impact	› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › Onshore Facilities will be sited to avoid or minimize impacts to potential terrestrial archeological resources, to the extent practicable. › Native American Tribal representatives were involved, and will continue to be involved, in terrestrial survey protocol design, execution of the surveys, and interpretation of the results. › An UDP will be implemented that will include stop-work and notification procedures to be followed if a cultural resource is encountered during installation.
Visual Resources	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Minor › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. › RWF WTGs will have uniform design, speed, height, and rotor diameter, thereby mitigating visual clutter. › The WTGs will be painted Pure White (RAL 9010) to Light Grey (RAL 7035) as recommended by BOEM and the FAA. This color white of the turbines generally blends well with the sky at the horizon and eliminates the need for daytime warning lights or red paint marking of the blade tips. › The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise. › Non-reflective paints and finishes will be used to the extent practicable on Onshore Facilities to minimize reflected glare. › Lighting at the OnSS and ICF will be kept to a minimum and turned on only as needed by manual switch.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Population, Economy, and Employment	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: No Impact	› Where possible, local workers will be hired to meet labor needs for Project construction, O&M, and decommissioning. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.
Property Values	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. › The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Public Services	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air emissions: No Impact › Visible Structures: No Impact › Lighting: No Impact	› The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values. › A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Project website, public notices to mariners and vessel float plans, and a fisheries liaison. Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities.
Recreation & Tourism	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Negligible › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Project website, public notices to mariners and vessel float plans, and a fisheries liaison. Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and

Resources	Potential Impacts by IPF	Environmental Protection Measures
		community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.
Commercial and Recreational Fishing	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Negligible › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: No Impact	› Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations. › To the extent feasible, installation of the Inter-Array Cable, OSS Interconnector Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. › As appropriate and feasible, BMPs will be implemented to minimize impacts on fisheries, as described in the Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM, 2015). › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing

Resources	Potential Impacts by IPF	Environmental Protection Measures
		industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › Each WTG will be marked and lit with both USCG and approved aviation lighting. Automatic Identification Systems (AIS) will be installed at the RWF marking the corners of the wind farm to assist in safe navigation. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication Plan. › Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and Department of Defense (DoD) command headquarters. › RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable. › A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel

Resources	Potential Impacts by IPF	Environmental Protection Measures
		movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG).
Commercial Shipping	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations. › Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and DoD command headquarters. › RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable. › A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG). › Revolution Wind will consult with USCG, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Coastal Land Use & Infrastructure	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
Other Marine Uses	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations. › Revolution Wind will consult with USCG, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts. › Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Environmental Justice	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Negligible › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: No Impact	› Where possible, local workers will be hired to meet labor needs for Project construction, O&M, and decommissioning. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values. › Investigation and remediation of contaminated soil and groundwater must be carried out in accordance with RIDEM regulations and policies regarding Environmental Justice Focus Areas including enhanced stakeholder outreach.

1.0 Introduction

1.1 Project Overview

Revolution Wind, LLC (Revolution Wind) (formerly DWW Rev I, LLC), a 50/50 joint venture between Orsted North America Inc. (Orsted NA)[1] and Eversource Investment, LLC (Eversource), proposes to construct and operate the Revolution Wind Farm Project (hereinafter referred to as the Project). The wind farm portion of the Project will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0486 (Lease Area).[2] The closest edge of the Lease Area is approximately 15 statute miles (mi) (13 nautical miles [nm], 24.1 kilometers [km]) southeast of the Rhode Island coast (Figure 1.1-1). The Lease Area was awarded through the BOEM competitive renewable energy lease auction of the Wind Energy Area (WEA) off the shores of Rhode Island and Massachusetts. Other components of the Project will be located in State Waters of Rhode Island and onshore in North Kingstown, Rhode Island. The proposed interconnection location for the Project is the existing Davisville Substation, which is owned and operated by The Narragansett Electric Company d/b/a National Grid (TNEC) and located in North Kingstown, Rhode Island.[3] The Project will specifically include the following offshore and onshore components:

› **Offshore**

- up to 100 Wind Turbine Generators (WTGs) connected by a network of Inter-Array Cables (IAC);
- up to two Offshore Substations (OSSs) connected by an OSS-Link Cable; and
- up to two submarine export cables (referred to as the Revolution Wind Export Cable [RWEC]), generally co-located within a single corridor.

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1 Note that in October 2018, Deepwater Wind LLC was acquired by Orsted North America Inc.

2 On January 10, 2020, a request was made to BOEM to segregate Lease Area OCS-A 0486 to accommodate both the Revolution Wind Farm Project and SFWF Project. The Revolution Wind Farm Project retained lease number OCS-A 0486 while a new lease number was assigned for the SFWF Project (OCS-A 0517).

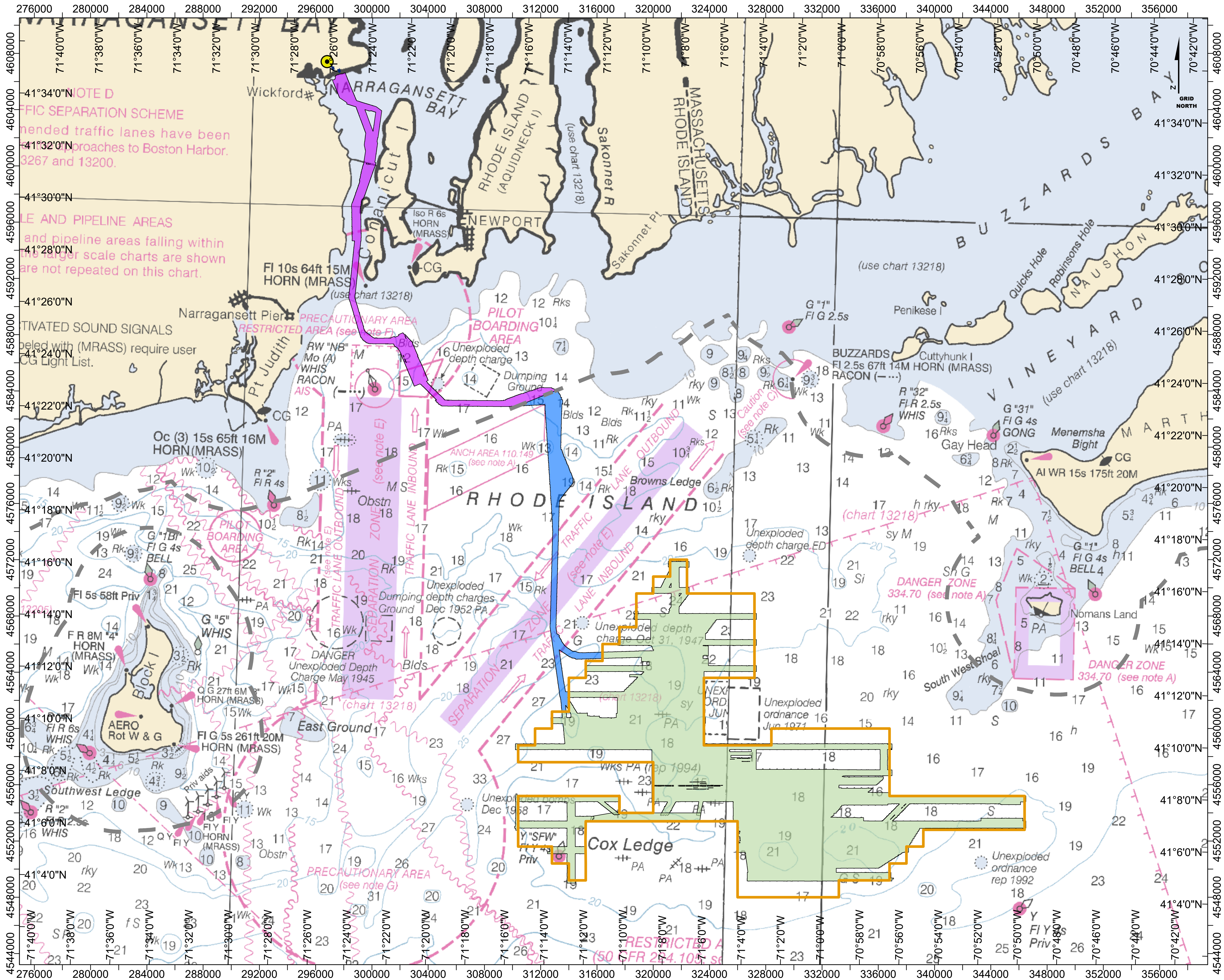
3 The Project's ISO-New England System Impact Study concluded that upgrades to the existing Davisville Substation and electrical grid beyond the substation are necessary for the Project's interconnection. The execution of any upgrades at the existing substation and of the broader electrical grid, and the specific permitting, engineering, and design requirements to achieve the upgrades, will be performed pursuant to the Project's Large Generator Interconnection Agreement currently being negotiated with TNEC and ISO-New England.

› **Onshore**

- a Landfall Work Area measuring up to 3.1 acres (ac) (1.3 hectare [ha]) located at Quonset Point in North Kingstown, Rhode Island;
- up to two underground transmission circuits (referred to as the Onshore Transmission Cable), co-located within a single corridor;
- an Onshore Substation (OnSS) and Interconnection Facility (ICF)[4] located adjacent to the existing TNEC Davisville Substation;
- an underground right-of-way (ROW) connecting the OnSS to the ICF (Interconnection ROW); and
- an overhead ROW connecting the ICF to TNEC's Davisville Substation (TNEC ROW).

A general schematic of the Project is provided in Figure 1.1-2.

4 The ICF is an expansion of TNEC's existing Davisville Substation and will be constructed by Revolution Wind as part of the overall Project.



Revolution Wind
Figure 1.1-1
Offshore Project Location

Legend

- OnSS

Offshore Envelope

- RWF Envelope
- RWEC-OCS Envelope
- RWEC-RI State Waters Envelope
- RWF Boundary Lease Area OCS-A 0486
- 3-Nautical Mile State Water Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
NOAA Raster Nautical Charts (RNC): NOAA Office of Coast Survey
Rhode Island Aerial Photographs (Spring 2018; State Plane):

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2500 5000 7500 Meters

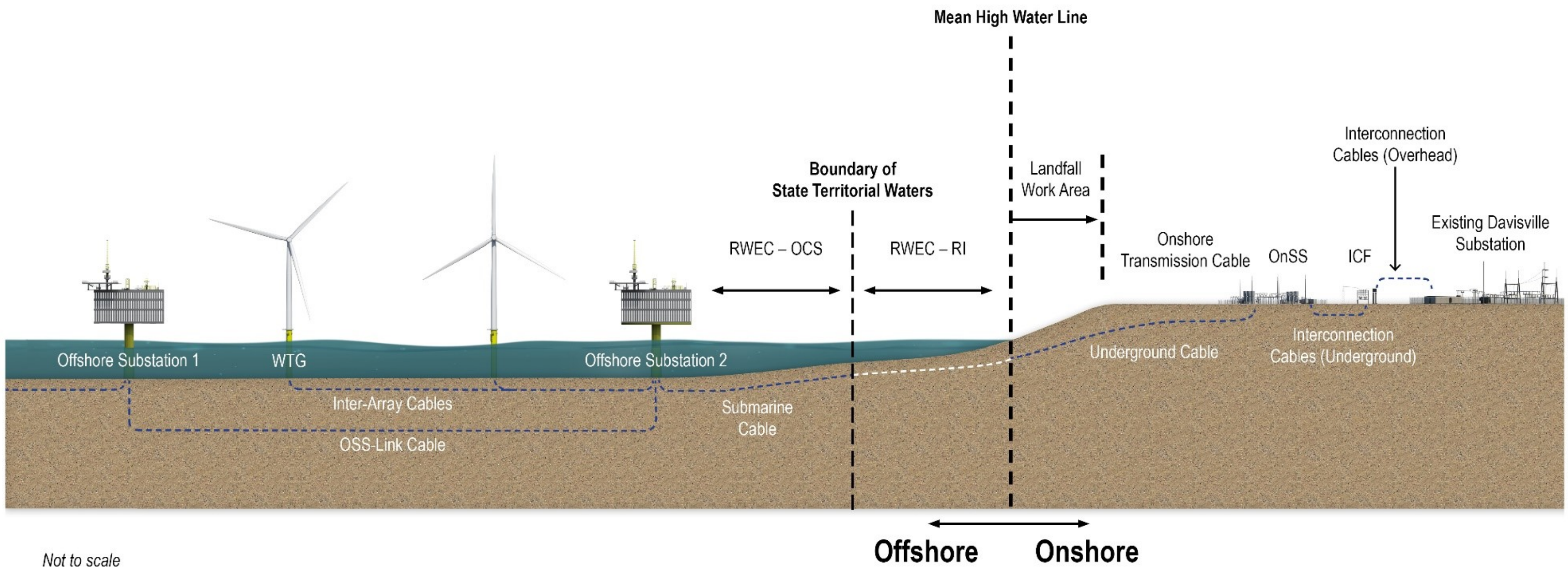
0 9,000 18,000 27,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

Revolution Wind

Powered by Ørsted & Eversource


Mean High Water Line
Interconnection Cables (Overhead)
Boundary of State Territorial Waters
Landfall Work Area
Existing Davisville Substation
RWEC – OCS
RWEC – RI
Onshore Transmission Cable
OnSS
ICF
Offshore Substation 1
WTG
Offshore Substation 2
Underground Cable
Interconnection Cables (Underground)
Inter-Array Cables
Submarine Cable
OSS-Link Cable
Offshore
Onshore
Not to scale

The Project's components are further grouped into four general categories: the Revolution Wind Farm (RWF), inclusive of the WTGs, OSSs, IAC, and OSS-Link Cable; the RWEC–OCS, inclusive of up to 25 mi (40 km) of the RWEC in federal waters; the RWEC–RI, inclusive of up to 23 mi (37 km) of the RWEC in state waters; and Onshore Facilities, inclusive of the Landfall Work Area, Onshore Transmission Cable, and OnSS and ICF (including associated interconnection circuits/ROWs). Also, Figure 1.1-1 depicts the RWF Envelope and RWEC Envelope areas within which offshore Project infrastructure will be sited; seafloor impacts (including from vessel anchoring) will not extend beyond these areas.

This Construction and Operations Plan (COP) contains a description of the siting and development process and a detailed description of all proposed offshore and onshore facilities and construction, operations and maintenance (O&M), and decommissioning activities associated with the Project. This COP also sets forth analyses of potential environmental and socioeconomic impacts relative to construction, O&M, and decommissioning of the Project. It is prepared in accordance with Title 30 of the Code of Federal Regulations (CFR) Part 585 (30 CFR § 585), BOEM's Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan (BOEM, 2016), and other BOEM policy, guidance and regulations as summarized in Table 1.10-1, located at the end of this section.

1.2 Project Design Envelope Approach

Development of an offshore wind farm is an extensive and complex process spanning several years. In addition, offshore wind technologies, including but not limited to WTGs, foundations, and installation techniques, are rapidly advancing and evolving. The flexibility to take advantage of industry advancements and innovative technologies as a project progresses through development (inclusive of the permitting, detailed engineering design, and procurement processes) is critical so that the most technologically sound, environmentally appropriate, and cost-effective project is constructed.

For these reasons, BOEM issued a guidance document entitled *Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan* (BOEM 2018). A Project Design Envelope (PDE) is defined as "a reasonable range of project designs" associated with various components of a project (e.g., foundation and WTG options) (BOEM 2018). The PDE is used to assess the potential impacts on key environmental and human use resources (e.g., marine mammals, fish, benthic habitats, commercial fisheries, navigation, etc.), focusing on the design parameter (within the defined range) that represents the greatest potential impact (i.e., the maximum design scenario) for each unique resource (BOEM 2017).

The primary goal of applying a PDE is to allow for meaningful assessments by the jurisdictional agencies of the proposed project elements and activities while concurrently providing the developer reasonable flexibility to make prudent development and design decisions prior to construction. Jurisdictional agencies' evaluation of the maximum potential effects that may occur from project-related activities and corresponding mitigation or monitoring measures would be satisfied through the evaluation of the PDE's maximum design scenario. It should be noted, however, that even if a PDE is applied to support environmental review and permitting, in accordance with 30 CFR §§

585.700(1) and (2), both a detailed Facility Design Report (FDR) and Fabrication and Installation Report (FIR) must be submitted to BOEM. Furthermore, these reports must be reviewed by the Project Certified Verification Agent (CVA) prior to submission to BOEM.

A partial summary of PDE parameters for the Project is provided below in Table 1.2-1. Section 3 of this COP fully describes the PDE of the Project. The PDE for the Project is based on an operating capacity ranging between 704 megawatts (MW) and 880 MW. While a final decision has not been made, existing ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland are being evaluated to support construction and operation of the Project. Section 3.3.9 of this COP provides further detail regarding specific ports being considered and their potential usage.

Table 1.2-1 Summary of PDE Parameters[1]

Summary of PDE Parameters
Foundations
› Up to 100 monopile foundations to support WTGs › Up to two monopile or piled jacket foundations to support OSSs › Maximum embedment depth of 164 ft (50 m) for monopile foundations and 210 ft (64 m) piled jacket foundations › Maximum area of scour protection: 0.7 acres (ac) (0.3 hectare [ha]) for monopile foundations and 1.0 ac (0.4 ha) for piled jacket foundations
WTG
› Up to 100 WTGs ranging in nameplate capacity of 8 to 12 MW › Rotor diameter between 538 ft (164 m) and 722 ft (220 m) › Hub height between 377 ft (115 m) and 512 ft (156 m) above mean sea level (AMSL) › Upper blade tip height up to 873 ft (197 to 266 m) AMSL
IAC
› Maximum 72-kilovolt (kV) high-voltage alternating current (HVAC) cables buried to a target depth of 4 to 6 ft (1.2 to 1.8 m) below seabed[2] › Maximum total length of up to 155 mi (250 km) › Maximum cable diameter of 8 in (200 mm) › Maximum disturbance corridor width of 131 ft (40 m) and maximum disturbance depth of 10 ft (3 m)
OSS
› Up to two OSSs connected by an up to 9-mi (15-km)-long 275 kV HVAC OSS-Link Cable[3] › OSS topsides installed atop monopile or piled jacket foundations › Up to 180 ft (55 m) AMSL in height (including lightning protection)
RWEC
› Up to two, 275-kV HVAC export cables (one per OSS) buried to a target depth of 4 to 6 ft (1.2 to 1.8 m) below seabed[2] › Maximum total length of up to 50 mi (80 km) per cable

Summary of PDE Parameters
› Maximum cable diameter of 11.8 in (300 mm)
› Maximum disturbance corridor width of 131 ft (40 m) and maximum disturbance depth of 10 ft (3 m)
Onshore Facilities
› Landfall Work Area totaling up to 3.1 ac (1.3 ha), inclusive of up to two underground Transition Joint Bays (TJBs) for jointing the RWEC and Onshore Transmission Cable and temporary access
› An Onshore Transmission Cable up to 1 mi (1.6 km) long, with a maximum disturbance corridor of 25 ft (7.6 m) (30 ft [9.1 m] at splice vaults) and maximum disturbance depth of 13 ft (4 m).
› An OnSS with an operational footprint[4] totaling approximately 3.8 ac (1.5 ha) and an underground ROW (Interconnection ROW) with up to two circuits each measuring approximately 527-feet (160.6 m) in length.
› An ICF with an operational footprint[4] totaling up to 1.6 ac (0.6 ha) and an overhead ROW (TNEC ROW) with up to two circuits measuring approximately 712 ft (217 m) and 474 ft (144 m) in length respectively.

1 This table represents a summary of PDE parameters. Refer to Section 3 for a complete description of the PDE.
2 Burial of the submarine cables (i.e., the RWEC, IAC, and OSS-Link) will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the cables will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
3 The OSS-Link Cable will have similar design and construction parameters as the RWEC.
4 The operational footprint refers to and includes all appurtenances of the OnSS and ICF within the perimeter fences including foundations, and overhead and underground equipment. Stormwater management features, managed vegetation, and a driveway will be located beyond the operational footprint of the OnSS and ICF.

1.3 Project Purpose

The Project will provide clean, reliable offshore wind energy that will increase the amount and availability of renewable energy to New England consumers while creating the opportunity to displace electricity generated by fossil fuel-powered plants and offering substantial economic and environmental benefits to the New England region. Massachusetts, Rhode Island, Connecticut, and New York have adopted substantial renewable portfolio standards and clean energy targets to address issues associated with climate change, highlighting the current and future demand for this Project.

In response to this expressed need and demand, Rhode Island and Connecticut have awarded the Project five Power Purchase Agreements (PPAs) to-date, totaling 704 MW of generation capacity. The Project will fulfill Revolution Wind’s obligations to both Connecticut and Rhode Island in accordance with the PPAs and provide substantial environmental and economic benefits. As noted in Section 1.2, the Project’s maximum generating capacity based on the PDE is between 704 MW and 880 MW.

1.4 Regulatory Framework

Several federal, state, and local regulatory agencies have jurisdictional authority over the Project based on the location of Project components in federal waters on the OCS, State Waters of Rhode Island, and onshore locations in North Kingstown, Rhode Island. Table 1.4-1 indicates where each Project component is located relative to federal and state waters, as well as onshore locations.

Table 1.4-1 Summary of Project Component by Location

Project Components	Federal Waters (OCS)	RI State Waters	Onshore[1]
WTGs/IAC	•		
OSSs/OSS-Link Cable	•		
RWEC	•	•	•
Landfall Work Area		•	•
Onshore Transmission Cable			•
OnSS			•
Interconnection ROW			•
TNEC ROW			•
ICF			•

1 Onshore locations include parcels owned by Quonset Development Corporation, a subsidiary of the Rhode Island Commerce Corporation, and various private entities, as well as public ROW.

The federal, state, and local permits, approvals, and consultations applicable to the Project are listed in Table 1.4-2 and described further in the subsections that follow. Note, applicable federal statutes that are delegated to the State of Rhode Island, including the CZMA, and Sections 401 and 402 of the CWA, are discussed in the Section 1.4.2 describing state permits, approvals, and consultation. A summary of consultations to-date with federal, state, and local agencies is provided in Appendix A.

Table 1.4-2 Summary of Permits, Approvals, and Consultations

Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
Federal Permits, Approvals, and Consultations		
BOEM	Commercial Lease of Submerged Lands for Renewable Energy Development on the OCS, in accordance with the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. §§ 1331 et seq.); Section 388 of the Energy Policy Act of 2005, BOEM implementing regulations (30 CFR § 585)	OCS-A 0486 Lease effective on October 1, 2013
	Site Assessment Plan (SAP) approval pursuant to 30 CFR §§ 585.610-618	Approved October 12, 2017
	COP approval pursuant to 30 CFR §§ 585.621-627	Anticipated between Q1 and Q3 2023

Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
	FDR approval pursuant to 30 CFR 585.701 (33 U.S.C. § 1221)	To be reviewed by a CVA and submitted to BOEM after COP approval
	FIR approval pursuant to 30 CFR § 585.700	To be reviewed by a CVA and submitted to BOEM after COP approval
	Consultation pursuant to Section 7 of the Endangered Species Act (ESA) (16 U.S.C. §§ 1531 et seq.), with NOAA National Marine Fisheries Service (NMFS) and USFWS	Anticipated between Q1 and Q3 2023
	Essential Fish Habitat (EFH) Consultation pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (16 U.S.C. §§1801 et seq.)	Anticipated between Q1 and Q3 2023
	Consultation pursuant to the Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703 et seq.) and Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668 et seq.)	Anticipated between Q1 and Q3 2023
	Review pursuant to the NEPA (42 U.S.C. §§4321 et seq.), BOEM regulations (30 CFR §§ 585.646,585. 648(b)), and other relevant regulations in consultation with the United States Army Corps of Engineers (USACE), DoD, Advisory Council on Historic Preservation, and other cooperating regulatory agencies	Anticipated between Q1 and Q3 2023
USACE New England District	Section 10 Individual Permit pursuant to the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. §§ 401 *et seq.*)	Anticipated between Q1 and Q3 2023
	Section 404 Individual Permit pursuant to the CWA (33 U.S.C. § 1344)	Anticipated between Q1 and Q3 2023
USCG, District 1	Private Aids to Navigation (PATON) Permit pursuant to 33 CFR § 66 (49 U.S.C. § 44718)	Issued four weeks prior to offshore construction
	Local Notice to Mariners (LNM)	Issued two weeks prior to vessel mobilization for offshore construction
United States EPA New England (Region 1)	OCS Air Quality Permit pursuant to 40 CFR § 55 (Clean Air Act., 42 U.S.C. § 7627)	Anticipated between Q1 and Q3 2023
Federal Aviation Administration (FAA)	Determination of No Hazard to Air Navigation pursuant to 14 CFR §77	Anticipated between Q3 and Q4 2022

Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
NOAA National Marine Fisheries Service	Request Incidental Take Authorization pursuant to the Marine Mammal Protection Act (MMPA) (16 U.S.C. §§ 1361 et seq.)	Anticipated between Q1 and Q3 2023
	Request for Incidental Take Statement (ITS) pursuant to Section 7 of the ESA of 1973 (16 U.S.C. §§ 1531 *et seq.*)	
State Permits, Approvals, and Consultation		
Rhode Island Energy Facility Siting Board (RI EFSB)	License pursuant to the Energy Facility Siting Act (Rhode Island General Laws [RIGL] §§ 42-98-1 *et seq.*)	Anticipated between Q1 and Q3 2022
Rhode Island Coastal Resources Management Council (RI CRMC)	Federal Consistency Determination pursuant to Section 307 of the CZMA (16 U.S.C. § 1456) and § 11.10 of RI Ocean Special Area Management Plan [Ocean SAMP] (650-RICR-20-05-2.1 *et seq.*)	Anticipated between Q1 and Q3 2023
	Category B Assent and Submerged Lands License pursuant to RI CRMC Management Procedures (the "Red Book") (650-RICR-20-00-1 *et seq.*; consultation as required with the Rhode Island Department of Environmental Management (RIDEM) regarding the Rhode Island Endangered Species of Animals and Plants Act (Rhode Island ESA) (RIGL § 20-37-3); Rhode Island Bureau of Natural Resources, Division of Fish and Wildlife; and Rhode Island Historical Preservation and Heritage Commission (RIHPHC) (RIGL 42-45-1 *et seq.*)	Anticipated between Q4 2022 and Q2 2023
	Permit to Alter Freshwater Wetlands in the Vicinity of the Coast (650-RICR-20-00-2)	Anticipated between Q4 2022 and Q2 2023
RIDEM Office of Water Resources	Water Quality Certification pursuant to RIGL § 46-12-3 and 250-RICR-150-05-1.1 *et seq.* (federal authority delegated to the State pursuant the CWA, 33 U.S.C. §§ 1341-1342). To be filed concurrently with RIPDES authorization (below).	Anticipated between Q1 and Q3 2022
	Authorization under the Rhode Island Pollutant Discharge Elimination System (RIPDES) General Permit for Stormwater Discharge Associated with Construction Activity (Construction General Permit or CGP). To be field concurrently with WQC Application.	Anticipated between Q1 and Q3 2022
RIDEM and CRMC	Dredge permit pursuant to the Rules and Regulations for Dredging and the Management of Dredged Materials (250-RICR-150-05-2.1 *et seq.*).	Anticipated between Q1 and Q3 2022

Regulatory Authority	Permit, Approval, or Consultation	Date of Approval or Anticipated Approval
Quonset Development Corporation (QDC)	Development Review Process (RIGL 42-64.10-5; QDC Development Regulations, 880-RICR-00-00-4 *et seq.*)	Anticipated between Q3 2021 and Q4 2021

1.4.1 Federal Permits, Approvals, and Consultations

1.4.1.1 Bureau of Ocean Energy Management

BOEM has the authority to regulate activities associated with the production, transportation, or transmission of renewable energy resources on the OCS under the Outer Continental Shelf Lands Act (OCS Lands Act) (43 United States Code [U.S.C.] § 1337). Pursuant to this authority, BOEM must ensure that any approved activities are safe, conserve natural resources on the OCS, are undertaken in coordination with relevant federal agencies, provide a fair return to the United States, and are compliant with all applicable laws and regulations (30 CFR § 585.102), including NEPA.

BOEM issued Renewable Energy Lease Area OCS-A 0486 (Lease Area) to the Applicant on October 1, 2013, for development of a renewable energy facility. The construction and operation of the Project will require a COP that is compliant with BOEM regulations (30 CFR § 585) and approved by BOEM prior to the start of construction. Additionally, the Applicant requests an easement from BOEM for the portion of the export cables that traverses federal waters.

1.4.1.2 National Environmental Policy Act Review

NEPA requires federal agencies to evaluate the potential impacts of any proposed federal action, and to consider alternatives to the proposed action (42 U.S.C. § 4332). The following federal actions associated with the Project require review under NEPA: BOEM's approval of the COP, the United States Army Corps of Engineers (USACE) issuance of an Individual Permit under the CWA, and the National Marine Fisheries Service' (NMFS) issuance of an Incidental Take Authorization (ITA), either in the form of an Incidental Harassment Authorization (IHA) or a Letter of Authorization (LOA) under the Marine Mammal Protection Act of 1972 (MMPA) and/or ITS under the federal Endangered Species Act (ESA). For renewable energy facilities on the OCS, BOEM acts as the Lead Federal Agency for NEPA review and compliance.

BOEM will lead the preparation of an Environmental Impact Statement (EIS) to evaluate potential impacts associated with implementation of the Project. Federal agencies, identifying as cooperating agencies in the NEPA process, are responsible for reviewing the Project's impacts to protected resources under their jurisdiction and evaluating the need for mitigation measures. These agencies will have the opportunity to comment through interagency consultations required for federal permitting (NEPA, USACE Individual Permit Application). In addition, through the NEPA process, BOEM will be required to satisfy Section 106 of the National Historic Preservation Act (NHPA), which requires consideration of historic properties.

Under Executive Order 13807 (One Federal Decision [OFD]), which mandated a process for improving the coordination and timeliness of environmental reviews of major infrastructure projects, BOEM is responsible for coordinating and streamlining the permitting review process undertaken by all federal agencies with jurisdiction over the Project except the United States Coast Guard (USCG) and the Federal Aviation Administration (FAA) as described below. This includes the following steps:

- Issuance of a Single EIS and Record of Decision (ROD) with a 90-day authorization deadline.
- Establishing concurrent agency reviews and limiting agency comments to issues that are within the agency's area of expertise or jurisdiction.
- All RODs issued within 2 years of the Notice of Intent.
- Establishing agency concurrence points.
- Timely elevation of inter-agency disputes.
- Establishing schedule exceptions limited to authorizing agency's "Special Circumstances" or applicable law making a 2-year schedule impracticable; or for developer requests or unresponsiveness.

1.4.1.3 United States Army Corps of Engineers—Section 10/404 Individual Permit

USACE has jurisdiction over the Project pursuant to Section 10 of the Rivers and Harbors Appropriation Act of 1899 (RHA), and Section 404 of the CWA due to the Project's location within navigable waters, federally maintained navigation channels and Waters of the United States.[5]

Section 10 of the RHA (33 U.S.C. § 403) requires authorization from the USACE for the construction of any structure in or over any navigable water of the United States. USACE Section 10 review of the Project will occur concurrently with the Section 404 review. Section 404 of the CWA (33 U.S.C. § 1344) establishes federal regulatory authority over the discharge of dredged or fill material into Waters of the United States, including wetlands. USACE will review the Project as an Individual Permit. The Individual Permit process includes an application sufficiency review, review of proposed project impacts on the environment, public notice and a public hearing.

The USACE New England District will be a cooperating agency under BOEM's NEPA process to satisfy the NEPA requirements for these authorizations. USACE reviews under RHA Section 10 and CWA Section 404 will be processed concurrently with BOEM's NEPA review and USACE approval would be issued as part of the OFD.

1.4.1.4 United States Coast Guard—Private Aids to Navigation Permit and Local Notice to Mariners

The USCG exercises authority over maritime navigation in Waters of the United States pursuant to 33 CFR § 66 (49 U.S.C. § 44718). Private Aids to Navigation (PATON) includes all marine aids to

5 Waters of the United States (WOTUS) are defined in 40 CFR 230.3(s).

navigation operated in the navigable waters of the United States other than those operated by the Federal Government or those operated in State waters for private aids to navigation.

The USCG will issue a PATON approval for installation of the WTGs, OSSs, and measurement buoys to alert mariners to potential hazards to navigation. The PATON will be obtained after receipt of the USACE permit, approximately four weeks prior to offshore construction.

A request for a Local Notice to Mariners (LNMs) will be submitted to the USCG prior to vessel mobilization for construction activities to enable USCG to issue the LNM. An LNM is a weekly notification published by the USCG to disseminate information to mariners concerning aids to navigation, hazards to navigation, and other items of interest to marine users.

1.4.1.5 United States Environmental Protection Agency—OCS Air Permit

United States Environmental Protection Agency (EPA) regulates air quality on the OCS pursuant to the Clean Air Act (CAA) Outer Continental Shelf Air Permit (42 U.S.C. § 7627; 40 CFR Part 55, 60), including emissions from the construction, operation, and decommissioning of the Project, including any equipment, activity or facility that emits, or has the potential to emit, any air pollutant; is regulated or authorized under the OCS Lands Act; and is located on the OCS, or in or on waters above the OCS. This definition includes vessels when they are permanently or temporarily attached to the seabed (40 CFR 55.2), as well as vessels associated with the Project while operating at the RWF or within 25 nm (46.3 km) of the activity. Due to the location of the Project, Massachusetts would most likely be designated as the Corresponding Onshore Area (COA), making the Project subject to Massachusetts air quality regulations in addition to EPA regulations.

1.4.1.6 Federal Aviation Administration/Department of Defense—Consultation

The United States Department of Transportation's FAA has jurisdiction over structures greater than 200 ft (61 m) above ground level (AGL) within 12 nm (22 km) of shore, which is the extent of the territorial sea. Although FAA's jurisdiction is limited to 12 nm (22 km), FAA airspace may extend beyond this distance requiring coordination between BOEM and the FAA to mitigate any impacts. Additionally, BOEM may require compliance with the marking and/or lighting recommendations identified in the FAA's Advisory Circular 70/7460-1L for WTGs beyond FAA jurisdiction given that BOEM does not currently have prescriptive guidelines for air navigation safety.

Advisory Circular 70/7460-1L recommends the guidelines and standards for marking and lighting obstructions affecting navigable airspace (FAA 2018). All structures that exceed 499 ft (152 m) AGL are considered obstructions and therefore the FAA is obligated to study them to determine their effect on the navigable airspace. In the offshore environment, the FAA's Obstruction Evaluation Group will conduct aeronautical studies to assess hazards to flight patterns and radar interference and to also impose requirements under federal obstruction lighting and marking regulations. For terrestrial WTGs in excess of 499 ft (152 m) AGL, all WTGs require lighting regardless of how many WTGs are in the array. BOEM has drafted marking and lighting guidelines that closely mirror the FAA's Advisory Circular, however at this time, they are not finalized.

In addition to FAA's input, the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment, United States Department of Defense (DoD) Siting Clearinghouse will provide an analysis of potential Project impacts to military operations (e.g., military testing and training operations and military radar capabilities) and the United States Naval Seafloor Cable Protection Office would assert its recommendations to avoid the Navy's submarine assets, including cable systems.

1.4.17 National Marine Fisheries Service/United States Fish and Wildlife Service—Consultation; Incidental Take Authorization

Pursuant to the MMPA (16 U.S.C. § 1361 et seq.) certain species and population stocks of marine mammals that are, or may be, in danger of extinction or depletion as a result of human activities should be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and the primary objective of their management should be to maintain the health and stability of the marine ecosystem. The MMPA designated NMFS as the primary agency responsible for the protection of whales, dolphins, porpoises, seals, and sea lions.

Construction and operation of the Project requires consultation with NMFS and will likely require an ITA under the MMPA and an ITS in accordance with the federal ESA. If construction or operation is likely to impact listed species under USFWS jurisdiction (such as terrestrial animal or plant species or avian species), then an ITS may be required from USFWS.

1.4.2 Rhode Island State Permits, Approvals, and Consultations

1.4.2.1 Rhode Island Energy Facility Siting Board—License

The Rhode Island Energy Facility Siting Act of 1986 (Rhode Island General Law [RIGL] § 42-98-1 *et seq.*) consolidated within the Rhode Island Energy Facility Siting Board (RI EFSB) authority for the licensing of major energy facilities. The definition of "major energy facilities" includes several types of facilities relating to the generation and transmission of electricity, including any transmission lines with a design rating of 69 kV or higher and facilities for the generation of electricity designed or capable of operating at a gross capacity of 40 MW or more (RIGL § 42-98-3). The RI EFSB's licensing authority preempts certain state and local agencies or boards from granting or denying licenses, with the exception of certain licenses, permits, or assents issued by RIDEM and RI CRMC. State and local agencies or boards designated by the RI EFSB will issue advisory opinions to the RI EFSB for review.

The RI EFSB process is a formal adjudicatory process in which applicants are represented by legal counsel. An application is submitted, and the RI EFSB will hold a preliminary hearing to designate agencies to issue advisory opinions. The designated agencies must follow their ordinary procedures for evaluating the license and will forward the record and a recommendation to the RI EFSB for final action. The RI EFSB will hold a final hearing to consider the application and advisory opinions and determine whether to grant the application. A decision to grant the application constitutes the granting of all licenses that would be required in the absence of the Energy Facility Siting Act. Any State or local permits and approvals not preempted by the RI EFSB may be applied for concurrently with EFSB processing of an application.

1.4.2.2 Rhode Island Coastal Resources Management Council—Coastal Zone Management Program Federal Consistency Determination

The CZMA requires that federal actions impacting any coastal use or resource (defined as land or water use, or natural resource of a state's coastal zone), be conducted in a manner that is consistent with the enforceable policies of a state's federally approved Coastal Zone Management Program (CZMP) or Coastal Resource Management Program (CRMP). Within this authority of the CZMA, state coastal programs that have been approved by NOAA may review federal actions impacting their coastal uses or resources or both, to verify that such activities are consistent with the state's enforceable program policies. The Project has prepared consistency certifications for review by Rhode Island, Connecticut, and Massachusetts to confirm consistency with each state's enforceable policies impacting any coastal use or resource.

RI CRMC is the state authority for federal consistency under the CZMA, 16 U.S.C. § 1456 (c). Included in the CRMP is the Ocean SAMP, which RI CRMC approved in 2010 and which NOAA approved in 2011. The Ocean SAMP contains requirements for activities in state waters and enforceable policies for federal agency activities, licenses, or permits in federal offshore waters.

A consistency certification is required for certain federal authorizations for activities proposed in two areas of federal waters designated as Geographic Location Description (GLD) 2011 and GLD 2018. The Project will require, among other approvals, an approval or authorization from the Department of the Interior (BOEM), which is a federal license or permit activity listed in the federally approved RI coastal management program.

The Project will file a CZMA Consistency Certification with RI CRMC seeking RI CRMC CZMA federal consistency concurrence for the Project. A draft copy of this certification is provided in Appendix B. The Consistency Certification provides the necessary data and information demonstrating how proposed Project activities potentially affecting the federal waters defined by the GLD will be consistent with the enforceable policies of the Ocean SAMP.

1.4.2.3 Rhode Island Coastal Resources Management Council—Category B Assent and Submerged Lands Lease

In addition to the CZMA Consistency Certification described above, Revolution Wind must submit a Category B Assent application and request for a license for use of submerged lands within Rhode Island coastal waters for the RWEC license to the RI CRMC. A license for use of submerged lands is necessary for construction of the RWEC within Rhode Island coastal waters, which are 3 miles (mi) seaward from the coastal feature (RIGL §46-23-1). The RI CRMC Category B Assent review process will evaluate the Project's compliance with the RI CRMP.

The Category B Assent process is a formal adjudicatory process in which applicants are represented by legal counsel. An application is submitted, and RI CRMC will allow for a public notice period. A RI CRMC Subcommittee may hold a full evidentiary hearing on the Category B Assent application and make a recommendation to the full RI CRMC as to whether to grant the Assent. The full RI CRMC will hold a hearing on whether to grant the Assent and whether to impose any conditions on the Assent.

1.4.2.4 Rhode Island Coastal Resources Management Council—Permit to Alter Freshwater Wetlands in the Vicinity of the Coast

Freshwater Wetlands within the Project Area are subject to the Rules and Regulations Governing the Protection and Management of Freshwater Wetlands in the Vicinity of the Coast (650-RICR-20-00-2.1 *et seq*.; Freshwater Wetland Rules) as administered by the RI CRMC. Project components that will impact freshwater wetlands must address the criteria established within the Freshwater Wetland Rules, including the construction of the OnSS and the ICF. Revolution Wind, LLC will address the impacts of the OnSS and the Interconnection ROW on freshwater wetlands according to the Freshwater Wetland Rules within the Category B Assent Application, described above. Impacts created by construction of the ICF, the Interconnection ROW and TNEC ROW will be addressed in a separate Application to Alter Freshwater Wetlands to be submitted by Revolution Wind, LLC and TNEC as co-applicants because the ICF will be located on parcel ID 179-005 which is owned and operated by TNEC.

1.4.2.5 Rhode Island Department of Environmental Management—Water Quality Certification/Dredge Permit/Rhode Island Pollutant Discharge Elimination System General Permit for Stormwater Discharge Associated with Construction Activity/RI ESA

RIDEM has been delegated federal authority to enforce Section 401 and 402 of the CWA, which regulate discharges into Waters of the United States (WOTUS), and RIDEM's review is therefore not preempted by the RI EFSB. Consequently, any development that has the potential to affect water quality of the State must apply for authorization from RIDEM under the Water Quality Regulations (250-Rhode Island Code of Regulations [RICR]-150-05-1.1 *et seq*.), the Rules and Regulations for Dredging and the Management of Dredged Materials (250-RICR-150-05-2.1 *et seq.* for a dredge permit) and authorization under the Rhode Island Pollutant Discharge Elimination System (RIPDES) General Permit for Stormwater Discharge Associated with Construction Activity (Construction General Permit or CGP), which includes adherence to the Stormwater Management, Design, and Installation Rules (250-RICR-150-10-1.1 *et seq*.). The RIDEM Division of Marine Fisheries must be consulted as part of RIDEM's Section 401 application review process.

The State's Water Quality Certification satisfies the requirements of the USACE Section 10/404 application review process. RIDEM review will occur concurrently with the CRMC Category B Assent and the Freshwater Wetland Application to Alter processing. An application is submitted, and RIDEM will allow for a public notice period and in certain circumstances hold a public hearing.

RIDEM may also declare animals and plants as endangered under the Rhode Island ESA (RIGL §§ 20-37-1 *et seq*.), which prohibits the importation, sale, transportation, storage, traffic, ownership, or other possession or use of any animal or plant listed under the federal ESA. While an independent permitting process does not exist for RI ESA review, RIDEM departments that having permitting authority are required to consult with the RIDEM Natural Heritage Program, which is a consortium of state and non-profit entities tasked with implementing the RI ESA.

1.4.2.6 Quonset Development Corporation—Development Plan Review

The Quonset Development Corporation (QDC) is a quasi-state agency, established as a special purpose subsidiary of the Rhode Island Commerce Corporation (formerly the RI Economic Development Corporation), which is responsible for the development and management of the Quonset Business Park. The QDC has promulgated Development Regulations that outline requirements for land development, building construction, and utilities in the Quonset Business Park (880-RICR-00-00-4). Development Plan Review is required for any and all proposed activities that change the existing character of lands within the Park. The onshore Export Cable system and the Onshore Facilities will be located within the Quonset Business Park.

1.4.3 Local Permits and Approvals

At the municipal level, Onshore Facilities are proposed in the Town of North Kingstown, Rhode Island. Zoning review, Special Use Permit, and Site Plan Review are pre-empted by the authority of the RI EFSB, and consequently these municipal approvals are not required. Local building permits, street opening permits and/or easements are not pre-empted by the authority of the RI EFSB and will be required. These permits, approvals and easements will be obtained prior to construction, after engagement with the local regulatory community, and once design of the Onshore Facilities is finalized.

1.5 Agency and Public Outreach

Since 2017, Revolution Wind has been engaged in extensive Project outreach with federal and state agencies, federally-recognized Native American tribes (Tribes), local agencies in Rhode Island, stakeholders representing a broad range of perspectives, and the public. A summary of agency, Tribal, and stakeholder meetings is provided in Appendix A. A summary of engagement with stakeholders outside of regulatory agencies and the Tribes is provided in Table 1.5-1.

Table 1.5-1 Stakeholder Engagement

Stakeholder	Summary of Engagement
Fishing Communities and Other Mariners are important stakeholders with which the Project strives to achieve "shared used" of the Lease Area.	› Employ Fisheries Liaisons ("FL") to work directly with myriad fisheries organizations to achieve broad engagement with both the commercial and recreational fishing industries › Utilize Fishing Industry Representatives ("FR") to represent their local fishing port or community and acts as a conduit between the fishing industry and the FL/Project › Employ fisheries observers to serve onboard surveys vessels to promote "real-time" communication with fishermen while on the water and to facilitate positive coexistence with ongoing fishing activity › Partner with the Responsible Offshore Science Alliance ("ROSA") and Responsible Offshore Development Alliance ("RODA") to create an opportunity for the commercial fishing industry to provide direct input to the wind energy industry

Stakeholder	Summary of Engagement
	› Conduct port hours at several significant fishing ports in New England and New York to provide an opportunity for fishermen and mariners to speak directly with Fisheries Liaisons regarding project activities and other questions they may have › Receive ongoing input on development of fisheries resource studies › Attend North Atlantic and Mid-Atlantic fisheries management council meetings, Massachusetts Fisheries Working Group and RI CRMC Fishermen's Advisory Board and Habitat Advisory Board (FAB/HAB) meetings › Attend fisheries trade events such as Massachusetts Lobstermen's Association Annual Trade show › Conducted over 2,000 conversations and communications with fisheries businesses and individual fishermen, many of which were face to face meetings, to collect and implement feedback on layout, schedule and other Project parameters
Labor and Local Business Interests can benefit from the Project through job creation, local purchasing of supplies and equipment and other development and operations support opportunities.	› Executed Memorandum of Understandings (MoUs) with regional labor unions to negotiate in good faith a project labor agreement (PLA) and the development of training programs. › Engaging with regional companies on Project needs to inform and develop local suppliers and equipment providers.
Non-Governmental Environmental Organizations (NGEOs) (including but not limited to the Natural Resources Defense Council, National Wildlife Federation, International Fund for Animal Welfare, Conservation Law Foundation, and Sierra Club) that are interested in the environmental benefits and potential impacts of the Project.	› Participated in regular meetings of the FAB/HAB, in collaboration with RI CRMC › Participated in externally led initiatives including the ad hoc Habitats Working Group established by the Massachusetts Office of Coastal Zone Management (MACZM) (in collaboration with the Massachusetts Clean Energy Center (MACEC), the American Wind Energy Association's Offshore Committee, and BOEM). › Held and attended meetings with environmental organizations (such as the Natural Resources Defense Council, National Wildlife Federation, International Fund for Animal Welfare, Conservation Law Foundation, Save the Bay and Sierra Club) to gather input, hear concerns, and share updates regarding Project plans and activity status. › Attended and supported marine science conferences including OCEANOISE2017, the Biennial Conference on the Biology of Marine Mammals in 2017 and 2019, Acoustical Society of America /Acoustics 2017 Boston, The Effects of Noise on Aquatic Life in 2019, American Fisheries Conference, the North Atlantic Right Whale Consortium and Ropeless Gear Consortium annual meeting, biennial National Wind Coordinating Collaborative's Wind Wildlife Research Meeting, BOEM-sponsored marine mammal workshops, as well as industry-specific conferences sponsored by the American Wind Energy Association and the International Partnering Forum
Rhode Island State Government can benefit from the Project environmentally and economically. It will help the state fulfill its environmental goals and generate	› Participate in monthly meetings with the Rhode Island Commerce Corporation, Rhode Island's quasi-public economic development agency to ensure the Project is beneficial to Rhode Island's economy

Stakeholder	Summary of Engagement
economic and job growth with a new industry.	› Financial support for Rhode Island's Offshore Wind Effort to foster the development of the offshore wind industry in the state that will focus on business attraction, supply chain growth, and marketing › Working collaboratively on port utilization planning in regular meetings with local ports, port authorities, and related stakeholders in Rhode Island and Connecticut › Developed planning to optimize supply chain development and the use of local labor including engagement with local businesses and applicable governmental agencies in Rhode Island and Connecticut
Local Communities and Government have the potential to be impacted by construction and operation of the Project. Revolution Wind is committed to engaging with these communities to share information and minimize potential disturbance; Town of North Kingstown, area chambers of commerce, civic groups, residents and businesses.	› Prepared overview of the Project to numerous stakeholders. Continued emails and calls to keep stakeholders apprised of the Project's progress › Active presence on social media, mailings to abutters and other impacted stakeholders to provide up-to-date information on surveys and other Project activities › Maintaining involvement and regular correspondence with several local and regional entities including the Town of North Kingstown and the QDC
Universities can provide a wealth of valuable data and have served as leaders in both science and job training.	› Worked with several area universities including the University of Rhode Island (URI) and other institutions to support workforce development, training, and primary research in offshore wind-related fields of study. › Financial commitments to Rhode Island institutions of higher education, including URI. › Financial commitment to the Rhode Island Department of Labor and Training for workforce development. › Financial commitment to University of Connecticut, Avery Point for collaborative science. › Financial commitment to Project Oceanology for the development of an offshore wind curriculum. › Collaborating with and funding an offshore wind supply chain study with the Thames River Submarine Supply Chain Consortium.

1.6 Authorized Representative and Designated Operator

Revolution Wind will be the operator of the Project. The contact information for the authorized representative for the Project is as follows:

Name of Authorized Representative:	Claus Bøjle Møller
Title:	Director, North East Offshore, LLC
Phone Number:	857-348-3279
Email:	claum@orsted.com
Address:	56 Exchange Terrace, Suite 300 Providence, Rhode Island 02903

Orsted A/S (Orsted) is the global industry leader in offshore wind and has significant experience with the rigors and challenges of the offshore wind business. Over the past 25 years, Orsted has constructed over 5 gigawatts (GW) of offshore wind capacity (approximately 30 percent of globally installed offshore wind capacity). Orsted's existing activities span a number of markets, including the United States, Denmark, the United Kingdom, Germany, the Netherlands, and Taiwan. It is the current Orsted leadership team that—within the short span of the past three to four years—has driven dramatic cost reductions and paved the way for exponential market growth. In 2018, Orsted NA acquired Deepwater Wind, LLC, the company that built the United States' first offshore wind farm off Block Island in the Town of New Shoreham, Rhode Island. Orsted NA's legacy Deepwater Wind, LLC team gained invaluable experience working with regulators, stakeholders, vendors, and United States (U.S.) construction contractors through the development and execution of the Block Island Wind Farm (BIWF) project. Together, Orsted NA's expanded team is leading a stakeholder-centric approach to development that has made it the go-to partner for states up and down the eastern seaboard as they seek to develop offshore wind resources. Currently, Orsted NA has in its United States portfolio commitments for approximately 3 GW of offshore wind serving five states. In connection with the BIWF project, Orsted NA also fully developed the Block Island Transmission System, which includes a thirty-mile onshore and offshore transmission system that connected Block Island to the mainland of Rhode Island for the first time. This was the first offshore renewable-energy transmission system developed in the United States.

Eversource is an industry leader in constructing and maintaining large transmission and distribution projects, including high-voltage and extra high-voltage overhead, underground, submarine, and hybrid transmission lines, and associated terminal equipment. Throughout New England and New York, Eversource has successfully completed hundreds of capital projects over the past decade, with a proven track record in successful single state and multi-state project siting and permitting; working closely with other companies to develop major projects; and safely and efficiently constructing transmission and distribution projects. It has successfully completed hundreds of traditional and major capital projects over the past decade, employing innovative solutions to technical and environmental challenges such as: the first and most extensive 345-kV applications of solid core cross-linked polyethylene (XLPE) underground cables in the United States; laying marine cable in Long Island Sound from a purpose-built ship; and constructing overhead transmission support structures from the air, using helicopters. Eversource is one of only four North American energy companies certified as an Environmental, Social and Governance leader, and is recognized as a leader in providing top-tier reliability with the utmost focus on safety.

1.7 Certified Verification Agent

Pursuant to 30 CFR § 585.705, a CVA must be engaged to certify to BOEM that the proposed facility is designed to withstand the environmental and functional load conditions for the intended life of a project at its proposed location. In accordance with 30 CFR § 585.706, Revolution Wind is including with this COP a CVA nomination for BOEM approval. This nomination (inclusive of a nomination statement, statement of qualifications, and scope of work and verification plan) is included as Appendix C under confidential cover.

1.8 Emergency Response Plan/Oil Spill Response Plan

Pursuant to 30 CFR § 585.627(c), an Oil Spill Response Plan must be submitted to the Bureau of Safety and Environmental Enforcement (BSEE). In accordance with 30 CFR Part 254, Revolution Wind has developed an Emergency Response Plan/Oil Spill Response Plan (ERP/OSRP) which is provided in Appendix D.

1.9 Safety Management System

Pursuant to 30 CFR § 585.627(d), a Safety Management System must be submitted to BOEM. In accordance, with 30 CFR § 585.810, Revolution Wind has developed a Safety Management System (SMS) which is provided in Appendix E. The SMS is certified under Occupational Health and Safety Assessment Series (OHSAS) 18001 and certification under International Organization for Standardization (ISO) 45001 is being sought.

1.10 Financial Assurance

Revolution Wind will provide financial assurance in accordance with 30 CFR § 585.516, prior to BOEM approval of this COP. Orsted and Eversource are stable and diversified publicly traded energy companies, with a combined market capitalization of approximately $75 billion, and combined operating cash flows of approximately $4 billion annually. Orsted is the global leader in financing, constructing and operating offshore wind, and—as a result of the recent acquisition of Deepwater Wind, LLC—its team now includes the individuals responsible for the first ever financing of an offshore wind farm in the United States, and the first tax-equity financing of an offshore wind farm anywhere in the world.

Table 1.10-1 BOEM Requirements for Developing a Construction and Operations Plan

BOEM Requirements	Location in COP
30 CFR §585.105(a)	
a) The Project will conform to all applicable laws, implementing regulations, lease provisions, and stipulations or conditions of the lease.	Section 1.4-Regulatory Framework
b) The Project will be safe.	Appendix D-Emergency Response Plan/Oil Spill Response Plan Appendix E-Safety Management System Appendix H-Supplemental Project Information and Conceptual Project Engineering Design Drawings Appendix R-Navigation Safety Risk Assessment Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study
c) The Project will not unreasonably interfere with other uses of the outer continental shelf (OCS), including those involved with National security or defense.	Section 4.6.4-Recreation and Tourism Section 4.6.5-Commercial and Recreational Fishing Section 4.6.6-Commercial Shipping Section 4.6.7-Coastal Land Use and Infrastructure Section 4.6.8-Other Marine Uses Appendix R-Navigation Safety Risk Assessment
d) The Project will not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine, coastal, or human environment; or sites, structures, or objects of historical or archeological significance.	Executive Summary (Table ES-1) Section 4-Site Characterization and Assessment of Impact-Producing Factors
e) The Project will use the best available and safest technology.	Section 3-Description of Proposed Activity
f) The Project will use best management practices.	Executive Summary (Table ES-1) Section 4.7-Summary of Potential Impacts and Environmental Protection Measures
g) The Project will use properly trained personnel.	Appendix E-Safety Management System

<table>
<tr><th colspan="2">BOEM Requirements</th><th>Location in COP</th></tr>
<tr><td colspan="3">30 CFR § 585.626(a) - You must submit the results of the following surveys for the proposed site(s) of your facility(ies). Your COP must include the following information:</td></tr>
<tr><td colspan="2">1) Shallow hazards: The results of the shallow hazards survey with supporting data.
Information sufficient to determine the presence of the following features and their likely effects on your proposed facility, including:
(i) Shallow faults;
(ii) Gas seeps or shallow gas;
(iii) Slump blocks or slump sediments;
(iv) Hydrates; or
(v) Ice scour of seabed sediments.</td><td>Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study</td></tr>
<tr><td>2) Geological survey relevant to the design and siting of your facility.</td><td>The results of the geological survey with supporting data.
Assessment of:
(i) Seismic activity at your proposed site;
(ii) Fault zones;
(iii) The possibility and effects of seabed subsidence; and
(iv) The extent and geometry of faulting attenuation effects of geologic conditions near your site.</td><td>Section 4.2.3-Geological Resources
Appendix J-Hydrodynamic and Sediment Transport Modeling Report
Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study
Appendix O2-Revolution Wind 2017-2020 Geophysical Surveys, Data Acquisition and Processing Report
Appendix O3-Field Operations and Final Results Report Revolution Wind Export Cable Route Geotechnical Investigation
Appendix O4-Measured and Derived Geotechnical Parameters and Final Results: REV01 GT1BInter Array Cable and Export Cable Route (IAC/ECR) Locations
Appendix O5-Measured and Derived Geotechnical Parameters and Final Results
Appendix O6-Preliminary Field Results Report: REV01 Inter-Array Cable and Export Cable Route (IAC/ECR) Locations
Appendix O7-Preliminary Field Results Report: REV01 Offshore Substation (OSS) Locations</td></tr>
</table>

BOEM Requirements		Location in COP
		Appendix O8-Preliminary Field Results Report: REV01 GT1B Wind Turbine Generator (WTG) Locations
3) Biological: The results of the biological survey with supporting data. A description of the results of biological surveys used to determine the presence of:	Live bottoms and hard bottoms.	Section 4.2.3-Geological Resources Section 4.3.2-Benthic and Shellfish Resources Appendix X-Benthic Assessment
	Topographic features.	Section 4.2.3-Geological Resources Section 4.2.4-Physical Oceanography and Meteorology Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study
	Surveys of other marine resources such as fish populations (including migratory populations).	Section 4.3.2-Benthic and Shellfish Resources Section 4.3.3-Finfish and Essential Fish Habitat Appendix X-Benthic Assessment Appendix L-Essential Fish Habitat Assessment
	Marine mammals.	Section 4.3.4-Marine Mammals Appendix Z-Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species
	Sea turtles.	Section 4.3.5-Sea Turtles Appendix Z-Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species
	Sea birds.	Section 4.3.6-Avian Species Appendix AA-Assessment of the Potential Effects of the Revolution Offshore Wind Farm on Birds & Bats
4) Geotechnical survey: The results of your sediment testing program with supporting data, the various field and laboratory test	(i) The results of a testing program used to investigate the stratigraphic and engineering properties of the sediment that may impact the foundations or anchoring systems for your facility.	Section 4.2.3-Geological Resources Appendix J-Hydrodynamic and Sediment Transport Modeling Report

BOEM Requirements		Location in COP
methods employed, and the applicability of these methods as they pertain to the quality of the samples, the type of sediment, and the anticipated design application. You must explain how the engineering properties of each sediment stratum impact the design of your facility. In your explanation, you must describe the uncertainties inherent in your overall testing program, and the reliability and applicability of each test method.	(ii) The results of adequate *in situ* testing, boring, and sampling at each foundation location, to examine all important sediment and rock strata to determine its strength classification, deformation properties, and dynamic characteristics. (iii) The results of a minimum of one deep boring (with soil sampling and testing) at each edge of the project area and within the project area as needed to determine the vertical and lateral variation in seabed conditions and to provide the relevant geotechnical data required for design.	Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study Appendix O2-Revolution Wind 2017-2020 Geophysical Surveys, Data Acquisition and Processing Report Appendix O3-Field Operations and Final Results Report Revolution Wind Export Cable Route Geotechnical Investigation Appendix O4-Measured and Derived Geotechnical Parameters and Final Results: REV01 GT1BInter Array Cable and Export Cable Route (IAC/ECR) Locations Appendix O5-Measured and Derived Geotechnical Parameters and Final Results Appendix O6-Preliminary Field Results Report: REV01 Inter-Array Cable and Export Cable Route (IAC/ECR) Locations Appendix O7-Preliminary Field Results Report: REV01 Offshore Substation (OSS) Locations Appendix O8-Preliminary Field Results Report: REV01 GT1B Wind Turbine Generator (WTG) Locations Note: Revolution Wind requested a departure from 30 CFR § 585.626(a)(4)(ii) and (iii) on March 2020 to submit these results prior to construction as part of the FDR required under 30 CFR § 585.701. This request was approved by BOEM on January 27, 2021.
5) Archaeological resources. The results of the archaeological resource survey with supporting data.	A description of the historic and prehistoric archaeological resources, as required by the National Historic Preservation Act (NHPA) (54 *United States Code* [U.S.C.] 300101 *et. seq.*), as amended.	Section 4.4-Cultural Resources Appendix N-Terrestrial Archaeological Resources Assessment Appendix M-Marine Archaeological Resources Assessment
6) Overall site investigation.	An analysis of the potential for: (i) Scouring of the seabed;	Section 4.2.3-Geological Resources Section 4.2.4-Physical Oceanography and Meteorology

BOEM Requirements		Location in COP
An overall site investigation report for your facility that integrates the findings of your shallow hazards surveys and geologic surveys, and, if required, your subsurface surveys with supporting data.	(ii) Hydraulic instability;	Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study
	(iii) The occurrence of sandwaves;	
	(iv) Instability of slopes at the facility location;	
	(v) Liquefaction, or possible reduction of sediment strength due to increased pore pressures;	
	(vi) Degradation of subsea permafrost layers;	
	(vii) Cyclic loading;	
	(viii) Lateral loading;	
	(ix) Dynamic loading;	
	(x) Settlements and displacements;	
	(xi) Plastic deformation and formation collapse mechanisms; and	
	(xii) Sediment reactions on the facility foundations or anchoring systems.	
30 CFR § 585.626(b) - Your COP must include the following project-specific information, as applicable.		
1) Contact Information.	The name, address, e-mail address, and phone number of an authorized representative.	Section 1.6-Authorized Representative and Designated Operator
2) Designation of operator, if applicable	As provided in § 585.405.	Section 1.6-Authorized Representative and Designated Operator
3) The construction and operation concept	A discussion of the objectives,	Section 1.3-Project Purpose
	Description of the proposed activities,	Section 1.1-Project Overview Section 3-Description of Proposed Activity

BOEM Requirements		Location in COP
	Tentative schedule from start to completion, and	Section 3.2-Project Schedule
	Plans for phased development, as provided in § 585.629.	Not applicable - the Project is a single, complete, and independent project that will not be developed in phases
4) Commercial lease stipulations and compliance	A description of the measures you took, or will take, to satisfy the conditions of any lease stipulations related to your proposed activities.	Executive Summary (Table ES-1) Section 4.7-Summary of Potential Impacts and Environmental Protection Measures
5) A location plat	The surface location and water depth for all proposed structures, facilities, and appurtenances located both offshore and onshore, including all anchor/mooring data.	Section 1.1-Project Overview Section 3-Description of Proposed Activity
	The surface location and water depth for all existing structures, facilities, and appurtenances located both offshore and onshore, including all anchor/mooring data.	Section 1.1-Project Overview Section 3-Description of Proposed Activity
6) General structural and project design, fabrication, and installation.	Information for each type of structure associated with your project and, unless BOEM provides otherwise, how you will use a Certified Verification Agent (CVA) to review and verify each stage of the project.	Section 1.7-Certified Verification Agent Section 3-Description of Proposed Activity Appendix C-Certified Verification Agent Appendix H- Supplemental Project Information and Conceptual Project Engineering Design Drawings
7) All cables and pipelines, including cables on project easements.	Location, design and installation methods, testing, maintenance, repair, safety devices, exterior corrosion protection, inspections, and decommissioning.	Section 3-Description of Proposed Activity
8) A description of the deployment activities	Safety, prevention, and environmental protection features or measures that you will use.	Section 3-Description of Proposed Activity Section 4.7- Summary of Potential Impacts and Environmental Protection Measures Appendix D-Emergency Response Plan/Oil Spill Response Plan Appendix E-Safety Management System Appendix R-Navigation Safety Risk Assessment

BOEM Requirements		Location in COP
9) A list of solid and liquid wastes generated	Disposal methods and locations.	Section 3-Description of Proposed Activity Section 4.1.6-Discharges and Releases
10) A listing of chemical products used (if stored volume exceeds EPA Reportable Quantities).	A list of chemical products used; the volume stored on location; their treatment, discharge, or disposal methods used; and the name and location of the onshore waste receiving, treatment, and/or disposal facility. A description of how these products will be brought onsite, the number of transfers that may take place, and the quantity that that will be transferred each time.	Section 3-Description of Proposed Activity Appendix D-Emergency Response Plan/Oil Spill Response Plan
11) A description of any vessels, vehicles, and aircraft you will use to support your activities.	An estimate of the frequency and duration of vessel/vehicle/aircraft traffic.	Section 3-Description of Proposed Activity Section 4.1.8-Traffic (Vessels, Vehicles, Air)
12) A general description of the operating procedures and systems.	(i) Under normal conditions.	Section 3.5-Operations and Maintenance
	(ii) In the case of accidents or emergencies, including those that are natural or manmade.	Section 3.5-Operations and Maintenance Appendix D-Emergency Response Plan/Oil Spill Response Plan Appendix R-Navigation Safety Risk Assessment
13) Decommissioning and site clearance procedures	A discussion of general concepts and methodologies.	Section 3.6-Decommissioning
14) A listing of all federal, state, and local authorizations, approvals, or permits that are required to conduct the proposed activities, including commercial operations.	(i) The USCG, USACE, and any other applicable authorizations, approvals, or permits, including any federal, state or local authorizations pertaining to energy gathering, transmission or distribution (e.g., interconnection authorizations).	Section 1.4-Regulatory Framework
	(ii) A statement indicating whether you have applied for or obtained such authorization, approval, or permit.	Section 1.4-Regulatory Framework

BOEM Requirements		Location in COP
15) Your proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts.	A description of the measures you will use to avoid or minimize adverse impacts and any potential incidental take before you conduct activities on your lease, and how you will mitigate environmental impacts from your proposed activities, including a description of the measures you will use as required by subpart H of this part.	Section 4.7-Summary of Potential Impacts and Proposed Environmental Protection Measures
16) Information you incorporate by reference	A listing of the documents you referenced.	Section 5-References Appendices A–DD
17) A list of agencies and persons with whom you have communicated, or with whom you will communicate, regarding potential impacts associated with your proposed activities.	Contact information and issues discussed.	Section 1.5-Agency and Public Outreach Appendix A-Agency Correspondence
18) Reference	A list of any document or published source that you cite as part of your plan. You may reference information and data discussed in other plans you previously submitted or that are otherwise readily available to BOEM.	Section 5-References Appendices A–DD
19) Financial assurance	Statements attesting that the activities and facilities proposed in your COP are or will be covered by an appropriate bond or security, as required by §§ 585.515 and 585.516.	Section 1.10-Financial Assurance
20) CVA nominations for reports required in subpart G of this part.	CVA nominations for reports in subpart G of this part, as required by § 585.706, or a request for a waiver under § 585.705(c).	Section 1.7-Certified Verification Agent Nomination Appendix C-Certified Verification Agent
21) Construction schedule	A reasonable schedule of construction activity showing significant milestones leading to the commencement of commercial operations.	Section 3.2-Project Schedule

BOEM Requirements		Location in COP
22) Air quality information	As described in § 585.659 of this section.	Section 4.2.1-Air Quality Appendix T-Air Emissions Calculations and Methodology
23) Other information	Additional information as required by BOEM.	N/A
30 CFR § 585.627(a) - You must submit with your COP detailed information to assist BOEM in complying with NEPA and other relevant laws. Your COP must describe those resources, conditions, and activities listed in the following table that could be affected by your proposed activities, or that could affect the activities proposed in your COP, including:		
1) Hazard Information	Meteorology and oceanography.	Section 4.2.4-Physical Oceanography and Meteorology
	Sediment transport, geology, and shallow geological or manmade hazards.	Section 4.2.3-Geological Resources Appendix J-Hydrodynamic and Sediment Transport Modeling Report Appendix O1-Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study
2) Water Quality	Turbidity and total suspended solids from construction.	Section 4.2.2-Water Quality and Water Resources Appendix J-Hydrodynamic and Sediment Transport Modeling Report
3) Biological resources	Benthic communities.	Section 4.3.2-Benthic and Shellfish Resources Appendix X-Benthic Assessment
	Marine mammals.	Section 4.3.4-Marine Mammals Appendix Z-Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species
	Sea turtles.	Section 4.3.5-Sea Turtles Appendix Z-Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species
	Coastal and marine birds.	Section 4.3.6-Avian Species Appendix AA-Assessment of the Potential Effects of the Revolution Offshore Wind Farm on Birds & Bats

BOEM Requirements		Location in COP
	Fish and shellfish.	Section 4.3.2-Benthic and Shellfish Resources Section 4.3.3-Finfish and Essential Fish Habitat Appendix L-Essential Fish Habitat Assessment Appendix X-Benthic Assessment
	Plankton.	Section 4.3.3-Finfish and Essential Fish Habitat Appendix L-Essential Fish Habitat Assessment
	Seagrasses.	Section 4.3.1-Coastal Habitat Section 4.3.2-Benthic and Shellfish Resources Section 4.3.3-Finfish and Essential Fish Habitat Appendix L-Essential Fish Habitat Assessment Appendix X-Benthic Assessment
	Plant life.	Section 4.3.1-Coastal Habitat Section 4.3.2-Benthic and Shellfish Resources Section 4.3.3-Finfish and Essential Fish Habitat Appendix L-Essential Fish Habitat Assessment Appendix X-Benthic Assessment
4) Threatened or endangered species	As defined by the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.).	Section 4.3.3-Finfish and Essential Fish Habitat Section 4.3.4-Marine Mammals Section 4.3.5-Sea Turtles Section 4.3.6-Avian Species Section 4.3.7-Bat Species Appendix Z-Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix AA-Assessment of the Potential Effects of the Revolution Offshore Wind Farm on Birds & Bats Appendix K-Onshore Natural Resources and Biological Assessment

BOEM Requirements		Location in COP
5) Sensitive biological resources or habitats	Essential fish habitat.	Section 4.3.3-Finfish and Essential Fish Habitat Appendix L-Essential Fish Habitat Assessment
	Refuges and preserves.	Section 4.6.8-Other Marine Uses
	Special management areas identified in coastal management programs, sanctuaries, rookeries.	Section 4.6.8-Other Marine Uses
	Hard bottom habitat.	Section 4.2.3-Geological Resources Section 4.3.2-Benthic and Shellfish Resources Appendix T-Benthic Assessment
	Chemosynthetic communities.	N/A
	Calving grounds.	N/A
	Barrier islands, beaches, and dunes.	Section 4.3.1-Coastal and Terrestrial Habitat
	Wetlands.	Section 4.3.1-Coastal and Terrestrial Habitat
6) Archaeological resources	As required by the NHPA (54 U.S.C. 300101 et seq.), as amended.	Section 4.4-Cultural Resources Appendix N-Terrestrial Archaeological Resources Assessment Appendix M-Marine Archaeological Resources Assessment
7) Social and Economic resources	Employment.	4.6.1-Population, Economy, and Employment Appendix BB-Assessment of Economic Development and Jobs Analysis Report
	Existing offshore and coastal infrastructure (including major sources of supplies, services, energy, and water).	4.6.3-Public Services 4.6.6-Commercial Shipping 4.6.7-Coastal Land Use and Infrastructure 4.6.8-Other Marine Uses
	Land use.	4.6.7-Coastal Land Use and Infrastructure

BOEM Requirements		Location in COP
	Subsistence resources and harvest practices.	4.6.5-Commercial and Recreational Fishing
	Recreation, recreational and commercial fishing (including typical fishing seasons, location, and type).	Section 4.6.5-Commercial and Recreational Fishing Appendix DD-Fisheries Communication Plan Appendix CC-Commercial and Recreational Fisheries
	Minority and lower income groups.	Section 4.6.1-Population, Economy, and Employment Section 4.6.2-Housing and Property Values Section 4.6.9-Environmental Justice
	Coastal zone management programs.	Appendix B-Coastal Zone Management Act Federal Consistency Certifications
	Viewshed.	Section 4.1.9-Visible Structures Section 4.5-Visual Resources Section 4.4.1-Above Ground Historic Properties Appendix U1-Visual Impact Assessment and Historic Resources Visual Effects Analysis - Revolution Wind Onshore Facilities Appendix U2-Historic Resources Visual Effects Analysis - Revolution Wind Farm Appendix U3-Visual Impact Assessment - Revolution Wind Farm Appendix N-Terrestrial Archaeological Resources Assessment
8) Coastal and marine uses	Military activities.	Section 4.6.6-Commercial Shipping Section 4.6.8-Other Marine Uses Appendix R-Navigation Safety Risk Assessment
	Vessel traffic.	
	Energy and nonenergy mineral exploration or development.	
9) Consistency Certification	As required by the Coastal Zone Management Act (CZMA): (i) 15 CFR part 930, subpart D, for noncompetitive leases. (ii) 15 CFR part 930, subpart E, for competitive leases.	Appendix B-Coastal Zone Management Act Consistency Certifications

BOEM Requirements		Location in COP
10) Other resources, conditions, and activities	As identified by BOEM.	N/A
30 CFR § 585.627(b) - You must submit one paper copy and one electronic copy of your consistency certification. Your consistency certification must include:		
CZMA Consistency Certification	1) One copy of your consistency certification under subsection 307(c)(3)(B) of the CZMA (16 U.S.C. 1456(c)(3)(B)) and 15 CFR 930.76 stating that the proposed activities described in detail in your plans comply with the State(s) approved coastal management program(s) and will be conducted in a manner that is consistent with such program(s); 2) ''Information,'' as required by 15 CFR 930.76(a) and 15 CFR 930.58(a)(2), and ''Analysis,'' as required by 15 CFR 930.58(a)(3).	Appendix B-Coastal Zone Management Act Consistency Certifications
30 CFR § 585.627(c)		
Oil Spill Response Plan	In accordance with 30 Part 254.	Appendix D-Emergency Response Plan/Oil Spill Response Plan
30 CFR § 585.627(d)		
Safety Management System	In accordance with 30 CFR 585.810.	Appendix E-Safety Management System

2.0 Project Siting and Design Development

This section presents a description of the siting process undertaken by Revolution Wind for the RWF, RWEC, and Onshore Facilities. Section 2.1 presents the siting history, including the siting of the RI-MA WEA, establishment of the Lease Area, and the proposed location of the RWF. Section 2.2 provides a summary of the alternatives considered by Revolution Wind for the siting, design, and construction of the Project. Finally, Section 2.3 summarizes the Preferred Alternative which is detailed in Section 3.0.

2.1 Revolution Wind Farm Siting History

In 2013, BOEM divided and auctioned the RI-MA WEA as two lease areas (North Lease OCS-A 0486 and South Lease OCS-A 0487). Both leases were competitively awarded to Deepwater Wind LLC.[6] The North Lease Area consists of 97,498 acres and the South Lease Area consists of approximately 67,250 acres (Figure 2.1-1). On January 10, 2020, a request was submitted to BOEM to segregate the North Lease Area (OCS-A 0486) to accommodate both the Revolution Wind Farm Project and South Fork Wind Farm (SFWF) Project. The Revolution Wind Farm Project retained lease number OCS-A 0486 while a new lease number was assigned for the SFWF Project (OCS-A 0517). With this segegation, Lease Area OCS-A 0486 totals 82,732 acres.

This section provides the history of the siting and screening of the RI-MA WEA and how the RWF was located.

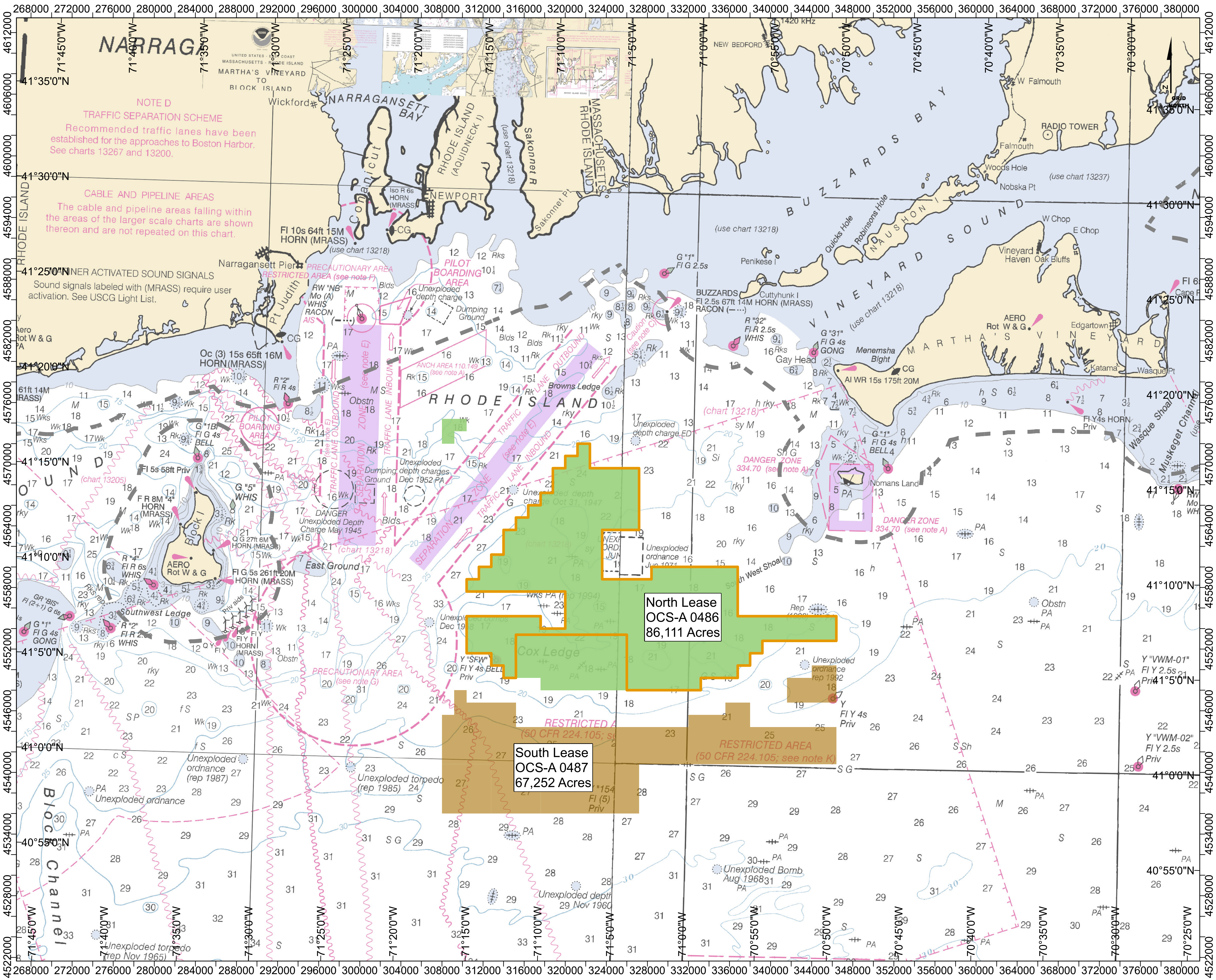
6 Note that in October 2018, Deepwater Wind LLC was acquired by Orsted North America Inc.

Revolution Wind

Figure 2.1.1-1

Rhode Island-Massachusetts Wind Energy Area Siting History

NORTH KINGSTOWN, RI



Legend

- RWF Boundary Lease Area OCS-A 0486
- OCS-A 0486 - North Lease Area
- OCS-A 0487 - South Lease Area
- 3-Nautical Mile State Water Boundary

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
NOAA Nautical Charts (Map Service): NOAA / NOS Special Projects / Office of Coast Survey

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 3000 6000 9000 Meters

0 10,000 20,000 30,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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2.1.1 Siting and Screening of the RI-MA WEA

The siting of the RI-MA WEA was the result of a multi-year effort by state and federal regulatory agencies to identify OCS areas suitable for offshore renewable energy development. The area was identified based on four years of preliminary site characterization, environmental assessment, and stakeholder discussions occurring primarily during the development of the Rhode Island Ocean Special Area Management Plan (OSAMP). Significant investment of public resources went into the compilation and review of site characterization data and the assessment of potential environmental impacts. A wide range of potential impacts were evaluated, including, but not limited to, environmental, economic, cultural and visual, and use conflicts.

Several planning efforts organized by federal and state entities involving private and public interest groups, as well as members of the academic community and the public, led to the identification of the areas that were eventually leased. The primary efforts and process milestones were as follows:

- BOEM's 2009 Intergovernmental Renewable Energy Task Forces in Massachusetts and Rhode Island.
- Massachusetts Ocean Management Plan, 2015 (update of 2009 version).
- *Rhode Island Ocean Special Area Management Plan*, 2010, assessed environmental, economic, cultural and visual resource data, and use conflicts of the entire Ocean SAMP region, creating a baseline of information that was considered during the designation of the RI-MA WEA (RI CRMC, 2015).
- Executive Order (EO) 13547 of July 19, 2010, which was signed on July 19, 2010, established the National Ocean Policy and provided a national framework and governance structure for sustainable management of U.S. ocean, coastal, and Great Lakes resources. This EO began a multi-year process which resulted in the Northeast Regional Ocean Plan (The White House, 2010).
- Memorandum of Understanding signed by the Governors of Rhode Island and Massachusetts in 2010, forming a partnership to collaborate with BOEM and defining an Area of Mutual Interest (AMI) for wind energy project development (Figure 2.1-2). The AMI was a contiguous block of 45 OCS lease blocks (256,199 acres or 1,035 square kilometers [km^2] or 302 square nm) (BOEM et al., 2010).
- In 2011, BOEM published in the *Federal Register* a Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore Rhode Island and Massachusetts-Call for Information and Nominations (Docket No. BOEM-2011-0049, 76 *Federal Register* 51383-51391), requesting expressions of interest from potential wind project developers (BOEM, 2011a).
- In compliance with its obligations under NEPA, BOEM published in the *Federal Register* a *Notice of Intent to Prepare an Environmental Assessment* (Docket No. BOEM-2011-0063, 76 Federal Register 51391-51393) in 2011 (BOEM, 2011b).
- On July 2, 2012, BOEM published a Notice of Availability for the Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts Environmental Assessment (EA) (77 *Federal Register* 39508). A 30-day comment

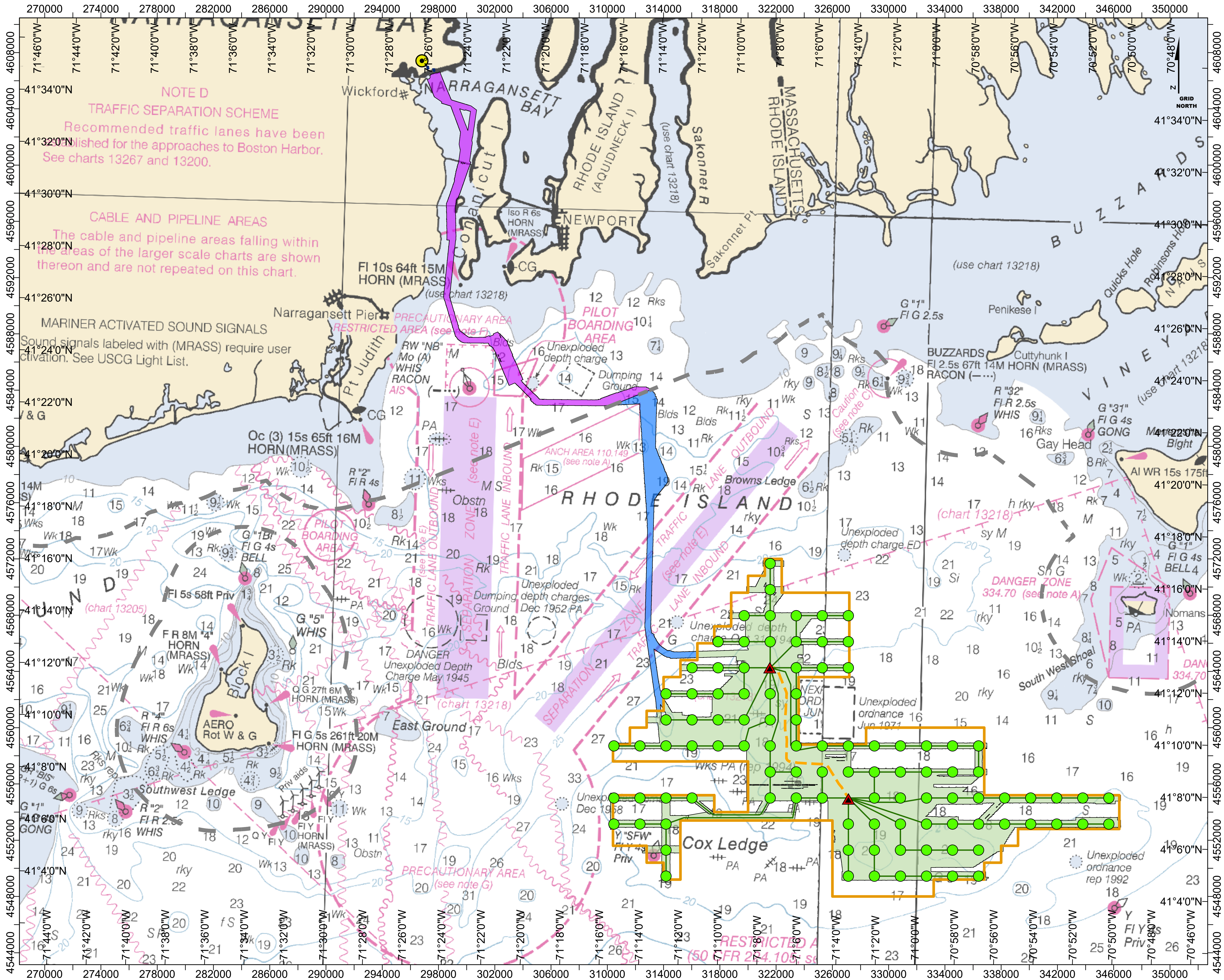
period was opened, and BOEM held public informational meetings in Massachusetts and Rhode Island (BOEM, 2012).

- BOEM revised the 2012 EA for the RI-MA WEA in May 2013 to address issues raised by stakeholders and agency consultation about lease issuances and site assessment activities. BOEM issued a Finding of No Significant Impact for these activities within the RI-MA WEA (BOEM, 2013a).

The Lease Area was established by BOEM through a coordinated, rigorous, and thorough siting and screening process consistent with the objectives of the National Ocean Policy and NEPA, and also took into consideration the policies and objectives of the State of Rhode Island and the Commonwealth of Massachusetts. BOEM reduced the original area considered for leasing based on environmental constraints, efforts to decrease user group conflicts, navigational safety, public health and safety, and stakeholder concerns (e.g., commercial fishing) (Figure 2.1-2). The key considerations used to refine the RI-MA WEA included:

- The Governors of Massachusetts and Rhode Island agreement to a boundary that was at least 6 nm (16.7 km or 10.4 mi) away from any coastal area of either state.
- A lengthy stakeholder and scientific review process that identified “high value” fishing grounds and excluded those areas from the RI-MA WEA (Figure 2.1-2, exclusion zone). High value fishing includes the overlap between fixed gear fisheries (traps, pots, and gillnets) and mobile fisheries (trawls, dredges). Areas excluded from the RI-MA WEA had three to four types of fishing specialties using the areas, such as bottom trawling, scallop dredging, and lobster trap fisheries.
- Removal of certain aliquots to avoid marine traffic, navigation zones, and an area of unexploded ordinance.

The RI-MA WEA was designated for offshore renewable energy development as the result of a coordinated, rigorous, and thorough siting and screening process consistent with the objectives of the National Ocean Policy and NEPA.



Revolution Wind
Figure 2.2.1-1
Aligned Grid Layout

Legend

- RWF Boundary Lease Area OCS-A 0486

Offshore Envelope

- RWF Envelope
- RWEC-OCS Envelope
- RWEC-RI State Waters Envelope
- WTG Location
- OnSS
- OSS
- Indicative IAC
- Indicative OSS-Link Cable Route
- 3-Nautical Mile State Water Boundary

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
NOAA Raster Nautical Charts (RNC): NOAA Office of Coast Survey

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2500 5000 7500 Meters

0 9,000 18,000 27,000 Feet

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2.1.2 Revolution Wind Farm Siting and Screening

As described in Section 1.3, the Project purpose is driven by PPAs awarded to Revolution Wind to-date. Beginning in 2017, Revolution Wind conducted comprehensive desktop studies of oceanographic, geologic, shallow hazards, archeological, and environmental resources in the Lease Area. These desktop studies informed the preliminary siting of the Project and supported the development of COP Survey Plans, which were conducted in 2017, 2018 and 2019. The purpose of the COP surveys was to conduct site characterization, marine archeological, and benthic studies necessary to further evaluate the seabed in the Lease Area and along potential RWEC routes. The COP Survey Plans were submitted in accordance with the stipulations of the Lease, as well as the following BOEM regulations and BOEM's guidelines:

- Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to CFR Title 30, Part 585 dated July 2, 2015 (BOEM, 2015a);
- Guidelines for Submission of Spatial Data for Atlantic Offshore Renewable Energy Development Site Characterization Survey dated February 1, 2013 (BOEM, 2013b);
- Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585 dated March 2017 (BOEM, 2017);
- Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf dated June 2019 (BOEM, 2019); and,
- Guidelines for Information Requirements for a Renewable Energy COP dated April 2016 (Version 3.0) (BOEM, 2016).

2.2 Project Alternatives

Revolution Wind considered multiple alternatives to achieve the Projects purpose (see Section 1.3). The evaluation of alternatives was undertaken in the context of creating the PDE for the Project to allow for reasonable flexibility while supporting the review and approval processes being undertaken by BOEM under the terms of the Lease, as well as other federal, state, and local regulations. The process involved siting, design, and construction alternatives for the Project, including:

- **Siting Alternatives**
  - WTG layouts
  - Location of transmission and interconnection facilities, including the RWEC, Onshore Transmission Cable, and OnSS
- **Design Alternatives**
  - WTG models
  - Foundation designs for WTGs and OSSs

- **Construction Alternatives**
  - Foundation installation methods
  - Submarine cable installation methods
  - Onshore Transmission Cable installation methods

General criteria for the evaluation of alternatives included:

- Meeting Project need, as described in Section 1.3
- Consideration of environmental resources
- Consideration of design characteristics
- Consideration of construction methodologies and feasibility
- Consideration of future O&M requirements
- Implications to the Project schedule
- Consideration of capital and maintenance costs

The following subsections describe the alternatives considered and provides the rationale for their inclusion or exclusion from the Preferred Alternative.

2.2.1 Siting Alternatives

During 2018 and 2019, Revolution Wind undertook a multi-phased approach to evaluate siting alternatives for the WTG layout and transmission and interconnection facilities (i.e., the RWEC, Onshore Transmission Cable, and OnSS). The following sections describe the siting alternatives considered for the Project.

2.2.1.1 WTG Layouts

Generally, the offshore location of the Project is fixed in that the WTGs, IAC and OSSs must be located within the Lease Area. However, Revolution Wind evaluated several WTG layouts within the Lease Area in an effort to satisfy the following criteria:

- Maximize use of available space within the Lease Area without limiting future development;
- Maximize use of available wind resources and energy production;
- Minimize interference with commercial and recreational use of the Lease Area;
- Avoid and/or minimize impacts to sensitive biological habitat and cultural marine resource sites; and,
- Minimize impacts to other sensitive environmental receptors in the surrounding area.

Layout for the IAC, OSS, and OSS-Link Cable was driven by the WTG layout and seabed constraints (e.g., boulders). Two primary WTG layout alternatives were considered relative to these criteria: a Variable East-West Layout and an Aligned Grid Layout.

› **Variable East-West Layout.** The WTGs in this layout are positioned along east-west corridors as necessary to maintain optimization and minimize wake loss. North-south spacing between each east-west row would be 1.15 mi (1 nm, 1.8 km). Within the east-west rows, WTGs would have an average spacing of 0.8 mi (0.7 nm, 1.3 km), and a minimum of 0.7 mi (0.6 nm, 1.1 km).

› **Aligned Grid Layout**. The WTGs in this layout are arranged in an approximate 1.15 mi (1 nm, 1.8 km) by 1.15 mi (1 nm, 1.8 km), with WTGs aligned with adjacent offshore wind projects proposed in the RI-MA WEA and MA WEA. In accordance with 30 CFR § 585.634(C)(6), micro-siting of WTG foundations may occur within a 500-ft (152-m) radius around each proposed WTG location. This micrositing will be performed on a case-by-case basis to avoid significant seabed hazards such as surface and subsurface boulders.

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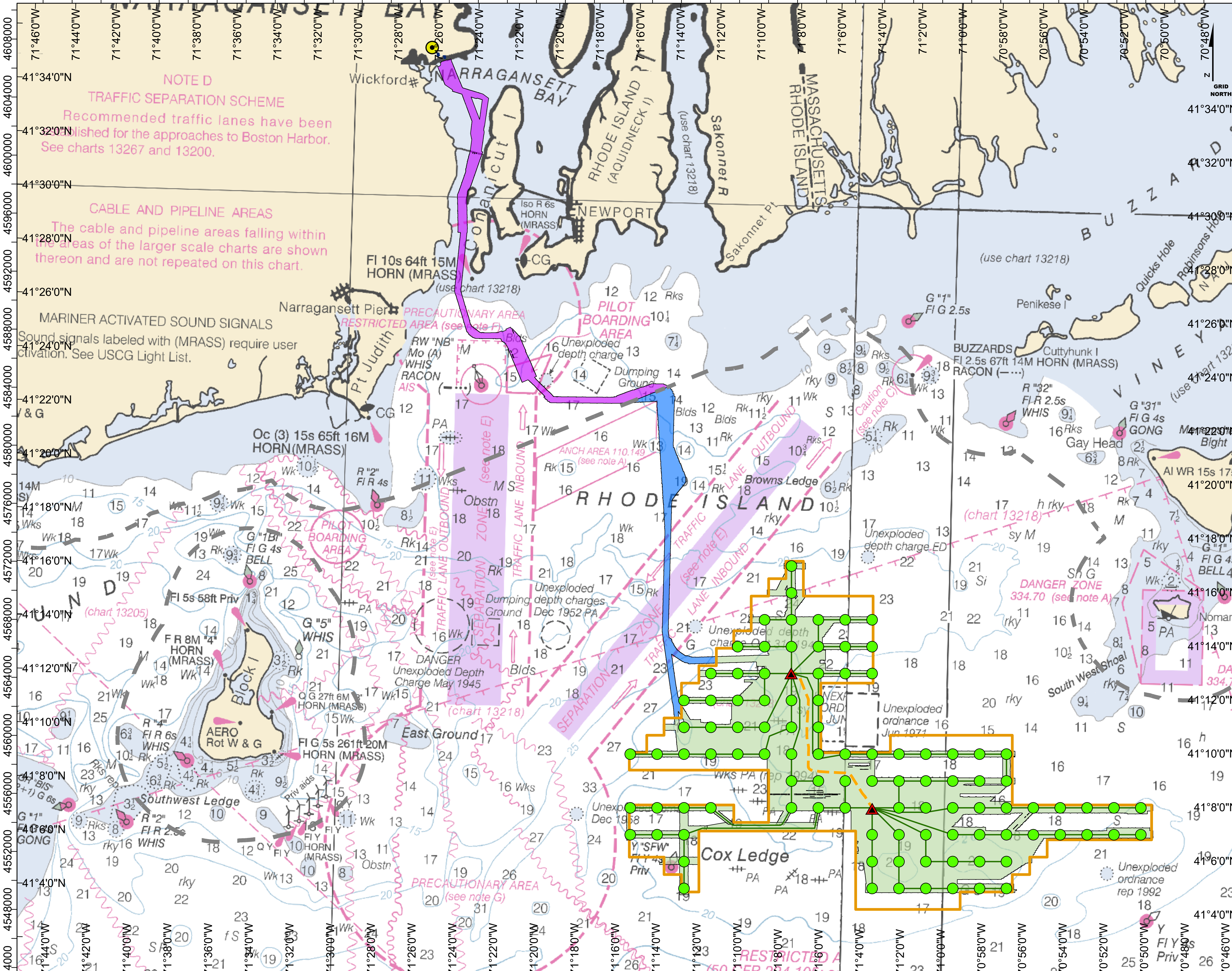
Figure 2.2.1-1
Aligned Grid Layout



Legend
- RWF Boundary Lease Area OCS-A 0486
- Offshore Envelope
  - RWF Envelope
  - RWEC-OCS Envelope
  - RWEC-RI State Waters Envelope
- WTG Location
- OnSS
- OSS
- Indicative IAC
- Indicative OSS-Link Cable Route
- 3-Nautical Mile State Water Boundary

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
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Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2500 5000 7500 Meters

0 9,000 18,000 27,000 Feet

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The Variable East-West Layout offered several advantages and certain challenges for the Project. Among others, while the Variable East-West Layout offers increased micro-siting flexibility, engagement with stakeholders, including federal and state regulatory agencies and the maritime community, highlighted that the Variable East-West Layout posed potential challenges for ensuring safe fishing vessel navigation.

Based on this feedback, Revolution Wind proposed adjusting the Project layout to an approximate 1.15 mi (1 nm, 1.8 km) by 1.15 mi (1 nm, 1.8 km) grid of WTGs, and aligned with layouts proposed for other projects in the RI-MA WEA and MA WEA. While the modification of the layout reduces the overall efficiency and energy production of the Project, it satisfies the concerns of the regulatory agencies and the maritime community, and still allows for commercially feasible development of the Lease Area. The Aligned Grid Layout maintains some flexibility for micro-siting within the parameters of 30 CFR § 585.634(c)(6) to address the constraints associated with the Lease Area's heterogeneous seabed. For this reason, the Aligned Grid Layout was selected as the preferred WTG layout for the Project. Figure 2.2.1-1 depicts the proposed WTG layout and indicative routing of the IAC, OSS, and OSS-Link Cable. Also shown are the Offshore Envelope areas, within which micro-siting of Project cables will occur. In addition, all associated seabed disturbance (e.g., vessel anchoring) associated with construction and O&M of the Project's WTGs, OSSs, and submarine cables will be confined to the Offshore Envelope areas. With the exception of within approximately 985 ft (300 m) of the shoreline (due to survey limitations associated with shallow water depths), geophysical data have been collected within the entire Offshore Envelope.

2.2.1.2 Transmission and Interconnection Facility Location Alternatives

Transmission and interconnection facilities are necessary to transfer electricity generated by the Project to the broader electrical grid. This specifically requires conveying electricity from the offshore wind farm to existing onshore electrical transmission facilities associated with the Project. The Project includes three transmission and interconnection components: the RWEC, Onshore Transmission Cable, and an OnSS. Alternatives considered for these Project components are discussed in the following subsections. Note, siting of the RWEC and Onshore Transmission Cable considered alternative landfall locations; the landfall locations considered are presented with the discussion of Onshore Transmission Cable routing alternatives.

Revolution Wind Export Cable Routing Alternatives

Identification of a suitable export cable route configuration must take into account a variety of factors including:

- Interconnection point to the onshore transmission grid having:
  - Existing infrastructure with sufficient capacity to accept the electricity produced by the Project, and
  - Proximity to the coastline to minimize the onshore transmission routes;
- Minimal conflicts with existing environmental and anthropogenic constraints and uses both onshore and offshore; and
- Proximity to the Lease Area.

Initial analysis of reconnaissance level geophysical data collected by Revolution Wind in 2017 identified origin points within the Lease Area where the RWEC could exit the Lease Area heading north towards an anticipated cable route to shore. One origin point was identified in the northwest quadrant of the Lease Area proximate to the East and West Passages of the Narragansett Bay. A second origin point was identified in the northern tip of the Lease Area proximate to the Sakonnet River.

Between the Lease Area and shore, Revolution Wind reviewed available data potentially affecting the route suitability such as seabed slope, geological hazards, tidal currents, subsea utilities, dumping grounds, shipwrecks and other seafloor obstructions, unexploded ordnances (UXO), Munitions and Explosives of Concern (MEC), existing cable crossings, anchorage/mooring areas, Pilot boarding zones, navigational safety zones, and DoD military practice areas. Subsequently, two potentially viable routes between the Lease Area and the entrances to the East and West Passages of Narragansett Bay, and a third potentially viable route between the Lease Area and the Sakonnet River, were identified.

To further support routing of the RWEC to a specific landfall location, with an intent to minimize the length of the submarine transmission route, Revolution Wind evaluated a number of potential grid interconnection points in southeastern Massachusetts, Rhode Island, and the eastern coast of Connecticut. In order to accept the maximum electricity produced by the Project at the most cost effective location, the Project only evaluated substations with operating capacities of 115-kV or higher as potential grid interconnection points. The following existing substations were identified as potential grid interconnection points for further evaluation (see Figure 2.2.1-2):

- Brayton Point 345-kV Substation, Somerset, Massachusetts
- Pottersville 115-kV Substation, Somerset, Massachusetts
- Kent County 115-kV and 345-kV Substation, Warwick, Rhode Island
- Davisville 115-kV Substation, North Kingstown, Rhode Island

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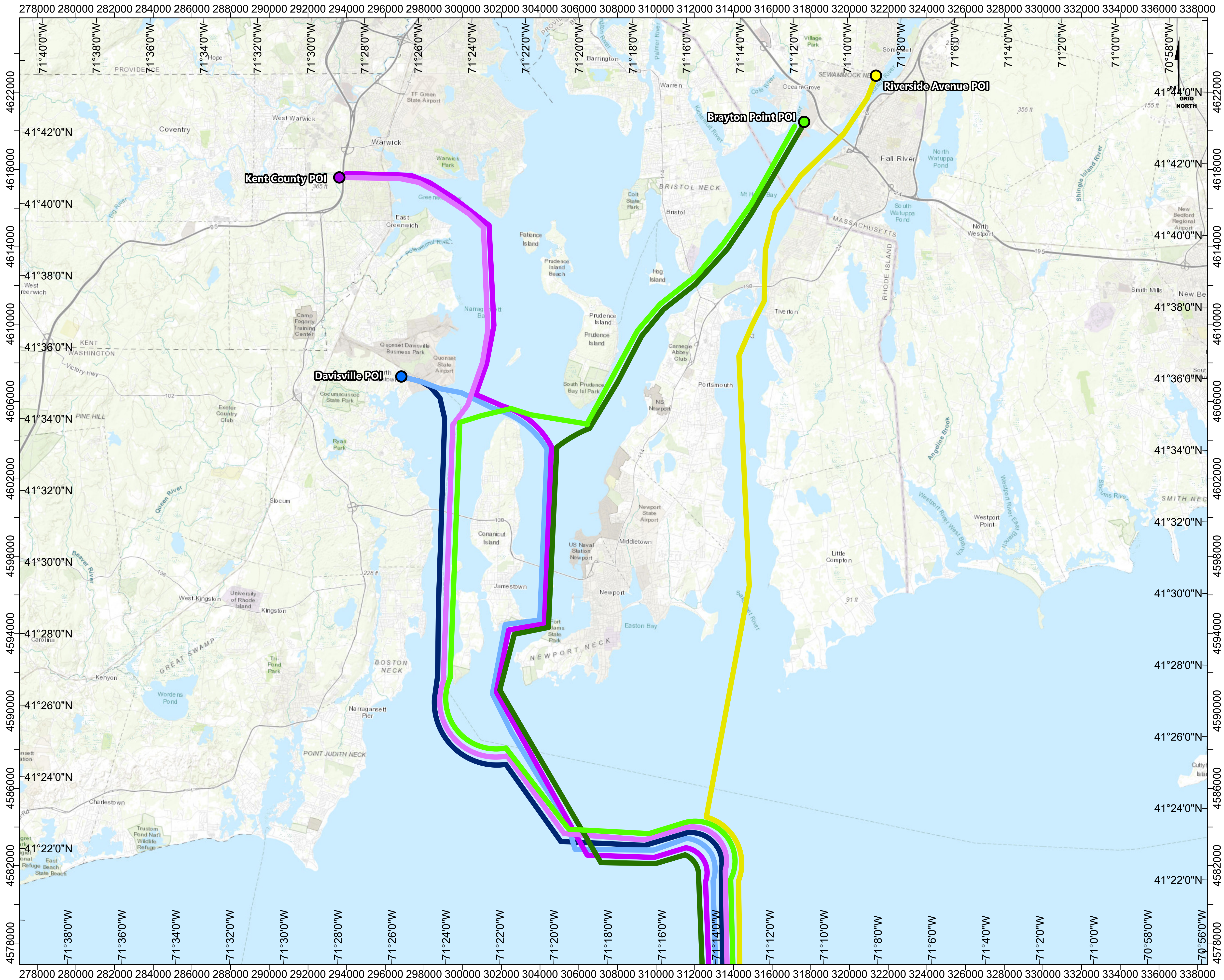
Figure 2.2.1-2
Export Cable Landfall Site Options



Legend

- Brayton Point POI
- Davisville POI
- Kent County POI
- Riverside Avenue POI
- Brayton Point Potenetial Route 1
- Brayton Point Potential Route 2
- Davisville Potnetial Route 1
- Davisville Potential Route 2
- Kent County Potential Route 1
- Kent County Potential Route 2
- Riverside Avenue Potential Route

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World Topographic Map: MassGIS, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2000 4000 6000 Meters

0 6,000 12,000 18,000 Feet

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Table 2.2.1-1 Interconnection Points and Corresponding Export Cable Routes Evaluated

Point of Interconnection Alternatives and Landfall Location		Potential RWEC Route	Constraints Identified
1	TNEC's Davisville Substation Point of Interconnection (Davisville POI) Landfall at Quonset Point in North Kingstown, Rhode Island POI at a new onshore substation that would be located adjacent to the existing TNEC Davisville Substation	The lower West Passage between the Towns of Jamestown, Narragansett and North Kingstown	› Route segment advantageous based on existing bathymetry, favorable geology, lack/avoidance of use conflicts and environmental constraints › Advantageous due to short overland route, land availability and location within generally consistent land use for interconnection facilities; unfavorable due to challenging site conditions relative to contaminated soils (brownfields), floodplain, and potential underground utility conflicts
		The lower East Passage between the City of Newport and Town of Jamestown	› Route segment was not preferred due on water depths, geologic hazards (bedrock), existing cable crossings, designation as primary commercial shipping channel to the Port of Providence and Quonset, and DoD use concerns
2	Kent County POI Landfall at private property identified as Brewer's Marina South in Warwick, Rhode Island POI at a new substation that would be located adjacent to the existing TNEC Kent County Substation	The lower West Passage between the Towns of Jamestown, Narragansett and North Kingstown	› Route segment advantageous based on existing bathymetry, favorable geology, lack/avoidance of use conflicts and environmental constraints
		The lower East Passage between the City of Newport and Town of Jamestown	› Route segment was not preferred due to water depths, geologic hazards (bedrock), existing cable crossings, designation as primary commercial shipping channel to the Port of Providence and Quonset, and DoD use conflicts
		The upper West Passage between City of Warwick, Prudence Island (Town of Portsmouth), and Town of North Kingstown	› Route segment was not preferred due to water depth, existing cable crossings and designation as primary commercial shipping channel to Quonset
		Greenwich Bay which is bounded by the City of Warwick and Kent County overland route	› Route segment was not preferred due to shallow water depths (<20 ft [6m]), significant submerged pre-contact archaeological resources, designated shellfish resources

	Point of Interconnection Alternatives and Landfall Location	Potential RWEC Route	Constraints Identified
			› Route segment not preferred due to longest overland route, private property ownership, shallow to bedrock, significant grade changes, narrow right of way, existing utility conflicts. › POI not preferred due to lack of reasonably available land for interconnection facilities
3	Brayton Point POI Landfall on the west side of Brayton Point in Somerset, Massachusetts POI at a new substation west of the former Brayton Point Power Generating Plant	The lower East Passage or West Passage, upper East Passage between Aquidneck Island and Prudence Island and Mount Hope Bay bounded by the Towns of Bristol, Portsmouth, and Tiverton, Rhode Island, and the City of Fall River, and Towns of Somerset and Swansea, Massachusetts	› Lower East Passage route segment abandoned from further consideration based on water depths, geologic hazards (bedrock), existing cable crossings, designation as primary commercial shipping channel to the Port of Providence and Quonset, and DoD use conflicts › Route segment not preferred due to existing cable crossings and designation as primary commercial shipping channel to the Port of Providence › Route segment not preferred due longest submarine route, challenging site conditions relative to potential contaminated soils, uncertainty regarding reasonably available land for interconnection facilities
4	Riverside Avenue POI Landfall at the former Montaup Power Generating Plant in Somerset, Massachusetts POI adjacent to the new New England Power Company Pottersville Substation west of Montaup	The Sakonnet River between the Towns of Little Compton and Tiverton, and Aquidneck Island, the Mount Hope Bay and the Taunton River	› Route segment not preferred due to geologic constraints, longest submarine route, designated shellfish resources, conflicting water use classification › Route segment not preferred due longest submarine routes, challenging site conditions relative to potential contaminated soils, uncertainty regarding reasonably available land for interconnection facilities

Of the POIs and routes evaluated, Alternatives 2, 3 and 4 were ultimately excluded from further consideration as additional evaluation determined that these routes and POIs would result in greater seabed and/or terrestrial disturbance due to increased length of transmission route; and/or conflicts with existing anthropogenic constraints and uses.

Consequently, Revolution Wind identified the preferred route for the RWEC, as entering Narragansett Bay via the West Passage and interconnecting at the TNEC Davisville Substation. This alternative accommodates the full generation capacity of the Project and results in minimal resource impacts due to the shortest overall transmission route offshore and onshore, existing baythmetry, favorable geology, avoidance of use conflicts and environmental constraints, available land for interconnection equipment, favorable zoning and beneficial reuse of contaminated properties.

Onshore Transmission Cable Routing Alternatives

The assessment of potential Onshore Transmission Cable routes relied on an evaluation of local zoning ordinances, bedrock, hazardous materials, coastal land uses, wetlands, Environmental Justice Areas, floodplain, property ownership, rare, threatened, and endangered species habitat and cultural resources.

Based on the preferred RWEC route (i.e., entering Narragansett Bay via West Passage) and interconnection location (i.e., the TNEC Davisville Substation), evaluation of potential Onshore Transmission Cable routes began with identification and evaluation of potential landfall sites around Quonset Point in North Kingstown, Rhode Island. Currently, multiple landfall sites remain under consideration, all of which are located within the Landfall Envelope depicted on Figure 2.2.1-3. The Landfall Envelope totals approximately 20 ac (8 ha) and is generally bounded by Whitecap Drive on the west, the Electric Boat property on the east, and Circuit Drive on the north. Regardless of the landfall site selected, the Onshore Transmission Cable will follow Circuit Drive northwest to 135 Circuit Drive, where it will cross this property and continue in a northwest direction to Camp Avenue (referred to as the Parking Lot By-Pass). The route then follows Camp Ave to the OnSS location on the north side of Camp Avenue. An alternative route segment that has been removed from conderiation continued along Circuit Drive northwest to Camp Avenue where it continued in a northwest direction to the OnSS location. The route was found to be inferrior due to legth, traffic impacts and support from the community for the 135 Circuit Drive route. route traversingFigure 2.2.1-3 depicts both the preferred Onshore Transmission Cable route as well as this alternative route that is no longer being considered.

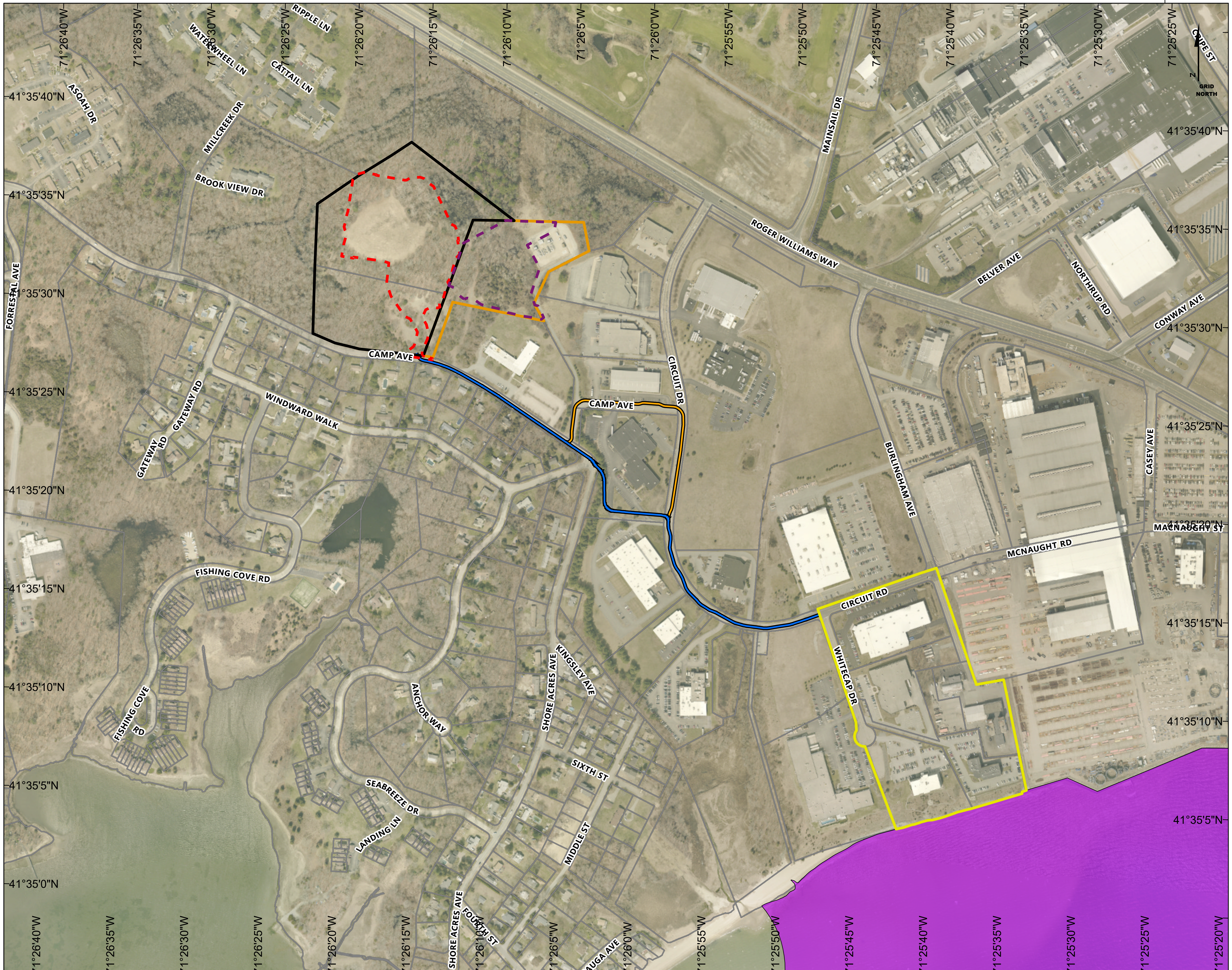

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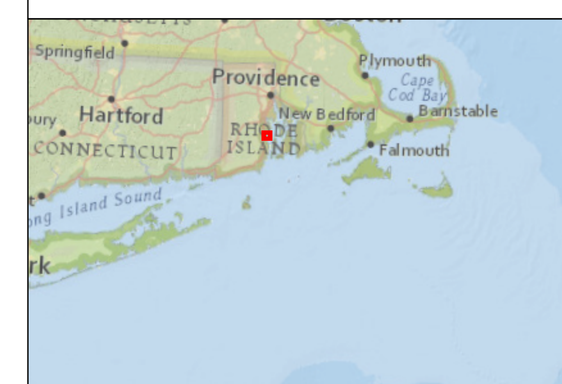
Figure 2.2.1-3
Potential Landfall Location and Onshore Cable Routes
NORTH KINGSTOWN, RI

Legend
- Onshore Transmission Cable
- Alternate Cable Route- Dismissed
- Landfall Envelope
- ICF Limit of Work
- Substation Limit of Work
- RWEC-RI State Waters Envelope
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 60 120 180 Meters

0 200 400 600 Feet

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Onshore Substation and ICF Siting Alternatives

An OnSS and ICF will be constructed to support interconnection to the existing TNEC Davisville Substation, which is located within the Quonset Business Park in North Kingstown, Rhode Island. The TNEC Davisville Substation operates at 115-kV and connects to the regional transmission grid via two 115-kV transmission tap lines. The existing substation is located within North Kingstown Assessor's Plat (AP) 179 Lot 005.

Revolution Wind evaluated siting alternatives for the OnSS using the following criteria:

- Proximity to the preferred grid interconnection point (i.e., the TNEC Davisville Substation);
- Proximity to adjacent waterways where the RWEC could make landfall;
- A parcel of adequate size (minimum 7-ac [2.8 ha] parcel), suitable shape, ground conditions (e.g., no severe slopes or shallow groundwater) and appropriate zoning/land-use compatibility (e.g., avoidance of residential areas and/or other sensitive receptors [schools, hospitals, day care centers, open space and recreational areas]) for construction and operation of the OnSS; and
- Avoidance or minimization of disturbance to sensitive natural resources (e.g., wetlands, forested areas; other protected and/or ecologically sensitive areas) and/or cultural resources (e.g., areas of potential archaeological sensitivity, avoidance of National Register of Historic Places (NRHP) structures/sites on the National Register or tribal lands).
- Parcel availability (property is either on the market or the owner is willing to sell).

Revolution Wind performed an evaluation of potentially suitable properties within a 1-mile radius of the TNEC Davisville Substation. This evaluation identified seven potentially viable properties depicted in Figure 2.2.1-4.

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Figure 2.2.1-4
Alternative Parcels Map with Fujifilm and Mainsail Property
NORTH KINGSTOWN, RI

Legend
- TNEC Davisville Substation
- Parcel 47 & NKFD
- Conservation Parcel
- Substation Parcel
- 1 Mile Substation Buffer
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):

Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 160 320 480 Meters
0 475 950 1,425 Feet

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Of these seven properties, two were found to have inconsistent zoning and land use, and two were found to be unavailable. Additional evaluation of the remaining three properties, as well as communication with the property owners, revealed that two of the three were not available e.g. the property owners were not willing to sell or lease the properties. This evaluation left one remaining site, totaling over 15 ac, immediately adjacent to the existing TNEC Davisville Substation that is available, undeveloped and previously disturbed area. The OnSS, ICF, Interconnection ROW, and TNEC ROW were sited in close proximity to TNEC's Davisville substation to minimize community impacts. Table 2.2.1-2 provides a summary of the results of the alternative sites evaluation.

Table 2.2.1-2 Summary of Alternative Substation Properties

Site Name	Distance from POI ft [m]	Distance from Landfall ft [m]	Parcel Size ac [ha]	Avoidance of Sensitive Resources	Parcel Availability
Parcel 17: QDC	7,870 [2,399]	8,366 [2,550]	10.6 [4.29]	Yes	No
Conservation Area 1: USA	2,741 [835]	7,778 [2,371]	13.2 [5.34]	No	No
Conservation Area 2: QDC	3,683 [1,123]	8,505 [2,592]	27.1 [10.97]	No	No
Parcel 47: QDC	6,787 [2,069]	7,633 [2,327]	10 [4.05]	Yes	No
Parcels 1 & 30: QDC	745 [227]	5,857 [1,785]	15 [6.07]	Yes	Yes
Parcel 8: FujiFilm	2,130 [649]	4,991 [1,521]	14 [5.67]	Yes	No
Parcel 9: Mainsail	3,510 [1,070]	8,333 [2,540]	9.9 [4.01]	Yes	No

Design of the OnSS within these two parcels is ongoing; a variety of design options are being considered based on Project needs and site constraints For the purposes of analyses in this COP, a maximum design scenario within the identified parcels is carried forward.

2.2.2 Design Alternatives

From a design perspective, Revolution Wind considered alternative WTG models and foundation designs for WTGs and OSSs. The design alternatives relative to WTGs and foundations are discussed in the following subsections.

2.2.2.1 Wind Turbine Generator Models

Revolution Wind considered multiple offshore WTG models based on various sizes that are commercially available. WTG models ranging in nameplate capacity of 8 to 12 MW were evaluated based on environmental, technical, and financial suitability for the Project.

2.2.2.2 Foundation Designs

Criteria for the evaluations of foundation alternatives for the WTGs and OSSs included the following:

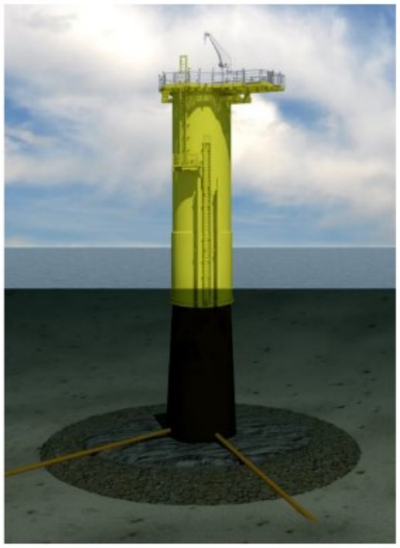
- Size of WTG selected (i.e., foundation needed to be able to support both the proposed minimum and maximum sized WTG);
- Fabrication and installation requirements;
- Maturity of supply chain and procurement approach;
- Environmental risks (e.g., soil/seabed conditions, metocean conditions); and
- Cost.

Five alternative foundation designs were considered:

- **Monopile**, which consists of a single tubular steel foundation that is driven into the soil, upon which a transition piece (TP) is placed which allows for adjustment of the foundation and provides that the turbine is installed at the correct angle;
- **Piled Three-, Four-, or Six-Legged Jacket**, which is formed with a steel lattice construction (comprising tubular steel members and welded joints) fixed to the seabed using steel piles that are driven or piled into the seabed;
- **Suction Caisson Jackets**, which is similar to the piled jacket except that it is fixed to the seabed using suction caissons (hollow steel cylinders which are fitted in a vertical position underneath the legs of the jacket structure);
- **Monopod Suction Caisson**, which consists of a monopile-type structure that is welded to the top of a single suction caisson; and
- **Gravity Base Structure (GBS)**, which is generally comprised of solid or hollow concrete caissons with a circular or cruciform shaped base, and a flat-based or conical profile.

These foundation designs are depicted in Figure 2.2.2-1.

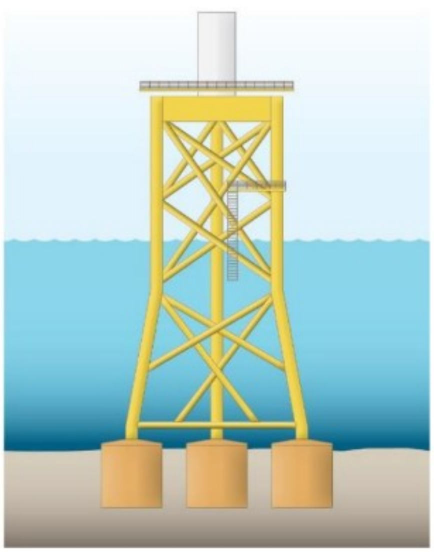
Figure 2.2.2-1 Alternative WTG and OSS Foundation Concepts



Monopile

Piled Three-, Four-, or Six-Legged Jacket

Monopod Suction Caisson



Suction Caisson Jacket

Gravity Base Structure

Of the foundation designs considered, the monopod suction caisson, suction caisson jacket, and gravity base structure foundation alternatives would not require impact pile driving, which generates underwater noise that may impact marine life. However, there are several other environmental, technical, and commercial challenges associated with utilizing these options for the Project's foundations, including:

- A larger footprint, resulting in greater long term impact on navigation safety and the seabed than other alternatives;

- Not suitable for site-specific conditions found within the Lease Area (e.g., water depth, geological substrate, boulders); and
- The supply chain is not mature enough at the present to make these options cost effective.

While these foundation types would not require impact pile driving, the larger footprint of suction bucket and gravity base foundations would increase seabed disturbance; additionally, all three foundation types would create less room for fishing activities between turbines when compared to monopile or jacket foundations. Moreover, site preparation and dredging activities for suction bucket and gravity-based foundations could increase environmental impacts when compared to monopile or jacket foundations. Overall, these alternative foundation types are not feasible for the Project.

For these reasons, Revolution Wind has eliminated the monopod suction caisson, suction caisson jacket, and gravity base structure foundation designs from further consideration for this Project. Monopile and piled three- or four-legged jacket foundations are a proven technology for offshore WTGs and OSSs and represent commercially available, mature technological solutions that are appropriate for the site-specific conditions in the Lease Area. That said, jacket foundations require a custom-made jacket to match the seabed and water depth at the siting location; thus, the logistics for construction and transportation of jacket foundations can be significant. As such, jacket foundations are considered a potential option for only the two OSSs. Monopile foundations are considered feasible for both the WTGs and OSSs.

2.2.3 Construction Alternatives

Revolution Wind considered various alternatives for installation of the foundations, the submarine cables (i.e., the RWEC, IAC, and OSS-Link Cable), and Onshore Transmission Cable. Construction alternatives related to installation of these Project components are discussed in the following subsections.

2.2.3.1 Foundation Installation Methods

As described above in Section 2.2.3.2, monopile and piled jacket foundations were selected as the most feasible design options for WTGs and OSSs. Both of these foundation types require tubular steel piles to be driven into the seabed to a target depth of embedment. Revolution Wind considered impact pile driving and vibratory pile driving. Impact pile driving requires use of a hydraulic hammer to embed foundations into the seabed. Revolution Wind considered varying hammers for this methodand a 4,000 kilojoule (kJ) hammer is considered the most feasible and commercially available option currently and, therefore, is the size carried through analyses in this COP. Vibratory driven piles have a number of vibratory drivers installed on top of the pile which apply quick sequences of downward and upward motions to the pile in order to reach target depth of embedment. This method may be used independently of or in combination with (prior to) impact pile driving. Both installation methods are still under consideration; thus, these options are assessed within this COP. Section 3.3.4.2 provides further information on these methods for foundation installation.

2.2.3.2 Submarine Cable Installation Methods

Various options for installation of submarine cables were considered, including placement on the seabed and burial beneath the seabed. Although placement on the seabed would minimize installation time and cost as well as potential sediment disturbance, Revolution Wind plans to bury the cable beneath the seabed. Burying the cable is a means of protecting it from potential damage caused by various external forces (e.g., fishing equipment, anchors) and minimizing the potential for interference with other marine uses. Burying the cable also minimizes the need for maintenance and associated potential for seabed disturbance. The target burial depths have been selected to balance the following design criteria: 1) physical conditions; 2) avoidance of physical damage from anchors, vessels, or other equipment that might penetrate the seabed; 3) avoidance and minimization of interference with other marine uses; and 4) to allow heat to flow away from the cable so that the temperature does not exceed the design basis of the cable.

Various installation methods for the RWEC were also considered, including hydraulic plow (i.e., jet-plow and controlled flow excavation [CFE]) mechanical plow, and mechanical dredging (i.e., mechanical cutter and trailing suction hopper dredger). Due to the variability of surface and subsurface seabed conditions, Revolution Wind may use a combination of cable installation methods to install the cable at the target burial depth.

Revolution Wind also considered multiple installation methods for the RWEC at the landfall location, including open trench and HDD methods. An HDD methodology involves drilling underneath the seabed surface and the intertidal area using a drilling rig situated onshore while an open cut method involves using an excavator (or similar equipment) on a shallow draught barge to excavate a trench through the intertidal area. Based on collection and review of site-specific geotechinical data and discussions with state and federal resource agencies, HDD has been selected as the preferred method and is assessed within this COP. Section 3.3.3.2 provides further information on this installation method.

2.2.3.3 Onshore Transmission Cable Installation Methods

Revolution Wind considered various options for installation of the Onshore Transmission Cable, including use of above ground structures and burying the cable. Although above ground installation would minimize construction time and cost, identifying and developing a transmission right of way (ROW) in this area for such a short distance was not considered practical due to potential siting and permitting requirements. Therefore, Revolution Wind proposes to bury the Onshore Transmission Cable within existing ROWs.

2.3 Preferred Alternative

Revolution Wind identified the Preferred Alternative for the Project based on the results of the alternative evaluations discussed above. To arrive at a Preferred Alternative for the entire Project, each of the separate Project component alternative evaluations were taken into consideration as a whole, to create the entire Preferred Alternative. The Preferred Alternative, which comprises the Project's PDE (see Section 1.2) and which meets the established purpose of the Project (Section 1.3), consists of the following:

- Aligned Grid Layout with approximately 1.15 mi (1 nm, 1.8 km) by 1.15 mi (1 nm, 1.8 km) WTG spacing;
- Landfall Location and Point of Interconnection Alternative 1, consisting of an RWEC route through the West Passage of Narragansett Bay to Quonset Point and connection to the existing TNEC Davisville Substation in North Kingstown, Rhode Island;
- Onshore Transmission Cable route from the Landfall Envelope to an OnSS located at Lot 001 and 030 adjacent to Camp Avenue and the TNEC Davisville Substation;
- Up to 100 WTGs with capacity sufficient to satisfy PPAs (e.g., 8 to 12 MW);
- Monopile and/or piled jacket foundations installed via hydraulic impact pile driving and/or vibratory pile driving;
- Installation of submarine cables (i.e., the RWEC, IAC, and OSS-Link Cable) via hydraulic plow (i.e., jet-plow and CFE) mechanical plow, mechanical dredging (i.e., mechanical cutter and trailing suction hopper dredger), or similar technology for displacing sediments to allow for cable burial;
- Installation of the RWEC at the landfall location via HDD; and
- Below-ground installation of the Onshore Transmission Cables.

Retaining these options allows for greater flexibility as the Project design advances, as technological advances occur, and as supply chain characteristics evolve in the U.S. offshore wind market.

3.0 Description of Proposed Activity

This section provides a description of the Project, including its anticipated schedule, design, construction, commissioning, O&M, and decommissioning activities. The Project is described herein relative to and consistent with the PDE concept outlined in Section 1.2. The PDE provides a framework for evaluating a range of possible design parameters, allowing Project flexibility over the permitting, final design and construction phases of the Project. The PDE for the Project is based on an operating capacity ranging between 704 MW and 880 MW. The Project will include the following offshore and onshore components:

› **Offshore**

- Up to 100 WTGs connected by a network of IAC measuring up to 155 mi (250 km) in total length;
- Up to two OSSs connected by an up to 9-mi (15-km)-long OSS-Link Cable; and
- Up to two submarine export cables (referred to as the RWEC), generally co-located within a single corridor up to 50 mi (80 km) in length.

› **Onshore**

- A Landfall Work Area measuring up to 3.1 ac (1.3 ha) and located at Quonset Point in North Kingstown, Rhode Island;
- Up to two underground transmission circuits (referred to as the Onshore Transmission Cable), co-located within a single corridor up to 1 mi (1.6 km) in length;
- An OnSS and ICF[7] located adjacent to the existing TNEC Davisville Substation;
- An underground ROW connecting the OnSS to the ICF (Interconnection ROW); and
- An overhead ROW connecting the ICF to TNEC’s Davisville Substation (TNEC ROW).

For the purposes of evaluations in Section 4 of this COP, Project components are further grouped into four general categories:

7 The ICF is an expansion of TNEC’s existing Davisville Substation and will be constructed by Revolution Wind as part of the overall Project

- The RWF, inclusive of the WTGs, OSSs, IAC, and OSS-Link Cable;
- The RWEC–OCS, inclusive of up to 25 mi (40 km) of the RWEC in federal waters;
- The RWEC–RI, inclusive of up to 23 mi (37 km) of the RWEC in state waters; and
- Onshore Facilities, inclusive of the Landfall Work Area, Onshore Transmission Cable, and OnSS and ICF (including underground and overhead ROWs).

Refer to Figure 1.1-1 for a general overview of the Project's layout and location and Figure 1.1-2 for a general schematic of the various components listed above.

Components have been selected based on the environmental and engineering site characterization studies that have been completed to date and are subject to refinement based on final engineering design as well as ongoing and continuing discussions, agency reviews, public input, and the NEPA review process. The final selections and installation strategies will be reviewed by the CVA and submitted to BOEM prior to construction.

3.1 Project Location

The RWF is proposed in federal waters within the designated BOEM Renewable Energy Lease Area OCS-A 0486; the closest edge of the lease area being approximately 15 mi (13 nm, 24 km) southeast of the Rhode Island coast. The RWEC will traverse both federal waters and state territorial waters of Rhode Island, extending up to approximately 50 mi (80 km) from the RWF to the Landfall Work Area at Quonset Point in North Kingstown, Rhode Island. Refer to Figure 1.1-1 for a depiction of the RWF and RWEC location.

Temporary construction staging areas for Onshore Facilities will also be located in North Kingstown, primarily on parcels owned by QDC (refer to Section 3.3.1.2 for additional information regarding temporary onshore staging areas). Additionally, while a final decision has not yet been made, existing port facilities in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland are being evaluated to support the Project. Section 3.3.9 provides further detail regarding specific ports being considered and their potential usage.

3.2 Project Schedule

Revolution Wind assumes all state and federal permits will be obtained between Q1 and Q3 2023. Construction will begin as early as Q1 2023 with installation of the onshore components and initiation of seabed preparation activities (clearing of debris and obstructions). Construction durations (inclusive of commissioning) are summarized below:

- OnSS and ICF – approximately 18 months
- Onshore Transmission Cable – approximately 12 months
- RWEC – approximately 8 months
- WTG Foundations – approximately 5 months

- IAC – approximately 5 months
- WTGs – approximately 8 months
- OSSs (including foundations and OSS-Link Cable) – approximately 8 months

3.3 Project Design and Construction Activities

The following sections describe design of the proposed Project infrastructure and provide details on construction methodologies. This section is organized in accordance with the standard construction sequence of an offshore wind farm (i.e., onshore facilities are discussed first followed by discussion of offshore facilities).

3.3.1 Onshore Substation and Interconnection Facility

A new OnSS and ICF adjacent to the existing TNEC Davisville Substation will be constructed to support interconnection of the Project to the existing electrical grid. Circuit connections include an Interconnection ROW between the OnSS and the ICF, and the TNEC ROW between the ICF and existing Davisville Substation. The OnSS will have a nominal operating capacity ranging between 704 MW and 880 MW. Design and construction of the OnSS and ICF are described further in the following subsections.

3.3.1.1 Onshore Substation Design

The OnSS will be designed to meet Rhode Island State Building Code/2015 International Building Code, American Society of Civil Engineers (ASCE) Standard 7-10, ASCE 113, ASCE 24-14, all applicable Institute of Electrical and Electronics Engineers (IEEE) standards, and local climate and geotechnical conditions. The engineering of these facilities currently proposes gas-insulated switchgear system bay positions. Major equipment associated with the OnSS is summarized in Table 3.3.1-1.

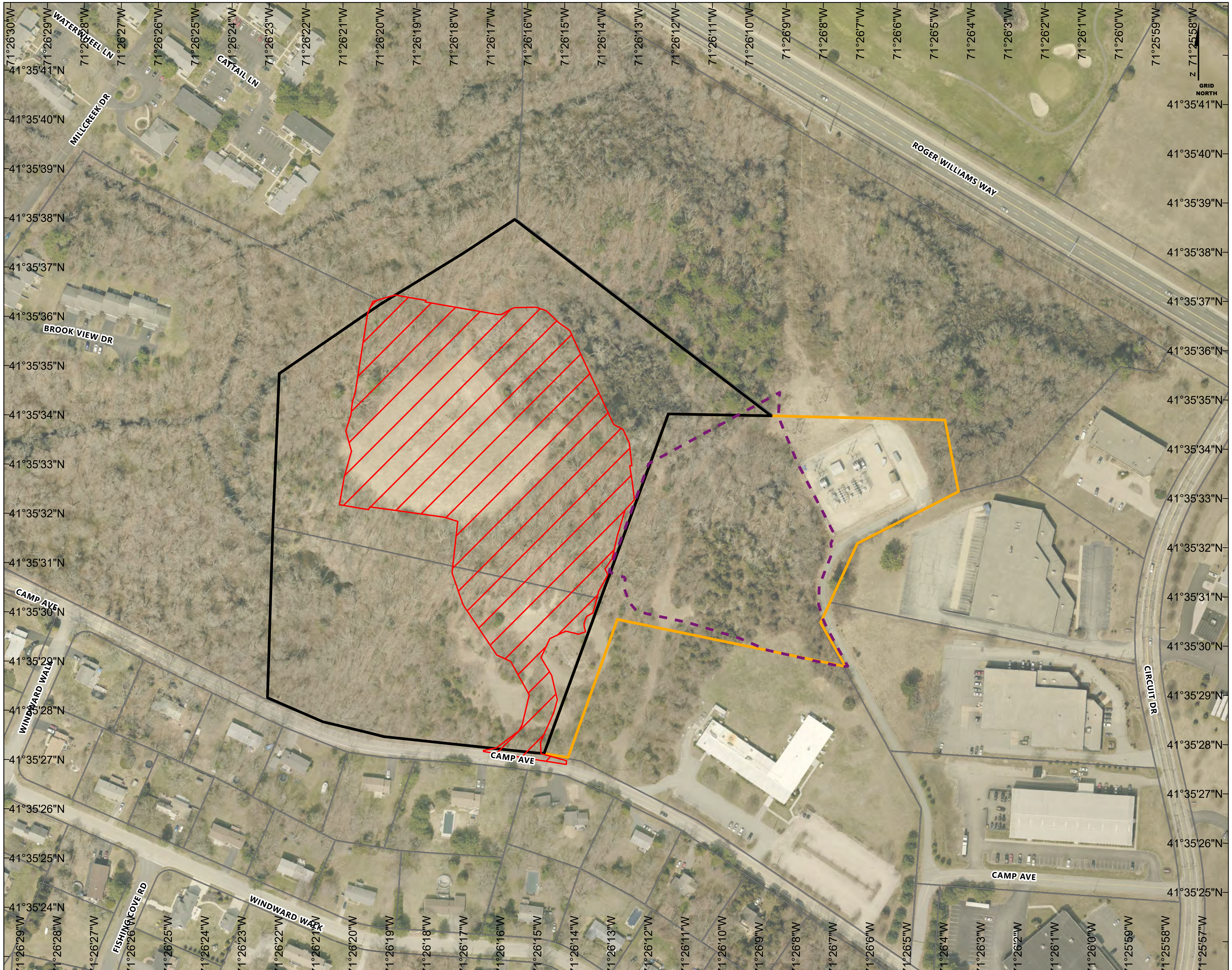
Table 3.3.1-1 Onshore Substation Facility Equipment

Equipment	Maximum Number Required
Major Electrical Equipment	
Synchronous Condenser Transformer	2
Auto Transformer	2
Shunt Reactor	4
Harmonic Filter	2
275kV and 115kV Gas Insulated Switchgear	1 (lot)
Synchronous Condenser Heat Exchanger	2

Equipment	Maximum Number Required
Control House	1
Synchronous Condenser Building Equipment	
Synchronous Condenser	2
Lube Oil Skid	2
Water Skid	2
Vacuum Pump	2
Auxiliary Transformer	2

The OnSS will occupy an operational footprint[8] measuring approximately 3.8 ac (1.5 ha) and will connect to the ICF with two 115-kV underground transmission cables located within the Interconnection ROW that are each up to approximately 527-feet (160.6 m). Maximum height of OnSS equipment will be up to 45 ft (13.7 m) with shielding masts measuring up to 65 ft (19.8 m) tall. Additionally, the OnSS will include a compacted gravel driveway, stormwater management features, and associated landscaped or managed vegetated areas totaling up to 7.1 acres (2.9 ha) inclusive of the up to 4-ac (1.6-ha) operational footprint of the facility. The underground transmission line ROW will be maintained free of woody vegetation that exceeds 15 feet in height. The maximum limits of work of the OnSS are depicted on Figure 3.3.1-1.

8 The operational footprint refers to and includes all appurtenances of the OnSS and ICF within the perimeter fences including foundations, and overhead and underground equipment.

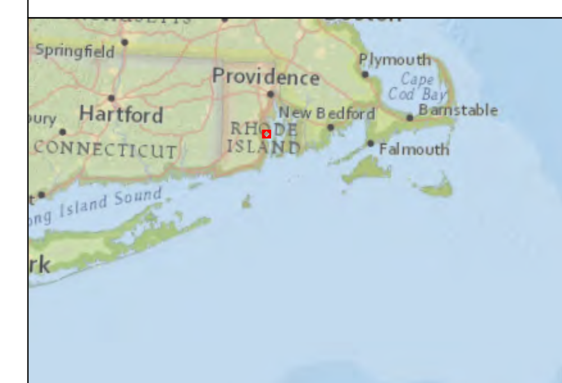


Revolution Wind

Figure 3.3.1-1
Maximum Limits of Work for the Onshore Substation
NORTH KINGSTOWN, RI

Legend
- Substation Limit of Work
- ICF Limit of Work
- Parcel 179-030 & 179-001
- Parcel 179-005
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 25 50 75 Meters
0 80 160 240 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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The OnSS will be equipped with a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system's main function will allow for operation and monitoring of local systems remotely by dispatch type personnel. Backup power for the OnSS will be provided via a 50 kW generator fed by portable propane tanks.

The OnSS will require various oils, fuels, and lubricants to support its operation (Table 3.3.1-2). Equipment will be mounted on concrete foundations with concrete secondary insulating fluid containment designed for 110 percent containment and in accordance with industry and local utility standards. A Spill Prevention, Control, and Countermeasure (SPCC) plan will be developed in support of National Pollutant Discharge Elimination System (NPDES) permitting. Sulfur hexafluoride ("SF6") gas will be used for electrical insulation in some switchgear components; OnSS devices containing SF6 will be equipped with integral low-pressure detectors to detect SF6 gas leakage, which will notify the dispatch center for response should they occur.

Table 3.3.1-2 Maximum Potential Quantities of Oils, Fuels, Lubricants, and SF_6 for the Onshore Substation

Oil/Fuel/Lubricant/Gas Type	Maximum Quantity
Transformer Insulating Fluid	60,000 gallon (gal) (227,125 liter [L])
Proprietary Hydrocarbon Fluid Blend	1,000 gal (3,785 L)
Propane (Generator)	240 gal (908 L)
SF6	40,000 pounds (lbs) (18,144 kg)

3.3.1.2 Interconnection Facility Design

TNEC's Davisville Substation serves as the point of interconnection for the Project. As part of the System Impact Study in accordance with ISO-NE's Open Access Transmission Tariff, the Project requires the 115kV side of TNEC Davisville Substation to be expanded to a 115-kV six-breaker ring bus to enable a more reliable connection between the Project (two 115kV underground duct bank connections), the existing TNEC Davisville Substation, and the ISO-NE Transmission System.

The six-breaker ring bus will be an air-insulated system consisting of circuit breakers, disconnect switches, structural steel, instrument and station service transformers, and associated miscellaneous equipment (i.e. insulators, surge arresters, electrical fittings and hardware). To support more timely cutovers, a new prefabricated control house will also be installed. Major equipment associated with the ICF is summarized in Table 3.3.1-3.

Table 3.3.1-3 Interconnection Facility Equipment

Equipment	Maximum Number Required
115 kV breakers	6
Breaker Disconnect switches	12
Line disconnects	4
Line traps	2
CCVTs (3-phase sets)	6
Open air bus work	1 (Lot)
Control building	1
Station Service Transformer	2

The ICF will occupy an operational footprint[9] measuring up to 1.6 ac (0.6 ha). Maximum height of ICF equipment will be up to 45 ft (13.7 m) with shielding masts measuring up to 55 ft (16.7 m) tall. Additionally, the ICF will include an asphalt paved driveway, stormwater management features, and associated landscaped or managed vegetated areas. The limit of work associated with development of the ICF totals up to 4.0 ac (1.6 ha).

The ICF will connect to the Davisville Substation with two 115-kV overhead transmission circuits located within the TNEC ROW. The transmission lines from the ICF to the Davisville Substation will be up to 474 ft (144 m) in length and will be supported on single circuit structures measuring up to 60 ft (18 m) tall. A short segment of the existing 115kV Davisville Transmission Tap line will also be re-built as part of ICF construction. The transmission line from the ICF to the Davisville Transmission Tap will be up to 712 ft (217 m) in length. The two circuits will be supported on a combination of single and double circuit structures measuring up to 80 ft (24.4 m) tall. The TNEC ROW will require an up to 120-ft (36.6-m) wide cleared ROW centered on each circuit to be maintained free of woody vegetation that exceeds 20 ft (6.1 m) in height.

3.3.1.3 Onshore Substation and Interconnection Facility Construction

The maximum area of land disturbance associated with the construction of the OnSS and ICF is depicted in Figure 3.3.1-1. Construction of the OnSS will require temporary disturbance of up to 7.1 additional ac (2.9 ha) inclusive of the 3.8-ac (1.5-ha) operational footprint of the facility. Construction of the ICF is expected to require a construction footprint of approximately 4.0 ac (1.6 ha) which includes the 1.6 ac (0.6 ha) operational footprint. Contingency staging and laydown areas also include previously disturbed areas owned by the QDC; staging/laydown in these areas will not require grading but may require

9 The operational footprint refers to and includes all appurtenances of the OnSS and ICF within the perimeter fences including foundations, and overhead and underground equipment.

graveling, erosion control, fencing, etc. The temporary disturbances will be associated with temporary work areas and staging/laydown areas. OnSS and ICF equipment and steel support structures are expected to be supported by reinforced concrete foundations on drilled shafts suitable for existing soil condition and coastal storm/flood events. The maximum depth of disturbance associated with construction of the OnSS and ICF is 60 ft (18.3).

The sequence in constructing the OnSS and the ICF under normal circumstances is described in Table 3.3.1-3. Once construction is complete, temporary disturbance areas beyond the operational footprint of both the OnSS and ICF will be restored to pre-construction conditions. It is anticipated that construction of the OnSS and ICF will take up to 18 months (see Section 3.2). It is assumed construction of the OnSS and ICF will generate approximately 3,000 cubic yards (cy) (2,294 m^3) of solid waste. This material will be disposed of in a landfill and/or recycling center.

Table 3.3.1-3 Typical OnSS and ICF Construction Sequence

Activity/Action	Construction Summary
Surveys and Protection of Sensitive Areas	Work at the OnSS and ICF site will begin with the survey, staking and protection of any sensitive areas. Access to the work site will then be established and the required safety measures will be implemented. Surveys for UXO and MEC will be performed by certified technicians prior to and during excavation activities in accordance with applicable guidance.
Clearing and Grading	The work site will be cleared of vegetation, and temporary environmental erosion controls such as swales and erosion control socks will be installed in accordance with BMPs. These controls will be maintained until the site is restored and stabilized. The work site will be graded; the disturbed areas outside of the final site footprint will be restored.
Installation of Foundations	Installation of foundations will require excavation to support construction of stormwater management components and installation of other equipment. Blasting is not expected; however, if required, the appropriate blasting plans and approvals will be obtained prior to any such activity. All the major equipment will be installed upon completion of concrete foundations and cable duct banks. The equipment will be rigged and placed on the concrete foundations. The rigging company who acts as sub-contractor to the equipment manufacturer is responsible for all logistical services (e.g. engineered rigging and hauling plans, routing, permitting, clearance checking, escort, police escort, load analysis of transport, as well as dimensional restrictions). Upon installation of the equipment on the foundations, alignment checking will be performed, and when required, anchoring and temporary protection from weather will be applied. Upon placing the equipment, all attachments will be completed associated with each equipment. When required, the equipment will be filled with insulating fluid and/or insulating gas.
Restoration	Restoration of any disturbed areas and appropriate landscaping will be performed as necessary. Environmental controls will be removed, though some may remain until the area is completely stabilized.
Commissioning	Upon the acceptance testing of the OnSS control center and upon TNEC's Davisville Substation upgrades being completed and put into service, the commissioning of the OnSS and ICF will commence.

Activity/Action	Construction Summary
	Prior to energization, all equipment will be tested to confirm proper operation. Energization is a sequential process that energizes the equipment and facilities in a logical order to coordinate with the equipment and system requirements to meet the Project milestones. The testing and commissioning will be performed by licensed testing personnel. The work will be performed in accordance with the applicable industry standards. The commissioning will be performed in strict adherence to ISO's protocol on receiving permits and clearances.

3.3.2 Onshore Transmission Facilities

Electrical transmission facilities for the Project will be comprised of both onshore and offshore cables. Specifically, power from the RWF will be delivered to the electric grid via two distinct transmission cable segments: the RWEC and the Onshore Transmission Cable. The intersect of the RWEC and Onshore Transmission Cable will occur at co-located TJBs, which will be located at the Landfall Work Area. As described in Section 2.2.1.2, multiple landfall sites are currently being evaluated within the approximate 20 ac (8 ha) Landfall Envelope (see Figure 2.2-3). Regardless of the landfall site selected, the Onshore Transmission Cable will be approximately 1 mi (1.6 km) in length, trending northwest to the OnSS via Circuit Drive and Camp Avenue.

The RWEC and Onshore Transmission Cable have different design and construction parameters; therefore, these transmission components are described separately. The Onshore Transmission Cable is described in this section while the RWEC and TJBs are described in Section 3.3.3.

3.3.2.1 Design

The Onshore Transmission Cable will consist of three individual cables in two circuits (six total cables). The Onshore Transmission Cable will be encased within a single thermal concrete duct bank. There will also be one fiber optic cable per circuit (two total fiber optic cables) installed within the duct bank. The typical installation configuration of underground onshore transmission circuits is provided in Figure 3.3.2-1 while a typical cross-section an onshore transmission cable is provided in Figure 3.3.2-2. Given the proposed length to the OnSS, splice vaults[10] are required for the Onshore Transmission Cable. Two splice vaults per circuit will be required at approximately the midpoint of the proposed route.

The OnSS will be equipped with two above ground circuit terminals that are connected to the 275-kV substation equipment. The Onshore Transmission Cable will terminate at these steel structures, transitioning them from underground to above ground and thereby completing the connection from the OSSs to the OnSS. The maximum design scenario for the Onshore Transmission Cable is provided in Table 3.3.2-1.

10 A splice vault is a structure, most commonly made of concrete, located at designated locations along the cable route to house the underground splices accompanying the cable system. Splice vault locations are determined based on the cable manufacturer's pulling tension and sidewall pressure limits, and are directly correlated to the alignment of the cable system.

Figure 3.3.2-1 Typical Installation Configuration of Underground Onshore Transmission Circuits

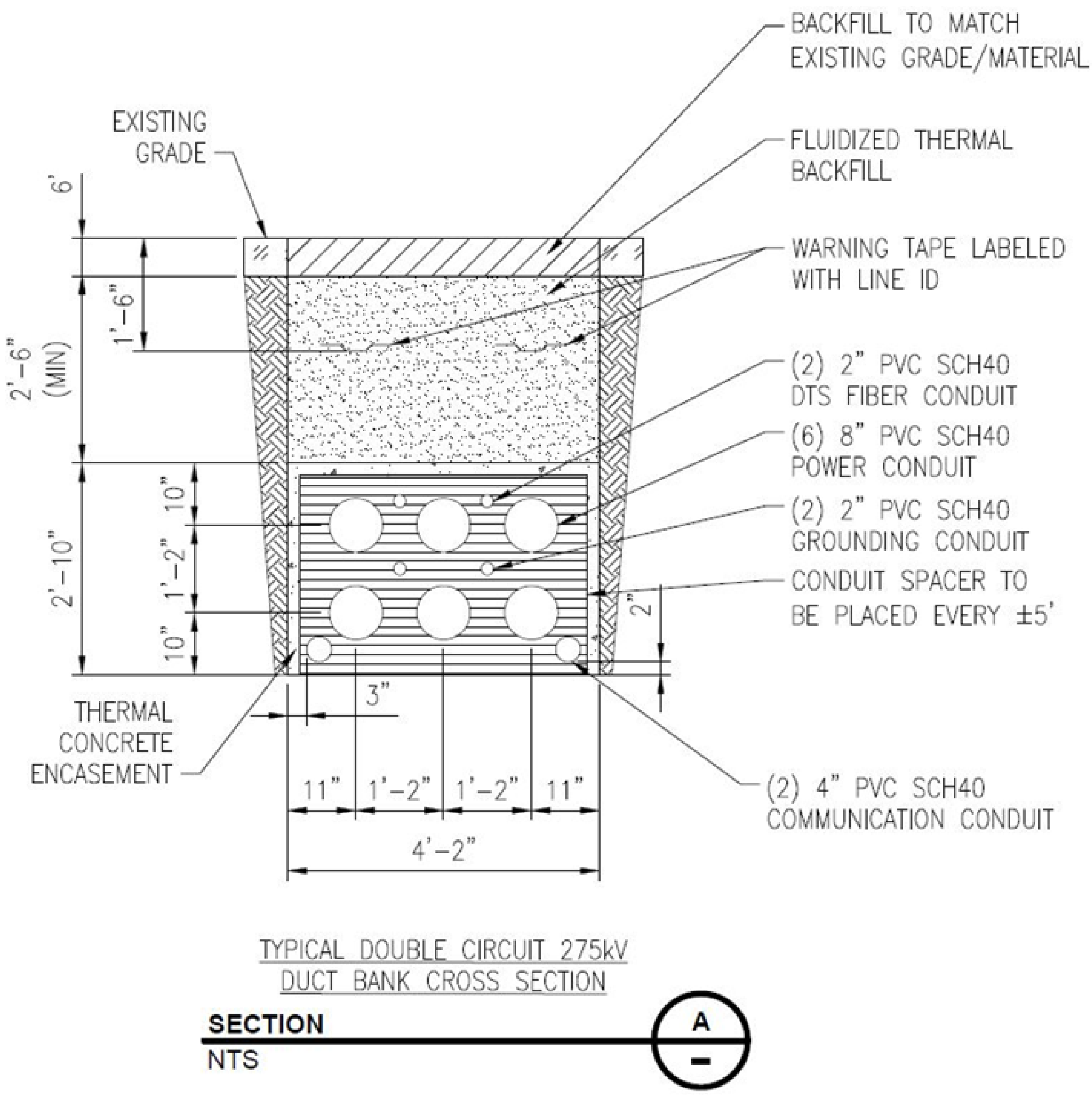


Figure 3.3.2-2 Cross Section of Onshore Transmission Cable

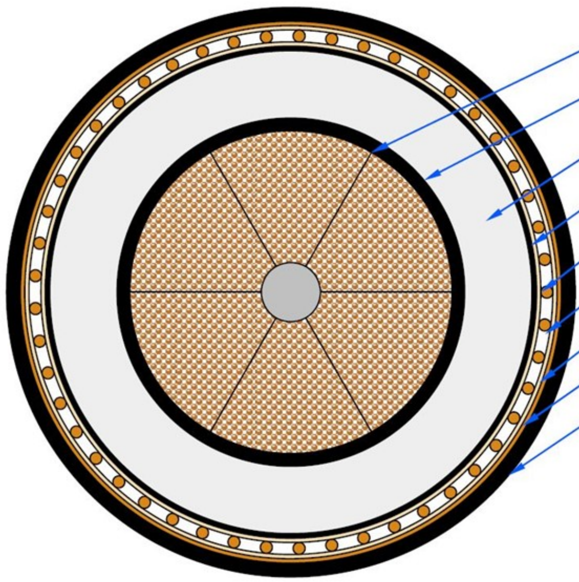


Table 3.3.2-1 Onshore Transmission Cable Maximum Design Scenario

Onshore Transmission Cable Characteristics	Maximum Design Scenario
Number of Cables / Fiber Optic Cables	6 / 2
Voltage of Cable Circuit	275 kV
Cable Diameter	5.1 in (13 centimeters [cm])
Target Burial Depth (below ground level)	3 to 6 ft (0.9 to 1.8 m)
Maximum Disturbance Depth	13 ft (4 m); 16 ft (5 m) at Splice Vaults
Approximate Cable Length	1 mi (1.6 km)
Disturbance Corridor (Total Width)[1]	25 ft (7.6 m)
Disturbance Area at Splice Vaults (Total Width by Total Length)[2]	30 x 75 ft (9.1 x 22.8 m)
Temporary Ground Disturbance[3]	3.1 ac (1.3 ha)
Operational Right-of-Way (Total Width)[4]	20 ft (6 m)

1 The disturbance corridor reflects the area needed for installation of the Onshore Transmissions Cable. Within this area, an approximate 8-ft (2.4-m)-wide trench will be excavated to support installation of the duct banks.

2 Two splice vaults per circuit (four total) will be required along the Onshore Transmission Cable route. Each splice vault measures 30 x 8 x 8ft (9 x 2.4 x 2.4m)

3 Permanent ground disturbance is not anticipated with construction of the Onshore Transmission Cable as the cable will be installed underground and areas disturbed during construction will be restored to pre-existing conditions post-construction.

4 The operational ROW for the Onshore Transmission Cable reflects the maximum corridor needed to support future access to the concrete duct bank or splice vaults located on private land and beyond the limits of the public road ROW.

3.3.2.2 Construction

Construction of the Onshore Transmission Cable will involve site preparation, duct bank installation, cable installation, cable jointing, final testing, and final restoration, as described in Table 3.3-5. Installation of the Onshore Transmission Cable will generally require excavation of an approximate 8-ft (2.4-m)-wide trench within a 25-ft (7.6-m)-wide temporary disturbance corridor; however, the disturbance area at the splice vaults will be 30-ft (9.1-m)-wide by 75-ft (22.8-m)-long. The Onshore Transmission Cable will be installed within a duct bank, buried to a target depth of 3 to 6 ft (0.9 to 1.8 m) to top of duct bank and consistent with local utility standards. The splice vaults will be buried to a depth of up to 16 ft (5 m) to the bottom of the vault. The entire temporary disturbance corridor will be restored to pre-construction conditions following installation of the Onshore Transmission Cable.

Construction of the Onshore Transmission Cable, from the TJBs to the OnSS, will result in up to 3.1 ac (1.3 ha) of temporary ground disturbance; permanent disturbance is not anticipated (Table 3.3-4). Note, design and construction parameters of the TJBs are discussed in Section 3.3.3; the area of disturbance associated with TJBs are presented in Table 3.3.3-2 below with disturbance estimates for the RWEC. It is anticipated that construction of the Onshore Transmission Cable will take approximately 12 months (see Section 3.2).

Table 3.3.2-2 Typical Underground Transmission Cable Construction Sequence

Activity/Action	Construction Summary
Site Preparation	Site preparation involves the surveying and staking the proposed Onshore Transmission Cable alignments, implementation of the specified traffic control measures required to perform the work, and soil erosion control methods to prevent runoff into the existing infrastructure. This stage of the construction will also include identification of any existing underground utilities (DigSafe or test pits) along the proposed alignment.
Clearing and Grading	The work area for the cable route will be cleared of vegetation, and temporary environmental erosion controls such as swales and erosion control socks will be installed in accordance with BMPs. These controls will be maintained until the site is restored and stabilized. Portions of the work area may also require grading.
Vault and Duct Bank Installation	The conduits will be encased in an approved concrete duct bank design installed via open trench for the majority of the Project. Once excavated, the open trench will be supported by a shoring system to allow for installation of the conduits inside of the trench. The conduits will be arranged per the design drawings and held in place using conduit spacers to allow the concrete to be poured and set between each duct without allowing the formation of any air pockets or voids. Once the concrete has been poured, it will be allowed to set up to a specific strength before the trench is backfilled. This operation will be repeated until all conduit and concrete has been installed to the specified jointing locations (i.e., manholes, termination structures, etc.). At the completion of the installation, all conduits will be proofed and mandreled[1] to verify continuity of the raceway for cable installation.
Cable Installation	Upon completion of the proofing and mandreling of the conduits, cable pulling operations can begin. The cable will be pulled through the raceway and is cut leaving a sufficient amount of slack to perform the jointing operations. Once pulling has been completed, each cable jacket

Activity/Action	Construction Summary
	integrity test will be completed. The cables will then be sealed to prevent moisture ingress until jointing operations can be performed.
Cable Splicing/Jointing	Cable jointing refers to the splicing and/or terminating of the cables. Splicing and terminating is performed once all the cables for a specific section have been successfully pulled into the jointing bay or termination structure. Once splicing and terminating is complete, the cables and accessories will be secured to the associated racking systems with the use of cable clamps. This mitigates lateral movements experienced by the cable during operation.
Final Restoration Activities	Once the duct bank has been installed, permanent restoration as required by the governing authority will be completed. For roadway installations this will include the installment of the road subbase and base layers followed by the surface layer (i.e., concrete or asphalt). For installations outside of roadways, such as greenbelt areas, final restoration typically involves backfilling to the original grade elevation and hydroseeding to prevent soil erosion.

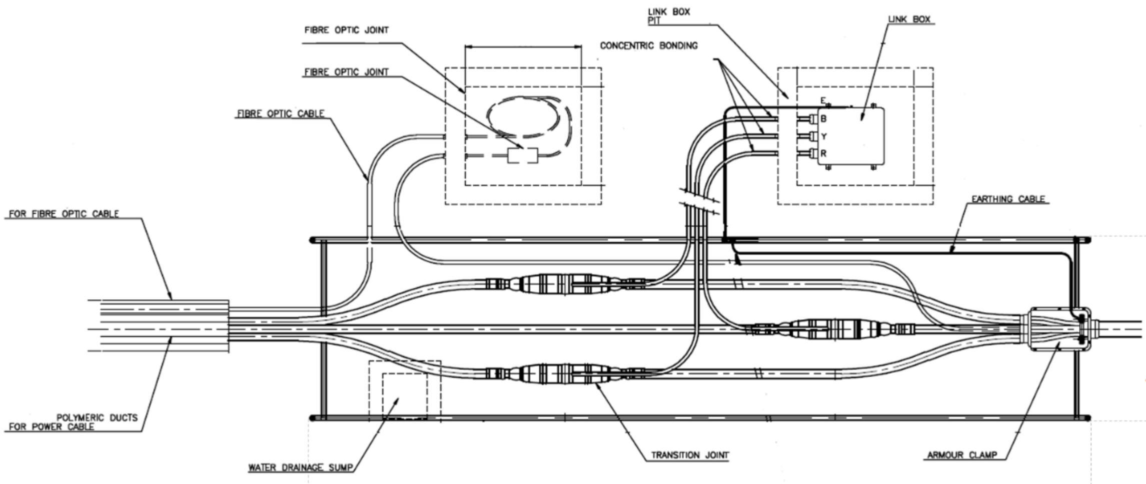
1 Mandrels are used to test the integrity of the conduit runs and remove small amounts of debris.

3.3.3 Revolution Wind Export Cable

The RWEC will transfer the electricity from the OSSs and will be jointed with the Onshore Transmission Cable at the TJBs. The RWEC corridor will traverse both federal and Rhode Island State Waters (see Figure 1.1-1). TJBs are comprised of pits that are dug in the soil and lined with concrete. The purpose of a TJB is to provide a clean, dry environment for the jointing of the RWEC and Onshore Transmission Cable as well as protecting the joint once the jointing is completed. There will be two TJBs (i.e., one for each cable of the RWEC). In each TJB, each RWEC cable will be spliced into 3-single conductor onshore cables. The sheaths from the RWEC and the Onshore Transmission Cable will be terminated into the Link Box via the cable joints. The fiber optic cables from the RWEC and Onshore Transmission Cable will be joined inside the Fiber Optic Joint Box. There will be two TJB’s, two Link Boxes, and two Fiber Optic Cable Joint boxes.

A conceptual schematic of the TJBs is provided in Figure 3.3.3-1. Each of the co-located TJBs will be up to 67 x 10 x 10 ft (20 x 3 x 3 m); the TJBs will be located entirely within the up to 3.1-ac (1.3-ha) Landfall Work Area. Access to the Fiber Optic Handhole and Link Box Handhole near the TJBs during the operational phase will be via manhole covers. Access to the splices in a TJB would require excavation from grade to expose the splices. A precast splice vault may also be used as an alternative to TJBs. The precast splice vault would consist of dimensions similar to the TJB; however, the splices would be housed in a precast enclosure on all sides, with manhole risers and covers for access from grade. The amount of ground disturbance would be similar between the two options.

Figure 3.3.3-1 Transition Joint Bay and Link Boxes Schematic



The following subsections describe the design and construction the RWEC further. From a construction perspective, installation techniques will vary by segment of the RWEC. Therefore, there are separate subsections describing construction of the RWEC at the landfall location and more generally in the offshore environment.

3.3.3.1 Design

The RWEC will consist of up to two 275-kV HVAC subsea cables, each originating at a respective OSS but eventually located within the same approximate 1,312-ft (400-m)-wide ROW. Offshore and based on site-specific conditions (e.g., water depth and seabed constraints), each cable of the RWEC will typically be spaced, where practical, greater than 164 ft (50 m) apart; spacing between each cable will be less at landfall (e.g., approximately 23-49 ft [7-15 m]). Each cable of the RWEC will consist of three bundled copper or aluminum conductor cores surrounded by layers of XPLE insulation and various protective armoring and sheathing to protect the cable from external damage. Fiber optic cables will also be included in the interstitial space between the three conductors for continuous monitoring of the RWF. A cross-section of a typical subsea cable is provided in Figure 3.3.3-2 The maximum design scenario for the RWEC is provided in Table 3.3.3-1.

Figure 3.3.3-2 Typical Subsea Cable Cross-Section

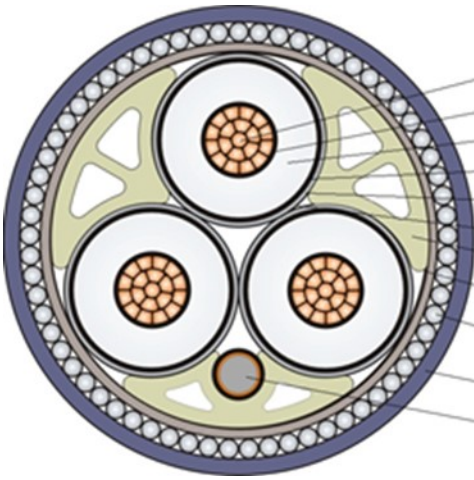


Table 3.3.3-1 RWEC Maximum Design Scenario

Export Cable Characteristics	Maximum Design Scenario
Number of Cables	2
Voltage per Cable	275-kV
Cable Diameter	11.8 in (300 mm)
Target Burial Depth (below seabed)	4 to 6 ft (1.2 to 1.8 m)[1]
Maximum Disturbance Depth	10 ft (3 m)
Corridor Length[2]	
Federal Waters	25 mi (40 km) originating from OSS1 16.5 mi (26.5 km) originating from OSS2
State Waters	23 mi (37 km)
Disturbance Corridor (Total Width per Cable)[3]	up to 131 ft (40 m)
Operational Right-of-Way (Total Width)[4]	approximate 1,312 ft (400 m)

1 Burial of the RWEC will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the RWEC will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
2 As noted in Table 1.2-1 and Section 3.0, the PDE assumes a maximum length of either RWEC corridor of up to 50 mi (80 km).
3 The disturbance corridor reflects the maximum area that will be subject to seafloor preparation prior to cable installation.
4 An operational ROW for the RWEC will be requested in accordance with 30 CFR § 585.200(b). This corridor reflects the approximate survey limits for the RWEC route; the two cables of the RWEC will be sited within this corridor.

3.3.3.2 Construction

The results of geotechnical and geophysical surveys will be used to select the most appropriate installation techniques and advance the design of the RWEC. Detailed design will be provided in the FDR/FIR, which will be reviewed by the CVA and submitted to BOEM prior to construction. The RWEC will be laid and buried using industry standard subsea cable lay and burial methods. The various methodologies for installation of the RWEC are presented separately for both the landfall and offshore zones.

Landfall Construction

Installation of the RWEC at the landfall will be accomplished using an HDD methodology. A cofferdam may be used to allow for a dry environment during construction and manage sediment, contaminated soils, and bentonite (for HDD operations). The cofferdam, measuring up to 164 ft x 33 ft x 10 ft (50 m x 10 m x 3 m) to align with HDD exit pits, may be required to keep the excavation free of debris and from silting back in. If required, the cofferdam may be installed as either a sheet piled structure into the sea floor or a gravity cell structure placed on the sea floor using ballast weight and will be conducted from an offshore work barge anchored near the cofferdam.

- **Sheet Pile Installation.** If the cofferdam is installed using sheet pile, a vibratory hammer will be used to drive the sidewalls and endwalls into the seabed. Installation of a sheet pile cofferdam may take approximately up to 3 days. For HDD, the sidewalls and endwall will be driven to a depth of up to 30 ft (9.1 m); sections of the shoreside endwall will be driven to a depth of up to 6 ft (1.8 m) to facilitate the HDD entering underneath the endwall. After the sheet piles are installed, the inside of the cofferdam will be excavated to approximately 10 ft (3 m). After HDD operations are complete and duct are installed, piles will be removed, placed on the work barge, and hauled back to shore.
- **Gravity Cell Installation.** If a gravity cell cofferdam is used, the cell will be lowered onto the seafloor by a crane that is on a barge. The sidewalls and seaside wall and end wall will be multi skinned to accommodate a rock ballast fill that will stabilize the cofferdam on the seabed. The gravity cell cofferdam may be of a multi-sectional design to allow transportation and assembly at the site. Assembled interior dimensions of the cofferdam will be similar to a sheet pile cofferdam with similar volumes of excavated.
- **No Containment**. If no containment is used, the HDD conduit will terminate in a dredged HDD exit pit. The dredged exit pit will have sloped sides to maintain side walls and exit pit opening. Rock bags maybe installed in the exit pit to support excavation temporarily during drilling activities and cable installation. After the HDD operations are completed the HDD exit pit will be backfilled leaving the duct end uncovered for cable pull in operations.

The area of ground and seabed disturbance estimated for construction at the RWEC landfall location, are provided in Table 3.3.3-2. Vessel anchoring may be required for cable installation at the landfall. If needed, anchoring will occur within a 1,312 ft (400 m) wide corridor centered on cable routes (see Section 3.3.9.2 for additional information on vessel anchoring). The installation technique for the RWEC landfall will be determined based on an analysis of the ground conditions and other engineering or environmental constraints. Detailed information on the final techniques will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

Table 3.3.3-2 Maximum Ground/Seabed Disturbance for Installation of RWEC at Landfall[1]

RWEC Landfall Component	Construction Footprint	Operation Footprint
TJBs[2]	1,340 sq ft (124.5 sq m)	-
Landfall Work Area[3]	3.1 ac (1.3 ha)	-
HDD Option		
Exit Pits/Temporary Cofferdam[4]	0.25 ac (0.1 ha)	-

1 Disturbance estimates presented in this table are not additive as disturbance types may overlap (e.g., TJBs will be located within the Landfall Work Area).
2 Two TJBs will be installed within the 3.1-ac (1.3-ha) Landfall Work Area (one per cable of the RWEC). Each of the TJBs will be up to 67 x 10 x 10 ft (20 x 3 x 3 m).
3 The Landfall Work Area (totaling up to 3.1 ac (1.3 ha) will be located within the 20 ac (8 ha) Landfall Envelope (see Figure 2.2-3).
4 Two exit pits each measuring 164 ft x 33 ft x 10 ft (50 m x 10 m x 3 m) will be excavated to facilitate the HDD operation (one per cable of the RWEC). Note, the onshore work area for the HDD operation will be located within the 3.1-ac (1.3-ha) Landfall Work Area.

The HDD methodology will involve drilling underneath the seabed surface and the intertidal area using a drilling rig located within the Landfall Work Area. The process uses drilling heads and reaming tools of various sizes controlled from the rig to create a passage that is wide enough to accommodate the cable duct. Drilling fluid, comprised of bentonite, drilling additives, and water, is pumped to the drilling head during the drilling process to stabilize the hole, prevent collapse, and to return the cuttings to the rig site where the cuttings will be separated from the drilling fluids. A temporary sheetpile anchor wall may be installed to provide stability of the HDD rig while conducting drilling activities. The temporary anchor wall is driven to a depth of approximately 20 ft (6 m) to secure the anchor. In addition to the anchor wall, the workspace may also require the installation of other temporary sheetpiles to aid in anchoring of the rig and/or to provide soil stabilization of the excavated area.

Once the reaming has taken place, the duct (assembled offsite) will be floated to site by tugs, connected to the drill string and pulled into the prepared hole towards the drilling rig located at the Landfall Work Area. The drilling rig will be repositioned, and the process will be repeated for drilling and installing the second duct. A pull winch attached to either a piled anchor or a gravity anchor (e.g., a large bulldozer) will then be used to pull the cable through the conduit.

There will be two HDD cable ducts, each with a diameter of 3 ft (900 mm). The maximum length of the cable ducts will be 0.6 mi (1,000 m). A barge or jack-up vessel may be used at this location to assist the drilling process, handle the duct for pull in, and to help transport the drilling fluids and mud back to an appropriate site for treatment, disposal and/or re-use. The jack-up vessel may also utilize a casing installed from the HDD exit pit to the jack-up barge. This casing is supported in the water by cross bars driven into the seabed. The casing provides an encloser to house the drill bit and string once it has exited the seafloor, to the jack-up barge. To minimize the potential risks associated with an inadvertent drilling fluid return/release, Revolution Wind will develop an HDD Contingency Plan prior to construction for the inadvertent release of drilling fluids.

Offshore Construction

Offshore, the RWEC (inclusive of two cables) will be installed within the approximate 1,312-ft (400-m)-wide operational ROW. The total width of the disturbance corridor for installation of the RWEC will be up to 131 ft (40 m) per cable, inclusive of any required sandwave leveling, dredging, and boulder clearance (see Sandwave Leveling, Dredging, and Boulder Clearance subsection below). Dynamic Positioning (DP) vessels will generally be used for cable burial activities. If anchoring (or a pull ahead anchor) is necessary during cable installation it will occur within an approximate 1,312 ft (400 m) wide ROW (see Section 3.3.9.2 for additional information on vessel anchoring).

Burial of the RWEC will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the RWEC will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. Where burial cannot occur, sufficient burial depth cannot be achieved, or protection is required due to cables crossing other cables or pipelines, additional cable protection methods may be used (cable protection is discussed further below). The location of the RWEC and associated cable protection will be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts. Target burial depths at specific locations will be formalized in the FDR/FIR. Included as Appendix F is a Preliminary Cable Burial Feasibility Assessment, which provides an initial assessment of cable burial based on available geotechnical and geophysical data.

Installation of the RWEC consists of a sequence of events, including pre-lay cable surveys, seabed preparation, cable installation, joint construction, cable installation surveys, cable protection, and connection to the OSSs, as summarized in Table 3.3.3-3. It is anticipated that construction of the RWEC will be completed within approximately 8 months (see Section 3.2). In addition to the summary provided in Table 3.3.3-3, the following subsections describe seabed preparation, cable installation methodologies, and cable protection strategies further.

Table 3.3.3-3 Typical Export Cable Construction Sequence

Activity/Action	Construction Summary
Pre-lay Cable Surveys	Prior to installation, geophysical surveys will be performed to check for debris and obstructions that may affect cable installation.
Seabed Preparation	Seabed preparation will include required sandwave leveling, boulder clearance and removal of any Out of Service Cables. Boulder clearance trials may be performed prior to wide-scale seabed preparation activities to evaluate efficacy of boulder clearing techniques.
Pre-Lay Grapnel Run (PLGR)	PLGR runs will be undertaken to remove any seabed debris along the export cable route. A specialized vessel will tow a grapnel rig along the centerline of each cable to recover any debris to the deck for appropriate licensed disposal ashore.

Activity/Action	Construction Summary
Cable Installation	The offshore cable laying vessel will move along the pre-determined route within the established corridor towards the OSSs. Cable laying and burial may occur simultaneously using a lay and bury tool, or the cable may be laid on the seabed and then trenched post-lay. Alternatively, a trench may be pre-cut prior to cable installation. Cable lay and burial trials within the 131-ft (40-m) wide disturbance corridor may be performed prior to main cable installation activities to test equipment.
Joint Construction	Installation of the RWEC will require offshore subsea joints due to the length of the RWEC (up to two per cable). The joints will be located within the 131-ft (40-m) wide disturbance corridor. The subsea joint will be protected by marinized housing approximately four times the cross-sectional diameter of the cable. The joint housing will be protected using similar methods to those described below for Cable Protection. In case of repair due to damage additional joints may be required during construction.
Cable Installation Surveys	Cable installation surveys will be required, including pre- and post-installation surveys, to determine the actual cable burial depth. Depending on the instruments selected, type of survey, length of cable, etc. the survey will be completed by equipment mounted to a vessel and/or remote operated vehicle.
Cable Protection	Cable protection in the form of rock berms, rock bags and/or mattresses will be installed as determined necessary by the Cable Burial Risk Assessment, and where the cable crosses existing submarine assets. Cable protection will be installed from an anchored or DP support vessel that will place the protection material over the designated area(s).
Connection to OSS	At the OSSs, the export cables will be pulled into each OSS and secured.

MEC/UXO Risk Mitigation

Prior to seafloor preparation, cable routing, and micrositing of all assets, Revolution Wind will implement a MEC/UXO Risk Assessment with Risk Mitigation Strategy (RARMS) designed to evaluate and reduce risk in accordance with the As Low As Reasonably Practicable (ALARP) risk mitigation principle. The RARMS consists of a phased process beginning with a Desktop Study and Risk Assessment that identifies potential sources of MEC/UXO hazard based on charted MEC/UXO locations and historical activities, assesses the baseline (pre-mitigation) risk that MEC/UXO pose to the Project, and recommends a strategy to mitigate that risk to ALARP. The Project's MEC/UXO Risk Assessment with Risk Mitigation Strategy is included as Appendix G.

Avoidance is the preferred approach for MEC/UXO mitigation; however, it is anticipated that there may be instances where confirmed MEC/UXO avoidance is not possible due to layout restrictions, presence of archaeological resources, or other factors that preclude micrositing. In such situations, confirmed MEC/UXO may be removed through in-situ disposal or physical relocation. Selection of a removal method will depend on the location, size, and condition of the confirmed MEC/UXO, and will be made in consultation with a MEC/UXO specialist and in coordination with the appropriate agencies.

In-situ disposal will be done with low noise methods like deflagration of the MEC/UXO or cutting the MEC/UXO to extract the explosive components. The MEC/UXO might also be relocated through a "Lift and Shift" operation. The relocation would be to another suitable location on the seabed within the Offshore Envelope or previously designated disposal areas for either wet storage or disposal through low noise methods as described for in situ disposal. For all MEC/UXO clearance methods, safety measures such as the use of guard vessels, enforcement of safety zones, and others will be identified in consultation with a UXO/MEC specialist and the appropriate agencies and implemented as appropriate.

During construction, the likelihood of MEC/UXO encounter is very low. Revolution Wind will work with BOEM to identify appropriate response actions, which may include developing an emergency response plan, conducting MEC/UXO-specific safety briefings, retaining an on-call MEC/UXO consultant, or other measures (see Appendix G for additional detail).

Sandwave Leveling, Dredging, and Boulder Clearance

As described in Table 3.3-9, prior to installation of the RWEC, seabed preparation activities including sandwave leveling and boulder clearance will be required. In addition, dredging or Controlled Flow Excavation (CFE) may be required in select areas where the RWEC crosses of higher vessel traffic (i.e., where the route crosses the TSS, pilot boarding area, and is located near anchorage areas) to obtain deeper cable burial depths (i.e., greater than approximately 6.5 ft [2 m]). As noted above, any required sandwave leveling, dredging, and boulder clearance will occur within the 131-ft (40-m) -wide disturbance corridor for each cable of the RWEC.

Sandwave leveling is typically completed for the following reasons:

- Many of the cable installation tools proposed require a relatively flat seabed surface to ensure operational criteria (pitch and roll) of the tools are not exceeded; and
- Sandwaves are generally mobile in nature; therefore, the export cables must be buried in a manner to prevent cable exposure over time. In areas where larger sandwaves exist, this is achieved by removing a portion of the mobile features before installation takes place.

Sandwave leveling and/or deeper burial may require use of a Trailing Suction Hopper Dredger or CFE. These tools are briefly described below. Any sediment removed will be relocated within the local area.

- **Trailing Suction Hopper Dredger** is mainly used for dredging loose and soft soils such as sand, gravel, silt or clay. One or two suction tubes, equipped with a drag head, are lowered on the seabed, and the drag head is trailed over the bottom to excavate a trench. This method is typically used for sandwave leveling.
- **Controlled Flow Excavation (CFE)** is a non-contact methodology. The jetting tool draws in seawater from the sides and then jets this water out at a specified pressure and volume. The tool can be positioned over the sandwaves to level the seabed.

Based on preliminary geophysical data, Revolution Wind conservatively assumes the use of these tools will occur along a maximum of 25 percent of each cable route of the RWEC (up to 7 percent of each route in state waters and up to 45 percent of each route in federal waters) will require sandwave leveling and/or dredging to facilitate cable installation.

The RWEC corridor passes through areas of boulder and debris fields linked to both the geologic (namely Pleistocene glacial till/moraine close to the surface) and anthropogenic debris (e.g. debris from the demolition of the old Jamestown Bridge). Micro-routing around larger boulders or boulder clusters will be performed to the extent practicable. The following two techniques may be used to relocate/remove surface or partially embedded boulders and debris during installation of the RWEC.

- **Boulder Grab**: A grab is lowered to seabed, over the targeted boulder. Once "grabbed", the boulder is relocated away from the RWEC route.
- **Boulder Plow**: Boulder clearance is completed by a high-bollard pull vessel, with a towed plow generally forming an extended V-shaped configuration, splaying from the rear of the main chassis. The V-shaped configuration displaces any boulders to the extremities of the plow, thus establishing a clear corridor. Multiple passes may be required.

Boulder/debris clearance will occur prior to installation and will be completed by a support vessel based on pre-construction surveys.

Based on a review of site-specific geophysical data, it is assumed that a boulder plow may be used in all areas of higher boulder/debris concentrations, conservatively estimated at up to 60 percent per cable route of the RWEC (up to 70 percent per cable route in state waters and 40 percent per cable route in federal waters). Both within these areas of higher boulder and debris concentrations and outside of these areas, a boulder grab may be used to remove larger and/or isolated targets. The size of boulders that can be relocated is dependent on a number of factors including the boulder weight, dimensions, embedment, density and ground conditions. Typically, boulders with dimensions less than 8 ft (2.5 m) can be relocated with standard tools and equipment.

Prior to wide-scale seabed preparation activities, boulder clearance trials may occur within cable corridors to test the equipment is working properly and is appropriate for the seabed conditions. Each trial would include the deployment and towing of boulder clearing equipment and/or use of boulder grab tool; each trial would be approximately 0.62 mi (1 km, 0.53 nm) in length. It is anticipated that approximately five to ten trials may be necessary in different areas. The trials may also include pre- and post-trial geophysical survey work potentially utilizing a remotely operated vehicle and bathymetric survey equipment. Because trials will occur within cable corridors, the temporary seabed disturbance from these trials is accounted for in estimates provided in Table 3.3-9.

Offshore Export Cable Installation Methodology

Revolution Wind has completed geophysical and geotechnical (G&G) surveys of the RWEC corridor to inform cable routing and selection of the most appropriate tools for installation of the RWEC. Based on current understanding of site-specific conditions between the landfall and the OSSs, Revolution Wind will use the following burial tools as the primary installation methodologies. See Appendix F for a Preliminary Cable Burial Feasibility Assessment, which provides an initial assessment of cable burial using these tools based on available geotechnical and geophysical data.

- **Jet-Plow:** This technique involves the use of water jets to fluidize the soil temporarily opening a channel to enable the cable to be lowered under its own weight or be pushed to the bottom of the trench via a cable depressor. The cable is either installed simultaneously to cable lay operations or after the cable has been laid on the seabed. Typical types of jet-plows include towed jet sleds, tracked jet-trencher, or vertical injectors. Backfill of the trench is expected shortly after installation due to settlement of fluidized sediments and/or trench collapse. Immediately after installation a trench will likely be visible on the seabed as well as tracks/skids from the installation equipment;

however, over time this will backfill to the original seabed level. No permanent seabed impacts are associated with this installation methodology.

- **Mechanical Plowing**: There are two types of mechanical plowing considered for cable installation:
  - Simultaneous lay and bury involves pulling a plow along the cable route to simultaneously lay and bury the cable. The plow's share cuts into the soil, opening a temporary trench which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. This narrow trench infills itself behind the tool, primarily by collapse of the trench walls and/or by natural infill, usually over a relatively brief period. Some plows may use additional jets to fluidize the soil in front of the share. The plow pulling force is either provided by bollard pull (moving vessel) or winches (anchored vessel). Backfill of the trench is expected shortly after installation due to trench collapse. Immediately after installation a trench will likely be visible on the seabed as well as tracks/skids from the installation equipment; however, over time this will restore to the original seabed level. No permanent seabed impacts are associated with this installation methodology.
  - Pre-cut plowing involves pre-cutting a trench in advance of the cable lay operations. Following cable lay, the trench is backfilled via an additional pass using the displaced material to provide sufficient protection to the cable. Trenching may require multiple passes. Pre-cut plowing is suitable to a range of soil conditions and is usually preferred over simultaneous lay and bury plowing when localized challenging ground conditions are expected (i.e., very hard soils and/or where subsurface boulder risk is high). Given that the tool is commonly used to target challenging ground conditions (i.e., very hard soils and/or where subsurface boulder risk is high), the disturbed area created by the plow is not expected to recover quickly. The volume of disturbed material is calculated as the cross-sectional area of the trench along its length; the disturbed area also includes the temporary berms created on the seabed. Temporary seabed impacts include the total area of the skids in contact with the seabed, the trench itself, and spoil on the sides of the trench.
- **Mechanical Cutters** employ either a cutting wheel or an excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor. This installation methodology is typically used for post lay burial operations. Seabed disturbance associated with mechanical cutting is less than that associated with pre-cut plowing, as described above.

Prior to the main cable installation activities, cable lay and burial trials may occur within the 131-ft (40-m) wide disturbance corridor to test the equipment is working properly and is appropriate for the seabed conditions. Each trial includes operating the installation equipment within a portion of the cable corridor, offset from the cable centerline, and may also include installing a proportion of cable. It is anticipated that approximately five to ten trials may be necessary to test the various pieces of equipment. The trial cable would be recovered towards the end of the cable installation process.

During cable installation there may be scenarios where installation to the target burial depth is not achievable using the primary installation methodologies due to mechanical problems with the trencher, adverse weather conditions, and/or unforeseen soil conditions. CFE (as described above) may be used in these circumstances. When used for cable installation, CFE uses stream of water to fluidize the sands around the cable, which allows the cable to settle into the trench under its own weight.

Based on the identified range of installation methods and requirements, Revolution Wind has established a design envelope for installation of the RWEC that reflects the maximum seabed disturbance associated with construction and operation (see Table 3.3.3-4). Note, because the cable lay and burial trials described above will occur within the 131-ft (40-m) wide disturbance corridor, the temporary seabed disturbance from these trials is accounted for in estimates provided in Table 3.3.3-4.

Upon receipt of the final G&G survey data, the Project will complete final cable route engineering. The purpose of the final cable routing process is to avoid, where possible, features along the route which have the potential to impact cable installation. In the event that features cannot be avoided (such as boulder fields), Revolution Wind will plan appropriate mitigation measures to manage the risks. In addition to final cable routing, the Project will complete a Cable Burial Risk Assessment in which the site conditions will be described in detail, identifying features such as boulder distribution and dimensions, sandwave height and mobility, soil strength and classification, seabed obstructions and UXO. Following this detailed information on the installation, final technique(s) will be selected and burial requirements will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

Table 3.3.3-4 Maximum Seabed Disturbance for RWEC Installation[1]

RWEC Disturbance	Construction Footprint	Operation Footprint
RWEC – OCS		
General Disturbance Corridor[2]	657.3 ac (266.0 ha)	-
Boulder Clearance (40% of route for each cable)	263.6 ac (106.7 ha)	-
Sandwave Leveling/Dredging (45% of route for each cable)[3]	296.5 ac (120 ha)	
Secondary Cable Protection (10% of route for each cable)	-	19.8 ac (8.0 ha)
RWEC – RI State Waters		
General Disturbance Corridor[2]	730 ac (295 ha)	-
Boulder Clearance (70% of route for each cable)	511.3 ac (206.9 ha)	-
Sandwave Leveling/Dredging (7% of route for each cable) [3]	51.1 ac (20.7 ha)	-
Secondary Cable Protection (10% of route for each cable)	-	22.0 ac (8.9 ha)

1 Disturbance estimates presented in this table are not additive as disturbance types may overlap (e.g., cable protection placed in areas where boulders were cleared). Refer to Table 3.3-7 for disturbances resulting from installation of the RWEC at the landfall location. Vessel anchoring disturbances are not included; if anchoring (or a pull ahead anchor) is necessary during cable installation it will occur within a 1,312 ft (400 m) wide corridor centered on cable routes.

2 The general disturbance corridor for both the RWEC–OCS and RWEC–RI is 131-ft (40-m) -wide. Refer to Table 3.3-6 for lengths of the RWEC–OCS and RWEC–RI. Boulder clearance, sandwave leveling, dredging, and secondary cable protection will not extend beyond this corridor. Also, if they are performed along the RWEC, boulder clearance and cable lay/burial trials will occur within this general disturbance corridor.

3 Accounts for use of CFE and/or Trailing Suction Hopper Dredger.

Secondary Cable Protection

Secondary cable protection may be applied where burial cannot occur, sufficient burial depth cannot be achieved due to seabed conditions or to avoid risk of interaction with external hazards. The need for secondary cable protection in specific locations will be based on the Cable Burial Risk Assessment. Revolution Wind assumes 10 percent of the route for each cable comprising the RWEC will require secondary cable protection. The area of impact for secondary cable protection is accounted for in Table 3.3-9. It is assumed that secondary cable protection will measure up to 39 ft (12 m) wide.

One or more of the following cable protection solutions may be used for secondary cable protection; schematics of these measures are provided in Appendix H. Cable protection solutions implemented will be of the type that minimizes the potential for gear snags, as feasible.

› **Rock berm** involves dumping or placing rock overtop and/or surrounding the cable.

› **Concrete Mattresses** are composed of cast concrete blocks interlinked to form a flexible, articulated mat, which can be placed on the seabed over a cable.

› **Fronded mattresses** are concrete mattress with ‘fronds’ that are designed to slow down current and naturally allow sediment to deposit and form a bank over the mattress.

› **Rock bags** are rock-filled mesh bags placed over the cable.

As noted previously, the location of the RWEC and associated cable protection will be provided to NOAA’s Office of Coast Survey after installation is completed so that they may be marked on nautical charts.

Cable Crossings

The Project’s network of submarine cable (inclusive of the RWEC, IAC, and OSS-Link Cable) may cross existing submarine assets. There are seven potential existing assets which have been identified to-date along the RWEC, some of which are in close proximity to each other. Their asset status is unknown at this stage and will require further investigation and engineering assessment for determining their status. Also, it is assumed the RWEC will cross two (up to four) of the Project’s own IAC. The actual locations of the cable crossings will be provided in the FDR/FIR.

Cable protection at these crossings will be applied for both In-Service assets as well as Out-of-Service assets which cannot be safely removed and pose a risk to the RWEC. Rock berm or concrete mattress separation layers will be installed prior to cable installation, while the rock berm or concrete mattress cover layers will be installed after cable installation. Any rock berm separation and cover layers and will be installed using suitably approved rock material. The rock berm separation and cover layers are defined by minimum geometry and vertical and horizontal tolerances. The amount of cable protection will be as required for suitable coverage and technical agreements with respective asset owners. It is assumed up to 1,640 ft (500 m) of cable protection will be required per crossing. The cable protection required for cable crossings is in addition to the secondary cable protection requirements previously described above.

Final crossing designs will be completed in coordination with asset owners and formalized in crossing and proximity agreements, in line with International Cable Protection Committee recommendations.

Crossing and proximity agreements will be provided in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

3.3.4 WTG and OSS Foundations

Revolution Wind requires flexibility in foundation design so that anticipated advancements in the available technology may be accommodated within the Project's final design. For the purpose of this COP, monopile foundations are considered for WTGs while monopile and piled jacket foundations are being considered to support OSSs.

In addition, for this COP and associated environmental assessments, Revolution Wind has committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA (see Figure 2.2-1). The indicative layout scenario and Offshore Envelope shown on Figure 2.2-1 have been used in support of the environmental assessments presented in Section 4 and associated technical appendices where appropriate. A final layout of the Project will be provided as part of the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

Designing and optimizing the layout of WTGs and OSSs is a complex, iterative process taking into account a large number of inputs and constraints including, but not necessarily limited to: site conditions (e.g., wind speed and direction, water depth, seabed conditions, environmental constraints, and seabed obstructions); design considerations (e.g., WTG type, installation set-up, foundation design, and electrical design); and stakeholder considerations (e.g., safe navigation and commercial and recreational fishing). As such, Revolution Wind requires flexibility to micro-site foundations. In accordance with 30 CFR § 585.634(c)(6), micro-siting of foundations will occur within a 500-ft (152-m) radius around locations identified in the indicative layout scenario.

The following sections describe the design and construction of monopile and piled jacket foundations.

3.3.4.1 Design

The dimensions for the WTG and OSS foundations are summarized in Table 3.3.4-1 and conceptual examples are depicted in Figure 3.3.4-1 to Figure 3.3.4-3 WTG support structures (i.e., towers and foundations) will be designed to withstand 500-year hurricane wind and wave conditions, and the external platform level will be designed above the 1,000-year wave scenario. The OSSs will be designed to at least the 5,000-year hurricane wind and wave conditions in accordance with the American Petroleum Institute standards.

A WTG monopile foundation typically consists of a single steel tubular section, with several sections of rolled steel plate welded together. A TP may be fitted over the top of the monopile and secured via a bolted connection. Secondary structures on each WTG monopile foundation will include a boat landing or alternative means of safe access (e.g., Get Up Safe – a motion compensated hoist system allowing vessel to foundation personnel transfers without a boat landing), ladders, a crane, and other ancillary components. The TP may either be installed separately following the monopile installation or the monopile and TP may be fabricated and installed as an integrated single component. If the monopile and TP are fabricated and installed as an integrated component, the secondary structures will be installed on the TP subsequently and in separate smaller operations. The TP will be painted yellow and marked according to USCG requirements.

An OSS monopile foundation will be similar to the WTG monopile foundation. However, OSS monopile foundations are larger in diameter and will include a Module Support Frame between monopile and Topside (see Figure 3.3.4-2).

Alternatively, a piled jacket foundation may be used for the OSSs. A piled jacket foundation is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seabed by means of hollow steel pin piles attached to the jacket. Unlike monopiles, there is no separate TP; the TP and ancillary components are fabricated as an integrated part of the jacket. Four-legged piled jacket foundations are being considered for the OSSs (Figure 3.3.4-3).

Figure 3.3.4-1 Example WTG Monopile Foundation with Secondary Structure Concept

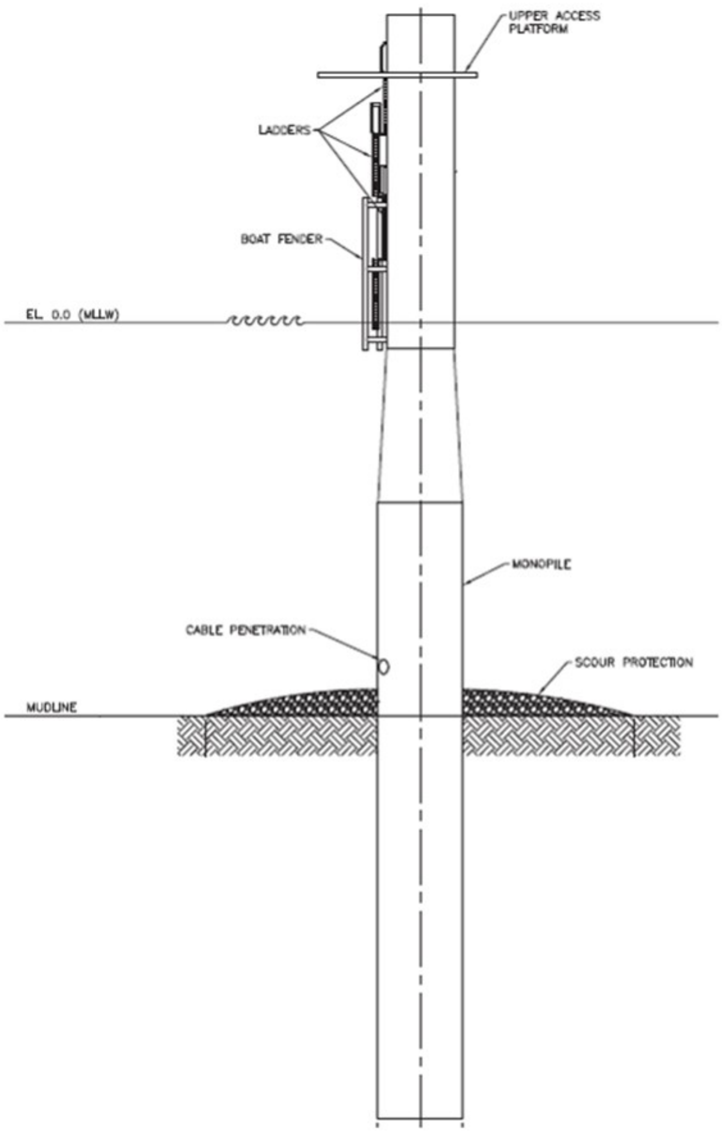


Figure 3.3.4-2 Example Monopile OSS Foundation Concept, including Module Support Frame

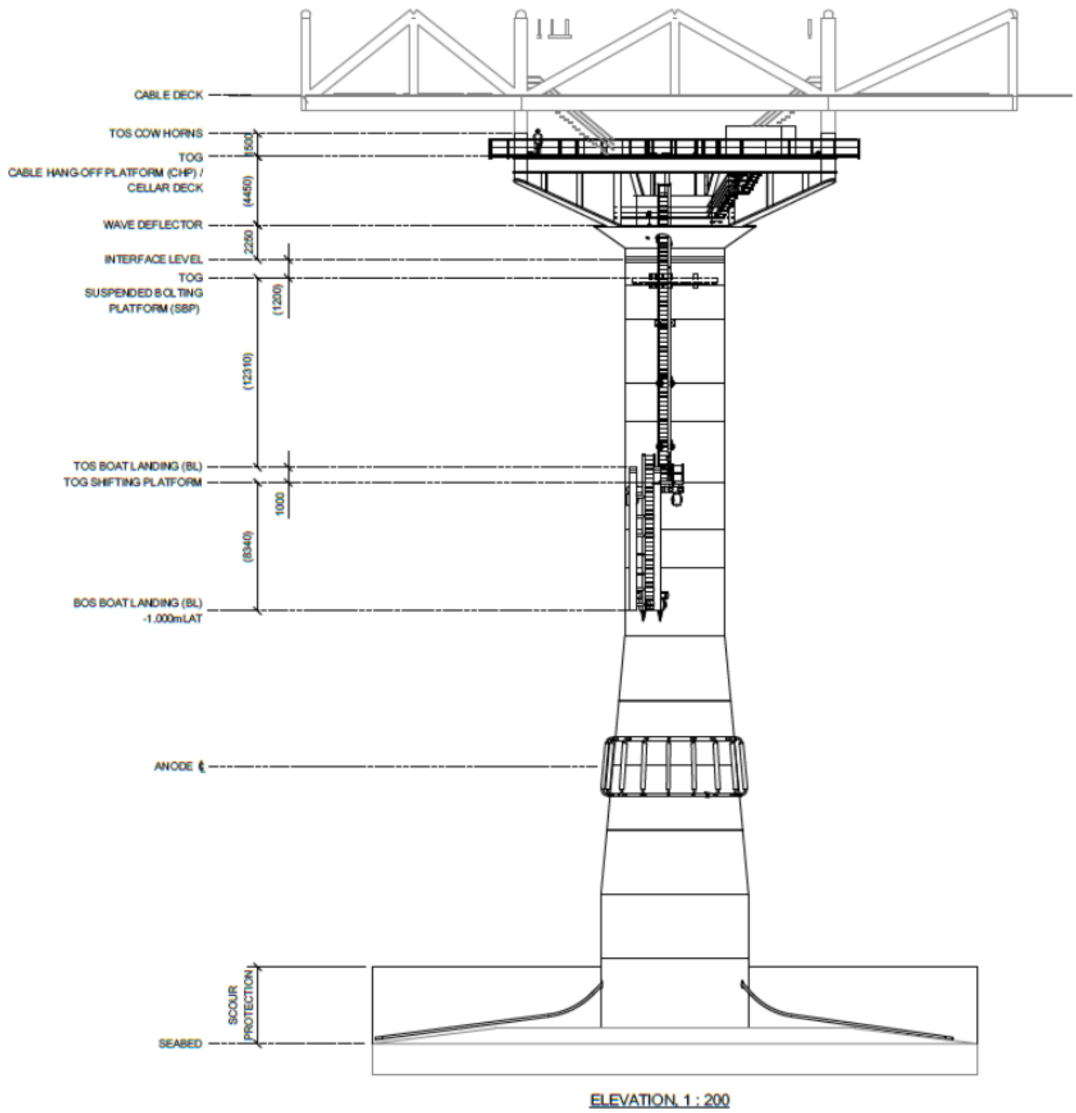


Figure 3.3.4-3 Example OSS Piled Jacket Foundation Concept

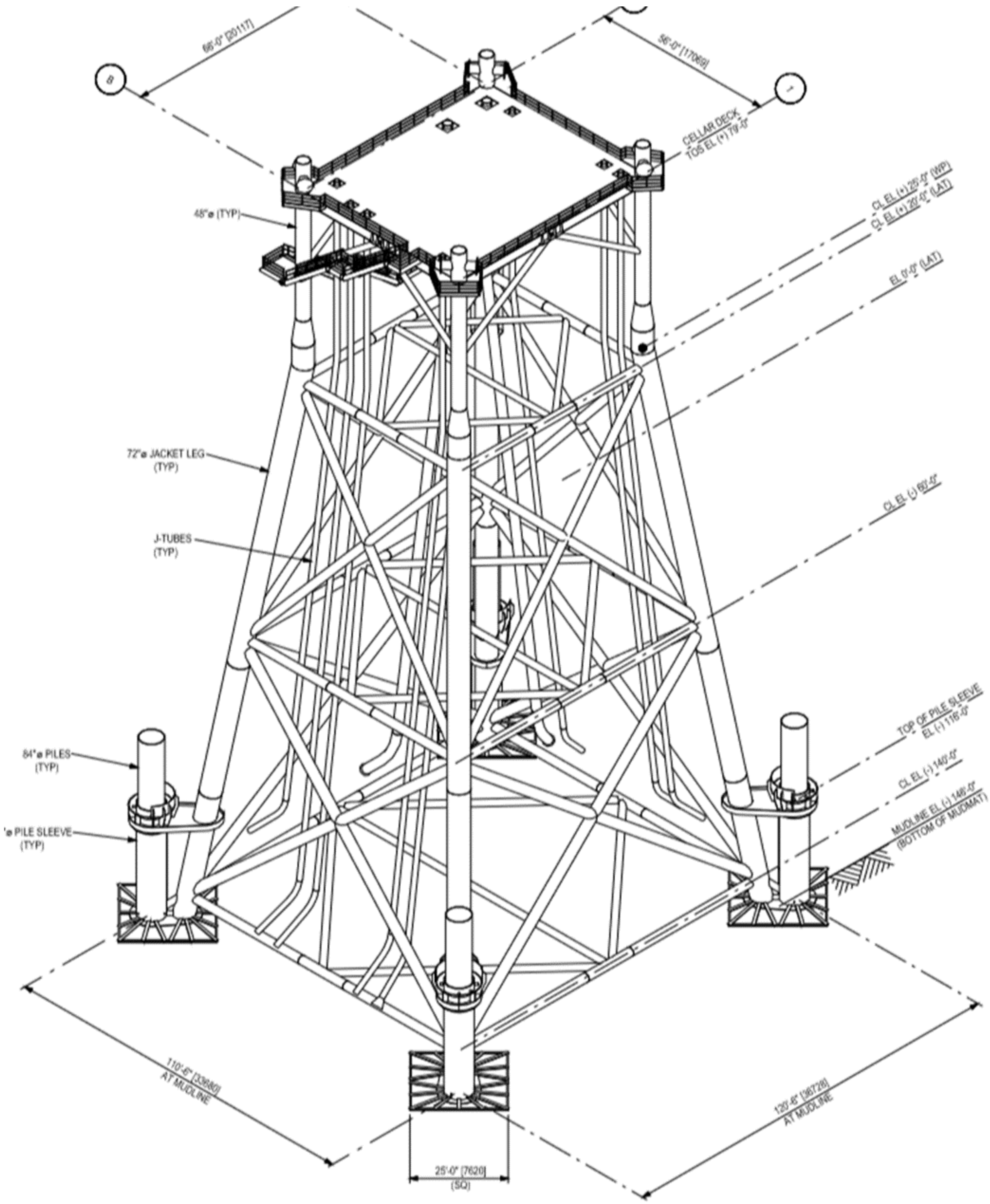


Table 3.3.4-1 Summary of WTG and OSS Foundation Types

Foundation Characteristics[1]	Maximum Values
Monopile Foundations	
Diameter (min. top – max bottom)	WTG Foundations: 20 – 39 ft (6 – 12 m) OSS Foundations: 49 ft (6 -15 m)
Target Embedment Depth (minimum – maximum below seabed)	98 – 164 ft (30 – 50 m)
Scour Protection Area (per monopile)	0.7 ac (0.3 ha)
Maximum Hydraulic Hammer Energy	4,000 kJ
Piled Jacket Foundations	
Number of Legs	4
Total Piles per Structure	4
Separation of Adjacent Legs at Seabed Level	120 ft x 110 ft (37 m x 34 m)[2]
Separation of Adjacent Legs at MSL	72 ft x 62 ft (21.9 m x 18.9 m)
Height of Platform AMSL	160 ft (50 m)
Leg Diameter	10 ft (3 m)
Pile Diameter	13 ft (4 m)
Target Embedment Depth (below seabed)	210 ft (64 m)
Scour Protection Area per Piled Jacket	1.0 ac (0.4 ha)
Mud-mat Area	66 ft x 66 ft (20 m x 20 m)
Maximum Impact Hammer Energy	2,000 kJ

1 WTGs will be installed on monopile foundations; OSSs will be installed on either monopile or piled jacket foundations.
2 Secondary steelwork (i.e. mudmats and anodic protection) and cables may protrude beyond this

The final foundation(s) selected and associated design specifications will be determined by the final engineering design process, informed by factors including soil conditions, wave and tidal conditions, Project economics and procurement approach. Detailed information on the foundation selected will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction. A feasibility study demonstrating technical feasibility of the Project's design envelope for WTG foundations based on available geotechnical data is included as Appendix I.

To promote safety while the foundations are awaiting installation of the TPs (if used) and WTGs, each foundation will be marked and lit in accordance with USCG requirements. In addition, without the TPs or ancillary structures with the equivalent features there will be no means for unauthorized access to the foundation.

3.3.4.2 Construction

Maximum seabed disturbance associated with foundation construction is summarized in Table 3.3.4-2.

Table 3.3.4-2 Maximum Seabed Disturbance for Foundation Installation[1]

Foundation Disturbance	Construction Footprint	Operation Footprint
WTG Foundations – Monopile Only		
WTG Monopile and Scour Protection (per foundation)	-	0.7 ac (0.3 ha)
Seafloor Preparation (per foundation)[2]	31.1 ac (12.6 ha)	-
Total (up to 100 foundations)	*3,110 ac (1,258.6 ha)*	*70.0 (28.3 ha)*
OSS Foundations – Monopile Only		
OSS Monopile and Scour Protection (per foundation)	-	0.7 ac (0.3 ha)
Seafloor Preparation (per foundation)[2]	31.1 ac (12.6 ha)	-
Total (up to 2 foundations)	*62.2 ac (25.2 ha)*	*1.4 ac (0.6 ha)*
OSS Foundations – Piled Jacket Option		
4-Legged Jacket and Scour Protection (per foundation)	-	1 ac (0.4 ha)
Seafloor Preparation (per foundation)[2]	31.1 ac (12.6 ha)	-
Total (up to 2 foundations)	*62.2 ac (25.2 ha)*	*2 ac (0.8 ha)*

1 Disturbance estimates presented in this table are not additive as disturbance types overlap (e.g., foundation footprints are located within the area subject to seabed preparation.

2 Seafloor preparation will occur within a 656 ft (200 m) radius centered on the foundations to ensure safe foundation installation as well as safe vessel jack-up. Jack-up vessels with up to four spudcans will be used for foundation installation; jack up will occur within the seafloor preparation area.

Regardless of the chosen foundation option(s), a number of operations will be completed prior to the foundation installation process, including:

- **Geophysical Surveys**: to identify seabed debris and potential UXO;
- **Geotechnical Surveys**: to identify the geological, archaeological, and cultural resource conditions;
- **MEC/UXO Clearance Surveys**: to identify and confirm MEC/UXO targets for removal/disposal, as described in Section 3.3.3.2; and
- **Seabed Debris Clearance**: removal of seabed debris, boulder clearance, etc. where necessary to ensure the seabed is suitable for safe foundation installation, as described in Section 3.3.3.2. Revolution Wind assumes boulder clearance will occur within a 656 ft (200 m) radius centered on the foundations to ensure safe foundation installation as well as safe vessel jack-up.

Foundations will be installed following completion of these operations, as summarized in Table 3.3-13 (monopile foundations) and Table 3.3-14 (piled jacket foundations). Monopile foundations or pin piles for jacket foundations will be driven to target embedment depths using impact pile driving and/or vibratory pile driving. The maximum impact hammer energies and target embedment depths for each foundation type are presented in Table 3.3.4-1. Installation of a single monopile foundation is estimated to normally require 1 to 4 hours (6 to 12 hours maximum) of pile driving; up to three monopile foundations will be installed in a 24-hour period. The WTG monopile installation campaign is expected to be completed in a single 5-month campaign (see Section 3.2).

Installation of a single piled jacket foundation is estimated to require approximately 16 hours (32 hours maximum) of pile driving per jacket (i.e., 4 hours per leg of the four-legged jacket). The duration for the OSS foundation installation is accounted for in the approximate 8-month window for OSS installation and commissioning (see Section 3.2).

Table 3.3.4-3 Typical Monopile Foundation Installation Sequence

Activity/Action	Installation Details
Foundation Delivery	monopiles may be transported directly to the Lease Area for installation or to the construction staging port. Monopiles (and TPs if used) are transported to site by an installation vessel or a feeder barge.
Foundation Setup	At the foundation location, the main installation vessel upends the monopile in a vertical position in the pile gripper mounted on the side of the vessel. The hydraulic hammer is lifted on top of the pile to commence pile driving.
Pile Driving	Piles are driven until the target embedment depth is met, then the pile hammer is removed and the monopile is released from the pile gripper.
TP Installation (if used) or Secondary Structures Installation	Once the monopile is installed to the target depth, the TP or separate secondary structures will be lifted over the pile by the installation vessel. If used, the TP will be bolted to the monopile.
Completion	Once installation of the monopile and TP is complete, the vessel moves to the next installation location.

Table 3.3.4-4 Typical Piled Jacket Foundation Installation Sequence

Activity/Action	Installation Details
Foundation Delivery	Pin piles and the associated jacket foundations may be transported directly to the Lease Area for construction or to the construction staging port. They are delivered to site by an installation vessel or a feeder barge.
Foundation Setup	If pin piles are installed first, a piling template is lowered to the seabed and the pin piles are upended and lifted into place in the piling template. The pile hammer is then placed on top of the pin piles for driving. If the jacket is installed first, the jacket is lifted vertically and lowered onto the seabed and the pin piles lifted into place through the jacket feet for driving.

Activity/Action	Installation Details
Pin Pile Driving	Each pin pile is driven in turn until the target embedment depth is met for each pin, then the pile hammer is removed, and the piling template is recovered.
Jacket Installation	If pin piles are installed first, then after driving (and drilling if necessary) the jacket structure is lifted into place by the installation vessel and the jacket leg stab-ins will be inserted into the pre-installed piles.
Grouting	The joint between the pin piles and the jacket may be cemented using grout, an inert cement mix. Grout is pumped from the installation vessel or another support vessel into the joint while being monitored to minimize loss to the environment.
Completion	Once installation of the jacket foundation is complete, the vessel moves to the next location.

Final engineering design may indicate that scour protection is necessary for the selected foundation type. Scour protection is designed to prevent foundation structures from being undermined by hydrodynamic and sedimentary processes, resulting in seabed erosion and subsequent scour hole formation. The shape of the foundation structure is an important parameter influencing the potential depth of scour hole formation.

It is anticipated that scour protection will be installed prior to installation of the foundations. Several types of scour protection may be considered, including rock placement, mattress protection, sandbags, and stone bags. However, rock placement, in which large quantities of crushed rock are placed around the base of the foundation structure, is the most frequently used solution. The rock placement scour protection solution may comprise a rock armor layer resting on a filter layer. The filter layer can either be installed before the foundation is installed ('pre-installed') or afterwards ('post-installed'). Alternatively, by using heavier rock material with a wider gradation, it is possible to avoid using a filter layer and pre- or post-install a single layer of scour protection.

The amount of scour protection required will vary for the different foundation types being considered and based on the local site conditions. The final choice and design of a scour protection solution for the Project will be made after detailed design of the foundation structure, taking into account a range of aspects including geotechnical data, metocean data, water depth, foundation type, maintenance strategy, agency coordination, stakeholder concerns, and cost. The maximum anticipated area of scour protection per foundation type is accounted for in permanent disturbance estimates provided in Table 3.3-12.

3.3.5 Offshore Substations

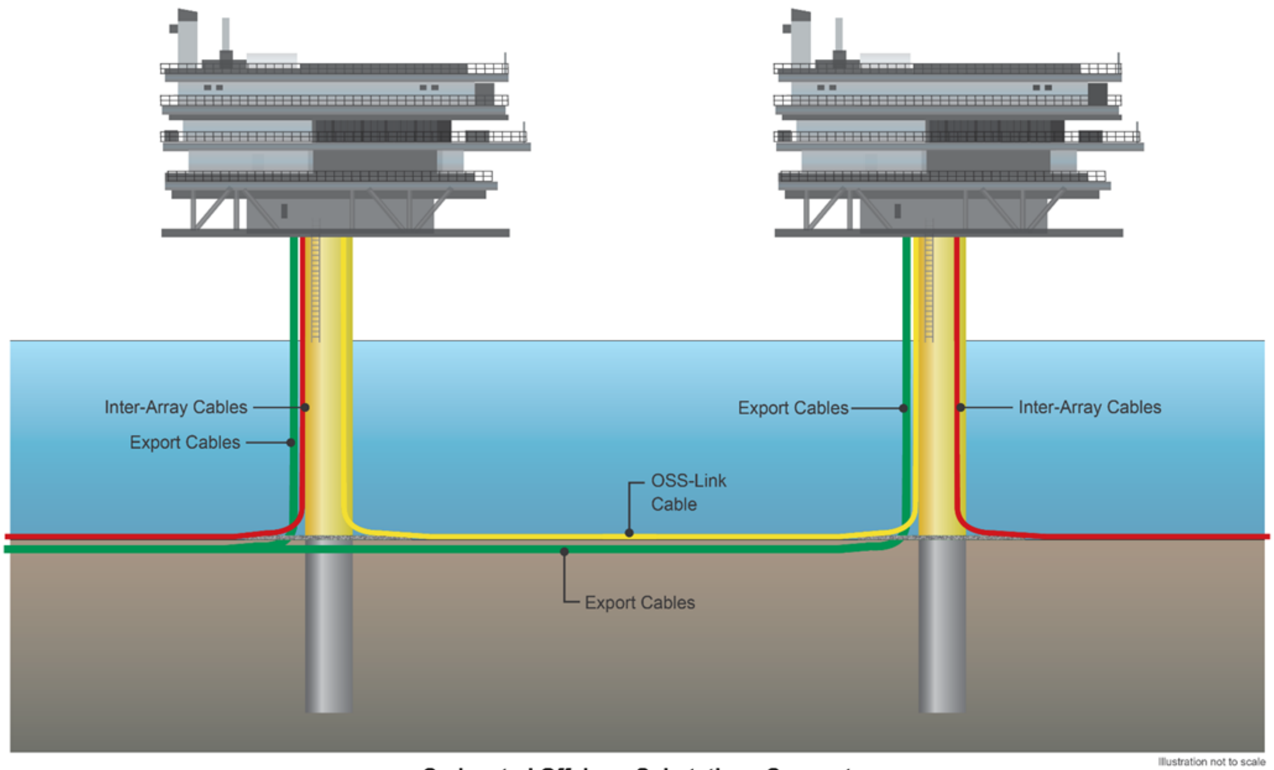
Up to two OSSs, each with a maximum nominal capacity of 440 MW, will be required to support the Project's maximum design capacity. An OSS is an offshore platform containing the electrical components necessary to collect the power generated by the WTGs (via the IAC), transform it to a higher voltage for transmission and transport of that power to the Project's onshore electricity infrastructure (via the export cables). The purpose of the OSS is to stabilize and maximize the voltage of power generated offshore, reduce the potential electrical losses, and transmit electricity to shore. The following subsections describe the design and construction of the Project's OSSs.

3.3.5.1 Design

The OSSs will house equipment for high-voltage transmission, including one high-voltage shunt reactor on each OSS, and medium-voltage 66-kV and 275-kV high-voltage gas-insulated switchgears. The high-voltage equipment on the OSS is expected to be rated between 220-kV and 400-kV. In addition to these components, the OSS will be equipped with low-voltage systems including SCADA supplying the topside platform with electrical power and lighting. This includes auxiliary systems for protection control, communication and light. An emergency diesel generator system will support necessary equipment in case of a power outage. As described in Section 3.3.4, the OSSs will be installed on either monopile or piled jacket foundations.

Though the OSSs will be unmanned, additional facilities on the OSSs may include break rooms, bathrooms, locker facilities, and general storage rooms for staff and equipment. There will not be any running water facilities on the platform and wastewater will be collected in holding tanks and removed from the OSS by transfer to a crew transfer vessel (CTV) or services operations vessel (SOV). Solid waste will also be removed by a CTV or an SOV and brought to shore for proper disposal. The maximum design scenario for the Project OSSs topside structure is provided in Table 3.3.5-1. Figure 3.3.5-1 provides a schematic of a typical OSS.

Figure 3.3.5-1 OSS Schematic[1]



Co-located Offshore Substations Concept

1 While a monopile foundation is depicted in this figure for the OSSs, the Project Design Envelope includes two foundation types (monopile and piled jacket) for these structures.

Table 3.3.5-1 OSS Maximum Topside Design Scenario

	Maximum Design Scenario
Number of OSSs	2
Topside Length and Width[1]	321.5 x 216.5 ft (98 m x 66 m)
Topside Maximum Height (excluding lightning protection) AMSL	108 ft (33 m)
Topside Maximum Height (including lightning protection) AMSL	180 ft (55 m)
Minimum Height of OSS AMSL[2]	82 ft (25 m)

1 Topside dimensions assume inclusion of a helideck as it represents the maximum design scenario.
2 Distance between mean sea level and bottom of OSS topside.

Each of the OSSs will require various oils, fuels, and lubricants to support its operation; SF_6 will also be used for insulation purposes. Table 3.3.5-2 provides a summary of the maximum potential quantities of oils, fuels, lubricants and SF_6 per OSS. The spill containment strategy for each OSS is comprised of preventive, detective, and containment measures. The OSSs will be designed with a minimum of 110 percent of secondary containment of all identified oils, grease, and lubricants. These measures are discussed in more detail in the ERP/OSRP provided in Appendix D. Additionally, OSS devices containing SF_6 will be equipped with integral low-pressure detectors to detect SF_6 gas leakages should they occur.

Table 3.3.5-2 Summary of Maximum Potential Quantities Oils, Fuels, Lubricants, and SF_6 per OSS

OSS Equipment	Oil/Fuel/Lubricant/Gas Type	Maximum Quantity per OSS
Transformers and Reactors	Transformer Oil	79,252 gal (300,000 L)
Generators	Diesel Fuel	52,834 gal (20,000 L)
Medium and High-Voltage Gas-insulated Switchgears	SF6	40 lbs (18 kg)
Crane	Hydraulic Oil	317 gal (1,200 L)

Appropriate safety systems will be included on the OSSs, including fire alarm and fire suppression systems, first aid and lifesaving equipment, emergency power supply, and lightning protection. The OSSs will not be manned; however, once functional, the OSSs will be subject to periodic O&M. Access to the OSSs will be provided from a boat landing or alternative means of safe access (e.g., Get Up Safe), and potentially a helideck. The boat landing located at the OSS substructure provides access to the cable deck via a staircase and an intruder cage, to prevent unauthorized access to the OSSs. In case of emergency on the OSS, the platform can be abandoned by means of life rafts. There will be an emergency room on the platform to house O&M staff in case of inclement weather.

The OSSs will be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. The lights will be equipped with back-up battery power, as well as an emergency power supply, to maintain operation should a power outage occur on an OSS.

3.3.5.2 Construction

The typical sequence for OSS installation is summarized in Table 3.3.5-3. It is anticipated that installation and commissioning of the OSSs will occur within an approximate 8-month window (see Section 3.2), not including cable pull-in. Seabed disturbance associated with installation of the OSSs is accounted for in Table 3.3.6-2, which summarizes disturbances associated with foundations.

Table 3.3.5-3 Typical OSS Construction Sequence

Activity/Action	Construction Details
Foundation Delivery and Installation	The OSS will be supported by either monopile or piled jacket foundations. The foundation delivery and installation process is described in Table 3.3-12 and Table 3.3-13 for these two foundations types.
Topside Installation	The topside platform, including the transformer module and switchgear, will be assembled as a single unit prior to being transported to the Lease Area via a heavy transport vessel or barge. This expedites the lift of the module onto the foundation. The lift will commence using a suitable installation vessel and the topside platform will be lowered onto the pre-installed foundation. The topside is then secured into position by use of grouted, bolted, or welded connection. This step will occur following installation of the OSS foundation.
Commissioning	Once the OSS topside is secured to the foundation, the RWEC, OSS-Link Cable, and IAC will be connected. Communication systems will be set-up with the shore, as well as lighting, fire-fighting system, etc. Once all systems are enabled, the electrical systems will be commissioned using back-feed (i.e., electricity is fed to the OSS from the onshore grid via the export cables). When completed, the OSS is operational.

3.3.6 OSS-Link Cable

The two OSSs will be connected by an up to 9-mi (15-km)-long 275 kV HVAC OSS-Link Cable. Design and construction of the OSS-Link Cable will generally be the same as outlined for the RWEC (see Section 3.3.3). The maximum design scenario for the OSS-Link Cable and maximum seabed disturbances are provided in Table 3.3-18 and Table 3.3-19, respectively, below.

Installation of the OSS-Link Cable will require similar methods described for offshore construction of the RWEC (see Section 3.3.3.2). Burial of the OSS-Link Cable will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the OSS-Link Cable will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. Refer to Appendix F for a Preliminary Cable Burial Feasibility Assessment, which provides an initial assessment of cable burial based on available geotechnical and geophysical data.

Revolution Wind assumes up to 10 percent of the OSS-Link Cable route will require secondary cable protection in areas where burial cannot occur, sufficient burial depth cannot be achieved due to seabed conditions or to avoid risk of interaction with external hazards. Based on a review of site-specific geophysical data, Revolution Wind further assumes up to 60 percent and up to 10 percent of the total OSS-Link Cable route will require boulder clearance and sandwave leveling and/or dredging, respectively, prior to installation of the cables. The location of the OSS-Link Cable and associated cable protection will be provided to NOAA’s Office of Coast Survey after installation is completed so that they may be marked on nautical charts. The duration for installation of the OSS-Link Cable is included in the approximate 8-month window for OSS installation and commissioning (see Section 3.2).

Table 3.3.6-1 OSS-Link Cable Maximum Design Scenario

OSS-Link Cable Characteristic	Maximum Design Scenario
Number of Cables	1
Voltage	275 kV
Cable Diameter	11.8 in (300 mm)
Target Burial Depth (below seabed)	4 to 6 ft (1.2 to 1.8 m)[1]
Maximum Disturbance Depth	10 ft (3 m)
Disturbance Corridor (Total Width)[2]	up to 131 ft (40 m)

1 Burial of the OSS-Link Cable will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the OSS-Link Cable will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
2 The disturbance corridor reflects the maximum area that will be subject to seafloor preparation prior to cable installation.

Table 3.3.6-2 Maximum Seabed Disturbance for OSS-Link Cable Installation[1]

OSS-Link Cable Disturbance	Construction Footprint	Operation Footprint
General Disturbance Corridor[2]	148.3 ac (60.0 ha)	-
Boulder Clearance (60% of total length)	85.7 ac (34.7 ha)	-
Sandwave Leveling/Dredging (10% of total length)[3]	14.3 ac (5.8 ha)	-
Secondary Cable Protection (10% of total length)	-	4.4 ac (1.8 ha)

1 Disturbance estimates presented in this table are not additive as disturbance types may overlap (e.g., cable protection placed in areas where boulders were cleared). Vessel anchoring disturbances are not included; if anchoring (or a pull ahead anchor) is necessary during cable installation it will occur within a 1,312 ft (400 m) wide corridor centered on cable routes.
2 The general disturbance corridor for the OSS-Link Cable is 131-ft (40-m) -wide. Boulder clearance, sandwave leveling, dredging, and secondary cable protection will not extend beyond this corridor. Also, if they are performed along the OSS-link Cable route, boulder clearance and cable lay/burial trials will occur within this general disturbance corridor.
3 Accounts for use of CFE and/or Trailing Suction Hopper Dredger.

3.3.7 Inter-Array Cables

The IAC will carry the electrical current produced by the WTGs to the OSSs. The length of the entire network of IAC will be up to 155 mi (250 km). The following subsections describe the design and construction of the IAC.

3.3.7.1 Design

The network of 72 kV HVAC IAC will be comprised of a series of cable “strings” that interconnect a small grouping of WTGs to the OSSs. The IAC will consist of three bundled copper or aluminum conductor cores surrounded by layers of XPLE insulation and various protective armoring and sheathing to protect the cable from external damage and keep it watertight. A fiber optic cable will also be included in the interstitial space between the three conductors and will be used to transmit data from each of the WTGs to the SCADA system for continuous monitoring of the IAC. Table 3.3.7-1 provides a summary of the IAC maximum design scenario.

Table 3.3.7-1 IAC Maximum Design Scenario

IAC Characteristic	Maximum Design Scenario
Voltage	72 kV
Cable Diameter	8 in (200 mm)
Target Burial Depth (below seabed)	4 to 6 ft (1.2 to 1.8 m)[1]
Maximum Disturbance Depth	10 ft (3 m)
Maximum Total Length[2]	155 mi (250 km)
Disturbance Corridor (Total Width)[3]	up to 131 ft (40 m)

1 Burial of the IAC will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the IAC will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
2 Maximum combined total of all cable strings.
3 The disturbance corridor reflects the maximum area that will be subject to seafloor preparation prior to cable installation.

3.3.7.2 Construction

The IAC will be installed within a 131-ft (40-m) -wide corridor. Burial of the IAC will typically target a depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth for the IAC will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. Refer to Appendix F for a Preliminary Cable Burial Feasibility Assessment, which provides an initial assessment of cable burial based on available geotechnical and geophysical data.

Installation of the IAC will follow a similar sequence as described for the RWEC in Table 3.3.5-3, with two exceptions:

- After pre-lay cable surveys and seabed preparation activities are completed, a cable-laying vessel will be pre-loaded with the IAC. Prior to the first end-pull, the cable will be fitted with a Cable Protection System (CPS)[11] and the cable will be pulled into the WTG or OSS. The vessel will then move towards the second WTG (or OSS). Cable laying and burial may occur simultaneously using a lay and bury tool, or the cable may be laid on the seabed and then trenched post-lay. Alternatively, a trench may be pre-cut prior to cable installation. The pull and lay operation, inclusive of fitting the

11 The CPS protects and supports the segment of the cable in the section between the foundation and the seabed. The end of the CPS is typically buried using the cable burial tool.

cable with a CPS, is then repeated for the remaining IAC lengths, connecting the WTGs and OSSs together.

- The IAC will typically not require in-field joints; thus, "Joint Construction," as described for the RWEC, will generally not be required. However, joints may be required in case of a cable repair.

Installation methods for the IAC will be similar to those described for the offshore portion of the RWEC (see Section 3.3.3.2). As described for offshore construction of the RWEC, seabed preparation (specifically boulder clearance and sandwave leveling) will be required; boulder clearance trials, as previously described for the RWEC, may also be implemented prior to wide-scale seabed preparation activities.

Like the RWEC, the IAC will pass through areas of boulder fields linked to the geology (namely Pleistocene glacial till/moraine close to the surface). Based on a review of site-specific geophysical data, it is assumed that a boulder plow may be used in all areas of higher boulder concentrations, conservatively estimated at up to 80 percent of the entire IAC network. Both within these areas of higher boulder concentrations and outside of these areas, a boulder grab may be used to remove larger and/or isolated targets. It is further assumed that up to 10 percent of the total IAC network will require sandwave leveling and/or dredging to facilitate cable installation. Each array cable will typically take 1 day to lay and bury. It is anticipated that installation of the complete IAC system will be completed within approximately 5 months (see Section 3.2).

Cable protection strategies will be required for the IAC. Revolution Wind assumes up to 10 percent of the entire IAC network may require secondary cable in areas where burial cannot occur, sufficient burial depth cannot be achieved due to seabed conditions or to avoid risk of interaction with external hazards. Also, as noted in Section 3.3.3.2 (see *Cable Crossings* subsection), there may be crossings of the Project's RWEC and IAC that will require cable protection. As previously described, rock berm or concrete mattress separation layers will be installed over the previously installed cable prior to installing a crossing cable, while the rock berm or concrete mattress cover layers will be installed after cable installation. The location of the IAC and associated cable protection will be provided to NOAA's Office of Coast Survey after installation is completed so that they may be marked on nautical charts.

Maximum seabed disturbance associated with construction and operation of the IAC is summarized in Table 3.3.7-2. The final installation methods and target burial depths will be determined by the final engineering design process, informed by detailed geotechnical data, discussion with the chosen installation contractor, and coordination with regulatory agencies and stakeholders. Detailed information on the final technique(s) selected will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

Table 3.3.7-2 Maximum Seabed Disturbance for IAC Installation[1]

IAC Disturbance	Construction Footprint	Operation Footprint
General Disturbance Corridor[2]	2,471 ac (1,000 ha)	-
Boulder Clearance (80% of total length)	1,969 ac (797 ha)	-
Sandwave Leveling/Dredging (10% of total length)[3]	246.1 ac (100 ha)	-
Secondary Cable Protection (10% of total length)	-	74.1 ac (30.0 ha)

1 Disturbance estimates presented in this table are not additive as disturbance types may overlap (e.g., cable protection placed in areas where boulders were cleared). Vessel anchoring disturbances are not included; if anchoring (or a pull ahead anchor) is necessary during cable installation it will occur within a 1,312 ft (400 m) wide corridor centered on cable routes.
2 The general disturbance corridor for the IAC is 131-ft (40-m) -wide. Boulder clearance, sandwave leveling, dredging, and secondary cable protection will not extend beyond this corridor. Also, if they are performed along the IAC, boulder clearance and cable lay/burial trials will occur within this general disturbance corridor.
3 Accounts for use of CFE and/or Trailing Suction Hopper Dredger

3.3.8 WTGs

The Project will consist of up to 100 WTGs, sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing (see Section 3.3.4 and Figure 2.2.1-1). As previously noted, a final layout of the Project will be provided as part of the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction. Design and installation of the WTGs are described further in the following subsections.

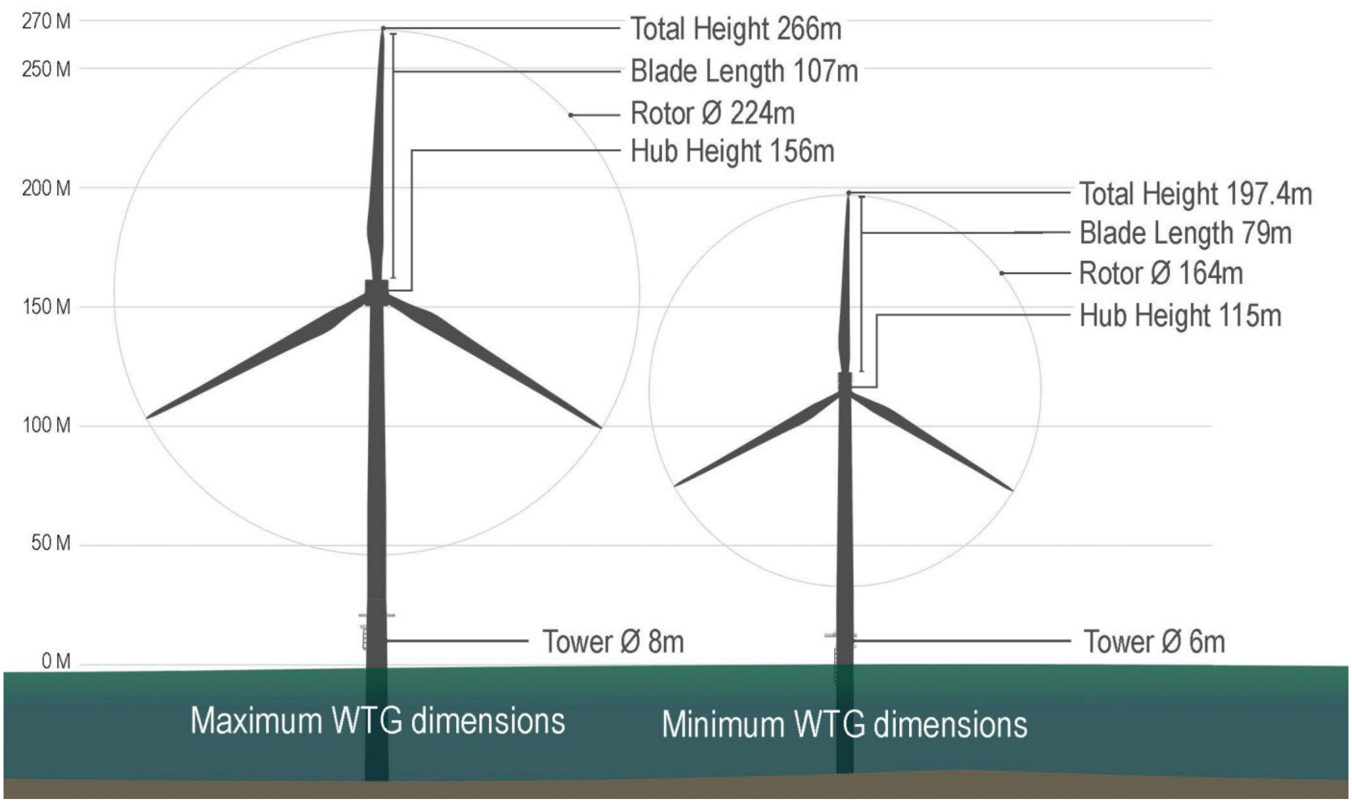
3.3.8.1 Design

Revolution Wind requires flexibility in WTG choice to anticipate advancements in the available WTG technology. Revolution Wind will select the WTG model that is best suited for the Project and that is commercially available to support the Project schedule. The selected WTG model and nameplate capacity will ultimately determine the number of WTGs. WTGs being considered range in nameplate capacity between 8 MW and 12 MW.

While a range of WTG models from various suppliers may be considered, all WTGs for the Project are expected to follow the traditional offshore WTG design with three blades and a horizontal rotor axis. Specifically, the blades will be connected to a central hub, forming a rotor which turns a shaft connected to the generator or gearbox (if required). The generator and gearbox (if applicable[12]) will be located within a containing structure known as the nacelle situated adjacent to the rotor hub. The nacelle will be supported by a tower structure affixed to the foundation. The nacelle will be able to rotate or "yaw" on the vertical axis in order to face the oncoming wind direction. Figure 3.3.8-1 shows a conceptual rendering of the WTGs with the maximum and minimum representative dimensions provided.

12 Note, some WTG models do not have a gearbox.

Figure 3.3.8-1 Conceptual Rendering of the Minimum and Maximum WTGs under Consideration



In support of the development of the Project, Revolution Wind is evaluating a range of WTGs sizes. For the purpose of the assessments presented within this COP, the WTG design envelope has been defined by minimum and maximum parameters which are representative of the WTGs currently on the market or expected to become available in time to be used for the Project based on ongoing discussions with suppliers. Table 3.3.8-1 provides a summary of the indicative minimum and maximum physical parameters of the WTG design scenarios under consideration for the Project. The WTGs will be designed following Class I-B specifications of the standards IEC-61400-1/IEC-61400-3. The design is specifically suited for offshore wind sites with referenced wind speeds of 112 miles per hour (mph) (50 meters per second [m/s] over a 10-minute average) and 50-year extreme gusts of 157 mph (70 m/s over a 3-second average) as well as air temperatures greater than -4° F (-20° C) and less than 122° F (50° C). However, standard environmental operating conditions for the proposed WTGs include cut-in wind speeds of 7 to 11 mph (3 to 5 m/s) and cut-out wind speeds of 55-80 mph (25-35 m/s), and air temperatures between -4º F and 104º F (-20º C and +40º C). The WTGs will automatically shut down outside of these operational limits.

Additionally, the WTGs will be type certified according to International Electrotechnical Commission (IEC) standards. The WTGs will comply with EC machinery directive (CE marked). Revolution Wind will seek compliance with American Wind Energy Association (AWEA) Offshore Compliance Recommended

Practices (2012) and future revisions as well as BOEM and BSEE regulations that directly govern operations and in-service inspections for offshore wind facilities in the U.S.

Table 3.3.8-1 WTG Design Envelope Specifications

WTG Characteristic	Minimum	Maximum
Hub Height (from MSL)	377 ft (115 m)	512 ft (156 m)
Turbine Height (from MSL)	646 ft (197 m)	873 ft (266 m)
Air Gap (MSL to the Bottom of the Blade Tip)	93.5 ft (28.5 m)	151 ft (46 m)
Base Height (foundation height – top of TP)	82 ft (25 m)	128 ft (39 m)
Base (tower) Width (at the bottom)	19.7 ft (6 m)	26 ft (8 m)
Base (tower) Width (at the top)	13 ft (4 m)	21 ft (6.4 m)
Nacelle Dimensions (length x width x height)	46 ft x 23 ft x 20 ft (14 m x 7 m x 6 m)	72 ft x 33 ft x 39 ft (22 m x 10 m x 12 m)
Blade Length	259 ft (79 m)	351 ft (107 m)
Maximum Blade Width	16 ft (5 m)	26 ft (8 m)
Rotor Diameter	538 ft (164 m)	722 ft (220 m)
Operation Cut-in Wind Speed	7 to 11 mph (3 to 5 m/s)	
Operational Cut-out Wind Speed	55 to 80 mph (25 to 35 m/s)	

Each of the WTGs will require various oils, fuels, and lubricants to support the operation of the WTGs; SF_6 may also be used for insulation purposes. Table 3.3.8-2 provides a summary of the maximum potential quantities of oils, fuels, lubricants, and SF_6 per WTG. The spill containment strategy for each WTG is comprised of preventive, detective and containment measures. These measures include 100 percent leakage-free joints to prevent leaks at the connectors; high pressure and oil level sensors that can detect both water and oil leakage; and appropriate integrated retention reservoirs capable of containing 110 percent of the volume of potential leakages at each WTG. Additionally, WTG switchgear containing SF_6 will be equipped with integral low-pressure detectors to detect SF_6 gas leakages should they occur.

Table 3.3.8-2 Summary of Maximum Potential Quantities Oils, Fuels, Lubricants, and SF_6 per WTG

WTG System/Component	Oil/Fuel/Lubricant/Gas Type	Maximum Quantity per WTG
WTG Bearings, Yaw, and Pitch Pinions	Grease[1]	343 gal (1,300 L)
Hydraulic Pumping Unit, Hydraulic Pitch Actuators, Hydraulic Pitch Accumulators	Hydraulic Oil	528 gal (2,000 L)
Drive Train Gearbox (if applicable), Yaw/Pitch Drives Gearbox	Gear Oil	582 gal (2,200 L)
Blades and Generator Accumulators	Nitrogen	104 cy (80 m^3)
High-Voltage Transformer	Transformer Silicon/Ester Oil	1,850 gal (7,000 L)
Emergency Generator	Diesel Fuel	793 gal (3,000 L)
Switchgear	SF_6	Up to 13 lb (6 kg)
Tower Damper and Cooling System	Glycol/Oil/Coolants	3,434 gal (13,000 L)

1 Approximately 26 gal to 40 gal (100 L to 150 L) per large bearing

Each WTG will have its own control system to carry out functions like yaw control and ramp down in high wind speeds. Each turbine will also connect to a central SCADA system for control of the wind farm remotely. This allows functions such as remote turbine shutdown if faults occur. The Project will be able to shut down a WTG within two minutes of initiating a shutdown signal. The SCADA system will communicate with the wind farm via fiber optic cable(s), microwave, or satellite links. Individual WTGs can also be controlled manually from within the nacelle or tower base in order to control and/or lock out the WTG during commissioning or maintenance activities. In case of a power outage or during commissioning, the WTG may be powered by a permanent battery back-up power solution with integrated energy harvest from the rotor or by a temporary diesel generator.

The WTGs will also be protected both externally and internally by a lightning protection system. The external lightning protection system is comprised of lightning receptors located within both the nacelle and blade tips which are designed to handle direct lightning strikes and will conduct the lightning's peak current through a conductive cabling system that leads through the tower into the WTG grounding/earthing system. To avoid and/or minimize internal damage from the secondary effects of lightning (e.g., power surges), the internal electrical systems will be protected by equipotential bonding, overvoltage protection, and electromagnetic coordination.

WTGs may be accessed either from a vessel via a boat landing or alternative means of safe access (e.g., Get Up Safe). The WTGs will be lit and marked in accordance with FAA and USCG requirements for aviation and navigation obstruction lighting, respectively. The lights will be equipped with back-up battery power to maintain operation should a power outage occur on a WTG. Additional operational safety systems on each WTG include fire suppression, first aid and survival equipment.

The WTGs will each be lit, individually marked, and maintained as private aids to navigation (PATONs) in accordance with the guidance provided in the Aids to Navigation Manual (USCG 2015) and will also comply with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA 2013) and recently proposed BOEM guidance on marking and lighting of offshore wind farms (84 FR 57471).

Additionally, Revolution Wind will also light and mark all WTGs in accordance with FAA Advisory Circular 70/7460-1L (2018), as recommended by BOEM's recently proposed guidance on marking and lighting of offshore wind farms (84 FR 57471).

Finally, the Project is evaluating the implementation of methods to limit the visual impact of the aviation light, for example light dimming or the use of a radar-based Aircraft Detection Lighting System (ADLS) to turn on, and off, the aviation obstruction lights in response to detection of aircraft in proximity to the RWF. Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval.

3.3.8.2 Construction

The typical sequence for WTG installation is summarized in Table 3.3.8-3.

Table 3.3.8-3 Typical WTG Construction Sequence

Activity/Action	Construction Details
Transport	WTG components will be transported to the laydown construction port to prepare components for loading and installation. Activities include pre-assembling tower sections, as well as preparing the nacelles, blades, and equipment necessary for WTG installation. The WTGs are anticipated to be transported to the Lease Area by either an installation vessel or feeder vessel.
WTG Towers	Once positioned, the installation vessel will install the tower either as a single lift if pre-assembled, or in multiple lifts for separate sections. The tower is then bolted to the foundation.
WTG Nacelle	Installation vessel then installs nacelle on top of the tower and secures it with bolts.
WTG Blades	Blades are installed either as a pre-assembled full rotor or in single lifts.
Commissioning	Once the WTG installation is complete the installation vessel will move on to the next installation location. Commissioning of the turbine will be executed by commissioning technicians working from separate commissioning vessels.

It is currently estimated that the construction of each WTG may take up to 36 hours allowing for vessel positioning and completion of all lifts; however, to allow time for vessel maneuvering between WTG locations as well as weather downtime, the total duration of the installation campaign for the WTGs is expected to be approximately 8 months (see Section 3.2).

Vessel activity during installation of WTGs will occur within a 656 ft (200 m) radius centered on foundations cleared during seabed preparations (see Section 3.3.4.2). Seabed disturbance associated with installation of WTGs will result from jack-up vessel spudcans. Seabed disturbance associated with WTG foundations is summarized in Table 3.3.4-2.

3.3.9 Measurement Buoys

Revolution Wind plans to install a series of monitoring instrumentation to monitor metocean conditions as part of the Project's construction and operation activities. The monitoring instrumentation will consist of wave buoys and bottom-mounted Acoustic Doppler Current Profiler (ADCP) systems. Each of the measurement buoys is described below in further detail.

3.3.9.1 Wave Buoy(s)

Up to two wave buoys will be deployed within the RWF proximate to the WTGs. The wave buoy(s) will collect information about the wave height, period, and direction to be fed to a forecasting system. The number and positions of the wave buoy(s) will be determined at a later date; however, the wave buoy(s) will be located up to a maximum of 1,640 ft (500 m) from a WTG position. The wave buoy(s) will be installed during the construction phase and will remain in the RWF three years past the start of the operations phase. During the operations phase, sensors installed on the wave buoy(s) will support asset management, structural monitoring, and marine transfer operations. Data collected will be stored locally and transmitted via telemetry to a satellite gateway to an onshore server.

The wave buoy(s) may also be equipped with a downward facing current profiler, which measures water velocity and direction through the water column. Generally, wave buoy diameters range from 1.6 to over 5 ft (0.5 to over 1.5 m) and range in weight from 440 to 1,320 lbs (200 to 600 kg). The mooring configuration will be dependent on buoy type, water depth, and environmental considerations, but generally consists of an anchor weight (approximately 11 ft^2 [1 m^2] and 1,765 lbs [800 kg]) and mooring line and are equipped with navigational lighting. The wave buoy(s) would be powered by lead acid and lithium batteries that are charged through solar panels but would operate using only solar power when available. Deployment of the wave buoy(s) would occur from vessels equipped with a crane or A-Frame and winch and would be conducted in accordance with manufacturer specifications by trained personnel.

3.3.9.2 Bottom Mounted Acoustic Doppler Current Profiler

Up to two near-shore floating bottom mounted ADCPs will be deployed during construction in the nearshore area at the cable landfall and along the RWEC route to support cable installation activities. Bottom mounted ADCPs collect current measurements, including direction and velocity through the water column by sending pulses through the water column at varying frequencies. This data may be stored internally and transferred upon equipment recovery, or for real-time monitoring. The data may be transmitted via telemetry to a satellite gateway to an onshore server using a transmission buoy. The number and locations of ADCPs will be determined as the cable route is further defined and in coordination with stakeholders; however, the ADCPs will be sited within the Offshore Envelope (see Figure 2.2-1).

The typical ADCP configuration includes an upward facing ADCP mounted on a seabed frame, a groundline connecting the frame to the ground weight, and a data storage/recovery system. The groundline will be relatively taut, with generally no sweep occurring throughout the tides. The seabed frame has an approximately 11 ft^2 (1 m^2) footprint. It is 1.6 to 3.3 ft (0.5 to 1 m) in height and weighs 220 to 1,100 lbs (100 to 500 kg). The frame may consist of simple tripod designs with gimbal and/or trawl resistant features such as low profile and protected sides. ADCPs are powered by alkaline or lithium batteries.

There are two standard mooring configurations that may be used. One includes a surface marker buoy that can be used for telemetry and navigation and acts as the primary recovery method. If used, the marker buoy may be affixed to the ground weight by chain or rope mooring. The second configuration does not have a surface marker and relies on an acoustic system to release floats, which are attached to the ADCP frame. ADCP deployment will be conducted in accordance with manufacturer specifications by trained personnel. Deployment and recovery of ADCP frames and moorings can generally be conducted on a small workboat or cat equipped with on-deck crane, winch, and bow roller.

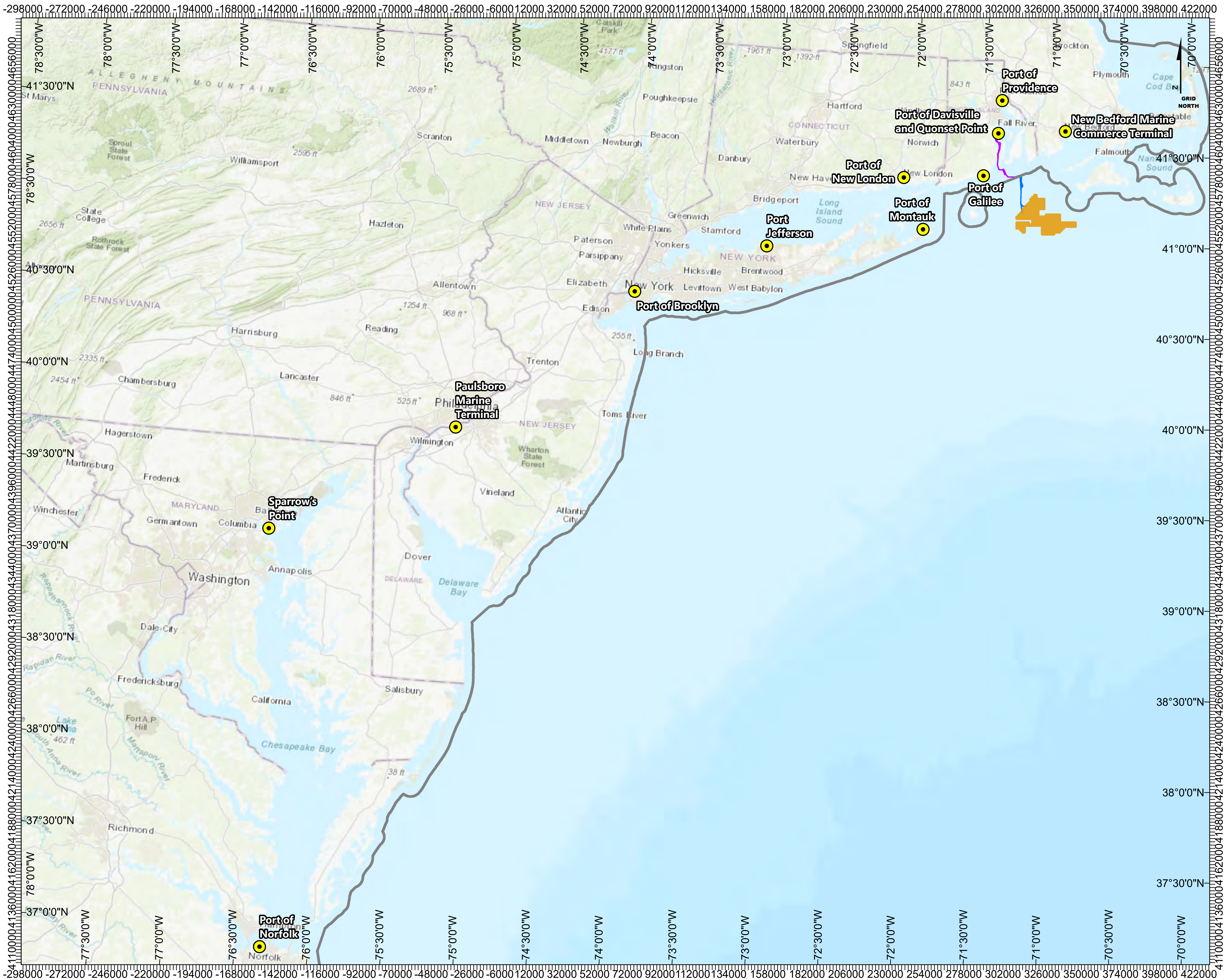
3.3.10 Ports, Vessels and Vehicles, Material Transportation, Chemical and Waste Management, and Construction Work Zones

3.3.10.1 Ports

Revolution Wind is evaluating the use of several existing port facilities located in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland to support offshore construction, assembly and fabrication, crew transfer and logistics (Table 3.3-24 and Figure 3.3-11). At this time no final determination has been made concerning the specific location(s) of these activities, which are limited in scope, temporary in nature, and could take place at various locations. To the extent that upgrades or modifications at an existing port facility may occur, Revolution Wind expects that those upgrades or modifications would serve to support the U.S. offshore wind industry in general. This is especially true as a number of states continue to procure, support, and fund such development. Thus, whether or not upgrades are required, port facilities are expected to serve multiple offshore wind projects and potentially also offshore wind-related and other maritime industries.

Revolution Wind

Figure 3.3.10-1
Location of Potential Port Facilities



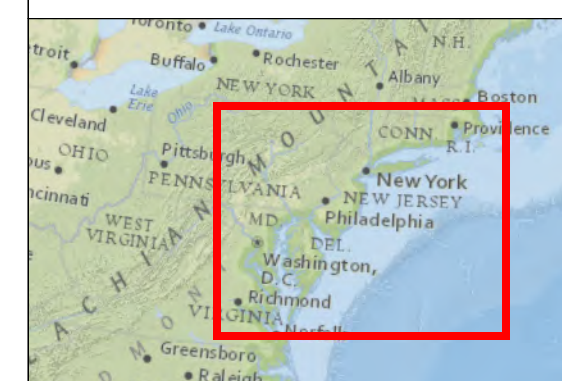
Legend

- Revolution Wind Farm (RWF) Boundary

Offshore Envelope

- RWEC-OCS Envelope
- RWEC-RI State Waters Envelope
- Port Facility
- 3-Nautical Mile State Water Boundary

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World Topographic Map: Esri, HERE, Garmin, FAO, USGS, EPA, NPS



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 20000 40000 60000 Meters

0 70,000 140,000 210,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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Table 3.3.10-1 Potential Port Facilities

			Summary of Potential Activities			
State	Port	City/Town, County	WTG Tower, Nacelle, and Blade Storage, Pre-commissioning and Marshalling	Foundation Marshalling and Advanced Foundation Component Fabrication	Construction Hub and/or O&M Activities	Electrical Activities and Support
New York	Port of Montauk	Montauk, Suffolk County			❍	
	Port Jefferson	Port Jefferson Village, Suffolk County			❍	
	Port of Brooklyn	Brooklyn, Kings County			❍	
Rhode Island	Port of Providence	Providence, Providence County	❍	❍		❍
	Port of Davisville and Quonset Point	North Kingstown, Washington County			❍	
	Port of Galilee	Narragansett, Washington County			❍	
Connecticut	Port of New London	New London, New London County	❍			
Virginia	Port of Norfolk	Norfolk, Norfolk County	❍			
Massachusetts	New Bedford Marine Commerce Terminal	New Bedford, Bristol County	❍			
Maryland	Sparrow's Point	Sparrow's Point, Baltimore County		❍		

			Summary of Potential Activities			
State	Port	City/Town, County	WTG Tower, Nacelle, and Blade Storage, Pre-commissioning and Marshalling	Foundation Marshalling and Advanced Foundation Component Fabrication	Construction Hub and/or O&M Activities	Electrical Activities and Support
New Jersey	Paulsboro Marine Terminal	Paulsboro, Gloucester County		❍		

3.3.10.2 Vessels and Vehicles

Construction of the Project will require the support of onshore construction equipment, various vessels, and helicopters (see Table 3.3.10-3 and Table 3.3.10-4). For each vessel type the route plan for the vessel operation area will be developed to meet industry guidelines and best practices in accordance with International Chamber of Shipping guidance. The Project will install operational Automatic Identification Systems (AIS) on all vessels associated with the construction of the Project. AIS will be used to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. All vessels will operate in accordance with applicable rules and regulations for maritime operation within U.S. and federal waters. Similarly, all aviation operation, including flying routes and altitude, will be aligned with relevant stakeholders (e.g., the FAA). Additionally, the Project will adhere to vessel speed restrictions as appropriate in accordance with NOAA requirements.

Project vessels will employ a variety of anchoring systems, which include a range of size, weight, mooring systems, and penetration depth. While DP vessels will generally be used for cable laying, vessels may anchor within a 1,312-ft (400-m)-wide corridor centered on cable routes. Anchors associated with cable laying vessels will have a maximum penetration depth of 15 ft (4.6 m). Jack-up vessels for foundation and WTG installation will include up to four spudcans with a maximum penetration depth of 52 ft (16 m). Jack up will occur within the 656 ft (200 m) radius cleared around foundation locations during seabed preparation activities.

3.3.10.3 Material Transportation

Large Project components, including the WTGs, the foundations, OSSs, and Export Cables, may be transported to an existing port for pre-assembly or storage prior to being delivered to the RWF, or they may be delivered directly to the RWF from offsite fabrication and manufacturing facilities located in North America, Europe, and/or Asia. Some large Project components, as well as secondary equipment, supplies and crew, will be transported to and from the RWF from existing ports. Helicopters may be used for crew changes during installation of the WTGs.

3.3.10.4 Chemical and Waste Management

During construction, all chemicals will be brought to site aboard vessels and be transported in manufacturer’s original packaging or in National Transportation Safety Council (NTSC) approved tote containers. It is anticipated that any chemicals to be stored on site will be integral with associated equipment and will not be transported independently from this equipment.

During construction, chemicals transfers may take place daily depending on operational requirements of the various contractors. Chemical transfers will be executed in accordance with industry best practices considering health, safety, and environment, and will be in compliance with local, state, and federal regulations. Chemical transfer volumes will be determined by operational requirements of the various contractors, and will be in compliance with all local, state, and federal regulations.

Any chemicals to be treated or disposed of will be transported to typical onshore waste receiving sites within the area that conform to safe and environmentally friendly methods in accordance with local, state, and federal regulations. Summaries of maximum quantities of anticipated chemicals are presented in Table 3.3.10-2, and 3.5.7-1. Revolution Wind will also implement an ERP/OSRP (Appendix D).

Revolution Wind will meet applicable regulations and standards, as set by the International Maritime Organization's (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL), the USCG, and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project. Solid and liquid waste volumes for the Project will be updated for the FDR/FIR.

Table 3.3.10-2 provides the amounts of solid and liquid wastes generated by vessel activity during the construction, and disposal and treatment methods. All vessels will comply with USCG standards in U.S. territorial waters to legally discharge uncontaminated ballast and bilge water, and standards regarding ballast water management. Outside of U.S. territorial waters, vessels will be compliant with the IMO Ballast Water Management Convention standards.

Table 3.3.10-2 Anticipated Solid and Liquid Wastes Generated During Offshore Construction

Source	Construction cubic yd (m3)	Method of Disposal
Oily bilge water	3,734 (2,855)	Stored onboard and delivered to a port reception facility or treated onboard with an oil water separator
Oily residues (sludge)	663 (507)	Stored onboard and delivered to a port reception facility
Sewage	6,667 (5,097)	Treated onboard with a USCG-certified Marine Sanitation Device and discharged overboard or delivered to a port reception facility
Plastics	4,000 (3,058)	Stored onboard and delivered to a port reception facility
Food wastes	667 (510)	Stored onboard and delivered to a port reception facility or discharged overboard in accordance with US regulations
Domestic wastes	667 (510)	Stored onboard and delivered to a port reception facility

Source	Construction cubic yd (m3)	Method of Disposal
Cooking oil	123 (94)	Stored onboard and delivered to a port reception facility
Operational wastes	3,309 (2,530)	Stored onboard and delivered to a port reception facility

Revolution Wind will meet applicable regulations and standards, as set by the International Maritime Organization's (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL), the United States Coast Guard (USCG), and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project.

3.3.10.5 Temporary Construction Work Zone

The USCG routinely establishes temporary safety zones to facilitate mariner safety for a variety of waterway activities such as bridge construction, cable laying, wreck removal, etc. Temporary safety zones were established during the construction of the BIWF, including inter-array and export cable installation activities. [13]

Revolution Wind will request, and it is expected the USCG will establish, temporary safety zones around each WTG site and each cable-laying vessel. Specifically, the following will be requested:

- The WTG safety zones would extend to a maximum 500-yd (457-m) radius and would be enforceable only while construction vessel is on-scene and engaged in construction activity.
- For cable-laying vessels, moving safety zones of up to 500-yd (457-m) total centered on each vessel as it progresses along the cable route would be established.

Revolution Wind will implement a communication plan during construction to inform mariners of construction activities, vessel movements, and how construction activities may affect the area. Communication will be facilitated through maintaining a Project website, the Fisheries Liaison Officer (FLO), submitting local notices to mariners and vessel float plans, and coordinating with the USCG.

13 81 Federal Register 31862. https://www.federalregister.gov/documents/2016/05/20/2016-11826/safety-zone-block-island-wind-farm-rhode-island-sound-ri.

Table 3.3.10-3 Summary of Vessels and Helicopters for Offshore Construction

Vessel Type	# of Vessels	Foundations	OSS	RWEC	IAC	OSS-Link Cable	WTGs
Jack-Up Installation Vessel	1-2	X					X
Jack-up Feeder/Supply Vessel	5-9	X					X
Crew Transfer Vessel (CTV)	6-8	X	X	X	X	X	X
Material Barge	3-6	X					
Feeder Barge	3-6	X					X
Tow Tug	2-6	X					X
Anchor Handling Tug	2-5	X		X		X	
Support Vessel - Inflatable	1-2	X					
Rock Installation Vessel	1	X					
Bunkering Vessel	1	X					
Helicopter	1-2	X					
Foundation Installation Vessel	1		X				
Heavy Transport Vessel	1		X				
Array Installation (CLV)	1				X		
Array Cable Burial	1				X		
Transport Freighter	1			X	X		
SOV	2			X	X	X	X

Vessel Type	# of Vessels	Foundations	OSS	RWEC	IAC	OSS-Link Cable	WTGs
PLGR	1			X	X	X	
Survey Vessel	1			X	X	X	
Cable Lay Vessel (Export)	1			X		X	
Cable Lay Vessel (Barge)	1			X			
Export Burial Vessel	1			X			
Tug (Support Tug)	1			X	X	X	

Table 3.3.10-4 Summary of Onshore Construction Equipment

OnSS			Landfall – HDD Installation		
Equipment Type	**# of Units**	**Fuel Type**	**Equipment Type**	**# of Units**	**Fuel Type**
Large Bulldozer	1	Diesel	Generator/Powerpack (1,305 kW)	1	Diesel
Small Bulldozer	1	Diesel	Crane (205 kW)	1	Diesel
Backhoe	2	Diesel	Dump Truck	1	Diesel
Front End Loader	9	Diesel	Excavator (132 kW)	1	Diesel
Small Crane	1	Diesel	**Onshore Transmission Cable**		
Medium Excavator	9	Diesel	**Equipment Type**	**# of Units**	**Fuel Type**
Compactors	1	Diesel	All-Terrain Forklift	3	Diesel
Concrete Saws	4	Diesel	Large Excavator	8	Diesel
Pumps	19	Diesel	Concrete Vibrator	7	Diesel
AC units	8	Diesel	Generator	5	Diesel
Compressors	2	Diesel	Welder	1	Diesel
Semi-Truck	23	Diesel	**WTG Assembly**		
Refuse Truck	2	Diesel	**Equipment Type**	**# of Units**	**Fuel Type**
Dump Truck	51	Diesel	Crane (641 kw)	3	Diesel
Concrete Truck	42	Diesel	Crane (241 kw)	1	Diesel
Bucket Truck	2	Diesel	Self-Propelled Modular Trailer	2	Diesel
Light Commercial Truck	51	Diesel	Forklift (130 kw)	2	Diesel
Passenger Truck	68	Gasoline	Forklift (60 kw)	1	Diesel
			Cherry Picker	2	Diesel
			Reach Stacker	2	Diesel
			Generator	2	Diesel
			Blade Movers	2	Diesel
			Site Vehicles	3	Diesel

3.4 Commissioning

Commissioning of the Project involves testing of Project components both onshore and offshore to meet standards for safety and grid interconnection reliability. Certain activities to support commissioning of offshore Project components are completed onshore prior to transit to the Lease Area. Commissioning of offshore Project components will require technicians to travel to each WTG and OSS to perform certain activities; it is expected that technicians will travel via CTVs, SOV, and/or helicopters. Commissioning of the various Project components is accounted for in the construction durations summarized in Section 3.2.

3.4.1 Onshore Substation

Commissioning of the OnSS and ICF will include Site Acceptance Testing and Site Integration Testing. To verify the high-voltage system of the OnSS, the system will be energized using the TNEC source line G-185S and L-190 and tested to confirm that all high-voltage apparatus, switching philosophy, protection, and metering apparatus associated with high-voltage equipment operate as per the design. Each system on the OnSS and ICF will be integrated, displayed, and controlled using a SCADA Control System at the TNEC control center.

3.4.2 Offshore Substation

The commissioning of the OSS will be at a high level of completion during the onshore construction period and will be verified prior to transport to the Lease Area. The onshore commissioning campaign will include Site Acceptance Testing and Site Integration Testing. The OSS will be energized using an external energy source and tested to confirm that all high-voltage apparatus, switching philosophy and interlocking associated with high-voltage equipment operate as per the design.

Once installed offshore, commissioning includes initial startup of the OSS and a final Offshore Site Acceptance Test of each individual system. Each system on the OSS will be integrated, displayed, and controlled using a SCADA Control System. At this point, the OSS auxiliary equipment will be operational and ready for energization. If it is not possible to energize directly after installation (e.g., due to lack of grid, defective component or vessel requirements, and/or to allow the vessel to meet certain weather windows), the use of diesel generators may be required to commence with initial commissioning activities.

Once the OSS is commissioned, it is ready to be connected to the grid network via the RWEC. This step is normally initiated immediately following the installation of the OSS.

3.4.3 WTG

A number of quality control and WTG commissioning activities will be completed onshore prior to transporting WTGs to the Lease Area. Upon successful completion of WTG installation and energization, offshore commissioning works will begin. If it is not possible to energize directly after installation (e.g., due to lack of grid, defective component or vessel requirements, and/or to allow the vessel to meet certain weather windows), then the WTG may be powered by either a permanent integrated battery back-up power solution or by use of temporary diesel generators to keep the WTG in a safe and dry condition (by operating the dehumidifiers in tower and nacelle) and to commence with initial commissioning activities. Final commissioning includes several system functionality and verification tests.

3.5 Operations and Maintenance

Per the Lease, the operations term of the Project is 25 years but could be extended to 30 or 35 years. The operations term will commence on the date of COP approval. To support O&M, the Project will be controlled 24/7 via a remote surveillance system (i.e., SCADA).

The O&M Plan for both the Project's onshore and offshore infrastructure will be finalized as a component of the FDR/FIR review process; however, a preliminary O&M plan for the onshore facilities, foundations, offshore transmission assets, and WTGs is provided in the following sections. As noted previously, various existing ports are under consideration to support offshore construction, assembly and fabrication, crew transfer and logistics (including for O&M activities) (see Section 3.3.9.1 and Table 3.3-24).

3.5.1 Onshore Facilities

Revolution Wind will monitor the OnSS remotely on a continuous basis. The ICF will be managed and operated by TNEC. The equipment in the OnSS will be configured with systems (SCADA) that will alarm upon detecting equipment problems, unintended shutdowns, or other issues. In addition, the OnSS will be inspected at periodic intervals, in accordance with manufacturer recommendations. Revolution Wind will put in place an established and documented program for the maintenance of all equipment critical to reliable operation.

In addition, a reliability maintenance program will be implemented. Preventive maintenance will be performed on the OnSS, ICF, and line equipment, and planned outages will be conducted in accordance with the North American Electric Reliability Corporation (NERC)/ Northeast Power Coordinating Council, Inc. (NPCC) Standard-TOP-003-1, and protective system maintenance will be performed in accordance with the NPCC PRC 005-2 standard. Equipment will be maintained in accordance with National Grid standards; maintenance will be completed by qualified personnel in accordance with applicable industry standards and good utility practice to provide maximum operating performance and reliability.

Vegetation management will occur on the OnSS and the ICF parcels. The Landfall Work Area and Onshore Transmission Cable will not require vegetative management and will be fully restored once construction is complete. The OnSS will have a 30-foot-wide perimeter around the fence line that will be maintained, the Interconnection ROW will have a 40-foot maintained ROW, the ICF will have a 10-foot wide perimeter around the fence line that will be maintained, and the TNEC ROW will have 120-foot-wide maintained ROW.

Per Eversource's Specifications for Rights-of-Way Vegetation Management, vegetation management on the OnSS and Interconnection ROW will be managed to promote a low-growing plant community dominated by grasses, flowers, ferns, and herbaceous plants. All woody vegetation including trees and shrubs will be removed and discouraged from becoming established by on-going IVM maintenance, including manual cutting, mowing and the prescriptive use of herbicides plus the use of environmental controls. The method of control is determined following inspections of the site scheduled for maintenance. The current maintenance cycle for vegetation control utilizing IVM practices is three or four years depending on the vegetation composition, facilities and site conditions. The cycle is based on the average growth rates of targeted species following maintenance. If vegetation is so thick or tall that they interfere with testing or maintenance, a narrow path directly over the conduit can be mowed. The allowed mature plant height may be modified, up to 15 ft (4.6 m) in height at maturity by species, to accommodate established herbaceous or woody plant communities that not only protect the electric facility and reduce long-term maintenance, but also enhance wildlife habitat, forest ecology and aesthetic values.

Per TNEC vegetation management requirements, vegetation control of the ICF and the TNEC ROW will be managed through integrated procedures combining removal of danger trees, hand cutting, targeted herbicide use, mowing, selective trimming, and side trimming. These procedures involve the cyclical management of vegetation along the active transmission line ROW. The vegetation maintenance cycle follows a five-year timeline and encourages the growth of low-growing shrubs and other vegetation which provide a degree of natural vegetation control. This vegetation management is necessary to allowing for the proper clearance between vegetation and electrical conductors.

Methods for tree removal involve the use of manual climbing crews, skidder bucket equipment, aerial saws and tree harvesting machines. The location of the work, type of work and the degree or amount of work dictates the type of crew and equipment to be employed.

3.5.2 Offshore Transmission Facilities

Pursuant to 30 CFR § 585.200(b), Revolution Wind has the right to one or more easements, without further competition, as necessary for the full utilization of the lease, and under applicable regulations in 30 CFR § 585. Revolution Wind anticipates requesting an operational ROW easement up to 1,640 ft (500 m) in width (centered on each RWEC) to support necessary O&M activities, particularly should a fault or failure occur.

A summary of offshore transmission facility (e.g., the RWEC, IAC, OSS Interconnection Cable, and OSS electrical components) routine maintenance activities and the indicative frequency at which they may occur is provided in Table 3.5.2-1. Routine maintenance requirements (including frequencies) referenced in this table are used to support analyses in this COP and are subject to change based on final design specifications and manufacturer requirements. Detailed information regarding maintenance and required frequencies will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

Table 3.5.2-1 Routine Maintenance Activities for Offshore Transmission Assets

Maintenance/Survey Activity	Indicative Frequency per OSS
Routine service of electrical components	20 per year
Electrical inspections	2 per year
Scheduled maintenance of OSS components	Annual
Seabed survey (i.e., bathymetry, cable burial depth, cable protection)	Immediately following installation, then 1 year after commissioning, 2 to 3 years after commissioning, and 5 to 8 years after commissioning
Minor corrective and preventative maintenance of OSS equipment	5 per year
Major corrective and preventative maintenance of OSS equipment	2 per lifetime

Revolution Wind will employ a proprietary state-of-the-art asset management system to inspect offshore transmission assets including the OSS (electrical components), RWEC, IAC, and OSS-Link Cable. This system provides a data-driven assessment of the asset condition and allows for prediction and assessment of whether inspections and/or maintenance activities should be accelerated or postponed. This approach allows the Project to maximize O&M efficiencies.

The RWEC, IAC, and OSS-Link Cable typically have no maintenance requirements unless a fault or failure occurs. To evaluate integrity of the assets, Revolution Wind intends to conduct an as-built survey/bathymetry survey along the entirety of the cable routes immediately following installation (scope of installation contractor). Bathymetry surveys will be performed one year after commissioning, two to three years after commissioning, and five to eight years after commissioning. Survey frequency thereafter will depend on the findings of the initial surveys (i.e., site seabed dynamics and soil conditions). A survey may also be conducted after a major storm event (i.e., greater than 10-year event). Surveys of the cables may be conducted in coordination with scour surveys at the foundations.

Should the periodic bathymetry surveys indicate that the cables no longer meet an acceptable burial depth (as determined by the Cable Burial Risk Assessment), the following actions may be taken:

- Alert the necessary regulatory authorities, as appropriate;
- Undertake an updated cable burial risk assessment to establish whether cable is at risk from external threats (i.e., anchors, fishing, dredging);
- Survey monitoring campaign for the specific zone around the shallow buried cable; and
- Assess the risk to cable integrity.

Based on the outcome of these assessments, several options may be undertaken, as feasible, permitted and practical:

- Remedial burial if feasible and practical;

- Secondary protection (rock protection, rock bags or mattresses); and/or
- Increased frequency of bathymetry surveys to assess reburial.

It is possible submarine cables may need to be repaired or replaced due to fault or failure. Also, it is expected that a maximum of 10 percent of the cable protection placed during installation may require replacement/remediation over the lifetime of the Project. These maintenance activities are considered non-routine. If cable repair/replacement or remedial cable protection are required, the Project will obtain necessary approvals. These activities will result in a short-term disturbance of the seabed similar to or less than what is anticipated during construction; these activities will be limited to the disturbance corridors previously defined for construction of the RWEC, OSS-Link Cable, and IAC (see Tables 3.3-7, 3.3-19, and 3.3-21, respectively).

3.5.3 WTG and OSS Foundations

A summary of WTG and OSS foundation maintenance activities and the indicative frequency at which they may occur is provided in Table 3.5.3-1. Maintenance requirements (including frequencies) referenced in this table are used to support analyses in this COP and are subject to change based on final design specifications and manufacturer requirements. Detailed information regarding maintenance and required frequencies will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction.

Table 3.5.3-1 Foundation Maintenance Activities

Maintenance/Survey Activity	Indicative Frequency
Above water inspection & maintenance[1] *Visual inspections for deterioration of coating system, inspection of corrosion, damage within the splash zone, reading of meters, inspection of alarm logs, etc.*	Annual
Seabed Survey *Bathymetry, scour, etc.*	At 1 year after commissioning, 2 to 3 years after commissioning, and 5 to 8 years after commissioning; frequency thereafter will depend on the findings of the initial surveys
Subsea inspection[1] *To detect, measure and record deterioration that affects structural integrity, including inspection of corrosion, minor maintenance activities that can be performed without outage/ reduced power production (yield)*	3 to 5 years or defined based on risk
Major maintenance	Every 8 years
Corrective Maintenance *Coating repair, inspection of corrosion and maintenance, maintenance activities that can be performed without outage/ reduced power production (yield)*	As needed

3.5.4 WTGs

A summary of WTG maintenance activities and the maximum frequency at which they may occur is provided in Table 3.5.4-1. Maintenance requirements (including frequencies) referenced in this table are used to support analyses in this COP and are subject to change based on final design specifications and manufacturer requirements. Detailed information regarding maintenance and required frequencies will be included in the FDR/FIR, to be reviewed by the CVA and submitted to BOEM prior to construction. As discussed in Section 3.3.8, WTGs will be continuously remotely monitored via the SCADA systems from shore.

Table 3.5.4-1 WTG Maintenance Frequency

Maintenance/Survey Activity	Indicative Frequency
Routine Service & Safety Surveys/Checks	Annual
Oil and HV Maintenance	Annual
Visual Blade Inspections (Internal and External)	Annual
Fault Rectification	As needed
Major Replacements	As needed
End of Warranty Inspections	At end of warranty period

Preventative maintenance activities will be planned for periods of low wind and good weather (typically corresponding to the spring and summer seasons), mostly during daylight hours. The WTGs will remain operational at night between work periods of the maintenance crews.

Certain O&M activities may require presence of either a jack-up vessel or anchored barge vessel. These activities will result in a short-term disturbance of the seabed similar to or less than what is anticipated.

3.5.5 Measurement Buoys

The operations phase of the measurement buoys to be deployed in the RWF and along the RWEC is anticipated to be two years during construction and an additional three years into the operations phase for the wave buoy(s), and one year for the ADCPs. At the end of the measurement periods, each of the buoys would be decommissioned and removed.

The buoys are typically fitted with satellite data transmission options for data transmittal and are not expected to require frequent maintenance. The need for servicing the ADCP is primarily based on the battery life of the instrumentation and biofouling of the instrument sensors but is assumed to be between 30 and 90 days. If redeployment is required, servicing can generally be done at sea, with new batteries installed for the instrumentation, biofouling removed, and mooring consumables replaced.

3.5.6 Ports, Vessels and Vehicle Mobilization and Material Transportation

Revolution Wind expects to use a variety of vessels to support O&M, including SOVs with deployable work boats (daughter craft), CTVs, jack-up vessels, and cable laying vessels. A hoist-equipped helicopter may also be used to support O&M. Table 3.5-5 provides a summary of O&M support vessels that are currently being considered to support Project O&M. The type and number of vessels and helicopters will vary over the operational lifetime of the Project. For each vessel type the route plan for the vessel operation area will be developed to meet industry guidelines and best practices in accordance with International Chamber of Shipping guidelines. The Project will install operational AIS on all vessels associated with the operation of the Project. AIS will be used to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. All vessels will operate in accordance with applicable rules and regulations for maritime operation within U.S. and federal waters. Similarly, all aviation operation, including flying routes and altitude, will be aligned with relevant stakeholders (e.g., the FAA). Additionally, the Project will adhere to vessel speed restrictions as appropriate in accordance with NOAA requirements.

The Project is evaluating the use of the Port of Davisville-Quonset Point, Port of Galilee, Port Jefferson, and Port of Montauk to support O&M of the Project (see Table 3.3-24). O&M buildings at/near some or all of these ports will be used for windfarm monitoring and equipment storage for multiple offshore wind projects, including the Revolution Wind Farm, South Fork Wind Farm, and Sunrise Wind Farm, and as such have utility that is independent of the Project. The O&M buildings are briefly summarized below. Note, there are no plans to establish an O&M building at, or otherwise implement improvements to, the Port of Galilee or Port of Brooklyn; use of these ports is assumed to be limited to existing facilities maintained by the ports.

- **Port of Davisville-Quonset Point O&M Building:** As described and evaluated in the South Fork Wind Farm COP (Deepwater Wind South Fork Wind, LLC 2020), a new building with up to 1,000 sq ft (93 sq m) of office space and up to 11,000 sq ft (1,022 sq m) of equipment storage space will be constructed at the Port of Davisville-Quonset Point. This building may serve as an O&M base for multiple offshore wind projects.
- **Research Way O&M Building**: Currently planned to serve as a regional O&M hub and headquarters for Ørsted and multiple offshore wind projects, this is an existing upland building, located approximately 6 mi (9.7 km) from Port Jefferson at 22 Research Way in Setauket-East Setauket, NY, within an office park that also hosts technology companies and healthcare providers (among other businesses). A review of publicly-available records and historic aerial photography indicates that this building was constructed between 1985 and 1992. The building was recently purchased by Northeast Offshore, LLC, and internal upgrades to establish office and warehouse space are planned.

  The contemplated work requires no governmental authorizations other than local building permits and will consist almost entirely of interior renovations to create workspaces. No external expansions or modifications are planned; instead, any work affecting the exterior of the building will be limited to repairs (e.g. broken windows) and will preserve the existing appearance. The only other exterior work being contemplated consists of maintenance of the parking lot and landscaping (which will be limited to the existing design and scope of use), and the potential addition of signage.

The Research Way facility will not be just an O&M facility for a particular project, but rather will be capable of serving multiple projects, as well as general Ørsted and Eversource business needs. The building will be a base for technical, commercial (e.g., contract managers), and warehouse employees, and will also serve as the management headquarters for Orsted's North American operations team. In addition, marine coordination activities for all North East Offshore projects will be conducted from the building.

- **Port of Montauk O&M Building:** As described and evaluated in the South Fork Wind Farm COP (Deepwater Wind South Fork Wind, LLC 2020), a new building with up to 1,000 sq ft (93 sq m) of office space and up to 6,000 sq ft (557 sq m) of equipment storage space will be constructed at the Port of Montauk. This building may serve as an O&M base for multiple offshore wind projects.

During O&M, helicopters will be used to provide supplemental means of access when vessel access is not practical or desirable. Flights are currently restricted to daylight operations when visibility is good. Helicopters will be used for two different purposes to support O&M:

- **Helicopter Hoist Operations**: An integrated helicopter hoist platform located on the roof of each WTG nacelle will provide access for O&M. SOVs and the OSSs may also be fitted with helicopter hoist platforms. The purpose of this effort is primarily for transport/transfer of technical personnel and equipment on to/from the WTGs via hoist to the nacelle but can also be conducted for transport/transfer of personnel and equipment to offshore installations that do not have a helideck. This is the most common means of access in the O&M phase and is typically used to perform minor repairs and restarts.
- **Transport/Transfer Operations**: Transport helicopter operations are flights from an onshore airport/heliport to an offshore installation or vessel with a helideck and back. Transfer helicopter operations are flights within the Wind Farm Area, from an offshore installation or vessel with a helideck to another, and back.

3.5.7 Chemical and Waste Management

During operations, all chemicals will be initial fills and will be handled on site in original manufactures packaging or in NTSC tote containers. With exception of diesel fuel and engine lubricants, all chemicals normally remain on-site for the life of the Project. Because any anticipated chemicals to be stored on site will be integral to equipment packages, it is anticipated that chemical transfers will only take place in the form of equipment installation and/or replacement which will take place only as required throughout the life of the installation. The quantities expected to be transferred are considered minimal. If disposal is required, transfer and transportation would be carried out by a licensed transporter.

Any chemicals to be treated or disposed of will be transported to typical onshore waste receiving sites within the area that conform to safe and environmentally friendly methods in accordance with local, state, and federal regulations. Summaries of maximum quantities of anticipated chemicals are presented in Table 3.3.10-2, and 3.5.7-1. Revolution Wind will also implement an ERP/OSRP (Appendix D).

Revolution Wind will meet applicable regulations and standards, as set by the IMO MARPOL, the USCG, and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project. Solid and liquid waste volumes for the Project will be updated for the FDR/FIR.

Table 3.5.7-1 provides the amounts of solid and liquid wastes generated by vessel activity during one year of operation, and disposal and treatment methods. All vessels will comply with USCG standards in U.S. territorial waters to legally discharge uncontaminated ballast and bilge water, and standards regarding ballast water management. Outside of U.S. territorial waters, vessels will be compliant with the IMO Ballast Water Management Convention standards.

Table 3.5.7-1 Anticipated Solid and Liquid Wastes Generated During One Year of Offshore Operations

Source	One Year of Operation cubic yd (m^3)	Method of Disposal
Oily bilge water	2,792 (2,135)	Stored onboard and delivered to a port reception facility or treated onboard with an oil water separator
Oily residues (sludge)	5,381 (4,114)	Stored onboard and delivered to a port reception facility
Sewage	15,468 (11,826)	Treated onboard with a USCG-certified Marine Sanitation Device and discharged overboard or delivered to a port reception facility
Plastics	9,281 (7,096)	Stored onboard and delivered to a port reception facility
Food wastes	1,547 (1,183)	Stored onboard and delivered to a port reception facility or discharged overboard in accordance with U.S. regulations
Domestic wastes	1,547 (1,183)	Stored onboard and delivered to a port reception facility
Cooking oil	86 (66)	Stored onboard and delivered to a port reception facility
Operational wastes	6,446 (4,928)	Stored onboard and delivered to a port reception facility

Revolution Wind will meet applicable regulations and standards, as set by the International Maritime Organization’s (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL), the United States Coast Guard (USCG), and the State of Rhode Island, for treatment and disposal of solid and liquid wastes generated during all phases of the Project.

Table 3.5.7-2 Summary of O&M Vessels and Helicopters

Activity Type	Vessel Type	Foundations	OSS	RWEC	IAC	OSS-Link Cable	WTGs
Routine (e.g. annual maintenance, troubleshooting, inspections)	Service Operations Vessel	X	X	X	X	X	X
	Daughter Craft	X	X	X	X	X	X
	Crew Transfer Vessel/Surface Effects Ship (SES)	X	X	X	X	X	X
	Helicopter		X				X
Non-Routine (e.g. major components exchange)	Jack-Up Vessel		X				X
	Cable-Lay/Cable Burial Vessel			X	X	X	
	Support Barge		X	X	X	X	X

3.6 Decommissioning

At the end of the Project's operational life, it will be decommissioned in accordance with a detailed Project decommissioning plan that will be developed in compliance with applicable laws, regulations, and BMPs at that time. All facilities will need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Care will be taken to handle waste in a hierarchy that prefers re-use or recycling, and leaves waste disposal as the last option. Absent permission from BOEM, Revolution Wind will complete decommissioning within two years of termination of the Lease.

Revolution Wind will develop a final decommissioning and removal plan for the facility that complies with all relevant permitting requirements. This plan will account for changing circumstances during the operational phase of the Project and will reflect new discoveries particularly in the areas of marine environment, technological change, and any relevant amended legislation.

4.0 Site Characterization and Assessment of Potential Impacts

The site characterization and assessment of potential impacts for the Project is structured in accordance with 30 CFR 585 and the BOEM guidelines on the information requirements for a COP for OCS renewable energy activities on a commercial lease, as required by 30 CFR 585.626(a) and (b). The approach also considers the additional detailed information and certifications, as specified under 30 CFR 585.627, which support BOEM's compliance with NEPA regulations and other applicable laws and regulations.

The approach to site characterization and impact assessment involves the following steps:

- **Identification and Analysis of Impact-producing Factors:** Project activities and infrastructure, as described in Section 3, that could impact resources were identified as impact-producing factors (IPFs). Where Project specifications are not available because final design has not been completed, the Project design envelope was considered to include the range of possible impact-producing activities. IPFs are identified and described in Section 4.1.
- **Characterization of Affected Environment:** The environmental setting of the Project, including the footprint of proposed infrastructure within federal and State Waters of Rhode Island, and onshore within the Town of North Kingstown, Rhode Island, is described for physical, biological, socioeconomic, cultural, and visual resources that have the potential to be impacted by Project activities. The affected environment for each resource includes a regional overview of the resource followed by characterization of the resource relative to the Project Area. The affected environment for each resource is described separately for the RWF, RWEC – OCS, RWEC – RI, and Onshore Facilities; refer to Section 3.0 for definition of these categories.
- **Impact Assessment**: The impact assessment used in this document approximately follows an assessment of significance as discussed in 40 CFR 1508.27. The impact assessment for the Project involves the evaluation of potential overlap of the IPF, in time and space, on the affected environment for each resource, during each Project phase. The type and degree of potential impacts from Project activities vary based on the characteristics of the resource (e.g., presence/absence, conservation status, abundance) and the IPF that may affect each resource. Similar to the description of the affected environment, potential impacts are discussed separately for the RWF, RWEC – OCS, RWEC – RI, and Onshore Facilities.

  Potential impacts are characterized as direct or indirect, short-term or long-term, and whether they result from construction, O&M, and/or decommissioning of the Project. The impact assessments in this COP are based on the following definitions:

- **Direct or Indirect**: Direct effects are those occurring at the same place and time as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity.
- **Short-term or Long-term Impacts:** Short- or long-term impacts do not refer to any defined period. In general, short-term impacts are those that occur only for a limited period or only during the time required for construction activities. Impacts that are short-lived, such as noise from routine maintenance work during operations, may also be short-term if the activity is short in duration and the impact is restricted to a short, defined period. Long-term impacts are those that are likely to occur on a recurring or permanent basis or impacts from which a resource does not recover quickly. In general, direct impacts associated with construction and decommissioning are considered short-term because they will occur within the approximate 1-year construction phase. Indirect impacts are determined to be either short-term or long-term depending on the duration of time required for the resource to recover. Impacts associated with O&M are largely considered long-term because they occur over the life of the Project; however, some O&M activities, such as cable repairs, may have short-term impacts.

Finally, for each resource, if environmental protection measures are proposed to avoid or minimize potential impacts, the impact evaluation included consideration of these environmental protection measures.

The characterization of environmental resources for the Project is limited spatially, as appropriate for the various resources. Sections 4.2, 4.3, 4.4, 4.5, and 4.6 refer to the "Project Area" when characterizing the affected environment for the Project; refer to Table 4.0-1 below for brief definitions for Project Area by resource.

Table 4.0-1 Project Area Definition by Environmental Resource[1]

Resource	Project Area Definition
Physical Resources	
Air Quality	States of Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Virginia; the Counties of New London (Connecticut), Baltimore (Maryland), Bristol (Massachusetts), Gloucester (New Jersey), Kings (New York) Suffolk (New York), Providence (Rhode Island), Washington (Rhode Island), and Norfolk City (Virginia).
Water Quality and Water Resources	Offshore: Offshore Envelope (RWF Envelope, RWEC-OCS Envelope, RWEC-RI State Waters Envelope) Onshore: Onshore Facilities and proximate areas.
Geological Resources	Offshore: Offshore Envelope (RWF Envelope, RWEC-OCS Envelope, RWEC-RI State Waters Envelope) Onshore: Onshore Facilities and proximate areas.
Physical Oceanography and Meteorology	Offshore Envelope (RWF Envelope, RWEC-OCS Envelope, RWEC-RI State Waters Envelope) Onshore Facilities and proximate areas.
Biological Resources	
Coastal Habitat	Onshore Facilities and the areas immediately adjacent that have the potential to be affected by the Project.

Resource	Project Area Definition
Benthic and Shellfish Resources	RWF, RWEC-OCS, and RWEC-RI
Finfish and Essential Fish Habitat (EFH)	RWF, RWEC-OCS, RWEC-RI and an 800-m wide corridor around RWEC centerline used to pull EFH data.
Marine Mammals	Offshore Envelope (RWF Envelope, RWEC-OCS Envelope, RWEC-RI State Waters Envelope) and associated Onshore Facilities.
Sea Turtles	Offshore Envelope (RWF Envelope, RWEC-OCS Envelope, RWEC-RI State Waters Envelope) Onshore Facilities and proximate areas.
Avian Species	Offshore: Project Lease Area, RWEC-OCS Envelope, RWEC-RI State Waters Envelope Onshore: Onshore Facilities
Bat Species	Offshore: Project Lease Area, RWEC-OCS Envelope, RWEC-RI State Waters Envelope Onshore: Onshore Facilities
Cultural Resources	
Above Ground Historic Properties	Area of Potential Effects (APE): portions of the mainland of Connecticut, Rhode Island and Massachusetts, and Long Island, Block Island, Conanicut Island, Prudence Island, Aquidneck Island, the Elizabeth Islands, Martha's Vineyard, Nantucket, and several smaller islands scattered along the coast of Connecticut, Massachusetts and Rhode Island
Marine Archaeological Resources	Offshore Envelope RWF Envelope, RWEC-OCS Envelope, RWEC-RI State Waters Envelope)
Terrestrial Archaeological Resources	Vertical and horizontal extents of potential ground disturbance from construction of Onshore Facilities
Visual Resources	Portions of the counties of New London (Connecticut), Barnstable (Massachusetts), Dukes (Massachusetts), Nantucket (Massachusetts), Plymouth (Massachusetts), Bristol (Massachusetts), Suffolk (New York), Bristol (Rhode Island), Kent (Rhode Island), Newport (Rhode Island), Providence (Rhode Island), and Washington (Rhode Island).
Socioeconomic Resources	
Population, Economy, and Employment	Primary Region of Influence (ROI): States of Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Virginia; the Counties of New London (Connecticut), Baltimore (Maryland), Bristol (Massachusetts), Gloucester (New Jersey), Kings (New York) Suffolk (New York), Providence (Rhode Island), and Washington (Rhode Island); and the City of New London (New London County), Sparrows Point/Edgemere (Baltimore County), New Bedford (Bristol County), Paulsboro (Gloucester County), Montauk (Suffolk County), Port Jefferson (Suffolk County), Port of Brooklyn (Kings County), City of Providence (Providence County), Towns of Narragansett and North Kingstown (Washington County), and City of Norfolk (Virginia). Expanded ROI: States of Connecticut, Massachusetts, New York and Rhode Island; the Counties of New London (Connecticut), Bristol, Dukes, Nantucket,

Resource	Project Area Definition
	Plymouth and Barnstable (Massachusetts), Suffolk (New York), Bristol, Kent, Newport, Providence and Washington (Rhode Island).
Housing and Property Values	Primary and Expanded ROIs
Public Services	Primary ROI
Recreation and Tourism	Primary and Expanded ROIs
Commercial and Recreational Fishing	RWF and a 46-mi (74-km)-long, 6.2-mi (10-km)-wide RWEC fisheries study corridor.
Commercial Shipping	Primary ROI
Coastal Land Use and Infrastructure	Primary ROI
Other Marine Uses	Primary ROI
Environmental Justice	Primary ROI

1 The Project Areas, as defined in this table, are also defined in resource- specific discussions in Sections 4.2, 4.3, 4.4, 4.5, and 4.6.

4.1 Summary of Impact Producing Factors

Applicable IPFs were identified for the Project based on the planned construction, O&M, and decommissioning activities described in Section 3, and are listed below. In this section, each IPF is characterized qualitatively and quantitatively when possible in accordance with the scope of each Project phase and activity.

- Seafloor and Land Disturbance
- Habitat Alteration
- Sediment Suspension and Deposition
- Noise
- Electric and Magnetic Fields (EMF)
- Discharges and Releases
- Trash and Debris
- Traffic
- Air Emissions
- Visible Structures
- Lighting

A summary of IPFs resulting from Project activities by phase is contained in Table 4.1-1. Table 4.1-2 indicates where in this COP the IPFs are specifically evaluated relative to resource topic areas.

Table 4.1-1 Summary of Impact-producing Factors Associated with Project Activities

Project Activities	Seafloor/ Land Disturbance	Habitat Alteration	Sediment Suspension /Deposition	Noise	Electric and Magnetic Fields	Discharges/ Releases	Trash Debris	Traffic	Air Emissions	Visible Structures	Lighting
Construction											
WTG/OSS											
Vessel and Heavy Equipment Use	•	•	•	•		•	•	•	•		•
Seafloor Preparation	•	•	•	•							
Foundation Installation/Placement of Scour Protection/Vessel Anchoring	•	•	•	•						•	
IAC/OSS-Link Cable/RWEC											
Vessel Use	•		•	•		•	•	•	•		•
Seafloor Preparation	•	•	•	•							
Cable Installation/Placement of Cable Protection/Vessel Anchoring	•	•	•	•							
Landfall Work Area											
Vessel and Heavy Equipment/Construction Vehicle Use	•	•	•	•		•	•	•	•		•
Cable/TJB Installation via HDD	•	•	•	•		•	•				•
Onshore Transmission Cable											
Site Preparation (clearing, grading) and Trenching	•	•	•	•		•	•		•		
Heavy Equipment and Construction Vehicle Use	•	•	•	•				•	•		•
OnSS and ICF											
Site Preparation (clearing, grading)	•	•	•	•		•	•		•		•
Substation/ICF Construction	•	•	•	•		•	•		•	•	•
Heavy Equipment and Construction Vehicle Use	•	•	•	•				•	•		•
Operations and Maintenance											
Material and Personnel Transportation											
Vessel Use			•	•		•	•	•	•		•
Helicopter Use				•				•	•		
Vehicle Use	•			•				•	•		•
WTG/OSS Operation (including foundations)	•	•	•	•	•	•				•	•
IAC/OSS-Link Cable/RWEC Operation	•	•	•		•						
Onshore Transmission Cable Operation					•						
OnSS and ICF Operation	•				•	•		•		•	•
Decommissioning											
Vessel Use		•	•	•		•	•	•	•		•
Foundation Removal	•	•	•	•		•	•				
WTG Disassembly		•		•			•				

Project Activities	Seafloor/ Land Disturbance	Habitat Alteration	Sediment Suspension /Deposition	Noise	Electric and Magnetic Fields	Discharges/ Releases	Trash Debris	Traffic	Air Emissions	Visible Structures	Lighting
Offshore Cable Removal	•	•	•	•		•	•	•	•		
Onshore Cable (removed or abandoned in place)	•	•									
OnSS and ICF (repurposing or demolition)	•	•	•							•	•

Table 4.1-2 Summary of the Evaluation of Impact-producing Factors associated with the Project and Affected Physical, Biological, Cultural and Socioeconomic Resources

	Physical Resources				Biological Resources							Cultural Resources				Socioeconomic Resources								
Impact-Producing Factor	Air Quality	Water Quality & Water Resources	Geological Resources	Physical Oceanography & Meteorology	Coastal Habitat	Benthic & Shellfish Resources	Finfish & Essential Fish Habitat	Marine Mammals	Sea Turtles	Avian Species	Bat Species	Above Ground Historic Properties	Marine Archaeological Resources	Terrestrial Archaeological Resources	Visual Resources	Population, Economy, & Employment	Housing & Property Values	Public Services	Recreation & Tourism	Commercial & Recreational Fishing	Commercial Shipping	Coastal Land Use & Infrastructure	Other Marine Uses	Environmental Justice
Impact Evaluation Section Number	4.2.1.2	4.2.2.2	4.2.3.2	4.2.4.2	4.3.1.2	4.3.2.2	4.3.3.2	4.3.4.2	4.3.5.2	4.3.6.2	4.3.7.2	4.4.1.2	4.4.2.2	4.4.3.2	4.5.2	4.6.1.2	4.6.2.2	4.6.3.2	4.6.4.2	4.6.5.2	4.6.6.2	4.6.7.2	4.6.8.2	4.6.9.2
Seafloor and Land Disturbance		•	•	•	•	•	•	•	•	•	•		•	•						•		•		
Habitat Alteration					•	•	•	•	•	•	•									•				
Sediment Suspension and Deposition		•	•	•	•	•	•	•	•	•			•							•				
Noise						•	•	•	•	•	•	•		•		•	•			•		•		•
Electric and Magnetic Fields						•	•	•	•											•				
Discharges and Releases		•			•	•	•	•	•	•										•				
Trash and Debris		•			•	•	•	•	•	•										•				
Traffic							•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•
Air Emissions	•																							
Visible Structures				•				•	•	•	•	•		•	•	•	•		•	•		•	•	•
Lighting							•	•	•	•	•	•		•	•				•			•		

4.1.1 Seafloor and Land Disturbance

Project activities that will result in seafloor and land disturbance are summarized in Table 4.1-1 and described further below. Seafloor and land disturbances are evaluated in several technical studies performed in support of this COP, including the: Hydrodynamic and Sediment Transport Modeling Report (Appendix J); Onshore Biological Assessment (Appendix K); Essential Fish Habitat Assessment (Appendix L); Marine Archaeological Resources Assessment (Appendix M) and; Terrestrial Archaeological Resources Assessment (Appendix N). The Revolution Wind Integrated Geotechnical and Geophysical Site Characterization Study (G&G Report; Appendix O1) characterizes existing seafloor conditions in marine environments within the Offshore Envelope; the G&G Report integrates results summarized in various geophysical and geotechnical data reports, which are also included herein as Appendices O2-O8.

4.1.1.1 Revolution Wind Farm

Construction and Decommissioning

Construction activities in the RWF that will result in seafloor disturbance include seafloor preparation activities and installation of WTG and OSS foundations, the IAC, and OSS-Link Cable. Detailed design parameters for these components were previously described in Section 3 of this COP. Section 3 also includes detailed breakdown of disturbances associated with each Project component; Table 4.1.1-1 below summarizes total anticipated seafloor disturbances for each component. Disturbance associated with seafloor preparation includes activities such as sandwave leveling, dredging, and boulder clearing. Decommissioning will involve removing components in the RWF to a depth of 15 ft (4.6 m) below the mudline. The disturbance associated with decommissioning operations will be similar to those described above for construction, although seafloor preparation will not be needed.

Table 4.1.1-1 Summary of Seafloor Disturbance in the RWF

RWF Component	Long-Term Disturbance[1]	Short-Term Disturbance[2]
WTG Foundations (Monopile)[3]	70.0 ac (28.3 ha)	3,110.0 ac (1,258.6 ha)
OSS Foundations (Monopile or Piled Jacket)[4]	2.0 ac (0.8 ha)	62.2 ac (25.2 ha)
OSS-Link Cable	4.4 ac (1.8 ha)	148.3 ac (60.0 ha)
IAC	74.1 ac (30.0)	2,471.1 ac (1,000 ha)

1 Long-term disturbance estimated in this table includes foundation footprints and associated scour protection, as well as cable protection. It is assumed 10 percent of the OSS-Link Cable and IAC will require cable protection. The physical space occupied by the buried cables is not included in the calculation of long-term seafloor disturbances.
2 Short-term disturbance estimated in this table includes sandwave leveling, dredging, and boulder clearance. Vessel anchoring will also result in short-term seafloor disturbance. Vessel anchoring will occur within a 656 ft (200 m) radius around WTG and OSS foundation locations. Vessel anchoring may also occur within a 1,312 ft (400 m) wide corridor centered on the OSS-Link Cable and IAC. Additional information on vessel anchoring is summarized in Section 3.3.9.2.
3 WTG foundation disturbances based on installation of up to 100 monopile foundations.
4 OSS foundation disturbances based on installation of up to two pile jacket foundations, which represents the maximum level of disturbance.

Seafloor Preparation

Preparation of the seafloor for the RWF foundations and submarine cables will generally involve the clearance of boulders, debris, and other obstructions and leveling of sandwaves in the area adjacent to foundations and cables. A pre-lay grapnel run (PLGR) will also be completed to clear cable routes of possible obstructions (e.g., derelict fishing nets, lobster pots, or rope) prior to installation. Seafloor preparation will occur within a 131-ft (40-m) -wide corridor along submarine cable routes and within a 656-ft (200-m) radius around WTG and OSS foundation locations. Seafloor preparation results in short-term disturbance prior to construction and installation activities. Leveling of sandwaves is considered a short-term disturbance as the bottom currents that construct and maintain these features will continue to act after the cable is embedded. Boulder clearance is also considered a short-term seafloor disturbance. Boulders will be relocated and may be in new physical configurations; however, relatively rapid (< 1 year) recolonization of these boulders is expected (Guarinello and Carey 2020) and will return these boulders to their pre-disturbance function as substrate for sessile fauna.

Foundation Installation

Impact pile driving from jack-up vessels is assumed for installation of WTG and OSS foundations. Impact pile driving will disturb the seafloor at the point of pile penetration and the immediately adjacent area, as will jack-up vessel spud cans. Monopile foundations will be driven to a maximum penetration depth of 164 ft (50 m) while piled jacket foundations (considered for the OSSs only) would be installed to a maximum penetration depth of 210 ft (64 m). Once installed, scour protection will be placed around each foundation. These foundations and certain scour protection will be removed at the end of the Project.

OSS-Link Cable Installation

The 9-mi (15-km) -long OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below the seabed, with a maximum trench depth of 10 ft (3 m) assumed for environmental analysis in this COP. The target burial depth for the OSS-Link Cable will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and the site-specific Cable Burial Risk Assessment. The OSS-Link Cable will be installed within a 131-ft (40-m) -wide disturbance corridor using one or more of the following burial tools, depending on the physical properties of the seafloor and the operating tolerances of the equipment: jet-plow, mechanical plowing, mechanical cutters, CFE, or trailing suction hopper dredger (refer to Section 3.3.6 for more details on equipment and methods). Secondary cable protection will be installed, as needed, in areas where the design burial depth cannot be achieved due to obstructions, mobile sediments, need to avoid risk of interaction with existing hazards, or where cables cross other cables or pipelines. It is anticipated that a maximum of 10 percent of the OSS-Link Cable will require protection. DP vessels will be used for cable installation to the extent feasible; if anchoring is required during cable installation, it will occur within a 1,312-ft (400-m) wide corridor centered on the OSS-Link Cable. Anchors associated with cable laying vessels will have a maximum penetration depth of 15 ft (4.6 m). Boulder clearance, sandwave leveling, and/or dredging within the disturbance corridor may be required prior to installation of the OSS-Link Cable. As discussed above under Seafloor Preparation, sandwave leveling, dredging and boulder clearance are considered short-term seafloor disturbance. Cable protection is considered a long-term seafloor disturbance.

Inter-Array Cable Installation

Up to 155 mi (250 km) of IAC will be installed using the same burial tools noted above for the OSS-Link Cable (refer to Section 3.3.7.2). Also, the same seafloor disturbance parameters noted above for the OSS-Link Cable apply to the IAC (i.e., target burial depth of 4 to 6 ft (1.2 to 1.8 m); maximum trench depth of 10 ft (3 m); and 131-ft (40-m) -wide disturbance corridor). Secondary cable protection will also be installed along the IAC, as needed, in areas where burial cannot occur or where sediment is mobile, areas where external hazards preclude sufficient burial depth, or where cables cross other cables or pipelines. It is anticipated that a maximum of 10 percent of the IAC will require protection. DP vessels will be used for cable installation to the extent feasible; if anchoring is required during cable installation, it will occur within a 1,312-ft (400-m) wide corridor centered on the IAC and will have a maximum penetration depth of 15 ft (4.6 m). Boulder clearance, sandwave leveling, and dredging within the disturbance corridor may be required prior to installation of the IAC. As discussed above, sandwave leveling, dredging, and boulder clearance are considered short-term seafloor disturbances while installation of cable protection is considered a long-term seafloor disturbance.

Operations and Maintenance

Seafloor disturbance during O&M of the RWF may occur during routine maintenance of bottom-founded infrastructure (e.g., foundations, scour protection, cable protection), nonroutine maintenance of the OSS-Link Cable and IAC, and anchoring by maintenance vessels. During O&M, anchoring will be limited to vessels required to be onsite for an extended duration; typically, CTVs are not expected to anchor when visiting the RWF. Seafloor disturbance is not quantified for RWF O&M as it is expected to be infrequent and short-term. Disturbance associated with nonroutine maintenance that may require uncovering and reburial of cables will be similar to those described above for the construction phase, although the extent of disturbance would be limited to specific areas along the cable route being repaired or replaced.

4.1.1.2 Revolution Wind Export Cable

Construction and Decommissioning

During construction of the RWEC-OCS and RWEC-RI, seafloor disturbance activities will be similar to those previously identified for the OSS-Link Cable and IAC. The same seafloor disturbance parameters noted above for the OSS-Link Cable and IAC apply to the RWEC (i.e., target burial depth of 4 to 6 ft [1.2 to 1.8 m]; maximum trench depth of 10 ft [3 m]; and 131-ft [40-m] -wide disturbance corridor). Where the RWEC – RI approaches the landfall area, the cables will either be installed via HDD through the intertidal transition zone to the onshore Landfall Work Area. This section focuses on submarine segments of the RWEC; land disturbance associated with the Landfall Work Area is described in Section 4.1.1.3.

A more detailed description of the design parameters for the RWEC, including the approach landfall area, is contained in Section 3.3.3. Table 3.3-8 includes detailed breakdown of disturbances associated with the RWEC; Table 4.1-4 below summarizes total anticipated seafloor disturbances for each segment of the RWEC. Seafloor disturbance associated with decommissioning of the RWEC will be similar to those described for construction, although seafloor preparation activities such as sandwave leveling, dredging, and boulder clearing will not occur during decommissioning.

Table 4.1.1-2 Summary of Seafloor Disturbance for the RWEC

RWEC Segment	Long-Term Disturbance[1]	Short-Term Disturbance[2]
RWEC – OCS[3]	19.8 ac (8.0 ha)	657.3 ac (266.0 ha)
RWEC – RI[4]	22.0 ac (8.9 ha)	731.4 ac (296.0 ha)
HDD - Offshore Impacts[5]	-	0.25 ac (0.1ha)

1 Long-term disturbance estimated in this table includes cable protection. The physical space occupied by the buried cables is not included in the calculation of long-term seafloor disturbances.
2 Short-term disturbance estimated in this table includes sandwave leveling, dredging, and boulder clearance. Vessel anchoring will also result in short-term seafloor disturbance. Vessel anchoring may occur within a 1,312-ft (400-m) ROW. Additional information on vessel anchoring is summarized in Section 3.3.9.2.
3 The two cables of the RWEC – OCS measure up to 25 mi (40 km) and up to 16.5 mi (26.5 km). Boulder clearance assumed for 40 percent of each cable route; sandwave leveling/dredging assumed for 45 percent of each cable route; and cable protection assumed for 10 percent of for each cable.
4 The two cables of the RWEC – RI each measure 23 mi (37 km). Boulder clearance assumed for 70 percent of each cable route; sandwave leveling/dredging assumed for 7 percent of each cable route; and cable protection assumed for 10 percent for each cable.
5 Two exit pits each measuring 164 ft long x 33 ft wide x 10 ft deep (50 m x 10 m x 3 m) will be excavated to facilitate the HDD operation (one per cable of the RWEC-RI). Note, the onshore work area for the HDD operation will be located within the 3.1-ac (1.3-ha) Landfall Work Area.

Seafloor preparation for and installation of the RWEC – OCS and RWEC – RI will be similar to what is described above for the OSS-Link Cable (see Section 4.1.1.1). Boulder clearance is conservatively estimated at up to 60 percent per cable route of the RWEC (up to 70 percent per cable route in state waters and 40 percent per cable route in federal waters), sandwave leveling/dredging is conservatively estimated at up to 25 percent of each route of the RWEC (up to 7 percent per cable route in state waters and 45 percent per cable route in federal waters). Cable protection is assumed at 10 percent of the entire length for each cable of the RWEC. Refer to Table 4.1.1-2 for estimation of long-term and short-term seafloor disturbance associated with installation of the RWEC – OCS and RWEC – RI.

As noted above, a segment of the RWEC – RI will be installed via HDD through the intertidal transition zone to the onshore Landfall Work Area. The HDD methodology will involve drilling underneath the seabed and the intertidal area using a drilling rig positioned onshore in the Landfall Envelope; the maximum design envelope for the HDD methodology includes excavation of two offshore exit pits (one per cable), each measuring up to 164 ft x 33 ft x 10 ft (50 m x 10 m x 3 m). The HDD exit pits will be at the approximate 13 ft (4 m) water depth contour (see Section 3.3.3.2). A temporary cofferdam may be utilized for HDD operations. Vessels including a shallow draught barge or jack-up vessel will be used to support these operations.

Operations and Maintenance

Seafloor disturbance during O&M of the RWEC will be limited to nonroutine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection and infrequent anchoring of maintenance vessels along the RWEC route. Seafloor disturbance is not quantified for routine RWEC O&M as it is expected to be infrequent and short-term. Disturbance associated with nonroutine maintenance that may require uncovering and reburial of the cables will be similar to those described above for the construction phase, although the extent of disturbance would be limited to specific areas along the RWEC route.

4.1.1.3 Onshore Facilities

Construction and Decommissioning

Land disturbance will result during the Project's construction phase from site clearing, grading, and excavation during site preparation of the Landfall Work Area, installation of the TJBs, installation of the Onshore Transmission Cable, construction of the OnSS, ICF, Interconnection ROW, and TNEC ROW (Table 4.1.1-3). Detailed design parameters for these components are described in Section 3. Further description concerning land disturbance can be found in Section 4.1.3. Onshore Facilities.

Land disturbance associated with decommissioning of Onshore Facilities is anticipated to be similar to those described for construction, although it is possible for the OnSS to be repurposed or Onshore Transmission Cable to be abandoned in place, which would limit land disturbance during decommissioning.

Table 4.1.1-3 Summary of Land Disturbance for Onshore Facilities

Onshore Facility	Long-Term Disturbance[1]	Short-Term Disturbance[2]
Landfall Work Area/TJBs	-	3.1 ac (1.3 ha)
Onshore Transmission Cable	-	3.1 ac (1.3 ha)
OnSS/Interconnection ROW	7.1 ac (2.9 ha)	7.1 ac (2.9 ha)
ICF/ TNEC ROW	4.0 ac (1.6 ha)	4.0 ac (1.6 ha)

1 Long-term disturbance includes operational footprints of onshore Project infrastructure as well as areas maintained for O&M purposes (e.g., vegetation management)
2 Short-term disturbance includes temporary construction work areas that will be restored to pre-existing conditions post-construction.

Landfall Work Area Preparation and Installation of Transition Joint Bays

Site preparation of the Landfall Work Area will require clearing, grading, and hardening to support installation of the RWEC to the TJBs, where the RWEC and Onshore Transmission Cable will be jointed. The Landfall Work Area will be returned to pre-existing conditions after construction is completed.

Excavation for installation of two TJBs (one for each RWEC cable/Onshore Transmission Cable circuit), each measuring up to 67 x 10 x 10 ft (20 x 3 x 3 m), will occur within the Landfall Work Area. The TJBs will be located underground with access maintained via manhole covers; thus, land disturbance associated with the TJBs is considered short-term. After installation is complete only manhole covers will be evident at the land surface.

Onshore Transmission Cable Installation

Land disturbance associated with installation of the Onshore Transmission Cable will be localized to the immediate construction areas and limited to the duration of cable installation activities (i.e., short-term). The Onshore Transmission Cable will be placed in an underground duct bank between the onshore TJB and the OnSS. The duct bank will cross previously developed lands owned by the QDC, with the layouts of public roads and within private properties in the Town of North Kingstown. It is not anticipated that any sensitive resource areas will be encountered along the final route. Excavation, grading and fill along the roadways may require cutting or trimming of vegetation and removal of large rocks from the construction work area to facilitate safe construction. The disturbance corridor associated with installation of the Onshore Transmission Cable is approximately 25-ft (7.6-m) -wide, except at splice vaults where the corridor width will be 30-ft (9.1-m) -wide for an approximate distance (length) of 75 ft (22.8 m). The trench width within this disturbance corridor will be narrower (approximately 8 ft [2.4 m]); maximum trench depth will be 13 ft (4 m), except at the splice vaults where the maximum depth will be 16 ft (5 m). The maximum length of the Onshore Transmission Cable will be 1 mi (1.6 km).

OnSS and Interconnection Facility Construction

Land disturbance associated with construction of the OnSS and ICF will occur on parcels owned by QDC and TNEC. The QDC-owned parcels are highly altered and include buried demolition waste from a former naval airbase, abandoned borrow pits where fill was taken to cover demolition materials and wetlands. Once constructed, the OnSS will occupy a operational footprint totaling approximately 3.8 ac (1.5 ha). The ICF will occupy an operational footprint of 1.6 ac (0.6 ha). In addition, underground interconnection cables will be installed to connect the OnSS to the ICF and overhead interconnection cables will be installed to connect the ICF to the existing TNEC Davisville Substation (see Section 3.3.1.1). The overhead cables will be constructed in a ROW corridor (i.e., TNEC ROW) with a maximum width of 120 ft (36.6 m). Vegetation will be periodically managed in the 120-ft (36.6-m) -wide TNEC ROW during the operational life of the Project. The 40-ft wide underground Interconnection ROW connecting the OnSS to the ICF will also be subject to periodic vegetation management (also see Section 3.5.1).

Foundations will be needed to support the OnSS and ICF equipment and some of the proposed transmission structures. A Project specific geotechnical analysis will be undertaken to develop design for foundations. Based on a preliminary review of publicly available soil and surficial geological data, Revolution Wind is anticipating that foundations for the proposed OnSS and ICF equipment may need to be cast in place concrete foundations supported on driven piles. The proposed control houses and condenser building will be set on cast in place concrete slab foundations constructed on concrete footings. It is anticipated that the transmission structure installation for the TNEC ROW will involve the use of concrete caisson foundations and direct embedding of the structures. Excess soil will be permanently removed and spread in appropriate upland areas within the Project's ROW and seeded and mulched to prevent erosion. Excess soils will be spread at a distance sufficient to prevent transport of the soils into waterbodies. Maximum depth of disturbance associated with the OnSS, ICF, and overhead transmission structures is assumed at 60 ft (18.3 m).

Access roads and driveways will be required to provide access and egress to the OnSS, the ICF, and the new transmission structures. The OnSS will be accessed from Camp Avenue via a 540-ft (164.6-m) -long, 18-ft (5.5-m) -wide compacted gravel driveway leading to the southern side of the OnSS where a gated entrance provides the primary access to the substation and accommodates larger trucks needed for large equipment delivery. A secondary driveway 560-ft (170.7-m) -long will provide a secondary gated access point on the east side of the OnSS for smaller vehicles. Compacted gravel access routes will be constructed within the OnSS yard, providing access to the OnSS equipment, condenser building and control house.

Compacted gravel access routes will be constructed within the OnSS yard, providing access to the OnSS equipment, condenser building and control house. The gated ICF driveway will be approximately 120-ft (36.6-m) -long and 18-ft (5.5-m) -wide. Within the ICF, a paved access route will be constructed that will provide access to the ICF equipment and control house, and access to the existing Davisville Substation. The length of these internal access routes is approximately 900 ft (274.3 m).

In order to access the proposed double and single circuit structures within the new TNEC ROW, a 385-ft (117.3-m) -long gravel access roadway will be constructed.

Operations and Maintenance

Land disturbance during the O&M phase of Onshore Facilities will occur if there is a system failure requiring re-excavation of the ducts housing buried cables. Land disturbance associated with O&M of the Onshore Facilities is not quantified; however, disturbance will be similar to those described above for the construction phase, although the extent of disturbance would be limited to specific areas along the cable routes.

4.1.2 Habitat Alteration

Habitat is defined as the natural home or environment of an animal, plant, or other organism. Habitat alteration is any physical change to areas necessary for breeding and survival of plant and animal species whether terrestrial, aquatic or airborne. Habitat alteration is only associated with biological resources and consequently does not apply as an impact producing factor for physical, cultural or societal resources. The effects of habitat alteration may be negative (e.g., elimination or degradation of habitat) or beneficial (e.g., creation or expansion of habitat).

Biological resources potentially affected by habitat alteration include:

- Coastal Habitat: impacts to specific sensitive species habitat and sensitive ecosystems (see section 4.3.1)
- Benthic/Shellfish Resources: impacts relative to Coastal and Marine Ecological Classification Standard mapping and other sensitive seafloor habitats (see Section 4.3.2)
- Finfish: impacts to habitats utilized by commercially and recreationally significant fisheries including demersal, pelagic, and shark finfish assemblages (see Section 4.3.3)
- Essential Fish Habitat: impacts on waters (e.g., aquatic areas and their associated physical, chemical, and biological properties used by fish) and substrate (e.g., sediment, hard bottom, underlying structures, and associated biological communities) necessary for the spawning, feeding, or growth to maturity of fish species managed under the Magnuson-Stevens Fishery Conservation and Management Act (see Section 4.3.3)
- Marine Mammals: impacts to important foraging/breeding habitat and seal haul out sites (see Section 4.3.4)
- Sea Turtles: impacts to important sea turtle foraging/breeding habitat (see Section 4.3.5)
- Avian Species: impacts to onshore nesting/foraging/roosting and stopover habitat or offshore migration corridors and foraging areas (see Section 4.3.6)
- Bat Species: impacts to onshore nesting/foraging/roosting and stopover habitat or offshore migration corridors (see Section 4.3.7)

Generally, most Project activities resulting in seafloor/land disturbance will also result in habitat alteration. Seafloor and land disturbances resulting from Project implementation are discussed and quantified in Section 4.1.1 above. Habitat alteration is species or resource-specific; therefore, the area of habitat alteration for a given species or resource will, in most cases, be a subset of the total area of seafloor and land disturbances estimated in Section 4.1.1.

4.1.2.1 Revolution Wind Farm

Construction and Decommissioning

Habitat alteration will result from construction and decommissioning activities associated with the RWF. Direct impacts to benthic communities, and shellfish habitat may result from seafloor preparation and foundation installation, and IAC/OSS-Link cable installation due to physical disturbance of these resources. Indirect impact to habitat for EFH, benthic communities, finfish, marine mammals, sea turtles and avian populations may result from the operation of vessels and heavy equipment needed to construct the RWF. Seafloor disturbances associated with construction of the RWF are estimated in Table 4.1.1-1; habitat alteration impacts to each of the resources noted above will be a subset of these total seafloor disturbances estimates.

Impacts from decommissioning activities are anticipated to be similar to construction phase impacts.

Operations and Maintenance

During the O&M phase of the RWF, direct impacts to marine mammals, sea turtles and benthic communities may result from the presence of the foundations and cable protection due to the creation of habitat beneficial to these resources. Periodic inspection and maintenance activities may disturb and consequently negatively affect these habitats. Indirect impact to habitat for finfish, EFH, marine mammals and sea turtles may result from the operation of WTGs. The presence of foundations and WTGs may cause marine and airborne species to change their migration and feeding patterns to avoid the RWF area. EMF generated by operation of the AC submarine cables is not anticipated to disrupt usage of these areas by finfish and invertebrate species such as lobster.

4.1.2.2 Revolution Wind Farm Export Cable

Construction and Decommissioning

Construction and decommissioning of the RWEC will have similar resource impacts to the IAC/OSS-Link cable installation. Seafloor disturbances associated with construction of the RWEC-OCS and RWEC-RI are estimated in Table 4.1.1-2. Habitat alteration impacts to each of the resources noted above will be a subset of these total seafloor disturbances estimates.

Operations and Maintenance

O&M of the RWEC will have similar resource impacts to the IAC/OSS-Link cable operation.

4.1.2.3 Onshore Facilities

Construction and Decommissioning

Construction of Onshore Facilities is anticipated to cause direct and indirect impacts to coastal and terrestrial habitats including freshwater wetlands, ruderal forest, and ruderal shrubland/grassland that provide habitat for vertebrate and invertebrate organisms. The construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW will require tree clearing and earthwork that will directly impact existing habitats through the elimination of these habitats (e.g. hard structures like the OnSS and ICF will create non-habitat) or conversion from one habitat type to another (e.g. forest to managed shrubland/grassland). Indirect impacts to onshore habitats resulting from the Project may include habitat fragmentation and the introduction or proliferation of invasive and non-native species. These "edge effects" may result in changes to habitat utilization by forest interior species and/or species that depend on native vegetation for their life cycle.

Decommissioning of the Onshore Facilities is not anticipated to cause new habitat alteration since the Project components will be demolished or abandoned in place. Pre-existing habitats are not likely to be restored as part of decommissioning.

Land disturbances associated with construction of the Landfall Work Area and TJBs, Onshore Transmission Cable, OnSS, ICF, Interconnection ROW, and TNEC ROW are estimated in Table 4.1-5. Habitat alteration impacts to each of the resources noted above will be a subset of these total disturbance estimates.

Operations and Maintenance

O&M of the Onshore Facilities may result in indirect impacts to adjacent habitats and habitat utilization caused by nuisance activities such as lighting and increased noise and human activity. Routine vegetation maintenance may cause short-term indirect impacts causing wildlife to temporarily avoid the vicinity of the Onshore Facilities.

4.1.3 Sediment Suspension and Deposition

Sediment suspension and deposition are naturally occurring processes in a highly dynamic oceanographic environment. Suspension of sediments into the water column in excess of what occurs naturally is expected to occur during construction and decommissioning activities in the RWF and RWEC. Cable burial activities will resuspend sediments into the water column, causing short-term localized increases to the natural turbidity. Once in suspension in the water column, these sediments are transported by currents, eventually settling back onto the seafloor, resulting in localized excess deposition. Additionally, the placement of infrastructure on the seafloor will change the hydrodynamics local to the infrastructure, causing localized movement of surrounding sediment and potential undermining of foundations and submarine cables.

Changes to turbidity and deposition from Project activities depend on the nature of the activity, characteristics of the seafloor (stable or mobile), physical sediment characteristics, and hydrodynamics in the area of disturbance. Project activities which will result in sediment suspension and deposition are summarized in Table 4.1-1 and described further below. A hydrodynamic and sediment transport modeling study was performed to inform evaluation of potential sediment suspension and deposition impacts associated with the Project (Appendix J).

4.1.3.1 Revolution Wind Farm

Construction and Decommissioning

Sediment suspension and deposition resulting from bottom-disturbing construction and decommissioning activities are expected to be localized and short-term. Temporary sediment suspension and deposition within the RWF will result from the following activities:

- Seafloor preparation including clearing and/or leveling of the seafloor prior to foundation and cable installation (e.g., boulder clearance and sandwave leveling)
- Embedment of foundations
- Burial of the IAC and OSS-Link Cable
- Vessel anchoring

Decommissioning activities involving the removal of installed Project components will also result in sediment suspension and deposition, similar to construction.

Seafloor Preparation and Foundation Installation

Sediment suspension and deposition will be caused by bottom-disturbing activities during installation of foundations. The effect of these activities is expected to be localized to the activity and short-term. Physical disturbances from boulder clearance, sandwave leveling, placement of scour protection/cable protection, vessel anchoring, or pile driving will cause small plumes of finer sediments to mobilize up into the water column where limited transport is anticipated. When the activity stops, the sediment suspension will abate, and sediment is expected to settle out onto the seafloor.

Inter-Array Cable and OSS-Link Cable Installation

The installation (or removal) of the IAC and OSS-Link Cable will produce effects that are short-term and involve a localized suspended sediment plume and related sediment deposition. The hydrodynamic and sediment transport modeling study performed for the Project (Appendix J) relied on conservative assumptions to represent the source of sediment resuspension from the cable burial activities, where these assumptions reflected the maximums from the range of possible trench sizes and installation methods. For the IAC, this resulted in an assumed trench depth of up to 10 ft (3 m) and width up to 43 ft (13 m), an assumed suspension rate of 25 percent that would introduce sediments into the bottom 8.5 ft (2.5 m) of the water column and an assumed cable installation rate of 410 ft/hr (125 m/hr). The conservative modeling of the IAC was performed for two current conditions and the segment of cable installation modeled was in an area where sediments had the highest proportion of fine material, which would produce the most turbid and persistent plume.

Table 4.1.3-1 Inter-Array Cable Parameters Used in the Representative IAC Section Cable Installation Modeling

Trenching Parameters							
Equipment	Length Modeled	Trench / Disturbance Width	Trench / Disturbance Depth	Trench / Disturbance Cross Sectional Area	Installation Rate [Length per Time]	Production Rate [Volume per Time]	Loss Rate
Mechanical Plow	1.4 mi (2.25 km)	42.7 ft (13 m)	10.0 ft (3.05 m)	426.5 ft^2 (39.6 m^2)	410.1 (125 m/hr)	174,909 ft^3/hr (4,953 m^3/hr)	25 %

The modeling produced estimates of the plume that varied in time and space for the duration of the model runs, and predictions of the cumulative sediment deposition footprint for the duration of the model run. Model predictions of suspended sediment concentrations are reported against background ambient concentrations. Key modeling results of the representative IAC installation scenario are presented in Table 4.1.3-2. Note that these are the results associated with the 1.4 mi (2.25 km) representative section of the IAC that was modeled and not the entire IAC. Further, the result maximums are provided; however, these maximums only occur in localized areas.

Table 4.1.3-2 Inter-Array Cable Installation Modeling Results Summary

Results						
Total Volume Resuspended	Maximum Extent of TSS > 100 mg/L	Maximum Duration of TSS >100 mg/L	Maximum Duration of TSS >0 mg/L	Total Area with Deposition > 1 mm	Maximum Extent of Deposition > 1 mm	Maximum Extent of Deposition > 80 mm
14,818 cy (11,329 m3)	853 ft (260 m)	2.7 hrs.	4.8 hrs.	118 ac (48 ha)	853 ft (260 m)	66 ft (20 m)

Operations and Maintenance

Once constructed, the RWF will result in localized changes to seafloor topography and hydrodynamics because of the presence of foundations, scour protection, and cable protection. The seafloor overlaying the majority of buried IAC and OSS-Link Cable (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected.

Hydrodynamic and sediment transport modeling was not conducted for the O&M phase of the RWF as sediment transport is expected to be insignificant and localized to anchoring activities of vessels. However, should a segment of the IAC or OSS-Link Cable need to be uncovered for repair or replacement, it is assumed that these activities would have impacts similar to those modeled for the construction phase, as outlined above.

4.1.3.2 Revolution Wind Farm Export Cable

Construction and Decommissioning

The processes of installing the RWEC will generate sediment effects including a short-term, localized sediment plume of increased TSS and a zone of sediment deposition. Physical disturbances from boulder clearance, sandwave leveling, placement of cable protection, and vessel anchoring will cause small plumes of finer sediments to mobilize up into the water column where limited transport is anticipated. When the activity stops, the sediment suspension will abate and sediment is expected to settle out onto the seafloor. RWEC removal activities are assumed to produce effects similar to the installation process. These two separate activities would occur decades apart from each other and are viewed as two separate events that have short term, localized impact.

The hydrodynamic and sediment transport modeling study performed for the Project (Appendix J) relied on conservative assumptions to represent the source of sediment resuspension from the cable burial activities for trench size and installation methods. The modeling of the RWEC assumed variable equipment and trench parameters as summarized in Table 4.1.3-3.

Table 4.1.3-3 RWEC Parameters Used in the Cable Installation Modeling

Trenching Parameters								
RWEC Segment	Equipment	Length Each	Trench / Disturbance Width	Trench / Disturbance Depth	Trench / Disturbance Cross Sectional Area	Installation Rate [Length per Time]	Production Rate [Volume per Time]	Loss Rate
RWEC - Shore to Splice Joint	CFE	5.0 mi (8.0 km)	32.8 ft (10 m)	10.0 ft (3.05 m)	328.1 ft2 (30.5 m2)	590.5 ft/hr (180 m/hr)	193,746 ft3/hr (5,487 m3/hr)	33 %
RWEC - Splice Joint	CFE	0.06 mi (0.1 km)	65.6 ft (20 m)	10.0 ft (3.05 m)	656.2ft2 (61.0 m2)	295.3 ft/hr (90 m/hr)	193,746 ft3/hr (5,487 m3/hr)	33 %
RWEC - Splice Joint to OSS	Mechanical Plow	42.8 mi (68.8 km)	42.7 ft (13 m)	10.0ft (3.05 m)	426.5 ft2 (39.6 m2)	410.1 (125 m/hr)	174,909 ft3/hr (4,953 m3/hr)	25 %

The modeling predicted the plume and resulting sediment deposition that varied in time and space. Sediment plume concentrations are reported in excess of ambient levels. Key points for the modeling results are presented in Table 4.1.3-4. Results for the landfall location are also indicative of the greater number of days (approximately 60 days) needed to complete landfall activities.

Table 4.1.3-4 RWEC Cable Installation Modeling Results Summary

Results						
Location	Total Volume Resuspended	Maximum Extent of TSS > 100 mg/L	Maximum Duration of TSS >100 mg/L	Maximum Duration of TSS >0 mg/L	Total Area with Deposition > 1 mm	Maximum Extent of Deposition > 1 mm
RWEC- OCS	554,173 cy (423,696 m3)	1,476 ft (450 m)	3 hrs	28 hrs	1,692 ac (685 ha).	951 ft (290 m)
RWEC - RI	442,351 cy (338,202 m3)	4,134 ft (1,260 m)	19.4 hrs	32.6 hrs	2,452 ac (992 ha)	3,609 ft (1,100 m)
Landfall Envelope	4,410 cy (3,371 m3)	580 ft (177 m)	237 hrs	256 hrs	39 ac (16 ha)	754 ft (230 m)

Operations and Maintenance

Cable protection may be placed in select areas along the RWEC. The introduction of engineered concrete mattresses or rock to areas of the seafloor can cause local disruptions to circulation, currents, and natural sediment transport patterns. Under normal circumstances these segments of the RWEC are expected to remain covered as accretion of sediment covers the cable and associated cable protection (where applicable).

Hydrodynamic and sediment transport modeling was not conducted for the O&M phase of the RWEC as sediment transport is anticipated to be insignificant and localized to anchoring activities of vessels. However, should a segment of RWEC need to be uncovered for repair or replacement, it is assumed that these activities would have impacts similar to those modeled for the installation phase, as outlined above.

4.1.3.3 Onshore Facilities

Construction and Decommissioning

Construction of the Onshore Facilities will be governed by several environmental permits including the RIPDES General Permit for Stormwater Discharges associated with Construction Activities. This General Permit requires the development of a site-specific SESC Plan that the operator must implement, inspect, and maintain during the entire construction process until the entire worksite is permanently stabilized by vegetation or other means. The measures employed in the SESC Plan minimize the opportunity for turbid discharges leaving a construction work area. The plan also includes specific measures for handling dewatering discharges and measures for refueling equipment to minimize the opportunities for uncontrolled spills. The construction and decommissioning phases of the Onshore Facilities are anticipated to have a short-term effect on turbidity and sediment deposition.

Operations and Maintenance

The O&M phase of the Project is not expected to create any significant opportunity for soil erosion or the conveyance of sediment to surface waters.

4.1.4 Noise

Sound is the rapid fluctuation of pressure above and below the ambient conditions and can occur in any medium such as air or water. When sound becomes unwanted, it is defined as noise. Sound becomes an adverse impact when it interferes with the normal habits or activities of fish, wildlife or people. Sound is described based on its loudness or intensity (sound level), the frequencies of sound, and the variation of sound over time. Sound levels are most often measured on a logarithmic scale of decibels (dB) relative to 20 micro-Pascals in air and relative to 1 micro-Pascal in water. Since airborne and underwater sound levels are based on different reference levels, they should not be directly compared. For some activities, such as pile driving for foundations, both airborne and underwater sound will be generated.

Airborne sound can have a range of effects on humans including pain and hearing loss, at high amplitudes, speech interference, sleep interference, annoyance, and physiological effects such as anxiety or tinnitus. Potential effects from underwater sound on fish and mammals include altering their behavior, disrupting their functions or physiology, causing injury or resulting in mortality. Behavioral effects from sound may include causing fish to be startled, moving away from typical habitats, reducing the ability to locate prey, or inability to communicate. Physiological effects may include stress, temporary hearing loss, or cellular changes to organs such as a fish's swim bladder, eyes or brain. The severity of these effects depends on the intensity and characteristics of underwater sound and the size and type of organisms present.

Three studies were conducted to evaluate Project-related noise in support of this COP: 1) an airborne sound study of offshore components including an assessment of construction and operational conditions (Appendix P1); 2) an airborne sound study of onshore components including construction and operational conditions (Appendix P2); and 3) an underwater acoustic study of potential construction activities (Appendix P3). Project activities which will result in noise are summarized in Table 4.1-1 and are described further below.

4.1.4.1 Revolution Wind Farm

Construction and Decommissioning

Underwater and in-air sound will be generated during RWF construction and decommissioning by vessel and aircraft traffic, impact pile driving, and other power equipment used to install the WTGs (e.g., cranes, compressors), IAC, and OSS-Link Cable. Construction vehicles and equipment will also generate noise at ports used for construction staging. Decommissioning may result in similar noise generation if it involves the removal of Project components with comparable equipment and methods as construction. All of these construction and decommissioning activities will be short-term, direct effects of the Project. The various sound-generating activities associated with construction and decommissioning of the RWF are further described and assessed below.

Vessel and Aircraft Noise

Several types of vessels will be used during construction activities such as a floating barge, towing tug, material barge, anchor handling tug, rock dumping vessel, crew transport vessel, feeder barge, and bunkering vessel. For each vessel type, the route plan for the vessel operation area will be developed to meet industry guidelines and best practices in accordance with International Chamber of Shipping guidance. These types of vessels will generate sound similar to vessels already operating in the waterways.

Helicopters will be used for additional crew transfers during construction activities. A helicopter route plan will be developed to meet industry guidelines and best practices in accordance with FAA guidance. These types of helicopter operations will generate sound similar to aircraft already operating in the airspace.

Inter-Array Cable and OSS-Link Cable Installation Noise

Underwater noise associated with cable installation is primarily generated by the DP cable lay vessel thrusters. The noise from the DP thrusters is non-impulsive and typically more dominant than mechanical or hydraulic noises from the cable trenching equipment. Noise produced by cable laying equipment and non-DP vessels would be comparable to or less than the noise produced by DP vessels, so impacts are also expected to be similar.

Pile Driving Noise

Vibratory pile driving with reduced ground vibrations and noise levels may be used for the foundation installations, but impact pile driving was modeled as a worst-case scenario. Impact pile driving for WTG on monopile foundations will involve use of a hammer that generates up to 4,000 kJ of energy. Impact pile driving for OSS foundations, which will be used for either monopile or piled jacket foundations, will involve the use of a hammer that generates up to 2,000 kJ of energy. Pile driving noise has been evaluated based on the use of a 4,000 kJ hammer for monopile foundations as this is representative of the worst-case condition as it relates to maximum noise levels. Installation of each monopile would include a 20-minute soft start where lower hammer energy is used and then would be followed by up to 12 hours of piling per monopile with an average duration of 1 to 4 hours.

The sound power level emission of the 4,000 kJ hammer is estimated to be up to 137 dBA based on typical reference data for impact pile driving equipment (Renterghem, 2014; FTA, 2018; Abbot, 2004). The sound power level emission represents the sound energy of the source alone and is independent of the distance from the source. Sound pressure levels are used to describe sound at receptor locations. Sound from the pile driving was modeled using sound prediction software to predict the levels at different distances from the source. The maximum sound from impact pile driving has been evaluated at the shoreline of Chilmark, Massachusetts which is the location closest to any of the WTG locations. The maximum sound level would be 11.3 dBA at the shoreline of Chilmark, Massachusetts which is substantially lower than existing ambient sound levels. At these low levels, sound from the pile driving activities would not be audible at the shorelines.

General Construction Noise at Ports

During construction, heavy equipment, vehicles and power tools will be used to support fabrication and material transport to the RWF. It is expected that most, if not all, of these activities will occur at existing ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland where there will be other ongoing industrial activities, independent of the RWF. Construction sounds specifically related to RWF activities at existing port facilities are expected to be similar to operational sounds associated with routine activities at these existing ports and therefore, are not considered a noise IPF.

Operations and Maintenance

Operational sound generated by offshore components of the RWF results from operation of the WTGs, OSSs, and nautical hazard prevention devices (foghorns), as well as vessel and aircraft traffic. All of these O&M activities are long-term, direct effects of the Project. Noise generated from these components is described and assessed further below.

WTG Operational Noise

Sound from operation of the WTGs has been modeled assuming they are all operating continuously and concurrently at the typical maximum rated sound power level of 120 dBA per WTG. These sound levels include mechanical and aerodynamic sources of the WTGs. Since WTGs typically radiate more sound in certain directions, the sound measurement test standard accounts for the maximum directional sound power level. Therefore, the sound emissions are worst-case as they relate to directivity.

Ambient sound levels range from 25 to 45 dBA during the night and 35 to 55 dBA during the day. For the quietest coastal areas with population densities less than 100 people per square mile, ambient sound levels ranged from daytime sound levels of 35 dBA (Leq

14

) and nighttime sound levels of 25 dBA (Leq). Sound levels from the simultaneous operation of the WTGs would be 27.3 dBA or less at all shoreline locations.

WTGs produce aerodynamic turbine blade noise and mechanical noise. While underwater noise from turbines has been measured within the hearing frequency of marine animals, impacts, at the anticipated noise levels, would be limited to audibility, and perhaps some degree of behavioral response or auditory masking (MMS, 2007).

OSS Operational Noise

Each of the two OSS will house a high-voltage shunt reactor, medium voltage 66-kV and 275-kV switchgear, and an emergency diesel generator. The emergency diesel generator is typically the loudest source of sound on the OSS. The sound emissions of the generator depend primarily on the sound attenuation performance of the acoustic enclosure and exhaust silencer. Although the specific manufacturer, model, and sound attenuation specifications of the generator have not yet been determined, the sound emissions of the OSS are typically lower than the WTG. The buffering nature of the water is expected to mute any operational noise underwater.

Nautical Hazard Prevention Noise

14 Equivalent Continuous Level

Audible nautical hazard prevention devices (i.e., foghorns) will be installed on select WTGs along the outer perimeter of the RWF. The foghorns are designed to provide a 2.0-nm (3.7-km) audible range and emit a 134 dB at 3 ft (1 m) tone at a frequency of 660 Hertz (Hz). Code of Federal Regulations Title 33 § 67 specifies that foghorns are to be installed less than 150 ft (46 m) above mean sea level (MSL). The foghorn will be placed atop the transition deck at a maximum of 132 ft (40 m) above MSL and will be equipped with fog detection device and allow for remote operation by passing vessel (i.e., non-continuous). The maximum sound level at shorelines surrounding the WTGs would be 15.1 dBA or less from the foghorns. In air noise from hazard prevention devices is expected to be muted underwater.

Vessel and Aircraft Noise

Noise from vessel and aircraft traffic during O&M of the RWF is expected to generally be the same as discussed for construction and decommissioning above. Noise from aircraft traffic during the O&M phase will be less compared to the need for helicopters to transfer crews during the foundation construction and decommissioning.

4.1.4.2 Revolution Wind Export Cable

Construction and Decommissioning

The potential for noise to be generated during construction and decommissioning of the RWEC is the result of vessel use, including the DP vessels for cable installation, aircraft use, and possible sheet pile cofferdam installation by vibratory pile driving. During construction and decommissioning of the RWEC, these activities are considered short-term, direct effects of the Project. Noise generated by vessels, aircraft, heavy equipment at ports, and cable installation equipment will be similar to described above for the RWF.

As described in Section 3.3.3.2, a temporary cofferdam may be installed for installation of the RWEC at the landfall location. The cofferdam will be installed using either sheet pile or gravity cell. If the temporary cofferdam is constructed of steel sheet pile, vibratory hammer pile driving will be used for installation and removal. Vibratory hammering for the cofferdam differs from impact hammering for the foundations because it is non-impulsive (or continuous). Installation of the sheet pile cofferdam would take approximately 3 days. Construction sound levels from cofferdam construction would be up to 51 dBA (Leq) at the nearest beach locations. At the nearest residential receptors on Middle Street and Sauga Avenue, cofferdam construction sound levels would typically range from the mid to upper 40’s dBA (Leq). Cofferdam construction would occur during daytime hours and would be within all applicable state and local noise standards.

Operations and Maintenance

Noise from vessel and aircraft traffic during O&M of the RWEC is expected to generally be similar as discussed for O&M of the RWF. The helicopter routes will be developed to meet industry guidelines and best practices in accordance with FAA guidance. These types of helicopter operations will generate sound similar to aircraft already operating in the airspace. All of these activities during O&M of the RWEC are long-term, direct effects of the Project.

4.1.4.3 Onshore Facilities

Construction and Decommissioning

Construction and decommissioning of the Onshore Facilities include landfall activities for the RWEC-RI via HDD, Onshore Transmission Cable installation, Interconnection ROW, TNEC ROW, ICF, and OnSS construction. All of these activities during construction and decommissioning of Onshore Facilities are short-term, direct effects of the Project.

RWEC Landfall Construction

There are there are three components to HDD installation that would be considered for noise: cofferdam installation; site preparation activities; and construction operations. Construction sound was been evaluated assuming operations on the western end of the Landfall Work Area envelope as this is closest to noise-sensitive receptors on Middle Street and Sauga Avenue. The building at 61 Whitecap Drive to the west of the site would provide sound acoustic shielding to the residences farther west. Onshore airborne construction sound levels from HDD site preparation activities would be up to 70 dBA (Leq(8h)) at the closest beach locations. At residential receptors on Middle Street and Sauga Avenue, HDD site preparation construction sound levels would be 36 to 43 dBA (Leq(8h)). HDD site preparation would occur during daytime hours and would be within all applicable state and local noise standards.

Sound from HDD operations at the Landfall Work Area envelope is estimated to be 14 to 33 dBA (Leq(8h)) at the nearest residences and 54 dBA (Leq(8h)) at the beach. These construction sound levels would be below the measured ambient sound conditions (50 dBA daytime and 45 dBA nighttime) at this location. HDD construction activities between 7 AM and 6 PM would comply with the Town of North Kingston noise ordinance. Since HDD operations would only be below ambient conditions at nearby residences, there would not be noise impact from HDD operations.

Onshore Transmission Cable Installation

Construction of the Onshore Transmission Cable involves different phases such as clearing the transmission cable route, excavation of the route, support of excavation with shoring, installing the duct, and then backfilling and final restorative activities. The types of construction equipment used during Onshore Transmission Cable installation generally include bulldozers, backhoes, front end loaders, aerial lifts, trenchers, compactors, concrete saws, graders, pumps, compressors and trucks. It is anticipated that construction of the Onshore Transmission Cable will take approximately 12 months occurring within the overall 18-month period for installation of Onshore Facilities. Since the Onshore Transmission Cable installation process progresses along the cable route during this period, the exposure to construction noise is of a substantially shorter duration at any particular location along the route.

Many of the industrial buildings are 100 ft (30.5 m) or farther away from the Onshore Transmission Cable route. Residential noise sensitive receptors (NSRs), such as the homes on Camp Avenue, are typically about 50 ft (15.2 m) away from the Onshore Transmission Cable route. At a distance of 50 ft (15.2 m), construction noise levels would range from 84 to 89 dBA (Leq). These construction sound levels would meet all applicable state and local noise standards.

OnSS and ICF Noise

Construction activities associated with the OnSS and ICF typically include clearing the site of vegetation, grading the site, installing erosion controls, installing the foundations and erecting buildings, and restoring any disturbed areas. The loudest phase of construction activities is typically associated with the foundation and excavation phase where there is a need for earth-moving equipment. The primary sound-generating equipment for construction of the OnSS and ICF includes a backhoe, cranes, dump trucks and flatbed trucks, a front-end loader and a generator. Sound from the OnSS has been conservatively evaluated assuming that all construction activities would be focused on the southwest portion of the OnSS and ICF sites which is closest to residential receptors. Sound from construction of the OnSS and ICF is estimated to be 45-54 to 61 dBA (Leq) at the closest residential receptors Cattail Lane, Brook View Drive, and Camp Avenue. The existing ambient sound levels at these receptors is 50 to 51 dBA-i during the daytime and 45 dBA-i during the night. Construction sound during the day would generally be 10 to 15 dBA above ambient conditions. These construction sound levels would meet all applicable state and local noise standards.

Operations and Maintenance

Once constructed, the only components of the Onshore Facilities that will emit sound will be the OnSS and two-line traps associated with the ICF 115kV ring bus. Table 4.1.4-1 presents the overall A-weighted sound emissions from the operations of the OnSS and ICF at nearby receptor locations. The highest sound level at an NSR is 43.9 dBA at 129 Cattail Lane. This sound level is below the EPA guideline of 48.6 dBA (Leq), which is equivalent to a day-night average sound level of 55 dBA (Ldn), and therefore complies with the EPA guidance for exterior noise. Operational sound from the OnSS and ICF would also be below 50 dBA at the nearest residential property lines and below 70 dBA at the nearest commercial/industrial property lines which is below the Town of North Kingston, RI Noise Ordinance limits.

Noise from the O&M of the Onshore Transmissions Cable is not typically expected except during non-routine maintenance that would require uncovering the buried cables/infrastructure.

Future sound levels at nearest NSR, which include existing ambient sources and the proposed OnSS and ICF, would experience an overall increase in sound of 0.9 dBA during the day and 2.5 dBA during the night at this location, which is nearly imperceptible (50.9 dBA and 47.5 dBA respectively). Since there are not existing ambient pure tone conditions and sound from the OnSS and ICF equipment would be lower than existing conditions, tonal conditions would not be anticipated. At NSRs east of the OnSS and ICF, which are commercial/industrial, sound would be 40.7 dBA (Leq) or quieter and future sound levels would increase by less than 3 dBA. An increase in sound level of 3 dBA or less is typically considered to be the threshold of perceptible change in sound. Therefore, the operation of the proposed OnSS and ICF would comply with relevant federal, state, and local noise limits.

Since most buildings with windows closed provide 20 dB or more, and buildings with windows open provide 10 dB of outdoor-to-indoor sound attenuation, interior noise conditions would be substantially quieter.

Table 4.1.4-1 Onshore Substation and ICF Operational Noise

Receptor	Address	Existing Sound Level (dBA-i, L_{eq})		Substation Sound Level (dBA, L_{eq})	Future Sound Level (dBA, L_{eq})		Increase (dBA)	
		Daytime	Nighttime		Daytime	Nighttime	Daytime	Nighttime
R1	129 Cattail Lane	50.0	45.0	43.9	50.9	47.5	0.9	2.5
R2	140 Brook View Drive	50.0	45.0	40.8	50.5	46.4	0.5	1.4
R3	10 Gateway Road	50.5	45.4	38.3	50.8	46.2	0.3	0.8
R4	511 Camp Avenue	50.5	45.4	38.8	50.8	46.3	0.3	0.9
R5	525 Camp Avenue	50.5	45.4	40.7	50.9	46.7	0.4	1.3
R6	541 Camp Avenue	50.5	45.4	39.3	50.8	46.4	0.3	1.0
R7	553 Camp Avenue	50.5	45.4	39.3	50.8	46.3	0.3	0.9
R8	571 Camp Avenue	50.5	45.4	39.9	50.9	46.5	0.4	1.1
R9	595 Camp Avenue	50.5	45.4	39.9	50.9	46.5	0.4	1.1
R10	613 Camp Avenue	50.5	45.4	41.0	51.0	46.7	0.5	1.3
R11	629 Camp Avenue	50.5	45.4	40.2	50.9	46.5	0.4	1.1
R12	643 Camp Avenue	50.5	45.4	43.0	51.2	47.4	0.7	2.0

Source: VHB, 2020

4.1.5 Electric and Magnetic Fields

Electric and magnetic fields (EMF) are invisible fields produced by electrically charged objects. Like all wiring and equipment connected to the electrical system, the EMF surrounding the IAC, OSS-Link Cable, RWEC, and Onshore Transmission Cable will oscillate with a frequency of 60 Hz. The magnetic field results from the flow of electricity along the cable and the magnetic flux density is reported in units of milligauss (mG), where 1 Gauss (G) = 1,000 mG. The magnetic field will be strongest at the surface of the cable and will decrease rapidly with distance from the cables. An electric field is created by the voltage applied to the conductors within the cable, but this electric field is shielded from the marine environment by cable insulation, grounded metallic sheaths and steel armoring around the cable. However, the oscillating nature of the 60-Hz magnetic field will induce a weak electric field around the cable that, similar to the magnetic field, will vary in strength based on the flow of electricity along the cable. The electric field is measured in units of millivolts/meter (mV/m).

Offshore and onshore EMF assessments were conducted in support of the Project (Appendix Q1 and Q2). Project activities which will result in EMF are summarized in Table 4.1-1 and are described further below.

4.1.5.1 Revolution Wind Farm

Construction and Decommissioning – Monopile Structures

There will be no EMF produced during construction of the project structures. The EMF present during operations (discussed below) will cease once the Project is decommissioned.

Operations and Maintenance – IAC and OSS-Link Cables

AC EMF oscillating at a frequency of 60 Hz will result from the flow of 60-Hz electricity along the IAC and the OSS-Link Cables. Project-specific EMF modeling at maximum output of the windfarm (i.e., peak loading) indicates that magnetic field and electric fields at 3.3 ft (1 m) above the seabed will be 58 mG or lower and 3.2 mV/m or lower, respectively, for the IAC and OSS-Link Cable for a 3.3-ft burial depth and peak loading. These EMF levels, calculated using conservative assumptions likely to overestimate field levels, indicate that the magnetic-field and induced electric field produced by the Project cables will be below the detection thresholds for magnetosensitive and electrosensitive marine organisms When the wind speed is not sufficient to generate the maximum output of the windfarm the levels of EMF from the cables will be lower. For these reasons, marine species' behaviors and populations are not expected to be altered by operating the IAC and OSS-Link Cable. This conclusion also is supported by years of biological surveys conducted at existing offshore windfarm sites that also indicate no long-term or large-scale changes to populations of marine organisms residing at these sites. (See evaluation of Leonhard et al., 2011; Dunlop et al., 2016; Vandendriessche et al., 2015; Vattenfall and Skov-og, 2006 in Appendix Q1).

4.1.5.2 Revolution Wind Export Cable

Construction and Decommissioning

There will be no EMF produced during construction of the RWEC. The EMF present during operations (discussed below) will cease once the Project is decommissioned.

Operations and Maintenance

EMF oscillating at a frequency of 60 Hz will result from the flow of 60-Hz electricity along the RWEC. Project-specific EMF modeling results indicate that the magnetic field and electric field at 3.3 ft (1 m) above the seabed during operation at maximum output of the windfarm (i.e., peak loading) will be 58 mG or lower and 4.0 mV/m or lower, respectively, for the RWEC (including at the landfall location) for a 3.3-ft burial depth and peak loading. These EMF levels, calculated using conservative assumptions likely to overestimate results, indicate that the magnetic-field and induced electric field produced by the Project cables will be below the detection thresholds for magnetosensitive and electrosensitive marine organisms. When the wind speed is not sufficient to generate the maximum output of the windfarm on the export cable the levels of EMF from the cable will be lower. Thus, as discussed above for RWF O&M, marine species' behaviors and populations are not expected to be adversely impacted by operating the RWEC.

4.1.5.3 Onshore Facilities

Construction and Decommissioning

There will be no EMF produced during construction of the Onshore Facilities. The EMF present during operations (discussed below) will cease once the Project is decommissioned.

Operations and Maintenance

Between the TJBs and OnSS, the Onshore Transmission Cables will be installed in a double-circuit underground duct bank. Exponent modeled the magnetic-field levels associated with the operation of these cables. The calculated magnetic field at peak loading directly over the duct banks is 73 mG or lower for the maximum 880 MW capacity of the RWF and is well below the International Commission on Non-Ionizing Radiation Protection reference level of 2,000 mG and the International Committee on Electromagnetic Safety exposure reference level of 9,040 mG for the general public. Lower magnetic fields would be produced if the power generated by RWF is less than 880 MW. The underground transmission cables will not be a direct source of any electric field above ground due to the cable construction, duct bank, and burial underground.

4.1.6 Discharges/Releases

Discharges and releases of liquids and solid waste to the ocean or land pose a threat to water quality and risks to marine life from exposure, ingestion or entanglement. Routine or accidental (non-routine) fuel spills, wastewater discharges and solid waste releases associated with construction, O&M, and decommissioning of the RWF, RWEC and Onshore Facilities are possible but considered unlikely. Per the information requirements outlined in 30 CFR 585.626, maximum quantities of and disposal methods for liquids and solid wastes, including hazardous materials, are summarized in Section 3.3.9.4 for construction and Section 3.5.6 for O&M, as well as in Table 3.3.1-2 for the OnSS, Table 3.3.1-3 for the ICF, Table 3.3.5-2 for the OSSs and Table 3.3.8-2 for the WTGs. Project activities that could result in discharges or release of liquids and solid waste are presented in Table 4.1-1 and are further described below.

4.1.6.1 Revolution Wind Farm

Construction and Decommissioning

Routine Discharges and Disposal

Routine discharges of wastewater (e.g., gray water or black water) or liquids (e.g., ballast, bilge, deck drainage, stormwater) in the RWF may occur from vessels, WTGs or the OSS during construction and decommissioning; however, all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations, such as the EPA and USCG requirements for discharges and releases to surface waters. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for adversely impacting water quality and marine life.

In accordance with the Oil Pollution Act of 1990 (OPA-90) and the International Convention for the Prevention of Pollution by Ships (known as MARPOL 73/78), owners and operators of certain vessels are required to prepare Vessel Response Plans (VRP) approved by the USCG. In addition, the USCG regulates the at-sea discharges of vessel-generated waste under the authority of the Act to Prevent Pollution from Ships (33 U.S.C. §§1905-1915). All Project vessels will be required to comply with the applicable USCG pollution prevention requirements. Additionally, all vessels less than 79 ft (24.1 m) will comply with the Vessel Incidental Discharge Act (VIDA) of 2018 for compliance with National Pollutant Discharge Elimination System (NPDES) permitting.

Accidental or Non-Routine Spills or Releases

During construction and decommissioning activities in the RWF, there is increased probability of spills and accidental releases of fuels, lubricants, and hydraulic fluids. BMPs for fueling and power equipment servicing greatly minimizes the potential for spills and accidental releases and will be incorporated into the Project's ERP/OSRP (Appendix D). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP.

Certain hazardous materials necessary to support the installation of the WTGs will be transported to and from the RWF and ports. The transport of this material may result in the accidental discharges of small volumes of hazardous materials, such as oil, solvents, or electrical fluids. The two OSSs will have transformers that contain large reservoirs of transformer oil, as well as smaller amounts of additional fluids, such as diesel fuel and lubricating oil.

Operation and Maintenance

The WTGs, and OSSs will be designed to contain any potential leakage of fluids, thereby preventing the discharge fluids into the ocean. During WTG operation, small accidental leaks could occur because of broken hoses, pipes, or fasteners. During WTG maintenance, small releases could occur during servicing of hydraulic units or gearboxes. Any accidental leaks within the WTGs are expected to be contained within the hub and main bed frame or tower. During operations, the only discharges to the sea that are anticipated are those associated with vessels performing maintenance. BMPs for fueling and power equipment servicing greatly minimizes the potential for spills and accidental releases. Accidental releases are minimized by containment and clean-up measures detailed in the ERP/OSRP (Appendix D).

4.1.6.2 Revolution Wind Export Cable

Discharges and releases of liquids and solid waste during construction, O&M, and decommissioning of the RWEC will be similar to those described for above for vessel use in the RWF. The cables of the RWEC do not contain liquid so there is no risk of cable rupture and release. Vessels used during RWEC construction or decommissioning will also comply with applicable local, state, and federal regulations and Project-specific plans and procedures.

In addition, installation of the RWEC at the landfall location will utilize an HDD approach to install the cables under the beach and intertidal water areas. The use of drilling fluid, which typically consists of a water and bentonite mud mixture or another non-toxic drilling fluid, will be required. Bentonite is a natural clay that is mined from the earth. While these fluids are considered non-toxic, Revolution Wind will implement BMPs during construction to minimize potential releases of the drilling fluid associated with HDD activities (e.g., use of a temporary cofferdam). An HDD Contingency Plan will also be developed prior to construction to address inadvertent release of drilling fluids.

4.1.6.3 Onshore Facilities

The OnSS and ICF will require various oils, fuels, and lubricants to support its operation (Table 3.3.1-2, and Table 3.3.1-3). Equipment will be mounted on concrete foundations with concrete secondary insulating fluid containment designed for 110 percent containment and in accordance with industry and local utility standards. A Spill Prevention Control and Countermeasures (SPCC) Plan will be developed in support of NPDES compliance and the potential for discharges and releases from onshore construction will be governed by Rhode Island regulations and the Project’s Construction Plan. It is assumed construction of the OnSS will generate approximately 3,000 cy (2,294 m^3) of solid waste. This material will be disposed of in a landfill and/or recycling center.

4.1.7 Trash and Debris

Solid wastes and construction debris will be generated predominantly during construction and decommissioning of the RWF, RWEC and Onshore Facilities. Per the information requirements outlined in 30 CFR 585.626, maximum quantities of and disposal methods for liquids and solid wastes, including hazardous materials, are summarized in Section 3.3.9.4 for construction and Section 3.5.6 for O&M, as well as in Table 3.3-2 for the OnSS. The discharge or disposal of solid debris into offshore waters from structures and vessels is prohibited by BOEM (30 CFR 250.300) and the USCG (MARPOL, Annex V, Pub. L. 100−220 [101 Stat. 1458]). Project activities that could result in the generation of trash and debris are presented in Table 4.1-1. The estimated 3,000 cy (2,294 m^3) of solid waste generated during construction of the OnSS will be disposed of in a landfill and/or recycling center.

In accordance with applicable federal, state, and local laws, comprehensive measures will be implemented prior to and during construction activities to avoid, minimize, and mitigate impacts related to trash and debris disposal. Offshore, trash and debris will be contained on vessels and offloaded at port/construction staging areas. Food waste that has been ground and can pass through a 25-millimeter (mm) mesh screen may be disposed of at sea according to 33 CFR 151.51-77. All other trash and debris returned to shore will be disposed of or recycled at licensed waste management and/or recycling facilities. Disposal of any solid waste or debris at sea will be prohibited. Good housekeeping practices will be implemented to minimize trash and debris in works areas of the RWF, RWEC, and Onshore Facilities.

During O&M of the RWF and RWEC, the generation of trash and debris will be limited. The nominal amounts of trash and debris generated by maintenance activities will be managed in accordance with federal, state, and local laws and not disposed of at sea or in an uncontrolled fashion on land.

4.1.8 Traffic (Vessels, Vehicles, and Aircraft)

Project-related traffic will include vessels (including barges, tugs, and a freighter), onshore vehicles, and helicopters. An overview of anticipated offshore vessels and helicopter usage, and onshore construction equipment is provided in Table 3.3-25 and Table 3.3-26, respectively. Vessels and helicopters will transit to and from existing ports facilities located in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and/or Maryland to RWF, while onshore vehicles will transit using existing roads and highways to these port locations (Table 3.3-24). Project activities that could result in traffic are presented in Table 4.1-1 and are further described below. The impacts of traffic on marine navigation are evaluated in detail in the Navigation Safety Risk Assessment prepared for the Project (Appendix R). Also, the impacts on air traffic are evaluated in the Obstruction Evaluation and Airspace Analysis (Appendix S1), Radar Line of Sight Study (Appendix S2), Air Traffic Flow Analysis (Appendix S3), and Aircraft Detection Lighting System Efficacy Analysis (Appendix S4).

4.1.8.1 Revolution Wind Farm

Construction and Decommissioning

Vessel Traffic

A temporary increase in vessel traffic will occur during construction and decommissioning of the RWF. Timing of vessel traffic will be clarified once final construction and decommissioning schedules are issued and approved. The amount of time vessels will transit back and forth to the RWF and how long they will remain on station is greatly dependent on final design factors, weather, sea conditions and other natural factors. The larger installation vessels (e.g., jack-up installation vessel and DP cable lay vessel) will generally travel to and from the construction area at the beginning and end of the RWF construction and not on a regular basis. Vessels transporting construction equipment and materials (e.g., tugs and feeder barges) will make more frequent trips while smaller support vessels carrying supplies and crew (e.g., CTVs) may travel to the RWF daily. However, construction crews will hotel onboard installation vessels at sea thus, limiting the number of crew vessel transits expected during RWF installation and decommissioning.

Vehicular Traffic

It is expected that the greater proportion of RWF components will be transported by sea; however, some components and equipment will arrive by land at varying frequencies throughout the construction period. Vehicular traffic during RWF construction and decommissioning will include truck and automobile traffic over existing roads and highways proximate to the particular marshaling and/or logistics facility. Project-related deliveries will result in trucks loading and unloading materials/equipment as well as vehicle movements to complete assembly, fabrication, and staging of RWF components and equipment.

Maintenance and protection of traffic setups will be implemented to minimize impacts to traffic. The projected traffic associated with the RWF is well within the daily fluctuation in traffic. Vehicular traffic volumes and frequencies associated with the RWF are therefore not expected to have a measurable impact on traffic operations in and around existing port facilities.

Aircraft Traffic

Anticipated aircraft traffic during construction of the RWF includes helicopter trips for crew changes. Estimated helicopter use for the RWF during the construction phase is estimated to be less than 9,000 hours.

Operations and Maintenance

During RWF O&M, vessel traffic will be limited to routine maintenance visits and nonroutine maintenance, as needed. Limited crew and supply runs using smaller support vessels will be required. Vessel traffic impacts during RWF O&M will be lower than those during the construction phase due to fewer operating vessels.

Vehicular traffic during O&M is generally anticipated to be localized to the planned O&M Facilities and of a volume that is negligible relative to existing traffic at these locations.

Helicopters may also be used to support O&M of the RWF. An integrated helicopter hoist platform located on the roof of each WTG nacelle will provide access for O&M. SOVs and the OSSs may also be fitted with helicopter hoist platforms. Estimated helicopter use for the RWF during O&M will be less, operating an estimated 0.75 hours per day and limited to crew transport offshore.

4.1.8.2 Revolution Wind Farm Export Cable

Construction and Decommissioning

Vessel Traffic

Construction of the RWEC will require various vessel types including a cable lay vessel, tugs, barges, and work and transport vessels. Cable installation will begin at the landfall location and proceed offshore to the OSSs. A comparable level of vessel activity is expected during decommissioning.

Vehicular Traffic

Vehicular traffic associated with the RWEC installation will be limited to activities related to the transport of materials, personnel and equipment in and out of the ports where staging, assembly, and fabrication occur. During the short RWEC installation period, impacts to local traffic will be short-term. The proposed existing port facilities currently experience fluxes in traffic volumes during normal operations.

Aircraft Traffic

Aircraft traffic during construction and decommissioning of the RWEC will be similar to that described above for the RWF.

Operations and Maintenance

Vehicular traffic during the O&M phase will be less than what is expected during the construction phase. There should be no impact to local traffic at and around the existing ports.

4.1.8.3 Onshore Facilities

Vessels and aircraft will not be utilized for onshore activities.

Construction and Decommissioning

Construction and decommissioning of Onshore Facilities will require construction vehicles which will result in temporary increases in traffic within residential areas of North Kingstown and industrial areas within Quonset Business Park. Vehicular traffic attributed to the Onshore Facilities will occur over the 18-month projected construction schedule and will include heavy equipment (e.g., excavators, cranes, dump trucks, and paving equipment). Onshore construction activities will abide by local ordinances and occur primarily between 7 AM and 6 PM. The increase in any construction traffic within Quonset Business Park and other proximate areas including Camp Avenue would be comparable to typical roadway or utility construction work.

Operations and Maintenance

During O&M, vehicle traffic will be limited to the anticipated use of pickup trucks making routine visits to the OnSS. During occasional maintenance and operational emergency visits, bucket trucks, cranes and similar vehicles may be needed to facilitate these activities. These limited additional trips are not expected to contribute to local traffic in any way.

4.1.9 Air Emissions

Primary emission sources associated with the Project will be the vessels' main and auxiliary engines used for transit and maneuvering; helicopters for transporting crew; heavy equipment for construction and moving of materials; onshore vehicles during construction; and electric generators, as needed. In general, most criteria pollutant emissions will be from internal combustion engines burning diesel fuel and will primarily include nitrogen oxides (NO_X) and carbon monoxide (CO); a lesser amount of particulate matter less than 10 micrometers aerodynamic diameter (PM_{10}) – mostly in the form of particulate matter less than 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$), and negligible amounts of sulfur dioxide (SO_2). Although not a criteria pollutant itself, volatile organic compounds (VOCs) can react in the atmosphere to form ozone (O_3) and will be emitted in relatively low amounts. Project air emissions are subject to the regulations summarized in Section 4.2.1.

Project activities that could result in air emissions are presented in Table 4.1-1 and are further described below. A detailed inventory of Project-related air emissions, calculations, and methodologies is provided in Appendix T

4.1.9.1 Revolution Wind Farm

Construction and Decommissioning

Potential impacts to air quality during construction of the RWF will result from the use of vessels, vehicles, helicopters and electric generators. Construction vessels will transit from existing ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and/or Maryland to RWF (see Table 3.3-24). It is expected that most, or all, of these vessels will utilize diesel engines burning low-sulfur fuel. Vehicles operating on roads will comply with federal emission control standards and anti-idling laws.

Emissions from decommissioning are expected to be less than construction emissions. Although similar construction activities will occur to decommission the Project components, the activity will be of a shorter duration and decommissioning activities would occur at least 20-years in the future when combustion energy and pollution control technologies will be improved.

Operations and Maintenance

O&M activities for the RWF will generally consist of SOVs, CTVs and helicopters for transporting technicians. Less frequently, a WTG installation vessel and IAC laying vessel may be used to service these components during the operational life of the Project (20 to 35 years). O&M emissions will produce significantly less emissions on a per year basis compared to those produced during construction.

4.1.9.2 Revolution Wind Export Cable

Construction and Decommissioning

Air emission sources during RWEC construction will include the vessels that will perform, or support, laying of the RWEC. Similar to construction vessels for the RWF, vessels supporting RWEC construction will transit from existing port facilities (see Table 3.3-24) and most, or all, of these vessels will utilize diesel engines burning low-sulfur fuel. Similar to RWF decommissioning, emissions from RWEC decommissioning are expected to be less than construction emissions due to improved technology.

Operations and Maintenance

O&M activities for the RWEC will be infrequent and O&M activities will produce less emissions on a per year basis compared to those produced during construction

4.1.9.3 Onshore Facilities

Construction and Decommissioning

Air emission sources during construction and decommissioning of Onshore Facilities will include on-road and non-road equipment emissions related to HDD and cable pulling in addition to several construction vehicles. With the exception of few on-road vehicles burning gasoline, it is expected that most of the on-road and all of the non-road construction equipment will utilize diesel engines burning low-sulfur fuel.

Operations and Maintenance

O&M activities for the Onshore Facilities will primarily include on-road vehicles used by staff traveling to and from the Onshore Facilities. It will also include exercising and maintenance of an emergency generator system, which would be used in case of a power outage. O&M activities will produce less emissions on a per year basis compared to those produced during construction.

4.1.10 Visible Infrastructure

Project components that will be permanently visible will occupy space underwater, above water and on land have the potential to impact resources. Vessels, vehicles, and equipment used during construction will be visible for a limited time and only from certain locations on the OCS and portions of the mainland affected by onshore construction support. The temporary nature of these components during construction are anticipated to have a minimal impact on surrounding resources. Once the Project is constructed, the visible structures will be the WTGs, OSS structures, and the Onshore Facilities (OnSS, ICF, and TNEC ROW).

RWF and RWEC activities resulting in visible structures are presented in Table 4.1-1 and are further described below. Resources potentially impacted by visible structures are identified in Table 4.1-2, and further described in Sections 4.4 and 4.5. Impacts to visual resources and viewsheds are summarized in Section 4.5 and analyzed in Appendix U1, Appendix U2, and Appendix U3.

4.1.10.1 Revolution Wind Farm

Construction and Decommissioning

Construction of the RWF will include visible infrastructure located both onshore and offshore. From an onshore perspective, construction of the RWF will include assembly, fabrication, and temporary storage of Project components and crew transfer and logistics from existing port facilities. Project-related visible infrastructure at existing port facilities will include large WTG components, cranes for positioning and loading of the Project components, and vehicles and vessels associated with Project components and crew transportation. Detail regarding the location of existing port facilities and equipment associated with them is included in Section 3.3.9. The onshore components and activities associated with construction of the RWF are generally similar to other activities associated with working waterfront ports. In addition, these structures and activities will be temporary in nature. Similarly, the vessel activity associated with the construction of the RWF will increase the frequency of vessels around the ports but will not appear out of place considering existing vessel traffic.

From an offshore perspective, construction will introduce large installation vessels, increased vessel and air traffic, and the installation of large turbine components along the visible horizon and will often be visible from onshore vantage points. At times this activity could result in visual clutter on the horizon resulting from the complex construction process and multiple types of vessels involved. However, the visibility will be temporary in nature and at times, will be obscured from view due to atmospheric conditions or curvature of the earth. Upon decommissioning, the WTGs and OSSs will no longer be visible as they will be dissembled and removed from the area.

Operations and Maintenance

During the O&M phase, the WTGs and OSSs will occupy space in the ocean and above the water surface. Design specifications for the OSSs and WTGs are summarized in Table 3.3-14 and Table 3.3-21, respectively.

The WTGs and OSSs will be visible from points on land and water, and the degree of visibility is dependent on a range of physical factors including elevation, weather conditions, sea state, and visual obstructions. Visual quality and significance of impact depend on the existing visual landscape and viewer groups, as discussed in Section 4.5 and Appendix U3.

4.1.10.2 Revolution Wind Export Cable

Visual infrastructure associated with the RWEC will be limited to the construction and decommissioning phase. As described above for the RWF, construction will introduce large installation vessels and increased vessel and air traffic along the visible horizon and will often be visible from on shore vantage points. At times this activity could result in visual clutter on the horizon resulting from the complex construction process and multiple types of vessels involved. However, the visibility will be temporary in nature and at times, will be obscured from view due to atmospheric conditions or curvature of the earth.

4.1.10.3 Onshore Facilities

Construction and Decommissioning

Construction activity will result in some visible site disturbance, such as tree clearing, earth moving, and facility installation, all of which could temporarily alter the visual character of the landscape. Following construction activities, temporarily disturbed areas around the substation will be seeded (and stabilized, as necessary) to reestablish vegetative cover in these areas. The potential visibility of the substation is evaluated in Appendix U1. If the Onshore Facilities are removed when the Project is decommissioned, the visual effect of the structure will cease.

Operations and Maintenance

Once constructed, the above-ground Onshore Facilities may be viewed from a few areas within approximately 3 mi (4.8 km). The visibility analysis performed in support of Section 4.5, suggests that only 15 percent of the 3-mi (4.8-km) study area would have visibility of the above-ground Onshore Facilities. Existing mature vegetation will be maintained as feasible to help screen the facility from nearby residences. Where visible, it is expected that views of the above-ground Onshore Facilities will be limited to the immediate vicinity and portions of the Quonset Business Park and Air National Guard Base. Where the OnSS and ICF are visible from greater distances, the lightning masts, even if visible, will be difficult to distinguish on the horizon because of their narrow profile and gray color. Some Camp Avenue residences are likely to experience limited visual impacts as a result of the vegetative clearing. While these impacts are expected to alter the existing views experienced by the residents directly adjacent to the OnSS/ICF, they are generally localized and can be minimized through the use of mitigation, such as vegetative screening.

4.1.11 Lighting

The impacts of lighting depend on the lighting source and factors that can affect light transmission, both in air and water. In air, the transmission of light can be affected by atmospheric moisture levels, cloud cover, and type and orientation of lights. In water, turbidity levels and waves can affect light transmission distance and intensity. Project activities that could result in potential impacts by lighting are identified in Table 4.1-1 and are further described below.

4.1.11.1 Revolution Wind Farm

Construction and Decommissioning

There will be a temporary increase in the amount of lighting during construction and decommissioning due to the presence of work vessels. In general, lights will be required on offshore platforms and structures, vessels, and construction equipment during construction and decommissioning of the RWF. In addition, temporary work lighting will illuminate work areas on vessel decks or service platforms of adjacent WTGs or OSS platforms during nighttime construction. Project construction lighting will meet USCG requirements, when required by federal regulations. Upon decommissioning, all operational lighting, as described further below, will be removed.

Operations and Maintenance

During operations, offshore structures will require lighting that conforms to FAA and BOEM guidelines, and USCG requirements. BOEM has indicated that offshore lighting should meet standard specifications in FAA Advisory Circulars 70/7460-1L, Change 2 (FAA, 2018) and 150/5345-43H (FAA, 2016), and USCG standards for marine navigation lighting.

The FAA Advisory Circular outlines steps to clearly mark and light meteorological towers. Further, FAA navigation marking and lighting recommendations apply to structures that are up to 12 nm (22 km) offshore. The majority of WTGs located in the RWF are outside of 12 nm (22 km), and under the jurisdiction of BOEM, however, portions of the RWF Lease Area are within 12 nm (22 km) of Rhode Island and Massachusetts. The FAA provides guidelines for wind turbines to be marked and lit during construction, O&M, and decommissioning to provide day and night conspicuity and to assist pilots in identifying and avoiding these obstacles (FAA, 2018).

Project lighting will follow lighting and marking design parameters as identified in BOEM's *Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development*, released October 2019. Control, lighting, marking, and safety systems will be installed on each WTG; the specific systems will vary depending on the turbine selected, and will be reviewed by the selected CVA and provided in the FDR.

Offshore turbines must be visible not only to pilots in the air, but also mariners navigating on water. In daylight, offshore wind turbines do not require lighting if the tower and components are painted white. The FAA and USCG consider white-colored turbines to be the most effective early warning technique for both pilots and mariners (Patterson, 2005). Marine Navigation Lighting (MNL) is regulated by the USCG through 33 CFR 67 [63]. Structures must be fitted with lights for nighttime periods.

A conceptual lighting scheme was developed in accordance with federal regulations and is included in the Navigation Safety Risk Assessment (Appendix R). A summary of this conceptual scheme is provided as follows:

- Special Peripheral WTGs are considered Class A structures. As such, they will be equipped with a flashing white light visible to 5 nm.
- Intermediate Peripheral WTGs are considered Class B structures. These will be equipped with a flashing white light visible to 3 nm.
- Internal WTGs are Class C structures. These must be fitted with white or red lights visible to at least 1 nm.
- All WTG unique identifiers/labels will be visible at a distance of at least 150 yards (137.2 m) for using lighting or phosphorescent material.
- The OSSs will be equipped with one or more lights. The number and arrangement of the lights will depend on the horizontal length of the platform.

As described above for RWF construction, USCG-approved navigation lighting is required for all vessels operating between dusk and dawn.

The OSSs will be lit and marked in accordance with FAA and USGS requirements for aviation and navigation obstruction lighting, respectively.

4.1.11.2 Revolution Wind Export Cable

Construction and Decommissioning

Similar to RWF, USCG-approved navigation lighting is required for all vessels during construction and decommissioning of the RWEC. All vessels operating between dusk and dawn are required to turn on navigation lights. Cable laying may occur 24 hours a day during certain periods, and these vessels will be illuminated at night for safe operation.

Operations and Maintenance

Lighting during the O&M phase will be short term, limited to the lighting required on vessels while operating along the corridor.

4.1.11.3 Onshore Facilities

Construction and Decommissioning

While most onshore construction will occur during daylight hours, some overnight lighting may be necessary for safety or to complete necessary work.

Operations and Maintenance

Considering the presence of an existing electrical substation and industrial uses of the area, new lighting associated with the OnSS and ICF can adversely affect residences directly adjacent to these facilities. These effects can be reduced through the use of mitigation such as visual screening. Lighting for the OnSS and ICF will be designed to the minimum standard necessary for substation safety and security per utility operational requirements, as well as state and local regulations. General yard lighting will be provided within the OnSS and ICF area for assessment of equipment. In general, yard lighting will be off at night unless is it necessary for work in progress on site or lights are left on for safety and security purposes.

4.2 Physical Resources

4.2.1 Air Quality

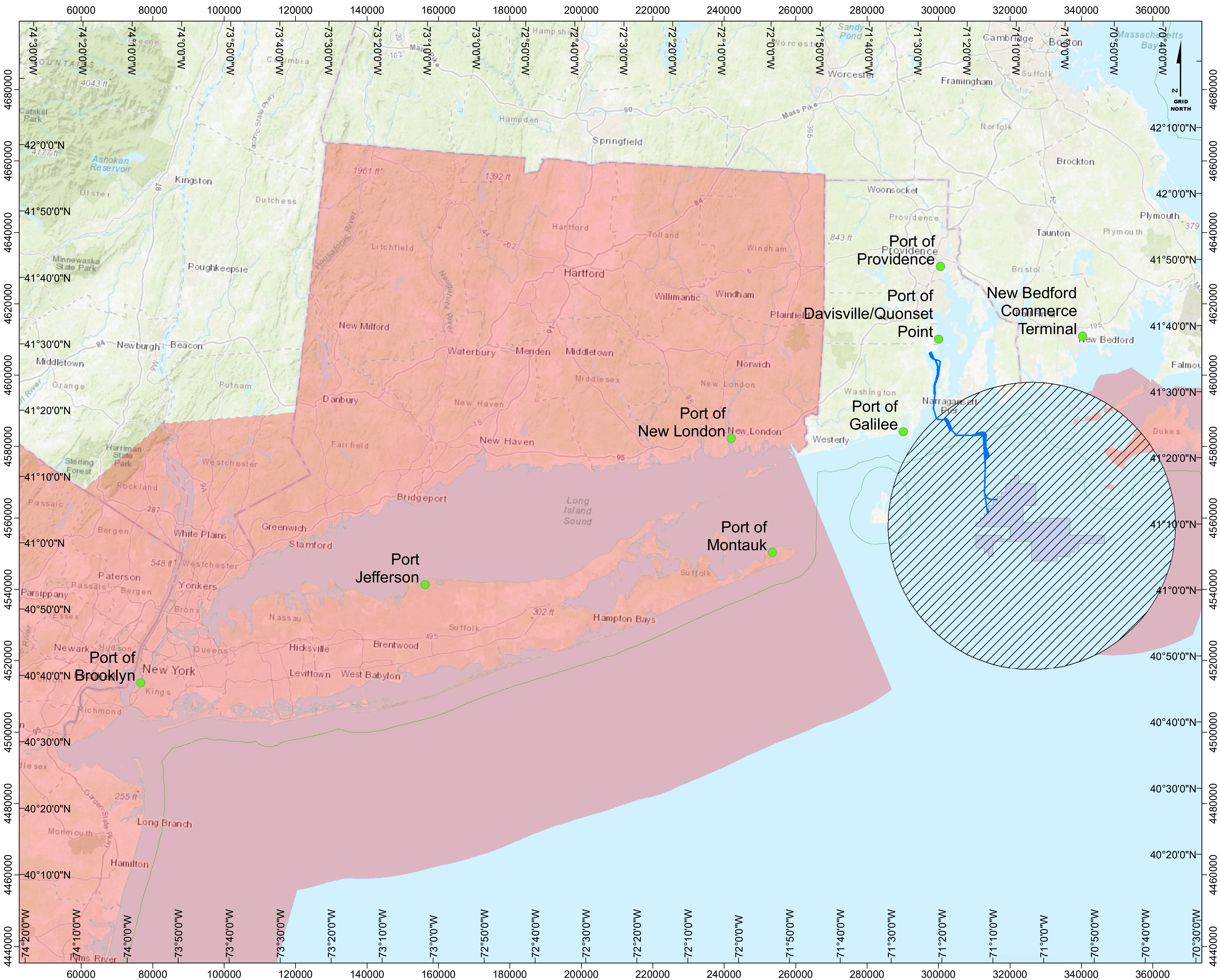
This section defines the affected environment as it relates to air resources and potential emissions from the RWF, RWEC-OCS, RWEC-RI, and Onshore Facilities (as defined in Section 1.1, Figure 1.1-1). It also summarizes the potential emissions from the three phases of the Project and presents them categorically according to the expected Clean Air Act (CAA) and NEPA review. The discussion of the affected environment for air quality is followed by an evaluation of potential Project-related impacts based on the expected Project air emissions. The environmental protection measures that Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to air quality are summarized following the Project air emissions and impact discussion.

The description of the affected environment and assessment of potential impacts to air quality were determined by reviewing federal and state air quality resources and comparing the existing conditions to those emissions that are expected to occur from the Project construction and O&M activities as calculated herein, per BOEM guidance.

All project emissions that occur within 200 nautical miles from shore are subject to NEPA review. In addition to NEPA review, emissions that occur within 25 miles of the RWF centroid (OCS Permit Area), and emissions that occur within 25 miles of shore and nearest to an area that is not in attainment with the National Ambient Air Quality Standards (NAAQS) (General Conformity) are also subject to review under the CAA. Figure 4.2.1-1 shows the OCS Permit Area and General Conformity areas where project emissions may occur. It should be noted that the OCS Permit Area includes a portion of Rhode Island State Waters where the RWEC - RI will be laid. Therefore, because this portion of the RWEC - RI will not be subject to General Conformity it is instead allocated to the RWEC - OCS when discussing air quality. The methodology and detailed results of the Project's air emissions inventory, along with additional detail regarding regulation of air emissions, are found in Appendix T.

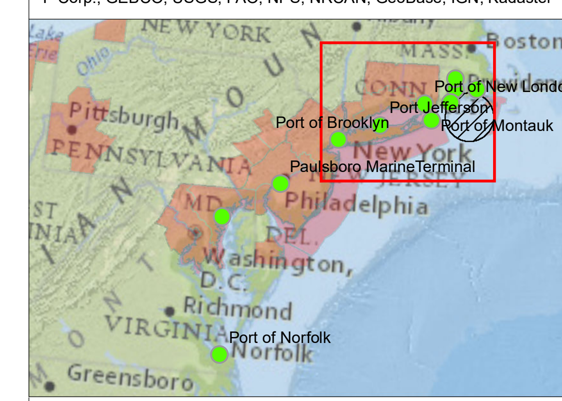
The NAAQS, provided in parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter ($\mu g/m^3$), were established by EPA to protect the public from common pollutants, known as criteria pollutants, which pose a risk to health. The current NAAQS for each of the criteria pollutants are presented in Table 4.2.1-1. The six criteria pollutants that comprise the NAAQS include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and particulate matter (PM). PM is a mixture of solid particles and liquid droplets found in the air and includes particles of varying sizes, categorized in the NAAQS as being smaller than 10 micrometers in diameter (PM_{10}) or smaller than 2.5 micrometers in diameter ($PM_{2.5}$) (40 CFR § 50). The standards are based on the total concentration of a criteria pollutant in ambient air that is accessible to the public. In an effort to achieve and maintain the standards, each state is required to monitor the ambient air to determine whether the state or area is in compliance. Therefore, baseline air quality conditions are typically evaluated by comparing the ambient concentration of a criteria pollutant, as measured at the nearest air monitoring station, to the NAAQS to determine whether the ambient concentration is in exceedance of any of the criteria pollutant standards.

Revolution Wind
Figure 4.2.1-1
Air Quality Project Area



Legend
- Lease Area
- RWEC Corridor
- Area Subject to OCS Permit
- General Conformity Areas
- Potential Ports

Anchorage, Environmental: Fugro
Shellfish Areas: MDMR
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 10000 20000 30000 Meters

0 50,000 100,000 150,000 Feet

Date: 04/06/2021
Document no:

Created by: K. MEARS
Approved by: M. WALLACE

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The General Conformity Rule ensures that federal actions do not interfere with a state's plan to attain or maintain the NAAQS in areas that are not in compliance with one or more of the standards, called a nonattainment area, or areas that have been out of compliance with one or more of the standards, called a maintenance area after re-establishing attainment. Before determining whether the General Conformity Rule is applicable, BOEM first must estimate emissions from the Project, which will not include those emissions already accounted for in the OCS Air Permit. General Conformity air emissions include onshore emissions and those within 25 miles (40.2 km), but outside the 25-mile radius centroid. If the estimated emissions for each pollutant are less than the applicable thresholds presented in Tables 4.2.1-2 and 4.2.1-3, the General Conformity Rule does not apply. In addition to the criteria pollutants, the thresholds also include volatile organic compounds, which can react in the atmosphere to form ozone.

Table 4.2.1-1 Criteria Pollutants National Ambient Air Quality Standards

Criteria Pollutant	Primary/Secondary	Averaging Time	Standard	
			Concentration	Form
CO	Primary	8 hours	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Lead	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	1 year	53 ppb	Annual mean
NO_2	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	1 year	53 ppb	Annual mean
Ozone	Primary and Secondary	8 hours	0.070 ppm	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years
$PM_{2.5}$	Primary	1 year	12 μg/m^3	Annual mean, averaged over 3 years
	Secondary	1 year	15 μg/m^3	
	Primary and Secondary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
PM_{10}	Primary and Secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Table 4.2.1-2 Nonattainment Areas Clean Air Act Conformity *de minimis* Emission Thresholds

Criteria Pollutant	tpy
40 CFR § 93.153(b)(1) – For purposes of paragraph (b) of this section the following rates apply in nonattainment area (NAAs):	
Ozone (volatile organic compounds or oxides of nitrogen):	
› Serious Nonattainment Areas	50
› Severe Nonattainment Areas	25
› Extreme Nonattainment Areas	10
Other ozone nonattainment areas outside an ozone transport region	100
Other ozone nonattainment areas inside an ozone transport region:	
› Volatile organic compounds (VOC)	50
› Oxides of nitrogen (NO_X)	100
Carbon monoxide (CO): All Nonattainment Areas	100
Sulfur dioxide (SO_2) or nitrogen dioxide (NO_2): All Nonattainment Areas	100
Particulate Matter smaller than 10 microns (PM_{10}):	
› Moderate Nonattainment Areas	100
› Serious Nonattainment Areas	70
Particulate matter smaller than 2.5 microns ($PM_{2.5}$) (direct emissions, SO_2, NO_X, VOC, and ammonia):	
› Moderate Nonattainment Areas	100
› Serious Nonattainment Areas	70
Lead: All Nonattainment Areas	25

Table 4.2.1-3 Maintenance Areas Clean Air Act Conformity *de minimis* Emission Thresholds

Criteria Pollutant	tpy
40 CFR § 93.153(b)(2) – For purposes of paragraph (b) of this section the following rates apply in maintenance areas:	
Ozone (NO_X), SO_2, or NO_2: All Maintenance Areas	100
Ozone (VOCs):	
› Maintenance areas inside an ozone transport region	50
› Maintenance areas outside an ozone transport region	100
CO: All maintenance areas	100

Criteria Pollutant	tpy
PM_{10}: All Maintenance areas	100
$PM_{2.5}$ (direct emissions, SO_2, NO_X, VOC, and ammonia): All maintenance areas	100
Lead: All maintenance areas	25

4.2.1.1 Affected Environment

Regional Overview

In 2013, prior to issuing the commercial wind leases for RI-MA WEA, BOEM prepared an EA of the WEA to evaluate the reasonably foreseeable environmental impacts and socioeconomic effects of issuing renewable energy leases and subsequent site characterization activities (BOEM, 2013). Included within the EA was an assessment of the existing air quality and the predominant emission sources in the WEA. It was presented in BOEM's EA that air emissions and the corresponding air quality in the RI-MA WEA is predominantly driven by vessels, as traffic transits to and from the many northeast commercial ports. Southerly winds in the region have the potential to transport these emissions onshore. Conversely, air quality in the RWF, is also influenced by onshore sources, as pollutants may also be carried offshore by westerly winds (BOEM, 2013). In comparison to existing emission sources regularly traversing the region, an incremental increase in vessel traffic and related emissions will result from the Project construction, O&M, and decommissioning. Although there are no air monitoring stations located offshore, the regional air quality discussed below effectively characterizes the offshore affected environment.

The scope of the affected environment for the assessment of potential Project-related emissions and impacts to ambient air quality encompass offshore areas and those states and counties where Project activities may occur. Construction and O&M activities may use several regional, existing port facilities, including:

- Port of Providence (Providence County, Rhode Island)
- Port of Davisville and Quonset Point (Washington County, Rhode Island)
- Port of Galilee (Washington County, Rhode Island)
- Port of Montauk (Suffolk County, New York)
- Port Jefferson (Suffolk County, New York)
- Port of Brooklyn (Kings County, New York)
- Port of New London (New London County, Connecticut)
- Paulsboro Marine Terminal (Gloucester County, New Jersey)
- New Bedford Marine Commerce Terminal (Bristol County, Massachusetts)
- Port of Norfolk (Norfolk City, Virginia)
- Sparrow's Point (Baltimore County, Maryland)

For the purposes of this discussion, the existing air quality conditions for each county where port activities may occur were evaluated.

According to EPA's Green Book, which provides the NAAQS attainment status for each state and/or county in the country, all of Rhode Island, Bristol County, Massachusetts, and Norfolk City, Virginia are attainment areas. Suffolk County, New York and Gloucester County, New Jersey are not in attainment with the 8-hour ozone standard and are maintenance areas for $PM_{2.5}$. New London County, Connecticut and Dukes County, Massachusetts and are not in attainment with the 8-hour ozone standard. Baltimore County, Maryland, is not in attainment with the 8-hour ozone standard or the SO_2 standard (EPA, 2019). Table 4.2.1-4 presents the attainment status for each potential Project area.

Table 4.2.1-4 Project Counties Criteria Pollutant Attainment Status

State	Designation Area	Attainment Status	Criteria Pollutants						
			CO	Lead	NO_2	Ozone	$PM_{2.5}$	PM_{10}	SO_2
RI	Providence County	Nonattainment							
		Maintenance							
		Attainment	✓	✓	✓	✓	✓	✓	✓
	Washington County	Nonattainment							
		Maintenance							
		Attainment	✓	✓	✓	✓	✓	✓	✓
NY	Kings County	Nonattainment				✓			
		Maintenance	✓				✓		
		Attainment		✓	✓			✓	✓
	Suffolk County	Nonattainment				✓			
		Maintenance					✓		
		Attainment	✓	✓	✓			✓	✓
CT	New London County	Nonattainment				✓			
		Maintenance							
		Attainment	✓	✓	✓		✓	✓	✓
NJ	Gloucester County	Nonattainment				✓			
		Maintenance					✓		
		Attainment	✓	✓	✓			✓	✓
MA	Dukes County	Nonattainment				✓			
		Maintenance							
		Attainment	✓	✓	✓		✓	✓	✓
	Bristol County	Nonattainment							

State	Designation Area	Attainment Status	Criteria Pollutants						
			CO	Lead	NO_2	Ozone	$PM_{2.5}$	PM_{10}	SO_2
		Maintenance							
		Attainment	✓	✓	✓	✓	✓	✓	✓
VA	Norfolk City	Nonattainment							
		Maintenance							
		Attainment	✓	✓	✓	✓	✓	✓	✓
MD	Baltimore County	Nonattainment				✓			✓
		Maintenance							
		Attainment	✓	✓	✓		✓	✓	

In addition to the criteria pollutants discussed above, air pollutants can be categorized as toxic or hazardous air pollutants (HAPs) or greenhouse gases (GHGs). There are no ambient air quality standards for HAPs or GHGs; however, emissions are regulated through national manufacturing standards and permit requirements. HAPs are those pollutants known, or suspected, to cause cancer or other serious health impacts, such as reproductive impacts or birth defects, or adverse environmental impacts. Examples of HAPs include benzene; dioxin; asbestos; toluene; and metals, such as cadmium, mercury, chromium, and lead. GHGs are gases that trap heat in the atmosphere and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases such as sulfur hexafluoride (SF_6). Many criteria pollutant monitoring stations also measure HAPs, which are then reported to EPA on a yearly basis to produce the "Monitor Values Report" (MVP). In the case of GHGs, EPA regulates total GHGs expressed as carbon dioxide equivalent (CO_2e). 40 CFR § Part 98 requires GHG emitters, fossil fuel suppliers, industrial gas suppliers, and facilities that inject CO_2 underground for sequestration or other reasons to report their GHG emissions so that individual states can produce an annual GHG emissions inventory.

Although the MVP presents data on many different HAPs, only those that are associated with fuel oil combustion and are routinely measured were evaluated for the purposes of establishing a baseline for the affected environment. These include acetaldehyde, benzene, and formaldehyde. Although HAPs are monitored at most monitoring stations, many do not measure for every HAP; therefore, the ambient concentration of fuel oil HAPs were evaluated for the entire state of Rhode Island, New York, Connecticut, New Jersey, Massachusetts, Virginia, and Maryland. Similar to HAPs, GHG data is not available for specific counties; therefore, the annual production of GHGs were also evaluated for each state.

Rhode Island

The discussion of air quality related to Project activity in Rhode Island applies to the Rhode Island territorial waters where port activity may occur. The Port of Davisville and Port of Galilee are being considered for construction and O&M support activities; while the Port of Providence is being considered for WTG and OSS foundations commissioning and fabrication activities. Although air quality data are not available specifically for Rhode Island State Waters, the RIDEM, in conjunction with the Rhode Island Department of Health, operates a network of eight air monitoring stations throughout the state that measure ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone.

Per EPA's MVP, concentrations of diesel HAPs in Rhode Island have been generally decreasing over the last ten years. The ten-year concentrations of acetaldehyde, benzene, and formaldehyde were generally at their highest in 2009 and their lowest in 2013 to 2014. The reported concentrations since 2014 have been slightly higher but are generally steady. For more details on the HAP trends in Rhode Island, see Appendix T.

Per the 2016 Rhode Island Greenhouse Gas Emissions Reduction Plan, emissions of GHGs in Rhode Island have been estimated at 11.3 million metric tons of CO_2e in 2015 (Executive Climate Change Coordinating Council [EC4], 2016). This is on target to meet the 2020 limit of 11.23 million metric tons of CO_2e in accordance with the 2014 Resilient Rhode Island Act, which outlines programs and policies the state could undertake to meet its commitment to reduce annual GHG emissions to at least 10 percent less than 1990 levels by 2020, and up to 80 percent less than 1990 levels by 2050 (EC4, 2016). For more details on the GHG trends in Rhode Island, see Appendix T.

New York

The discussion of air quality in New York applies to the New York territorial waters where port activity may occur. The Project may use three existing New York port facilities for construction support and O&M activities, Port of Montauk and Port Jefferson, both of which are in Suffolk County, and Port of Brooklyn which is in Kings County. Although air quality data are not available specifically for New York State Waters, the New York State Department of Environmental Conservation (NYSDEC), operates a network of 58 air monitoring stations throughout the state that measure ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone.

Per EPA's MVP, concentrations of diesel HAPs in New York have been generally decreasing over the last ten years. Other than acetaldehyde, the ten-year concentrations of the HAPs were at their highest in 2009 and their lowest in 2014. The reported concentrations since 2014 are slightly higher but are generally steady. For more details on the HAP trends in New York, see Appendix T.

Per the 2019 New York State Greenhouse Gas Inventory, emissions of GHGs in New York have been estimated at 205.6 million metric tons of CO_2e in 2016 (New York State Energy Research and Development Authority [NYSERDA], 2019). This is on target to meet the 2030 limit of 141.7 million metric tons of CO_2e in accordance with New York's State Energy Plan, which outlines programs and policies the state could undertake to meet its commitment to reduce annual GHG emissions to at least 40 percent less than 1990 levels by 2030 and up to 80 percent less by 2050 (New York State [NYS], 2015). For more details on the GHG trends in New York, see Appendix T.

Connecticut

The discussion of air quality related to Project activity in Connecticut applies to the Connecticut territorial waters where port activity may occur. The Project may use one existing Connecticut port facility during construction for WTG pre-commissioning activities, the Port of New London in New London County. Although air quality data are not available specifically for Connecticut State waters, the Connecticut Department of Energy and Environmental Protection (CT DEEP), operates a network of 15 air monitoring stations throughout the state that measures ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone.

Since diesel HAP concentrations for Connecticut were not available through EPA's MVP, concentrations of diesel HAPs in Connecticut were determined from EPA's Ambient Monitoring Archive (EPA, AMA). The ambient concentrations of acetaldehyde, benzene, and formaldehyde between 2007 and 2015 were evaluated for Connecticut and it was found that ambient concentrations have been generally steady. The six-year concentrations of all three HAPs between 2007 and 2012 were at their highest in 2007 and their lowest in 2012, the last year that all three HAPs were reported. For more details on the HAP trends in Connecticut, see Appendix T.

Per the 2016 Connecticut Greenhouse Gas Emissions Inventory, Connecticut GHG emissions have been estimated at 41.1 million metric tons of CO_2e in 2016 (CT DEEP, 2018). This is on target to meet the 2020 limit of 40.71 million metric tons of CO_2e in accordance with the Global Warming Solutions Act (GWSA), which outlines programs and policies the state could undertake to meet its commitment to reduce annual GHG emissions to at least 10 percent less than 1990 levels by 2020, and up to 45 and 80 percent less than 2001 levels by 2030 and 2050, respectively (CT DEEP, 2018). For more details on the GHG trends in Connecticut, see Appendix T.

New Jersey

The discussion of onshore air quality related to Project activity in New Jersey applies to the New Jersey territorial waters where port activity may occur. The Project may use one existing New Jersey port facility during construction for foundation fabrication activities, the Paulsboro Marine Terminal in Gloucester County. Although air quality data are not available specifically for New Jersey State waters, the New Jersey Department of Environmental Protection (NJDEP), operates a network of 32 air monitoring stations throughout the state that measures ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone.

Per EPA's MVP, concentrations of diesel HAPs in New Jersey have been generally steady over the last ten years. The ten-year concentrations of all three HAPs were at their highest in 2014 and their lowest in 2018. For more details on the HAP trends in New Jersey, see Appendix T.

Per the 2015 Statewide Greenhouse Gas Emissions Inventory, emissions of GHG in New Jersey have been estimated at 100.9 million metric tons of CO_2e in 2015 (NJDEP, 2017). This is less than the 2020 target of 125.6 million metric tons of CO_2e, in accordance with the 2007 Global Warming Reduction Act, which outlines programs and policies the state could undertake to meet its commitment to reduce annual GHG emissions to at least 1990 levels by 2020, and up to 80 percent less than 2006 levels by 2050 (NJDEP, 2017). For more details on the GHG trends in New Jersey, see Appendix T.

Massachusetts

The Project may use one existing Massachusetts port facility during construction for WTG pre-commissioning activities, the New Bedford Marine Commerce Terminal in Bristol County. In addition, as the nearest onshore area (NOA) the Project emissions have the potential to impact Dukes County, Massachusetts. Although air quality data are not available specifically for Massachusetts State waters, the Massachusetts Department of Environmental Protection (MassDEP), operates a network of 22 air monitoring stations throughout the state that measure ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone. In addition, MassDEP receives data from the Wampanoag Tribe of Gay Head (Aquinnah), which operates an air monitoring station on Martha's Vineyard, in Dukes County, Massachusetts.

Per EPA's MVP, concentrations of diesel HAPs in Massachusetts have been generally steady over the last ten years. The ten-year concentrations of all three HAPs peaked in 2013 to 2015 and have since returned to similar concentrations as 2009. For more details on the HAP trends in Massachusetts, see Appendix T.

Per the 2020 Statewide Greenhouse Gas Emissions Level Report, GHG emissions have been estimated at 73.3 million metric tons of CO_2e in 2017 (MassDEP, 2020). This is on target to meet the 2020 limit of 70.8 million metric tons of CO_2e in accordance with the GWSA, which outlines programs and policies the state could undertake to meet its commitment to reduce annual GHG emissions to at least 25 percent less than 1990 levels by 2020, and up to 80 percent less than 1990 levels by 2050 (MassDEP, 2020). For more details on the GHG trends in Massachusetts, see Appendix T.

Virginia

The Project may use one existing Virginia port facility during construction for WTG pre-commissioning activities, the Port of Norfolk in Norfolk City. Although air quality data are not available specifically for Virginia State waters, the Virginia Department of Environmental Quality (DEQ), operates a network of 38 air monitoring stations throughout the state that measures ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone.

Per EPA's MVP, concentrations of diesel HAPs in Virginia have been generally decreasing over the last ten years. With the exception of benzene, the ten-year concentrations of the HAPs were at their highest in 2010 and their lowest in 2015 to 2016. The reported concentrations since 2016 have been slightly higher but are generally steady. For more details on the HAP trends in Virginia, see Appendix T.

Virginia has not performed a greenhouse gas emissions inventory; therefore, GHG emissions specific to Virginia are not discussed.

Maryland

The Project may use one existing Maryland port facility during construction for foundation fabrication activities, Sparrow's Point in Baltimore County. Although air quality data are not available specifically for Maryland State waters, the Maryland Department of the Environment (MDE), operates a network of 24 air monitoring stations throughout the state that measures ambient concentrations of criteria pollutants; HAPs; and ozone precursors, which are substances that react in the atmosphere to form ground-level ozone.

Per EPA's MVP, concentrations of diesel HAPs in Maryland have been generally decreasing over the last ten years. It should be noted that acetaldehyde and formaldehyde are monitored at only one location in Maryland; therefore, the measured ambient concentrations are susceptible to local variations in air quality, rather than being an average of the entire state. Acetaldehyde peaked in 2015 and 2016, before returning to an ambient concentration less than 1.0 micrograms per cubic meter. Benzene peaked in 2012 before also returning to an ambient concentration less than 1.0 micrograms per cubic meter. Prior to 2018, ambient formaldehyde concentrations had peaked in 2010, however, measured concentrations in 2018 were slightly higher than those measured in 2010. For more details on the HAP trends in Maryland, see Appendix T.

Per Maryland's 2017 Periodic GHG Emissions Inventory, emissions of GHGs in Maryland have been estimated at 78.5 million metric tons of CO_2e in 2017 (MDE, 2017). This is below the 2020 limit of 80.4 million metric tons of CO_2e, in accordance with the state's Greenhouse Gas Emissions Reduction Act (GGRA) Plan, which outlines programs and policies the state could undertake to meet its commitment to reduce annual GHG emissions to at least 25 percent less than 2006 levels by 2020 (MDE, 2015). For more details on the GHG trends in Maryland, see Appendix T.

RWEC –OCS

Similar to the RWF, the discussion of baseline offshore air quality conditions specific to RWEC–OCS, applies to the vessel traffic that is expected to occur in the OCS Permit Area. Since the offshore component of RWF and RWEC–OCS are expected to occur within the same OCS area, the baseline conditions associated with RWEC–OCS is the same as that of the offshore component of the RWF. Refer to offshore discussion in the Regional Overview section for an evaluation of the affected environment related to RWEC–OCS.

RWEC–RI

The RWEC–RI segment traverses the RWEC route outside of the OCS Permit area on its way to landfall at Quonset Point in North Kingstown, Rhode Island (Washington County). As discussed above, there is no air quality data available specifically for Rhode Island State waters. Therefore, the discussion of baseline conditions for RWEC–RI is the same as that of Rhode Island port activities, specifically Washington County. Refer to the discussion of Rhode Island air quality above, for an evaluation of the affected environment conditions related to RWEC-RI near Washington County, Rhode Island.

Onshore Facilities

The discussion of baseline air quality conditions specific to Onshore Facilities, applies to the onshore segment of the RWEC, the Landfall Work Area, the Onshore Transmission Cable, the OnSS, and ICF. The Onshore Facilities are located in the Quonset Business Park in North Kingstown, Rhode Island (Washington County). Refer to the discussion of Rhode Island air quality above for an evaluation of the affected environment related to Onshore Facilities.

Summary

BOEM prepared an EA of RI-MA WEA that included an assessment of the offshore baseline air quality conditions and the predominant emissions sources in the WEA (BOEM, 2013). The assessment of the onshore baseline air quality conditions is based on air monitoring stations operated by the Rhode Island, New York, Connecticut, New Jersey, Massachusetts, Virginia, and Maryland state environmental regulatory agencies. It is anticipated that the trend of improving air quality will continue with expected changes in energy production, air emission standards, and emission control technologies.

As discussed in Section 4.2.1, the attainment status of areas where Project activities are expected to occur determines the applicable *de minimis* thresholds from Tables 4.2.1-2 and 4.2.1-3. Since Washington County, Providence County, Bristol County, and Norfolk City, are attainment areas, the General Conformity Rule does not apply to the Project emissions nearest to these areas. Since Suffolk County, Kings County and New London County are in marginal and serious nonattainment with the 2015 and 2008 8-hour ozone standard, respectively, the emissions nearest to New York and Connecticut presented in Section 4.2.1.2 will be compared to the de minimis thresholds presented in Table 4.2.1-5 below. Kings County is also a CO maintenance area and is the only area of Project activity that is subject to General Conformity for CO. Therefore, the CO emissions nearest to New York presented in Section 4.2.1.2 will also be compared to the

CO de minimis threshold presented in Table 4.2.1-5. Since Gloucester County is a moderate maintenance with $PM_{2.5}$ and in moderate nonattainment with the 2015 and 2008 8-hour ozone standards, the emissions nearest to New Jersey presented in Section 4.2.1.2 will be compared to the de minimis thresholds presented in Table 4.2.1-5 below. Since Baltimore County is in marginal and moderate nonattainment with the 2015 and 2008 8-hour ozone standard, respectively, and out of attainment with the 2010 SO_2 standard, the emissions nearest to Maryland presented in Section 4.2.1.2 will be compared to the *de minimis* thresholds presented in Table 4.2.1-5 below. Because emissions that are expected to occur nearest to Dukes County are included in the OCS Air Permit emissions, Dukes County emissions are not applicable to General Conformity, so the de minimis thresholds in this area have been omitted from Table 4.2.1-5.

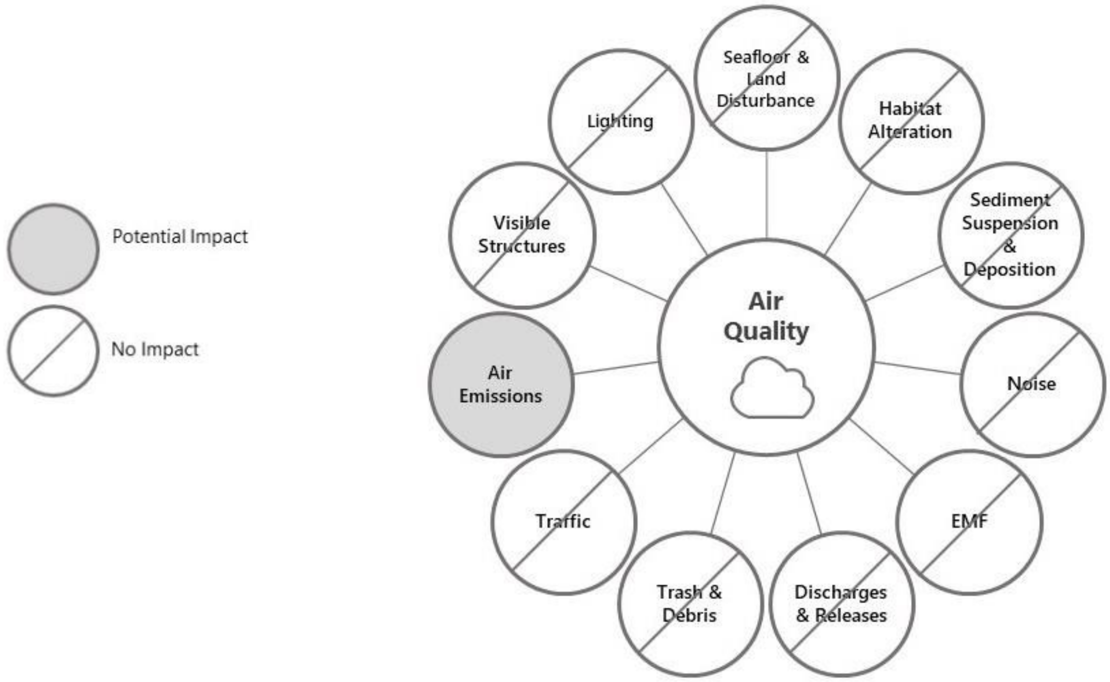
Table 4.2.1-5 Applicable General Conformity *de minimis* Thresholds Based on Project Counties' Attainment Status

State	County	CO	Lead	NO_X	VOCs	$PM_{2.5}$	PM_{10}	SO_2
		tpy	tpy	tpy	tpy	tpy	tpy	tpy
RI	Washington County	Attainment Area - Not Applicable (N/A)						
	Providence County	Attainment Area - Not Applicable (N/A)						
NY	Kings County	100	-	50	50	100	100	100
	Suffolk County	-	-	50	50	100	100	100
CT	New London County	-	-	50	50	-	-	-
NJ	Gloucester County	-	-	100	50	100	100	100
MA	Bristol County	Attainment Area - Not Applicable (N/A)						
VA	Norfolk County	Attainment Area - Not Applicable (N/A)						
MD	Baltimore City	-	-	100	50	-	-	100

4.2.1.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the existing air quality conditions discussed above (Section 4.2.1.1). A summary of the IPFs that could potentially impact air quality are depicted in Figure 4.2.1-2. The primary causes of potential air quality impacts from the RWF and RWEC include air emissions from vessels, vehicles, helicopters, and stationary engines. More detailed information regarding potential impacts on air quality can be found in Appendix T.

Figure 4.2.1-2 IPFs on Air Quality



The operation of the WTGs will not itself emit any contaminants, but there will be emissions associated with installation of the turbines and other activities associated with construction, O&M, and the decommissioning of the Project. Emissions have been estimated separately for each phase of the Project. The primary causes of potential air quality impacts from the RWF and RWEC include emissions from vessels, vehicles, helicopters, and stationary engines. These sources are further categorized in the emissions inventory presented in Appendix T.

Project-related aircraft, vessel, vehicle, and equipment usage will generate emissions offshore and onshore, predominantly during the approximate 18-month construction phase. This analysis presumes that construction could occur as quickly as one year to be conservative. During the 20- to 35-year estimated O&M phase, the RWF and RWEC will generate few emissions from infrequent use of equipment engines, vessels, and vehicles. O&M activities will produce relatively little emissions compared to those produced during construction. Emissions from decommissioning are estimated to be a percentage of construction-phase emissions – though similar construction activities will be conducted to decommission Project components; the activity will be of a much shorter duration. However, decommissioning activities would occur 20-to-35 years in the future when combustion energy and pollution control technologies will be different, so it is speculative to predict emissions.

A summary of the air quality Study Area has been provided below that details the locations of potential emission sources associated with each Project segment, potential port, and the applicable air quality regulatory program for each segment. The Project segments described below have different existing air quality conditions; therefore, in addition to their differing applicability to regulatory programs, the segments are used for comparing to location-specific air quality conditions to make a determination of whether the air quality impacts have the potential to be direct or indirect, and short-term or long-term.

Study Area

Table 4.2.1-6 provides details on the air quality Study Area that is intended to help the reader understand the Project segment activities, impacted states, and port transit distances, that are used to determine the emissions presented in this section, and to which regulatory program the emissions are allocated to. The estimated emissions are associated with the construction, O&M and decommissioning of RWF, RWEC-OCS, RWEC-RI, or Onshore Facilities.

OCS Air Permit emissions include emissions from OCS sources, vessels meeting the definition of OCS Source (40 CFR § 55.2), and vessels traveling to and from the Project when within 25 mi (40.2 km) of the RWF's centroid. General Conformity air emissions include emissions outside of the 25-mi (40.2-km) radius centroid and within 25 mi (40.2 km) of a state's seaward boundary. General Conformity emissions are apportioned to the state nearest to where the emissions will occur based on the assumptions for Project vessel trips between the RWF and ports, as well as the RWEC landfall location. NEPA emissions include emissions that occur outside of the OCS Permit Area, and beyond 25 mi of any onshore area, and therefore, are not subject to any other permitting or General Conformity programs. In addition, emissions that are expected to occur within 25 mi of shore, but nearest to attainment areas are also only subject to NEPA. Emissions that could occur beyond 200 nautical miles from shore (outside of federal waters) during travel to and from European ports are not considered within the OCS Permit, General Conformity, or NEPA review process and so are not provided herein.

For those ports that are along the coastline, the emissions from transit were determined using a linear distance between the Project centroid and the port, per the BOEM Wind Tool Technical Documentation. This method was used for Port of Providence, Port of Davisville/Quonset Point, Port of Galilee, Port of Montauk, Port Jefferson, Port of Brooklyn, Port of New London, New Bedford Marine Commerce Terminal, and Port of Norfolk. For ports that are up river, the emissions from the coastline to the port were determined using the U.S. Department of Commerce's (DOC) 2019 Distances Between United States Ports document (DOC, 2019). This method was used for Paulsboro Marine Terminal and Sparrow's Point. Using this method, the linear distance was determined between the Project centroid and Cape May, which was added to the distance from Cape May to Paulsboro Marine Terminal provided in the DOC document. Similarly, the linear distance between the Project centroid and Port of Norfolk was added to the distance from Port of Norfolk to the Potomac River (Virginia), and the Potomac River to Sparrow's Point (Maryland), as provided in the DOC document from for Sparrow's Point.

Table 4.2.1-6 Air Quality Study Area and Emissions Allocation

Project Segment	Segment Description	Project Activity	Nearest State	Transit Distance	Applicable Regulatory Program
RWF	A circular area with a 25-mile (40.2 km) radius, in which the WTGs and OSSs are in the center, and all emissions within the area are subject to OCS air permitting.	Marine Vessels (transit & on-site) Helicopters (transit & on-site)	N/A	25 miles (40.2 km)	OCS Air Permit
		Generators	N/A	N/A	
	Area outside of OCS Permit Area in which transit to Port of Providence may occur.	Marine vessels (transit)	Rhode Island	18.9 miles (30.4 km)	NEPA[1]
		Non-road equipment On-road vehicles		N/A	
	Area outside of OCS Permit Area in which transit to Port of Davisville/Quonset Point may occur.	Marine vessels (transit) Helicopters (transit)	Rhode Island	5.9 miles (9.5 km)	NEPA[1]
	Area outside of OCS Permit Area in which transit to Port of Galilee may occur.	Marine vessels (transit) Helicopters (transit)	Rhode Island	2.6 miles (4.3 km)	NEPA[1]
	Area outside of OCS Permit Area in which transit to Port of Montauk may occur	Marine vessels (transit)	New York	16.5 miles (26.6 km)	General Conformity (See Table 4.2.1-5)
	Area outside of OCS Permit Area in which transit to Port Jefferson may occur	Marine vessels (transit)	New York	76.3 miles (122.8 km)	General Conformity (See Table 4.2.1-5)
	Area outside of OCS Permit area in which transit to Port of Brooklyn may occur.	Marine vessels (transit)	New York	132.1 miles (212.6 km)	General Conformity (See Tables 4.2.1-5)
	Area outside of OCS Permit Area in which transit to Port of New London may occur	Marine vessels (transit)	Connecticut	26.4 miles (42.4 km)	General Conformity (See Table 4.2.1-5)
		Non-road equipment On-road vehicles		N/A	
		Marine vessels (transit)	New Jersey	120.8 miles (194.4 km)	General Conformity

Project Segment	Segment Description	Project Activity	Nearest State	Transit Distance	Applicable Regulatory Program
	Area outside of OCS Permit Area, in which transit to Paulsboro Marine Terminal may occur.				(See Table 4.2.1-5)
			Federal Waters	195.1 miles (314.1 km)	NEPA[2]
	Area outside of OCS Permit Area in which transit to New Bedford Marine Commerce Terminal may occur.	Marine vessels (transit)	Massachusetts	5.3 miles (8.5 km)	NEPA[1]
		Non-road equipment On-road vehicles	Massachusetts	N/A	NEPA[1]
	Area outside of OCS Permit Area, in which transit to Port of Norfolk may occur.	Marine vessels (transit)	Virginia	25 miles (40.2 km)	NEPA[1]
		Non-road equipment On-road vehicles		N/A	
		Marine vessels (transit)	Federal Waters	350.3 miles (563.8 km)	NEPA[2]
	Area outside of OCS Permit Area, in which transit to Sparrow's Point may occur.	Marine vessels (transit)	Maryland	95.5 miles (153.7 km)	General Conformity (See Table 4.2.1-5)
			Virginia	105.9 miles (170.3 km)	NEPA[1]
			Federal Waters	350.3 miles (563.8 km)	NEPA[2]
	Area outside of OCS Permit Area, in which transit to European ports may occur.	Marine vessels (transit)	Massachusetts	25 miles (40.2 km)	NEPA[1]
			Federal Waters	201.4 miles (324.1 km)	NEPA[2]
RWEC–OCS	The section of the RWEC that is expected to be laid within the 25-mile (40.2 km) radius OCS Permit Area, subject to OCS air permitting.	Marine vessels	N/A	N/A	OCS Air Permit
RWEC–RI	Area outside of OCS Permit Area in which the RWEC is expected to be laid.	Marine vessels	Rhode Island	N/A	NEPA[1]

Project Segment	Segment Description	Project Activity	Nearest State	Transit Distance	Applicable Regulatory Program
Onshore Facilities	The Landfall Work Area, the Onshore Transmission Cable, OnSS, and ICF.	Marine Vessels Non-road equipment On-road vehicles Generators	Rhode Island	N/A	NEPA[1] and RIDEM[3]

1 Attainment areas are not subject to General Conformity; therefore, emissions that occur within 25 miles from shore (General Conformity Area), but are nearest to an onshore attainment area are only subject to NEPA.

2 Emissions that occur beyond 25 miles from shore and outside of the OCS Permit Area are only subject to NEPA.

The BOEM Offshore Wind Energy Facilities Emission Estimating Tool (BOEM Wind Tool) was developed to provide consistent sets of air quality emission factors for proponents preparing OCS air emissions inventories. The BOEM Offshore Wind Energy Facilities Emission Estimating Tool Technical Documentation (ERG, 2017) provides a summary of the emission factors, and emission estimating methods, which were used in the independently developed air emissions estimations presented herein. A summary of the emission factors for the equipment and vessels, along with the classification of each type of equipment and number of vessels expected for use, is shown in Appendix T.

The following pollutants were included in the air emissions inventory for the Project:

- Nitrogen oxides (NO_X)
- Volatile organic compounds (VOCs)
- Carbon monoxide (CO)
- Particulate matter smaller than 10 microns (PM_{10})
- Particulate matter smaller than 2.5 microns ($PM_{2.5}$, a subset of PM_{10})
- Sulfur dioxide (SO_2)
- Lead (Pb)
- Black Carbon (BC)
- Greenhouse gas emissions including nitrous oxide (N_2O), methane (CH_4), carbon dioxide (CO_2), and total greenhouse gases expressed as carbon dioxide equivalent (CO_2e).

The potential air quality impacts from air emissions associated with construction and O&M of the Project have been calculated for each of the above pollutants. In the case of decommissioning, associated air emissions would occur 20-to-35 years in the future when air quality conditions will be changed, emissions technology will be improved, and regulations will be different; therefore, quantifying decommissioning emissions now is speculative and is not addressed further in this section. The decommissioning activities would be subject to a future OCS Air Permit, or similar, application. There would be no further air emissions from RWF once decommissioning is complete.

All ports referenced in Section 4.2.1.1, except Port of Montauk and Port Jefferson and Port of Brooklyn (New York), were used for estimating construction emissions. The three (3) ports in New York and the two (2) ports in Rhode Island were used for estimating worst-case O&M emissions. Refer to Table 3.3-24 for a summary of potential Project activities for each port.

In the cases where both the Port of Davisville and the Port of Galilee are being considered as potential ports for vessel and helicopter activities, it was conservatively assumed that Port of Davisville would be used since the transit distance is further. Similarly, where both the Port of Montauk, Port Jefferson, and Port of Brooklyn were listed, it was conservatively assumed that Port of Brooklyn would be used since the transit distance is further. Also, in the cases where multiple ports were listed as potential ports for vessel activities, the emissions were conservatively allocated to all potential ports. This approach provides a very conservative estimate of potential emissions for each state.

As presented in Table 4.2.1-4, Washington County, Rhode Island, Providence County, Rhode Island, Bristol County, Massachusetts, and Norfolk City, Virginia are in attainment with all NAAQS; therefore, air emissions that are expected to occur nearest to these areas are not subject to a determination of conformity. However, BOEM's NEPA review will consider all Project-related air emissions; therefore, these emissions have been provided in this section and in detail in Appendix T so BOEM can perform their NEPA review.

Construction and Decommissioning

Over the approximate one-year construction period, IPFs resulting in potential impacts to air quality conditions from the construction and decommissioning phases are summarized in Table 4.2.1-7. Only IPFs with the potential to result in air quality impacts are included. The calculated Project air emissions that were used to determine the potential impacts to air quality are described in the following sections.

Table 4.2.1-7 IPFs and Potential Impacts on Air Quality During Construction and Decommissioning

IPF	Project Segment	Project Activity	Project Component	Impact Characterization
Air Emissions	RWF	Marine Vessels	WTGs, Foundations, OSS, IAC, OSS-Link Cable	Direct, short-term
		Helicopters	Foundations	
		Generators	WTGs	
		Non-road Equipment	WTGs	
		On-Road Vehicles	WTGs	
	RWEC-RI	Marine Vessels	RWEC	Direct, short-term
	RWEC-OCS	Marine Vessels	RWEC	Direct, short-term
	Onshore Facilities	Marine Vessels	Landfall - HDD	Direct, short-term
		Non-road Equipment	OnSS, ICF, Landfall - HDD, Onshore Transmission Cable	

IPF	Project Segment	Project Activity	Project Component	Impact Characterization
		On-road Vehicles	OnSS, ICF, Landfall - HDD	
		Generators	Landfall - HDD, Onshore Transmission Cable	

RWF construction air emissions activities include vessels, helicopters, generators, and fuel-burning equipment associated with construction of the WTGs, Foundations, OSSs, IAC, and OSS-Link Cable. RWEC construction air emissions activities include vessels associated with laying of the RWEC. Over the approximate 18-month construction period, Onshore Facilities construction air emissions activities include vessels, non-road equipment, on-road equipment, and generators associated with preparation of the Landfall Work Area and HDD operations, and construction of the Onshore Transmission Cable, and the OnSS. This analysis presumes that Onshore Facilities construction could occur as quickly as one year to be conservative.

OCS Permit Area

Estimated construction emissions within the 25-mi radius OCS Permit Area are provided in Table 4.2.1-8. Over the approximate one-year construction period, air emissions could have ***direct*** and ***short-term*** impacts to air quality. The majority of RWF emissions will occur over relatively short spans of time and occur offshore. Impacts to air quality near populated areas will be limited in duration. Similarly, over the approximate one-year construction period, potential impacts to air quality from RWEC-OCS installation air emissions occurring in the OCS Permit Area are considered ***direct*** and ***short-term***.

Table 4.2.1-8 Summary of OCS Permit Area Construction Emissions for Each Project Component

Project Component	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
RWF OCS Permit Area Emissions from Construction (tons):												
WTGs	22,936	0.1	1.1	23,231	6.9	81.8	332.5	9.2	9.0	0.2	4.3	0.0
Foundations	174,436	1.2	8.3	176,661	62.1	625.0	2,555.2	83.9	81.1	8.7	58.9	0.0
OSS	9,633	0.1	0.5	9,758	3.8	34.9	145.8	5.1	4.9	0.9	3.2	0.0
IAC	36,522	0.2	1.8	36,994	13.8	135.4	555.1	18.5	17.9	1.7	9.8	0.0
OSS-Link Cable	17,438	0.1	0.8	17,663	6.5	64.8	265.4	8.8	8.5	0.7	4.5	0.0
Total	**260,965**	**1.8**	**12.4**	**264,307**	**93.2**	**941.9**	**3,854.1**	**125.5**	**121.3**	**12.3**	**80.6**	**0.0**
RWEC - OCS Permit Area Emissions from Construction (tons):												
RWEC - OCS	17,731	0.1	0.9	17,961	6.7	65.7	270.0	9.0	8.7	0.9	4.8	0.0

General Conformity Areas

Estimated General Conformity construction emissions are provided in Table 4.2.1-9. Over the approximate one-year construction period, potential impacts to air quality from port and transit activities near

Connecticut, New Jersey, and Maryland are considered ***direct*** and ***short-term.*** The majority of port and transit-related RWF emissions will occur over relatively short spans of time and occur offshore. Impacts to air quality near populated areas will be limited in duration.

Table 4.2.1-9 Summary of General Conformity Construction Emissions for Each State and Project Component

Project Component	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
Connecticut (Port of New London, CT) (tons):												
WTGs	14,935	0.2	0.2	14,980	1.2	22.3	101.6	3.4	3.3	0.1	3.6	0.0
New Jersey (Paulsboro Marine Terminal, NJ) (tons):												
Foundations	187,811	1.2	9.0	190,238	70.0	672.5	2,785.9	94.1	90.9	8.2	49.2	0.0
OSS	680	0.0	0.0	689	0.3	2.3	10.3	0.4	0.4	0.1	0.3	0.0
Total	**188,491**	**1.2**	**9.1**	**190,927**	**70.3**	**674.8**	**2,796.2**	**94.5**	**91.2**	**8.4**	**49.5**	**0.0**
Maryland (Sparrow's Point, MD) (tons):												
Foundations	148,460	0.9	7.1	150,379	55.3	531.6	2,202.2	74.4	71.8	6.5	38.9	0.0
OSS	537	0.0	0.0	544	0.2	1.8	8.1	0.3	0.3	0.1	0.3	0.0
Total	**148,998**	**0.9**	**7.2**	**150,923**	**55.5**	**533.4**	**2,210.3**	**74.7**	**72.1**	**6.6**	**39.1**	**0.0**

Attainment Area and Federal Water Areas (NEPA only)

Estimated NEPA construction emissions are provided in Table 4.2.1-10. Over the approximate one-year construction period, potential impacts to air quality from port and transit activities occurring nearest to Rhode Island attainment areas are considered ***direct*** and ***short-term.*** Similarly, potential impacts to air quality from RWEC-RI installation air emissions occurring outside of the OCS Permit Area are considered ***direct*** and ***short-term***. Potential impacts to air quality from the approximate 12- to 18-month construction of Onshore Facilities are also considered ***direct*** and ***short-term***. Overall air quality impacts to Rhode Island from construction of the RWF, RWEC, and Onshore Facilities are considered ***direct*** and ***short-term***.

Over the approximate one-year construction period, potential impacts to air quality from port and transit activities occurring nearest to Massachusetts and Virginia attainment areas are considered ***direct*** and ***short-term***. The majority of port and transit-related RWF emissions will occur over relatively short spans of time and occur offshore. Impacts to air quality near populated areas will be limited in duration.

Table 4.2.1-10 Summary of NEPA Construction Emissions for Each State and Project Component

Project Component	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
Rhode Island Attainment Area Emissions from Construction (tons):												
WTGs	14,328	0.2	0.1	14,366	0.9	20.2	92.3	3.1	3.0	0.1	3.4	0.0
Foundations	35,355	0.2	1.7	35,811	13.2	126.6	524.0	17.7	17.1	1.6	9.3	0.0

Project Component	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
OSS	128	0.0	0.0	130	0.1	0.4	1.9	0.1	0.1	0.0	0.1	0.0
IAC	4,648	0.0	0.2	4,708	1.8	16.7	69.9	2.4	2.3	0.4	1.5	0.0
OSS-Link Cable	1,569	0.0	0.1	1,589	0.6	5.6	23.5	0.8	0.8	0.1	0.5	0.0
Total RWF	**56,027**	**0.4**	**2.1**	**56,604**	**16.5**	**169.5**	**711.7**	**24.1**	**23.3**	**2.2**	**14.8**	**0.0**
RWEC-RI	5,150	0.0	0.2	5,216	1.9	19.0	78.2	2.6	2.5	0.3	1.4	0.0
Onshore Facilities	174,903	5.0	0.4	175,138	0.0	380.7	433.5	17.1	16.3	1.4	30.2	0.0
Total	**236,080**	**5.5**	**2.7**	**236,958**	**18.5**	**569.1**	**1,223.4**	**43.9**	**42.1**	**3.9**	**46.4**	**0.0**
Massachusetts Attainment Area Emissions from Construction (tons):												
WTGs	12,959	0.2	0.1	12,980	0.4	15.3	71.3	2.5	2.4	0.1	3.1	0.0
Foundations	44,717	0.3	2.2	45,295	16.7	160.1	663.3	22.4	21.6	2.0	11.7	0.0
Total	**57,676**	**0.4**	**2.2**	**58,274**	**17.1**	**175.4**	**734.6**	**24.9**	**24.0**	**2.1**	**14.9**	**0.0**
Virginia Attainment Area Emissions from Construction (tons):												
WTGs	14,935	0.2	0.2	14,980	1.2	22.3	101.6	3.4	3.3	0.1	3.6	0.0
Foundations	164,559	1.0	7.9	166,685	61.3	589.2	2,441.0	82.4	79.6	7.2	43.1	0.0
OSS	596	0.0	0.0	604	0.3	2.0	9.0	0.3	0.3	0.1	0.3	0.0
Total	**180,089**	**1.2**	**8.1**	**182,269**	**62.7**	**613.5**	**2,551.6**	**86.2**	**83.2**	**7.5**	**47.0**	**0.0**
Maximum Federal Waters Emissions from Construction (tons):												
WTGs	35,889	0.2	1.7	36,350	12.8	128.2	552.0	17.1	16.6	0.6	7.9	0.0
Foundations	550,351	3.4	26.5	557,461	205.0	1,970.6	8,163.6	275.6	266.3	24.1	144.1	0.0
OSS	1,992	0.0	0.1	2,018	0.8	6.6	30.1	1.1	1.1	0.4	1.0	0.0
Total	**588,231**	**3.7**	**28.3**	**595,830**	**218.6**	**2,105.5**	**8,745.7**	**293.9**	**283.9**	**25.1**	**153.0**	**0.0**

Overall, the potential impacts to air quality from the approximate 12- to 18-month construction period of the RWF, Onshore Facilities and RWEC installation, air emissions are expected to have ***direct*** and ***short-term*** impacts to regional air quality. This analysis presumes that construction could occur as quickly as one year to be conservative. Emissions during decommissioning would result largely from the operation of the construction equipment and vessels or aircraft and are not be expected to result in a decrease of air quality within the area surrounding RWF. Because of improving emission control technologies, it can be reasonably assumed that emissions from decommissioning activities would be less than those from construction activities.

Operations and Maintenance

IPFs resulting in potential impacts to air quality conditions from the 20-to-35-year O&M phase are summarized in Table 4.2.1-11. Only IPFs with the potential to result in air quality impacts are included. Although O&M air emissions are expected to be of longer duration than construction air emissions, annual air emissions from O&M activities are expected to be significantly less than those from construction activities. The calculated Project air emissions that were used to determine the potential impacts to air quality are described in the following sections.

Table 4.2.1-11 IPFs and Potential Levels of Impact on Air Quality During O&M

IPF	Project Segment	Project Activity	Impact Characterization
Air Emissions	RWF	Marine Vessels	Direct, long-term
		Helicopters	
		Generators	
	Onshore Facilities	Generators	Direct, long-term

RWF O&M air emissions activities include vessels, helicopters, and generators associated with the O&M of the WTGs and OSSs. Onshore Facilities O&M air emissions activities include generators associated with the O&M of the OnSS and ICF. RWEC O&M activities are not expected to produce air emissions. Estimated air emissions from the proposed O&M activities are expected to have ***direct, long-term*** impacts to regional air quality. Air emissions during O&M would not be expected to result in a decrease of air quality within the surrounding area of RWF.

OCS Permit Area

Estimated OCS Permit Area O&M emissions are provided in Table 4.2.1-12. Over the 20-to-35-year O&M period, potential impacts to air quality from RWF air emissions in the OCS Permit Area are considered ***direct*** and ***long-term***. RWF O&M emissions will occur offshore and on an annual basis are estimated to be less than one-quarter of the RWF construction emissions in the OCS Permit Area.

Table 4.2.1-12 Summary of OCS Permit Area O&M Emissions for Each Project Segment

Project Segment	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
OCS Permit Area Emissions from O&M (tons/year):												
RWF	57,088	0.4	2.7	57,820	20.5	207.6	847.7	27.4	26.6	0.6	12.4	0.0

General Conformity Areas

Estimated General Conformity O&M emissions are provided in Table 4.2.1-13. Over the 20-to-35-year O&M period, potential impacts to air quality from port and transit activities occurring nearest to New York are considered ***direct*** and ***long-term***.

Table 4.2.1-13 Summary of General Conformity O&M Emissions for Each State

Project Segment	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
New York (Port of Montauk, NY or Port Jefferson, NY or Port of Brooklyn, NY) (tons/year):												
RWF	14,322	0.1	0.7	14,506	5.1	51.2	205.3	6.9	6.7	0.1	3.0	0.0

Attainment Area and Federal Water NEPA Emissions

Estimated NEPA O&M emissions are provided in Table 4.2.1-14. Over the 20-to-35-year O&M period, potential impacts to air quality from port and transit activities occurring nearest to Rhode Island attainment areas are considered ***direct*** and ***long-term***. Potential impacts to air quality from O&M of Onshore Facilities are also considered ***direct*** and ***long-term***. Overall air quality impacts to Rhode Island from O&M of the RWF and Onshore Facilities are considered ***direct*** and ***long-term*****.**

Table 4.2.1-14 Summary of NEPA O&M Emissions for Each State

Project Segment	CO_2	CH_4	N_2O	CO_{2e}	BC	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb
Rhode Island Attainment Area Emissions from O&M (tons/year):												
RWF	989	0.0	0.0	1,001	0.3	3.3	13.0	0.4	0.4	0.0	0.3	0.0
Onshore Facilities	22	0.0	0.0	22	0.0	0.6	0.2	0.0	0.0	0.0	0.0	0.0
Total	**1,011**	**0.0**	**0.0**	**1,023**	**0.3**	**4.0**	**13.1**	**0.4**	**0.4**	**0.0**	**0.3**	**0.0**

Overall, the potential impacts to air quality from the 20-to-35-year O&M period of the RWF and Onshore Facilities are considered ***direct*** and ***long-term***.

Summary

Project air quality impacts are expected to be of limited duration. Although there will be air emissions associated with the Project construction, O&M, and decommissioning, the avoided air emissions, both annually and over the expected Project life, far exceed the expected air emissions created by the Project (See Table 4.2.1-16 below).

As discussed in Section 4.2.1, the Project emissions determine whether the RWF and RWEC will be subject to a determination of conformity in addition to permitting programs discussed in Appendix T. Table 4.2.1-15 below presents the calculated emissions for the RWF and RWEC by study area and compares them to the de minimis conformity thresholds from Table 4.2.1-5. It is expected that BOEM will need to make a determination of conformity for the RWF activity expected to take place within 25 miles (40.2 km) of Connecticut, New Jersey, Maryland, and New York.

Washington County, Rhode Island, Providence County, Rhode Island, Bristol County, Massachusetts, and Norfolk City, Virginia are in attainment with all NAAQS; therefore, the emissions that are expected to occur nearest to these areas are only subject to BOEM's NEPA review. In addition, emissions that occur outside of the OCS Permit Area, and beyond 25 miles, of any onshore area are also only subject to NEPA.

Table 4.2.1-15 Summary of General Conformity and OCS Permit Area Emissions for Each Phase

Project Segment	CO_{2e}	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Pb	Exceeds Conformity Thresholds?
Conformity Emissions from Construction (tons):									
RWF - Connecticut	14,980	22.3	**101.6**	3.4	3.3	0.1	3.6	0.0	Yes
RWF - New Jersey	190,927	674.8	**2,796.2**	94.5	91.2	8.4	49.5	0.0	Yes
RWF - Maryland	150,923	533.4	**2,210.3**	74.7	72.1	6.6	39.1	0.0	Yes
OCS Permit Emissions from Construction (tons):									
RWF	264,307	941.9	3,854.1	125.5	121.3	12.3	80.6	0.0	N/A
RWEC-OCS	17,961	65.7	270.0	9.0	8.7	0.9	4.8	0.0	N/A
General Conformity Area Emissions from Operations and Maintenance (tons/year):									
RWF - New York	15,506	51.2	**205.3**	6.9	6.7	0.1	3.0	0.0	Yes
OCS Permit Area Emissions from Operations and Maintenance (tons/year):									
RWF	57,820	207.6	847.7	27.4	26.6	0.6	12.4	0.0	N/A

4.2.1.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following environmental protection measures to reduce potential impacts on air quality.

- Vessels providing construction or maintenance services for the RWF and RWEC will use low sulfur fuel where possible.
- Vessel engines will meet the appropriate EPA air emission standards for NOX emissions when operating within Emission Controls Areas.
- Onshore Facilities equipment and fuel suppliers will provide equipment and fuels that comply with the applicable EPA or equivalent emission standards.
- Marine engines with a model year of 2007 or later and non-road engines complying with the Tier 3 standards (in 40 CFR § 89 or 1039) or better will be used to satisfy Best Available Control Technology (BACT) or Lowest Achievable Emission Rate (LAER.)

It is important to acknowledge the use of wind to generate electricity reduces the need for electricity generation from new traditional fossil fuel powered plants in New England that produce greenhouse gas emissions. Table 4.2.1-16 presents the estimated annual avoided emissions from the operation of the RWF. Avoided emissions were based on New England's annual non-baseload emission rates (Abt Associates, 2020). The estimated annual emissions were calculated based on a maximum 2,991,014 MW-hours generated per year, and a minimum 2,392,812 MW-hours generated per year. The estimated lifetime emissions were calculated by applying the maximum and minimum generated MW-hours per year to the maximum and minimum project life of 20 and 35 years, respectively. The Project is expected to annually displace CO_2, CH_4, N_2O, NO_X, and SO_2 produced by the New England electric grid and decrease the creation of GHG in the atmosphere from these sources.

Table 4.2.1-16 Annual and Lifetime Avoided Emissions for the Operation of the RWF (tons)

Term	Power Generated (MW-hours)	CO_2	CH_4	N_2O	CO_2e	NO_X	SO_2
Maximum Annual Avoided Emissions	2,991,014	1,392,275	128.6	16.5	1,400,236	749.2	397.8
Minimum Annual Avoided Emissions	2,392,812	1,113,820	102.9	13.2	1,120,189	599.4	318.2
Maximum Lifetime (35-year) Avoided Emissions	104,685,504	48,729,637	4,105.5	575.8	49,008,257	26,223.7	13,923.2
Minimum Lifetime (20-year) Avoided Emissions	47,856,230	22,276,405	2,075.8	263.2	22,403,775	11,988.0	6,364.9

4.2.2 Water Quality and Water Resources

This section provides a description of water quality and water resource conditions within the Offshore Envelope (inclusive of the RWF Envelope, RWEC-OCS Envelope, and RWEC-RI Envelope), the Onshore Facilities (inclusive of the Landfall Work Area, Onshore Transmission Cable, ICF, OnSS, Interconnection ROW, and TNEC ROW), and proximate areas as defined by several parameters including dissolved oxygen (DO); chlorophyll *a*; nutrient content; and turbidity. This section also briefly discusses relevant anthropogenic activities that have in the past or currently may impact water quality, including point and nonpoint source pollution discharges, deposition and spills, and pollutants in the water or in sediment. The discussion of the affected environment for water quality is followed by an evaluation of potential Project-related impacts and a summary of environmental protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts.

The description of the affected environment and assessment of potential impacts for water quality were determined by reviewing public data sources and conducting project-specific studies including the following: Rhode Island OSAMP (RI CRMC, 2010); Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Continental Shelf Offshore RI-MA WEA (BOEM, 2013); National Coastal Condition Report IV (NCCR) (US EPA, 2012); Narragansett Bay Commission (NBC) Snapshot of Upper Narragansett Bay data; State of Narragansett Bay and Its Watershed Technical Report (NBWTR) (Narragansett Bay Estuary Program [NBEP], 2017); Hydrodynamic and Sediment Transport Modeling Report (Appendix J,); and Revolution Wind Integrated G&G Report (Appendix O).

4.2.2.1 Affected Environment

Regional Overview

The RWF and RWEC-OCS are in offshore federal waters where available water quality data are limited. Water quality data are also limited for the Rhode Island coastal marine waters where the RWEC-RI will be installed. The EPA rated the quality of the nation's coastal waters as "poor," "fair," and "good" in the NCCR based on data collected at 238 Northeast Coast sampling locations from Maine through Virginia. The NCCR used physical and chemical indicators to rate water quality, including concentrations of phosphorous, nitrogen, DO, salinity, and chlorophyll *a* along with pH, and water clarity (turbidity). The NCCR also presents a summary of data collected for assessing the ecological and environmental conditions of U.S. coastal waters. These data have been collected since 1997 and are summarized for four different periods in four separate reports. The referenced NCCR presents an assessment of data collected from 2003 to 2006. The water quality of the coastal waters ranging from Maine to North Carolina, which is inclusive of the RWF and RWEC, were primarily rated as "good" to "fair" with nine percent of the coastal area rated as "poor" (EPA, 2012), which includes Narragansett Bay. This survey included five sites near the RWF and RWEC, all of which were in Narragansett Bay.

The Onshore Facilities begin at the MHWL in the Landfall Envelope and includes the Landfall Work Area and TJBs, the Onshore Transmission Cables, the ICF, the OnSS, Interconnection ROW, and TNEC ROW. Cable routing in the Landfall Envelope has not yet been determined as routing will be dependent ultimately on the location of the Landfall Work Area. The Landfall Envelope is located within areas classified as Class GB (RIDEM *A Summary of Rhode Island Groundwater Classification and Groundwater Standards*, September 2009). Class GB waters may not be suitable for drinking without treatment and are serviced by public water systems. RI DEM established groundwater quality standards and preventative action limits for classes to protect public health. The OnSS and ICF will be constructed on two separate parcels and will connect to TNEC's Davisville Substation and will require activities within freshwater wetlands and floodplains. The OnSS and ICF properties are also located within Class GA and Class GB waters. Class GA waters are presumed to be suitable for drinking without treatment. There is very limited water quality data available for the Onshore Facilities except for Rhode Island Surface Water Quality Standards (RIDEM, 2010). However, if groundwater is encountered during construction, BMPs will be in place and any contaminated groundwater would be managed in accordance with the RIPDES Remediation General Permit (RIPDES Permit No. RIG850000).

Revolution Wind Farm

The RWF is in OCS waters where available water quality data are limited. However, the threat to marine water quality is reduced at greater distances from shore and with exposure to the movement of high-water volume through oceanic circulation, causing pollutants to be dispersed, diluted, and biodegraded (BOEM, 2013).

Dissolved Oxygen

DO refers to the concentration of oxygen present in water. The source of the DO may be the atmosphere and from photosynthesis from aquatic plants including phytoplankton. Low levels of oxygen (hypoxia) or no oxygen levels (anoxia) can occur when excess organic material, such as produced during large algal blooms are decomposed by microorganisms (LICAP, 2016). Water sampling conducted at four stations in Rhode

Island Sound in 2002 by the USACE found that DO concentrations both at the surface and in bottom waters remained above established levels for the "highest quality marine waters" and suggests that hypoxic and anoxic conditions do not typically occur in those areas (RI CRMC, 2010).

Chlorophyll a

Chlorophyll *a* is measured as a surrogated to determine concentrations of phytoplankton, which can indicate overproduction of algae and degraded water quality (NCCR, US EPA 2012). For this reason, chlorophyll *a* is used as a metric of plant production, called "primary production" because of the ability of plants to capture energy from sunlight and is measured in units of grams of carbon per meter squared per day (g C m-2 day-1).

The RI CRMC OSAMP adapted a table (Table 4.2.2-1) from Hyde (2009) to compare the range of primary production throughout the year for OSAMP waters and nearby ecosystems. Primary production in the OSAMP area is comparable to other coastal systems and is just slightly lower than the value ranges presented for Narragansett Bay and New York Bight. Chlorophyll *a* sampling at four locations in Rhode Island Sound found concentrations ranging from six to nine µg 1^{-1} (USACE 2002), which is "consistent with oceanic systems and slightly lower than an average estimate of phytoplankton production on continental shelves (Mann 2000)," (RI CRMC 2010).

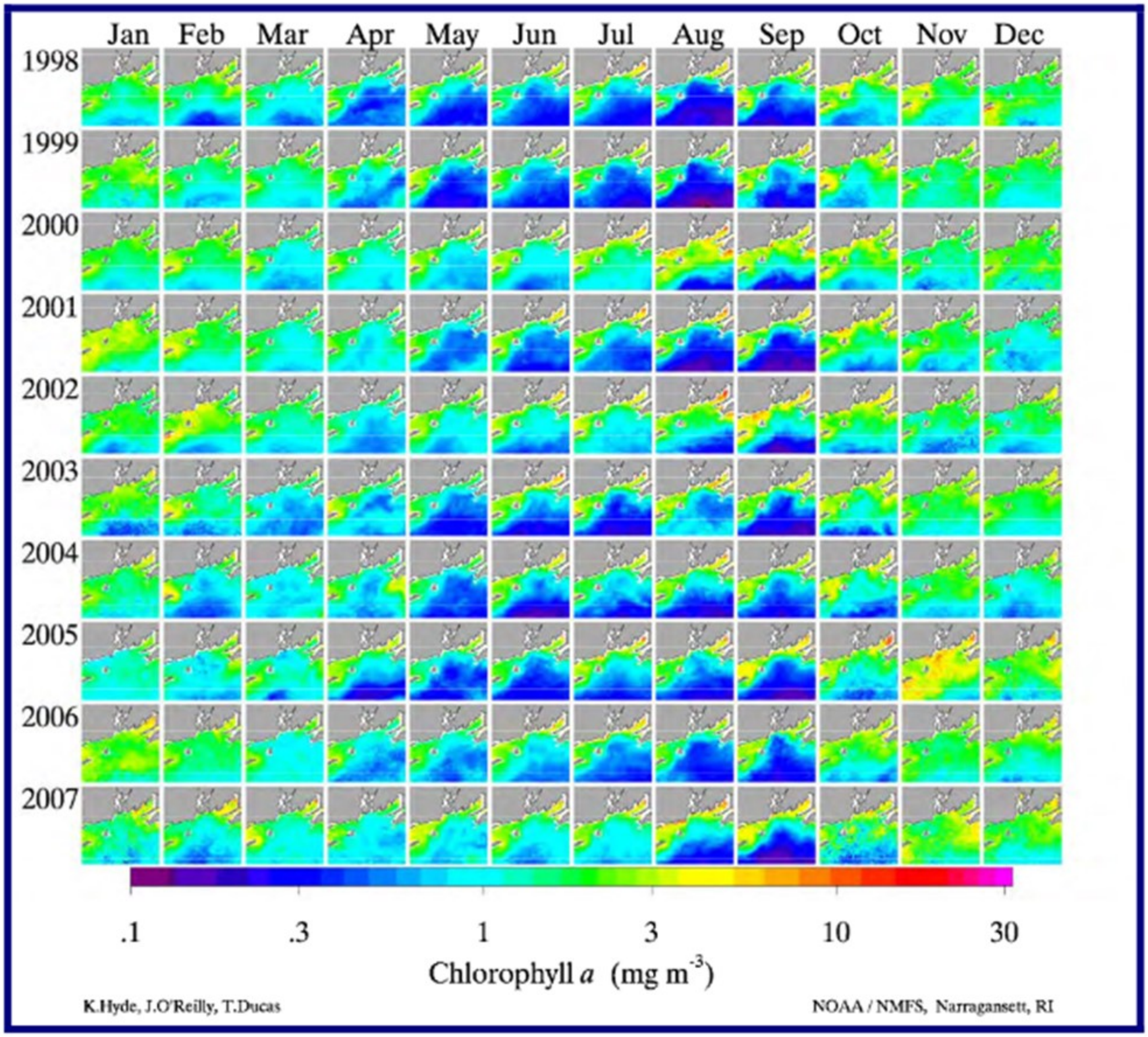
Table 4.2.2-1 Comparison of the Range of Primary Production (g C m^{-2} day^{-1})

Ecosystem	Production (g C m^{-2} d^{-1})	Reference
OSAMP	143-204	Hyde, 2009
Narragansett Bay	160-619	Oviatt et al., 2002
Massachusetts Bay	160-570	Keller et al., 2001; Oviatt et al., 2007; Hyde et al., 2008
New York Bight	370-480	Malone and Chervin, 1979

Source: RI CRMC OSAMP, 2010
Table adapted from RI CRMC, 2010

Measurements of chlorophyll *a* concentrations show peak levels during late fall and early spring and a consistent minimum during the summer (RI CRMC 2010). Figure 4.2.2-1 below was taken from the RI CRMC OSAMP (2010) and shows monthly averages of chlorophyll *a* concentrations from 1998 through 2007 (RI CRMC 2010).

Figure 4.2-1 Monthly Averaged Chlorophyll *a* Concentrations from 1998 through 2007 in the OSAMP Area (from Hyde 2009).



Nutrients

Nutrients are chemical elements that all living organisms need to sustain life and for growth. Problems may arise when too much of a particular nutrient is introduced into the environment through human activities (i.e., eutrophication). In surface waters, excess nutrients fuel algal blooms which can lead to water quality degradation. Severe or harmful algal blooms can result in the depletion of oxygen in the water column and benthos that aquatic life needs for survival. Algal blooms also reduce water clarity, which reduces desirable plant growth, such as seagrasses, reduces the ability of aquatic life to find food, and clog fish gills. Freshwaters are more sensitive to excess phosphorus, while in coastal waters, nitrogen is the nutrient of highest concern. In some cases, both nutrients may interact and contribute to a water pollution problem (RIDEM, 2010).

Dissolved nutrients reach the OCS from Narragansett Bay, Long Island Sound, and Buzzards Bay. Table 4.2.2-2 below was taken from the RI CRMC OSAMP (2010), which published the Oviatt and Pastore 1980 nutrient sample results for the Rhode Island Sound. Research on Block Island Sound water quality suggests that nutrient concentrations (measured in micromoles, μM) have seasonal variation, with peaks in the autumn, and nearly undetectable levels in the late spring and early summer months (Staker and Bruno, 1977). Although additional sampling is required, the data suggest that nutrient availability may be a limiting factor, resulting in lower primary production.

Table 4.2.2-2 Nutrient Concentrations Measured in the Rhode Island Sound (Oviatt and Pastore, 1980)

Nutrient	Concentration (μM)		
	Station 16 (mouth of Narragansett Bay)	Station 17 (just outside mouth of Narragansett Bay)	Time
Ammonia (NH_3)	-	0	Jan-May
	1	1.5-2	Jun-Aug
	3-4	2-2.5	Nov-Dec
Nitrite + Nitrate (NO_2 + NO_3)	6	6	Jan
	1-2	5	Feb
	0.5	0.5	Mar
	5	4	Apr
	0	1-2	May-Aug
	6	6	Nov
	12	10	Dec
Orthophosphate (PO_4)	1-2	1-1.5	Jan-Aug
	1.5	1.5-2	Nov-Dec

Source: RI CRMP OSAMP, 2010

Pathogens

Waterborne pathogens include bacteria, viruses, and other organisms that may cause disease or health problems in native species and in humans. When pathogens are present in water at elevated concentrations, the recreational uses of waters are adversely affected prompting restrictions (closures) at public beaches and on the harvest of shellfish.

The RWF is in waters that are considered temperate and therefore are subject to highly seasonal variation in temperature, stratification, and productivity. There is little information on the algal and bacteria dynamics in either Block Island or Rhode Island Sounds. According to RI CRMC (2010), there were no documented reports of harmful algal blooms or waterborne pathogen outbreaks in the waters of either Block Island or Rhode Island Sounds as of 2010.

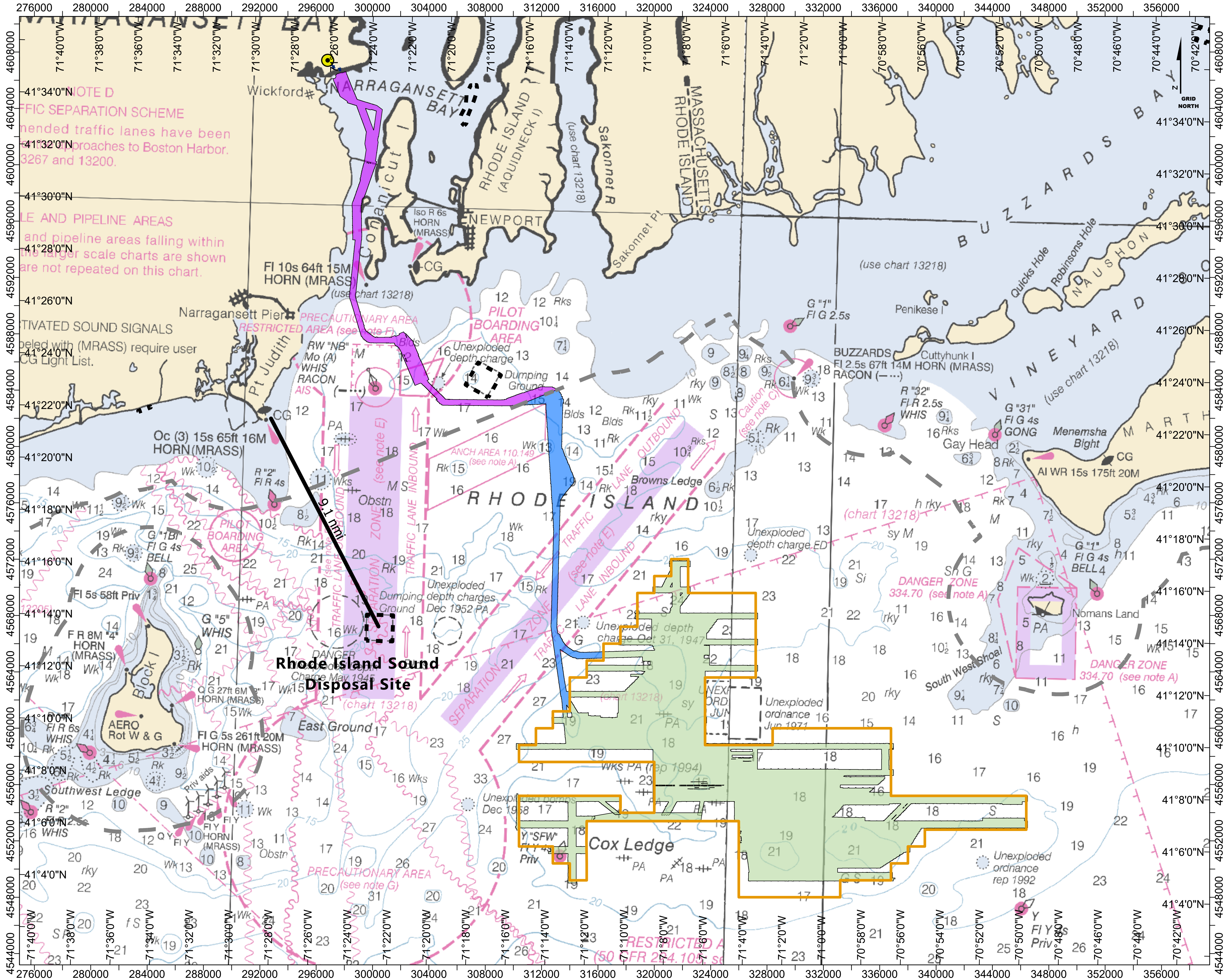
Contamination

Data on water-column contaminant levels in Rhode Island Sound are limited. Organic contaminants (polychlorinated biphenyls [PCBs] and pesticides) measured in 2001 and 2002 were generally below method detection limits for these analytes (USACE, 2004). For example, total PCB concentrations were less than 46 nanograms per liter (ng/L), and total dichlorodiphenyltrichloroethanes (DDTs) were less than 4 ng/L. Water-column dissolved metals concentrations in Rhode Island Sound were also low, with concentrations generally less than 1 microgram per liter (µg/L). Dissolved metal concentrations appeared similar throughout the year and throughout Rhode Island Sound. Metals, PCBs, and organic and inorganic pollutant concentrations measured in the water column within the OSAMP area in 2002 were well below ambient RI DEM water quality criteria (RI CRMC, 2010).

The 1.3 mi^2 (3.2 km^2) Rhode Island Sound Disposal Site in east-central Rhode Island Sound was designated for the disposal of dredge material in December 2004. Approximately 120 million ft^3 (3.4 million m^3) of sediment from Providence River was disposed at this site. The disposal site is approximately 13 mi (21 km) south of Narragansett Bay and approximately 6 mi (9 km) northwest from the closest corner of the RWF (RI CRMC, 2010). Refer to Figure 4.2.2-2 below for the location of the Rhode Island Sound Disposal Site. There are no other active open water disposal sites in federal waters near the RWF. Toxicity testing at dredged materials disposal sites in Rhode Island Sound indicates that the constituents do not appear to pose a significant threat to water quality in the Rhode Island Sound area (RI CRMC, 2010).

Revolution Wind

Figure 4.2.2-2
Rhode Island Sound Disposal Site



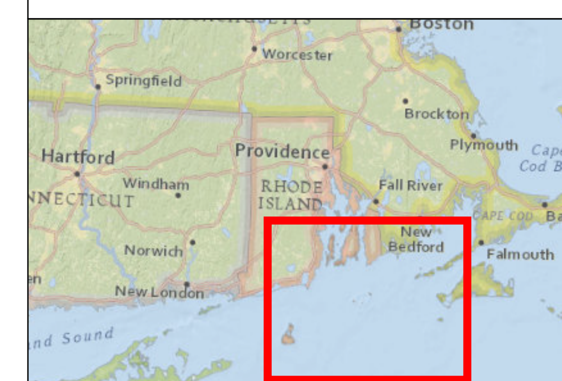
Legend

- OnSS

Offshore Envelope

- RWF Envelope
- RWEC-OCS Envelope
- RWEC-RI State Waters Envelope
- RWF Boundary Lease Area OCS-A 0486
- 3-Nautical Mile State Water Boundary
- Ocean Disposal Sites

Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
NOAA Raster Nautical Charts (RNC): NOAA Office of Coast Survey



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2500 5000 7500 Meters

0 8,000 16,000 24,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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Turbidity

Turbidity is the measure of cloudiness or haziness (opacity) of water caused by suspended solids (e.g., sediments or algae). Ocean waters beyond 3 mi (4.8 km) offshore typically have very low concentrations of suspended particles and low turbidity. Turbidity in Rhode Island Sound from five studies cited by the USACE (2004) ranged from 0.1 to 7.4 milligrams per liter (mg/L) of total suspended solids (TSS). Bottom currents may re-suspend silt and fine-grained sands, causing higher suspended particle levels in benthic waters. Storm events, particularly frequent intense wintertime storms, may also cause a short-term increase in suspended sediment levels (BOEM, 2013).

Project effects on turbidity and sediment deposition resulting from construction activities in the RWF are described further in the Hydrodynamic and Sediment Transport Modeling Report in Appendix J.

Anthropogenic Activities

Current anthropogenic activities that are sources of water quality degradation include point source pollution and nonpoint source pollution. Point source pollutants, which enter waterways at well-defined locations, such as pipe or sewer outflows, are common sources of water pollution. There are no direct municipal wastewater or industrial point sources for pollution into or within the RWF. Vessels operating in the RWF area may release discharges that have the potential to impact water quality. These discharges are discussed in Section 4.1.6.

Nonpoint source pollutants are considered the largest contributors to water pollution and water quality degradation. Various human land use practices, such as agriculture, construction activities, urban runoff, and deposition of airborne pollutants, can introduce nutrients, bacterial and chemical contaminants and sediments, which all can impact coastal water quality and water resources (NYSDEC, 2018). The states of New York, Rhode Island, and Massachusetts may contribute nonpoint source pollution to the coastal waters near the RWF.

Revolution Wind Export Cable–OCS

The RWEC-OCS will run from the northwestern side of the Lease Area in a general north/northwest direction until it enters Rhode Island State Waters. The affected environment for water quality for the RWEC-OCS is the same as described for the RWF.

Revolution Wind Export Cable–RI

The affected environment for the portion of the RWEC-RI within Rhode Island Sound (i.e., within the OSAMP study area) for water quality is the same as presented for the. The following sections discuss water quality for the portion of the RWEC-RI that is within Narragansett Bay.

Dissolved Oxygen

The Narragansett Bay Fixed Site Monitoring Network (NBFSMN) is a multi-agency collaborative that continuously collects data, including DO, at 13 fixed stations throughout the Narragansett Bay. The data collected at the fixed stations shows that the majority of the stations experience or are vulnerable to periodic episodes of hypoxia and occasional anoxia (RIDEM, [ND]). In addition, although the NCCR (EPA, 2012) states that the overall condition of DO in the Northeast Coast region is fair, more extensive data collection, such as that by NBFSMN and Brown University, have shown that the Narragansett Bay has a higher incidence of hypoxia.

DO within the Bay was also evaluated by the NBEP, which used a Hypoxia Index. The Hypoxia Index evaluated data from the NBFSMN to identify sample areas that experience hypoxia and combined the duration that this condition persisted. The Hypoxia Index "measures of the amount or magnitude that bottom water DO concentrations fell below a fixed threshold, and how long they stayed below the threshold" (NBEP, 2017). NBEP used a threshold of 2.9 mg/L and the Hypoxia Index to identify acute hypoxia, which evaluated each individual site/year as the sum of all deficit-durations from mid-May through mid-October (NBEP, 2017). The occurrences of hypoxia at given sites varied from year to year, with precipitation playing a factor. Wetter years experienced greater incidents of hypoxia. NBEP also found that periods of hypoxia have a higher chance of occurrence during the summer months, when the warm waters support high productivity and respiration rates and the Bay is thermally stratified with poor exchange between strata (NBEP, 2017). The proposed RWEC-RI will make landfall at Quonset Point within North Kingstown and pass within a portion of the Upper West Passage that is prone to sporadic hypoxic events (NBEP, 2017).

Chlorophyll a

A Chlorophyll Bloom Index (CBI) was developed to quantify phytoplankton blooms based on a time series of chlorophyll measurements and data from ten NBSFMN sites that were analyzed (NBEP, 2017). The CBI measured the surplus-duration of an event, which is both the intensity and time period of the event. Since the State of Rhode Island has not established water quality criteria for chlorophyll *a* concentration, the federal threshold of 20 µg/L was used. Although long-term trends could not be readily identified, the CBI indicated that spikes in chlorophyll *a* levels in Narragansett Bay are most frequent in the summer and show a spatial gradient decrease when moving north to south throughout the Bay with the Upper West Passage having values ranging from five to nine µg/L (NBEP 2017). This is likely the result of nutrient inputs from rivers and wastewater treatment facilities (WWTF) (i.e., riverine loading) (NBEP 2017).

The NBC also monitored chlorophyll *a* in the Providence and Seekonk River estuaries within the upper Narraganset Bay. Table 4.2-19 below was adapted from available 2019 NBC data from the two buoys (Bullock Reach Buoy and Conimicut Point Buoy) maintained proximate to the southern terminus of the Providence River at Upper Narragansett Bay. Samples were taken 1.6 to 3.3 ft (0.5-1 m) below the surface. As shown in Table 4.2.2-3, the chlorophyll *a* levels exceeded the federal threshold (20 µg/L) on June 19, 2019 at the Bullock Reach Buoy and on August 15, 2019 at both the Bullock Reach Buoy and the Conimicut Point Buoy.

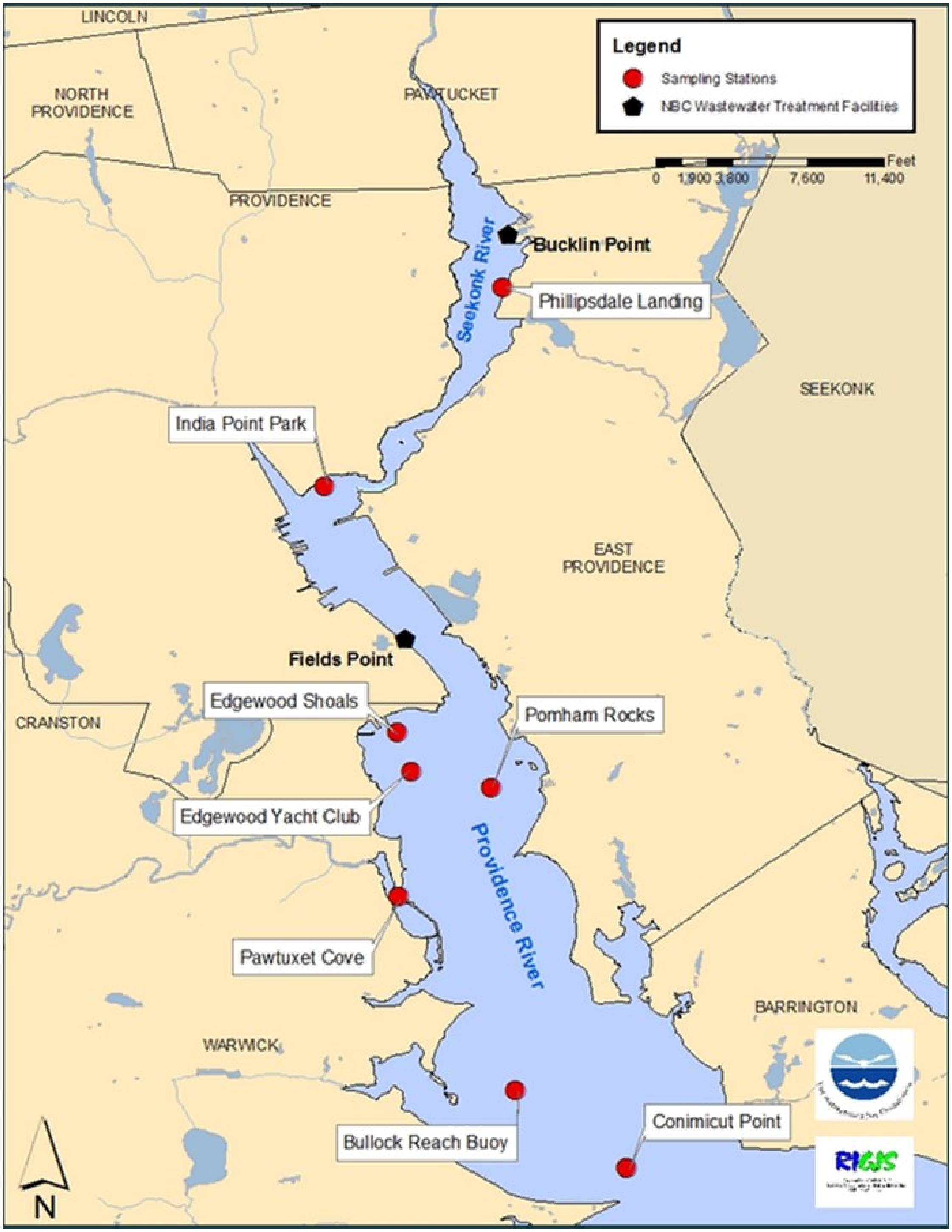
Table 4.2.2-3 2019 Chlorophyll *a* Levels from NBC Data Collected at Bullock Reach Buoy and Conimicut Point Buoy

Collection Date	Station	Chl a (µg/L)	Station	Chl a (µg/L)
1/3/2019	Bullock Reach Buoy Surface	2.2302	Conimicut Point Surface	0.36123
3/13/2019	Bullock Reach Buoy Surface	0.8307	Conimicut Point Surface	7.13
3/27/2019	Bullock Reach Buoy Surface	3.5457	Conimicut Point Surface	2.7547
4/10/2019	Bullock Reach Buoy Surface	7.0368	Conimicut Point Surface	7.7439
4/24/2019	Bullock Reach Buoy Surface	7.9713	Conimicut Point Surface	19.647
5/8/2019	Bullock Reach Buoy Surface	1.7406	Conimicut Point Surface	1.7828
5/21/2019	Bullock Reach Buoy Surface	3.3849	Conimicut Point Surface	4.1268
6/5/2019	Bullock Reach Buoy Surface	3.1776	Conimicut Point Surface	2.709
6/19/2019	Bullock Reach Buoy Surface	30.393	Conimicut Point Surface	14.577
7/3/2019	Bullock Reach Buoy Surface	9.3984	Conimicut Point Surface	5.1741
7/17/2019	Bullock Reach Buoy Surface	10.909	Conimicut Point Surface	9.3837
7/31/2019	Bullock Reach Buoy Surface	1.8061	Conimicut Point Surface	2.1052
8/15/2019	Bullock Reach Buoy Surface	33.026	Conimicut Point Surface	48.981

Source: NBC Snapshot of Upper Narragansett Bay 2019 Nutrient Monitoring Results
http://snapshot.narrabay.com/WaterQualityInitiatives/NutrientMonitoring
Adapted from 2019 NBC River and Bay Nutrients Data

Figure 4.2.2-3 was taken from the NBC Snapshot of the Bay and shows the sampling stations within the Providence and Seekonk River estuaries.

Figure 4.2.2-3 NBC Sampling Stations within the Providence and Seekonk River Estuaries



http://snapshot.narrabay.com/WaterQualityInitiatives/NutrientMonitoring

Nutrients

There is limited data available for nutrient levels within Narragansett Bay. However, NBEP monitors nitrogen and phosphorus levels with a focus on WWTFs and riverine discharges. Data suggests that nutrient levels have dropped within a 15-year period since Rhode Island enacted a statute to reduce summer nutrient loading into the Bay from WWTFs (NBEP, 2017). Table 4.2.2-4 below was adapted from the NBWTR (NBEP, 2017) and summarizes a comparison of WWTF nitrogen loading levels from 2000-2004, 2007-2010, and 2013-2015. The data indicates a decrease in total nitrogen discharging from WWTFs in the Coastal Narragansett Bay Basin.

Table 4.2.2-4 NBEP Data For Nitrogen Loading Levels From Wastewater Treatment Facilities

	WWTF Total Nitrogen Loading ($x10^3$ lbs/year)		
	Nixon et al (2008)	Krumholz (2012)	NBEP Study
Coastal Narraganset Bay Basin	2000-2004	2007-2010	2013-2015
Narraganset Bay	5,253	4,420	2,777
Ten Mile River	379	328	170
Woonasquatucket River	134	45	52

Source: NBEP 2017, Chapter 8 page 176
http://nbep.org/01/wp-content/uploads/2017/03/State-of-Narragansett-Bay-and-Its-Watershed-lower-resolution.pdf

Total phosphorus was similarly analyzed for discharges from WWTFs and it was found that WWTFs that directly discharge to "Narragansett Bay account for 74 percent of total phosphorus loading" (NBEP, 2017). Table 4.2.2-5 below was adapted from the NBWTR (NBEP, 2017) and summarizes a comparison of phosphorus loading levels from 2000-2004, 2007-2010, and 2013-2015.

Table 4.2.2-5 NBEP Data for Phosphorus Loading Levels from Wastewater Treatment Facilities

	WWTF Total Nitrogen Loading ($x10^3$ lbs/year)		
	Nixon et al (2008)	Krumholz (2012)	NBEP Study
Coastal Narraganset Bay Basin	2000-2004	2007-2010	2013-2015
Narraganset Bay	551	618	526
Ten Mile River	26	3	3
Woonasquatucket River	21	1	1

Source: NBEP 2017. The State of Narragansett Bay and Its Watershed Technical Report
http://nbep.org/01/wp-content/uploads/2017/03/State-of-Narragansett-Bay-and-Its-Watershed-lower-resolution.pdf

Pathogens

The NBEP monitors Narragansett Bay for pathogens to monitor potential health concerns regarding recreation (e.g., swimming and boating) and shellfishing by testing for *Escherichia coli*, general fecal coliform, and *Enterococci* bacteria (NBEP, 2017). Sources of these pathogens include WWTFs, stormwater runoff, septic systems, and wildlife. It was found that 20 percent of streams and rivers and 97 percent of lakes and ponds in the Coastal Narragansett Bay area were acceptable for recreational use (NBEP, 2017). For shellfishing, 63 percent of Narragansett Bay was classified as approved, 13 percent was classified as conditionally approved, and 24 percent was classified as prohibited in 2015. However, the sampling locations at the Mouth of the Bay and the West Passage, where the Project will occur, each have 90 percent classified as approved for shellfishing, indicating good water quality regarding pathogens.

Contamination

NBEP monitors both of what it considers legacy and emerging contaminants in Narragansett Bay. Legacy contaminants are those such as heavy metals that have been present and regulated for many years and may persist in the environment (NBEP, 2017). Research conducted during the 1980s and 1990s on legacy contaminants found that there was a north-south gradient in the Bay, with the northern reaches having the highest concentrations of legacy contaminants. NBEP also evaluated legacy contaminants by analyzing dated sediment cores and blue mussel (*Mytilus edulis*) tissue (NBEP, 2017). The sediment cores were evaluated for levels of copper, lead, cadmium and chromium and the effects range median (ERM - threshold where detected levels of a contaminant above the ERM likely or always result in observed effects) were compared to levels of the contaminants in the 1770s. The analysis showed that the levels for all contaminants spiked during the Industrial Revolution and then dramatically reduced with the introduction of environmental regulations (i.e., CWA and Clean Air Act). Additional analysis showed that all analyzed contaminants within the sediment cores dropped below the ERM after 1990. Similarly, data on metals and PCBs from tissue from blue mussels showed a trend in declining levels of contaminants from 1976 to 2012 (NBEP, 2017).

Emerging contaminants, or "chemical contaminants of emerging concern (CECs) refers to chemicals with unknown ecological effects and no associated regulatory standards" (NBEP, 2017). Sources of CECs include pharmaceuticals, personal care products, and industrial chemicals, and information on them within the Bay is limited (NBEP, 2017). Due to the lack of sufficient data, the extent and magnitude of CECs within the Bay are not available.

Turbidity

There are limited data available on turbidity within Narragansett Bay. The NBC measures turbidity using a Secchi disk. A Secchi disk measures water clarity by lowering a black and white disk into the water column until it is no longer visible; the depth at which the disk is last visible is then recorded. Table 4.2.2-6 below was adapted from available data from NBC for Bullock Reach and Conimicut Point, which are the two monitoring locations that are closest to the mouth of Narragansett Bay. Several readings were taken every month and the data below represents the annual average for depth visibility. All depths are in meters (NBC, 2019).

Table 4.2.2-6 2017-2019 Water Clarity Depths Measured by NBC at Bullock Reach and Conimicut Point Monitoring Stations (using a Secchi disk)

Sample Location and Year	Greatest Depth (m) (Date)	Shallowest Depth (m) (Date)	Annual Average Depth of Visibility (m)
Bullock's Reach - 2017	3.9 (11/29/2017)	0.8 (8/23/2017)	1.7
Bullock's Reach – 2018	3.9 (10/17/2018)	1.3 (5/24/2018, 7/25/2018, 8/1/2018, 8/8/2018)	2.1
Bullock's Reach - 2019	3.9 (3/13/2019)	0.9 (5/30/2019	1.7
Conimicut Point - 2017	4.2 (10/18/2017)	1.1 (7/6/2017)	1.8
Conimicut Point - 2018	5.4 (3/28/2018)	1.3 (8/8/2018)	1.7
Conimicut Point - 2019	3.6 (1/3/2019)	0.9 (5/30/2019)	2.3

Source: NBC data taken from http://snapshot.narrabay.com/WaterQualityInitiatives/WaterClarity
All depths are in meters and are rounded to the nearest tenth of a meter

Anthropogenic Activities

The watersheds of Narragansett Bay have experienced development and population growth since the 1700s and continued residential, commercial, and industrial development. These factors have shaped the area and introduced nutrients, pathogens and pollutants into streams, rivers and the Bay. Both point and non-point sources of pollution are present, and the effects of those sources as well as others are discussed above.

Onshore Facilities

The Onshore Facilities begin at the MHWL in the Landfall Envelope and include the Landfall Work Area and TJBs, the Onshore Transmission Cables, ICF, and the OnSS. Cable routing in the Landfall Envelope has not yet been determined as routing will be dependent on ultimate location of the Landfall Work Area. Regardless of the specific route selected, the Onshore Transmission Cable route, ICF, and OnSS are not within a community wellhead protection area, groundwater recharge area, or sole source aquifer (RIDEM Environmental Resource Map, accessed 11/20/2019). The maximum potential footprint of the OnSS encroaches into freshwater wetlands and wetland buffers. Figure 4.2.2-4 shows an overview of the Landfall Envelope, Onshore Transmission Cable routing, ICF, and OnSS.

Revolution Wind

Figure 4.2.2-4

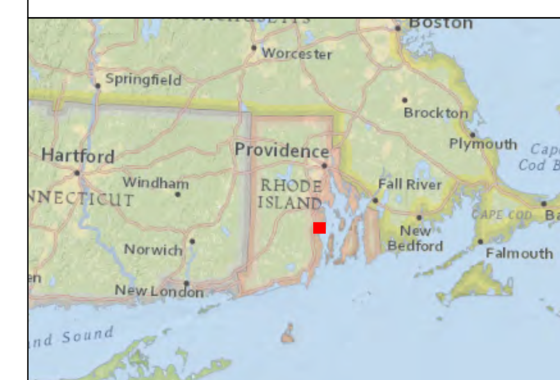
Onshore Facilities

NORTH KINGSTOWN, RI

Legend

- Onshore Transmission Cable
- Substation Limit of Work
- ICF Limit of Work
- Landfall Envelope
- RWEC-RI State Waters
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 60 120 180 Meters

0 200 400 600 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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Dissolved Oxygen

The Onshore Facilities will not be installed within any waterbodies. As such, DO is not considered part of the affected environment for this portion of the Project.

Chlorophyll a

The Onshore Facilities will not be installed within any waterbodies. As such, chlorophyll *a* is not considered part of the affected environment for this portion of the Project.

Nutrients

The Onshore Facilities will not be installed within any waterbodies. As such, nutrients not considered part of the affected environment for this portion of the Project.

Pathogens

The Onshore Facilities will not be installed within any waterbodies. As such, pathogens are not considered part of the affected environment for this portion of the Project.

Contamination

Groundwater quality can be negatively impacted by a variety of anthropogenic activities that result in contamination including, but not limited to, stormwater runoff and infiltration; spills and releases from commercial and industrial properties; storage tanks; machinery, and vehicles; road salt application; fertilizers and pesticides; agriculture; and septic systems. Along the cable route, there are several areas designated as RIDEM Site Investigation and Remediation sites, several Environmental Land Use Restrictions, two Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) sites, one above ground storage tank, and several Emergency Planning and Right-to-Know Act (EPCRA) Tier II facilities. Environmental investigations of these sites have revealed that groundwater in the Project Area has been impacted by historic releases of contaminants and may contain chlorinated volatile organic compounds (Appendix V).

Turbidity

The Onshore Facilities will not be installed within any waterbodies. As such, turbidity is not considered part of the affected environment for this portion of the Project.

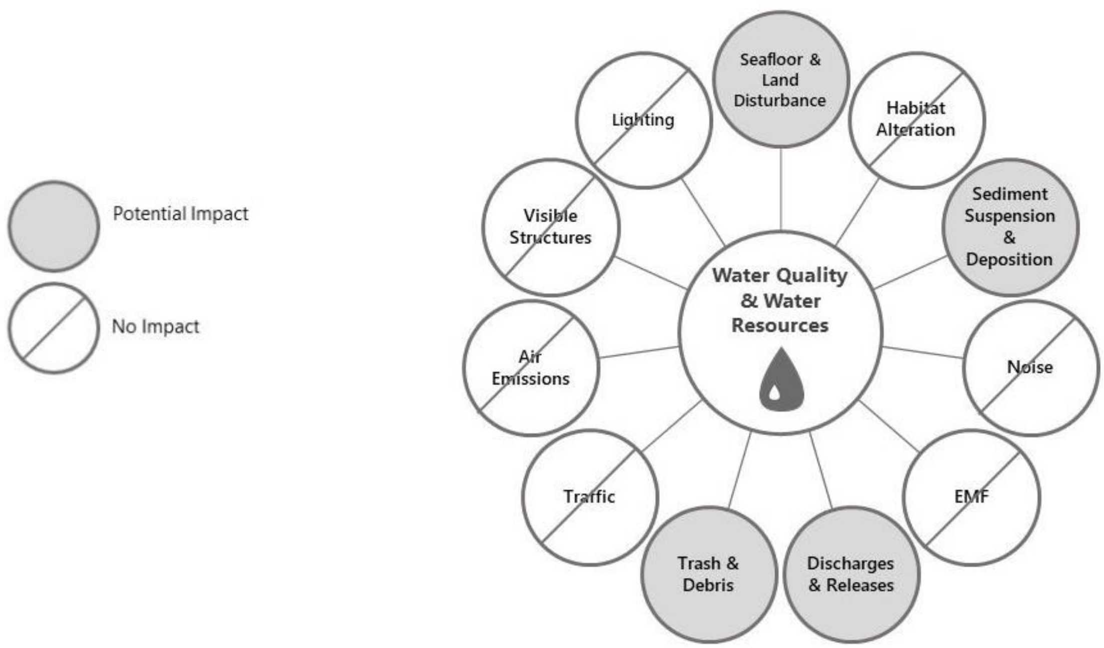
Anthropogenic Activities

The Onshore Transmission Cable route is located within areas classified as Class GA and Class GB (RIDEM A Summary of Rhode Island Groundwater Classification and Groundwater Standards, September 2009). Class GA waters are presumed to be suitable for drinking without treatment and Class GB may not be suitable for drinking without treatment and are serviced by public water systems. RIDEM established groundwater quality standards and preventative action limits for classes to protect public health. In addition, as discussed in above, there are several contaminated sites along the cable route. Please refer to that section for additional information for anthropogenic activities within the affected environment.

4.2.2.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact water quality. IPFs that may result in direct or indirect impacts to water quality are depicted in Figure 4.2.2-5. Impacts are characterized as direct or indirect, and short-term or long-term as defined in Section 4.0

Figure 4.2.2-5 Impact-producing Factors on Water Quality and Water Resources



Revolution Wind Farm

Based on the IPFs discussed in Table 4.2.2-7, construction and decommissioning of the RWF is expected to result in ***direct*** and ***short-term*** impacts to water quality from seafloor disturbance, sediment suspension and deposition, discharges and releases, and trash and debris. As discussed in Table 4.2.2-8, O&M of the RWF is expected to result in ***direct*** and ***short-term*** impacts from seafloor disturbance, sediment suspension and deposition, and discharges and releases. No impacts to water quality from trash and debris are expected during O&M.

Construction and Decommissioning

IPFs resulting in potential impacts on water quality in the RWF area from construction and decommissioning are summarized in Table 4.2.2-7 below. The foundation removal, WTG disassembly, and offshore cable removal Project activities are associated with decommissioning only. Additional details regarding these potential impacts from the various IPFs during construction/decommissioning of the RWF are described in the following sections.

Table 4.2.2-7 Summary of RWF Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation	Direct, Short-term
	Vessels and Heavy Equipment (WTG and OSS)	Direct, Short-term
	Foundation Installation/Placement of Scour Protection (WTG and OSS)	Direct, Short-term
	RWF IAC and OSS-Link Cable Installation/Cable Protection	Direct, Short-term
	Foundation Removal	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
Sediment Suspension and Deposition	Seafloor Preparation	Direct, Short-term
	Vessels and Heavy Equipment (WTG and OSS)	Direct, Short-term
	Foundation Installation/Placement of Scour Protection (WTG and OSS)	Direct, Short-term
	RWF IAC and OSS-Link Cable Installation/Cable Protection	Direct, Short-term
	Foundation Removal	Direct, Short term
	Offshore Cable Removal	Direct, Short term
Discharges and Releases	Vessels and Heavy Equipment (WTG and OSS)	Direct, Short-term
	Foundation Removal	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
Trash and Debris	Vessels and Heavy Equipment (WTG and OSS)	Direct, Short-term
	Foundation Removal	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
	WTG Disassembly	Direct, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

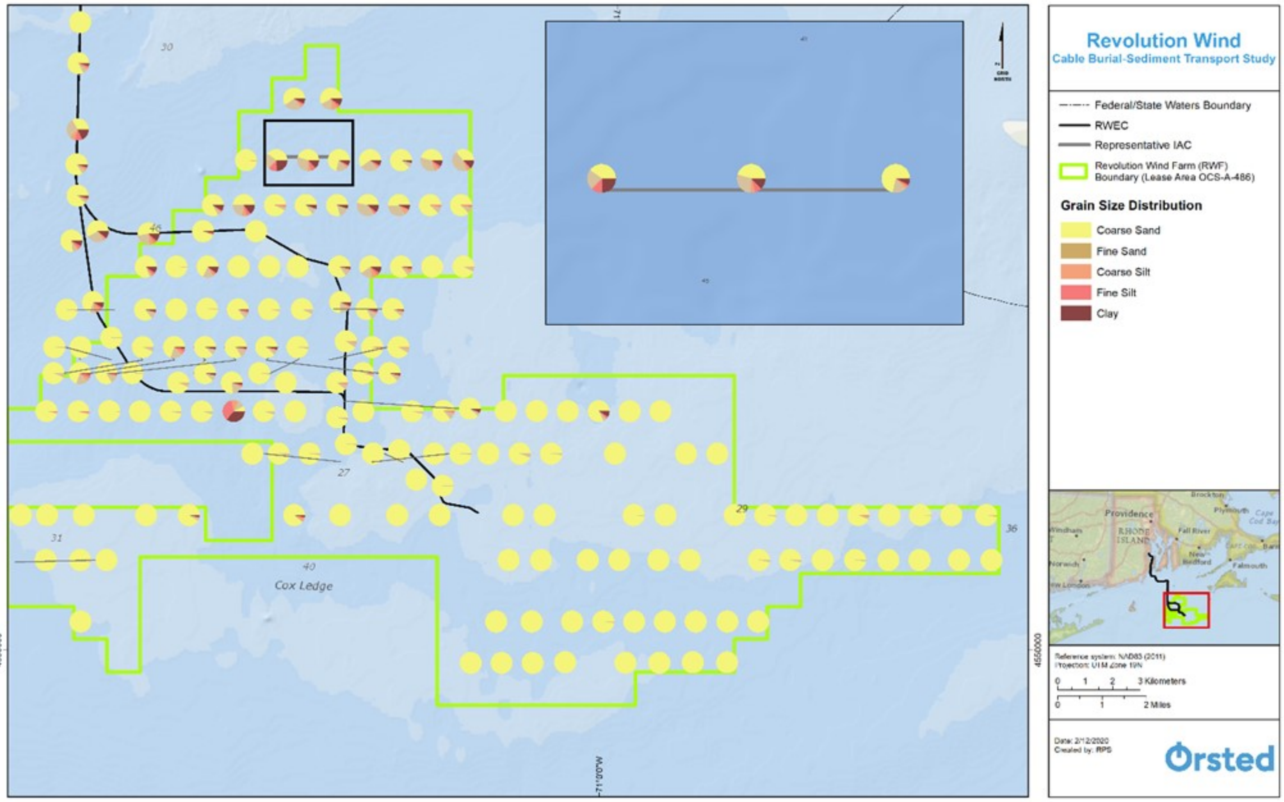
Seafloor disturbance and sediment suspension and deposition are discussed together because they are interrelated from a water quality perspective (i.e., seafloor disturbance results in sediment suspension and deposition). Disturbance will result from seafloor preparation activities including sandwave leveling and the clearance of boulders, debris, and other obstructions; jackup vessels; installation of foundations, IACs, and OSS-Link Cable; and placement of scour and cable protection. Jack-up vessel(s) with four spud cans will be used during installation of the WTGs, OSSs, and foundations. Similar activities will occur during the decommissioning phase; however, Project components will be removed rather than installed.

With the implementation of environmental protection measures outlined in Section 4.2.2.3 below and the amount of seafloor disturbance and subsequent sediment suspension and deposition, seafloor preparation activities, the use of jackup vessels, foundation installation, and installation of scour protection is expected to result in ***direct*** and ***short-term*** impacts to water quality. Refer to Table 4.1.1-1 in Section 4.1.1.1 for details regarding temporary and permanent impacts for foundation installations and vessel anchoring.

RWF also includes installation of the export cable that connects to the OSS, IACs, and OSS-Link Cable. Installation of these cables is considered to have a greater risk of suspending sediments in comparison with pile driving. Depending on the substrate, installation of the offshore cables may involve use of jet-plows, mechanical plows, mechanical cutters, CFE and/or trailing suction hopper dredger within the seafloor to allow for installation of the IACs and OSS-Link Cable. Refer to Section 3.3.2 for a discussion regarding the different methodologies for installing the cables, and Sections 3.3.6 and 3.3.7 for details regarding construction of the OSS-Link Cable and IACs, respectively. This trenching will temporarily disturb the seafloor, which will result in sediment suspension and deposition during construction. In general, the disturbed area will naturally resettle within the trench and/or be backfilled depending on the installation method; therefore, no permanent impact is assumed where the cables are completely installed beneath the seafloor and the trench is backfilled. With the implementation of environmental protection measures outlined in Section 4.2.2.3 below and the amount of seafloor disturbance and subsequent sediment suspension and deposition, construction and decommissioning of the export cable are expected to result in ***direct, short-term*** impacts to water quality.

A Hydrodynamic and Sediment Transport Modeling analysis was prepared to assess the sediment effects from cable burial activities (Appendix J). The study included employing a HYDROMAP model and a Suspended Sediment FATE (SSFATE) model. A HYDROMAP hydrodynamic modeling system was used to simulate water levels, circulation patterns and water volume flux throughout the study area, and to provide spatially and temporally varying currents for input into the sediment transport model (Appendix J). The SSFATE model computes "TSS concentrations and sedimentation patterns resulting from sediment disturbing activities" (Appendix J). Figure 4.2.2-6 below shows the sediment size distribution at grab sample locations within the RWF (Appendix J).

Figure 4.2.2-6 Sediment Grain Size Distribution at Grab Sample Locations Used in the Modeling Simulation for RWF (RPS, 2020)



The modeling simulation was conducted on a representative section of the IACs using a conservative set of assumptions to model the maximum sediment resuspension from the IAC burial. For details regarding the assumptions used for the simulation and the results, please refer to Section 4.1.3.2 and RPS's report in Appendix J.

Based on the results of RPS's simulation, the implementation of environmental protection measures outlined in Section 4.2.2.3 below and the construction methodology, installation of the IACs, OSS-Link Cable and cable protection is expected to result in ***direct*** and ***short-term*** impacts to water quality from seafloor disturbance and sediment suspension and deposition. Based on the amount of sediment suspension and deposition, impacts to DO, chlorophyll *a*, or nutrient balance in the region are not anticipated. Cable protection will be placed on the seabed near the OSS foundations where the OSS-Link Cable leaves the trench; cable protection will also be placed in areas where burial cannot occur, sufficient burial depth cannot be achieved to avoid risk of interaction with external hazards or where cables cross other cables or pipelines, as determined necessary by a Project-specific Cable Burial Risk Assessment. In addition, the sediment in the RWF is not expected to contain contaminants; therefore, water quality will be affected primarily by the short-term physical suspension of sediments.

Similar to construction, decommissioning of RWF, with the implementation of environmental protection measures as outlined in Section 4.2.2.3 below, the foundation and offshore cable removals are expected to result in ***direct*** and ***short-term*** impacts to water quality from seafloor disturbance and sediment suspension and deposition. There are no anticipated impacts to water quality from seafloor disturbance or sediment suspension and deposition associated with the WTG disassembly.

Discharges and Releases

As discussed in Section 3.3.9.2, multiple vessels will be used during the construction and decommissioning of the RWF, including for foundation and offshore cable installation and removal. Vessels will comply with regulatory requirements for management of onboard fluids and fuels, including prevention and control of discharges and accidental spills. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations, and vessels will be equipped with spill containment and cleanup materials. Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D).

Some liquid wastes are allowed to be discharged to marine waters during the construction phase of the RWF. These discharges include domestic water, deck drainage, treated sump drainage, uncontaminated ballast water and uncontaminated bilge water, as described in Appendix D. These discharges are not expected to pose an impact to marine water quality, because these releases would quickly disperse, dilute, and biodegrade (BOEM, 2013). All vessels will comply with USCG standards in U.S. territorial waters to legally discharge uncontaminated ballast and bilge water, and standards regarding ballast water management. Other liquid wastes such as sewage, chemicals, solvents, and oils and greases from equipment, vessels or facilities will be stored and properly disposed of on land. A list of chemicals to be utilized during the project is provided as required by 30 CFR 585.626 in E and Section 3.3.9.4.

As such, with the implementation of the environmental protection measures outlined in Section 4.2.2.3, any discharges or releases are expected to result in ***direct*** and ***short-term*** impacts to water quality. Please refer to Section 4.1.6.1 for additional information regarding potential discharges and releases in the RWF.

Trash and Debris

Any construction operation has the potential to create trash and debris during construction and decommissioning from workers. However, all solid and liquid trash and debris will be properly stored on vessels and will be disposed of on land at an appropriate facility per 30 CFR 585.626(b)(9). Therefore, with the implementation of the environmental protection measures outlined in Section 4.2.23 below, trash and debris are expected to result in ***direct*** and ***short-term*** impacts to water quality. Please refer to Section 4.1.7 for additional information regarding potential releases of trash and debris. Similar trash and debris containment and storage will occur on vessels during decommissioning.

Operations and Maintenance

IPFs resulting in potential impacts to water quality in the RWF area from the O&M phase are summarized in Table 4.2.2-8. There are no water quality impacts expected from trash and debris during the O&M phase and as such, this IPF is not discussed in this Section. Additional details regarding potential impacts from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.2.2-8 Summary of RWF O&M Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	WTG/OSS Operation (Including Foundations)	Direct, Short-term
	IAC/OSS-Link Cable/RWEC Operation	Direct, Short-term
Sediment Suspension and Deposition	WTG/OSS Operation (Including Foundations)	Direct, Short-term
	IAC/OSS-Link Cable/RWEC Operation	Direct, Short-term
Discharges and Releases	WTG/OSS Operation (Including Foundations)	Direct, Short-term
	IAC/OSS-Link Cable/RWEC Operation	Direct, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

Similar to the construction phase analysis, seafloor and sediment suspension and deposition are evaluated together because they are interrelated activities. Increases in sediment suspension and deposition during O&M activities would primarily result from vessel anchoring and any maintenance activities associated with a repair of the WTGs, IACs, OSS-Link Cable and RWEC, including scour protection replenishment. These activities are expected to be nonroutine events and are not expected to occur with any regularity. If maintenance or an emergency repair is required, activities would only include local suspension of sediments and temporary increases in turbidity, and with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, are expected to result in ***direct*** and ***short-term*** impacts to water quality.

Discharges and Releases

There may be a small, temporary diesel generator at each WTG location on the work deck of the foundation during construction. If present, the generator will have a 50-gallon diesel tank with secondary containment. However, the O&M of the RWF is not anticipated to generate any sources of pollutants to the marine environment. To make sure that no discharges of fluids (oil, hydraulic, cooling, etc.) occur even under abnormal circumstances, the WTGs will be designed for secondary levels of containment as described in more detail in Section 3.3.8.1 and in Appendix J. Most maintenance would occur inside the WTGs, thereby reducing the risk of a spill, and no oils or other waste is expected to be discharged during service events. Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D). The original coating system on the towers is designed to last the lifetime of the structure; therefore, no painting is anticipated during the life of the WTGs other than to repair minor surface damage. As a result, with the implementation with the environmental protection measures outlined in Section 4.2.2.3 below, O&M activities are expected to result in ***direct*** and ***short-term*** impacts to water quality.

As discussed in Section 3.36., the OSSs will require various oils, fuels and lubricants to support operation. The OSSs will be designed with a minimum of 110 percent of secondary containment for all identified oils, grease and lubricants, and they will contain integral low-pressure sensors to detect sulfur hexafluoride (SF_6) leakage. Please refer to Section 4.1.6.1 and Appendix D for additional details. As a result, there are no anticipated impacts to water quality from OSS O&M.

Revolution Wind Export Cable–OCS

Based on the IPFs discussed in Table 4.2.2-9, during construction and decommissioning of the RWEC water quality is expected to experience ***direct*** and ***short-term*** impacts from seafloor disturbance, sediment suspension and deposition, discharges and releases, and trash and debris. As discussed in Table 4.2.2-10, during O&M of the RWEC, water quality is expected to experience, ***direct*** and ***short-term*** impacts from seafloor disturbance and sediment suspension and deposition. O&M of RWEC–OCS will not result in any impacts from discharges and releases, and trash and debris.

Construction and Decommissioning

IPFs resulting in potential impacts to water quality in the RWEC from the construction and decommissioning phases are summarized in Table 4.2.2-9. The impacts discussed in Table 4.2.2-9 apply to both the RWEC–OCS and RWEC–RI, though the impacts could vary slightly between the nearshore and offshore portions of the RWEC route. In addition, the HDD Project activity only applies to the RWEC–RI portion of the cable discussed in subsequent sections. Additional details regarding potential impacts on water quality from the various IPFs during construction and decommissioning are described in the following sections.

Table 4.2.2-9 Summary of RWEC-OCS and RI Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation	Direct, Short-term
	RWEC Cable Installation/Cable Protection	Direct, Short-term
	RWEC-RI HDD	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
Sediment Suspension and Deposition	Seafloor Preparation	Direct, Short-term
	RWEC Cable Installation/Cable Protection	Direct, Short-term
	RWEC-RI HDD	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
Discharges and Releases	Vessels	Direct, Short-term
	RWEC-RI HDD	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
Trash and Debris	Vessels	Direct, Short-term
	RWEC-RI HDD	Direct, Short-term
	Offshore Cable Removal	Short-term, Direct

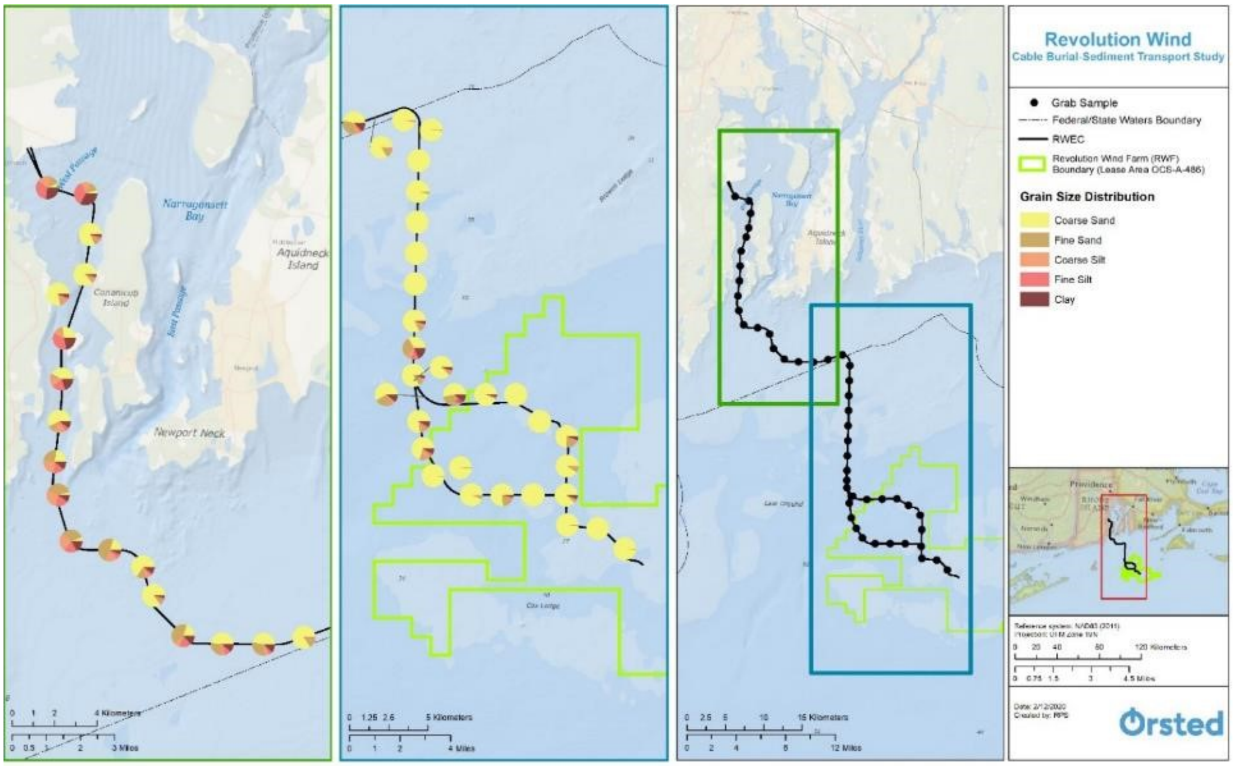
Seafloor Disturbance/Sediment Suspension and Deposition

Seafloor disturbance and sediment suspension and deposition are discussed together because they are interrelated from a water quality perspective (i.e., seafloor disturbance results in sediment suspension and deposition). Disturbance will result from seafloor preparation activities including sandwave leveling and the clearance of boulders, debris and other obstructions; installation of the RWEC; and placement of cable protection. Similar activities will occur during decommissioning; however, Project components will be removed rather than installed.

Installation of the RWEC - OCS and cable protection will have the same construction methodology and disturbance parameters for seafloor and sediment suspension and deposition as the IACs and OSS-Link Cable. Refer to Section 3.3.3.2 and Table 3.3.3-1 for a discussion regarding the construction methodology for the RWEC and Table 3.3.3-2 for the maximum seabed disturbance for RWEC installation. In addition, the anticipated RWEC-OCS maximum disturbance corridor during construction is provided in Table 4.1.1-2. Cable protection will be placed in areas where burial cannot occur, sufficient burial depth cannot be achieved to avoid risk of interaction with external hazards, or where cables cross other cables or pipelines, as determined necessary by a Project-specific Cable Burial Risk Assessment. With the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, the installation of the cable protection is expected to result in a ***direct*** and ***short-term*** impacts to water quality from seafloor disturbance and sediment suspension and deposition. Please refer to Section 4.1.1.2 and Table 4.1.1-2 for additional details regarding seafloor and land disturbance.

RPS simulated a model for TSS and sedimentation patterns for RWEC. For details regarding the assumptions used for the simulation and the results, please refer to Section 4.1.3.2 and Appendix J. Figure 4.2.2-7 below depicts the sediment grain size distribution at grab sample locations within the RWEC-OCS and RWEC-RI (Appendix J).

Figure 4.2.2-7 Sediment Grain Size Distribution at Grab Sample Locations Used in the Modeling for RWEC-OCS and RWEC-RI (RPS, 2020)



Based on the results of RPS's simulation, the implementation of the environmental protection measures outlined in Section 4.2.2.3 below and the construction methodology, installation of the RWEC-OCS is expected to result in ***direct, short-term*** impacts to water quality from seafloor disturbance and sediment suspension and deposition and should not impact DO, chlorophyll *a*, or nutrient balance in the region. In addition, the sediment in the RWEC-OCS is not expected to contain contaminants; therefore, water quality will be affected primarily by the short-term physical suspension of sediments. Similar to construction, decommissioning the removal of the RWEC–OCS is expected to result in ***direct*** and ***short-term*** impacts to water quality.

If needed, vessel anchoring during installation of the RWEC–OCS would occur within the approximate 400 m wide cable corridor. There are no anticipated impacts to water quality from seafloor disturbance or sediment suspension and deposition.

Discharges and Releases

The implementation of environmental protection measures and impacts associated with discharges and releases during construction and decommissioning of the RWEC-OCS are expected to be similar to those described for the RWF IACs and OSS-Link Cable and are therefore expected to result in ***direct*** and ***short-term*** impacts from vessels, installation of the RWEC-OCS, and RWEC–OCS removal. In addition, the proposed RWEC-OCS does not contain any fluid. There will be no risk to the environment if they are disturbed by anchors or keels because no fluids or materials will be released.

Trash and Debris

The implementation of environmental protection measures and impacts associated with trash and debris during construction and decommissioning of the RWEC-OCS are expected to be similar to those described for the RWF IACs and OSS-Link Cable and are therefore expected to result in ***direct*** and ***short-term*** impacts from vessels, installation of the RWEC-OCS, and RWEC–OCS removal.

Operations and Maintenance

IPFs resulting in potential impacts to water quality in the RWEC-OCS area from the O&M phase are summarized in Table 4.2.2-11. Additional details regarding potential impacts on water quality from the various IPFs during O&M are described in the following sections.

Table 4.2.2-11 Summary of RWEC-OCS and RI O&M Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	RWEC Maintenance	Direct, Short-term
Sediment Suspension and Deposition	RWEC Maintenance	Direct, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

No effect on water quality conditions is anticipated during routine operations because there is no routine maintenance of the RWEC–OCS that would require work on the seafloor. Therefore, routine operations of the RWEC-OCS are expected to result in no impact to water quality conditions from seafloor disturbance and sediment suspension and deposition. However, should there be a need for Project-related maintenance of the RWEC-OCS, vessels similar in size to the cable lay barge spread or smaller would likely be used for the repair. With the implementation of environmental protection measures, if maintenance is required, it is expected to result in ***direct*** and ***short-term*** impacts.

Revolution Wind Export Cable – RI

Construction and Decommissioning

Please refer to Table 4.2.2-10 for the IPF summary table for RWEC-RI. Additional details regarding potential impacts on water quality from the various IPFs during construction and decommissioning are described in the following sections.

Seafloor Disturbance/Sediment Suspension and Deposition

Seafloor disturbance and sediment suspension and deposition are discussed together because they are interrelated from a water quality perspective (i.e., seafloor disturbance results in sediment suspension and deposition). Except for the portion of the RWEC-RI that will be installed via HDD, all Project activities and the impact characterization for the RWEC-RI are the same as RWEC-OCS (Table 4.2.2-10). A discussion of impacts associated with the HDD method follows.

The nearshore portion of the RWEC-RI will traverse through the intertidal zone and will be installed via HDD. No seafloor/land disturbance will occur within intertidal areas from installation of the RWEC-RI; however, a barge or jack-up vessel may be required to assist with the drilling process. A cofferdam may be used during construction to provide a dry work environment and will serve as containment from drilling returns during the HDD installation. If constructed, the cofferdam would temporarily impact 0.25 acres (0.1 ha) and would be removed and the area restored once the cable was installed. If a cofferdam is not used for HDD, two exit pits will be excavated and will result in 0.25 ac (0.1 ha) of temporary impacts. Please refer to Section 3.3.3.2 for a discussion regarding the HDD installation.

Based on RPS's simulation for the landfall location using the HDD method, the plume above background may persist for up to 256 hours and for above 100 mg/L may persist for up to 237 hours from the exit pit when a cofferdam is not used (Appendix G). For deposition, the simulation modeled that for HDD, it would extend up to 216 ft (66 m) (Appendix G). Figures 4.2.2-8 and 4.2.2-9 show RPS's simulated maximum TSS and seabed deposition, respectively, for HDD methods at the Landfall Envelope.

Figure 4.2.2-8 Maximum TSS from Simulated Landfall Activities for HDD (RPS, 2020)

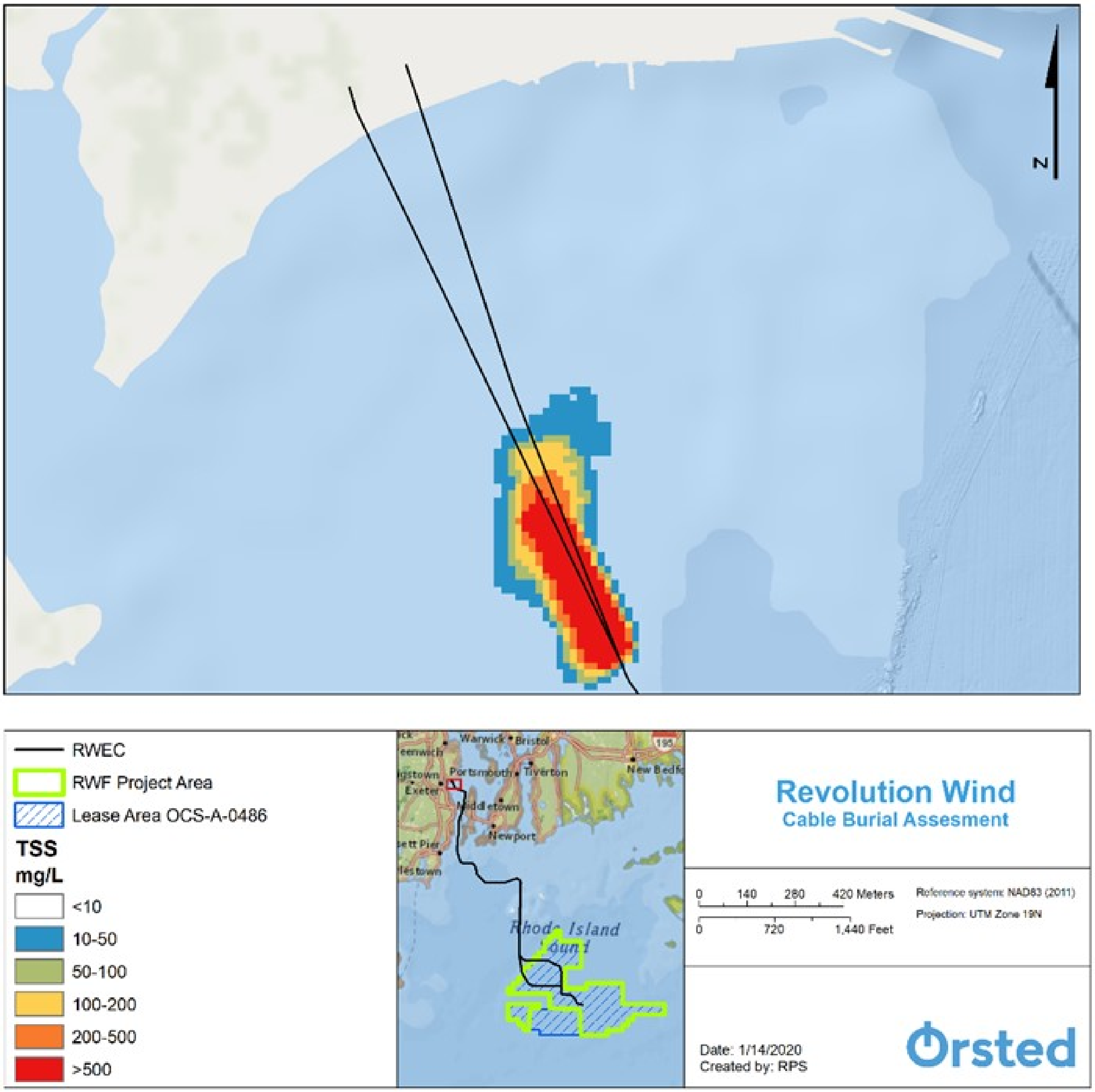
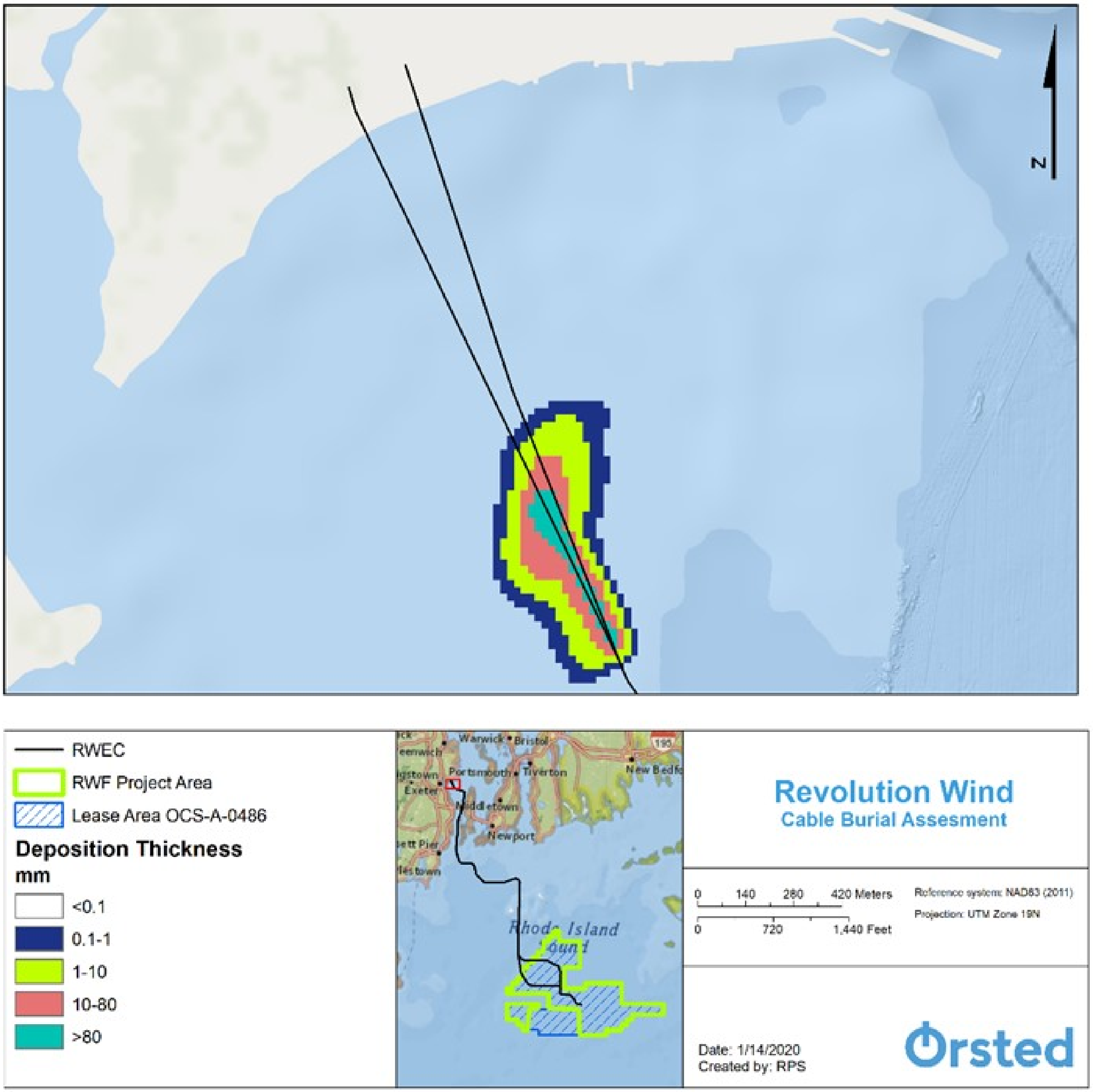


Figure 4.2.2-9 Cumulative Seabed Deposition from Simulated Landfall Activities for HDD (RPS, 2020)



Based on RPS's simulation and the implementation of the environmental protection measures outlined in Section 4.2.2.3, the disturbance would be temporary and is expected to result in ***direct*** and ***short-term*** impacts to water quality from seafloor disturbance and sediment suspension and deposition and should not impact DO, chlorophyll *a*, or nutrient balance in the region.

Planned survey efforts in 2020 will include the collection of vibracore samples which will be analyzed for environmental contaminants in accordance with RIDEM requirements to support State permitting activities. Environmental sampling will focus on the physical and chemical parameters dictated by RIDEM. Physical analysis of samples will include sieve analysis for grain size distribution, percent organic matter and moisture content, and total solids/specific gravity. Chemical analyses will include metals, poly-aromatic hydrocarbons, PCBs, and pesticides.

Discharges and Releases

Impacts associated with discharges and releases during construction of the RWEC–RI are anticipated to be similar to those described for the RWEC–OCS. However, additional water quality impacts could occur during HDD operations, which are discussed below.

During HDD installation, either exit pits or a temporary cofferdam will be temporarily utilized to create a contained, dry work area. HDD uses a drilling fluid that consists of water and bentonite, a natural clay mineral, to stabilize the hole, prevent collapse and return the cuttings to the drill rig where they will be separated from the drilling fluid. A barge or jack-up vessel may also be used to assist the drilling process, handle the pipe for pull in, and help transport the drilling fluids and mud for treatment, disposal and/or reuse. To minimize the potential risks for an inadvertent drilling fluid release, an HDD Contingency Plan will be developed and BMPs will be implemented during construction. With the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, if an inadvertent release does occur, it is expected to result in ***direct*** and ***short-term*** impacts to water quality. Please refer to Section 3.3.3.2 for additional details regarding HDD installation and the use of drilling fluids.

Trash and Debris

Impacts associated with trash and debris during construction of the RWEC–RI are expected to be similar to those described for the RWF and RWEC-OCS and with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, are therefore expected to result in ***direct*** and ***short-term*** impacts.

Operations and Maintenance

Please refer to Table 4.2.2-11 for the IPF summary table for RWEC-RI. Additional details regarding potential impacts on water quality from the various IPFs during O&M are described in the following sections.

Seafloor Disturbance/Sediment Suspension and Deposition

Impacts associated with seafloor disturbance during O&M of the RWEC–RI are expected to be similar to those described for the RWEC–OCS. Therefore, if a repair is needed and the environmental protection measures outlined in Section 4.2.2.3 below are implemented, it is expected to result in ***direct*** and ***short-term*** impacts to water quality.

Onshore Facilities

Based on the IPFs discussed in Tables 4.2.2-12 and 4.2.2-13, construction, O&M, and decommissioning of the Onshore Facilities, are expected to result in ***direct*** and ***short-term*** water quality impacts from land disturbance, discharges and releases, and trash and debris.

Construction and Decommissioning

IPFs resulting in potential impacts to water quality on the Onshore Facilities area from construction and decommissioning are summarized in Table 4.2.2-12. Additional details regarding potential impacts are described in the following sections.

Table 4.2.2-12 Summary of Onshore Facilities Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Land Disturbance	Site Preparation (Clearing, Grading) and Trenching	Direct, Short-term
	Heavy Equipment and Construction Vehicles	Direct, Short-term
	Onshore Substation and ICF Construction	Direct, Short-term
	Onshore Substation Decommissioning	Direct, Short-term
Discharges and Releases	Site Preparation (Clearing, Grading) and Trenching	Direct, Short-term
	Onshore Substation and ICF Construction	Direct, Short-term
Trash and Debris	Site Preparation (Clearing, Grading) and Trenching	Direct, Short-term
	Onshore Substation and ICF Construction	Direct, Short-term

Land Disturbance

Land disturbance will result from site preparation for the Landfall Work Area, excavation for the TJBs, installation of the Onshore Transmission Cable, and site preparation for the ICF, Interconnection ROW, and OnSS. Please refer to Section 4.1.1.3 for construction details for the Onshore Facilities and Table 4.1-5 for the maximum land disturbance for onshore facilities.

The offshore portion of the RWEC through the intertidal zone will be installed via HDD. No land disturbance will occur within intertidal areas from installation of the RWEC. Refer to Table 3.3.3-2 in Section 3.3.3.2 for maximum disturbance associated with the landfall works. The disturbance will be temporary and, with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, are expected to result in ***direct*** and ***short-term*** impacts to water quality.

The Onshore Transmission Cable will be installed within an underground duct bank between the TJBs and the OnSS and will be installed within or along previously disturbed areas including the shoulders of existing public roadways, lands owned by QDC, and private properties. The Onshore Transmission Cable will result in 3.1 ac (1.3 ha) of land disturbance but will be located outside wetlands and other waterbodies. The Landfall Work Area will require clearing, grading, and hardening to support the installation of the TJBs, and will temporarily result in up to 3.1 ac (1.3 ha) in land disturbance. The TJBs will be excavated and installed underground within the Landfall Work Area and access inside the TJBs will be provided by manholes. Therefore, land disturbance associated with the TJB area is temporary. As discussed above, the Onshore Transmission Cable, Landfall Work Area, and TJBs will all result in temporary impacts only. In addition, work will be sited in uplands and all activities will be conducted in compliance with the RIPDES General Permit for the Discharge of Stormwater Associated with Construction Activities and an approved SESC Plan. Therefore, with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, land disturbance activities during construction of the Onshore Transmission Cable are expected to result in ***direct*** and ***short-term*** water quality impacts. Figure 4.2.2-10 shows the Landfall Work Area with wetland resources and Figure 4.2.2-11 shows the details of the OnSS with wetland resources.

The OnSS will require temporary disturbance (construction footprint) of up to 7.1 ac (2.9 ha) to facilitate construction which includes an operational footprint of 3.8 ac (1.5 ha). The ICF will require a temporary disturbance (construction footprint) of approximately 4.0 ac (1.6 ha) which includes the 1.6-acre operational footprint. The temporary disturbances will be associated with temporary work areas and staging/laydown areas. Construction will include tree clearing, excavation, grading, and filling, with activities occurring within freshwater wetlands, freshwater wetland buffer (Area of Land within 50-feet), 100-foot riverbank wetland buffer from streams, and floodplains. However, to prevent impacts to water quality, stormwater discharge rates, volumes and quality will comply with the RI Stormwater Design and Installation Standards Manual (RISDISM) and earth disturbing activities will be conducted in compliance with the RIPDES General Permit for the Discharge of Stormwater Associated with Construction Activities and an approved SESC Plan. As such, with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, construction of the OnSS and ICF is expected to result in ***direct*** and ***short-term*** impacts to water quality. Decommissioning of the OnSS and ICF will either consist of repurposing it or demolishing it. If the OnSS and/or ICF are demolished, it is expected to result in ***direct*** and ***short-term*** impacts to water quality.

Land disturbance associated with decommissioning of Onshore Facilities is anticipated to be similar to those described for construction, although it is possible for the OnSS and ICF to be repurposed or the Onshore Transmission Cable to be abandoned in place, which would limit land disturbance.

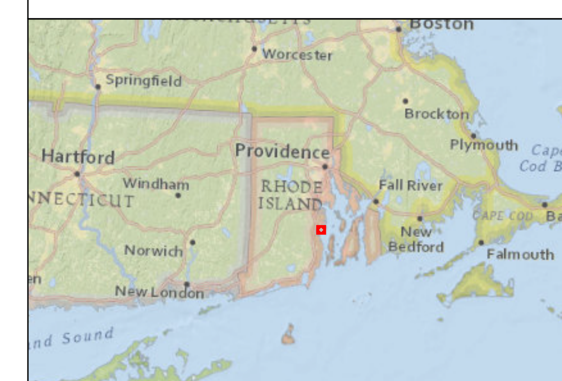
Revolution Wind

Figure 4.2.2-10
Landfall Work Area Envelope
Wetland Resources
NORTH KINGSTOWN, RI

Legend

- Onshore Transmission Cable
- Landfall Envelope
- Delineated Wetland Resources
- Interpolated Wetland
- Delineated Wetland Edge
- Approximate Wetland Edge
- 50' Perimeter Wetland
- Wetland (NWI)
- Coastal Beach
- Coastal Dune
- Manmade Shoreline
- Tidal Salt Marsh
- Coastal Bank
- One-Percent Annual Chance Flood Hazard Area
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 25 50 75 Meters

0 80 160 240 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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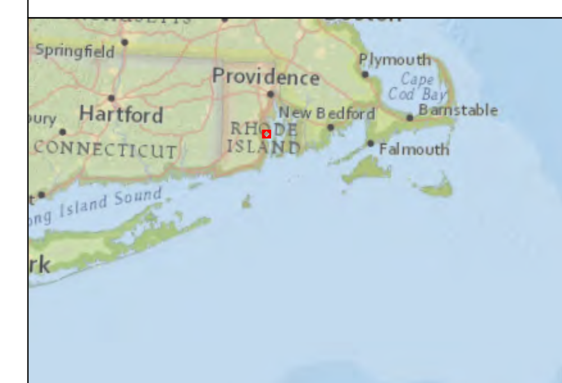
Figure 4.2.2-11
Onshore Substation
Wetland Resources
NORTH KINGSTOWN, RI

Legend

- Onshore Transmission Cable
- Substation Limit of Work
- ICF Limit of Work
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- One-Percent Annual Chance Flood Hazard Area
- Potential Vernal Pool
- 100' Riverbank Wetland
- Area of Land within 50' of Wetland
- VHB Delineated Wetland Edge
- LEC Delineated Wetland Edge
- Approximate Wetland Edge
- LEC Delineated ASSF
- Approximate Stream
- Delineated Wetland Resources
- Interpolated Wetland
- Wetland (NWI)
- Vernal Pool Area

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 25 50 75 Meters

0 80 160 240 Feet

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Discharges and Releases

Although no impacts from discharges and releases are anticipated during routine construction activities, some spills and accidental releases of fuels, lubricants, and hydraulic fluids may occur during site preparation and the Onshore Facilities construction. These non-routine spills or accidental releases are expected to result in ***direct*** and ***short-term*** impacts to water quality from runoff and infiltration with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below.

Trash and Debris

Any construction operation has the potential to create trash and debris during construction from normal construction activities and workers. However, all solid and liquid trash and debris will be properly stored and will be disposed of at an appropriate facility. Therefore, with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, any trash or debris is expected to result in ***direct*** and ***short-term*** water quality impacts during site preparation and Onshore Facility construction activities.

Operations and Maintenance

IPFs resulting in potential impacts to water quality in the Onshore Facilities area from O&M are summarized in Table 4.2.2-14. The Onshore Facilities have minor maintenance needs, which will be performed under a routine preventative maintenance plan in accordance with manufacturer requirements and industry guidelines. This plan will be created during the project execution and construction period. Routine maintenance required during the lifespan of the Onshore Facilities will primarily involve observation and testing of equipment and impacts are expected to be significantly less than those described for the construction phase. Additional details regarding potential impacts to water quality are described in the following sections.

Table 4.2.2-14 Summary of Onshore Facilities O&M Impacts

IPF	Project Activity	Impact Characterization
Land Disturbance	Onshore Facilities Operation/Maintenance	Direct, Short-term
Discharges and Releases	Onshore Facilities Operation/Maintenance	Direct, Short-term

Land Disturbance

Given that minimal maintenance needs are anticipated, no impacts to water quality or water resources are expected from land disturbance activities. In the event of a fault or failure, impacts are expected to be similar to those described for the construction phase but constrained to a smaller, isolated location. In many cases, faults can be repaired with no land disturbance. Therefore, with the implementation of the environmental protection measures outlined in Section 4.2.2.3 below, if any non-routine maintenance occurs that requires land disturbance, the activities are expected to result in ***direct*** and ***short-term*** water quality impacts. Please refer to Section 4.1.1.3 for additional information regarding potential land disturbance associated with maintenance of Onshore Facilities.

Discharges and Releases

Given that minimal maintenance needs are anticipated, no impacts to water quality or water resources are expected from discharges and releases. In the event of a fault or failure of the onshore cable, impacts are expected to be similar to those described for the construction phase and, with the implementation of the environmental protection measures outlined in Section 4.2.2.3, are expected to result in ***direct*** and ***short-term*** water quality impacts.

During normal operation, the OnSS will require various oils, lubricants, and fuels, and SF_6 gas will be used for electrical insulation purposes. To prevent discharges and releases, equipment will be on concrete foundations with concrete secondary containment designed for 110 percent containment and integral low-pressure sensors will be installed to detect SF_6 leakages in the event they occur. In addition, a SPCC Plan will be developed in support of CWA compliance. Refer to Section 3.3.1.1 and Table 3.3.1-2 for additional details. Therefore, inadvertent discharges and releases are not anticipated during O&M; however, should a discharge or release occur, the environmental protection measures outlined in Section 4.2.2.3 would be implemented and it would be expected to result in ***direct*** and ***short-term*** impacts to water quality. There are no oils, lubricants, fuel, or gasses required for the ICF, Interconnection ROW, or TNEC ROW.

4.2.2.3 Proposed Environmental Protection Measures

The protection of water quality in marine and onshore environments is incorporated into many facets of the Project's design and construction. Site selection and routing, installation techniques and equipment technologies have been selected to avoid and minimize potential impacts to the environment, including water quality.

Several environmental protection measures will reduce potential impacts to water quality:

› To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment.

› Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.

› Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).

› All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.

- At the landfall location, drilling fluids will be managed within a contained system to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids.
- An SESC Plan will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.

4.2.3 Geological Resources

This section provides an overview of the regional geological setting and characterization of the potentially affected environment. This serves as the basis for the evaluation of potential impacts to geological resources from the construction, O&M and decommissioning of the Revolution Wind Project in accordance with 30 CFR § 585.626. IPFs that can influence existing geological resources are described in Section 4.1.

Revolution Wind, in collaboration with Fugro USA Marine Inc., developed and executed a series of marine geophysical and geotechnical site investigations for the Revolution Wind Farm Project in accordance with BOEM regulations 30 CFR § 585. The results of these investigations are summarized in this section and detailed further in the G&G Report (Appendix O1).

The geophysical surveys performed for the Project acquired a full coverage dataset of multibeam bathymetry, backscatter, side scan sonar, magnetic field, sub-bottom profiler, single channel sparker and multichannel sparker data. Seabed grab samples and sediment plan and profile images were also collected to support other COP studies (i.e., sediment transport modeling and evaluation of benthic resources). Geotechnical investigations completed in the RWEC-OCS and RWEC-RI included seabed cone penetration tests, vibracore sampling, and associated index and strength laboratory tests to inform cable design. Geotechnical investigations within the RWF included seabed and downhole (deep) cone penetration tests and deep borehole sampling, seismic cone penetration and P-S logging tests, water profiling tests, thermal needle probes to classify the soils and characterize the soil engineering parameters. The G&G surveys executed for the Project are listed in Table 4.2.3-1.

Table 4.2.3-1 Geophysical and Geotechnical Surveys Completed

Survey Name	Vessel(s)	Description
2019 – 2020 Fugro RWF Survey	R/V Fugro Enterprise, M/V Fugro Discovery, R/V Kommandor Iona, R/V Westerly	Survey of the entire RWF and RWEC corridor, except the final approach of the RWEC-RI north of the Jamestown Verrazzano Bridge. M-UHRS data was acquired aboard Fugro vessels and processed and interpreted by a third party. Grab samples and environmental data were similarly collected, processed and interpreted by a third party.
2018 – 2019 Fugro RWEC Route Survey	M/V Megan Miller, R/V Westerly	Survey of the RWEC corridor, discontinued prior to completion due to expiration of permits. The area north of JV Bridge was largely completed and incorporated into the G&G Report. All data south of the bridge were reacquired in 2019 - 2020.
2018 Fugro South Fork Wind Farm Extension Survey (SFW01)	M/V Fugro Discovery	The proposed SFW01 development site was surveyed in 2017 (Phase 1) together with a reconnaissance survey of the entire OCS-A 0486 lease. In 2018 coverage of the SFW01 development site was extended eastwards (Phase 2). The SFW01 geophysical data were incorporated into the Integrated G&G Site Characterization Study submitted to BOEM by Deepwater Wind South Fork, LLC, in 2019. In 2020, part of OCS-A 0486 was assigned to SFW01 through the creation of OCS-A 0517, leaving a small section of data from the SFW01 survey within the RWF Project Area; this section of data has been incorporated into the current submittal.
2017 Fugro SFW01 Survey	R/V Fugro Enterprise	
2019 Fugro RWEC Geotechnical Investigation (REV01 GT1A)	M/V Conti	The survey scope included seabed cone penetration tests (CPT), vibracore boring and sampling and laboratory soil testing
2019 Fugro OSS WTG, IAC and RWEC Geotechnical Investigation (REV01 GT1B)	M/V Conti, M/V Regulus	Phase I (July and August 2019): The survey scope included downhole sample borings, downhole cone penetration tests, P-S logging tests, and offshore and onshore laboratory soil testing.
		Phase II (August – October 2019): The survey scope included seabed CPTs, thermal cone penetration tests (TCPT), seismic cone penetration tests (SCPT), conductivity, temperature, and density (CTD) profiling tests, thermal needle probe tests (TNP), vibracore sampling, and onshore laboratory soil testing.

Data for onshore surficial geological resources were obtained from the Rhode Island Geographic Information System (RIGIS) hosted by the University of Rhode Island Environmental Data Center and soils data from the United States Department of Agriculture (USDA) Natural Resources Conservation Service's (NRCS) Web Soil Survey. These data were combined with field observations to describe the geological resources applicable to the Onshore Facilities located at Quonset Point in North Kingstown, Rhode Island. Geotechnical borings will also be completed in 2020 to provide site-specific data that will be used to identify specific constraints and inform the final designs for the Onshore Facilities.

4.2.3.1 Affected Environment

For the evaluation of Project effects on geological resources, the Project Area is defined as those resources at or below the seafloor in the RWF, RWEC-OCS and RWEC-RI and adjacent areas. The zone of interest in the RWF is greatest because foundations may penetrate up to 210 ft (64 m) below the seafloor. For the RWEC, the maximum depth of disturbance is 30 ft (9.1 m) below the seafloor, based on the HDD installation at the landfall. The Project Area also includes the geological resources at the Onshore Facilities. Onshore the zone of interest may be closer to 20 ft (6 m) to 66 ft (20 m) below grade.

Regional Overview

The regional surficial geology of southern Rhode Island and the RI-MA WEA have been strongly influenced by the last series of continental glaciations during the Quaternary Period; especially the last Wisconsin glacial advance which occurred approximately 23,000 years before present (Uchupi et al., 2001). Offshore post-glacial pre-transgressional erosion and transgressional processes altered the glacial deposits. Holocene post-transgressional dynamic coastal and marine processes remain active along the shore, and in state waters, and the outer continental shelf where they continue to reshape the coastline and seafloor.

The Laurentide continental ice sheet advanced and retreated several times over all but the southernmost portion of the RWF resulting in the creation of Rhode Island Sound. End moraine deposits from the ice lobes on Nantucket, Martha's Vineyard, Block Island, and Long Island are thought to represent the approximate southern limit of ice advance during the Late Wisconsin Episode approximately 23,000 years ago (ka) (Uchupi et al., 2001). In the Atlantic OCS advancing ice folded and thrusted shallow shelfs of the OCS and then added glacial sediments resulting in the formation of Block Island, Martha's Vineyard, and Long Island. Rhode Island Sound is bounded by glacial features Block Island, Martha's Vineyard and the Rhode Island and Massachusetts shorelines.

Major geological characteristics and geographic locations in the RI-MA WEA and adjoining state waters are listed below and illustrated on Figure 4.2.3-1. Geological hazards mapped along the RWEC-RI are depicted on Figure 4.2.3-1 and surficial geology of the Onshore Facilities at Quonset Point are depicted on Figure 4.2.3-3.

- **Brenton Reef.** Outcrop of metasedimentary or potentially igneous rock along the RWEC-RI, south of Jamestown.
- **Browns Ledge**. Browns Ledge is approximately 0.4 mi (0.6 km) north of the RWF and is avoided by the RWEC-OCS.
- **Buzzards Bay Moraine.** The Buzzards Bay Moraine extends westward from Falmouth and Martha's Vineyard into Rhode Island Sound and the RWF. The feature is a bathymetric ridge with the seafloor consisting of gravels and boulders. These coarse fragments are potential hazards to foundation embedment and cable entrenchment.
- **Cox Ledge.** The southwestern part of the RWF is in an area identified as Cox Ledge. Seafloor geology is anticipated to be sandy with varying amounts of coarser material, including boulders

and may include outcropping bedrock consisting of Miocene to Cretaceous-aged coastal plain deposits as well as glacial materials from the Ronkonkoma and Harbor Hill moraines.

- **Dutch Island.** A bedrock cored island in the West Passage south of the Jamestown Verrazano Bridge along the RWEC-RI. Strong tidal currents have carved a steep sided channel in this area. These currents construct and maintain a tall bar deposit with a northwest-southeast axial trend that crosscuts the deeply incised channels near Dutch Island.
- **New England OCS.** Atlantic Ocean Seafloor south of the furthest extent of Laurentide continental ice sheet. The northern limit of this unit is marked by the end moraines including Long Island, Block Island, the submerged Buzzards Bay Moraine, Martha's Vineyard, and Nantucket Moraine.
- **Point Judith Moraine.** The Point Judith terminal moraine extends into the western entrance to Narragansett Bay where the seafloor is described as rocky and bouldery. These potential obstructions to the RWEC-RI likely represent the lag materials from the reworked Pleistocene deposit.
- **Rhode Island Sound Channel.** The channel contains soft fine to coarse sandy sediments, depending on the water current velocities within the channel feature. The western boundary of the Rhode Island Sound is at Cox Ledge.
- **Ronkonkoma and Harbor Hill Moraines.** The two moraines that make up Long Island. A submerged portion of the Ronkonkoma Moraine extend eastward to Cox Ledge.

Regional Bedrock and Surficial Geology

The RWF and RWEC–OCS occupy a southern portion of Rhode Island Sound and the proximate outer continental shelf between Block Island and Martha's Vineyard, with the RWEC–RI routed north through the west passage of Narragansett Bay to Quonset Point where the Onshore Facilities will be constructed. This section reviews bedrock and surficial geology relative to Project facilities.

Regional Bedrock Geology

The geological framework of the southern Rhode Island region is characterized by a mix of Mesozoic-aged metamorphic and plutonic igneous bedrock. In the Narragansett Basin, which includes the Onshore Facilities, Narragansett Bay and much of Rhode Island Sound. This basement crystalline rock is locally superimposed with deposits of softer, dark, carbon-rich sedimentary Pennsylvanian-age rock up to hundreds of feet thick. The east and west passage of Narragansett Bay and the Sakonnet River are drowned eroded valleys cut into this bedrock (McMaster and Ashraf 1973). The geology and shallow structure of Rhode Island Sound was studied using seismic reflection by O'Hara et al. (1980), Needell et al. (1983), McMullen et al. (2007a), McMullen et al. (2008), McMullen et al. (2011) and Poppe et al. (2014). McMaster (1984) and McMullen et al (2007b) completed similar work in Narragansett Bay.

This bedrock suite within the Narragansett Basin dips southward into Rhode Island Sound. The surfaces of this rock are cut by unconformities that are now drowned and filled valleys and ancient river channels that extend waterward from the coast. These features were formed by erosive forces during extended periods of sea level depression. Approximately 7.5 to 12.5 mi (12 to 20 km) south of the Rhode Island coastline this southward dipping bedrock contacts and then slips below a separate geologic unit associated with the submerged coastal plain and continental shelf strata laid down in the late Cretaceous and early Tertiary. The contact between the two contrasting bedrock types is abrupt and occurs along a strongly oscillating line where coastal plain deposits were severely eroded during the late Tertiary and early Pleistocene. The eroded face of these coastal plain deposits forms a steep north-facing escarpment or cuesta (see Figure 4.2.3-1) along the contact. This feature can be traced from western Long Island Sound north to Georges Bank (Weed et al. 1974). The coastal plain deposits of the OCS south of this contact were also strongly eroded by streams and rivers which flowed across the exposed surface before reaching an ancient shoreline. The coastal plain deposits are poorly studied with little information available concerning physical properties. Fugro (2020) describes Coastal Plain Formation as consisting of unconsolidated to semi-consolidated sand, gravel, silt, and clay and may include Tertiary age deposits.

Regional Surficial Geology

The geomorphology in the Quonset Point area, the ocean bottom, shorelines, and island masses in RI-MA WEA have been influenced by glacial processes. Deposits range from fine-grained clays to sand, gravel, and boulders as evidenced on the exposed erosional cliffs of the offshore islands, such as Block Island (RI CRMC, 2010).

For most of the RWF, the ocean bottom has been shaped by a series of glacial advances and retreats during the Quaternary Period that began 2.5 million years before present (BP) and ended approximately 10,000 years BP. The last advance of the Laurentide continental ice sheet reached its southernmost extent during the late Wisconsin glacial episode circa 23,000 years BP. The limits of this advance are traced by broken submerged terminal moraine deposits that stretch between Long Island, Block Island, and Martha's Vineyard. During this last maximal glacial advance, sea level was 410 ft (125 m) below its current elevation and the coastline was at the edge of the continental shelf some 62 mi (100 km) south of the glacial front. The advancing ice scoured valleys and hilltops and reworked older surficial deposits. Till was also deposited during the advance of the ice as ground moraine and during retreat as ablation till.

During initial glacial retreat Glacial Lake Block Island, Glacial Lake Rhode Island, Glacial Lake Narragansett and others formed behind their impounding moraines. Thinly layered (varved) sediments of silts and fine sands or silts and clays were deposited within the quiet glacial lake waters with coarser (sand and gravel) deltaic deposits laid down at the lake inlets. With sea levels still depressed, flow from these lakes eroded outlet channels through the moraines and further cut river channels through the exposed continental shelf to the coast. Some of the channels cut during deglaciation convey present day tidal currents.

Later during deglaciation, meltwaters transported and deposited stratified sands and gravels sediments which were superimposed over older till, outwash and glaciolacustrine deposits. As sea level rose, the shoreline transgressed these features which became submerged and subject to erosion, sediment transport and deposition driven by storms and tidal currents. During this process, fluvial-estuarine deposits covered much of the submerged outwash plain and infilled low-lying areas with sandy or finer grained sediments. In general, sandy sediments were deposited in higher energy environments and fine-grained deposits in quieter, deep water areas. Other areas were eroded, such as ground moraine deposits, to leave behind exposed boulder field lag deposits (RI CRMC, 2010).

Offshore Envelope

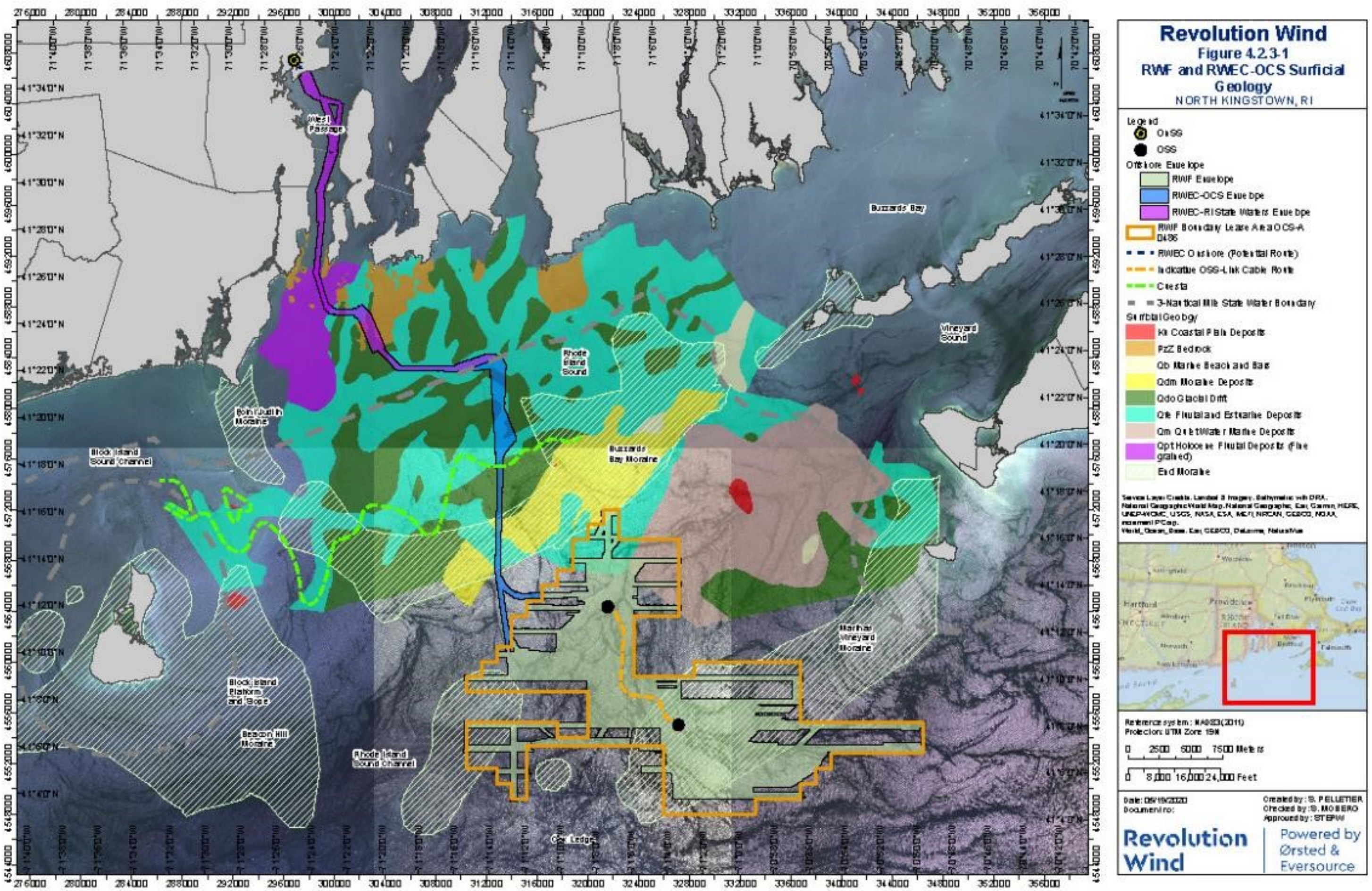
Data collected for the G&G Report (Appendix O1) characterized the surficial and subsurface geology within the Offshore Envelope as consisting of coastal plain deposits, glacial drift, and Pleistocene and Holocene marine and fluvial/estuarine deposits. Glacial drift describes undifferentiated deposits that include moraine, till, outwash, and glacio-lacustrine deposits. Moraine and outwash are the predominant type of glacial deposits in the Offshore Envelope (Fugro, 2020).

The stratigraphic history of the continental shelf and RI-MA WEA greatly predates the Quaternary Period with Cenozoic-aged geologic units mostly deposited in marine or fluvial environments that alternated in response to repeated sea level rises and retreats. Based on published data and findings of the G&G Report, the Offshore Envelope was inferred to be underlain by Quaternary, Tertiary, Cretaceous and Paleozoic aged strata. The characteristic stratigraphic units described by Fugro (2020) in the Offshore Envelope are presented in chronological order (youngest to oldest) below with the USGS comparable map unit in parenthesis:

- **Unit 5** – Holocene Marine Deposits (Qm) – consists of predominantly silty fine sand in thin accumulations across the site.
- **Unit 10** – Holocene Transgressive Shoal or Bar Deposits (Qb) – consists primarily of clean sand.
- **Unit 20** – Holocene Transgressive Fluvio-Estuarine Deposits (Qfe) – consists of primarily fine-grained clays and silts deposited in regressive channel ravinements.
- **Unit 25** – Pleistocene Channel Deposits (Qdc) – consists of dense to very dense sand.
- **Unit 27** – Pleistocene Terminal Moraine Deposits (Qdm) – younger moraine system consisting of exposed boulders at the seafloor in the northernmost WTG corridor.
- **Unit 30** – Pleistocene Glacio-Lacustrine Deposits (Qdl) – fine-grained lacustrine deposits within medium to large channel system.
- **Unit 40** – Pleistocene Terminal Moraine Deposit (Qdm) – older moraine system found widespread in the southern portion of the site with exposed boulders at the surface.
- **Unit 45** – Pleistocene Glacial Outwash Deposits (Qdo) – predominantly sandy outwash deposits found in isolated channels in the southern portion of the site.
- **Unit 50** – Pleistocene Glacial Outwash Deposits (Qdo) – widespread glacial outwash deposits with a mix of sand, silt, and clay that may be of Illinoian age.
- **CPD** – Coastal Plain Deposits (Ku) – Interpreted to be late Cretaceous marine deposits that consist of unconsolidated to semi-consolidated sands, silts, and clays.
- **Bedrock** – Consolidated and Crystalline Bedrock (PzZ) in the region are thought to be Paleozoic and Proterozoic rock units found along the RWEC (e.g., Brenton Reef).

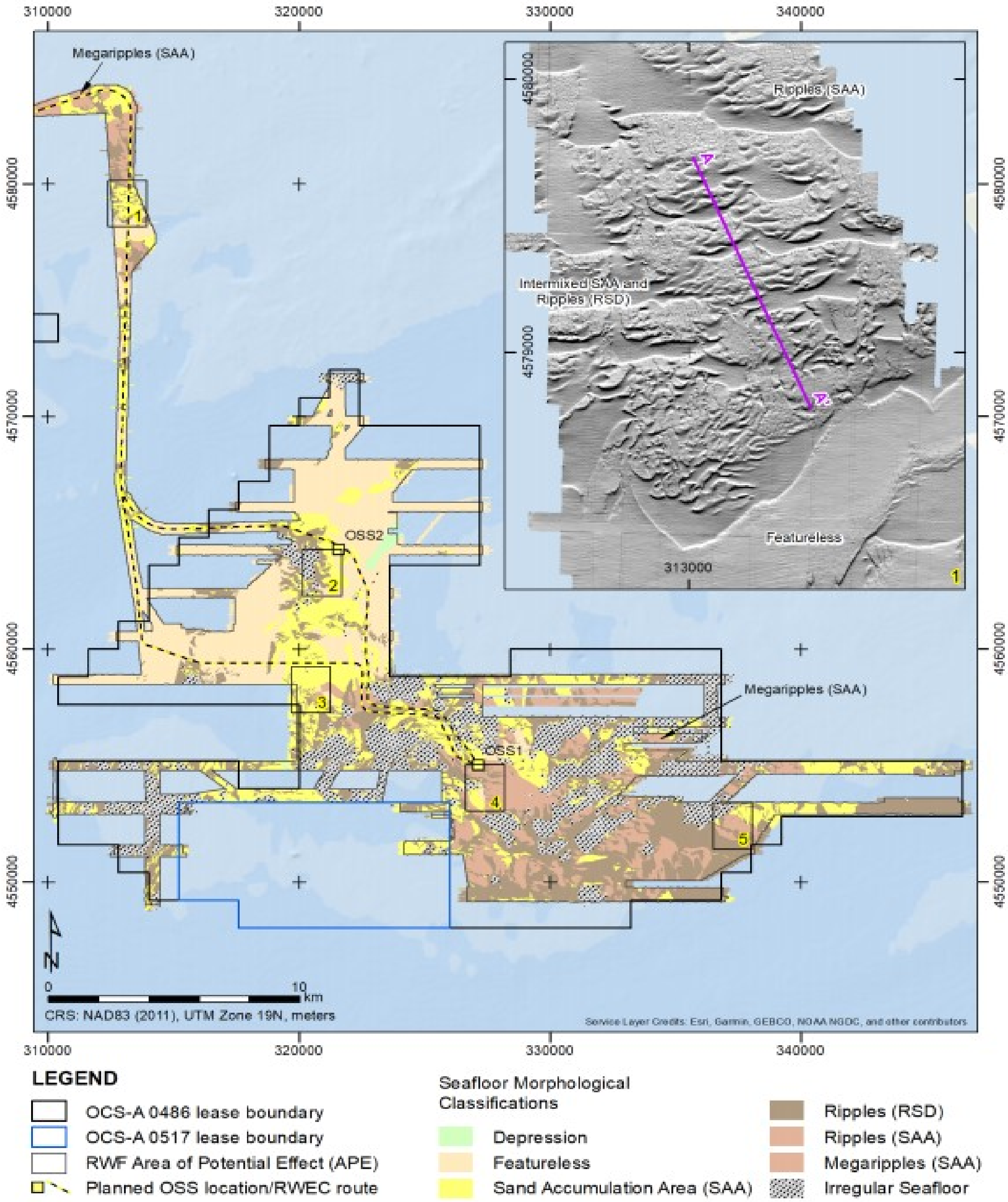
Figure 4.2.3-1 provides a general depiction of these units depicts these units in the RWF and RWEC-OCS. More specific data and mapping obtained from site specific investigations are available in the G&G Report (Appendix O1).

Figure 4.2.3-1 RWEC and RWEC -OCS Surficial Geology



Fugro (2020) also characterized the seafloor morphological types present within the Offshore Envelope as shown in Figure 4.2.3-2.

Figure 4.2.3-2 Seabed Morphology Overview and Hillsade Image



These morphological types are described in descending order of prevalence:

- **Ripples, Megaripples, and Sandwaves**: Wave-generated coarse-grained ripples in rippled scour depressions (RSDs) and unrelated bedforms generated by unidirectional current flow. Ripple fields have wavelengths < 1.6 ft (0.5 m) and heights< 0.3 ft (10 cm). These accretionary features are described as mobile. Ripples generated by bidirectional tidal currents are present in the West Passage. Rippled seafloor is estimated to make up 35 percent of the RWEC and RWF (Fugro, 2020). Megaripples generated by unidirectional flow only cover about one percent of the Offshore Envelope (Fugro, 2020). Fugro's G&G surveys did not identify seafloor features with wavelengths or heights great enough to meet BOEM's classification as sandwaves.
- **Featureless**: Smooth seafloor without bedforms or other large-scale structure; at a local scale, however, the seabed may be pitted through bioturbation and/or scarred by mobile fishing gear. Typically associated with muddier sediment types. This bedform is estimated to make up 25 percent of the Offshore Envelope.
- **Sand Accumulation Areas (SAA)**: Veneer of clean and well sorted fine sand, often with well-defined limits, formed through wave orbital current at the seafloor. These deposits occupy approximately 21 percent of the Offshore Envelope. SAA have wavelengths > 82 feet (25 m) and peak to trough heights < 1.6 ft [0.5 m].
- **Irregular Seafloor**: Predominantly composed of outcropping glacial moraine/till but also includes boulder fields. This seafloor type is most prevalent within the RWF and covers about 17 percent of the Offshore Envelope.

The G&G Report (Appendix O1) provides six other morphological types: bedrock, anthropogenic, bar, channel, dredge area, and depression each which occupies one percent or less of the Offshore Envelope.

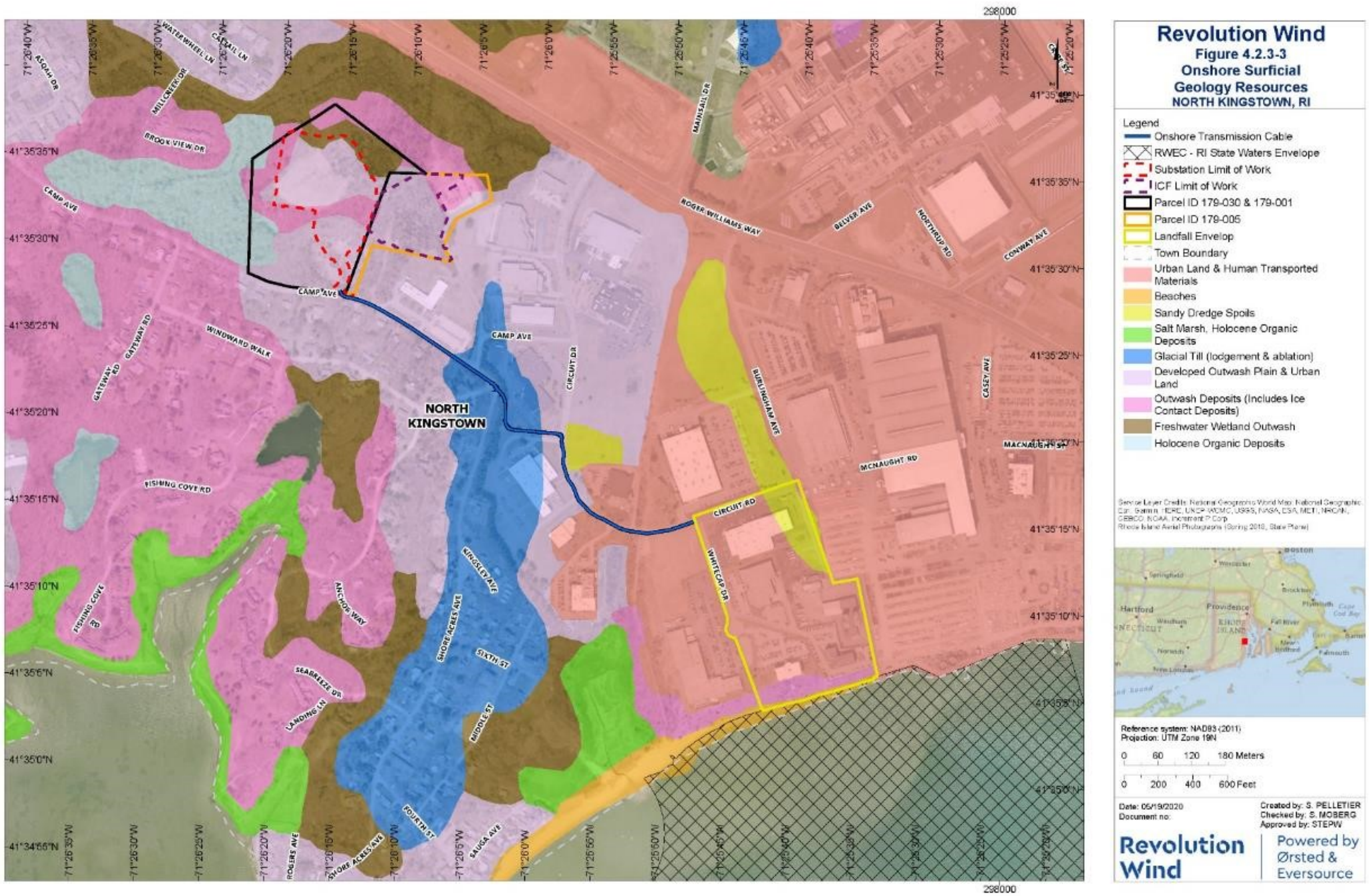
Landfall Envelope and Onshore Facilities

The Landfall Envelope for the RWEC and access to the Onshore Facilities is in an industrial district of Kiefer Park, at Quonset Point in North Kingstown, Rhode Island. Surficial geologic mapping of the Landfall Envelope and Onshore Envelope is provided on Figure 4.2.3-3. This area is part of the large outwash plain that characterizes Quonset Point. Holocene deposits also present in this area include:

- **Coastal Beach**: Areas of unconsolidated, accreted, usually unvegetated sediments commonly subject to wave action, extending from mean low water landward to an upland rise or backed by a dune or marsh. The beaches at the Landfall Envelope Area range from sandy to cobbly or stony. There is very little coastal beach present within the Landfall Envelope because the shoreline has been fortified with a concrete seawall. Small sections of coastal beach may be present at low tide.
- **Freshwater Wetland**: Areas outside of the limits of tidal influence which support hydrophytic vegetation and where organic materials accumulated under the influence of prolonged periods of inundation or saturated soil conditions.

- **Human Transported Materials**: Areas where the natural soil or surficial geological deposits have been altered, typically by grading, filling, or excavation. These actions obscure the structure of the original surficial deposits and soil forming processes. This unit includes areas where dredge spoils were disposed of on land.

Figure 4.2.3-3 Onshore Surficial Geology Resources



The OnSS and ICF sites are situated in a glacial outwash plain that has been greatly disturbed by the disposal of solid waste from the decommissioning of Naval Air Station Quonset Point and the mining of earthen cover materials for this waste. Freshwater wetlands are also present on the properties where the OnSS is proposed to be constructed.

Regional Seismic Activity

The Project is not within an active plate boundary area associated with elevated seismic hazard. However, earthquakes do occur in intra-plate areas. Seismic activity in the northeastern United States is infrequent and generally not destructive. The Northeast States Emergency Consortium (NESEC) provides general descriptions of the seismic hazards within the region. Data compiled by NESEC reports that 408 earthquakes strong enough to be felt were reported in Massachusetts over a period of 348 years, averaging slightly more than one per year. Only two of these earthquakes, one in 1727 with an estimated magnitude of 5.6 and one in 1755 with an estimated at a magnitude of 6.2 were considered "Damaging Earthquakes" (NESEC 2019). There were only 34 earthquakes reported in Rhode Island between 1766 and 2016 and none which were classified as "Damaging Earthquakes". Based on these data, Rhode Island averages one earthquake every eight years.

As described in the G&G Report (Appendix O1), the nearest cluster of micro-seismicity is associated with the Ramapo fault zone west of New York City. Researchers have suggested that the microseismicity of this area may indicate that the Ramapo fault zone is reactivating. Fugro (2020) notes that even if this fault zone were to reactivate, it represents *a low potential hazard to an export cable in Long Island Sound*.

Hazards to WTG and OSS Foundation Installation and RWEC Burial

In the G&G Report, Fugro (2020) provided a summary of all hazard types they encountered during their surveys and sampling of the Offshore Envelope (Appendix O1). These included:

- Potential obstructions to cable and foundation installation from seabed contacts, magnetic anomalies (e.g., pipeline), and boulders;
- Current-driven ripple scale bedforms; however, they have a low potential for impact on reduction of cable burial protection;
- Seabed scarring (e.g., trawling) which could potentially impact the WTGs and IAC if they are not buried deep enough;
- Potential for subsurface faults and subsurface deformation that could result in altered engineering properties;
- Buried channels, which could present a hazard by abrupt changes in soil types and channels might be infilled with soft sediments or gravelly deposits; and
- Buried boulders, which could represent a potential obstruction for cable installation.

Offshore hazards are summarized in the following two tables.

Table 4.2.3-2 Summary of Potential Seafloor Geologic Hazards

Hazard	Description	Implications for Installation of Foundations and Cables	WTG	OSS	IAC	RWEC - OCS	RWEC-RI	Comments
Seafloor Features								
Seabed Contacts	Features that may represent a potential obstruction	Potential obstruction to cable/foundation installation or deployment of jack-up work vessel legs.	X	X	X	X	X Former bridge debris near existing JV Bridge	G&G Report provides summary and detailed contact reports with data renderings of thousands of seabed contacts.
Magnetic Anomalies	Features that may represent a potential obstruction on seabed or shallowly buried.		X	X	X	X	X	G&G Report provides summary of interpreted magnetic anomaly locations and potential linear objects (e.g. cable, pipeline, etc.).
Boulders on Seabed	Boulders larger than 20in (0.5m)		X	X	X	X	X Eastern perimeter of survey corridor	G&G Report provides maps of boulder fields with varying densities and isolated boulders outside of the mapped fields.
Bedrock Outcrop						X Exposed in Brenton Reef area	X Potential in West Passage north of JV Bridge	Bedrock outcrops in Brenton Reef area will be avoided by micro-routing cable through areas with sediment > 2m thick. Bedrock outcrops in the upper West Passage appear to be avoidable.
Mobile Seabed Features	Seabed features interpreted to be mobile on an engineering timescale.	Mobile seabed features could lead to reduction or increase in cable burial protection.	X		X	X	X	WTG/OSS/IAC/RWEC Offshore: Current-driven, ripple scale (up to 0.4m tall) bedforms observed. In RWF, bedforms interpreted to migrate approximately 1.3m/yr in northwest direction. One local area identified with megaripples up to 0.6m tall in RWEC - OCS. Not anticipated to adversely impact foundations and inferred to have a low potential impact on cable burial protection reduction. RWEC-RI: West Passage: Area between JV Bridge and Dutch Island inferred to have faster tidal currents and is a potential area for higher seabed mobility.
Seabed Scar	Evidence of activities that disturb the seafloor such as bottom trawling.	Inadequately buried cables potentially impacted by Seabed disturbance.	X		X	X	X	

Table 4.2.3-3 Summary of Potential Geologic Hazards below the Seafloor (Subsurface)

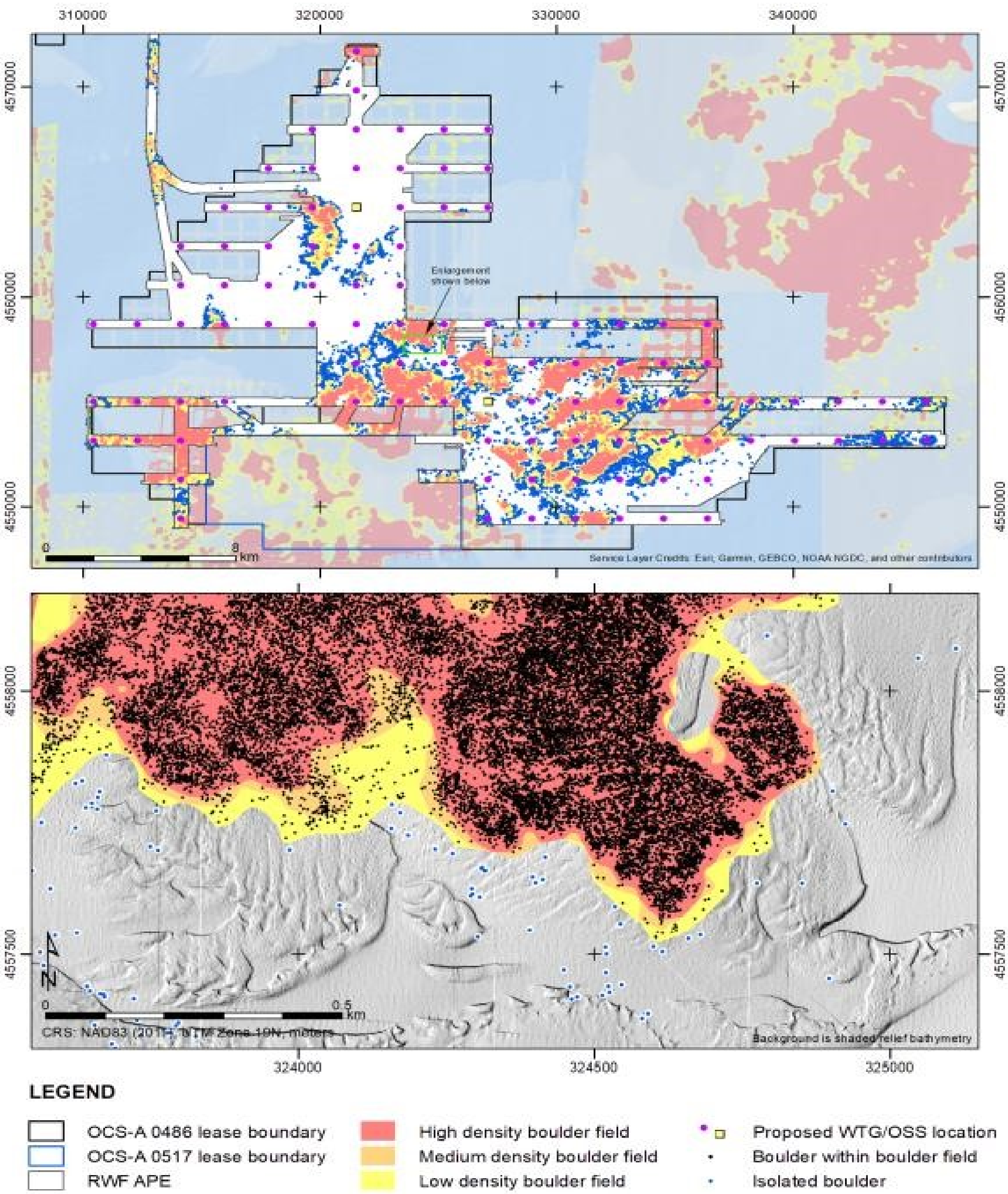
<table>
<tr><th>Hazard</th><th>Description</th><th>Implications for Foundations and cable Installation</th><th>WTG</th><th>OSS</th><th>IAC</th><th>RWEC - OCS</th><th>RWEC-RI</th><th>Comments</th></tr>
<tr><td colspan="9">Subsurface Features</td></tr>
<tr><td>Subsurface Faults</td><td>Micro-faulting due to soft-sediment deformation and potential glacio-tectonic thrust faults.</td><td rowspan="2">Deformed glacial moraine and outwash units may have different engineering properties than undeformed areas; variable thickness and depth below seabed to soil boundaries</td><td colspan="4">X
Interpreted to be micro-faulting. Faulting may be present in the glacio-tectonic deformation zone (WTG Corridor 10 and 11) but discrete faults are difficult to discern in the seismic data.</td><td>X</td><td rowspan="2">Faulting/subsurface deformation are interpreted to be present at the site but are not considered related to recent seismic activity. Most of the interpretations envision faulting related to forces associated with glacial advances over older strata. The interpreted faulting/subsurface deformation is not anticipated to impact cables.</td></tr>
<tr><td>Subsurface Deformation</td><td>Soft sediment and glacio-tectonic deformation.</td><td colspan="4">X
The G&G Report provides mapping of glacio-tectonic deformation in certain WTG Corridors. Soft sediment deformation also interpreted in deep channel in western portion of site.</td><td></td></tr>
<tr><td>Subsurface Gas</td><td>Biogenic production and migration of methane to form shallow accumulations of gas.</td><td>Soils holding shallow gas within foundation or cable zone may have lower undrained sediment shear strengths affecting foundation integrity. Biogenic gas poses potential hazard to foundation and cable lifespan and power transmission efficiency.</td><td></td><td></td><td></td><td>X</td><td>X
Eastern perimeter of survey corridor</td><td>G&G Report notes numerous patches of shallow gas concentrated near the cable landfall area and scattered in West Passage. Small isolated zones were observed near Brenton Reef. These areas can either be avoided or occur at depths well below cable burial.</td></tr>
<tr><td>Buried Channels</td><td>Infilled Paleo-channels</td><td>Potential for abrupt changes in soil types in horizontal or vertical directions. Channels may be infilled with soft sediments or gravelly deposits</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td></tr>
<tr><td>Buried Anomalies/Boulders</td><td>Buried anomalies interpreted using point diffractions in seismic data and magnetic anomaly trends. May represent buried boulders or cables/pipelines</td><td>Buried boulders represent potential obstruction for pile and cable installation</td><td colspan="3">X
Buried boulders are interpreted to be present widely across the site at shallow depths that could impact cable installation and WTG foundations.</td><td>X
RWEC crosses Ronkonkoma and Point Judith-Buzzard Bay moraines that may contain shallow boulders</td><td>X
Boulders may be present in the glacial deposits and inferred to have high potential along the eastern part of the central West Passage</td><td>Buried boulders are interpreted to be present throughout much of the Offshore Envelope. Boulder relocation and microtargeting of cable burial routes will be employed.</td></tr>
<tr><td>Organic Soils/Peat</td><td>Soft compressible soils that may contain shallow gas</td><td>Soft soils pose hazard to foundation stability and biogenic gas poses hazard to cable lifespan and efficiency</td><td></td><td></td><td></td><td></td><td>X</td><td>Geotechnical explorations did not encounter materials classified as peat. However, interpreted gas in seismic data observed along the RWEC may be associated with organic soils.</td></tr>
<tr><td>Bedrock within 10m of seabed</td><td rowspan="2">Bedrock within foundation zone of interest</td><td>Hard driving, possible refusal of piles and pile tip buckling</td><td></td><td></td><td></td><td>X</td><td>X</td><td rowspan="2">WTG and OSS foundations are not anticipated to encounter bedrock. RWEC cable route in West Passage and Brenton Reef include areas where shallow bedrock has been interpreted</td></tr>
<tr><td>Bedrock 10 to 65m below seabed</td><td>Cable installation constraints</td><td></td><td></td><td></td><td>X</td><td>X</td></tr>
</table>

RWF Envelope

The RWF is proposed in federal waters within the designated BOEM Renewable Energy Lease Area OCS-A 0486, approximately 20 mi (17.4 nm, 30 km) south of the coast of Rhode Island. The entire RWF is south of the cuesta which separates basement rock of the Narragansett Basin from Atlantic Coastal Plain sediments (Refer to Figure 4.2.3-1).

The RWF occupies waters of Rhode Island Sound and the Atlantic OCS and depths range from approximately -78 ft (-24 m) and -165 ft (-50) m relative to MLLW (Fugro, 2020). The greatest depths are in the northern part of the RWF. The RWF is crossed by the Buzzards Bay Moraine, known to contain high densities of boulders through northern and central portions of the RWF Figure 4.2.3-4. The moraine ends near Cox Ledge, where boulders and bedrock outcrops are also prevalent (most of Cox Ledge has been excluded from the RWF).

Figure 4.2.3-4 RWF Envelope Boulder Distribution (top) and Classification into Boulder Fields (bottom) (Fugro, 2020)



Most boulders are associated with terminal moraines and their flanks and other till deposits. However, boulders rafted by ice can occur almost anywhere in the RWF.

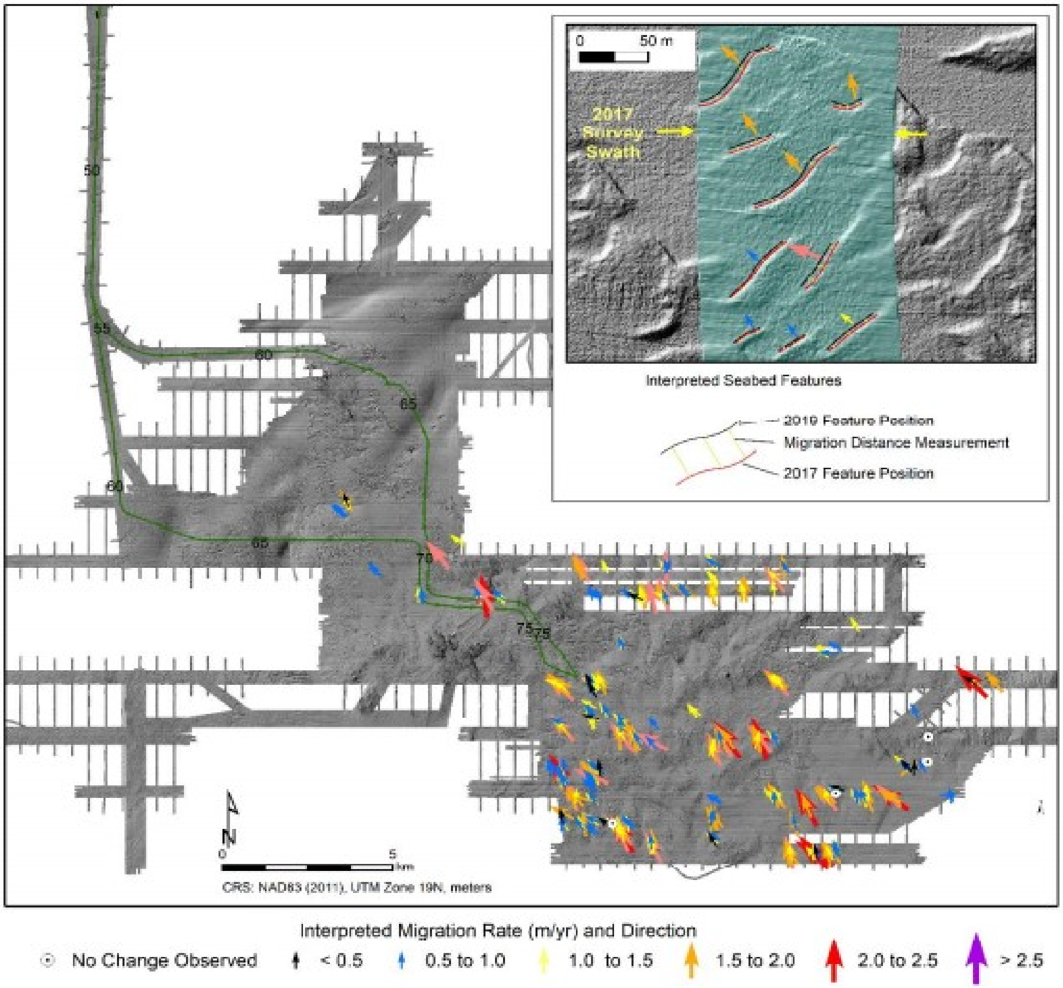
Fugro (2020) describes notable geologic features that constitute potential hazards to WTG or RWEC installation: (1) glacial deposited boulder areas, (2) depressions representing paleo-drainage channels, and (3) patchy areas of Holocene marine deposits. Boulder laden deposits are described as prominent in the southern part of the RWF and patchy in the central portion. Prominent paleo-drainage depressions are present in the northern part of the RWF and an east-west oriented paleo-drainage feature cuts across the southern boulder field (Fugro, 2020).

Small sandwaves and megaripples were mapped proximate to the RWF in western Rhode Island Sound by McMullen et al (2008). Fugro (2020) identified potential mobile seabed areas by comparing bathymetric survey data, evaluating seafloor morphology and oceanographic conditions. Bathymetric data collected during a 2017 reconnaissance survey of the RWF lease area were compared with the 2019/2020 bathymetric data to assess bedform changes. The time lapse between mid-date of the 2017 and 2019/2020 surveys is approximately 1.9 years. The bedforms analyzed included ripples, megaripples, SAA features, and RSD edges. Between two to four measurements were made on each bedform feature and an average distance and direction were calculated using ArcGIS (Figure 4.2.3-5)

Ripples approximately 0.6 to 1.6 ft (0.2 to 0.5 m) tall with asymmetrical shapes were observed to move the greatest distance between the two surveys. The morphology of the asymmetrical ripples suggest they are current-driven features. Migration distances range from approximately 0.5 to 3 m and predominant migration direction is northwest. Current driven ripples migration rates ranged from 1.6 to 10.5 ft/yr (0.5 to 3.2 m/yr) with an average of 4.3 ft/yr (1.3 m/yr).

Ripples RSD and SAA bedforms were assigned a low seabed mobility hazard. Ripples with a 165 ft (50 m) wavelength it would take approximately 25 years for the trough position to migrate to peak position. For a 1.6 ft (0.5 m) tall ripple, this would result in a 1.6 ft (0.5 m) lowering of the seabed or reduction of cable burial protection but would not lead to exposure of the cable.

Figure 4.2.3-5 Mobile Bedform Assessment for Current Driven Features (Fugro, 2020)



Features interpreted to be current driven bedforms are interpreted to exhibit the highest rate of change between the 2017 and 2019 surveys. Graphic illustrates interpreted results of current driven features. Overall, general direction of net migration is in the northwest direction. Magnitude, rates and direction of bedform movement were interpreted by comparing bedform positions interpreted from multibeam surveys conducted in 2017 and 2019. The timespan between the mid-date of the two surveys is 1.9 years. Arrows indicate the interpreted direction of movement and the arrow size and color indicate the rate of movement. The reconnaissance survey conducted in 2017 collected multibeam data along a grid of survey lines spaced 900m apart. The 2017 bathymetric swath width is approximately 110 to 140m wide as shown in the upper inset image.

RWEC–OCS

The RWEC–OCS originates at the OSSs near the center of the RWF. The two cables comprising the RWEC–OCS are routed separately within the RWF before running together in the northwest part of the windfarm to co-occupy a single cable corridor. The southern cable route may encounter the western lobe of the Buzzards Bay Moraine and shallow bedrock and boulders associated with Cox Ledge. The northern cable route is also aligned to encounter the Buzzards Bay Moraine.

North of the RWF, high resolution seismic reflection data collected by O'Hara and Oldale (1980) and Needell et al. (1983) are available for the parts of the RWEC–OCS. The results of published reconnaissance surveys show the RWEC encountering three different sea floor map units (Figure 4.2.3-1).

- **Qfe**: This map unit consists of Holocene fluvial gravel, sand, silt or clay and may include freshwater peats and estuarine mud deposited during the post-glacial sea level rise (Needell, 1983). Finer sediments included in this unit are susceptible to resuspension into the water column when disturbed.
- **Qdo**: This map unit indicates the presence of glacial drift presumed to be late Wisconsin age. This unit is also highly variable as it includes well sorted, coarse-grained outwash, very fine textured Glacial Lake Rhode Island deposits, and even ice contact material which may contain cobbles and boulders stranded near the front of the wasting glacier.
- **Qdm**: This unit identifies a lobe of the Buzzards Bay Moraine within the RWEC–OCS route. This unit typically is stony and includes boulders which are significant hazards to cable embedment.

According to mapping prepared by Needell et al (1983), transgressional deposits and till deposits resting on coastal plain sediment or bedrock are generally 80 ft (24 m) or more thick, such that shallow bedrock is unlikely to be a hazard for cable installation. Very fine sediments that may be associated with the Qfe or Qdo deposits may present a challenge for controlling sediment re-suspension and backfills.

The G&G Report (Appendix O1) reports bedforms are similar to those described for the RWF, however, a local area was identified with megaripples up to 2 ft (0.6 m) tall in the RWEC-OCS which may require cable protection in a mobile bedform. Microrouting the cables to avoid boulders and boulder clearance will be the most challenging component of RWEC embedment. Very fine sediments (clay and silts) may be encountered in featureless seafloor areas. These fine sediments may present a challenge for controlling sediment re-suspension and adequate cable protection during backfilling.

RWEC–RI

The surficial geology along the RWEC–RI route has been described by J. King Consulting, LLC, prepared by analyzing published work by Needell et al. (1983), McMaster (1984), Oakley (2012), and by re-analyzing open file data from these surveys (McMullen et al. 2009). More recent data were also evaluated from a multiyear seismic reflection survey conducted by the University of Rhode Island between 2004 and 2008. The entire 50 mi (80 km) RWEC route (inclusive of both the RWEC–OCS and RWEC–RI) is evaluated in the G&G Report (Appendix O1).

King (Undated) defined an obstruction as outcropping or shallow bedrock (less than 16 ft (5 m) below the seafloor) or sediment containing boulders. The West Passage of Narragansett Bay includes several islands that are bedrock cored along with bouldery glacial till and moraine deposits. High concentrations of boulders are associated with the Point Judith Moraine in the southern part of the RWEC–RI alignment. Fugro (2020) identified high energy zones along this route associated with tidal channels and recommended routing RWEC–RI through interfluves in these settings. McMaster (1984) documented the presence of gas bearing silt-clay estuarine deposits in the Narragansett Bay that should be avoided. Entrapped gas is detected in seismic reflectivity surveys by abruptly extinguished return signals.

King (Undated) identified three sub-areas that are located along the RWEC–RI (Figure 3.2.3-6):

- Rhode Island Sound and Lower West Passage sub-area;
- Middle West Passage sub-area; and
- Upper West Passage sub-area.

These areas, as described by King (Undated), are characterized further in the following subsections.

Rhode Island Sound and Lower West Passage Sub-Area

This sub-area begins in Rhode Island Sound and continues north to Beavertail on Conanicut Island (Jamestown). Shallow bedrock was encountered in several areas in this sub-area including submerged continuations of Aquidneck and Conanicut Islands that extend several miles (km) south from their coastlines. This includes outcrops of bedrock near Brenton Reef.

King reports that this bedrock is the same suite associated with the islands, a late Paleozoic meta-sedimentary rock rich in carbon. Boulder fields and bedrock outcrops extend offshore from Point Judith to Narragansett Pier. Part of this boulder field is associated with the Point Judith and Buzzards Bay recessional moraines. King notes that seismic reflections from this boulder field end about 0.9 miles (1.5 km) from the shoreline, but NOAA charts indicate that this obstruction is continuous to the shore.

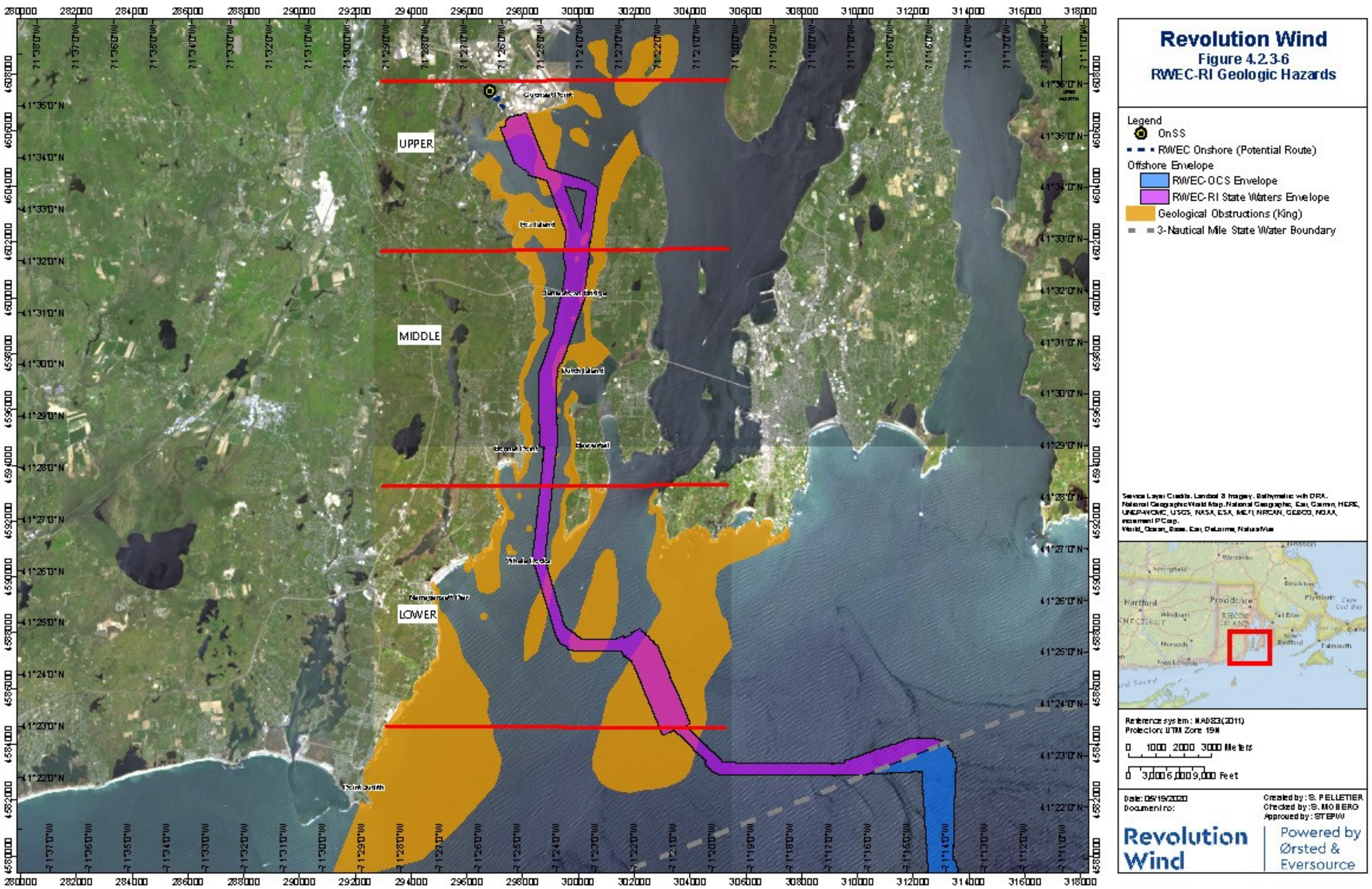
Other obstructions in this sub-area include named features such as Whale Rock, Jones Ledge and River Ledge. These all represent outcropping bedrock or rocky seafloor conditions.

Middle West Passage Sub-Area

This sub-area begins at Bonnet Point at the south and continues north to the Jamestown Verrazano Bridge (Jamestown Bridge). King used Compressed High Impact Radar Pulse (CHIRP) seismic reflection data collected by the University of Rhode Island to evaluate obstructions. King describes this reach of the West Passage as mostly unobstructed. Shallow depths to bedrock are reported along the western coastline of Conanicut Island and the rocky shorelines of Narragansett, Saunderstown and North Kingstown. Borings completed in 1979 for the Jamestown Bridge indicated 16 ft (5 m) and 33 ft (10 m) of sediment over bedrock along the eastern third of the bridge approaching Jamestown. The area around Dutch Island, including Dutch Harbor contains bouldery till or shallow bedrock.

Oakley (2012) studied the stratigraphy of Glacial Lake Narragansett and identified two glacial deltaic deposits fed by subglacial flows emerging at the ice front in this area: The Dutch Island Delta west of Dutch Island and the Annaquatucket Delta near the Jamestown Bridge. King noted that these thick sand and gravel deposits are unlikely to contain obstructions but cautioned that the seismic reflection data collected was not sufficient to confirm the absence of obstructions.

Figure 4.2.3-6 RWEC-RI Geologic Hazards



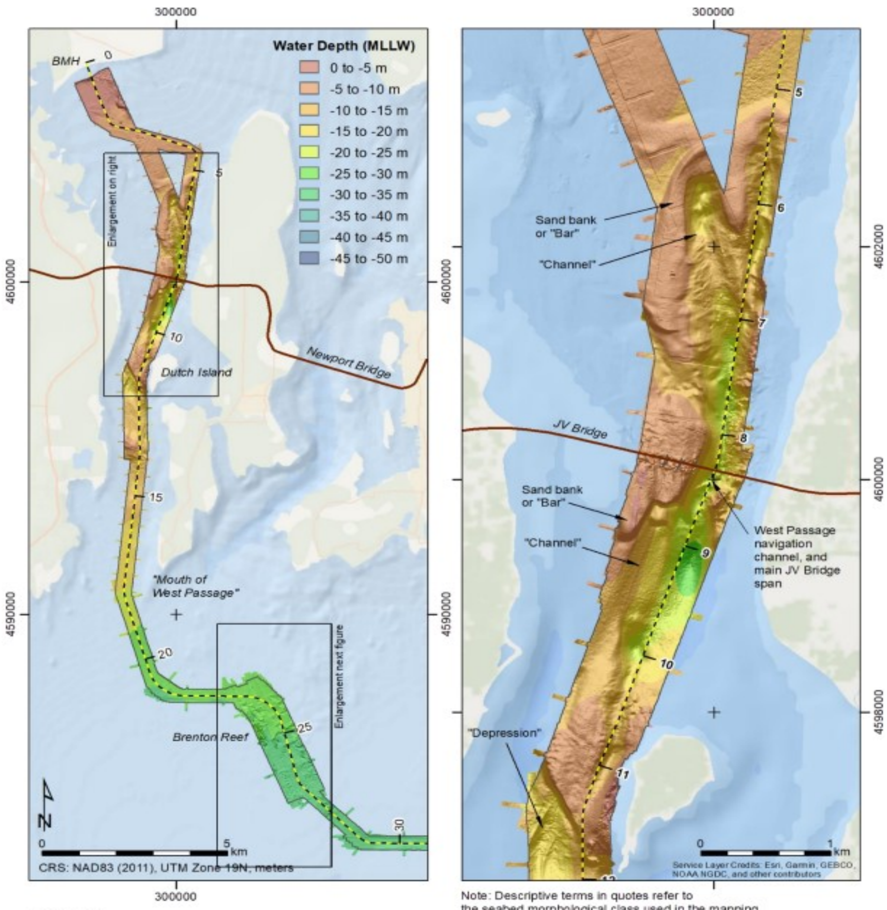
Upper West Passage Sub-Area

This sub-area begins north of the Jamestown Bridge and continues north to the landfall location at Quonset Point in North Kingstown. The surveys in the sub-area revealed several potential obstructions including shallow bedrock and bouldery till. Seismic data in the vicinity of Fox Island showed the area to be very rocky and that these obstructions were continuous as it approached the mid-point of the west passage with only a narrow unobstructed corridor remaining. Prominent obstructions are also present on the seafloor south of Quonset Point. Approaching the landfall location, Fugro (2020) identified a line of boulder piles with an 820 ft (250 m) gap where the RWEC–RI will need to be routed.

RWEC-RI and RWEC-OCE Envelope G&G Survey

Data collected by Fugro (2020) along the RWEC-RI Envelope is reported in G&G Report and is summarized below. The data represented in this report is more detailed but does not conflict with the data noted by the King report noted above. For more detailed descriptions of findings including documentation of individual obstructions encountered during surveys please see the G&G Report in Appendix O1.

Figure 4.2.3-7 RWEC-RI Envelope Bathymetry and Kilometer Posts (Fugro 2020)



LEGEND

RWF Area of Potential Effect (APE)

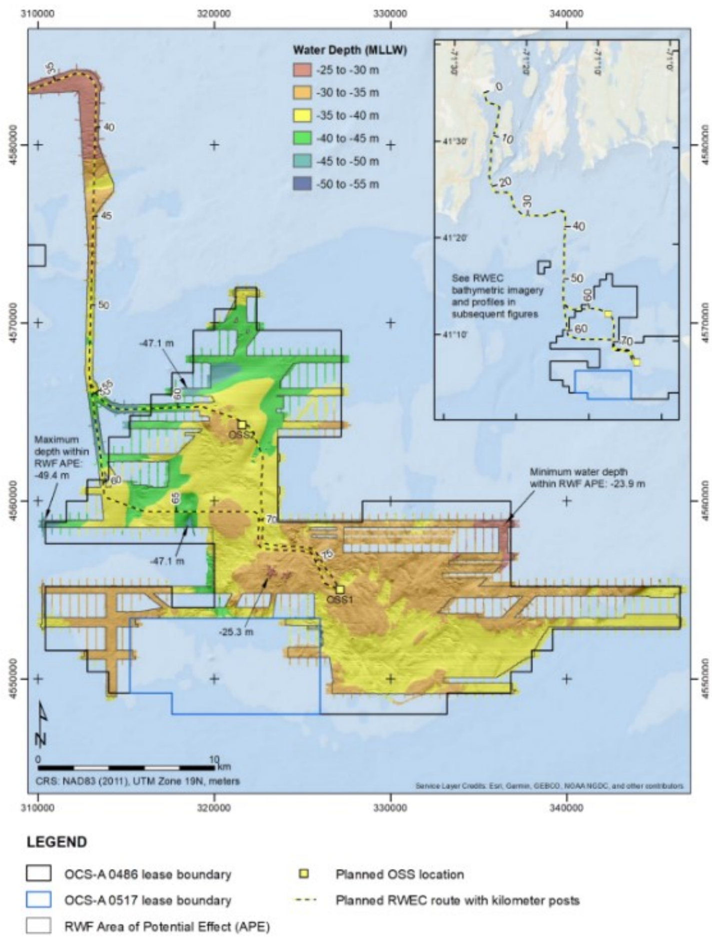
Major road or highway

Planned RWEC route with kilometer posts

Beginning at the offshore portion of the Landfall Envelope, the surficial geology of the seafloor is predominantly comprised of fine-grained sediment in the upper 10 ft (3 m),with potential bedrock and/or glacial till exposed in localized areas (Figures 4.2.3-7 and 4.2.3-8). Bedrock/glacial till is exposed in the eastern portion of the Offshore Envelope and is interpreted to only be 33 ft (10 m) deep in the western portion.

The cable route crosses an area of limited sediment thickness as it proceeds south. A north-south trending feature described on nautical charts as "ledge" may represent shallow glacial till or rock. Before reaching the JV Bridge a prominent flood shoal or bar feature comprised of 10 ft (3 m) of coarse-grained deposits is passed. This bar feature may shift during tidal currents or varying flow conditions in the river system. As the JV Bridge is approached, bouldery glacial till deposits are exposed in the eastern portion of the RWEC-RI Offshore Envelope and large amounts of debris from the demolition of the former JV Bridge were observed. The main part of the channel appears to be naturally deep in this area, which is indicative of strong tidal currents. These currents, the presence of the bridge, and bridge demolition debris present challenges for cable installation and protection.

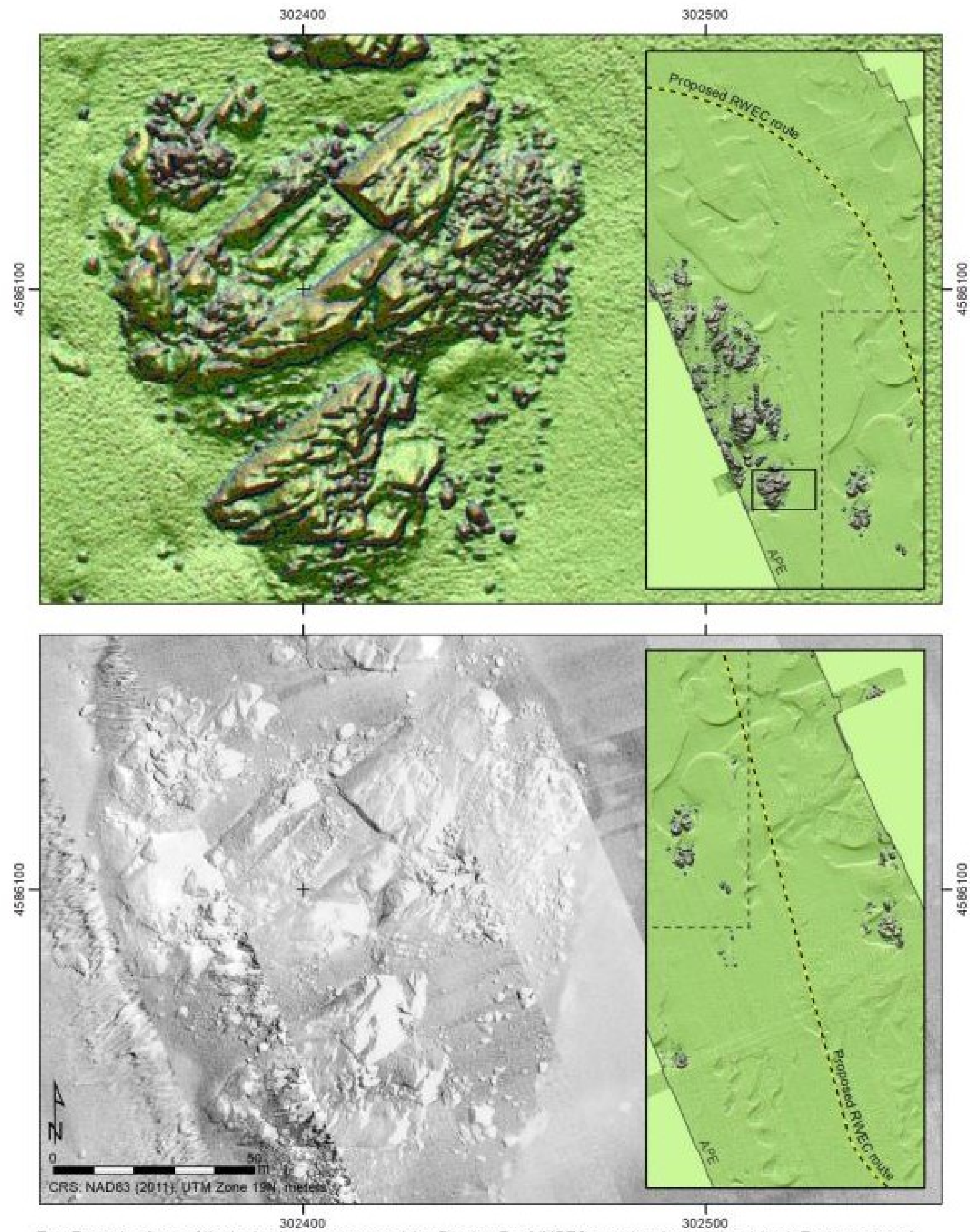
Figure 4.2.3-8 RWEC-RI & RWEC-OCS Bathymetry and Kilometer Posts (Fugro 2020)



South of the bridge, the upper 10 ft (3 m) is comprised of very soft to firm fine-grained deposits. The main part of the channel is naturally deep and, based on hydrodynamic studies, is prone strong ebb and flood tidal currents. Continuing south toward Dutch Island, the naturally deepened channel achieves depths of 33 ft (10 m) to 66 ft (20 m). A prominent bar deposit crosses the channel at a northwest-southeast orientation. This feature may be the result of high ebb and flood tidal currents and is an area with high potential seabed mobility conditions. Glacial till outcrops in localized areas along the eastern perimeter of the survey corridor. South of Dutch Island headed to the mouth of the West Passage glacial till deposits were interpreted to be present within 1 to 3 ft (0.3 to1 m) of the seafloor surface. Bedrock may also be present beneath the till surface.

At the mouth of the West Passage, the typical stratigraphy consists of approximately 0.5 m thick layer of sand overlying soft to firm clay to Brenton Reef. At Brenton Reef, shallow bedrock is exposed or covered by sediment mantles of ranging from sand to clay texture Figure 4.2.3-9.

Figure 4.2.3-9 Surface Expression of Brenton Reef (Fugro, 2020)



Top: Example of one of the bedrock outcrops comprising Brenton Reef (MBES curvature image). Inset (top): Eastern edge of Brenton Reef and relation to proposed RWEC route. Bottom: Coincident SSS view of MBES image above. Inset (bottom): Continuation of inset above illustrating bedrock outliers on either side of the proposed RWEC route.

Along the RWEC-RI, potential mobile seabed areas were interpreted based morphology and oceanographic/tidal conditions. Asymmetrical bedforms inferred to be current driven and mobile. One area of megaripples along the RWEC route between kilometer posts 35 and 36 (Figure 4.2.3-8) and ripples (approximately 0.1 to 0.6 m tall) at various locations along the RWEC were assigned a moderate seabed mobility hazard to the megaripple area and low seabed mobility hazard to the current driven ripples that are 0.1 to 0.5 m tall.

Onshore Facilities

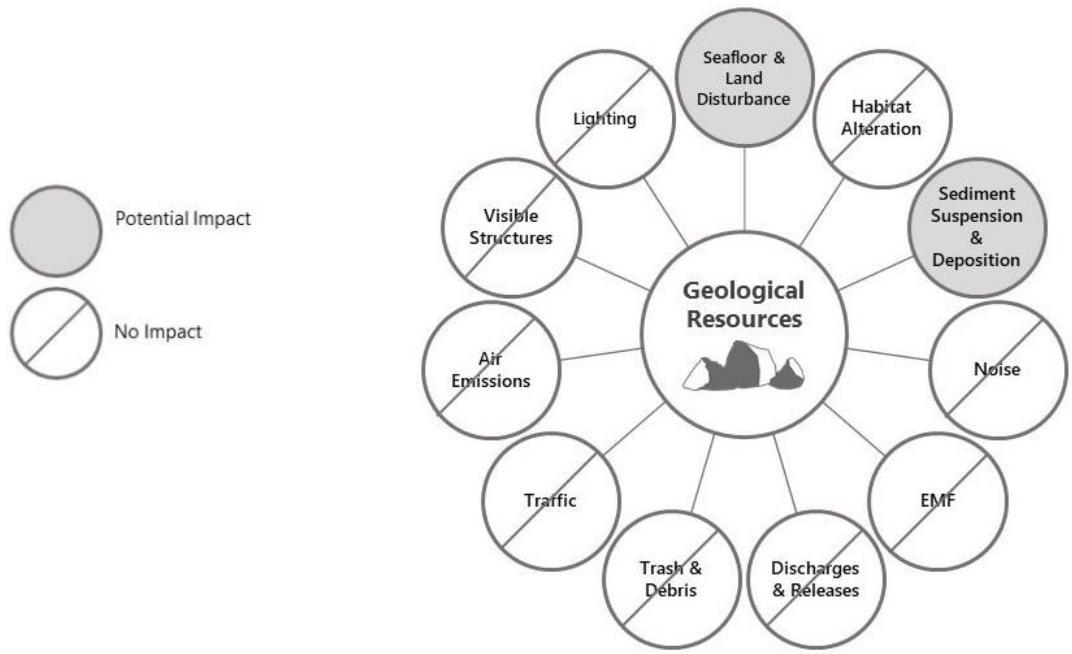
The Onshore Facilities are proposed at Quonset Point in an outwash plain that consists primarily of proglacial outwash near the coast and pitted ice-contact stratified drift further inland at the Onshore Facilities site. Holocene deposits of freshwater peat and mucks and alluvium are also present at the Onshore Facilities site. Quonset Point is characterized by high levels of disturbance of the original Pleistocene-aged surficial deposits by previous development. The site includes the former Quonset Point Naval Air Station originally commissioned in 1941, later demolished, and converted to an important industrial manufacturing area for the State of Rhode Island.

The Onshore Facilities will occupy lands altered by the naval air station. Decommissioning of the naval air station began in 1974 and included demolition of much of the former facility. Gravel borrow areas and bulky waste dumps for demolition materials (landfills) are present within the Onshore Facilities site. While the well sorted coarse-textured soils associated with the outwash surficial deposits are typically well suited for development, geotechnical investigations will be necessary to characterize the physical characteristics of the widespread human altered deposits including demolition. This geotechnical investigation will identify subsurface conditions that will inform the design on the Onshore Facilities including areas where apparently suitable fill materials may have been placed over unsuitable soils such as organic mucks, silts or clays.

4.2.3.1 Potential Impacts

Construction, O&M, and decommissioning activities associated with the RWF, RWEC, and Onshore Facilities have the potential to cause both direct and indirect impacts on geological resources, as discussed in the following sections. IPFs associated with the construction, O&M, and decommissioning phases for the Project are described in Section 4.1. An overview of the IPFs for geological resources associated with the construction, maintenance, and decommissioning of the RWF, RWEC–OCS, RWEC–RI and Onshore Facilities is presented in Figure 4.2.3-10.

Figure 4.2.3-10 IPFs on Geological Resources



Construction and decommissioning of RWF and RWEC will result in seafloor disturbance and sediment suspension and deposition. Impacts to geological resources will be direct and short-term due to the widely spaced layout of the foundations, and minimal disturbance of the seafloor relative to the vastness of the resource. Construction, operation, and decommissioning of the RWF and RWEC will alter the seafloor composition and topography in the immediate work areas. Cable burial will mostly affect surficial geological resources, but not to such an extent that there would be a perceptible change in the overall regional geological resource.

The RWF and RWEC will be designed to address existing geologic hazards and minimize direct and indirect effects on the seafloor, as well as minimize land disturbance and sediment suspension and deposition. Similarly, cable embedment and decommissioning will directly disturb the seafloor and cause sediment suspension in the lower water column and indirect effects associated with sediment deposition.

Table 4.2.3-5 Summary of Project Activities Affecting IPFs

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation	Direct, Short-term
	Vessels and Heavy Equipment (WTG and OSS)	Direct, Short-term
	Foundation Installation/Placement of Scour Protection (WTG and OSS)	Direct, Long-term
	RWF IAC and OSS-Link Cable Installation/Cable Protection	Direct, Short-term and Long-term
	Foundation Removal	Direct, Short-term
	Offshore Cable Removal	Direct, Short-term
Sediment Suspension and Deposition	Seafloor Preparation	Direct and Indirect, Short-term
	Vessels and Heavy Equipment (WTG and OSS)	Direct and Indirect, Short-term
	Foundation Installation/Placement of Scour Protection (WTG and OSS)	Direct and Indirect, Short-term
	RWF IAC and OSS-Link Cable Installation/Cable Protection	Direct and Indirect, Short-term
	Foundation Removal	Direct and Indirect, Short term
	Offshore Cable Removal	Direct and Indirect, Short term

Onshore Facilities will be constructed on land that was significantly disturbed by the landfill disposal of demolition materials generated during the naval air station decommissioning. This disturbance also includes abandoned borrow pits apparently used to cover the disposed materials. Selection of an existing brownfield for the Onshore Facilities minimizes impact to undisturbed onshore geological resources. The Onshore Transmission Cable will be housed in concrete duct banks that will be routed along the shoulders of existing roads and other previously disturbed areas. All onshore work will be conducted following strict RIPDES permit conditions, which require erosion and sediment control management minimizing any adverse effect associated with the sediment suspension and deposition IPF.

4.2.3.3 Revolution Wind Farm

Construction and Decommissioning

Table 4.2.3-6 Summary of RWF Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Pile driving and foundation installation (WTG and OSS)	Direct, long-term
	IAC and OSS-Link Cable installation	Direct, short-term
Sediment Suspension and Deposition	Pile driving and foundation installation (WTG and OSS)	Direct and indirect, short-term
	IAC and OSS-Link Cable installation	Direct and indirect, short-term

Seafloor Disturbance and Sediment Suspension and Deposition

Seafloor disturbance and sediment suspension and deposition are discussed together because the two IPFs are closely inter-related. Certain Project activities apply mechanical or hydraulic forces on the seafloor and underlying geological resources during construction. These forces also act to suspend the seafloor sediments into the water column above the active disturbance. Once suspended these sediments are transported by currents and later are deposited at varying distances from the initial disturbance.

Section 4.1.1 provides descriptions of and quantifies the maximum short-term and long-term seafloor disturbances for construction of each component of the RWF. These disturbances result from construction activities including the installation of up to 100 WTGs and two OSS foundations, the anchoring of one or more jack-up vessels for each foundation installation, the installation of IACs and OSS-Link Cables, seabed preparation for construction, and installation of cable and scour protection. Potential direct impacts to the seafloor will occur at specific locations where monopile foundations or piles for jacket foundations are driven into the seabed, where the OSS-Link and IACs are entrenched into the seafloor, where existing boulders are relocated, and sandwaves leveled. Indirect impacts include transient increases in seawater turbidity and the deposition of sediment within and outside of the immediate work area.

The maximum embedment depth for WTG monopole foundations is anticipated to be up to 164 ft (50 m) and for OSS jacketed foundations the target pile embedment depth is anticipated to be up to 210 ft (64 m). The disturbance of the geological strata will be limited to each pile point or the circumference of the monopole foundations and each WTG is projected to be spaced 1.15 mi (1 nm [1.93 km]) apart. Disturbance will not occur on a broader scale that would alter the geological setting.

The installation of IACs and OSS-Link Cables will result in seafloor disturbance and the suspension and deposition of sediments. Installation of these cables is considered to have a greater risk of suspending sediments in comparison with pile driving. Completed geophysical surveys have confirmed the presence of areas of fine textured Holocene transgressive sediments and shallow glaciolacustrine deposits especially susceptible to resuspension. Depending on the substrate, installation of the offshore cables may involve use of jet-plows, mechanical plows, mechanical cutters, CFE and/or trailing suction hopper dredger within the seafloor to allow for installation of the cable. In general, the disturbance area will naturally resettle within the trench and/or be backfilled depending on the method; therefore, no permanent impact is anticipated. Construction methods for the IAC and OSS-Link Cable, are similar to those described in further detail for the RWEC in Section 3.3.3.2 of the COP under offshore construction. This trenching will temporarily disturb the seafloor, which will increase sediment suspension and deposition during construction.

RPS (2020) prepared a Hydrodynamic and Sediment Transport Modeling Report (Appendix J) for cable embedment within the RWF, the RWEC-OCS and RWEC-RI. The model run for the RWF predicted the suspended sediment plume will remain within the bottom few meters of the water column and the maximum amount of time a plume of greater than 100 mg/L will stay suspended will be 2.7 hours. Sediment deposition greater than 1 mm was predicted to extend up to 853 ft (260 m) from the IAC, though typically this was a shorter distance.

Activities associated with WTG and OSS installation will temporarily disturb the seafloor and suspend sediment during construction and can result in sediment deposition that is ***direct,*** and ***short-term*** to the seafloor and ***direct*** and ***indirect****,* and ***short-term*** to sediment suspension and deposition. Based on the hydrodynamic model, it is anticipated that the ***indirect*** impacts associated with sediment suspension and deposition associated with submarine cable embedment within the RWF will be ***short-term***. From the perspective of geological resources, the leveling of sandwaves and movement of boulders will be ***direct*** and ***short-term***.

At the end of the Project's operational life, it will be decommissioned in accordance with a detailed Project decommissioning plan that will be developed in compliance with applicable laws, regulations, and BMPs at that time. All facilities will need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM.

Sediment suspension during foundation removal will be controlled by the scour protection installed around each foundation. Removal of IAC and OSS-Link Cables is likely to produce temporary impacts to geological resources associated with seafloor disturbance and sediment suspension and deposition that will be similar to those described for construction if removal of these components uses similar equipment and methods. Cable protection placed over the cables will be removed before the cable is recovered.

The impacts to seafloor disturbance and sediment suspension and deposition during decommissioning the same as described during the construction phase and will therefore be ***direct*** and ***indirect,*** and ***short-term.***

Table 4.2.3-7 Summary of RWF O&M Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Foundation scour protection	Direct, Short-term
	Cable protection	Direct, Short-term
Sediment Suspension and Deposition	Foundation scour protection	Direct and Indirect, Short-term
	Cable protection	Direct and Indirect, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

During the operational phase of the RWF, routine maintenance may include additions of cable protection for some foundations for portions of the IACs and OSS-Link Cable will result in relatively small areas of seafloor disturbance and sediment suspension and deposition. The widely spaced of foundations (i.e., approx. 1.15 mi by 1.15 mi (1 nm by 1 nm [1.93 km by 1.93 km]) and generally small footprint of these features will not affect overall geological resources, and direct seafloor disturbance will be ***direct*** and ***short-term,*** and sediment suspension and deposition ***indirect*** and ***direct,*** and ***short-term.***

4.2.3.4 RWEC–OCS

Construction and Decommissioning

Table 4.2.3-8 Summary of RWEC-OCS Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Cable installation	Direct, Short-term
Sediment Suspension and Deposition	Cable installation	Direct and Indirect, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

Seafloor, sediment suspension, and redeposition of the sediment will result from the installation of the RWEC–OCS, associated sea bottom preparatory works, and the installation of cable protection where determined necessary. A conservative assumption is that RWEC installation will create a disturbance corridor of up to 131 ft (40 m) for each cable to account for boulder clearance and sandwave leveling. Section 4.1.1 quantifies the anticipated maximum area of seafloor disturbance that will result from the installation of the RWEC–OCS. This same disturbance corridor may be disturbed by during anchor deployment and dragging by work vessels.

Boulder clearance is a discreet action with limited disturbance to the seafloor. Sandwaves are formed and maintained by ocean currents, and sandwave leveling is thought to be a temporary impact, except where anti-scour measures are utilized to maintain adequate burial depth.

Methods and equipment proposed for cable installation are discussed in Section 3.3.3.2. Two common methods are jet-plow and mechanical plowing where the trench is cut and cables can be simultaneously installed and backfilled. In other methods such as CFE a pre-laid cable may be moved into the trench. Other methods first cut a trench and lay a cable into the prepared excavation then backfill. Cable installation rates of between 590 ft/hr (180 m/hr) and 295 ft/hr (90 m/hr) are anticipated. These cable installation methods are not considered to create permanent impacts to the geological resources unless cable protection is installed.

The installation of the RWEC–OCS will disturb the seafloor and suspend and deposit sediment during construction. RPS (2020) completed a modeling simulation for sediment suspension and deposition associated with construction and decommissioning of the RWEC-OCS for two circuits (Appendix J). The simulation predicted that the suspended sediment plume will be confined to a few meters above the seafloor and the maximum amount of time a plume of greater than 100 mg/L will remain suspended will be three hours. Sediment suspension and settling is affected by particle size and current, and along most of the cable route concentrations of 100 mg/L or greater did not persist for three hours. Sediment deposition greater than 0.04 in (1 mm) in thickness was predicted to extend up to 951 ft (290 m) from the route centerline but typically extended shorter distances.

During construction, seafloor disturbance is considered ***direct*** and ***short-term*** and sediment suspension and deposition are considered ***direct*** and ***indirect,*** and ***short-term***.

At the end of the Project's operational life, the project infrastructure will be decommissioned in accordance with a detailed Project decommissioning plan that will be developed in compliance with applicable laws, regulations, and BMPs at that time. Presuming no change to applicable laws, regulations or BMPs, all facilities will need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM.

Impacts to geological resources from seafloor disturbance and sediment suspension and deposition involving the removal of the RWEC–OCS components will be similar to those impacts described for construction, unless different equipment is used. Scour protection may need to be removed in order to recover the cable. Any impact associated with seafloor disturbance or sediment suspension and deposition will be short-term.

Operations and Maintenance

Table 4.2.3-9 Summary of RWEC-OCS O&M Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	RWEC Non-routine maintenance	Direct, Short-term
Sediment Suspension and Deposition	RWEC Non-routine maintenance	Direct and Indirect, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

Once the RWEC–OCS is installed, there are no further impacts to geological resources anticipated with operation of the facility. The RWEC, IAC, and OSS-Link Cable typically have no maintenance requirements unless a fault or failure occurs. Repair or replacement of cables or cable protection are considered non-routine maintenance activities potentially resulting in the same or lesser impacts as construction, i.e. potential ***direct***, and ***short-term*** impact to seafloor disturbance and potential ***direct*** and ***indirect,*** and ***short-term*** sediment suspension and deposition.

4.2.3.5 RWEC–RI

Construction and Decommissioning

Seafloor Disturbance/Sediment Suspension and Deposition

As with the RWEC–OCS, impacts to geological resources during installation of the RWEC–RI will be limited to the area of the seafloor disturbed during preparation for and installation of the two export cables. Sandwave leveling and boulder removal/relocation will be carried out as described for the RWEC–OCS.

The installation of the RWEC–RI will disturb the seafloor and suspend and deposit sediment during construction. RPS's Hydrodynamic and Sediment Transport Modeling Report (Appendix J) provided model data concluding that the sediment will remain suspended within the bottom few meters of the water column and the maximum amount of time a plume of greater than 100 mg/L will stay suspended will be 9.7 hours, which is a total of 19.4 hours for both cables. In many locations with coarser sediment and weaker currents, concentrations of 100 mg/L did not persist for 9 hours. Most locations south of Narragansett Bay will experience plumes for less than three hours per circuit, and inside Narragansett Bay, it will be less than five hours. In addition, sediment deposition greater than 1 mm was predicted to extend up to 3,609 ft (1,100 m) from the route centerline, but typically extended for shorter distances.

In addition to the cable installation measures described for the RWEC–OCS, the RWEC–RI will utilize HDD to transition from the RWEC to the Onshore Transmission Cable. This method may include installation of an offshore cofferdam supported by driven sheet piles or a supported or unsupported dredge pit to create an exit pit to retrieve the drilling head and attach conduit that will be pulled back to the onshore HDD rig.

Using an HDD method is estimated to suspend 4,358 cy (3,332 m^3) of sediment during installation. The area of sediment deposition exceeding 0.4 in (10 mm) of sediment deposition for is 38 ac (15 ha) for HDD. For the HDD method, the plume above background (0 mg/L) may persist in any given location for up to 256 hours and the plume above 100 mg/L may persist in any given location for up to 237 hours.

Impacts to geological resources resulting from seafloor disturbance and sediment suspension and deposition during the installation of the RWEC–RI, including the HDD, are anticipated to be insignificant to overall geological resources and processes in the area. Once buried, the area above the cable will recover as part of ongoing processes associated with dynamic marine sediments. These impacts can be characterized as ***direct*** and ***indirect,*** and ***short-term.***

At the end of the Project's operational life, the Project infrastructure will be decommissioned in accordance with a detailed Project decommissioning plan that will be developed in compliance with applicable laws, regulations, and BMPs at that time. Presuming no change in applicable laws, regulations, or BMPs, all facilities will need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM.

Operations and Maintenance

Seafloor Disturbance/Sediment Suspension and Deposition

Similar to the RWEC-OCS, repair or replacement of cables or cable protection associated with the RWEC-RI are considered non-routine maintenance activities potentially resulting in the same or lesser impacts as construction, i.e. potential ***direct*** and ***short-term*** impact to seafloor disturbance and potential ***direct*** and ***indirect, short-term*** sediment suspension and deposition.

4.2.3.6 Onshore Transmission Facilities

Construction and Decommissioning

Table 4.2.3-10 Summary of RWEC-Onshore and Onshore Transmission Cable Construction Impacts

IPF	Project Activity	Impact Characterization
Land Disturbance	RWEC-Onshore / Onshore Transmission Cable	Direct, Short-term
Sediment Suspension and Deposition	RWEC-Onshore / Onshore Transmission Cable	Direct and Indirect, Short-term

Land Disturbance/Sediment Suspension and Deposition

Landfall sites within the Landfall Envelope are currently being evaluated (Figure 2.2.1-3). HDD will be used to extend the RWEC from MHHW to the TJBs, where the RWEC and Onshore Transmission Cable will be jointed. (Refer to Figure 3.3.3-1-7 and Landfall Construction in Section 3.3.3.2 for detailed description of HDD.)

Impacts to geological features will be ***direct*** and ***short-term*** with the installation of conduit and cable at the Landfall Work Area. The Landfall Work Area will temporarily disturb up to 3.1 ac (1.3 ha). To the extent feasible, the drilling pits proposed for the Landfall Work Area will be aligned with previously altered areas. The TJBs will also be situated in this human-altered deposit avoiding impact to less disturbed geological resources. While the Onshore Transmission Cable route from landfall to the Onshore Facilities is still being finalized, all potential alignments follow roads and previously developed parts of the former Quonset Point Naval Air Station.

Trenches for the Onshore Transmission Cable duct banks will generally be excavated along the sides of roads and, while the alignments follow different roads, the lengths among the alternatives are comparable. This excavation will result in the mixing of soil materials during backfill, destroying any natural soil development which may be present. This disturbance will only extend 4 to 6 ft (1.2 to 1.8 m) below grade, with the width of disturbance 40 ft (12 m) or less. This impact to geological resources in the highly disturbed setting of Quonset Point will be ***direct* and *short-term*.**

Working in a terrestrial setting, sediment suspension and deposition along the Onshore Transmission Cable route will have insignificant impacts to surficial geology because all earth disturbances will be conducted in compliance with the RIPDES General Permit, which includes a site specific Soil Erosion and Sediment Control Plan and weekly monitoring until soils are stabilized after construction. Impacts to geological resources associated with sediment transport will be ***indirect*** and ***short-term***.

At the end of the Project's operational life, the Project infrastructure will be decommissioned in accordance with a detailed Project decommissioning plan that will be developed in compliance with applicable laws, regulations, and BMPs at that time. Presuming no change to applicable laws, regulations or BMPs, all facilities will need to be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM.

Impacts associated with decommissioning are anticipated to be less than those reported for the construction of the Landfall Work Area and Onshore Transmission Cable. It is assumed that the RWEC could be pulled from the HDD conduit and the conduit itself could remain in place where it was installed. Decommissioning of cables within the duct banks and TJBs is simpler because the work occurs above ground.

Operations and Maintenance

Table 4.2.3-11 Summary of RWEC Onshore and Onshore Transmission Cable O&M Impacts

IPF	Project Activity	Impact Characterization
Land Disturbance	Onshore Transmission Cable Non-routine maintenance	Direct, short-term
Sediment Suspension and Deposition	Onshore Transmission Cable Non-routine maintenance	Direct, short-term

Land Disturbance/Sediment Suspension and Deposition

Similar to the offshore segment of the RWEC, onshore cable systems may suffer faults and/or failures potentially requiring the cables to be excavated and exposed for repair or replacement. These types of repairs would be considered non-routine maintenance. Potential impacts on geological resources during O&M may be ***direct*** and ***short-term***. Routine maintenance activities will have no impact on geological resources.

4.2.3.7 Onshore Facilities

Construction and Decommissioning

Table 4.2.3-12 Summary of Onshore Facilties Construction Impacts

IPF	Project Activity	Impact Characterization
Land Disturbance	Onshore Facilities	Direct, long-term
Sediment Suspension and Deposition	Onshore Facilities	Indirect, short-term

Land Disturbance/Sediment Suspension and Deposition

Construction of the Onshore Facilities will temporarily disturb approximately 11 acres (4.5 ha) (up to 7.1 acres and 4.0 acres respectively) of land associated with grading, filling and cutting and occupy up to 5 ac (2 ha) (3.8 and 1.6 acres respectively) of land which are part of two separate parcels in North Kingston, Rhode Island. The two parcels are highly altered and include buried demolition and abandoned borrow pits used for fill. Wetlands are also present on the properties. Tree clearing excavation, grading, and filling will be required to prepare building pads for the OnSS and ICF.

Site grading and constructions of foundations are permanent impacts to geological resources. In as much as wetlands can be avoided, these construction activities will occur in a highly altered landscape and represent insignificant impacts to geological resources. This impact to geological resources from land disturbance will be ***direct*** and ***long-term.***

The Onshore Facilities will be constructed using BMPs from the 2016 Rhode Island Soil Erosion and Sediment Control Handbook and work will be governed by a RIPDES permit, which will require the submission of a site-specific Soil Erosion and Sediment Control Plan and weekly monitoring and reporting. Any impact from sediment suspension and deposition associated with construction of the Onshore Facilities and will be ***indirect*** and ***short-term.***

Decommissioning of the Onshore Facilities will create similar disturbances to construction. Geological resources will not be further impacted by removal of Onshore Facilities, as no additional grading or filling will be required to remove the infrastructure. There will be no land disturbance associated with decommissioning, and sediment suspension and deposition will be ***indirect*** and ***short-term.***

Operations and Maintenance

Onshore substations and appurtenant facilities are routinely operated without impact to geological resources. Even contingencies where equipment may need to be removed and replaced do not create opportunities for impacts to geological resources. Likewise, there will be no land disturbance or excessive sediment suspension and deposition associated with the operation of the Onshore Facilities.

4.2.3.8 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to geological resources:

- The IACs, OSS-Link Cable, and RWEC will be sited to avoid identified shallow hazards to the extent practicable.
- To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment.
- DP vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent possible.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable.
- An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.

4.2.4 Physical Oceanography and Meteorology

This section describes the affected environment for physical oceanographic and meteorological conditions within the RWF, RWEC-OCS, RWEC–RI, and proximate areas. The Onshore Facilities are not discussed within this section given their location on land. The discussion of the affected environment for physical oceanography and meteorology is followed by an evaluation of potential Project-related impacts.

The description of the affected environment and assessment of potential impacts to physical oceanography and meteorology were determined by reviewing public data sources and project-specific studies including the following: Rhode Island Ocean Special Area Management Plan (OSAMP) (RI CRMC, 2010); Environmental Assessment prepared by BOEM for the RI-MA WEA. Additional Resource Information: Geology and Physical Oceanography (BOEM, 2013); Hydrodynamic and Sediment Transport Modeling Report (Appendix J); South Fork Wind Farm Metocean Design Criteria report (DNV GL, 2018); G&G Report (Appendix O1), and Metocean Conditions Based on 1 Year of Measurements from F240 at Lease Area OCS-A 0489 (Appendix W).

Physical oceanographic conditions include circulation, currents, and water column stratification by temperature and salinity. Meteorological conditions include wind speed and direction, occurrence of storms and cyclones, and ice and fog.

4.2.4.1 Affected Environment

Revolution Wind Farm

This section summarizes the affected environment relative to oceanography and meteorology for the RWF, which includes the proposed WTGs, OSSs, IACs, and OSS-Link Cable (Section 1.1 and Figure 1.1-1). The following parameters are specifically discussed: circulation, water column stratification, wind, storms, cyclones, and ice and fog.

Circulation

Circulation patterns are influenced by winds, tides, differences in water density (dependent on temperature and salinity), and geomorphology (bathymetry and land masses). Overall, net transport of water from Rhode Island Sound moves toward the southwest and west. However, bottom water may flow toward the north, particularly during the winter. Circulation patterns are influenced by water moving in from Block Island Sound and the colder water coming in from the Gulf of Maine. Also, "warm core rings" split off from the northward flowing Gulf Stream could move into Rhode Island Sound, bringing entrained warm water biota. (RI CRMC, 2010). Regionally, currents from Rhode Island Sound meet outflow from Block Island Sound off Montauk Point and flow towards the southwest, south of Long Island. Although current flow south of Long Island follows the overall southwestern movement, nearshore currents flow towards the east (RI CRMC, 2010).

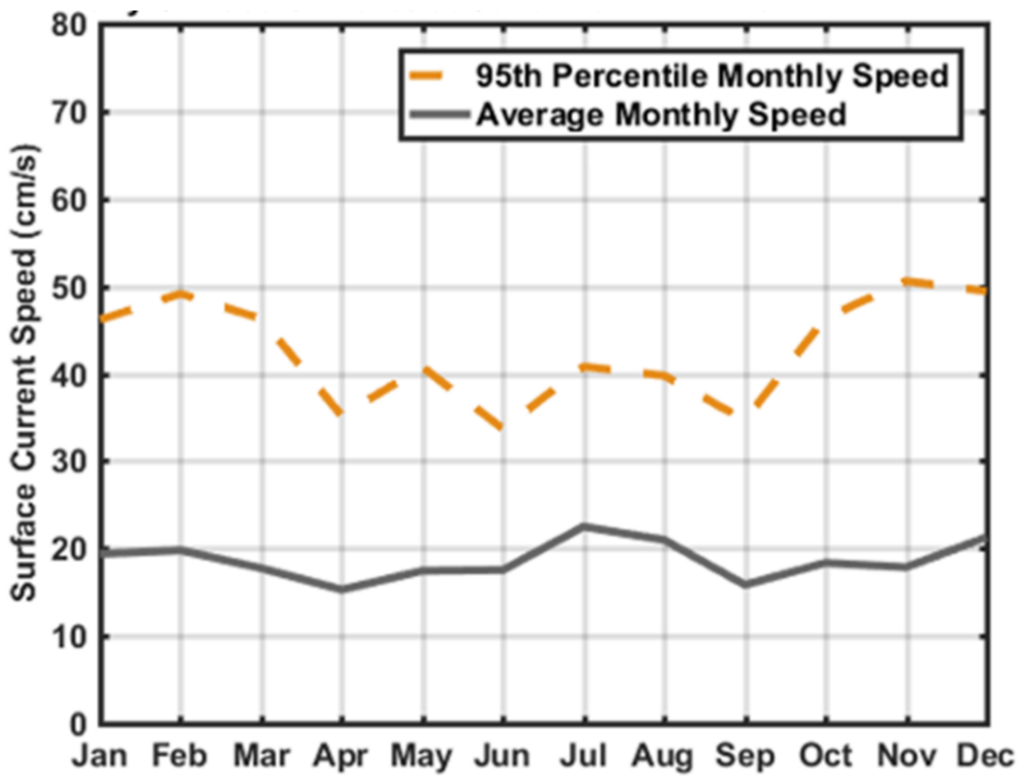
Waves generally move across the area from the south and are on average between 3.3 and 9.8 ft (1 and 3 m). Highest storm waves are up to 30 ft (9 m). Under normal conditions, wave action results in little disturbance to bottom waters or sediments. Semi-diurnal (i.e., twice daily) tides flood in from the southeast, with an average tidal range of 3.2 feet (1.0 m) across Block Island and Rhode Island Sounds. (RI CRMC, 2010).

The ocean current data for RWF Metocean Report (Appendix W) was reviewed, which compared the data from the South Fork Wind Farm (SFWF) metocean report. It was generally found that the values from the F240 floating LiDAR (flidar) was within the range predicted for SFWF. See Figure 4.2.4-1 for location of the F240 flidar.

Figure 4.2.4-1 Location of the F240 Floating Lidar wtihin RWF Lease Area OCS-A 0486 (DNV GL, 2018)

The SFWF metocean report, which is included as an attachment to the RWF metocean report, included a preliminary assessment of ocean currents, and statistics were generated based on modeled hindcast reanalysis of inputs for the years 2001 to 2010, from the Hybrid Coordinate Ocean Model (HYCOM) 1/12-degree global simulation assimilated with Navy Coupled Ocean Data Assimilation (NCODA) from the United States Naval Research Laboratory (Halliwell, 2004). The 2001 to 2010 data period was chosen as the most recent 10 years of re-analysis data for HYCOM currents and its matching wind Climate Forecast System Reanalysis (CFSR) that is available. Average surface current speeds were consistently found to be about 8 inches per second (in./s; 20 centimeters per second [cm/s]) throughout the year, with the strongest currents of 20 in./s (50 cm/s; as the 95th percentile) in late fall and early spring, as depicted in Figure 4.2.4-42.

Figure 4.2-2 HYCOM Monthly Current Speed Statistics Near the RWF and RWEC Study Area from January 2001 to December 2010



Sources: Halliwell, 2004; Chassignet et al, 2007

Estimated average currents at depth of 98.4 ft (30 m) range between approximately 2.8 in./s (7 cm/s) as the mean, to 6.7 in./s (17 cm/s) as the 95th percentile. Currents show directional variability from the surface to the bottom depth, changing from easterly in the surface to north-easterly/west-south-westerly at depth. Differences between surface currents and seabed currents can be attributed partly to the influence of wind effect on the surface layer and bathymetric features around the study area on the bottom layer, as depicted on Figure 4.2.4-3.

Figure 4.2.4-3 Vertical Profile of the HYCOM 2001-2010 Horizontal Current Speed (cm/S) Dataset

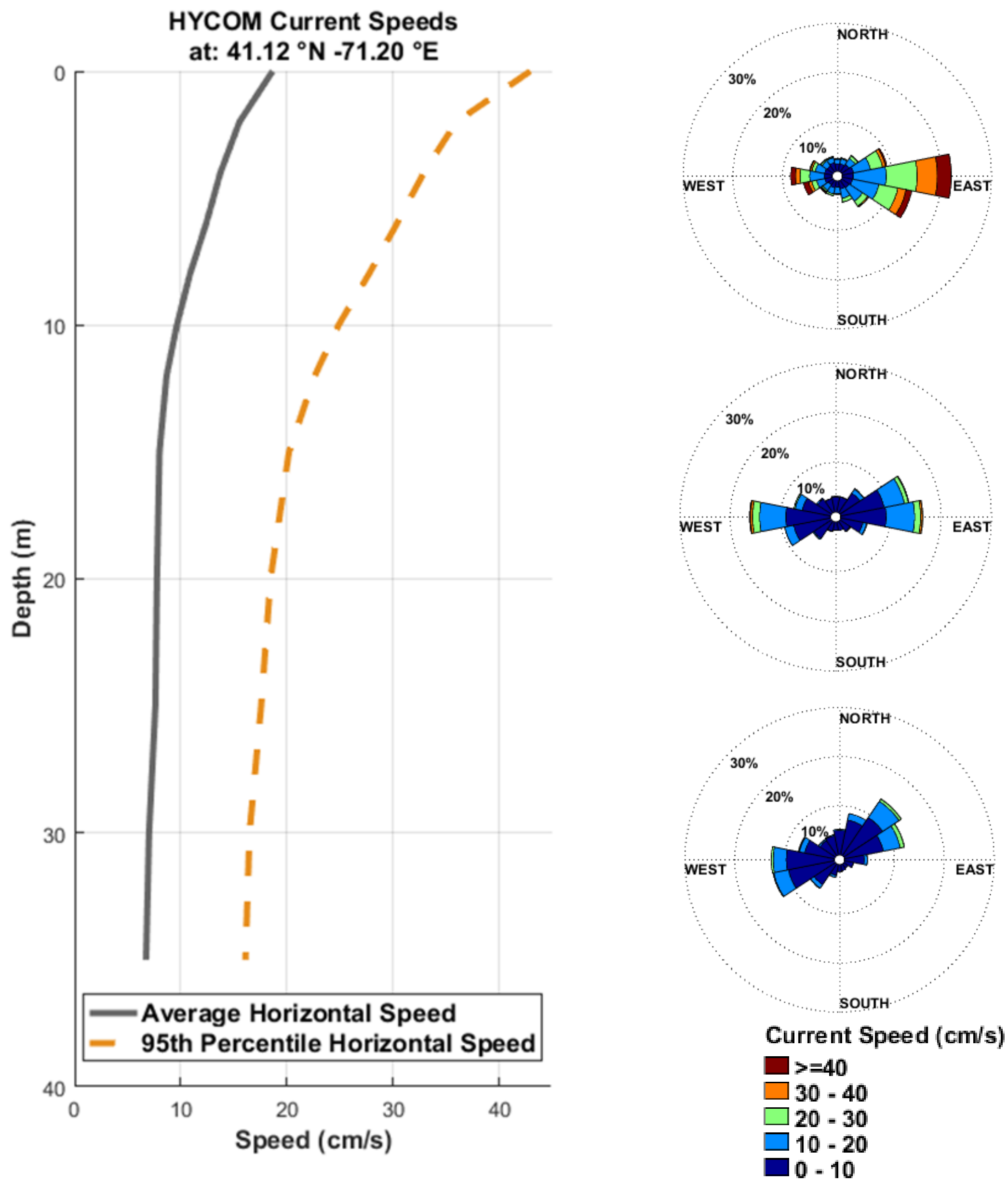
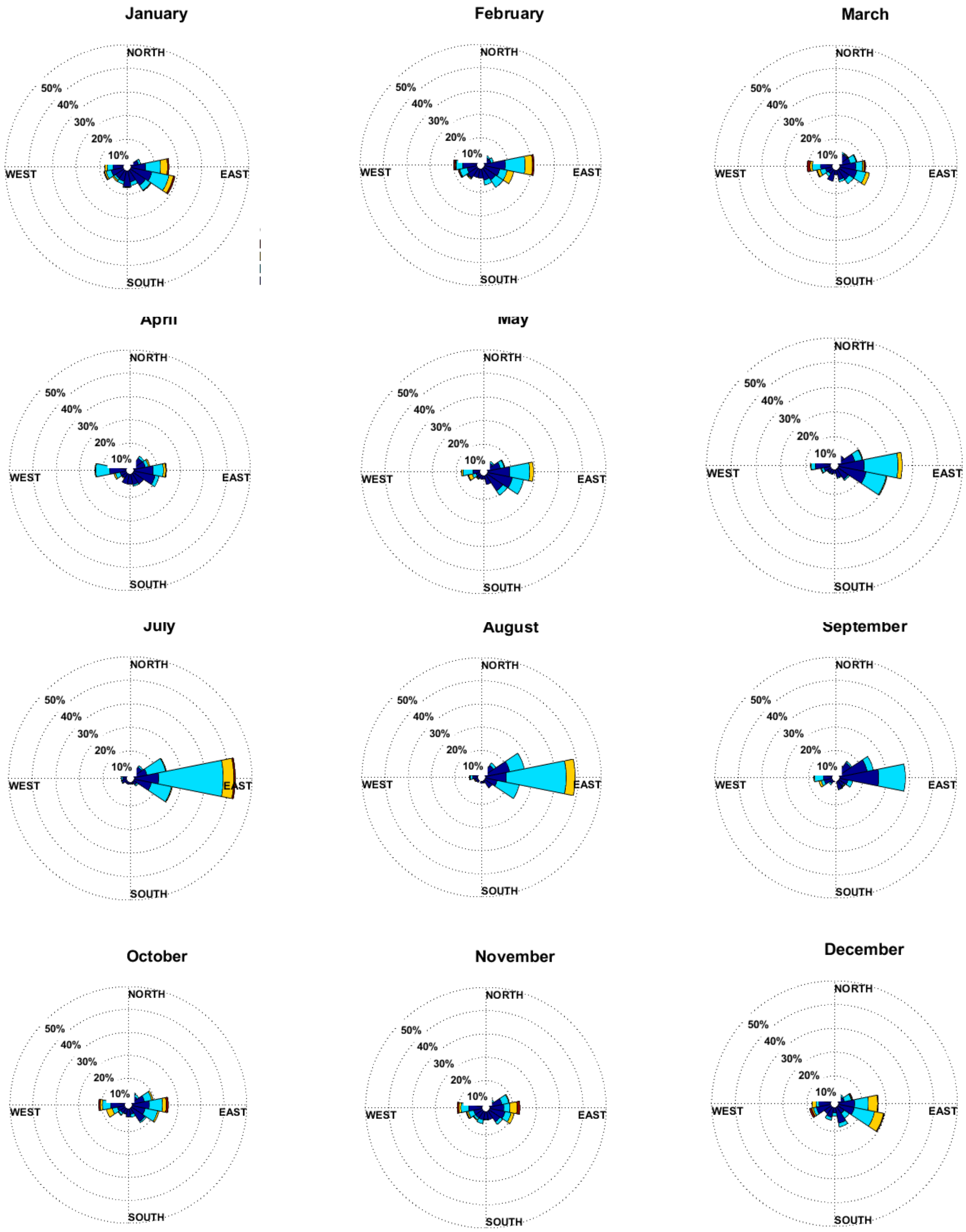


Figure depicts average and 95th percentile speed and variation with depth near the study area. Current roses of annual current are from the surface, 15 m and 30 m water depths. Current roses show the direction to which the current is flowing.

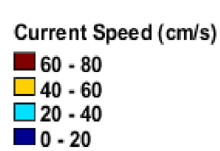
Figure 4.2.4-4 illustrates that surface currents consistently move toward the east.

Figure 4.2.4-4 Monthly Averaged HYCOM Surface Currents Near the Study Area from January 2001 to December 2010 (DNV GL, 2018)



Note: Direction convention is standard (i.e., direction currents are headed).

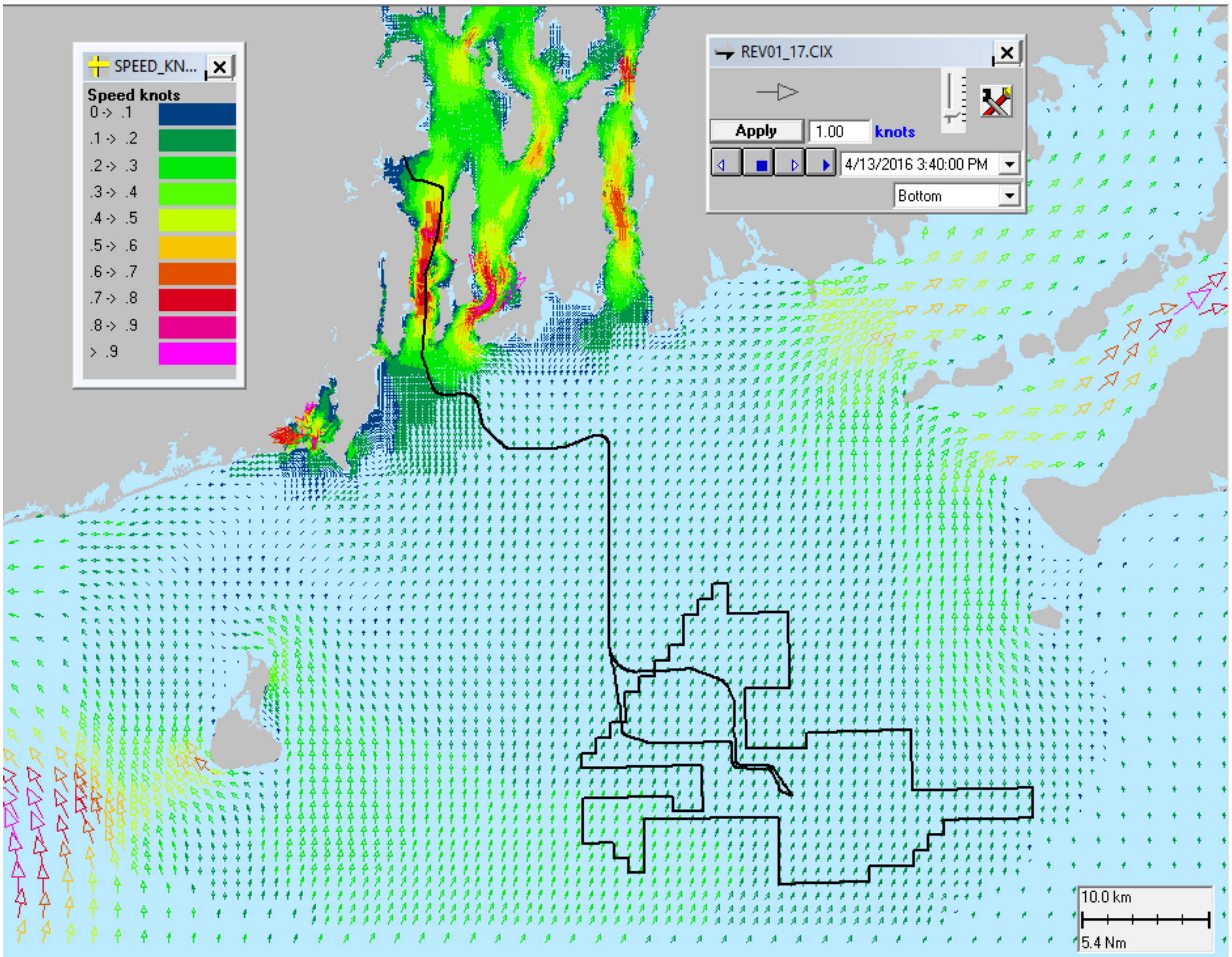
Source: Saha et al., 2010



In addition to the metocean analysis, RPS applied hydrodynamic and sediment transport and dispersion models to assess potential effects from sediment resuspension during construction (Appendix J). The study included evaluating circulation patterns near the seabed by applying a three-dimensional hydrodynamic model, HYDROMAP™. HYDROMAP™ simulates complex circulation patterns due to tidal forcing, wind stress, and freshwater flows (RPS, 2020). The model was used to simulate water levels, circulations patterns, and water volume flux throughout the study area, and to provide spatially and temporally varying currents for input into the sediment transport model (RPS, 2020). Figure 4.2.4-5 indicates flow direction at peak flow (flood), and Figure 4.2.2-6 indicates flow direction at peak ebb.

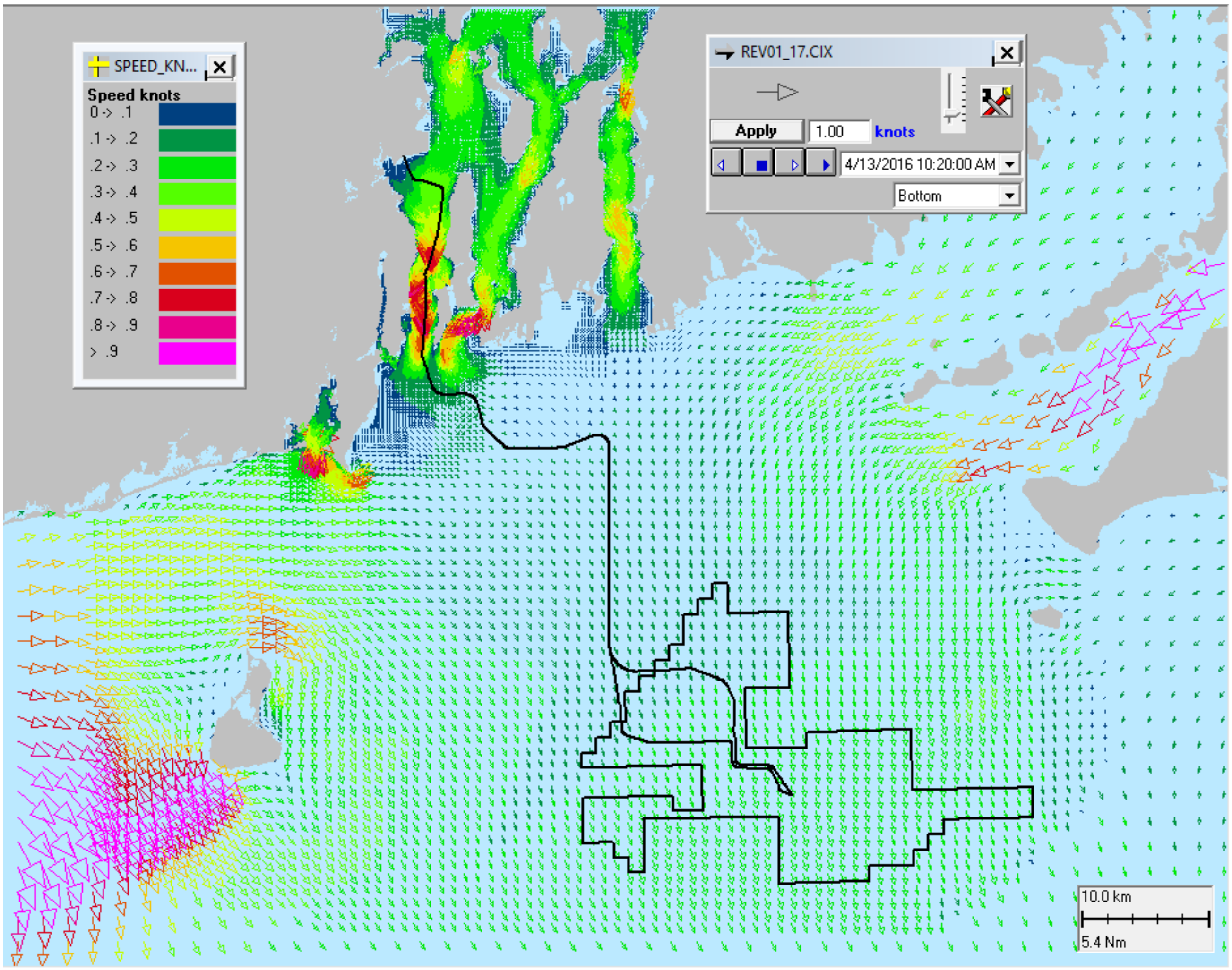
RPS also modeled surface currents in the HYCOM model. A map of surface currents in Figure 4.2.4-7 from RPS's 2019 HYCOM modeling indicates flow direction at peak flow (flood) and Figure 4.2.4-8 indicated flow direction at peak ebb. Based on this preliminary assessment of currents for SFWF, it appears that the RWF may be located outside the zone of regional southwestward surface current flow from Block Island and Rhode Island Sounds.

Figure 4.2.4-5 Bottom Currents with Flow Direction Indicated at Peak Flow



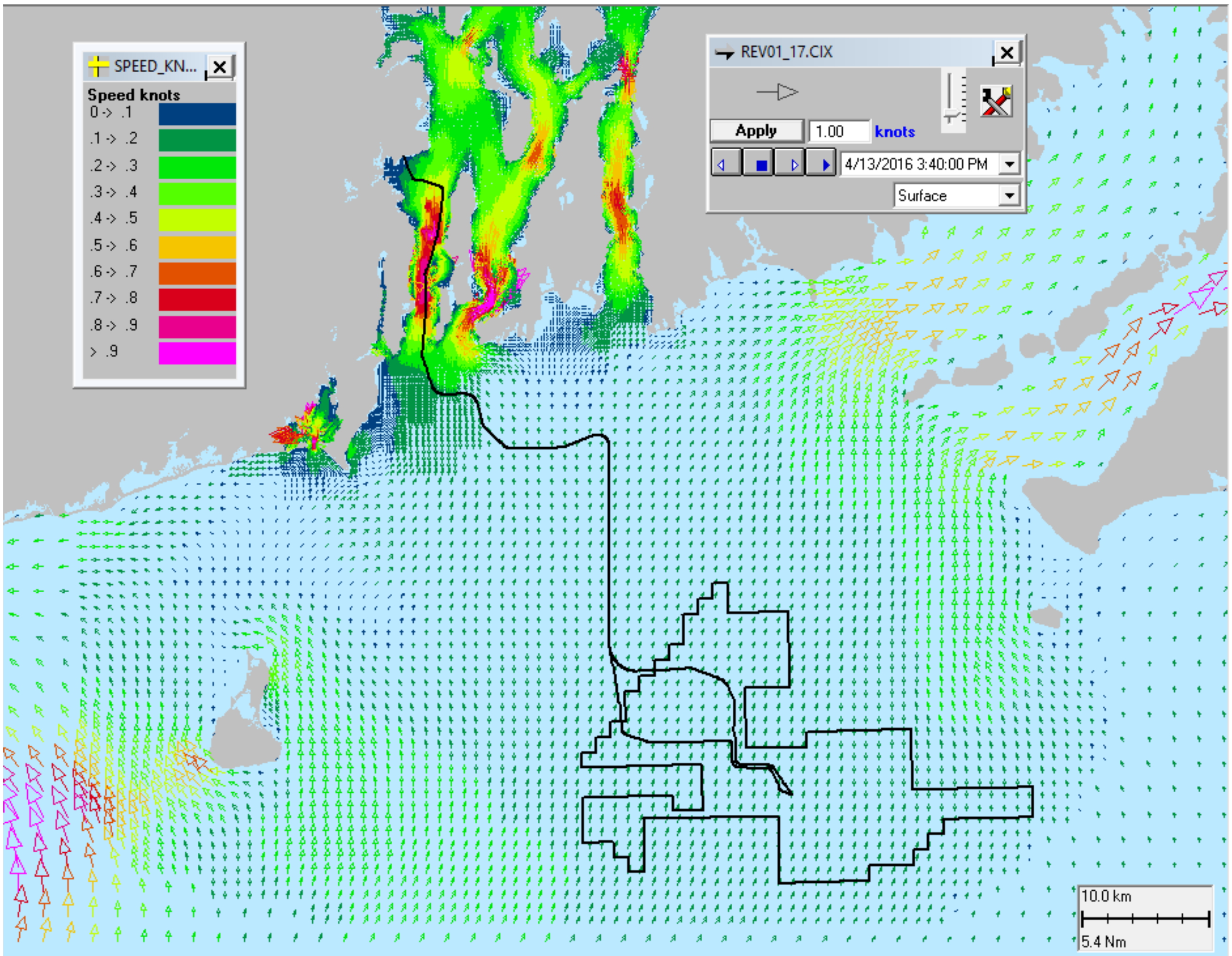
Source: RPS, 2020

Figure 4.2.4-6 Bottom Currents with Flow Direction Indicated at Peak Ebb



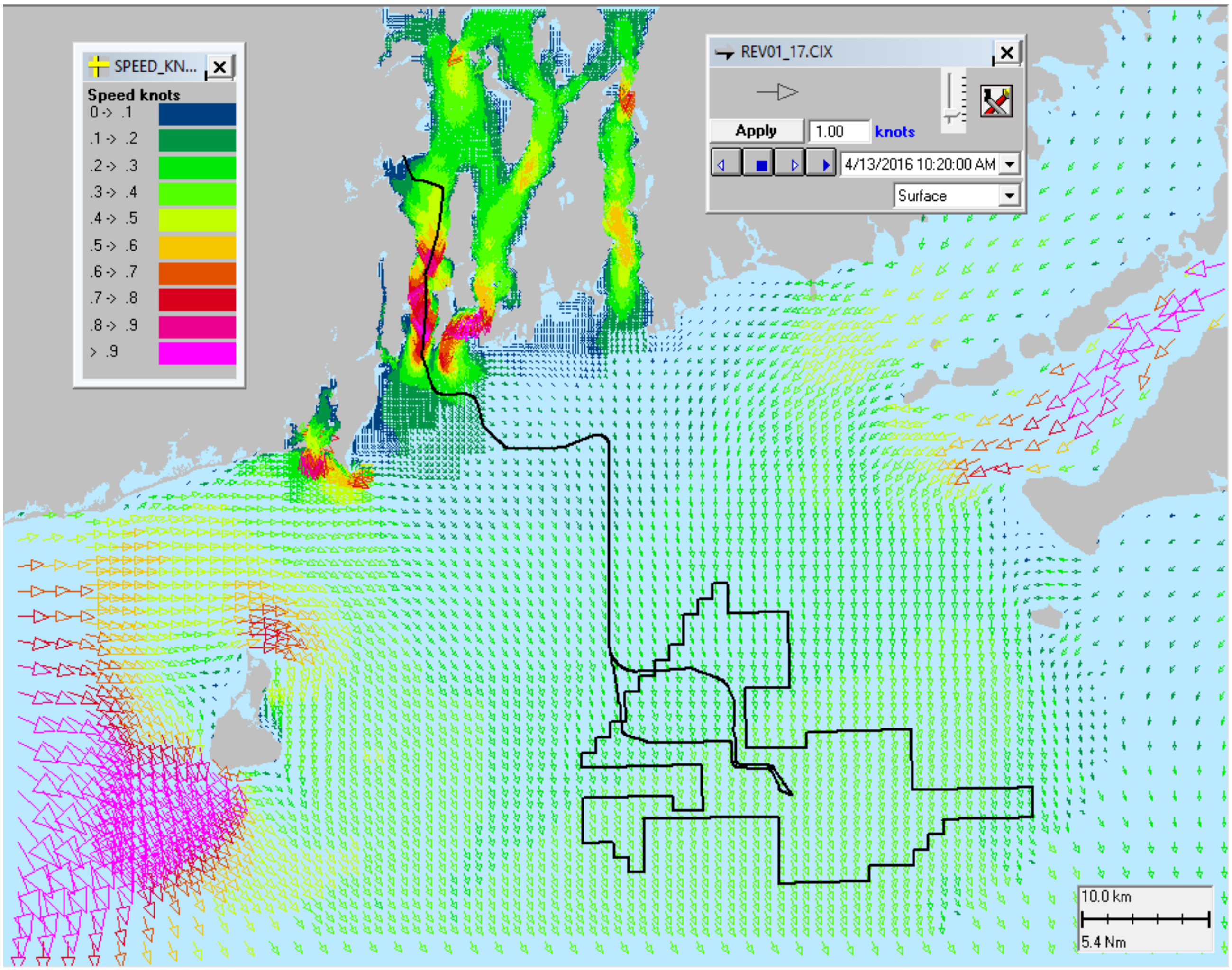
Source: RPS, 2020

Figure 4.2.4-7 Surface Currents with Flow Direction Indicated at Peak Flow Tides



Source: RPS, 2020

Figure 4.2.4-8 Surface Currents with Flow Direction Indicated at Peak Ebb



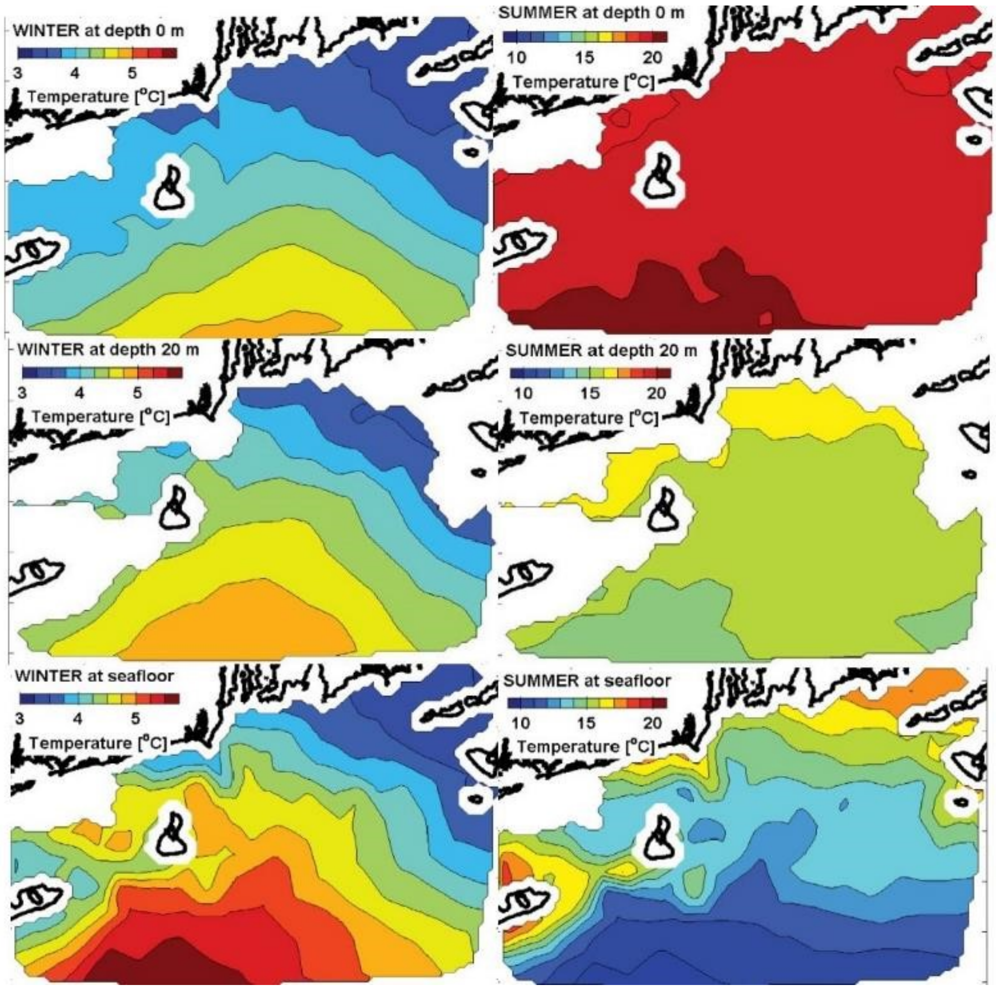
Source: RPS, 2020

Water Column Stratification

In general, the heating of water and increased salinity during the late summer and early fall results in a stratified water column that is subjected to mixing in the fall from upwelling bottom waters and storm action. The temperature and salinity trends described below contribute to this seasonal stratification.

Averages of seasonal water temperature data collected by the RI CRMC between 1980 and 2007 are depicted on Figure 4.2.4-9 (RI CRMC, 2010). Surface water temperatures fluctuate up to 59 degrees Fahrenheit (°F) (15 degrees Celsius [°C]) seasonally, and as expected, bottom waters have smaller seasonal temperature fluctuation of approximately 41°F (5°C). Water temperatures are highest in July and August when the water column becomes stratified; surface water temperatures are close to 68°F (20°C), with bottom waters in the RWF area of about 50°F (10°C). This stratification can set up physical conditions by reducing interactions between surface waters and the rest of the water column, which can concentrate food items and become a “hot spot” of biological activity (RI CRMC, 2010). During the winter, average surface water temperatures range from approximately 39 to 41°F (4 to 5°C), with bottom waters staying slightly warmer at the southern edge of Rhode Island Sound.

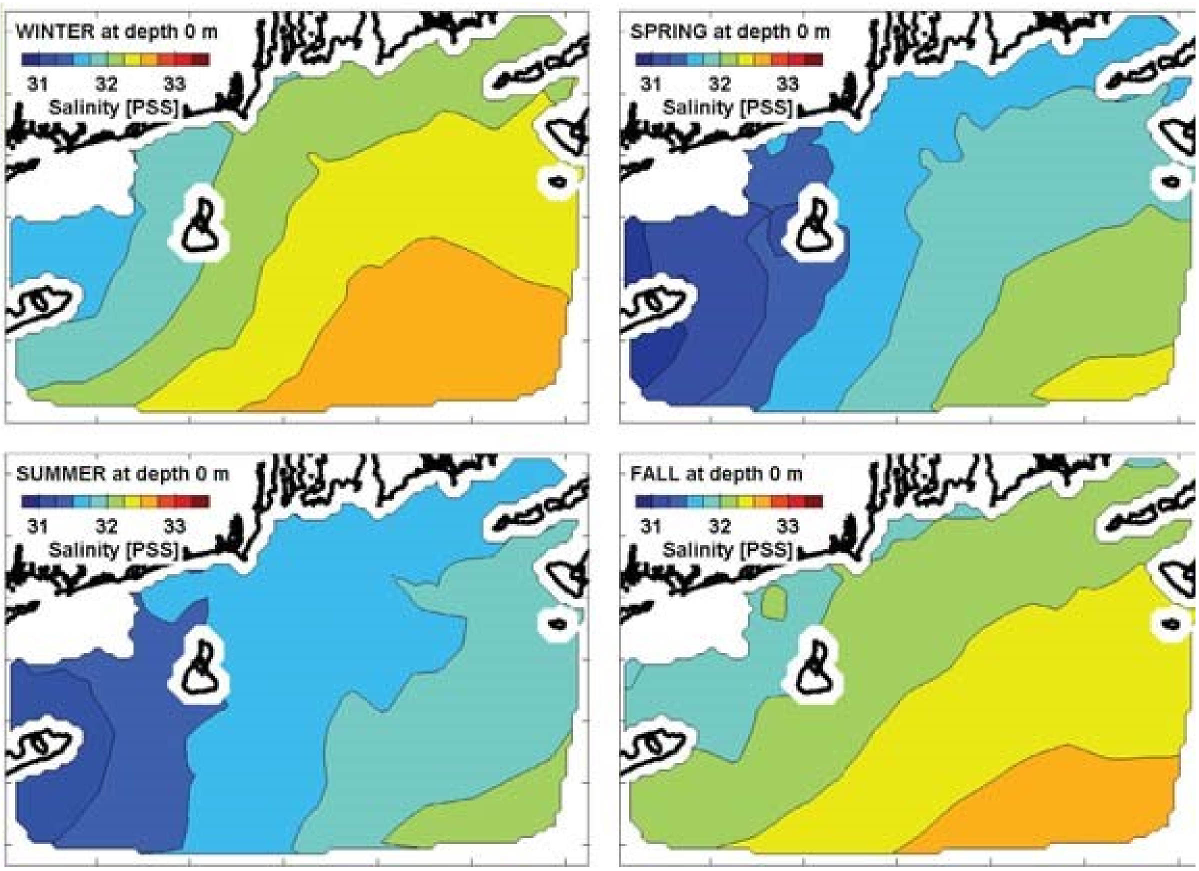
Figure 4.2.4-9 Seasonal I Water Temperature Based on Data Collected Between 1980 and 2007



Source: RICRMC, 2010

Surface water salinity decreases in the spring with freshwater inflows from ice melts and spring rains, and increases with temperature in the summer, with highest surface water salinities in the fall and winter. Bottom water salinities are higher than surface water salinities throughout the year, setting up for the stratification described above. Highest salinities within Rhode Island Sound (approximately 33 Practical Salinity Scale) are bottom waters at the southern end of the Sound, near the RWF. Seasonal water salinities at the sea surface in Rhode Island Sound are shown in Figure 4.2.4-10.

Figure 4.2.4-10 Seasonal Water Salinities at Sea Surface (Depth 0 m), Based on Archived Conductivity, Temperature, and Depth Data Collected Between 1980 and 2007

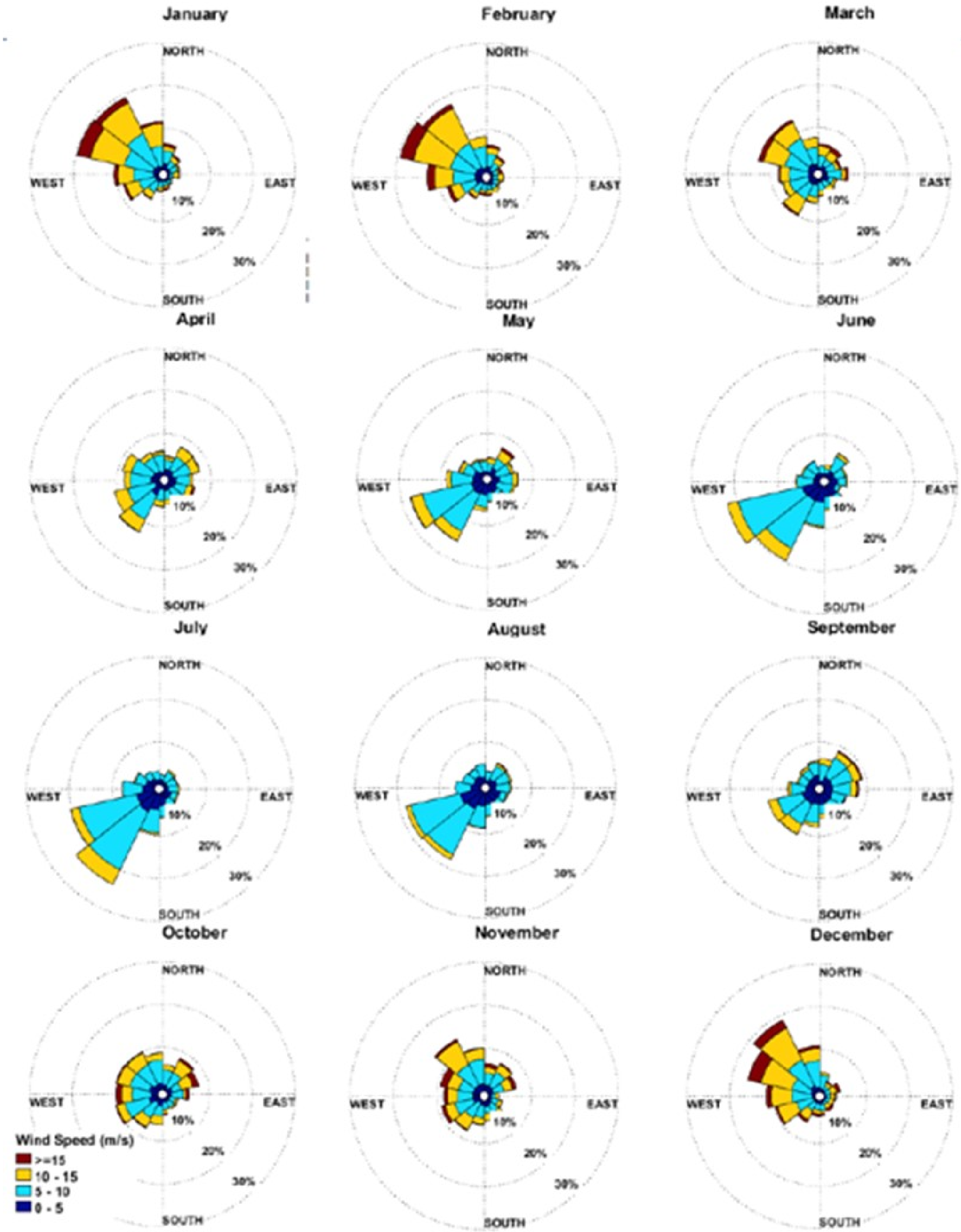


Source: RICRMC, 2010

Wind

Wind in the RWF area influence various physical attributes of the water column and ocean surface, and increased wind speeds that occur later in the summer help breakdown the water column stratification in Rhode Island Sound (RI CRMC, 2010). Wind data was obtained from the National Centers for Environmental Prediction CFSR product for 2001 through 2010 to provide a preliminary evaluation of wind direction and speed. Predominant wind direction is from the southwest during the summer months, and from the northwest during the winter when wind speeds are higher. Monthly wind direction and speed at a representative point within the Rhode Island Sound are depicted in Figure 4.2.4-11.

Figure 4.2.4-11 Monthly Wind Roses for the CFSR Grid Point Nearest to the RWF

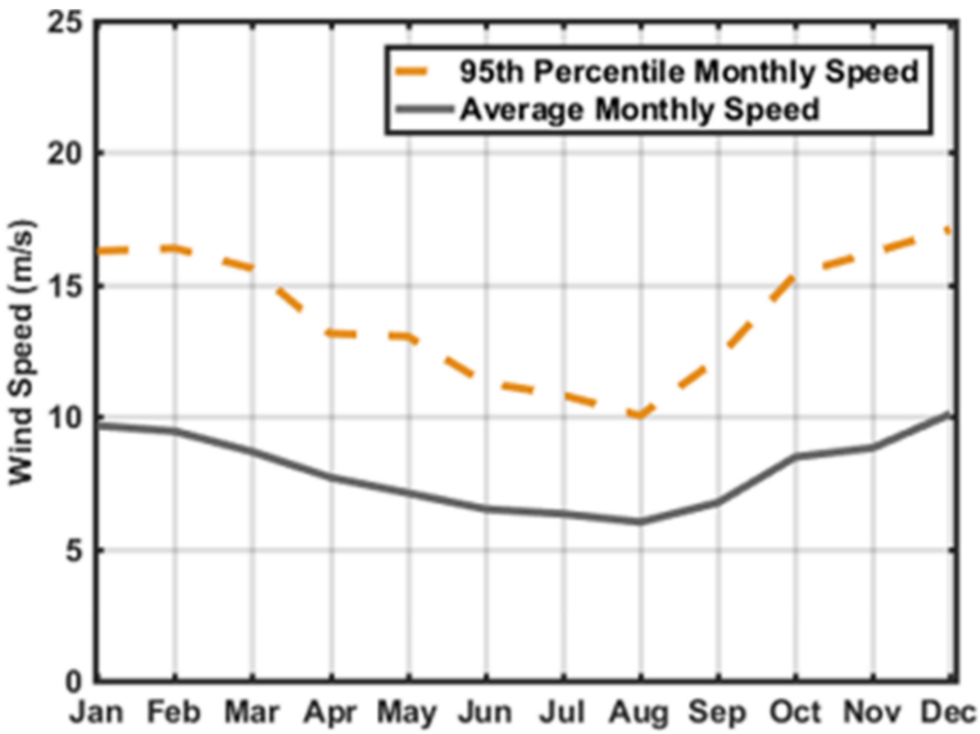


Note: Wind speeds are in m/s. using meteorological convention (i.e., direction from which wind is coming.

Source: Saha et al., 2010

Average monthly wind speeds and strongest winds (represented by the 95th percentile) are depicted on Figure 4.2.4-12 for the years 2001 through 2010. Average wind speeds are between 16 and 32 feet per second (ft/s) (5 and 10 meters per second [m/s]), with stronger wind in the winter. The occurrence of stronger winds from the northwest during winter is seen by the 95th percentile curve that reaches over 49 ft/s (15 m/s). According to wind measurements from meteorological measurement sites in Massachusetts and Rhode Island, the wind rose figures show the predominant winds for Block Island, Martha's Vineyard, and Nantucket during the years 2003 through 2012 are from the southwest through northerly directions and the average speeds are between 12.5 and 20.3 ft/s (3.8 and 6.2 m/s).

Figure 4.2.4-12 Monthly Wind Speed Statistics for the CFSR Grid Point Nearest to the RWF



Source: Halliwell, 2004; Chassignet et al. 2007

Regional data reports indicating the magnitude of wind events within the NOAA National Centers for Environmental Information Storm Events Database (NCEIFSD) provides a characterization of recently recorded wind events in the general vicinity of the RWF. Table 4.2.4-1 includes the high wind events for Barnstable and Nantucket Counties in Massachusetts from January 2017 through September 2019.

Table 4.2.4-1 Recorded High Winds for Barnstable and Nantucket, Massachusetts from January 2017 through September 2019

Date of Measurement	Location (County)	Magnitude (Knots)	Magnitude (m/s)	Measured (MG) or Estimated (EG)
1/23/2017	Barnstable, MA	51	26.24	MG
2/13/2017	Barnstable, MA	50	25.72	EG
3/2/2017	Barnstable, MA	50	25.72	MG
3/14/2017	Barnstable, MA	69	35.50	MG
3/14/2017	Nantucket, MA	51	26.24	MG
3/19/2017	Nantucket, MA	52	26.75	MG
4/1/2017	Barnstable, MA	54	27.78	MG
4/1/2017	Nantucket, MA	56	28.81	MG
10/25/2017	Barnstable, MA	50	25.72	MG
10/29/2017	Barnstable, MA	81	41.67	MG
10/30/2017	Nantucket, MA	61	31.38	MG
12/25/2017	Barnstable, MA	66	39.95	EG
12/25/2017	Nantucket, MA	57	29.21	MG
1/4/2018	Barnstable, MA	53	27.27	MG
1/4/2018	Nantucket, MA	57	29.21	EG
1/12/2018	Barnstable, MA	57	29.21	EG
1/30/2018	Barnstable, MA	36	18.52	MS
3/2/2018	Nantucket, MA	78	40.13	EG
3/2/2018	Barnstable, MA	84	43.21	EG
3/5/2018	Nantucket, MA	35	18.01	MS
3/13/2018	Nantucket, MA	67	34.47	EG
10/16/2018	Barnstable, MA	50	25.72	MG
10/27/2018	Nantucket, MA	54	27.28	MG
10/27/2018	Barnstable, MA	56	28.81	MG
11/3/2018	Barnstable, MA	51	26.24	MG
11/13/2018	Barnstable, MA	50	25.72	EG
11/16/2018	Nantucket, MA	54	27.28	MG

Date of Measurement	Location (County)	Magnitude (Knots)	Magnitude (m/s)	Measured (MG) or Estimated (EG)
11/16/2018	Barnstable, MA	56	28.81	MG
1/24/2019	Barnstable, MA	52	26.75	EG
1/30/2019	Barnstable, MA	54	27.28	MG
2/9/2019	Barnstable, MA	50	25.72	EG
2/25/2019	Barnstable, MA	55	28.29	EG

Source: NOAA National Centers for Environmental Information

Storms

Few hurricanes pass through New England, but the area is subjected to frequent Nor'easters that form offshore between Georgia and New Jersey, and typically reach maximum intensity in New England. These storms are usually characterized by winds from the northeast, and can bring heavy precipitation, wind, storm surges, and rough seas. They primarily occur between September and April but can form any time of the year. Although hurricanes are relatively infrequent in New England, wave heights up to 30 ft (9 m) were recorded south of Block Island (Scripps Buoy 44097) during Hurricane Sandy in 2012 (NOAA, 2012). However, although seafloor sediments are mobilized during storms, net sediment transport is low (Appendix O).

The NOAA NCEIFSD Database was researched for records of severe storm events, including blizzards, hurricanes, tornadoes, tropical depressions, tropical storms, tsunamis, and winter storms within Barnstable and Nantucket Counties, Massachusetts from January 2017 through December 2019. A total of nine events, five winter storms, two tropical storms, one blizzard, and one tornado were recorded.[2] See Table 4.2.4-2 for details.

2 NOAA definitions for storm events are as follows (taken from National Weather Service Instruction 10-1605, dated July 16, 2018 https://www.nws.noaa.gov/directives/sym/pd01016005curr.pdf):

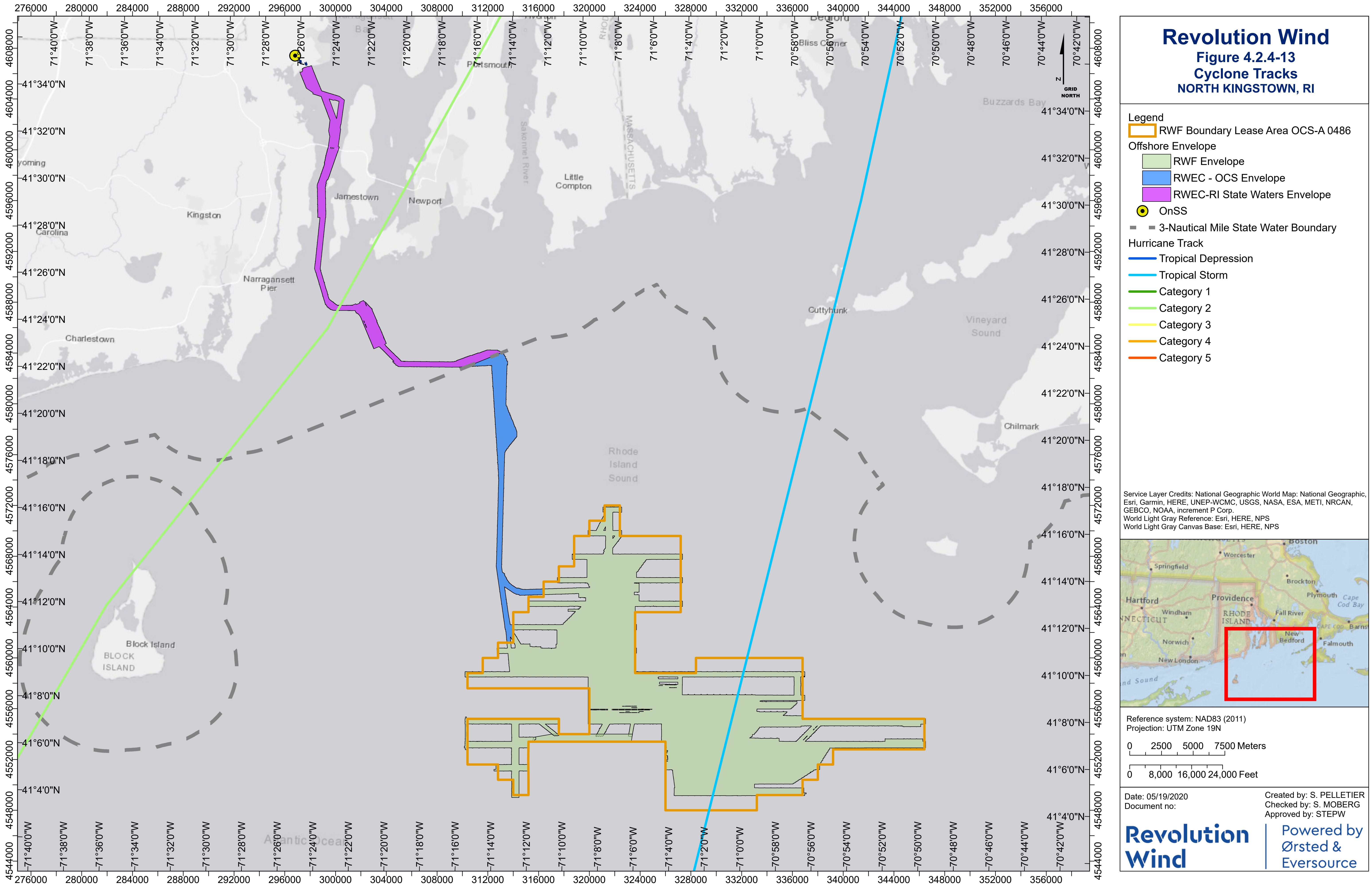
- Blizzard – a winter storm that produces sustained winds or frequent gusts of 30 knots (35 mph) or greater and falling or blowing snow reducing visibility frequently to less than ¼ mile for a minimum of three consecutive hours
- Tornado – a violently rotating column of air extending to or from a cumuliform cloud or underneath a cumuliform cloud to the ground and often, but not always, visible as a condensation funnel. It must be in contact with the ground and extend to/from the cloud base and there should be some semblance of ground-based visual effects such as dust/dirt/rotational markings/swirls, or structural or vegetative damage or disturbance.
- Tropical Storm – a tropical cyclone where the one-minute sustained surface wind ranges from 34 to 63 knots (39 to 73 mph)
- Winter Storm – a winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet, and ice) and meets or exceeds the locally/regionally defined 12 and/or 24-hour warning criteria for at least one of the precipitation elements.

Table 4.2.4-2 Recorded Storm Events for Barnstable and Nantucket Counties, Massachusetts from January 2017 to September 2019

Date of Measurement	Location (County)	Storm Type
1/7/2017	Nantucket, MA	Winter Storm
1/7/2017	Barnstable, MA	Winter Storm
2/9/2017	Barnstable, MA	Winter Storm
3/10/2017	Barnstable, MA	Winter Storm
3/10/2017	Nantucket, MA	Winter Storm
9/20/2017	Barnstable, MA	Tropical Storm
9/21/2017	Nantucket, MA	Tropical Storm
3/13/2018	Barnstable, MA	Blizzard
10/29/2018	Barnstable, MA	Tornado
7/23/2019	Barnstable, MA	Tornado
9/6/2019	Barnstable, MA	Tropical Storm

Cyclones

The International Best Track Archive for Climate Stewardship (IBTrACS) project contains the most complete global set of historical tropical cyclones available. It combines information from numerous tropical cyclone datasets, simplifying interagency comparisons by providing storm data from multiple sources in one place. As part of the IBTrACS project, the quality of storm inventories, positions, pressures, and wind speeds are checked and information about the quality of the data is passed on to the user. The version of the database that has been used is IBTrACS v03r09, which contains cyclone data from 1848 up to 2015 and was released in September 2016. Figure 4.2.4-13 illustrates the track of cyclones having passed within 5 degrees of the RWF between 1971 and 2015.



Revolution Wind
Figure 4.2.4-13
Cyclone Tracks
NORTH KINGSTOWN, RI
Legend
RWF Boundary Lease Area OCS-A 0486
Offshore Envelope
RWF Envelope
RWEC - OCS Envelope
RWEC-RI State Waters Envelope
OnSS
3-Nautical Mile State Water Boundary
Hurricane Track
Tropical Depression
Tropical Storm
Category 1
Category 2
Category 3
Category 4
Category 5
Service Layer Credits: National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World Light Gray Reference: Esri, HERE, NPS
World Light Gray Canvas Base: Esri, HERE, NPS
Reference system: NAD83 (2011)
Projection: UTM Zone 19N
0 2500 5000 7500 Meters
0 8,000 16,000 24,000 Feet
Date: 05/19/2020
Document no:
Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW
Revolution Wind
Powered by Ørsted & Eversource
Jamestown
Newport
Kingston
Narragansett Pier
Charlestown
Little Compton
Rhode Island Sound
Block Island
BLOCK ISLAND
Cuttyhunk
Vineyard Sound
Chilmark
Buzzards Bay
Portsmouth
Carolina

Ice and Fog

Given the cold air temperatures experienced during many New England winters, there is potential for icing of equipment and vessels above the water line in the RWF. To evaluate the potential for icing and fog conditions within the OSAMP, Merrill (2010) assessed data from two locations: Buzzard's Bay Tower (west of the Elizabeth Islands) and Martha's Vineyard Coastal Observatory (1.9 mi [3 km] offshore). Results of the data analysis indicate the highest potential for fog development during the summer, with 10 potential days in June compared to one to four potential days during each of the winter months. Days with potential for icing conditions were limited to November through March, with the highest number of days (9) in January.

Revolution Wind Export Cable–OCS

This section summarizes the affected environment relative to physical oceanography and meteorology for the RWEC-OCS, which includes an up to 25-mi (40-km)-long corridor extending from the northwestern side of the Lease Area in a general north/northwest direction through the Rhode Island Sound until it enters Rhode Island State Waters (Section 1.1 and Figure 1.1-1). The same parameters described above for the RWF are discussed below.

Circulation

The circulation for the RWEC–OCS is generally the same as was discussed in the OSAMP for RWF. However, the morphology is slightly different, consisting of sand accumulation areas, ripples, megaripples, irregular seafloor, bedrock, and featureless areas (e.g., seafloor without bedforms or large-scale structures (Fugro, 2020); see Figure 4.2.3-2.

Water Column Stratification

The water column stratification for the RWEC–OCS is the same as was discussed in the OSAMP for RWF.

Wind

The RWEC–OCS will be located either beneath or laying on the seafloor. As such, wind is not considered part of the affected environment for this portion of the Project.

Storms

The RWEC–OCS will be located either beneath or laying on the seafloor. As such, storms are not considered part of the affected environment for this portion of the Project.

Cyclones

The RWEC–OCS will be located either beneath or laying on the seafloor. As such, cyclones are not considered part of the affected environment for this portion of the Project.

Ice and Fog

The RWEC–OCS will be located with beneath or laying on the seafloor. As such, ice and fog are not considered part of the affected environment for this portion of the Project.

Revolution Wind Export Cable–RI

This section summarizes the affected environment relative to physical oceanography and meteorology for the RWEC–RI, which includes an up to 23-mi (37-km)-long corridor extending from the 3-mile state water boundary in Rhode Island Sound north through the West Passage of Narraganset Bay to the landfall location at Quonset Point in North Kingstown, Rhode Island (Section 1.1 and Figure 1.1-1). The same parameters described above for the RWF and RWEC-OCS are discussed below.

Circulation

The portion of the RWEC–RI affected environment that is within open ocean is the same as already presented and described for the RWF and RWEC-OCS; however, within Narraganset Bay, circulation is also affected by tidal mixing and freshwater inputs (e.g., streams) (Raposa and Schwartz [eds.], 2009). Tidal mixing associated with currents can reach up to 77 cm/s and nontidal currents are approximately 10 cm/s (Raposa and Schwartz [eds.], 2009).

Seafloor morphology within the RWEC-RI also differs, with the main morphologic feature being the Brenton Reef, where outcrops and steep to very steep slopes are located (Fugro, 2020). Other morphologic features include of sand accumulation areas, ripples, megaripples, irregular seafloor, bedrock, anthropogenic (i.e., debris fields), sand bars, channel, dredged area, depression, and featureless areas (e.g., seafloor without bedforms or large-scale structures).

Within the RWEC-RI, water depth varies between approximately -6.5 ft (-2 m) near shore to -131.2 ft (-40 m) relative to MLLW (Fugro, 2020). See Figure 4.2.3-7 for bathymetry within the REWC-RI (Fugro, 2020).

Water Column Stratification

The portion of the RWEC–RI affected environment that is within open ocean is the same as already presented and described for the RWF and RWEC-OCS.

The portion of the Narraganset Bay where the RWEC is routed is considered a well-mixed estuary (Raposa and Schwartz [eds], 2009), with little to no thermal stratification. Thermal stratification is more evident in the upper reaches of the bay which are influenced by rivers and/or shallow water depths.

Wind

The RWEC–RI will be located either beneath or laying on the seafloor. As such, wind is not considered part of the affected environment for this portion of the Project.

Storms

The RWEC–RI will be located either beneath or laying on the seafloor. As such, storms are not considered part of the affected environment for this portion of the Project.

Cyclones

As noted previously, the RWEC–RI will be located either beneath or laying on the seafloor within open ocean and beneath the bay floor within Narragansett Bay and will not be susceptible to cyclone related concerns.

Ice and Fog

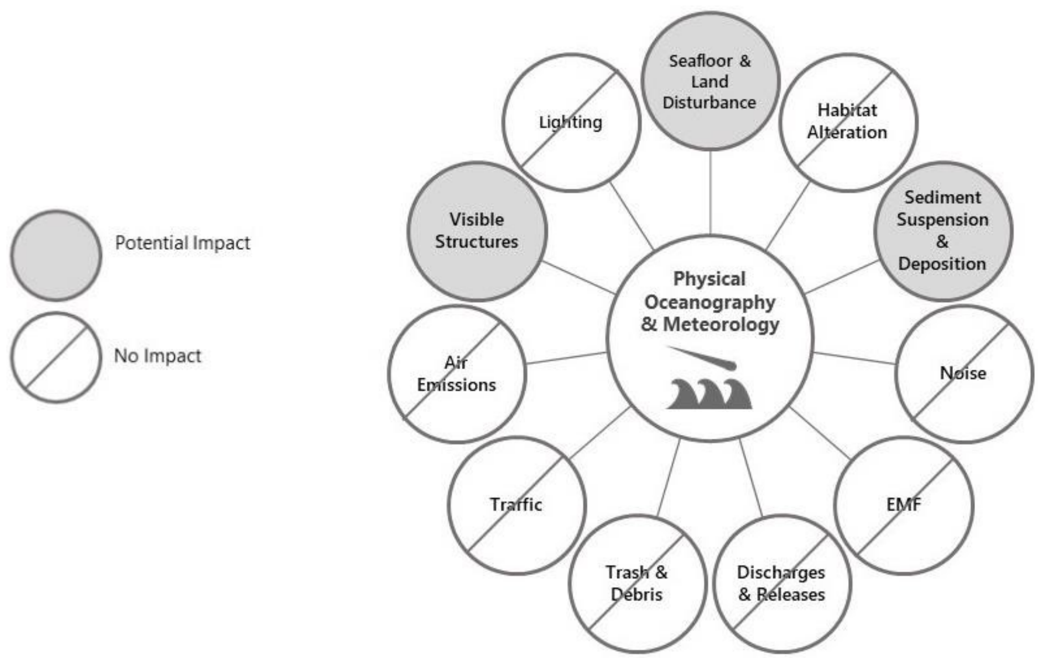
The RWEC–RI will be located either beneath or laying on the seafloor within open ocean and beneath the bay floor within Narragansett Bay. As such, ice and fog are not considered part of the affected environment for this portion of the Project.

4.2.4.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact physical oceanography and meteorology. Construction, operation, and decommissioning of the RWF, RWEC–OCS, and RWEC–RI will affect water and wind currents as well as seafloor topography that, on a small scale, impact oceanographic and meteorological conditions but not to such a degree that would result in altering these conditions or processes. The RWF and RWEC will be designed to address risks that the identified oceanographic and meteorological factors pose. The design will be reviewed by BOEM during the FDR in accordance with 30 CFR 585.700-702.

IPFs that may result in direct impacts to physical oceanography and meteorology are depicted in Figure 4.2.4-14; there are no indirect impacts. Impacts are characterized as direct or indirect and short-term or long-term as defined in Section 4.0.

Figure 4.2.4-14 Impact-Producing Factors on Physical Oceanography and Meteorology Impact-



Revolution Wind Farm

Based on the IPFs discussed in Table 4.2.4-4, construction and decommissioning of the RWF is expected to result in ***direct*** and ***short-term*** impacts from seafloor disturbance and sediment suspension and deposition to physical oceanography resources. No impacts are expected to physical oceanography resources from visible structures during construction or decommissioning. In addition, no impacts to meteorological resources are expected during construction and decommissioning of RWF. As discussed in Table 4.2.4-5, O&M of the RWF is expected to result in ***direct*** and ***short-term*** impacts to physical oceanography resources from seafloor disturbance and sediment suspension and deposition. O&M of the RWF is also expected to result in ***direct*** and ***long-term*** impacts from visible structures to meteorological resources.

Construction and Decommissioning

IPFs resulting in potential impacts to physical oceanography in the RWF area from construction and decommissioning are summarized in Table 4.2.4-4 below. Additional details regarding these potential impacts from the various IPFs during construction and decommissioning of the RWF are described in the following sections. Visible structures are not discussed within this section because there are no anticipated impacts to physical oceanography or meteorology during construction or decommissioning Project activities.

Table 4.2.4--4 Summary of Revolution Wind Farm Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation	Direct, Short-term
	Vessel and Heavy Equipment Use	Direct, Short-term
	Foundation Installation/Placement of Scour Protection/Vessel Anchoring (WTG/OSS)	Direct, Short-term
	Cable Installation/Placement of Cable Protection/Vessel Anchoring (IAC/OSS-Link Cable	Direct, Short-term
Sediment Suspension and Deposition	Seafloor Preparation	Direct, Short-term
	Vessel and Heavy Equipment Use	Direct, Short-term
	Foundation Installation/Placement of Scour Protection/Vessel Anchoring (WTG/OSS)	Direct, Short-term
	Cable Installation/Placement of Cable Protection/Vessel Anchoring (IAC/OSS-Link Cable	Direct, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

Seafloor disturbance and sediment suspension and deposition are discussed together because they are interrelated (i.e., seafloor disturbance results in sediment suspension and deposition). Disturbance will result from seafloor preparation activities including sandwave leveling and the clearance of boulders, debris, and other obstructions; vessel anchoring; installation of foundations, IACs, and OSS-Link Cable; and placement of scour and cable protection. Jack-up vessel(s) with four spud cans will be used during installation of the WTGs, OSSs, and foundations. Similar activities will occur during the decommissioning phase; however, Project components will be removed rather than installed. The seafloor preparation activities, vessel anchoring for pile driving, foundation installation, and scour protection will temporarily disturb the seafloor and suspend sediment and are expected to result in ***direct*** and ***short-term*** impacts to physical oceanography resources. Refer to Table 4.1-1 in Section 4.1.1.1 for details regarding temporary and permanent impacts for foundation installations and vessel anchoring.

RWF also includes installation of the export cable that connects to the OSS, IACs, and OSS-Link Cable. Installation of these cables is considered to have a greater risk of suspending sediments in comparison with pile driving. Depending on the substrate, installation of the offshore cables may involve use of jet-plows, mechanical plows, mechanical cutters, CFE and/or trailing suction hopper dredger within the seafloor to allow for installation of the IACs and OSS-Link Cable. Refer to Section 3.3.2 for a discussion regarding the different methodologies for installing the cables and Sections 3.3.6 and 3.3.7 for details regarding construction of the OSS-Link Cable and IACs, respectively. This trenching will temporarily disturb the seafloor, which will increase sediment suspension and deposition during construction. In general, the disturbance area will naturally resettle within the trench and/or be backfilled depending on the method; therefore, no permanent impact is assumed where the cables are completely installed beneath the seafloor and the trench is backfilled. Cable protection will be placed on the seabed near the OSS foundations where the OSS-Link Cable leaves the trench; cable protection will also be placed in areas where burial cannot occur, sufficient burial depth cannot be achieved to avoid risk of interaction with external hazards, or where cables cross other cables or pipelines, as determined necessary by a Project-specific Cable Burial Risk Assessment. The cable installation and cable protection are expected to result in ***direct*** and ***short-term*** impacts to physical oceanography resources. Please refer to Section 4.1.1.1 and Table 4.1-1 for additional details.

As discussed above, RPS completed a modeling simulation for sediment suspension and deposition associated with construction and decommissioning of the IACs. The simulation predicted that the suspended sediment (i.e., plume) would stay within the bottom few meters of the water column and the maximum amount of time a plume of greater than 100 mg/L would stay suspended would be 2.7 hours. In addition, sediment deposition greater than 1 mm was predicted to extend up to 853 ft (260 m) from the IAC centerline but typically extended shorter distances in the simulation. Based on these results, the seafloor disturbance and sediment suspension and deposition are expected to result in ***direct*** and ***short-term*** impacts to circulation and currents. No impacts are anticipated to water column stratification or meteorological conditions. For more details regarding the simulation please refer to Appendix J.

Operations and Maintenance

IPFs resulting in potential impacts to physical oceanography and meteorology in the RWF area from the O&M phase are summarized in Table 4.2.4-5. Additional details regarding potential impacts from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.2.4-5 Summary of Revolution Wind Farm O&M Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	WTG/OSS Operation, Including Foundations	Direct, Long-term,
	IAC, OSS-Link Cable, and Cable Protection	Direct, Long-term
Sediment Suspension and Deposition	WTG/OSS Operation, Including Foundations	Direct, Short-term
	IAC, OSS-Link Cable, and Cable Protection	Direct, Short-term
Visible Structures	WTG/OSS Operation, Including Foundations	Direct, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

During the operational phase of the RWF, foundations and cable protection for some portions of the IAC and OSS-Link Cable will result in relatively small and isolated changes to bottom current patterns, sediment scour, suspension, and transport. These changes are expected to result in ***direct*** and ***long-term*** impacts to physical oceanographic resources. However, the impacts would be minimal because of the relatively wide spacing of foundations (i.e., approx. 1.15 mi by 1.15 mi [1 nm by 1 nm]) and generally small footprint of these features relative to the oceanic current systems. For sediment suspension and deposition, O&M activities are expected to result in ***direct*** and ***short-term*** impacts to physical oceanography resources.

Visible Structures

The WTGs have the potential to create turbulence in the immediate vicinity of the tower, nacelle, and the blades. The impacts to air flow are expected to result in ***direct*** and ***long-term*** impacts to meteorological conditions. No impacts to physical oceanography are expected from the visible structures.

Revolution Wind Export Cable–OCS

Based on the IPFs discussed in Table 4.2.4-6, construction and decommissioning of the RWEC-OCS are expected to result in both ***direct*** and ***short-term*** and ***direct*** and ***long-term*** impacts to physical oceanography resources from seafloor disturbance and sediment suspension and deposition. No impacts to meteorological resources are expected during construction, O&M, or decommissioning of RWEC-OCS. As discussed in Table 4.2.4-7, O&M of the RWEC-OCS, is expected to result in ***direct*** and ***short-term*** impacts from seafloor disturbance and sediment suspension and deposition to physical oceanography resources.

Construction and Decommissioning

IPFs resulting in potential impacts to physical oceanography and meteorology in the RWEC from the construction and decommissioning phases are summarized in Table 4.2.4-6. The impacts discussed in this section apply to both the RWEC–OCS and RWEC–RI, though the impacts could vary slightly between the nearshore and offshore portions of the RWEC route. In addition, impacts associated with HDD activities only apply to the RWEC–RI portion of the cable. Additional details regarding potential impacts on physical oceanography and meteorology from the various IPFs during construction/decommissioning are described in the following sections.

Table 4.2.4-6 Summary of RWEC-OCS and RWEC–RI Construction and Decommissioning Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation	Direct, Short-term
	Vessel Use	Direct, Short-term/Long-term
	Cable Installation/Placement of Cable Protection	Direct, Long-term
	Cable/TJB Installation via HDD	Direct, Short-term
Sediment Suspension and Deposition	Seafloor Preparation	Direct, Short-term
	Vessel Use	Direct, Short-term
	Cable Installation/Placement of Cable Protection	Direct, Short-term
	Cable/TJB Installation via HDD	Direct, Short-term

Seafloor Disturbance/Sediment Suspension and Deposition

The installation of the RWEC–OCS will disturb the seafloor and suspend and deposit sediment during construction. As discussed above, RPS completed a modeling simulation for sediment suspension and deposition associated with construction and decommissioning of the RWEC-OCS for two circuits. The simulation predicted that the suspended sediment (i.e., plume) would stay within the bottom few meters of the water column and the maximum amount of time a plume of greater than 100 mg/L would stay suspended would be three hours, which is a total of six hours for both circuits (three hours per circuit). However, most locations would have concentrations of 100 mg/L for less than three hours. In addition, sediment deposition greater than 1 mm was predicted to extend up to 951 ft (290 m) from the route centerline but typically extended shorter distances in the simulation. Based on these results, installation of the RWEC–OCS is expected to result in ***direct*** and ***short-term*** impacts to circulation and currents; no impacts are anticipated to water column stratification or meteorological conditions. However, due to the amount of sediment suspension and deposition, the impacts are expected to be minimal. For more details regarding the simulation please refer to Appendix J.

Operations and Maintenance

IPFs resulting in potential impacts to physical oceanography and meteorology in the RWEC from the O&M phase are summarized in Table 4.2.4-7. The impacts discussed in this section apply to both the RWEC–OCS and RWEC–RI. Additional details regarding potential impacts on physical oceanography and meteorology from the various IPFs during O&M are described in the following sections.

Table 4.2.4-7 Summary of RWEC - OCS and RWEC - RI O&M Impacts

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	RWEC Operation	Direct, Short-term
Sediment Suspension and Deposition	RWEC Operation	Direct, Long-term

Seafloor Disturbance

Disturbance to physical oceanographic conditions is not expected during routine operations because there is no routine maintenance of the RWEC–OCS that would require work on the seafloor. Therefore, routine operations of the RWEC-OCS are not expected to impact physical oceanographic conditions. However, should there be a need for major maintenance of the RWEC–OCS that requires seafloor disturbance to access buried cable, impacts would be similar to those described above for the construction phase and are therefore expected to result in ***direct*** and ***short-term*** impacts.

Sediment Suspension and Deposition

Except in some areas of the RWEC-OCS that require cable protection, the physical presence of the RWEC-OCS would have no impacts to currents because the cables will be buried beneath the seabed. In the areas that require cable protection, there is the potential for sediment to accumulate, which could have the potential to affect currents. However, because of the small acreage associated with this cable protection relative to the greater oceanic current systems in the region, the potential for RWEC–OCS O&M impact is expected to be minimal and would result in ***direct*** and ***long-term*** impacts. There are no anticipated impacts to meteorological conditions.

Revolution Wind Export Cable–RI

Construction and Decommissioning

Please refer to Table 4.2-40 for the IPF summary table for RWEC-RI. Additional details regarding potential impacts on physical oceanography and meteorology from the various IPFs during construction and decommissioning are described in the following sections.

Seafloor Disturbance/Sediment Suspension and Deposition

The installation of the RWEC–RI will disturb the seafloor and suspend and deposit sediment during construction. As discussed above, RPS completed a modeling simulation for sediment suspension and deposition associated with construction and decommissioning of the RWEC-RI for two circuits. The simulation predicted that the suspended sediment (i.e., plume) would stay within the bottom few meters of the water column and the maximum amount of time a plume of greater than 100 mg/L would stay suspended was 9.7 hours, which is a total of 19.4 hours for both cables; however, most locations would have concentrations of 100 mg/L for less time. Most locations south of Narragansett Bay would experience plumes for less than 3 hours per circuit and inside Narragansett Bay, it would be less than 5 hours. In addition, sediment deposition greater than 1 mm was predicted to extend up to 3,609 ft (1,100 m) from the route centerline but typically extended shorter distances. Based on these results, installation of the RWEC-RI is expected to result in ***direct*** and ***short-term*** impacts to circulation and currents; no impacts are anticipated to water column stratification or meteorological conditions. For more details regarding the simulation please refer to and Appendix J.

Operations and Maintenance

Please refer to Table 4.2.4-7 for the IPF summary table for RWEC-RI. Additional details regarding potential impacts on physical oceanography or meteorology from the various IPFs during O&M are described in the following sections.

Seafloor Disturbance/Sediment Suspension and Deposition

The impacts to seafloor disturbance and sediment suspension and deposition during the O&M of the RWEC–RI are the same as described above for the RWEC–OCS and are therefore expected to result in ***direct*** and ***short-term*** impacts.

4.2.4.3 Proposed Environmental Protection Measures

Revolution Wind has designed the Project to account for site-specific oceanographic and meteorological conditions within the Project Area, and environmental protection measures are not proposed.

4.3 Biological Resources

4.3.1 Coastal and Terrestrial Habitat

This section provides an overview of the coastal and terrestrial habitats within and adjacent to the limits of the proposed Onshore Facilities; the RWF, RWEC-OCS, and RWEC-RI are not discussed in this section given their location offshore. As described in Sections 1 and 3 of the COP, the Onshore Facilities include:

- the Landfall Work Area,
- the Onshore Transmission Cable,
- the OnSS (Plat 179 Lots 001 and 030; OnSS Parcels),
- the ICF on the existing TNEC Davisville Substation parcel (Plat 179 Lot 005), and
- up to two Interconnection Cable Routes (underground Interconnection ROW connecting the OnSS with the ICF, and the overhead TNEC ROW connecting the ICF to the TNEC Davisville Substation).

The Onshore Facilities are located at Quonset Point in North Kingstown, Rhode Island (Figure 4.3.1-1). For the purposes of this COP Section, the Project Area discussed herein includes the components of the Onshore Facilities and the areas immediately adjacent that have the potential to be affected by the Project (refer to Table 4.0-1 in Section 4.0 for Project Area definitions).

Potential IPFs on the coastal and terrestrial habitats from the construction, O&M, and decommissioning of the Onshore Facilities have been assessed and proposed environmental protection measures are addressed at the end of this section. A detailed account of the coastal and terrestrial habitats and the associated biological resources, such as wildlife and rare, threatened, and endangered species (RTE) are addressed within the Onshore Natural Resources and Biological Assessment (Appendix K). Coastal and terrestrial habitat are addressed in Section 4.3.1, and other habitats, including benthic and shellfish habitats and finfish and essential fish habitat (EFH), are discussed separately in Sections 4.3.2 and 4.3.3, respectively. Sections 4.3.4, 4.3.5, 4.3.6 and 4.3.7 provide an assessment of potential Project impacts on marine mammals, sea turtles, bird, and bat species supported by the coastal and terrestrial habitats. Other habitats, such as benthic and shellfish habitats and finfish and essential fish habitat (EFH), are discussed separately in Sections 4.3.2 and 4.3.3, respectively.

The following primary sources were used to describe the baseline conditions of the coastal and terrestrial habitats, to assess the IPFs on these resources during the different phases of the Onshore Facilities, and to understand the regulatory requirements regarding impacts to these resources.

- RIDEM Environmental Resource Map (RIDEM, 2020) was used to assess different spatial overlays within the limits of the Onshore Facilities, including wetlands and hydric soils, floodplain mapping, and aerial photos.
- 2015 Rhode Island Wildlife Action Plan (RI WAP) (RIDEM et al., 2015) was used to classify the Key Habitat types within the limits of the proposed Onshore Facilities;
- Rhode Island Conservation Opportunity Area (COA) Mapper hosted by RIDEM and produced as an accompaniment to the RI WAP (RIDEM et al. 2020);
- RI CRMC Coastal Resources Management Plan (CRMP; 650-RICR-20-00-1, effective date June 17, 2019);
- RI CRMC Water Use Classification Maps for North Kingstown (RI CRMC, 2010). These maps indicate the water use classification (Type 1 through Type 6) assigned by CRMC to tidal waters or coastal ponds according to the characteristics of the adjacent shoreline, water use, and density of use. CRMC has developed policies specific to each water use classification that regulate the types of projects that may be undertaken within tidal waters or coastal ponds and the adjoining shoreline.
- RI CRMC Rules and Regulations Governing the Protection and Management of Freshwater Wetlands in the Vicinity of the Coast (Freshwater Wetland Rules; 650-RICR-20-00-2, effective date December 12, 2018);
- USFWS Refuge mapping, RIDEM Environmental Resource Map, and Marine Cadastre National Viewer for review of refuges/preserves for marine or estuarine resources;
- An Ecological Profile of the Narragansett Bay National Estuarine Research Reserve (NBNERR), Chapter 8: Estuarine Habitats of Narragansett Bay (Narragansett Bay National Estuarine Reserve, 2009);
- Project-specific field investigations of onshore biological resources to aid in the characterization of the affected environment for coastal and terrestrial habitats conducted by VHB between July 2019 and July 2020. The field surveys included classification of observed habitats, delineations of freshwater and tidal wetlands, identification of plant and wildlife species, observations of RTE species, and documentation of invasive species occurrences within and adjacent to the limits of the proposed Onshore Facilities.
- Site Evaluation Report (SER) of the TNEC Davisville Substation parcel (Plat 179 Lot 005), prepared by LEC Environmental Consultants, Inc. (LEC) dated December 18, 2019 provided by TNEC. This report provides an overview of the habitat conditions and wetland resources within the TNEC Davisville Substation parcel

and is included as an attachment to the Onshore Natural Resources and Biological Assessment (Appendix K).

- Follow-up SER of the TNEC Davisville Substation parcel, prepared by LEC, dated August 6, 2020. This follow-up investigation reviewed the isolated Freshwater Wetland 5, verified the presence of ASSF, and verified that further evaluate the potential presence of RTE species within the parcel.

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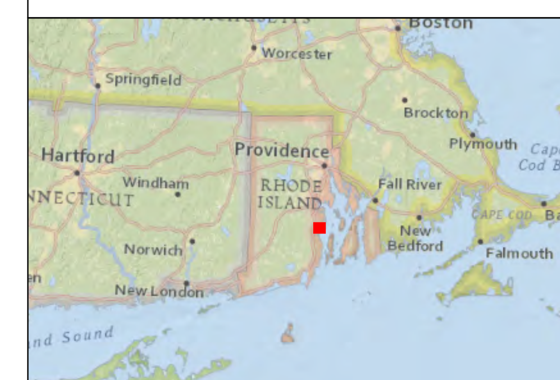
Figure 4.3.1-1
Onshore Facilities Overview
NORTH KINGSTOWN, RI

Legend
- Onshore Transmission Cable
- Landfall Envelope
- RWEC-RI State Waters
- Substation Limit of Work
- ICF Limit of Work
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

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Date: 05/19/2020
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4.3.1.1 Affected Environment

Regional Overview

The Onshore Facilities border on the West Passage of the Narragansett Bay, Rhode Island. Many different habitat types are found in and around the Bay, including open water, salt marshes, subtidal bottom habitat, brackish waters, a complex intertidal zone of sandy beaches, mud and sand flats, and rocky intertidal areas, submerged aquatic vegetation with macroalgal and eelgrass beds, and human-modified shorelines (NBNERR, 2009). The diverse habitats supported by the Bay foster an abundance and diversity of wildlife such as shorebirds, fish, and shellfish. A discussion of the coastal and terrestrial habitat types and biological resources specific to the Onshore Facilities is provided below.

Onshore Facilities

The following section describes the occurrence of Key Habitat types within the three main components of the Onshore Facilities: 1) Landfall Work Area, 2) Onshore Transmission Cable Route and 3) the OnSS and ICF parcels.

Landfall Work Area/Landfall Envelope

The exact location of the Landfall Work Area has not yet been finalized; thus, Key Habitat types are considered across a broader Landfall Envelope. Figure 4.3.1-1 depicts the Landfall Envelope, and Table 4.3.1-1 below provides an overview of the coastal and terrestrial habitat types included within the Landfall Envelope. Full descriptions of each Key Habitat type are provided in Appendix K.

Table 4.3.1-1 Key Habitat Types Present Within the Landfall Envelope

Key Habitat Type	Description	Corresponding Figures
Manmade Shoreline	The shoreline along the Landfall Envelope includes riprap revetment within the western reaches of the Landfall Envelope and a concrete seawall within the eastern reaches of the Landfall Envelope. These hard structures are classified as “manmade shoreline” by RI CRMC. Tidal waters adjoining this area are regulated as Type 6 “Industrial Waters” as regulated by the RI CRMC.	4.3.1-2: Habitat Cover Types 4.3.1-3: Wetland Resources 4.3.1-4: View of Manmade Shoreline
Ruderal Grassland/Shrubland	The area landward of the manmade shoreline is characterized as ruderal grassland/shrubland. Ruderal grasslands and shrublands constitute early successional habitats, defined by Anderson, et. al. (1976) as uplands where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs. Such habitats are typically anthropogenically created or maintained due to management strategies.	4.3.1-2: Habitat Cover Types 4.3.1-5: View of Ruderal Grassland/Shrubland Habitat inland of seawall

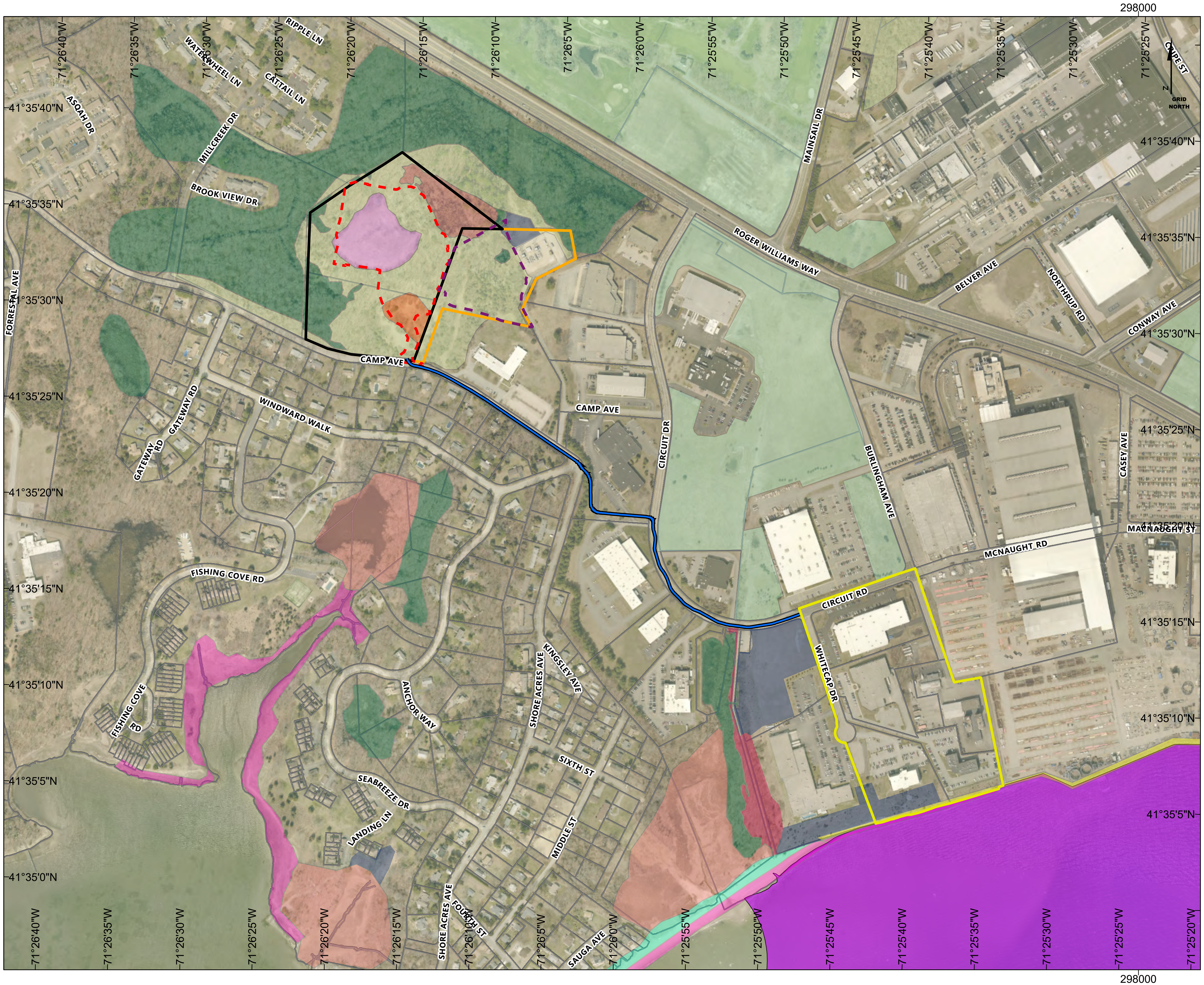

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Figure 4.3.1-2

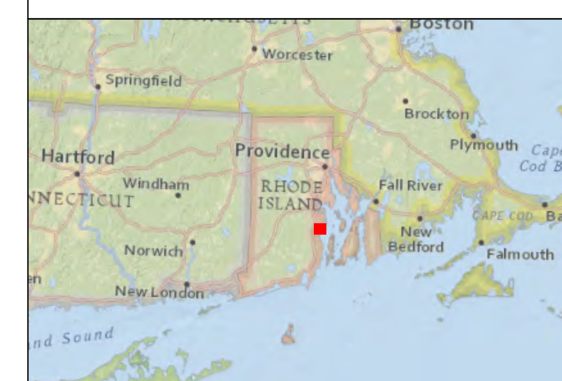
Habitat Cover Type

NORTH KINGSTOWN, RI

Legend

- Onshore Transmission Cable
- Landfall Envelope
- RWEC-RI State Waters Envelope
- Substation Limit of Work
- ICF Limit of Work
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Parcel Boundary
- Ruderal Mixed Oak/White Pine Forest
- Ruderal Oak Forest
- Ruderal Forested Swamp
- Ruderal Shrub Marsh
- Ruderal Grassland/Shrub Land
- Landfill
- Ruderal Pitch Pine Barren
- Coastal Beach
- Coastal Dune
- Tidal Salt Marsh
- Manmade Shoreline
- Managed Lawn

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



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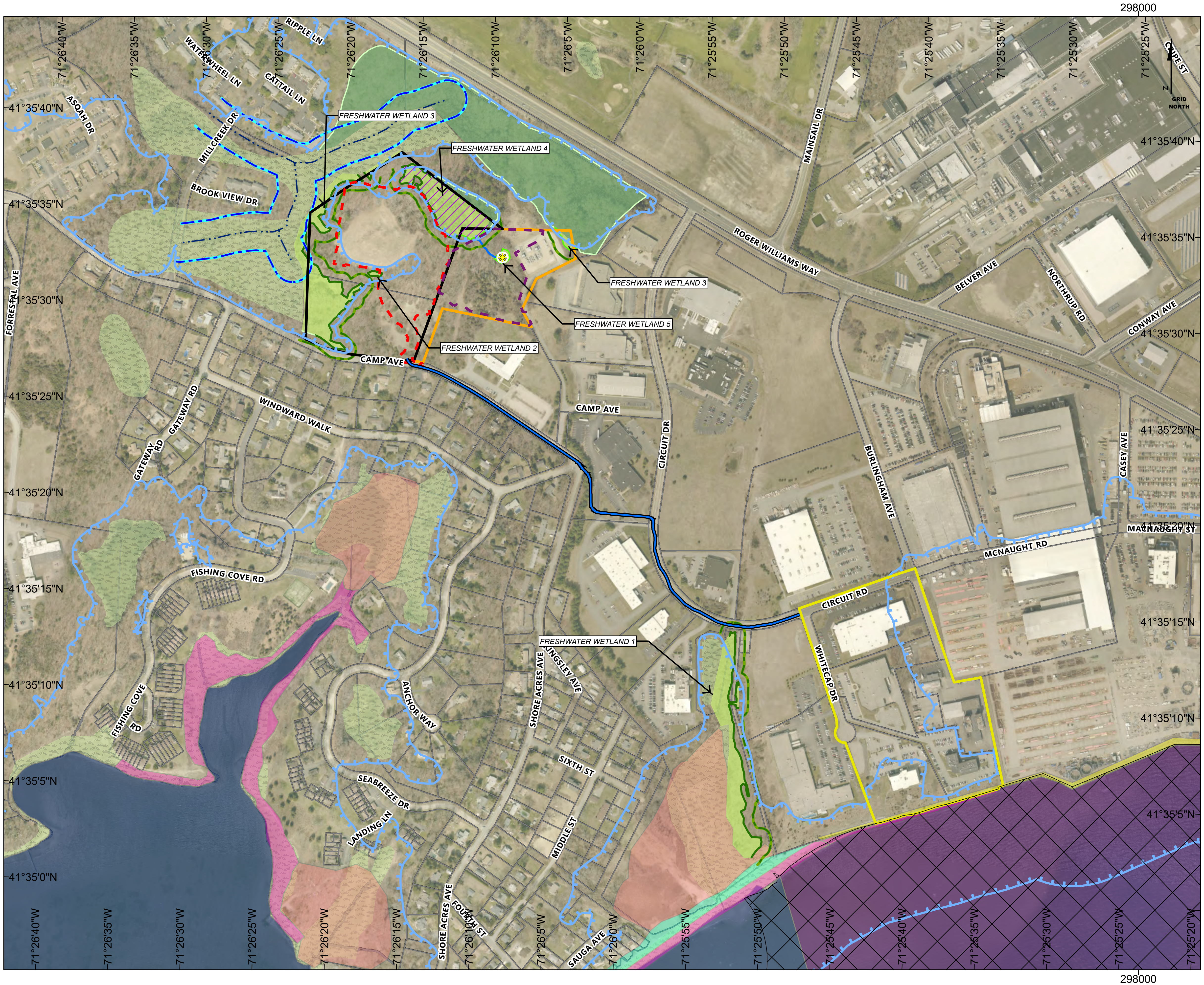

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Figure 4.3.1-4

Wetland Resources

NORTH KINGSTOWN, RI

Legend

- Onshore Transmission Cable
- Substation Limit of Work
- ICF Limit of Work
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Landfall Envelope
- RWEC-RI State Waters Envelope
- Parcel Boundary
- One-Percent Annual Chance Flood Hazard Area
- Potential Vernal Pool
- Area of Land within 50' of Wetland
- 100' Riverbank Wetland
- LEC Delineated ASSF
- Approximate Stream
- VHB Delineated Wetland Edge
- LEC Delineated Wetland Edge
- Approximate Wetland Edge
- Delineated Wetland Resources
- Interpolated Wetland
- Coastal Beach
- Coastal Dune
- Manmade Shoreline
- Tidal Salt Marsh
- Coastal Bank
- Wetland (NWI)
- Vernal Pool Area

CRMC Water Use Types

- Type 2: Low Intensity Use
- Type 6: Industrial Waterfronts and Commercial Navigation Channels

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):

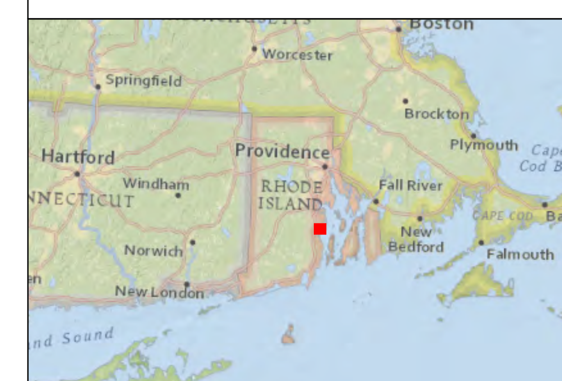

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Figure 4.3.1-4 View of manmade shoreline within Landfall Envelope. This concrete seawall is present south of 50 Whitecap Drive.

Figure 4.3.1-5 View of Ruderal Grassland/Shrubland Landward of Seawall. This vegetation does not appear to be maintained.

Onshore Transmission Cable Routes

The Onshore Transmission Cable route will be up to 1 mi (1.6 km) in length. Generally, the disturbance corridor associated with the potential cable routes will be limited to established road ROWs and parking lots. The habitat types adjacent to the Onshore Transmission Cable Routes are described below in Table 4.3.1-2. Full descriptions of each Key Habitat type are provided in Appendix K.

Table 4.3.1-2 Key Habitat Types Present Within the Onshore Transmission Cable Route

Key Habitat Type	Description	Corresponding Figures
Ruderal Grassland/Shrubland	Ruderal grassland shrubland is present immediately inland of the manmade shoreline sea wall which does not appear to be managed. The Onshore Transmission Cable route follows Burlingham Avenue before turning west onto Circuit Drive. From this point it passes developed Plat 185 Lot 023 passes and then vacant lot Plat 179 Lot 025 that is east of the Blue Beach parking area and south of Circuit Drive. This vacant lot does not appear to be managed regularly and supports a dry ruderal grassland/shrubland field that gently slopes downward towards the Blue Beach walking path. This habitat type also supports sporadic occurrences of butterfly milkweed (*Asclepias tuberosa*), a state species of concern within Rhode Island.	4.3.1-2: Habitat Cover Types 4.3.1-6: View of Ruderal Grassland/Shrubland Within Vacant Lot East of Blue Beach Parking Lot 4.3.1-7: Rare/Protected Species
Managed Lawn	The Onshore Cable Transmission Route passes by several lots within Quonset Business Park that contain managed lawn. Although managed lawn is not considered a Key Habitat by the RI WAP, it provides limited utility to some species of wildlife, such as passerines and rodents, in an otherwise heavily developed industrial and commercial area. While the Project will not be located within these parcels, the parcels containing managed lawn habitats may be subject to other development pressure.	4.3.1-2: Habitat Cover Types 4.3.1-8: View of Managed Lawn Within the Quonset Point

Figure 4.3.1-6 View of Ruderal Grassland/Shrubland Within Vacant Lot

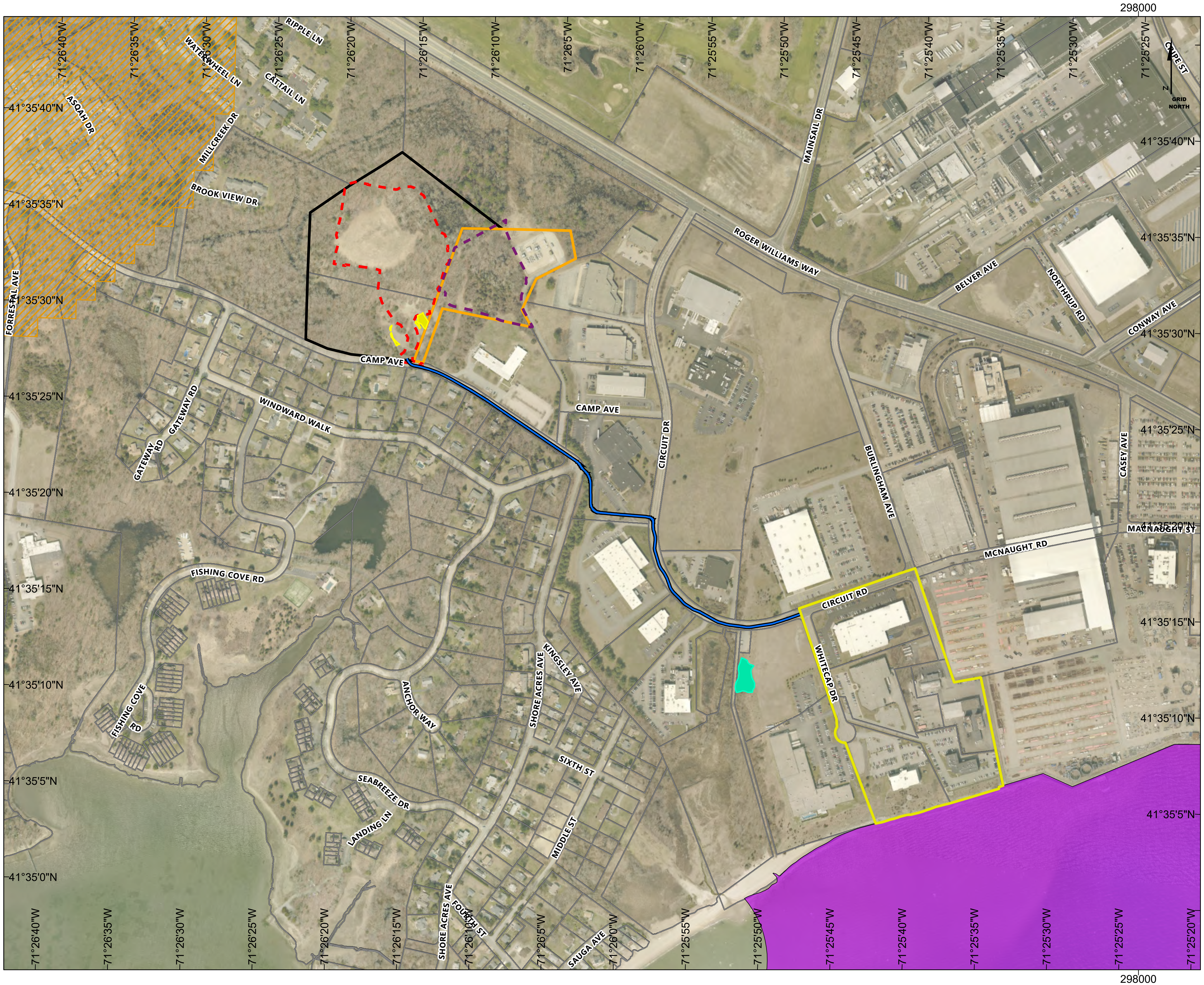

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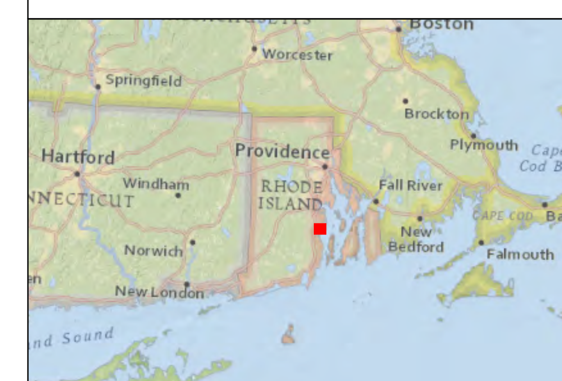
Figure 4.3.1-7

Rare and Protected Species

NORTH KINGSTOWN, RI

Legend
- Onshore Transmission Cable
- Landfall Envelope
- Substation Limit of Work
- ICF Limit of Work
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- RWEC-RI State Waters Envelope
- State Species of Concern: Sickle-leaved golden aster
- State Species of Concern: Butterfly milkweed
- Natural Heritage Areas
- Parcel Boundary

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

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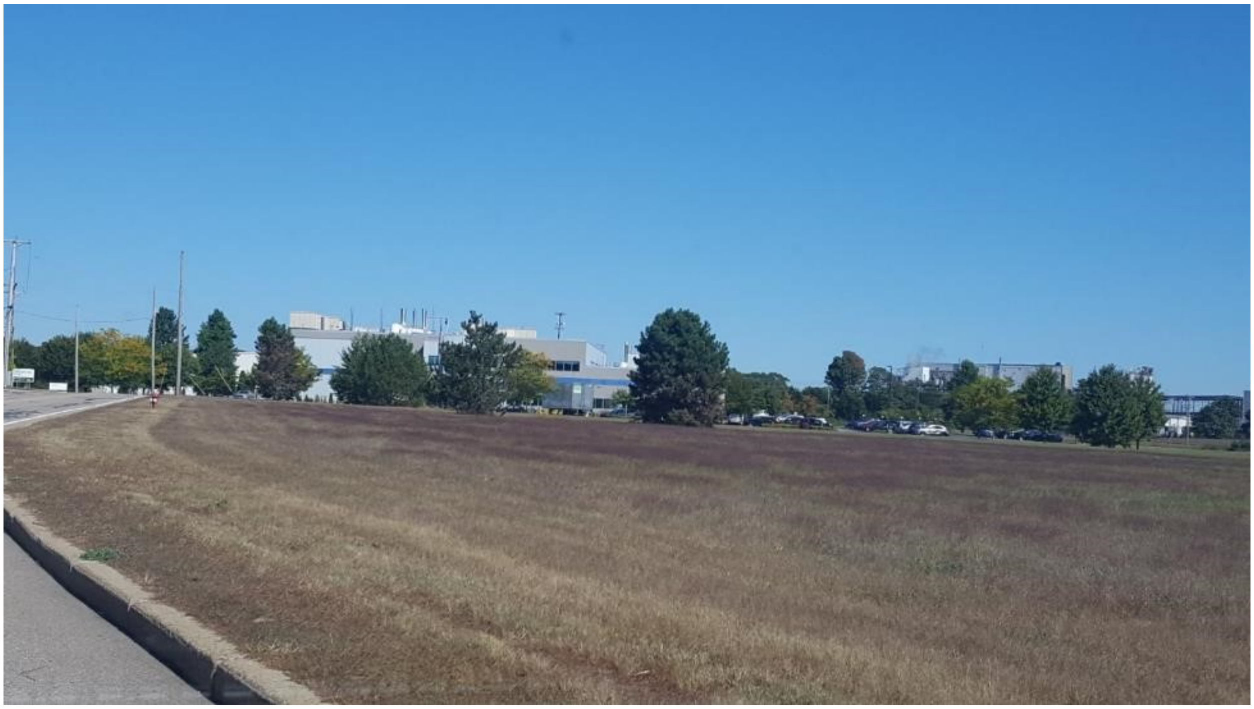
Figure 4.3.1-8 Example of Parcel with Managed Lawn Within Quonset Business Park



OnSS and Interconnection to TNEC's Davisville Substation

The proposed OnSS will be constructed within the undeveloped parcels Plat 179 Lots 001 and 030 north of Camp Avenue and adjacent to the TNEC Davisville Substation at Plat 179 Lot 005. The existing Davisville Substation is the proposed point of interconnection with the regional electrical transmission grid. The ICF and TNEC ROW linking the ICF with the Davisville Substation will be constructed within the same parcel as the existing TNEC Davisville Substation. As noted above, the descriptions of the onshore habitat and associated biological resources within the TNEC Davisville Substation parcel are provided by TNEC via the SER and follow-up SER prepared by LEC.

Table 4.3.1-3 Key Habitat Types Present Within the OnSS and TNEC Davisville Substation/ICF Parcels

Key Habitat Type	Description	Corresponding Figures
Ruderal Forested Swamp	The wetland types within the OnSS and TNEC's Davisville Substation/ICF parcels are considered ruderal because of the alterations associated with the former Camp Avenue Dump which is listed as a State Hazardous Waste Site. Evidence of the site's past use as a landfill is present throughout with fill artifacts, disturbed topography that indicates previous cutting and filling, and pervasive invasive vegetation. According to the COA map, the OnSS parcels and most of the TNEC Davisville Substation/ICF parcel are mapped as	4.3.1-2: Habitat Cover Types 4.3.1-3: Wetland Resources 4.3.1-9: Wetland Resources: Large Scale View Near OnSS and TNEC's Davisville Substation Parcels 4.3.1-10: View of Freshwater Wetland 3 Within the OnSS Parcel Boundary

Key Habitat Type	Description	Corresponding Figures
	an “Ecological Land Unit” which indicates that the land has been considered as a potential conservation opportunity. Several regulated freshwater wetland resources have been mapped within this habitat type[1]: › Freshwater Wetland 2: small isolated forested wetland. › Freshwater Wetland 3: Forested Swamp with associated Area of Land Within 50 ft of Wetland Boundary. › Freshwater Wetland 4: Shrub Marsh/Special Aquatic Site with associated Area of Land Within 50 ft of Wetland Boundary. › Freshwater Wetland 5: isolated scrub-shrub wetland/ Special Aquatic Site. › Freshwater Wetland 5 is hydrologically connected to Freshwater Wetland 4 via a manmade ditch that is regulated as an Area Subject to Stormwater Flowage (ASSF). › Tributaries to Mill Creek flow through Freshwater Wetland 3 north and west of the OnSS parcel boundary. They receive a 100-foot Riverbank Wetland. › Freshwater Wetland 4 is regulated as a Special Aquatic Site because surveys performed in Spring 2020 verified that this wetland functions as a vernal pool. › Freshwater Wetland 5 is regulated as a Special Aquatic Site because surveys performed in Spring 2021 verified that this wetland provides habitat for vernal pool species. According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), portions of the OnSS parcels occur within the one-percent annual flood hazard area (Zone AE) with a base flood elevation of 13 ft above the North American Vertical Datum of 1988 (NAVD88.) This floodplain extends into the northeast and northwest corners of the TNEC Davisville Substation/ICF parcel.	
Ruderal Mixed Oak/White Pine Forest	The upland area within the OnSS parcels and the undeveloped portion of TNEC’s Davisville Substation/ICF parcel is a mixed oak/white pine forest. As with the adjoining ruderal forested swamp, the oak/white pine forest receives the modifier of ruderal because it is within the footprint of the former Camp Avenue Dump and evidence of anthropogenic	4.3.1-2: Habitat Cover Types 4.3.1-11: View of Mixed Oak/White Pine Forest Within the OnSS Parcels

Key Habitat Type	Description	Corresponding Figures
	disturbance is present. Wildlife and invasive species composition are also similar.	
Ruderal Pitch Pine Barren	The southeast corner of Plat 179/Lot 1 (nearest Camp Avenue) is an apparent former gravel excavation pit that sits at a lower elevation than the surrounding grade and has transitioned to a sand barren over time and includes pitch pine scattered throughout patches of bare sand. This habitat classification of pitch pine barren includes the modifier of "ruderal" because it was likely created by anthropogenic activities. Human disturbance in this area is apparent due to the presence of all-terrain vehicle and bicycle tire tracks and miscellaneous trash and debris. Despite the disturbance, this area provides a unique habitat type that may be capable of supporting flora and fauna not suited to the surrounding forested landscape. Sickle-leaved golden aster (*Pityopsis falcata*), a state species of concern within Rhode Island, was observed within this habitat type.	4.3.1-2: Habitat Cover Types 4.3.1-7: Rare/Protected Species 4.3.1-12: View of Pitch Pine Barren
Landfill	Although not a designated Key Habitat within the RI WAP, it is worth noting that there is an approximately 2.5-acre portion of the former Camp Avenue landfill within the OnSS parcels that is mounded with an herbaceous cover that appears to be regularly mowed.	4.3.1-2: Habitat Cover Types 4.3.1-13: View of Landfill Cover

1: Note that Freshwater Wetland labels begin with Freshwater Wetland 2 because a resource previously delineated as Freshwater Wetland 1 is no longer within the Project Area.

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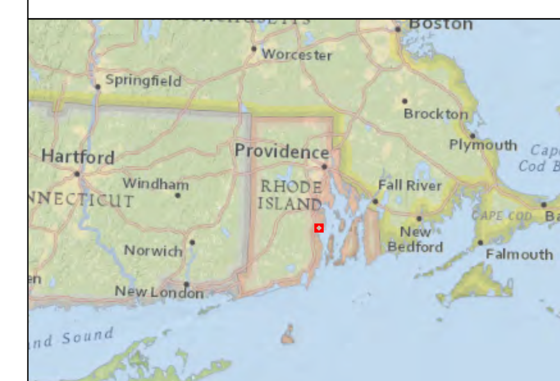
Figure 4.3.1-13
Wetland Resources: Large Scale view near OnSS and Davisville Substation Parcels
NORTH KINGSTOWN, RI

Legend
- Onshore Transmission Cable
- Substation Limit of Work
- ICF Limit of Work
- Parcel ID 179-030 & 179-001
- Parcel ID 179-005
- Parcel Boundary
- One-Percent Annual Chance Flood Hazard Area
- Potential Vernal Pool
- Delineated Wetland Edge
- Approximate Wetland Edge
- LEC Delineated ASSF
- Approximate Stream
- Delineated Wetland Resources
- Interpolated Wetland
- Wetland (NWI)

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 20 40 60 Meters
0 60 120 180 Feet

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Figure 4.3.1-10 Photo of Freshwater Wetland 3, a Ruderal Forested Swamp Within OnSS Parcel Boundary

Figure 4.3.1-11 View of Mixed Oak/White Pine Forest Within OnSS Parcels

Figure 4.3.1-12 View of Pitch Pine Barren View of Pitch Pine Barren Within Southeastern Corner of OnSS

Figure 4.3.1-13 View of the Landfill Cover within OnSS Parcels

Summary

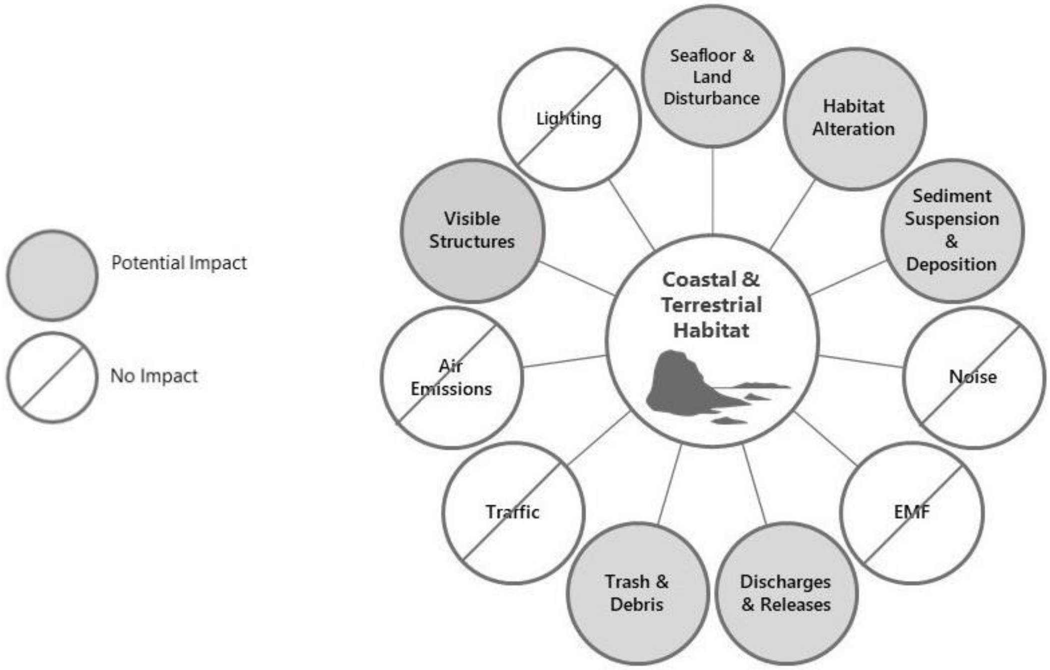
Most of the coastal and terrestrial habitats within the limits of the proposed Onshore Facilities are disturbed from previous anthropogenic uses. However, there are several different Key Habitats that are suitable to a range of wildlife and plant species. Key habitats present within the Project Area include ruderal forested swamp and marsh, ruderal mixed oak/white pine forest, ruderal grassland/shrubland, and ruderal pitch pine barren. There were no wildlife refuges, rookeries, or sanctuaries identified within the Project Area (USFWS, 2020; RIDEM, 2020; NOAA 2020). Regulated wetland resources within the Project Area include manmade shoreline, four freshwater wetlands, ASSF, and floodplain. Invasive plant species are prevalent throughout the Project Area due to the prior anthropogenic disturbance. One plant species of state concern was identified within the OnSS parcels and a second plant species of state concern was recorded in vacant lot along the Onshore Transmission Cable Route.

4.3.1.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact coastal and terrestrial habitat resources discussed above (Section 4.3.1.1). IPFs that may result in direct or indirect impacts to coastal and terrestrial habitat are depicted in Figure 4.3.1-18. Impacts are characterized as direct or indirect and short-term or long-term, as defined in Section 4.1 and will vary according to habitat type. All IPFs with potential impact coastal and terrestrial habitat are evaluated in this section. The full impact analysis of all onshore biological resources is included within the Onshore Natural Resources and Biological Assessment Technical Report (Appendix K).

The analysis of impacts on coastal and terrestrial habitat are discussed separately for the Landfall Envelope, Onshore Transmission Cable Route, OnSS, Interconnection ROW, ICF, and TNEC ROW in the following sections. The IPFs are further defined for the construction and decommissioning phases of the Project and the O&M phase of the Project.

Figure 4.3.1-18 Impact-producing Factors on Coastal and Terrestrial Habitat



Landfall Work Area

The IPFs associated with the Landfall Work Area that could physically affect coastal and terrestrial habitat include land disturbance and habitat alteration, sediment suspension and deposition, discharges and releases, and trash and debris. Based on the summary of the IPFs on Table 4.3.1-6, the impacts of land disturbance and habitat alteration associated with construction and decommissioning of the Landfall Work Area are considered ***direct/indirect*** and ***short-term*** to ***long-term.*** Impacts of sediment suspension and distribution are considered ***direct*** and ***short-term***. Discharges and releases of trash and debris is considered an ***indirect*** and ***short-term*** impact.

Routine O&M of the infrastructure in the Landfall Work Area (e.g., TJBs) will not result in impacts on coastal and terrestrial habitats. Occasional non-routine maintenance may cause limited land disturbance to create access to the infrastructure, which is considered an ***indirect*** and ***short-term*** impact. A more detailed discussion of IPFs that may affect the use of habitats within the Landfall Work Area by wildlife and RTE species are addressed in Appendix K.

Construction and Decommissioning

The IPFs with the potential to affect coastal and terrestrial habitat during construction of the Landfall Work Area have been summarized in Table 4.3.1-4 based on the Landfall Envelope under consideration. Additional details on potential impacts from the various IPFs are described in the following sections.

Decommissioning of the infrastructure within the Landfall Work Area will have similar impacts on coastal and terrestrial habitats to those described below for the construction phase if the underground infrastructure is to be removed. If the infrastructure is abandoned in place it will not have any impacts on coastal and terrestrial habitats.

Table 4.3.1-4 IPFs and Potential Levels of Impact on Coastal and Terrestrial Habitat During Construction and Decommissioning of the Landfall Envelope

IPF	Project Activity	Impact Characterization
Seafloor/Land Disturbance and Habitat Alteration	Vegetation clearing and grading, Wetland fill, General construction activities	Direct/indirect, short-term to long-term
Sediment Suspension and Deposition	Interconnection between RWEC-RI and Landfall Work Area, General construction activities	Direct, short-term
Discharges and Releases	General construction activities	Indirect, short-term
Trash and Debris	General construction activities	Indirect, short-term

Land Disturbance and Habitat Alteration

Land disturbance and habitat alteration are discussed together because they are interrelated from a habitat perspective (i.e. land disturbance has the potential to result in habitat alteration). A direct impact to coastal and terrestrial habitats will result from land disturbance and habitat alteration generated from construction of the Landfall Work Area. Because the Landfall Envelope is limited to anthropogenically made or disturbed features of manmade shoreline and ruderal grassland/shrubland, the potential for land disturbance and habitat alteration to significantly affect these resources is limited but discussed in greater detail below. Habitat conversion is not a factor for developed areas of the Landfall Envelope, such as buildings, mowed lawn, parking lots and roads.

The construction period for the Onshore Facilities will occur over approximately 18 months and when completed the infrastructure at the Landfall Work Area will be placed underground. HDD will be employed to make the connection between the RWEC and the Landfall Work Area which will limit or completely avoid impacts to manmade shoreline and the ruderal grassland/shrubland because the RWEC will be installed under these resources. The temporary onshore construction work area for the HDD operations will likely be situated within a previously developed area such as an existing parking lot and will not impact the manmade shoreline and/or the ruderal grassland/shrubland. However, if these habitat types are disturbed, they will re-establish to existing conditions relatively quickly since the area would be re-planted in similar condition to the existing cover type. The manmade shoreline does not support any vegetative growth. Habitat conversion resulting from land disturbance and habitat alteration on the existing coastal and terrestrial habitat from the construction of the Landfall Work Area is considered a ***direct*** and ***short-term*** impact.

Construction of the Landfall Work Area will have an impact on floodplain since much of the Landfall Envelope occurs within the one-percent annual chance flood hazard area which is further designated as coastal high hazard area (VE Zone) that is subject to wave action as designated in FIRM No. 44009C0108J (effective date October 16, 2013) produced by the FEMA. The one-percent annual chance flood hazard area is regulated as a wetland resource by RI CRMC under the Freshwater Wetland Rules. Impacts to floodplain related to land disturbance and habitat alteration are expected to be temporary since infrastructure will be placed underground and will not create permanent fill within floodplain. The impacts to floodplain during construction are therefore considered ***direct*** and ***short-term***.

A potential indirect impact to coastal and terrestrial habitat generated from land disturbance and habitat alteration linked to construction of the Landfall Work Area is habitat degradation via the spread of invasive species. If vegetative clearing will be required within the ruderal grassland/shrubland for construction of the Landfall Work Area then this may provide invasive plant species competitive growth advantage over native plants because they are able to leaf out earlier than native plants (Hancock, 2018). The baseline conditions of the ruderal grassland/shrubland habitat already support a high occurrence of invasive plant species. Habitats with high levels of invasive species can degrade habitat quality for wildlife by reducing the amount of native plant material available for foraging, however, this area of habitat is so small it is unlikely to provide a significant habitat resource to wildlife. The spread of invasive species will be managed in compliance with state and federal regulations. Habitat degradation resulting from land disturbance and habitat alteration during construction of the Landfall Work Area is considered an ***indirect*** and ***long-term*** impact.

Sediment Suspension and Deposition

Sediment suspension and deposition in the intertidal area may result from the interconnection between the RWEC-RI and the Landfall Work Area. Excavation activities associated with HDD will suspend sediments into the water column causing short-term localized increases to naturally-occurring turbidity. When the activity stops, the sediment suspension will abate, and sediment is expected to settle out onto the seafloor. Impacts resulting from sediment suspension and deposition within coastal waters are considered ***direct*** and ***short-term*** as construction-related turbidity would cease once construction operations are complete. If turbid conditions are anticipated within the intertidal area as a result of the proposed interconnection between the RWEC-RI and the Landfall Work Area, the water use classification of the tidal water that will be impacted will be a consideration of RI CRMC in reviewing and permitting the Project. The waters adjacent to the Landfall Envelope are classified as Type 6 "Industrial Waters."

Construction of the Landfall Work Area and the rest of the Onshore Facilities will be governed by several environmental permits including the RIPDES General Permit for Stormwater Discharges associated with Construction Activities, which requires the use of BMPs to minimize the opportunity for turbid discharges leaving a construction work area. Impacts to coastal and terrestrial habitat resulting from sediment suspension and deposition during construction of the Landfall Work Area are considered ***direct*** and ***short-term***.

Discharges and Releases

During construction of the Landfall Work Area and the rest of the Onshore Facilities, sanitary waste will be generated and other fluids such as gasoline and oil will be required for the refueling of construction equipment. However, all wastes will be properly managed in accordance with applicable federal and state laws. Accidental discharges, releases, and disposal could cause habitat degradation that would negatively impact the use of habitat by wildlife, but risks will be avoided through compliance with the RIPDES General Permit for Stormwater Discharges associated with Construction Activities which requires the implementation of spill prevention and control measures. Section 4.3.1.3 describes further how discharges and releases will be managed. Therefore, discharges and releases are considered ***indirect*** and ***short-term*** impacts.

Trash and Debris

Trash and debris will be generated by construction of the Landfall Work Area and the rest of the Onshore Facilities, but all solid and liquid trash and debris will be stored in designated receptacles and will be disposed of at an appropriate facility per 30 CFR 585.626(b)(9). Accidental disposal of trash into the habitat surrounding the construction has the potential to degrade habitat quality. With proper waste management procedures (see Section 4.3.1.3), trash or debris discarded into habitats surrounding the construction areas of the Onshore Facilities would be unlikely. Therefore, trash and debris are considered ***indirect*** and ***short-term*** impacts.

Operations and Maintenance

During routine O&M of the Onshore Facilities the infrastructure of the Landfall Work Area will be underground and will have no impact on coastal and terrestrial habitats. Non-routine maintenance may cause limited land disturbance to create access to the infrastructure, but such occurrences are expected to be infrequent and are considered ***indirect*** and ***short-term*** impacts.

Onshore Transmission Cable

The IPFs associated with the Onshore Transmission Cable routes under consideration that could physically affect coastal and terrestrial habitat include land disturbance and habitat alteration, sediment suspension and deposition, discharges and releases, and trash and debris. Based on the IPFs summarized in Table 4.3.1-8, the impacts from construction and decommissioning of the Onshore Transmission Cables are considered ***direct/indirect*** and ***short-term*** to ***long-term***, in terms of land disturbance and habitat alteration, ***direct*** and ***short-term*** in terms of sediment suspension and deposition, and ***indirect*** and ***short-term*** in terms of discharges and releases and trash and debris. During routine O&M of the Onshore Facilities the infrastructure of the Onshore Transmission Cables will be underground and will have no impact on coastal and terrestrial habitats. Occasional non-routine maintenance may cause limited land disturbance to create access to the infrastructure, which is considered an ***indirect*** and ***short-term*** impact.

The potential impacts associated with these IPFs for each phase of the Onshore Transmission Cables are addressed separately in greater detail in the following sections.

Construction and Decommissioning

Table 4.3.1-5 summarizes the IPFs, including the potential level of impact, expected to occur to the coastal and terrestrial habitats during the construction of the Onshore Transmission Cable. Additional details on potential impacts from the various IPFs are described in the following sections.

Decommissioning of the Onshore Transmission Cable will have similar impacts on coastal and terrestrial habitats to those described below for the construction phase if the underground infrastructure is to be removed. If the infrastructure is abandoned in place it will not have any impacts on coastal and terrestrial habitats.

Table 4.3.1-5 IPFs and Potential Levels of Impact on Coastal and Terrestrial Habitat During Construction and Decommissioning of the Onshore Transmission Cable

IPF	Project Activity	Impact Characterization
Seafloor/Land Disturbance and Habitat Alteration	Vegetation clearing and grading, General construction activities	Direct/indirect, long-term to short-term
Sediment Suspension and Deposition	General construction activities	Direct, short-term
Discharges and Releases	General construction activities	Indirect, short-term
Trash and Debris	General construction activities	Indirect, short-term

Habitat Alteration and Land Disturbance

As described within Section 3.0 of this COP, the Onshore Transmission Cable will be up to 1 mi (1.6 km) long with a maximum temporary disturbance corridor of 25 ft (7.6 m) (30 ft [9.1 m] at splice vaults) and a maximum disturbance depth of 13 ft (4 m) that will be mostly limited to established road ROWs or previously disturbed areas such as parking lots with little to no impact to adjacent coastal and terrestrial habitat. The portions of the Onshore Transmission Cable Route within these previously developed areas are expected to have ***indirect*** and ***short-term*** impacts in terms of habitat alteration and land disturbance.

Where the Onshore Transmission Cable will connect to the OnSS it will be installed below the proposed access driveway within Plat 179 Lots 001 and 030. Since this segment of the Onshore Transmission Cable route will be installed within a previously undeveloped area the impacts resulting from habitat alteration and land disturbance are considered ***direct*** and ***long-term*** in terms of habitat conversion.

Potential indirect impacts to coastal habitat described within the construction of the Landfall Work Area include reduction in habitat quality via the spread of invasive species. However, as noted previously, the spread of invasive species will be managed in compliance with state and federal regulations. Therefore, in the case of the Onshore Transmission Cable Route from the Landfall Envelope, the impact of habitat degradation resulting from land disturbance and habitat alteration is considered an ***indirect*** and ***long-term*** impact. The indirect impact of habitat degradation is not expected to affect the Onshore Transmission Cable routes within previously developed areas. Any land disturbance and habitat alteration on habitat quality that these routes pass through are considered ***indirect*** and ***short-term*** impacts.

Sediment Suspension and Deposition

As discussed in the construction section of the Landfall Work Area above, any sediment suspension and deposition generated from construction activities will be minimized via the use of BMPs. Impacts to coastal and terrestrial habitat resulting from sediment suspension and deposition during construction of the Onshore Transmission Cable Route are expected to be ***direct*** and ***short-term***.

Discharges and Releases

The description of the impacts from discharges and releases described within the above Landfall Work Area construction section also applies to the construction of the Onshore Transmission Cable. Potential impacts associated with discharges and releases are considered ***indirect*** and ***short-term***.

Trash and Debris

The description of the impacts from Trash and Debris described within the above Landfall Work Area Construction Section also applies to the construction of the Onshore Transmission Cable. Potential impacts associated with Trash and Debris are considered ***indirect*** and ***short-term***.

Operations and Maintenance

During routine O&M of the Onshore Facilities the infrastructure of the Onshore Transmission Cable will be underground and will have no impact on coastal and terrestrial habitats. Non-routine maintenance may cause limited land disturbance to create access to the infrastructure, but such occurrences are expected to be infrequent and are considered ***indirect*** and ***short-term***.

OnSS, Interconnection ROW, ICF, and TNEC ROW

The IPFs associated with the proposed OnSS, Interconnection ROW, ICF and TNEC ROW that could physically affect coastal and terrestrial habitat include land disturbance and habitat alteration, sediment suspension and deposition, discharges and releases, and trash and debris, and visible structures. Based on the IPFs summarized in Table 4.3.1-9, the impacts from construction and decommissioning of the OnSS, Interconnection ROW, ICF, and TNEC ROW are considered ***direct/indirect*** and ***long-term***, in terms of land disturbance and habitat alteration, ***direct*** and ***short-term***, in terms of sediment suspension and deposition, and ***indirect*** and ***short-term***, in terms of discharges and releases, trash and debris, and visible structures. During routine O&M of the OnSS, Inteconnection ROW, ICF, and TNEC ROW the IPFs of discharges and releases and visible structures are considered ***indirect*** and ***long-term*** impacts.

The potential impacts associated with these IPFs for each phase of the OnSS, Interconnection ROW ICF, and TNEC ROW are addressed separately in greater detail in the following sections.

Construction and Decommissioning

The IPFs with the potential to affect coastal and terrestrial habitat during construction of the OnSS, Interconnection ROW, ICF, and the TNEC ROW have been summarized in Table 4.3.1-6. Additional details on potential impacts from the various IPFs are described in the following sections.

Decommissioning of the OnSS, Interconnection ROW, ICF, and TNEC ROW will have similar or lesser impacts to those described below for the construction phase.

Table 4.3.1-6 IPFs and Potential Levels of Impact on Coastal and Terrestrial Habitat During Construction and Decommissioning of the OnSS, Interconnection ROW, ICF, and TNEC ROW

IPF	Project Activity	Impact Characterization
Habitat Alteration and Seafloor/Land Disturbance	Vegetation clearing and grading, Wetland fill, General construction activities	Direct, indirect, long-term
Sediment Suspension and Deposition	General construction activities	Direct, short-term
Discharges and Releases	General construction activities	Indirect, short-term

IPF	Project Activity	Impact Characterization
Trash and Debris	General construction activities	Indirect, short-term
Visible Structures	General construction activities	Indirect, short-term

Habitat Alteration and Land Disturbance

Impacts from habitat alteration and land disturbance on coastal and terrestrial habitats generated from the construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW will create habitat loss and conversion, affect habitat utilization by wildlife, and has the potential to create habitat degradation. These impacts are addressed in greater detail below.

The OnSS will occupy an operational footprint measuring up to 3.8 ac (1.5 ha) and will connect to the ICF with two 115-kV underground transmission cables up to 527-feet (160.6 m) long within the Interconnection ROW. Additionally, the OnSS will include a compacted gravel driveway, stormwater management features, and associated landscaped or managed vegetated areas totaling up to 7.1 acres (2.9 ha) inclusive of the up to 4-ac (1.6-ha) operational footprint of the facility. The adjacent ICF will consist of a 115kV ring-bus with an operational footprint of 1.6 ac (0.6 ha). The ICF will also include a paved access road, stormwater management features, and associated landscaped or managed vegetated areas within the approximate 4.0 ac (1.6 ha) construction footprint. This construction footprint includes the TNEC ROW. The ICF will connect to the existing substation with two 115-kV overhead transmission circuits located within the TNEC ROW. The transmission line from the ICF to the Davisville Transmission Tap will be up to 712 ft (217 m) long.

Temporary contingency staging and laydown areas that may be required to facilitate construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW and will be sited at previously disturbed areas owned by the QDC. Staging/laydown in these areas will not require grading but may require graveling, erosion control, fencing, etc.

In addition to the vegetation clearing that will be necessary to construct the OnSS, Interconnection ROW, ICF, and TNEC ROW, on-going vegetation management will be needed within the OnSS and the ICF parcels. The Landfall Work Area and Onshore Transmission Cable will not require vegetative management because these components of the Onshore Facilities are being constructed in previously developed areas. The OnSS will have a 30-foot-wide perimeter around the fence line that will be maintained, the Interconnection ROW will have a 40-foot maintained ROW, the ICF will have a 10-foot wide perimeter around the fence line that will be maintained, and the TNEC ROW will have 120-foot-wide maintained ROW.

Per Eversource's Specifications for Rights-of-Way Vegetation Management, vegetation management on the OnSS and Interconnection ROW will be managed to promote a low-growing plant community dominated by grasses, flowers, ferns, and herbaceous plants. All woody vegetation including trees and shrubs that exceed 15 ft (4.5 m) will be removed and discouraged from becoming established by on-going integrated vegetation management (IVM) maintenance, including manual cutting, mowing and the prescriptive use of herbicides plus the use of environmental controls. The method of control is determined following inspections of the site scheduled for maintenance. The current maintenance cycle for vegetation control utilizing IVM practices is three or four years depending on the vegetation composition, facilities and site conditions.

Per TNEC vegetation management requirements, vegetation control of the ICF and the TNEC ROW will be managed through integrated procedures combining removal of danger trees, hand cutting, targeted herbicide use, mowing, selective trimming, and side trimming.

In their existing state the OnSS and ICF parcels include ruderal forested swamp, shrub marsh, ruderal mixed oak/white pine forest, and in the case of the OnSS parcel ruderal pitch pine barren and a landfill. The vegetation clearing and on-going vegetation management will convert some of these cover types to developed land in the cases of the hard structures associated with the OnSS and ICF and to shrubland within the areas that will undergo vegetation maintenance. Habitat conversion resulting from the habitat alteration and land disturbance is considered a ***direct*** and ***long-term***, impact.

Wetland fill is not proposed within the OnSS or ICF parcels, though portions of some wetlands and the associated wetland buffers (Area of Land within 50-ft of the wetland boundary) will be subject to on-going vegetation maintenance to be maintained as shrubland. All wetland impacts will require coordination with the regulating agencies, including USACE, RI CRMC, RIDEM, and QDC.

The construction of the OnSS and ICF will not only result in habitat conversion due to construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW, but construction of these facilities will also result in habitat loss. Habitat loss occurs when an area supporting wildlife is converted to non-habitat that lacks the natural resources to support occupancy for any species, such as paved areas. The operational footprints of the OnSS and ICF will create habitat loss when forested upland is cleared and replaced with hard structures and crushed gravel yards that are not capable of supporting plants or wildlife. The OnSS will create a loss of mixed oak white pine forest and of forested ruderal swamp, which represent a relatively small fraction of the contiguous mapped 52 ac (21 ha) COA habitat unit. In addition to impacts on the mixed oak/white pine forest, the LOW for the OnSS encompasses a portion of the ruderal pitch pine barren. However, the OnSS has been designed to avoid occurrences of sickle-leaved golden aster, a plant species of state concern, within the pitch pine barren. In accordance with the state environmental permitting needed for this Project, the occurrence of this State-listed species must be reported to RIDEM which will advise if a mitigation plan will be needed. The habitat loss that will be created due to the construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW is considered ***direct*** and ***long-term***. However, the amount of habitat loss is small relative to the similar habitat that will remain unimpacted in the general region.

As previously described, land disturbance and habitat alteration from the construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW has the potential to create the indirect impact of habitat degradation through the spread of invasive species. As noted previously, invasive plant growth within the OnSS parcels is pervasive. The SER for the TNEC Davisville Substation/ICF parcel noted that invasive plant species were observed throughout the forested portion of the TNEC Davisville Substation/ICF parcel though the highest density occurred in the areas immediately abutting the TNEC Davisville Substation and the access road to the substation. This observation indicates that invasive species are likely to become further established in disturbed areas if proper management techniques are not followed. Section 4.3.1.3 describes environmental protection measures that will be used to manage invasive species within the OnSS parcels and the Interconnection Cable Routes. Therefore, habitat degradation resulting from land disturbance and habitat alteration during construction of the OnSS, ICF, and Interconnection Cable Routes is considered an ***indirect*** and ***long-term*** impact.

Sediment Suspension and Deposition

As discussed in the construction section of the Landfall Work Area above, any Sediment Suspension and Deposition generated from construction activities will be minimized via the use of BMPs. Impacts to coastal and terrestrial habitat resulting from Sediment Suspension and Deposition during construction of the OnSS, ICF, and Interconnection Cable Routes are considered ***direct*** and ***short-term***.

Discharges and Releases

The description of the impacts from Discharges and Releases described within the above Landfall Work Area Construction Section also applies to the construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW. Potential impacts associated with Discharges and Releases are considered ***indirect*** and ***short-term***.

Trash and Debris

The description of the impacts from Trash and Debris described within the above Landfall Work Area Construction Section also applies to the construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW. Potential impacts associated with Trash and Debris are considered ***indirect*** and ***short-term***.

Visible Structures

Visible structures within the Onshore Facilities during construction include construction equipment and the construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW. As described within the land disturbance and habitat alteration impact analysis, construction on the OnSS and ICF will result in visible site disturbance, such as tree clearing, earth moving, and facility installation, all of which will temporarily and permanently alter the visual character of the landscape within the OnSS parcels. After the aforementioned facilities have been installed the visual structure changes related to construction equipment operation and site alteration will cease. These changes in the visual landscape are an extension of the impacts from land disturbance and habitat alteration as they relate to habitat degradation. Habitat degradation from the change in visual landscape during construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW is considered an ***indirect*** and ***short-term*** impact.

Operations and Maintenance

Table 4.3.1-7 summarizes the IPFs, including the potential level of impact, expected to occur to coastal and terrestrial habitat during the O&M of the OnSS, Interconnection ROW, ICF, and TNEC ROW. Additional details on potential impacts from the various IPFs are described in the following sections.

Table 4.3.1-7 IPFs and Potential Levels of Impact on Coastal and Terrestrial Habitat During O&M of the OnSS and Interconnection Cable Route

IPF	Project Activity	Impact Characterization
Discharges and Releases	Operations and routine and non-routine maintenance	Indirect, long-term
Visible Structures	Operations and routine and non-routine maintenance	Indirect, long-term

Discharges and Releases

The OnSS and ICF will require various oils, fuels, and lubricants to support its operation; sulfur hexafluoride (SF_6) gas will also be used for electrical insulating purposes. Equipment will be mounted on concrete foundations with concrete secondary fluid containment designed for 110 percent containment volume and in accordance with industry and local utility standards. As described above in the construction section, accidental discharges, releases, and disposal could indirectly cause habitat degradation, but risks will be avoided through implementation of the spill prevention and control measures and associated BMPs. Therefore, potential impacts associated with discharges and releases are considered ***indirect*** and ***long-term***.

Visible Structures

The OnSS ICF and structures within the TNEC ROW will be visible structures that will result in habitat conversion and loss and will fragment habitat. The perimeter of the OnSS, Interconnection ROW, perimeter of ICF, and TNEC ROW will be converted from forest to shrub cover type and increase edge habitat. Taken in context with the adjacent landscape consisting of residential and commercial developments, the forested habitat fragmentation from the OnSS is considered an ***indirect*** and ***long-term*** impact.

4.3.1.3 Proposed Environmental Protection Measures

The protection of coastal and terrestrial habitats is incorporated into many facets of the Project’s design and construction. Site selection and routing, installation techniques and equipment technologies have been selected to avoid and minimize potential impacts to the surrounding environment.

The following protective measures will reduce potential impacts to coastal and terrestrial habitat:

- Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).
- At the landfall location, drilling fluids will be managed within a contained system to be collected for reuse. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids.
- Compliance with the RIPDES General Permit for Stormwater Discharges associated with Construction Activities which requires the implementation of an SESC Plan and spill prevention and control measures.
- The operator must implement the site-specific SESC Plan and maintain it during the entire construction process until the entire worksite is permanently stabilized by vegetation or other means. The measures employed in the SESC Plan use BMPs to minimize the opportunity for turbid discharges leaving a construction work area.
- The spill prevention and control measures mandate that the operator identify all areas where spills can occur and their accompanying drainage points. The operator must also establish spill prevention and control measures to reduce the chance of spills, stop the source of spills, contain and clean-up spills, and dispose of materials contaminated by spills. Spill prevention and control training will be provided for relevant personnel.

- The perimeter surrounding Onshore Facilities will be managed to encourage the growth of native grasses, ferns, and low growing shrubs. The management strategy will include the removal of invasive plants in compliance with state and federal regulations (e.g. herbicide use will not be permitted within regulated wetlands).
- In accordance with Section 2.9(B)(1)(d) of the Freshwater Wetland Rules, the Onshore Facilities will be designed to avoid and minimize impacts to freshwater wetlands to the maximum extent practicable. Any wetlands that will be impacted as a result of the Project will be mitigated via the federal and state permitting process in accordance with Section 404 of the CWA and the Freshwater Wetland Rules.
- An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
- The documented sickle-leaved golden aster population on the OnSS parcel will be protected during construction.

4.3.2 Benthic and Shellfish Resources

This section describes the affected environment for benthic and shellfish resources within offshore portions of the RWF, RWEC-OCS, and RWEC-RI (as defined in Section 1.1, Figure 1.1-1). The Onshore Facilities are not discussed within this section given their location on land. The discussion of the affected environment for benthic and shellfish resources is followed by an evaluation of potential Project-related impacts and a summary of environmental protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to these resources.

The description of the affected environment and assessment of potential impacts for benthic and shellfish resources were determined by reviewing public data sources and conducting project-specific studies. Sources reviewed included state and federal agency-published papers and databases (McMullen et al., 2009; RI CRMC, 2010; LaFrance et al., 2010; Poppe et al., 2014a; Collie and King, 2016; Siemann and Smolowitz, 2017), published journal articles (McMaster, 1960), online data portals and mapping databases (Northeast Ocean Data, 2019; USGS, 2017), an academic thesis (Malek, 2015), studies conducted for the planned SFWF (Deepwater Wind South Fork, 2019), and correspondence and consultation with federal and state agencies. Project-specific studies conducted to aid in the characterization of the affected environment and to address BOEM Benthic Habitat Guidelines (2019) for benthic and shellfish resources included:

- G&G Reconnaissance Surveys, completed by Fugro from July to November 2017, characterized and evaluated seafloor surface and subsurface conditions (Fugro, 2020).
- Benthic Habitat Surveys, conducted by INSPIRE Environmental (INSPIRE) on July 04 to 14 and 25, 2019, characterized surface sediments and identified dominant benthic macrofaunal and macrofloral communities (Appendix X).
- Submerged Aquatic Vegetation (SAV) Survey, conducted by INSPIRE on September 04, 05, and 14, 2020, collected towed video imagery to document SAV presence.

Benthic and shellfish resources are described in the following subsections in terms of benthic habitat types and commonly associated taxa, including (SAV, macroalgal assemblages, and micro- and macrobenthic communities. A brief discussion of ecologically and economically important shellfish species is also included;

more detail with regard to these species are provided in the commercial and recreational fisheries section of the COP.

4.3.2.1 Affected Environment

Regional Overview

The RI-MA WEA is located offshore on the northwestern Atlantic continental shelf in Rhode Island Sound. The waters in the vicinity of the RWF and RWEC are transitional waters that separate Narragansett Bay and Long Island Sound from the OCS. Benthic communities in these areas are adapted to survive in this dynamic environment. In general, the benthic communities of these OCS areas are diverse, with lower densities of organisms than in the northern portion of the Mid-Atlantic Bight and in deeper areas of the OCS (MMS, 2007).

The RI-MA WEA is composed of a mix of soft and hard bottom environments defined by dominant sediment grain size and composition. The USGS conducted sediment studies in the vicinity of Block Island and in Rhode Island Sound. These areas were found to have sandy sediments that ranged from very fine to medium sand; very fine sands were prevalent in deeper, lower energy areas, while coarser sediments were found in shallower and higher energy areas (McMullen et al., 2007a, 2007b, 2008; Poppe et al., 2011, 2014a, 2014b, 2014c). The USGS data and other data available for the RI-MA WEA suggest that surface sediment cover in the RWF and along the RWEC are comprised of mostly sandy sediments with some areas of coarser material (gravel or small cobble) and boulder fields (RI CRMC 2010; Malek et al., 2014; USGS, 2017; Collie and King, 2016; BOEM, 2017), patterns that are generally confirmed by the available site-specific data (McMaster, 1960; Poppe et al., 2014a; McMullen et al., 2009; LaFrance et al., 2010; Deepwater Wind South Fork, 2019). This range of grain sizes is typical of OCS glacial moraine depositional environments that include Holocene marine transgressive deposits. O'Hara and Oldale (1980) and subsequent authors recognized that within the broad distribution of the glacial moraine, identified in the RI-MA WEA, there are deep channels cut into the glacial moraine by meltwaters and subsequent reworking and deposition as the glaciers retreated and transgressive seas flooded the area. These processes left a complex mosaic of geological deposits across the surface of the RI-MA WEA. Site-specific studies conducted for the South Fork Wind Farm, which is in close proximity to the southern portion of the RWF, demonstrated the glacial history of the area shaped the distribution of boulders, with these gravels coinciding with moraine deposits (Deepwater Wind South Fork, 2019). Site-specific G&G reconnaissance surveys revealed more detailed information on surficial and subsurface geology (Fugro, 2020).

The Coastal and Marine Ecological Classification Standard (CMECS) (FGDC, 2012), the use of which is recommended by BOEM Benthic Habitat Survey Guidelines (2019), provides a standard means to categorize the physical (Substrate) and biological (Biotic) components of environments. CMECS definitions and utility are provided in more detail in the Benthic Assessment (Appendix X). Most relevant to the RI-MA WEA are the Attached Fauna and Soft Sediment Fauna CMECS Biotic Subclasses, which provide broad-scale categories for these seafloor habitats (Appendix X). In the Northwest Atlantic OCS, the Soft Sediment Fauna Subclass typically includes sand dollars, tube building worms, amphipods, sea squirts, and bivalves, among other taxa. The Attached Fauna Subclass in the Northwest Atlantic OCS indicates the dominance of sessile biota living on hard bottom substrata (macroalgae, sponges, bryozoans, hydroids).

Hard bottom habitats are limited in regional distribution in the Northwest Atlantic OCS compared to sandy and soft bottom habitats (CoastalVision and Germano and Associates, 2010). Attached Fauna habitats, also commonly referred to as "live bottom", are hard bottom habitats considered to be potentially valuable and sensitive resources for regionally important taxa, such as Atlantic cod (*Gadus morhua*), longfin squid, and American lobster (*Homarus americanus*). For example, cobble and boulder habitat can serve as a nursery ground for juvenile lobster and as preferable habitat for squid to deposit eggs (Griswold and Prezioso, 1981; Roper et al., 1984). Both lobster and squid have highly specific habitat requirements and are also economically important species in New England. For these reasons, federal and state agencies consider evidence of these taxa to indicate the presence of potentially sensitive habitats (BOEM, 2013). In addition to valuable hard bottom habitats, other potentially sensitive seafloor habitats include SAV beds and areas where corals are present (BOEM, 2013). Legally protected species of reef building corals are not found in the RI-MA WEA (Guida et al., 2017). However, the Northern Star Coral, a non-reef building taxon, was observed at the RWF, although in limited spatial distribution (Appendix X). Due to light requirements, SAV beds are limited to shallower depths and thus, do not occur within the RI-MA WEA. However, SAV beds are found in parts of Narragansett Bay, Rhode Island, through which the RWEC transits before making landfall.

Benthic community structure at the RWF can be inferred from studies in surrounding areas, including the OSAMP and related publications (RI CRMC, 2010; LaFrance et al., 2010), studies conducted at the Block Island Wind Farm (CoastalVision and Germano and Associates, 2010; DWW, 2012; Guarinello and Carey, 2020), BOEM-funded research (Collie and King, 2016; Siemann and Smolowitz, 2017), and surveys conducted for the planned South Fork Wind Farm (Deepwater Wind South Fork, 2019). Data available from these studies suggest which physical substrata and biotic communities that may be present within the RWF and RWEC. One study, which included lobster trawls, examined the lobster habitat at RI-MA WEA and confirmed the importance of the lease area as lobster habitat compared to inshore areas (Collie and King, 2016).

Benthic community structure within Narragansett Bay, the setting for the northern portion of the RWEC-RI, has been extensively studied; Hale et al. 2018 provides a synthesis of over 100 biodiversity studies conducted over 184 years across Narragansett Bay. Specifically, sediment profile imaging (SPI) was used to evaluate benthic habitats and community condition throughout the Bay (Shumchenia and King, 2019; Shumchenia et al., 2016; Valente et al., 1992). The benthic community in Narragansett Bay, a generally urbanized estuary, is strongly shaped by anthropogenic stressors along a north-to-south gradient, from the Providence River to the mouth of the Bay. These stressors include excess nutrients and contaminants (Hale et al., 2016; Shumchenia et al., 2016; Calabretta and Oviatt, 2008; Valente et al., 1992). Additionally, changes in management strategies have been reflected in the benthic community composition (Shumchenia et al., 2016). Bay sediments are generally soft sediments ranging from soft silts and clays in the north to very fine and fine sand in the south, near the mouth of the Bay (Murray et al., 2007; McMaster, 1960). A recent study showed that over a period of six decades, during which time drastic changes in pollution were documented, the benthic community shifted, decreasing in diversity in response to excess nutrients, contamination, and low oxygen, particularly in the northern reaches of the estuary (Hale et al., 2018). Prevalent and distinct recurring biotopes dominated by burrowing fauna or tube-building amphipods, both accompanied by tube-building polychaetes, characterize the soft sediments (Shumchenia and King, 2019). The RWEC-RI route goes through the West Passage of Narragansett Bay, a region that has experienced less anthropogenic influence compared to other areas of the Bay. The West Passage is generally populated by burrowing fauna and tube-building taxa with successional stages indicating mature benthic communities (Shumchenia and King, 2019).

Over the past several decades, in the Project vicinity, benthic communities have experienced increasing water temperatures and declining average pH, which is expected to continue to decline as seawater becomes more saturated with carbon dioxide (Saba et al. 2016). Acidification of seawater is associated with decreased survival and health of organisms with calcareous shells (such as the Atlantic scallop, blue clam, and hard clam). Larvae that survive to the recruitment stage may have thinner or deformed shells and poor behavior responses to predators (Stevens and Gobler 2018). Modeled scenarios of decreasing seawater pH predict a substantial decline in the harvestable stock of the Atlantic scallop, with collateral loss of economic value (Rheuban et al. 2018).

Numerous benthic and pelagic species are predicted to shift their ranges northward and into deeper waters in response to increasing water temperatures (Selden et al. 2018; Kleisner et al. 2017). Modeling predicts that bottom temperatures in southern New England will become too warm to support larval development of the commercially valuable American lobster causing this species to move offshore and northward (Rheuban et al. 2017). Lobster catches have declined in recent decades, which may be attributable to increases water temperatures and associated increases in shell disease (Groner et al. 2018; Jaini et al. 2018; Collie and King 2016; Wahle et al. 2015). Egg-bearing female lobsters occur in warm coastal water in spring but may aggregate offshore for spawning where waters are cooler and strong currents are favorable for larval transport (Carloni et al. 2018). Larval lobster may be transported from Georges Bank to Rhode Island waters by currents along the continental shelf during the 2 to 9 weeks of development to recruitment size (Carloni et al. 2018). Cascading socioeconomic effects on the industries that harvest these species are anticipated although it can be difficult to accurately predict which industries; some fishermen may benefit from the presence of new target species. For example, black seabass and spiny dogfish are predicted to increase in the vicinity of the Project as sea temperatures continue to increase (Selden et al. 2018).

To better understand the site-specific benthic characteristics of the RWF and the RWEC, a benthic habitat assessment was conducted in the summer of 2019, using a combined Sediment Profile and Plan View Imaging (SPI/PV) system. The data generated from this survey meets BOEM Benthic Habitat Guidelines (BOEM, 2019) to characterize surface sediments; delineate and characterize hard bottom areas; identify and confirm benthic flora and fauna, including sessile and slow-moving invertebrates; identify sensitive habitats; establish preconstruction baseline benthic conditions against which postconstruction habitats can be compared; and determine the suitability of a sampled reference area to serve as a control site for future monitoring and assessment. A summary of the data is provided below and more details are provided in the full SPI/PV survey technical report presented as part of Appendix X. The habitat types observed during the site-specific SPI/PV survey are discussed here in concert with previously existing data on surface sediments, biota, and habitat types found and likely to be found in the region. A list of species commonly associated with the benthic habitats and the depth ranges found at the RWF and along the RWEC-RI and RWEC-OCS and are provided in Table 4.3.2-1 (flora), Table 4.3.2-2 (fauna), and Table 4.3.2-3 (ecological and economically important shellfish). In each of these tables, taxa that were directly observed in the SPI/PV survey are denoted with an asterisk (*).

Benthic habitat types, and specifically macrohabitat types, are used here as a construct to describe repeatable physical-biological associations and were derived from CMECS classifiers and modifiers obtained from the SPI/PV analysis. Given the spatial scale of the SPI/PV data, benthic habitat types derived from replicate SPI/PV images are considered macrohabitats (*sensu* Greene et al. 2007). The specific Substrate and Biotic Component classifications associated with these macrohabitat types are provided in the Benthic Assessment (Appendix X). Each PV replicate image is between 0.2 and 0.5 m^2 and the replicate images were collected within approximately 10 m of each other. Thus, this design can provide insight into the degree of patchiness of habitat features such as boulders and cobbles within this spatial context. This sampling approach cannot capture larger habitat features such as sandwaves or smaller habitat features such as cracks and crevices on a boulder. Recognizing scale is a critical component to habitat descriptions and delineations, the habitat types derived from the SPI/PV approach are most accurately described as macrohabitats, which as defined by Greene et al. 2007 as encompassing a scale of one to 10 meters. A summary of SPI/PV parameters across the replicate images were used to inform macrohabitat type at each station. The macrohabitat type at each station cannot be extrapolated beyond the scale of the station. These point data will be used to ground-truth and inform future benthic habitat mapping efforts to support Essential Fish Habitat (EFH) consultation. This habitat mapping will utilize geophysical data (bathymetry, backscatter, side-scan sonar), these SPI/PV data, as well as video transect data (where available), to provide a large-scale delineation of benthic habitats across the Project area.

During the site-specific SPI/PV survey, five stations were surveyed within a potential reference area, located to the east of the northern portion of the RWF. These stations were classified with the macrohabitat type of sand sheet, with the exception of the middle station, Station 503, where sand with mobile gravel was observed (Figure 4.3.2-1). The reference area had similar substrate composition and species assemblages as the northern portion of the RWF. Soft Sediment Fauna was documented as the CMECS Biotic Subclass at the majority of the reference area stations (Benthic Assessment Appendix X).

Revolution Wind Farm

During the site-specific SPI/PV survey, a total of eight benthic macrohabitat types were observed at the RWF, ranging in complexity from sand sheet to continuous large cobbles and boulders on sand (Table 4.3.2-4, Figure 4.3.2-1). These macrohabitats varied in the proportion of hard substrate relative to soft sediment and subsequently the faunal community assemblages. Four of these macrohabitat types make up the vast majority of the RWF as observed during the SPI/PV survey: (1) patchy cobble and boulders on sand, (2) patchy pebbles on sand with mobile gravel, (3) sand with mobile gravel, and (4) sand sheet (Table 4.3.2-4).

Example images depicting each of the four most prevalent macrohabitat types observed across the RWF surveyed area are provided in Figure 4.3.2-2. Here, images (A) and (B) are representative of patchy cobble and boulders on sand with associated fauna annotated; images (C) and (D) are representative of patchy pebbles on sand with mobile gravel; (E) and (F) are examples of sand with mobile gravel; and images (G) and (H) are representative of sand sheet habitats, shown here with infaunal tubes annotated in the SPI image and in the PV image. The species found in these types of habitats are typically described as infaunal species, those living in the sediments (e.g., polychaetes, amphipods, mollusks), and epifaunal species, those living on the seafloor surface (mobile, e.g., sea stars, sand dollars) or attached to substrates (sessile, e.g., barnacles, anemones, tunicates). Below is a summary of the distribution of these macrohabitat types across the RWF as well as brief descriptions of the physical and biological attributes associated with the four most common habitat types observed at the RWF. The spatial distribution of macrohabitats across the RWF lease area broadly corresponded with the surficial geology of the region. In general, the occurrence of Pleistocene moraine deposits corresponded with macrohabitats consisting of pebbles and larger gravel types (e.g., southwest region of the RWF) (Appendix X).

In regions of the RWF where fluvial-estuarine deposits and Holocene marine deposits dominated the surficial geology (O'Hara and Oldale, 1980), macrohabitats of low complexity, such as sand sheets and sand with mobile gravel, occurred. For example, across the vast majority of the northern region of the RWF, the macrohabitat type was sand sheet, aside from a small number of stations where pebbles, cobbles, and boulders were observed (Figure 4.3.2-1). Sand sheet and sand with mobile gravel macrohabitat types at the RWF were characterized by generally fine to coarse sand grain sizes. These sands are mobile, influenced by bottom currents that form ripples on the seafloor surface; which, in turn, influence sediment resuspension, deposition, and sorting. The sand with mobile gravel macrohabitat type, which was found interspersed throughout the RWF and more frequently in the central and southeastern portion of the RWF, has small-sized gravels (granules, pebbles, and small cobbles) that are also influenced by bottom currents (tides, storms) and are transported often enough, appearing "washed clean," that biota are not able to attach and grow on their surfaces. The frequent hydrodynamic forcing and subsequent sediment mobility in sand sheet and in sand with mobile gravel habitats, creates a dynamic environment for biota. Therefore, these habitats do not include more than occasional sparse presence of attached flora or sessile attached epifauna. Instead, these habitats are inhabited by mobile epifauna, such as sea stars, Jonah crabs, American lobster, and small tube-building and burrowing infauna (Tables 4.3.2-2 and 4.3.2-3). However, there is still potential, specifically in the sand with mobile gravel macrohabitats, that hydrozoans, anemones, and encrusting sponges will be present in low densities, particularly when in close proximity to boulders and cobbles.

Sand sheet and sand with mobile gravel macrohabitat types are suitable for the following ecologically and economically important shellfish species: Atlantic rock crab (*Cancer irroratus*), Atlantic sea scallop (*Placopecten magellanicus*), Atlantic surf clam (*Spisula solidissima*), channeled whelk (*Busycotypus canaliculatus*), and horseshoe crab (*Limulus Polyphemus*), Jonah crab (*Cancer borealis*), and ocean quahog clam (*Arctica islandica*) (Table 4.3.2-3). Additionally, longfin squid (*Doryteuthis (Amerigo) pealeii)* may utilize sand with mobile gravel macrohabitats. Table 4.3.2-3 includes a summary of these species, likelihood of presence, and the potential time of year that they could be present in the region.

Sand sheet biota are characterized by the Biotic Subclass Soft Sediment Fauna, and the dominant Biotic Groups include Larger Burrowing Fauna, Larger Tube-Building Fauna, and Small Tube-Building Fauna (Appendix X). The dynamic nature of these environments results in high turnover of infauna, and, combined with the low organic loads found in medium and coarse sands, typically results in the development of transitional infaunal successional stages of Stage 2 taxa, with indications of the possible presence of Stage 3 head-down deposit feeders (Stage 2 -> 3) (Benthic Assessment Appendix). Because they are accustomed to a certain degree of natural disturbance, the benthic biological communities associated with sand sheet as well as sand with mobile gravel macrohabitat types are considered generally resilient to change and quick to recover (Pearson and Rosenberg, 1978; Rhoads and Germano, 1982; Rhoads and Boyer, 1982). Podocerid amphipods and/or their associated vertical mucus strands were present at approximately 90 percent of the stations within the RWF and often co-occurred with Caprellid amphipods and/or Ampeliscid amphipods. The presence of these amphipods was often documented as the Co-occurring CMECS Biotic Group Mobile Crustaceans on Soft Sediment. Amphipods have limited mobility and are restricted to a localized area incapable of migrating out of an area if there is a perturbation. However, the CMECS definition of Mobile Crustaceans on Soft Sediment specifically states, "This group is limited to the relatively non-motile, epifaunal, crustacean taxa (e.g., hermit crabs, mole crabs, amphipods, mysids, isopods) and does not include the more mobile arthropod forms…" (FGDC, 2012), and thus these amphipods are considered under this classification. The dominance of these podocerid amphipods may be a seasonal phenomenon as they were not observed in high frequency at the nearby South Fork Wind Farm, which was surveyed during a different time of year and different year than the SPI/PV survey conducted at the RWF (Deepwater Wind South Fork, 2019 SFWF COP Appendix R). Other organisms that were prevalent across sand sheet, as well as at sand with mobile gravel habitats included solitary sea squirts (*Mogula* sp.), sea stars, Corymorpha (hydroids), Cerianthids (burrowing anemones), sea pens (*Halipteris finmarchia*), and small tube building fauna (e.g., *Spionid polychaetes*).

The southwest and the central regions the RWF, which are associated with Pleistocene moraine deposits (O'Hara and Oldale, 1980), tended to have more heterogenous macrohabitat types composed of patchy pebbles on sand with mobile gravel, patchy cobbles on sand, and patchy boulders on sand. Boulders were observed at 28 stations at the RWF (and one station along the RWEC-OCS). As a result of the more heterogenous physical composition and generally coarser substrates in the southwestern and central portions of the RWF, these benthic environments harbored more diverse epifaunal assemblages compared to the northern region of the RWF (Appendix X). Generally, patchy cobble and boulder on sand tends to be characterized by Gravel and Gravel Mixes (CMECS Substrate Groups) and Sandy Gravel, Cobble, and Pebble (CMECS Substrate Subgroups). Patchy pebbles on sand with mobile gravel is associated with Slightly Gravelly, Gravel Mixes, and Gravel (CMECS Substrate Groups) and CMECS Substrate Subgroups Slightly Gravelly Sand, Sandy Gravel, and Gravelly Sand (Table 4.3.2-4).

In areas of patchy pebbles on sand with mobile gravel, patchy cobbles on sand, and patchy boulders on sand, the CMECS Biotic Subclasses associated with these heterogenous macrohabitat types were a mix of Soft Sediment Fauna and Attached Fauna. Infauna biota associated with soft sediments were found in the patches of sand between the boulders, cobbles, and pebbles, on which the attached fauna were found (Appendix X). The hard substrate associated with these macrohabitat types, generally supports increasingly diverse epifaunal assemblages as grain sizes increase. Cobbles and boulders provide substrate and stability for biota to attach and grow; additionally, these habitats provide variable topography that creates complexity and additional niches for fauna to occupy. Where present, these large gravels were often colonized by attached epifauna, predominantly colonial tunicates, anemones, encrusting sponges, bryozoan, hydroids, and non-reef building hard corals, as well as diverse mobile epifauna such as hermit crabs, sea stars, and gastropods (Appendix X). Because the presence of cobbles and boulders is patchy in these macrohabitat types, these areas are interspersed with sandy habitats, further increasing niche space and diversity within these areas. Where coarser gravel (i.e., cobbles and boulders) on sandy substrates were documented at the RWF, epifaunal organisms were typically found growing on the physical substrate, including hydroids, bryozoa, barnacles, colonial tunicates, and occasional anemones. Orange colonial tunicates that were observed at 20 stations within the RWF (Appendix X) may be one of two non-native species, either the non-native tunicate *Botrylloides violaceus* (the violet tunicate) (Oka, 1927) or the non-native tunicate *Botrylloides diegensis* (the orange sheath tunicate) (Ritter and Forsyth, 1917). However, despite the high-resolution of the PV images, it is not possible to identify this organism to taxonomic rank of species and definitively state, without doubt, that this organism is a known non-native species. Sea pens (*Pennatulacea* sp.) were also often associated with these habitats at the RWF (Appendix X).

The structure provided by the cobbles and boulders in these habitats can also serve as nursery habitat for juvenile lobster, feeding ground for fish such as cod and black sea bass (*Centropristis striata*), and substrate upon which squid (including longfin squid, lay their eggs (Table 4.3.2-3). Further, the presence of boulders in mixed bottom types has been noted as an important feature for understanding the distribution of lobsters and Jonah crab in the region of the RWF (Collie and King, 2016; Table 4.3.2-4).

The Northern Star Coral, *Astrangia poculata* was documented at 4 stations at the RWF, all of which occurred within the central east portion of the RWF lease area. *Astrangia poculata* is not a reef forming coral but enhances the value of hard substratum by attracting other fauna when it occurs (Guida et al., 2017) and is considered a sensitive taxa for purposes of this assessment. This taxon is found in hard bottom habitats attached to cobbles and boulders. The four stations where *Astrangia poculata* was observed were characterized by habitats of continuous or patchy cobbles and/or boulders on sand. *Astrangia* spp. has a broad geographical distribution, and its low relief and non-reef building life history strategy provides a population level resiliency to disturbance. *Astrangia* spp. is also not documented to provide essential fish habitat (Dimond and Carrington, 2007). Any impacts to the star coral from construction should be minimal, localized, and recovery should be rapid (Aronson et al., 2008).

There were 4 instances in which a species of concern (defined in Guida et al. 2017) was documented at the RWF, all of which were the sea scallop, *Placopecten magellanicus*. In each instance, a single sea scallop individual was observed. The macrohabitat types these individuals were documented inhabiting were patchy cobbles on sand, patchy pebbles on sand with mobile gravel, and sand sheet (Table 4.3.2-4). Notably, the specific scallop individual observed in the sand sheet habitat was a small juvenile.

RWEC–OCS

Along the majority of the RWEC-OCS environmental complexity was low and the seafloor was overwhelmingly characterized by the macrohabitat types sand sheet or sand with mobile gravel (Figure 4.3.2-3). The exceptions were three stations adjacent to the RWF lease area where continuous large pebbles, cobbles, and boulders on sand were observed. It is possible given the habitats documented at these three stations that the northern star coral, a sensitive taxon, could inhabit this region, although no sensitive taxa were observed during the SPI/PV survey along the RWEC-OCS. No species of concern were observed along the RWEC-OCS. Given the prevalence of sand sheet along the RWEC-OCS, the CMECS Biotic Subclass was overwhelmingly Soft Sediment Fauna, with Small Tube-Building Fauna occurring as the CMECS Biotic Group in the northern portion of the RWEC-OCS and Larger Deep-Burrowing Fauna documented along the southern portion of the RWEC-OCS, which overlaps with regions of the RWF (Appendix X).

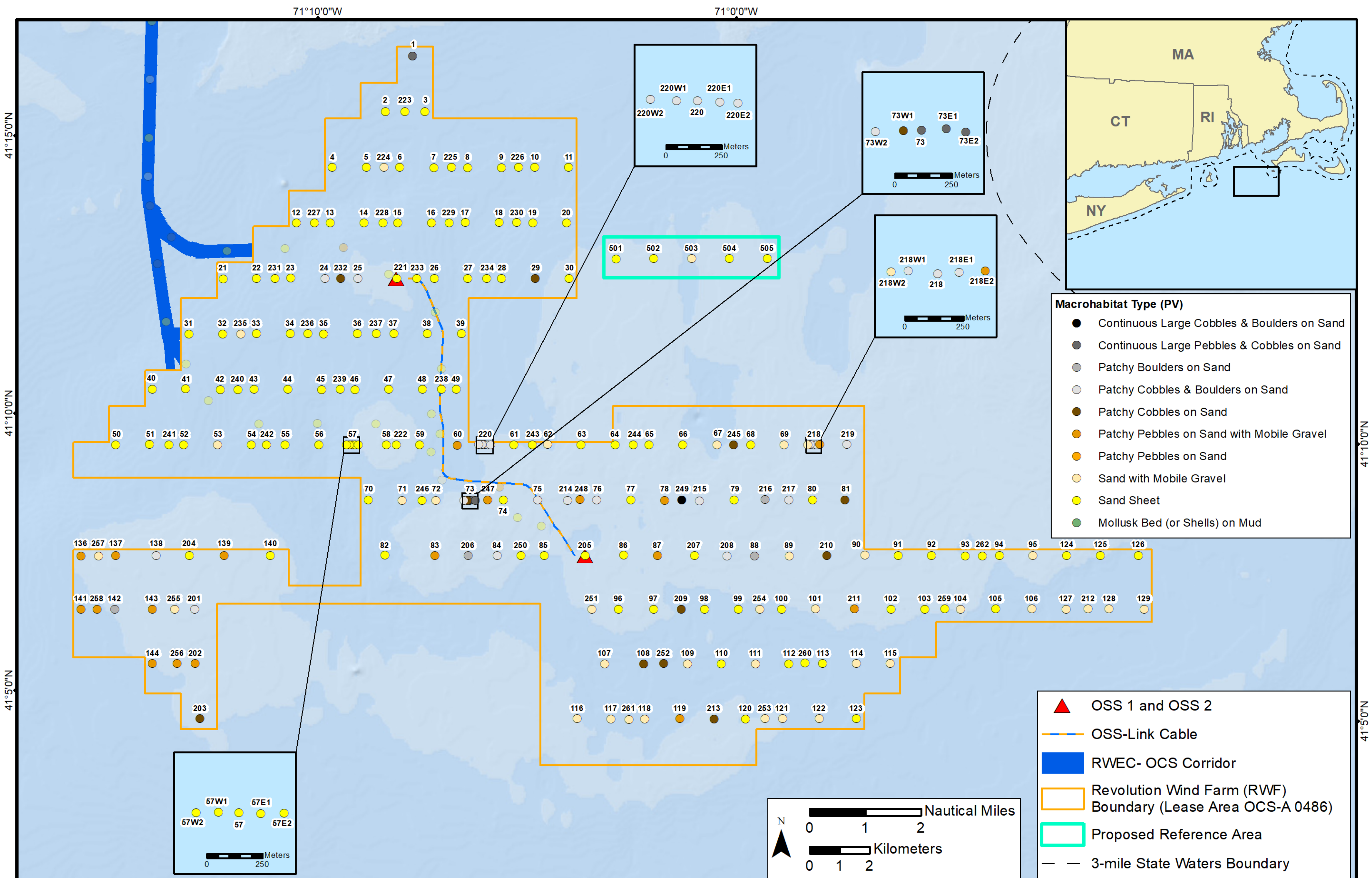
RWEC–RI

Broadly, the habitats along the RWEC-RI were low in environmental complexity, consisting mainly of sand sheet macrohabitat type. The exceptions were stations located in the central portions of Narragansett Bay, which were characterized as the macrohabitat types mollusk bed (or shells) on mud and patchy cobbles on sand (Figure 4.3.2-3). Despite the general consistency of this high-level macrohabitat type classification and distribution, the CMECS Biotic Group classifications were diverse across these RWEC-RI stations (e.g., Filamentous Algal Bed, Attached Sponges, Sessile Gastropods, Larger Deep-Burrowing Fauna), providing a greater level of detail in describing these benthic environments and highlighting the spatial variation in diversity found on the seafloor along this portion of the export cable (Appendix X) .

Along the RWEC-RI there were distinct spatial trends associated with the observed biological and physical features. The RWEC-RI northern-most stations were generally characterized by finer substrate, dominated by soft-sediment fauna, higher turbidity, and more reduced sediments. Stations in the middle of the West Passage of Narragansett Bay were characterized by mussel and *Crepidula* beds with other attached organisms including barnacles, sponges, and macroalgae. The stations at the mouth of Narragansett Bay and the stations leading offshore to the 3-mile state water boundary were generally dominated by soft sediment infauna concurrent with inferred fauna through visible tracks, trails, and burrows; these stations tended to be characterized by Larger Deep-Burrowing Fauna or Small Tube-Building Fauna, with Larger Tube-Building Fauna (CMECS Biotic Groups) increasing in prevalence at stations near the state waters boundary. These findings are consistent with recent surveys in the area (Shumchenia and King, 2019) and expected fauna based on historical studies.

No sensitive taxa or species of concern were observed along the RWEC-RI. However, SAV beds consisting primarily of eelgrass (*Zostera marina*), with additional presence of widgeon grass (*Ruppia maritima*) recorded in mapping efforts, occur in Narragansett Bay. SAV beds are found in shallow coastal areas, including along the western shores of Conanicut and Dutch Islands, proximal to the RWEC-RI route. However, no SAV were observed during the SPI/PV survey along the RWEC-RI route (Appendix X). During the SAV video survey, a total of 52 transect lines of a variety of distances and orientations were mapped in nearshore regions around the landfall where SAV was expected at a higher probability, as well as potential HDD exit pit locations. SAV, specifically eelgrass (*Zostera marina*), was observed at two locations within the area identified as potential material storage near the landfall. An eelgrass bed was also observed along the shoreline approximately 492 feet (150 m) east of the potential material storage area near landfall. In addition, based on GIS analysis of available eelgrass mapping for Narragansett Bay (RIGIS, 2017), a small section of eelgrass is present on the western side of Dutch Island, approximately 679 feet (207 m) from the proposed RWEC-RI cable centerline. The next closest area of mapped eelgrass is on the western side of Conanicut Island, approximately 1,411 feet (430 m) from the RWEC-RI cable centerline.

Figure 4.3.2-1 Predominant Benthic Macrohabitat Types Observed at the RWF and Reference Area



Background: ESRI Oceans

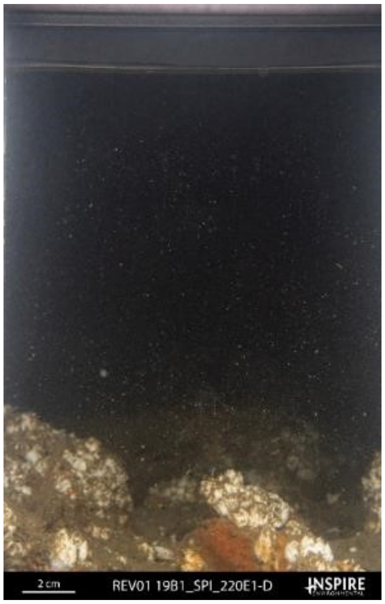
The RWEC route shown here and described in the COP differs slightly from that used at the time of the SPI/PV survey, however the SPI/PV results are considered reflective of the proposed route.

Document Name: REV01_19B1_PV_HabitatType_stn_site

Coordinate System: NAD 1983 UTM Zone 19N (meters)

Date: 10/1/2020

Figure 4.3.2-2 Example SPI and PV Images Depicting Macrohabitat Types Observed Across the RWF and Along the RWEC-OCS and RWEC-RI



(A)

(B)

(C)

(D)

Figure 4.3.2-2 (*continued*)

(E)

(F)

(G)

(H)

Figure 4.3.2-3 Predominant Benthic Macrohabitat Types Observed Along the RWEC-OCS and RWEC-RI

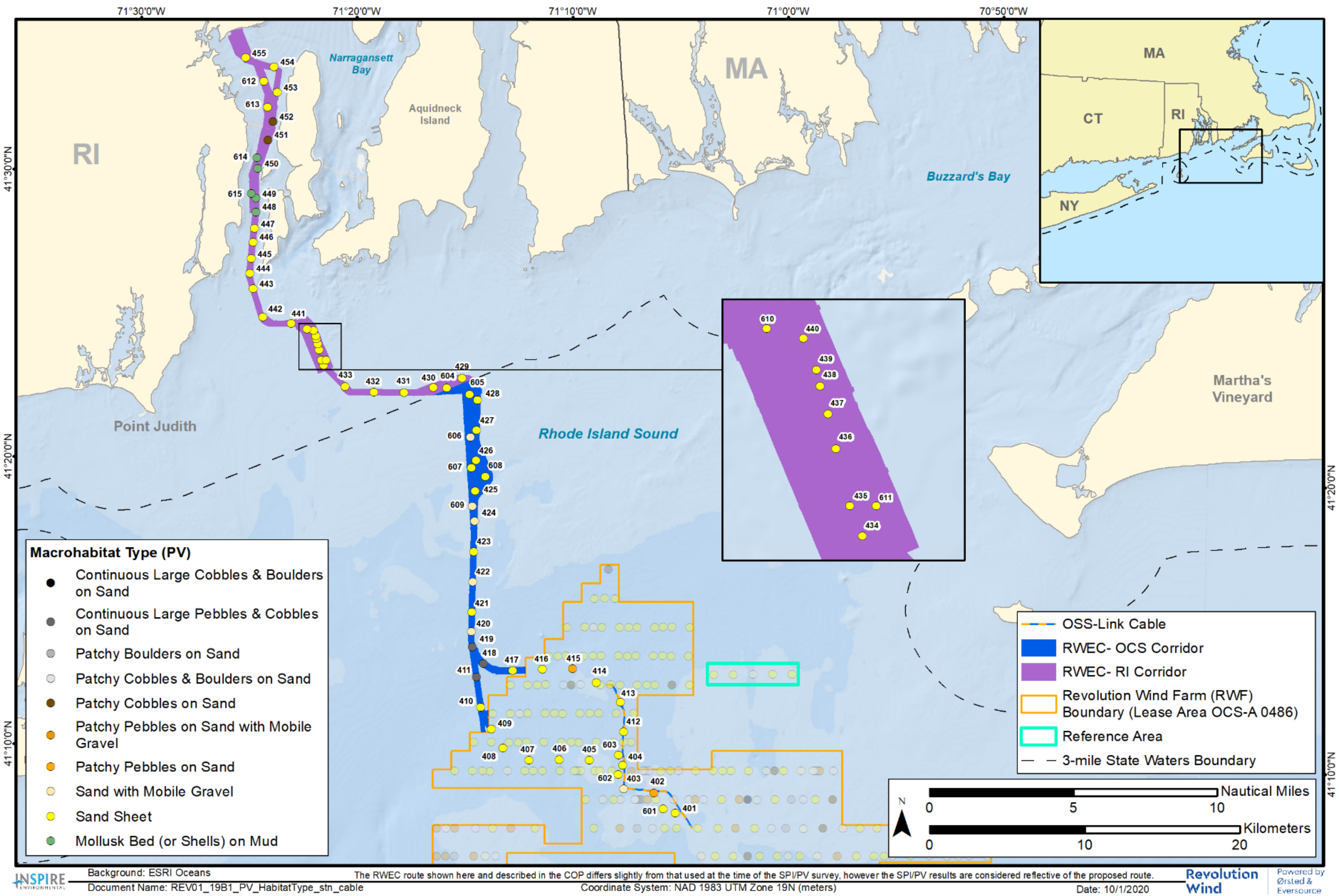


Table 4.3.2-1 Common Macroalgal Species Known from the Vicinity of the RWF and RWEC and Their Potential to Occur

Species	Preferred Habitat	Depth Range	Growth Type	Potential for Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI
Agarum cribrosum	Rocks, cobble	Subtidal to approximately 131 ft (40 m)	Single blade up to 59 in (150 cm) with stipe attached to a holdfast	Limited potential for occurrence due to depth restrictions, but possible where continuous boulders are present (Vadas and Steneck, 1988; McGonigle et al., 2011).	Limited potential, but possible where boulders and cobbles are present (Vadas and Steneck, 1988; McGonigle et al., 2011).	Limited potential because minimal cobbles and no boulders present in the surveyed area (Vadas and Steneck, 1988; McGonigle et al., 2011).
Coral weed (*Corallina officinalis*)	Rocks, cobble, large gravel, shells	Lower intertidal and subtidal	Coralline red algae that can encrust on rocks and shells; grows to about 4 in (10 cm)	No potential due to depth restrictions.	No potential due to depth restrictions.	Limited potential because minimal cobbles and no boulders present in the surveyed area (Van Patten and Yarish, 2009).
Coralline red algae (*Order Corallinales*)	Rocks, cobble, large gravel, or epiphytic on shells or algae	Subtidal	Algal crusts	Potential presence, within depth range (Vadas and Steneck, 1988; McGonigle et al., 2011).	Potential presence, within depth range (Vadas and Steneck, 1988; McGonigle et al., 2011).	Potential presence, within depth range (Vadas and Steneck, 1988; McGonigle et al., 2011).
Encrusting macroalgae (*Hildenbrandia sp.)*	Rocks, cobble, large gravel, shells	Subtidal	Algal crusts	Potential presence on hard substrata (DiPreta, 2019).	Potential presence on hard substrata (DiPreta, 2019).	Potential presence on hard substrata (DiPreta, 2019).

Species	Preferred Habitat	Depth Range	Growth Type	Potential for Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI
*Foliose red algae (*Phylum Rhodophyta*)	Rocks, cobble, large gravel, or epiphytic on shells or algae	Subtidal	Low-growing, foliose red algae	Potential presence, known to occur in the region within depth ranges (Vadas and Steneck, 1988; McGonigle et al., 2011).	Potential presence, known to occur in the region within depth ranges, potentially suitable habitat is present at the portions of the RWEC near the RWF (Vadas and Steneck, 1988; McGonigle et al., 2011).	Potential presence, known to occur in the region within depth ranges (Vadas and Steneck, 1988; McGonigle et al., 2011).
Green thread (*Chaetomorpha linum*)	Free floating or drifting; often entangled with other algae	Upper Intertidal, and free-floating mats	Filamentous clumps and tangles	Potential for occasional presence as free-floating mat (Van Patten and Yarish, 2009).	Potential for occasional presence as free-floating mat (Van Patten and Yarish, 2009).	Potential for occasional presence as free-floating mat (Van Patten and Yarish, 2009).
Gut weed *(Ulva intestinalis)*	Rocks, mud, sand, tide pools, epiphyte on other algae and shells	Intertidal- Upper Intertidal and free-floating mats	Unbranched, flattened, gas-filled tubes with undulating edges to approximately 16 in (40 cm) long	Potential for occasional presence as free-floating mat (Van Patten and Yarish, 2009; Shimada et al., 2003).	Potential for occasional presence as free-floating mat (Van Patten and Yarish, 2009; Shimada et al., 2003).	Potential for occasional presence as free-floating mat (Van Patten and Yarish, 2009; Shimada et al., 2003).

Species	Preferred Habitat	Depth Range	Growth Type	Potential for Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI
Hooked red weed *(Bonnemaisonia hamifera)*	Rocks, cobble, large gravel, often epiphytic on shells and algae	Subtidal	Small, highly branched red foliose algae growing to 4 in (10 cm)	Potential presence. Known to occur in the region within depth ranges, and potentially suitable habitat is present (Van Patten and Yarish, 2009).	Potential presence. Known to occur in the region within depth ranges, potentially suitable habitat is present at portions of the RWEC near the RWF (Vadas and Steneck, 1988; McGonigle et al., 2011).	Potential presence. Known to occur in the region within depth ranges (Vadas and Steneck, 1988; McGonigle et al., 2011).
Horsetail kelp *(Laminaria digitata)*	Rocks, large cobble	Subtidal in wave exposed areas	Large, wide, brown blade with central holdfast; grows to 39 in (1 m)	Very limited potential for occurrence because of unsuitable depth, habitat, and offshore location; only possible where boulders are present (Van Patten and Yarish, 2009).	Very limited potential for occurrence because of unsuitable depth, habitat, and offshore location; only possible where boulders are present (Van Patten and Yarish, 2009), particularly at portions of the RWEC near the RWF.	Very limited potential for occurrence because of unsuitable depth, habitat, and offshore location.
Irish moss *(Chondrus crispus)*	Rocks	Lower intertidal and shallow subtidal	Shrub-like, densely branched; grows to 6 in (15 cm)	No potential due to depth restrictions.	No potential due to depth restrictions.	Limited potential in nearshore intertidal areas along the RWEC -RI route if rocks or boulders are present (Van Patten and Yarish, 2009; Green-Gavrielidis et al., 2018).

Species	Preferred Habitat	Depth Range	Growth Type	Potential for Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI
Kelp *(Saccharina latissimi, S. longicruris)*	Rocks, large cobble, rocky reef	Subtidal to approximately 115 ft (35 m)	Single blades with stipe that grow to 36 ft (11 m) (*S. longicruris*)	Very limited potential because of because of unsuitable depth, habitat, and offshore location; only possible where boulders are present (Vadas and Steneck, 1988; Van Patten and Yarish, 2009).	Very limited potential for occurrence on boulders, particularly at portions near the RWF because of depth, habitat, and offshore location (Vadas and Steneck, 1988; Van Patten and Yarish, 2009).	Very limited potential for occurrence on boulders, because of depth, habitat, and offshore location (Vadas and Steneck, 1988; Van Patten and Yarish, 2009).
Lacy red weed *(Callophyllis cristata)*	Rocks, cobble, large gravel, or epiphytic on shells or algae	Subtidal, deeper waters	Small, highly branched red foliose algae growing to 2 in (5 cm)	Potential presence. Known to occur in the region within depth ranges, and potentially suitable habitat (Van Patten and Yarish, 2009).	Potential presence. Known to occur in the region within depth ranges; potentially suitable habitat particularly at portions near the RWF (Van Patten and Yarish, 2009).	Potential presence. Known to occur in the region within depth ranges; potentially suitable habitat (Van Patten and Yarish, 2009).
Purple claw weed *(Cystoclonium purpureum)*	Hard substrata such as rocks and shells over sand and mud	Intertidal and shallow subtidal	Soft cylindrical, purplish fronds, 0.1 in (3 mm) wide up to 23.6 in (60 cm) long	Very limited potential for occurrence due to depth limitations.	Very limited potential for occurrence due to depth limitations.	More likely to occur along the RWEC-RI in Narragansett Bay (Green-Gavrielidis et al., 2018).
Red alga *(Gracilaria vermiculophylla)**	Hard substrata such as rocks and shells over sand and mud	Intertidal and upper sublittoral zones.	Coarsely branched, loose lying or attached, cylindrical and up to 19.7 in (50 cm) long	Very limited potential for occurrence due to depth limitations.	Very limited potential for occurrence due to depth limitations.	More likely to occur along the RWEC-RI in Narragansett Bay (Green-Gavrielidis et al., 2018).

Species	Preferred Habitat	Depth Range	Growth Type	Potential for Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI
Sargasso weed *(Sargassum filipendula)*	Free floating	Open water and embayments	Multi-branched with small, gas-filled nodules	Potential for occasional presence as free-floating mats (Van Patten and Yarish, 2009).	Potential for occasional presence as free-floating mats (Van Patten and Yarish, 2009).	
Sea lettuce *(Ulva lactuca, U. compressa, U. rigida)*	Rocks and rocky reefs, epiphyte on other algae and shells	Intertidal- Upper Intertidal and free-floating mats	Attached via holdfast; grows to approximately 7.1 in (18 cm) in length	Very limited potential for species to occur as free-floating mats because of the distance to nearshore habitat where this species occurs.	Very limited potential for species to occur as free-floating mats because of the distance to nearshore habitat where this species occurs.	More likely to occur along the RWEC-RI in Narragansett Bay (Van Patten and Yarish, 2009; Shimada et al., 2003; Green-Gavrielidis et al., 2018; Guidone and Thornber, 2013).
Wire weed *(Ahnfeltia plicata)*	Rocks and drift	Subtidal	Branched algae attached to bottom substrate or drifting	Limited potential for species to occur as drift algae because of the distance to nearshore habitat where this species occurs.	Limited potential for species to occur as drift algae because of the distance to nearshore habitat where this species occurs.	More likely to occur along the RWEC -RI (Van Patten and Yarish, 2009).

Table 4.3.2-2 Common Species by Benthic Habitat Type

Habitat Type	Phylum or Class	Species (With Common Name if Available)	References
Sand substrates	Arthropoda	Horseshoe crab (*Limulus polyphemus*)	ASMFC, 2010; Collie et al., 2008; NJDEP, 2016; Smith et al., 2017
	Asteroidea	Blood star	DWW, 2012
	Bivalvia	Atlantic sea scallop (*Plactopecten magellanicus*)*, ocean quahog (*Artica islandica*), Atlantic nut clam (*Nucula proxima)*, Waved astarte (*Astarte undata*), chestnut astarte (*A. castanea*), Atlantic surf clam (*Spisula solidissima*), dwarf surf clam (*Mulinia lateralis)*, hard clam (*Mercenaria mercenaria*), gem clam (*Gemma gemma*)*, clams (*Lyonsia arenosa, Macoma tenta, Periploma fragile, Pitar morrhuana, Solemya velum, Tellina agilis, Yoldia limatula)*	Steimle, 1982; Zajac, 1998; Fay et al., 1983; Meyer et al., 1981; Cargnelli et al., 1999a; Henry and Nixon 2008; Calabretta and Oviatt, 2008; URI GSO, 2019
	Cnidaria	Tube-dwelling anemone (*Ceriantheopsis americana)**	URI GSO, 2019
	Cephalopoda	Squid egg masses and newly hatched larvae	Macy and Brodziak, 2001; NEFSC, 2005
	Crustacea	Tube forming amphipods*: including *Ampelisca agassizi, A. abdita, A. vadorum,*and *Microdeutopus gryllotalpa* Free-living amphipods: Caprellidae and Podoceridae	Steimle, 1982; Wigley,1968; DWW, 2012; URI GSO, 2019
		American lobster, Atlantic rock crab, sand shrimp (*Crangon septemspinosis*), hermit crabs*, Genus *Haustorid, Phoxocephalid, Leptocuma, Chiridotea, and Cancer* spp. Jonah crab (*Cancer borealis*)*, lady crab (*Ovalipes ocellatus*), commensal crabs *Pinnixia sayana*, Cumaceans *Diastylis sculpta* and *Leucon americanus*	Robichaud et al., 2000; Williams and Wigley, 1977; Collie et al., 2008; Calabretta and Oviatt, 2008; Shumchenia et al. 2016; URI GSO, 2019
	Echinoidea	Hairy sea cucumber (*Sclerodactyla briareus*), Sand dollar˙(*Echinarachnius parma*)*	Wigley, 1968; DWW, 2012; URI GSO, 2019
	Gastropoda	Northern moon snail (*Lunatia heros*)*, *Nassarius* spp., *Ilyanassa trivittata*, channeled whelk (*Busycotypus canaliculatus*), common slipper shell, *Turbonilla*	Wigley, 1968; DWW, 2012; Peemoeller and Stevens, 2013; NBEP, 2017; URI GSO, 2019
	Ophiuroidea	More detailed taxonomy not provided	Poppe et al., 2014b
	Sipunculoidea	Peanut worm (*Phascolopsis gouldii*)	URI GSO, 2019

Habitat Type	Phylum or Class	Species (With Common Name if Available)	References
Gravel/granule substrates	Asteroidea	Sea star*, blood star, common sea star	Collie et al., 1997; Redmond and Scott, 1989; Dickinson et al., 1980
	Bivalvia	Waved astarte, chestnut astarte, Genus *Placopecten,* including Atlantic sea scallop*, ocean quahog, jingle shell, *Anomia simplex*	Collie et al., 1997; Redmond and Scott, 1989; Dickinson et al., 1980; Wigley, 1968; Jenkins et al., 1997; Hargis and Haven; 1999; URI GSO, 2019
	Cephalopoda	Squid egg masses, including longfin squid and newly hatched larvae	Macy and Brodziak, 2001; NEFSC, 2005
	Crustacea	Tube-forming Amphipods*: *Ampelisca agassizi, A. abdita and A. vadorum*; Free-living Amphipods*: Caprellidae and Podoceridae, American lobster, sand shrimp*, hermit crabs, Genus *Haustorid, Phoxocephalid, Leptocuma, Chiridotea*, and *Cancer* spp.*, Jonah crab (*Cancer borealis*)*, Atlantic rock crab	Collie et al., 1997; Redmond and Scott, 1989; Dickinson et al., 1980; Cobb and Wahle, 1994; Shumchenia et al. 2016; Wahle et al., 2015
	Gastropoda	Northern moon snail, *Nassarius* spp., channeled whelk, common slipper shell	Collie et al., 1997; Redmond and Scott, 1989; Dickinson et al., 1980; NBEP 2017
	Ophiuroidea	Genus *Ophiopholis* and *Ophiacantha*	Collie et al., 1997; Wigley, 1968
Gravel/granule substrates	Polychaeta	Tube-forming*: *Phyllochaetopterus socialis*, *Spiochaetopterus oculatus*, *Filograna implexa, Chone infundibuliformis, Protula tubalaria* Carnivorous and omnivorous: *Nephtys incisa*, *Eunice norvegica* Deposit feeding: *Thelephus cincinnatus*	Collie et al., 1997; Redmond and Scott, 1989; Dickinson et al., 1980; URI GSO, 2019
Cobbles, boulders, rocky reef, rock outcrop	Anthozoa	Sea anemones*˙, Order Alcyonacea (both gorgonians and non-gorgonians) tulacea[b]; schleractinian coral *Astrangia poculata*	Poppe et al., 2011; Northeast Ocean Data, 2019; DWW, 2012; Grace, 2017
	Asteroidea	Blood star, common sea star, Genus *Solaster* and *Crossaster*	DWW, 2012; Wigley, 1968; Collie et al., 1997
	Bivalvia	Horse mussel (*Modiolus modiolus*), eastern oyster, Atlantic sea scallop *, waved astarte, chestnut astarte, genus *Brachiopoda, Placopecten, Anomia,* and *Musculus*	DWW, 2012; Wigley, 1968; Jenkins et al., 1997; Hargis and Haven; 1999

Habitat Type	Phylum or Class	Species (With Common Name if Available)	References
	Bryozoa*	More detailed taxonomy not provided	DWW, 2012
	Cephalopoda	Squid egg masses and newly hatched larvae including longfin squid	Macy and Brodziak, 2001; NEFSC, 2005
	Chordata	Tunicates (*Boltenia* spp.); Didemnum vexilllum	Wigley, 1968; Grace, 2017; Auker, 2019
	Crustacea	Tube-forming Amphipods *˙: *Ampelisca agassizi* and *A. vadorum* Free-living Amphipods: Caprellidae* and Podoceridae* Barnacles* (Infraclass Cirripedia and genus *Balanus*), America lobster, sand shrimp*˙, hermit crabs*˙, Genus *Cancer* and *Hyas*˙, Jonah crab, Atlantic rock crab, green crab *Carcinus maenas*, Asian shore crab *Hemigrapsis sangineus*	DWW, 2012; Wigley, 1968; Wahle et al., 2015; Jaini et al., 2018
	Echinoidea	Green sea urchin (*Strongylocentrotus droebachiensis*)	Collie et al., 1997; Wigley, 1968
	Gastropoda	Northern moon snail, *Nassarius* spp.*, limpet*, channeled whelk, knobbed whelk (*Busycon carica*)*, whelk (*Sinistrofulgur sinistrum*), common slipper shell*, genus *Neptunea, Dendronotus*, and *Doris*	Poppe et al., 2014b; Wigley, 1968
	Hydrozoa	Hydroids*˙, including genera Eudendrium, Sertularia, and Bougainvilia	Poppe et al., 2011; DWW, 2012
	Ophiuroidea	*Ophiopholis aculeate* and *Ophiacantha* spp.	Collie et al., 1997; Wigley, 1968
	Polychaeta	Tube-forming and suspension feeding: *Phyllochaetopterus socialis, Filograna implexa, Chone infundibuliformis, Protula tubalaria*, genus *Serpula* and *Spiorbis*, *Ninoe nigripes* Carnivorous and omnivorous: *Nephtys incisa, Eunice norvegica*	Wigley, 1968; DWW, 2012; URI GSO, 2019
	Porifera	Encrusting sponges* of genera *Halichondria, Clathria, Polymastia*, Clionia*,* and *Myxilla, Suberites* spp.	Poppe et al., 2011; DWW, 2012; Wigley, 1968; Grace, 2017; URI GSO, 2017

Table 4.3.2-3 Ecologically and Economically Important Shellfish Species and Potential for Occurrence at the RWF and RWEC

Species	Life Stage Present	Preferred Habitat	Potential Time of Year in Region	Potential Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI	References
American lobster (*Homarus americanus*)	All	Prefers rocky habitat, including mixed bottom types, but may burrow in featureless sand or mud habitat.	Year-round	Potential presence in the vicinity of rocky areas; may seasonally pass through during migratory movements.	Potential presence in the vicinity of rocky areas along the RWEC-OCS near the RWF; may seasonally pass through during migratory movements.	May seasonally pass through the RWEC-RI, including nearshore waters, during migratory movements.	Collie and King, 2016; ASMFC, 2015; Cobb and Wahle, 1994; MADMF, 2019; RIDEM, 2019; URI GSO, 2017
Atlantic rock crab (*Cancer irroratus*)	All	Prefers depths ranging from 20 to 1,496 ft (6 to 456 m), but most common in waters less than 65 ft (20 m) deep. Prefers rocky and gravely substrate but also occurs in sand.	Year-round	Limited potential for presence because species prefers areas that are shallower than the RWF.	Limited potential for presence along the RWEC-OCS near the RWF because species prefers areas that are shallower.	Potential presence in the RWEC-RI and in nearshore waters.	Krouse, 1980; Robichaud et al., 2000; Williams and Wigley, 1977; URI GSO, 2017
*Atlantic sea scallop (*Plactopecten magellanicus*)	All	Found on sand, gravel, shells, and other rocky habitat. Larvae settle out on gravel and rocky substrate. Found from mean low water to depths of 656 ft (200 m). This species also has designated EFH in the RWF and RWEC (Essential Fish Habitat Assessment Appendix L).	Year-round	Potential for presence throughout the RWF	Potential for presence throughout RWEC-OCS	Potential for presence at offshore portions of the RWEC-RI	NEFSC, 2004; Mullen and Moring, 1986

Species	Life Stage Present	Preferred Habitat	Potential Time of Year in Region	Potential Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI	References
Atlantic surf clam (*Spisula solidissima*)	All	Prefers depths ranging from 26 to 216 ft (8 to 66 m) in medium-grained sand but may also occur in finer-grained sediments. Burrows up to 3 ft (0.9 m) below the sediment-water interface. This species also has designated EFH along the RWEC route (Appendix L).	Year-round	Potential for presence in sandy substrates.	Potential for presence in sandy substrates.	Potential for presence in sandy substrates.	Fay et al., 1983; Meyer et al., 1981; Cargnelli et al., 1999a
Channeled whelk (*Busycotypus canaliculatus* and *B. carica*)	All	Commonly found in nearshore and offshore environments, but preferred depth range is not known. Occurs in sandy and fine-grained sediments where they can bury themselves. Eggs are laid on sand in intertidal and subtidal areas.	Year-round	Potential for presence in sandy substrates.	Potential for presence in sandy substrates.	Potential for presence in sandy substrates. Potential for eggs to be laid in nearshore portions of the RWEC-RI route.	Fisher, 2009; Peemoeller and Stevens, 2013; URI GSO, 2017
Eastern oyster (*Crassostrea virginica*)	All	Larvae and adults can be found on hard bottom substrate or shell substrate to a depth of 36 ft (11 m) but is most common between 8 to 18 ft (2.5 to 5.5 m) deep.	Year-round	Not expected to occur, as no oyster reefs are known to occur in the vicinity.	Not expected to occur, as no oyster reefs are known to occur in the vicinity.	Not expected to occur, as no oyster reefs are known to occur in the vicinity.	Jenkins et al., 1997; Hargis and Haven, 1999

Species	Life Stage Present	Preferred Habitat	Potential Time of Year in Region	Potential Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI	References
Hard clam (*Mercenaria mercenaria*)	All	Adults and juveniles are commonly found in intertidal and shallow subtidal waters. Eggs and larvae are planktonic and settlement occurs over sandy substrata.	Year-round	Not expected to occur as clam beds are not known to occur in the vicinity and depths are too great.	Not expected to occur as clam beds are not known to occur in the vicinity and depths are too great.	Potential presence near RWEC-RI within Narragansett Bay. Not expected to occur at the offshore portions of RWEC-RI as clam beds are not known to occur in the vicinity and depths are too great.	Henry and Nixon, 2008
*Hermit crab (*Pagurus pollicaris*)	All	Adults and juveniles are common in shallow subtidal sandy habitats and salt marshes. Eggs and larvae are planktonic.	Year-round	Potential presence but may be restricted by depth.	Potential presence but may be restricted by depth.	Potential presence at the offshore portions of RWEC-RI but may be restricted by depth. More likely to be present along RWEC-RI within Narragansett Bay.	URI GSO, 2017
Horseshoe crab (*Limulus polyphemus*)	All	Prefer depths shallower than 98 ft (30 m) but known to occur in depths greater than 656 ft (200 m). Occurs commonly on sandy substrate but is a habitat generalist and may be found on gravel and cobbles as adult. During full moon tides in spring and summer, migrates inshore to shallow bays and sandy beaches to spawn. Juveniles use shallow nearshore areas	Year-round	Potential presence throughout.	Potential presence throughout.	Potential presence throughout. Juveniles may be present in higher densities in the vicinity of nearshore portions of the RWEC-RI.	NJDEP, 2016; ASMFC, 2010; URI GSO, 2017

Species	Life Stage Present	Preferred Habitat	Potential Time of Year in Region	Potential Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI	References
		as nurseries before moving into deeper waters.					
*Jonah crab (*Cancer borealis*)	Adults	Prefers depths ranging from 164 to 984 ft (50 to 300 m), but also occurs in shallower waters, perhaps associated with circadian rhythms. Found across sediment types, from sand, to small gravel, to rocky areas.	Year-round	Presence at the RWF. Studies found higher abundances in fine sand, followed by coarse sand, and boulders on sand.	Potential presence along the RWEC-OCS. Studies found higher abundances in fine sand, followed by coarse sand, and boulders on sand.	Potential presence along the RWEC-RI. Studies found higher abundances in fine sand, followed by coarse sand, and boulders on sand.	Collie and King, 2016; Robichaud and Frail, 2006; Jeffries, 1966
Longfin squid (*Doryteuthis pealeii*)	All	May-November found in inshore waters, and adults are demersal during the day. Eggs are laid on a variety of substrates, including sand and hard bottom. Newly hatched squid become demersal then migrate to offshore waters. December-April: Offshore waters between 328 and 550 ft (100 and 168 m) deep. This species also has designated EFH in portions of the RWF and RWEC route (Appendix L).	May-November	Presence where rocky and gravelly areas are found between May-November; eggs have been observed at the RWF. Not expected to be present between December and April.	Potential presence where rocky and gravelly areas are found between May-November; eggs may be laid along the RWEC-OCS. Not expected to be present between December and April.	Potential presence along offshore portions of the RWEC-RI where rocky and gravelly areas are found, between May-November; eggs may be laid along offshore portions of the RWEC-RI. Not expected to be present between December and April.	Macy and Brodziak, 2001; NEFSC, 2004; URI GSO 2017

Species	Life Stage Present	Preferred Habitat	Potential Time of Year in Region	Potential Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI	References
Northern shortfin squid (*Illex illecebrosus)*	Adults	Prefers depths ranging from 328 to 656 ft (100 to 200 m) but is also known to occur in waters shallower than 60 ft (18 m). Egg masses are thought to be neutrally buoyant. This species also has designated EFH within the RWF (Appendix L).	Year- round	Preferred depth range is deeper than the RWF but may occasionally be present within this area. Neutrally buoyant egg masses may occasionally be present throughout the RWF.	Preferred depth range is deeper than the RWEC-OCS but may occasionally be present within this area. Neutrally buoyant egg masses may occasionally be present throughout both the RWEC-OCS.	Preferred depth range is deeper than the offshore portion of the RWEC-RI but may occasionally be present within this area. Neutrally buoyant egg masses may occasionally be present along the offshore portions of the RWEC-RI.	Black et al., 1987; Grinkov and Rikhter, 1981' O'Dor and Balch, 1985
Ocean quahog clam (*Artica islandica*)	Juveniles and Adults	Prefers depths ranging from 82 and 200 ft (25 and 61 m) in medium to fine grain sand. This species also has designated EFH within the RWF and along the RWEC-OCS (Appendix L).	Year- round	Potential presence throughout	Potential presence at deeper portions of the RWEC-OCS.	Potential presence along the offshore portions of the RWEC-RI. Nearshore portions of the RWEC-RI are outside of the preferred depth range of the species.	Cargnelli et al., 1999b
*Sand shrimp (*Crangon septemspinosa*)	Juveniles and Adults	Migrates to deeper waters out of estuaries in the fall as water temperatures decrease, returning in the spring when temperatures increase.	Spring through fall	Potential presence throughout.	Potential presence along the RWEC-OCS.	Potential presence along the RWEC-RI.	Taylor and Collie, 2003

Species	Life Stage Present	Preferred Habitat	Potential Time of Year in Region	Potential Presence at the RWF	Potential for Presence along the RWEC-OCS	Potential for Presence along the RWEC-RI	References
Spider crab (*Libinia emarginata*)	Juveniles and Adults	Occurs in shallow subtidal nearshore habitats and on the continental shelf to depths approaching 164 ft (50 m).	Year-round	Potential presence throughout.	Potential presence along the RWEC-OCS.	Potential presence along the RWEC-RI.	URI GSO, 2017

Table 4.3.2-4 Description of the Habitat Types Observed at the RWF, Along the RWEC, and/or at the Reference Area

Habitat Type	No. of Stations (Predominant)	Substrate Group	Substrate Subgroup	Biotic Subclass	Some General Biotic Groups[1]	Sensitive Taxa Observed	Species of Concern Observed
Continuous Large Cobbles and Boulders on Sand	1	Gravel	Cobble	Attached Fauna	Diverse Colonizers	Northern Star Coral	No
Patchy Cobble and Boulders on Sand[2]	21	Gravel, Gravel mixes	Sandy Gravel, Cobble, Pebble	Soft Sediment Fauna; Attached fauna	Attached Hydroids; Larger Deep-Burrowing; Larger Tube building	Northern Star Coral	No
Patchy Boulders on Sand	4	Gravel mixes, Gravelly, Slightly Gravelly	Slightly Gravelly Sand; Sandy Gravel; Gravelly Sand	Soft sediment fauna	Larger Deep-Burrowing Fauna	None	No
Continuous Large Pebbles and Cobble on Sand	7	Gravel Mixes; Gravel	Sandy Gravel; Cobble; Pebble	Attached Fauna	Attached Hydroids, Barnacles	None	No
Patchy Cobbles on Sand	13	Sand; Gravelly; Slightly Gravelly	Sand or finer; Gravelly Sand; Slightly Gravelly Sand	Soft sediment fauna; Benthic macroalgae	Larger Deep-Burrowing Fauna; Larger Tube-Building Fauna; Mobile Crustaceans on Soft Sediments; Filamentous Algal Bed; Attached Sponges	None	Sea Scallop

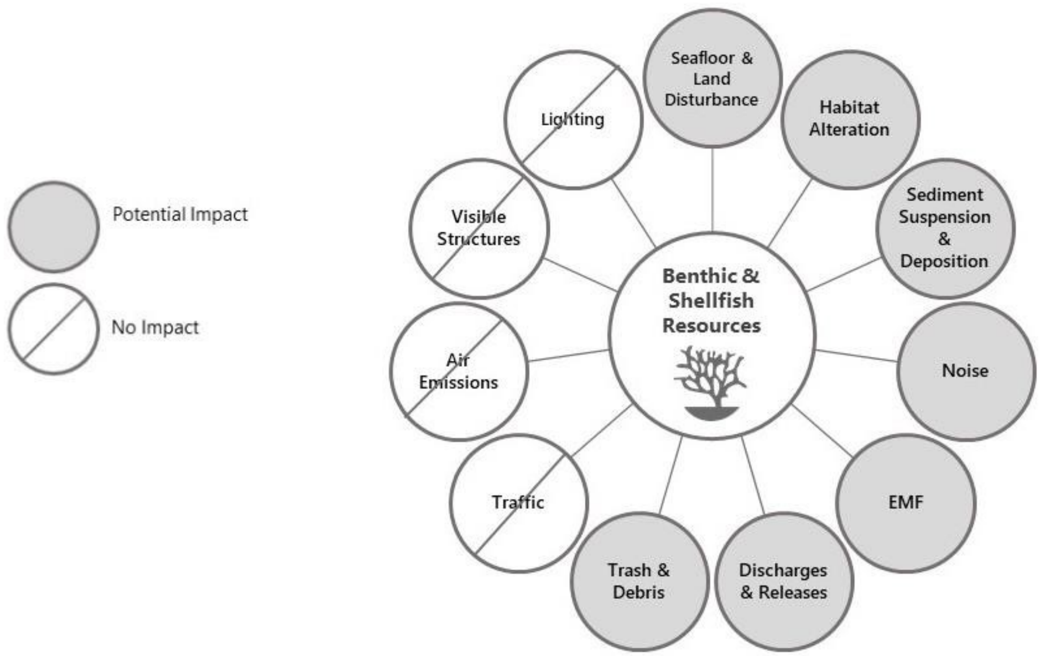
Habitat Type	No. of Stations (Predominant)	Substrate Group	Substrate Subgroup	Biotic Subclass	Some General Biotic Groups[1]	Sensitive Taxa Observed	Species of Concern Observed
Patchy Pebbles on Sand with Mobile Gravel[2]	18	Slightly gravelly; Gravel Mixes; Gravelly; Gravel	Slightly Gravelly Sand; Sandy Gravel; Gravelly Sand	Soft sediment fauna; Attached fauna	Larger Deep-burrowing Fauna; Small and Larger Tube-Building Fauna; Barnacles; Attached Hydroids	None	Sea Scallop
Patchy Pebbles on Sand	2	Slightly Gravelly	Slightly Gravelly Sand	Soft Sediment Fauna	Larger Deep-Burrowing Fauna; Small Tube-Building Fauna	None	None
Sand with Mobile Gravel[2]	42	Slightly Gravelly; Gravelly; Gravel	Slightly Gravelly Sand; Gravelly Sand; Sand Gravel; Granule;	Soft Sediment Fauna	Larger Deep-Burrowing Fauna; Small Tube-Building Fauna	None	None
Sand Sheet[2]	178	Sand	Sand or Finer	Soft Sediment Fauna	Small and Larger Tube-Building Fauna; Larger Deep-burrowing; Mobile Crustaceans on Soft Sediments	None	Juvenile Sea Scallop
Mollusk Bed (or Shells) on Mud	5	Sand	Sand or finer	Soft Sediment Fauna; Attached Fauna	Mussel Bed, Small Tube-Building Fauna, Sessile Gastropods, Attached Hydroids	None	None

4.3.2.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the benthic and shellfish resources discussed above (Section 4.3.2.1). IPFs that may result in direct or indirect impacts to benthic and shellfish resources are depicted in Figure 4.3.2-4. Impacts will vary by habitat, species, and life stage, with some species/life stages being more vulnerable than others.

The analysis of impacts on benthic resources and shellfish are discussed separately for the RWF, RWEC–OCS, and RWEC–RI in the following sections. The IPFs are further defined for the construction and decommissioning phases of the Project and the O&M phase of the Project.

Figure 4.3.2-4 IPFs on Benthic and Shellfish ResourcesIPFs on Benthic and Shellfish Resources



Revolution Wind Farm

Based on the IPFs discussed in Table 4.3.2-5, during construction and decommissioning of the RWF, seafloor disturbance, habitat alteration, and sediment suspension/deposition are expected to affect sessile species and organisms with limited mobility, including early life stages (e.g., larvae and eggs) more than mobile species. However, these impacts, as well as impacts associated with construction noise, are expected to be temporary and cease when construction activity stops. During O&M and decommissioning of the RWF, impacts associated with seafloor disturbance, sediment suspension/deposition, and noise are expected to be similar but lesser in extent compared to construction. Seafloor disturbance activities that result in the conversion of soft sediment habitats to hard bottom habitat associated with foundations, scour protection, and cable protection (e.g., concrete mattresses or rock berms) along portions of the OSS–Link Cable and IAC routes, is expected to have long-term beneficial impacts on benthic organisms that rely on complex, hard bottom habitats. **Long-term impacts** may occur as a result of habitat alteration, as benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels in disturbed areas (e.g., Guarinello and Carey, 2020; AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Benthic species may experience **long-term impacts** caused by the conversion of soft bottom habitat to hard bottom habitat associated with foundations and associated scour protection, and cable protection (e.g., concrete mattresses) along portions of the OSS-Link Cable and IAC routes. These long-term impacts would be reversed following decommissioning of the Project. Inadvertent discharges/releases, trash and debris, and EMF are expected to have minimal impacts on benthic and shellfish resources during construction, O&M and decommissioning of the RWF. None of the IPFs are expected to result in population-level effects on benthic species, due to the scale and intensity of the Project activities, and the availability of similar habitat in the surrounding area. The impacts discussed in this section would vary slightly by habitat composition within the RWF.

Construction and Decommissioning

IPFs resulting in potential impacts on benthic resources and shellfish in the RWF area from the construction and decommissioning phases are summarized in Table 4.3.2-5. Only IPFs with potential impacts are included. Additional details regarding these potential impacts from the various IPFs during construction/decommissioning of the RWF are described in the following sections. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of these activities are anticipated result in impacts similar to or less than those described for construction, unless otherwise noted.

Table 4.3.2-5 IPFs and Potential Levels of Impact on Benthic and Shellfish Resources at the RWF During Construction and Decommissioning

IPF	Project Activity	Impact Characterization	
		Sessile Species and Life Stages *Includes eggs and larvae of mobile species, as well as species with limited mobility*	Mobile Species and Life Stages
Seafloor Disturbance	Seafloor preparation	Direct, short-term	Direct, short-term
	Impact pile driving and/or vibratory pile driving and foundation installation (WTG and OSS)	Direct, short-term	Direct, short-term
	IAC and OSS-Link Cable installation	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Habitat Alteration	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation	Direct, long-term	Direct, long-term Indirect, long-term

IPF	Project Activity	Impact Characterization	
		Sessile Species and Life Stages *Includes eggs and larvae of mobile species, as well as species with limited mobility*	Mobile Species and Life Stages
	RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)		
Sediment Suspension and Deposition	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Noise	Impact pile driving and/or vibratory pile driving	Direct, short-term	Direct, short-term
	Vessel noise, construction equipment noise, aircraft noise	Direct, short-term	Direct, short-term
Discharges and Releases	Hazardous materials spills Wastewater discharges	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term

Seafloor Disturbance and Habitat Alteration

Direct impacts on benthic resources and shellfish from seafloor disturbing activities will primarily affect species that prefer the types of habitats that will be disturbed. Seafloor-disturbing activities will include seafloor preparation, impact pile driving and/or vibratory pile driving/foundation installation, IAC and OSS-Link Cable installation, and vessel anchoring (including spuds). These activities could cause injury or mortality to benthic species and negatively affect their habitats.

Direct impacts on benthic resources and shellfish associated with the IAC and OSS-Link Cable installation, installation of cable protection, and seafloor preparation are expected to be similar, as the IAC will be installed in the same area that was disturbed during seafloor preparation. Sessile and slow-moving benthic species, including infaunal species that cannot get out of the way of the cable installation equipment, may be subject to mortality and injury. Because of the slow speed of the installation equipment and limited size of the impact area, it is expected that most mobile benthic species will be able to move out of the way and not be subject to mortality or injury but may still experience ***direct*** and ***short-term*** impacts. Sessile species and species with limited mobility may be subject to mortality or injury if they are present within the impact area during construction. Impact pile driving and/or vibratory pile driving and the installation of the WTG and OSS foundations and associated scour protection could crush and/or displace benthic species, particularly sessile species and eggs and larvae, resulting in ***direct*** and ***short-term*** impacts.

Impacts on benthic resources and shellfish associated with vessel anchoring (including spuds) are expected to be ***short-term*** and could include mortality or injury of slow-moving or sessile species within the impact areas of the spuds, anchors, anchor chain sweep. The extent of vessel anchoring impacts will vary, depending on the vessel type, number of vessels, and duration onsite, but would be smaller in spatial extent than other seafloor-disturbing construction/decommissioning activities.

Impacts on benthic resources and shellfish associated with boulder clearance and related seafloor preparation activities are expected to be ***direct*** and ***short-term***. Boulders relocated during seafloor preparation will be in new locations and may be in new physical configurations in relation to other boulders. Short-term loss of attached fauna is expected during relocation. Concerning these spatial and physical attributes, the boulders are not expected to return to pre-project conditions. However, relatively rapid (< 1 year) recolonization of these boulders is expected (Guarinello and Carey, 2020) and will return these boulders to their pre-project habitat function. Additionally, if relocation results in aggregations of boulders, these new features could serve as high value refuge habitat for juvenile lobster and fish as they may provide more complexity and opportunity for refuge than surrounding patchy habitat.

Overall, direct impacts on benthic resources and shellfish from seafloor preparation, impact pile driving and/or vibratory pile driving/foundation installation, IAC and OSS-Link Cable installation, and vessel anchoring (including spuds) are expected to be short-term, as the impacts will cease after the seafloor disturbance is completed in a given area; the activity will disturb a small portion of similar available habitat in the area.

In areas of sediment disturbance , benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization rates of benthic habitats are driven by the benthic communities inhabiting the area surrounding the affected region. Sand sheet and mobile sand with gravel habitats as found within and near the RWF are often more dynamic in nature; therefore, they are quicker to recover than more stable environments, such as fine-grained (e.g., silt) habitats and rocky reefs (Dernie et al., 2003). Species found in these more dynamic areas are often adapted to deal with more dynamic habitats and handle increases in sedimentation associated with wind and waves. These communities are expected to quickly recolonize a disturbed area, while communities not well adapted to frequent disturbance (e.g., cobble and boulder habitats) may take upwards of a year to begin recolonization. Regardless, the time needed for benthic recovery would result in a ***direct*** and ***long-term*** impact on both mobile and sessile species and life stages. Mobile species may also be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be minimal given the availability of similar habitats in the area.

During decommissioning, foundations and other facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the structures during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWF (Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

Seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model, which is a three-dimensional model developed jointly with the USACE and the Environmental Research Development Center. SSFATE is a well-known model that has been successfully applied in projects around the globe to simulate the sediment transport from dredging, cable and pipeline burial operations, sediment dumping, dewatering operations, and other sediment-disturbing activities. SSFATE computes TSS concentrations released into the water column and predicts the transport, dispersion, and settling of the suspended sediment. RPS also performed hydrodynamic modeling using their three-dimensional HYDROMAP modeling system to simulate water levels, circulation patterns, and water volume flux through the study area and to provide hydrodynamic input (spatially and temporally varying currents) for input into the sediment transport model. The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report Appendix O.

Several model simulations were run to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from Project cable burial activities. The grain size distributions used for modeling were based on samples collected during field studies performed for the project (Fugro, 2020), which indicate the sediments are predominately coarse grained in the RWF. The sediment transport modeling results are summarized in Table 4.3.2-6, including the maximum distance of the predicted TSS plumes from the cable centerline, the expected time for elevated TSS to return to ambient conditions, the maximum distance of sediment deposition from the cable centerline for various threshold thicknesses, and the area of sediment deposition for various threshold thicknesses.

Table 4.3.2-6 Summary of Sediment Transport Modeling Results

Project Component	Installation Equipment	Location	Max Time for TSS to Return to Ambient (hours)	Max Distance of TSS Plume (feet)		Max Distance of Sediment Deposition (feet)			Area of Sediment Deposition (acres)		
				>50 mg/L Above Ambient	>100 mg/L Above Ambient	>0.1 mm	>1.0 mm	>10 mm	>0.1 mm	>1.0 mm	>10 mm
RWEC	Controlled Flow Excavator and Plow	RI State Waters	32.6	4,528	4,134	5,184	3,609	919	4,061	2,452	1,126
		Federal Waters	28.0	1,542	1,476	1,640	951	328	2,790	1,692	1,020
RWEC Landing Alternatives	HDD	RI State Waters	256	649	580	1,088	754	509	59	39	19
RWF IAC	Plow	Federal Waters	4.8	1,296	853	1,444	853	197	215	118	47

For the IAC, a representative segment of 7,392 ft (2,253 m) of installation was simulated. Modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 853 ft (260 m) from the cable centerline. The plume is expected to be mostly contained within the bottom of the water column. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions in less than 4.8 hours following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial may exceed 0.4 in (10 mm) of deposition up to 197 ft (60 m) from the cable and could cover up to 47 ac (190,202 m^2).

Suspension of sediments in the water column and the redistribution of sediments that fall out of suspension, could result in mortality of benthic organisms through smothering and irritation to respiratory structures; however, mobile benthic organisms are expected to temporarily vacate the area and move out of the way of incoming sediments (MMS, 2007). Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (MMS, 2009). However, eggs and larval organisms are especially susceptible to smothering through sedimentation, and smaller organisms are likely more affected than larger organisms, as larger organisms may be able to extend feeding tubes and respiratory structures above the sediment (U.K. Department for Business Enterprise and Regulatory Reform, 2008). Maurer et al. (1986) found that several species of marine benthic infauna (e.g., the clam *Mercenaria mercenaria*, the amphipod *Parahaustorius longimerus*, and the polychaetes *Scoloplos fragilis* and *Nereis succinea*) exhibited little to no mortality when buried under up to 3 in (8 cm) of various types of sediment (from predominantly silt-clay to pure sand). Deposition thicknesses greater than 3 in resulting from Project installation activities would occur within very limited areas, less than 66 ft (20 m) from the centerline of the IAC.

In areas of sediment disturbance, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization rates of benthic habitats are driven by the benthic communities inhabiting the area surrounding the affected region. Sand sheet and mobile sand with gravel habitats as found within and near the RWF are often more dynamic in nature; therefore, they are quicker to recover than more stable environments, such as fine-grained (e.g., silt) habitats and rocky reefs (Dernie et al., 2003). Species found in these more dynamic areas are often adapted to deal with more dynamic habitats and handle increases in sedimentation associated with wind and waves. These communities are expected to quickly recolonize a disturbed area, while communities not well adapted to frequent disturbance (e.g., cobble and boulder habitats) may take upwards of a year to begin recolonization. Based on this information, increases in sediment suspension and deposition associated with construction/decommissioning may cause ***short-term*** impacts on sessile species and species with limited mobility.

Noise

Several sources of noise are expected during construction at the RWF including construction equipment, pile driving, and vessels. The effects of underwater noise on benthic invertebrates are not well understood, and sound exposure level criteria for assessing injury and mortality have not been established (Morley et al. 2014; Hawkins et al. 2015; Murchy et al. 2019). However, because benthic species and shellfish lack gas-filled organs, they are likely to be less sensitive than finfish and marine mammals to sound pressure waves. Few marine invertebrates have the sensory organs to perceive sound pressure, but many can perceive particle motion (Vella et al., 2001), detecting acoustic energy with sensory organs such as mechanoreceptor hairs, chordotonal organs, statocysts and statoliths (Vella et al. 2001; Popper and Hawkins 2018; Jones et al. 2020). Several studies have documented the responses of different marine invertebrates to natural and anthropogenic vibration, although no exposure criteria have been established (as reviewed in Roberts and Elliot 2017).

Several recent studies have focused on determining threshold detection and responses of cephalopods to underwater noise. Cephalopods, including cuttlefish, octopus, and squid species, are sensitive to particle motion rather than sound pressure (e.g. Packard et al. 1990; Mooney et al. 2010), with the lowest particle motion thresholds reported at 1 to 2 Hz (Packard et al. 1990). Particle motion thresholds were measured for longfin squid between 100 and 300 Hz, with a threshold of 110 dB re 1 µPa reported at 200 Hz (Mooney et al. 2010). No other studies have measured particle motion. Specific hearing thresholds for sound pressure at higher frequencies have been reported for the oval squid (*Sepiooteuthis lessoniana*) and the common octopus (134 and 139 dB re 1 µPa at 1,000 Hz, respectively) (Hu et al. 2009).

Cephalopods appear to be particularly sensitive to low frequency sound. Sole et al. (2017) estimated that trauma onset may begin to occur in cephalopods at sound pressure levels (SPL_{rms}) from 139 to 142 dB re 1 µPa at one-third octave bands centered at 315 Hz and 400 Hz. Low frequency continuous noise (2 hours of 50 to 400 Hz at received SPL_{rms} of 157 dB re 1 uPa) resulted in lesions on the sensory hair cells of the statocysts, which worsened over time, in several cephalopod species (Andre et al. 2016, Sole et al. 2013). At sound frequencies lower than 1,000 Hz, cephalopod behavioral and physiological responses have included inking, locomotor responses, body pattern changes, and changes in respiratory rates (Kaifu et al. 2008; Hu et al. 2009). Common cuttlefish exhibited escape responses (i.e., inking, jetting) when exposed to sound frequencies between 80 and 300 Hz with SPL_{rms} above 140 dB re 1 µPa, but they habituated to repeated 200 Hz sounds (Samson et al. 2014).

Decapod crustaceans, including crab, lobster, and shrimp species, detect sound through an array of hair-like receptors within and upon the body surface that potentially respond to water- or substrate-borne vibrations. These organisms also have proprioceptive organs that could serve secondarily to perceive vibrations (as reviewed in Popper et al. 2001). While it is believed that decapod crustaceans would be most sensitive to particle motion, studies have focused on sound pressure level measurements. A change in feeding and stress response in American lobster was observed at an exposure level of 202 dB re 1µPa (Payne and Funds 2007); this exposure level was modelled to occur at up to 1,640 ft (500 m) from the source of pile driving, where particle velocity was estimated to be 0.1 cm s^{-1} (Miller et al. 2016). Given the experimentally determined sensitivities of blue mussel (*Mytilus* edulis) and common hermit crab (*Pagurus* bernhardus) to particle motion (Roberts et al. 2015; Roberts et al. 2016), this modelled particle velocity would likely elicit behavioral response from these organisms (Roberts and Elliot 2017; Roberts et al. 2017). Prawns (*Palaemon serratus*) showed auditory sensitivity to sounds from 100 to 3,000 Hz (Lovell et al. 2005, 2006). Prawns showed greatest sensitivity at an SPL_{rms} of 106 dB re 1 µPa at 100 Hz, although this was the lowest frequency tested, so prawns might be more sensitive at frequencies below this (Lovell et al. 2005).

Sessile invertebrates such as bivalves may respond to sound exposure by closing their valves (e.g. Kastelein 2008; Roberts et al. 2015; Solan et al. 2016) much as they do when water quality is temporarily unsuitable. In one study, the duration of valve closure was shown to increase with increasing vibrational strength (Roberts et al. 2015). Clams may respond to anthropogenic noise by reducing activity and moving to a position above the sediment-water interface, which affects ecosystem processes such as bioirrigation, as documented in the clam *Ruditapes philippinarum* (Solan et al. 2016).

In response to noise associated with construction at the RWF, it is expected that mobile macroinvertebrates would temporarily relocate during construction and would not be in the areas of greatest acoustic stressors. Slow start (ramp up) of pile driving equipment would allow mobile benthic species to move out of the area and not be subject to mortality or injury but they may still experience some direct impact, such as behavioral responses. A recent study found impulsive pile driving noise resulted in a change in squid (*Doryteuthis* pealeii) behavior, with squid exhibiting body pattern changes, inking, jetting, and startle responses (Jones et al. 2020). Indirect impacts on benthic species may also result from a temporary degradation of habitat quality due to elevated noise levels associated with construction activities at the RWF. Noise from impact pile driving and/or vibratory pile driving may temporarily reduce benthic habitat quality for exposed species. These impacts will be short-lived as habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of pile driving activity.

Short-term impacts on benthic resources and shellfish could occur due to vessel noise, construction equipment noise (exclusive of impact pile driving and/or vibratory pile driving noise), and/or aircraft noise. Sounds created by mechanical/hydro-jet plows, vessels, or aircraft are continuous or non-impulsive sounds, which have different characteristics underwater and impacts on marine life. Limited research has been conducted on underwater noise from mechanical/hydro-jet plows. Generally, the noise from this equipment is expected to be masked by louder sounds from vessels. The duration of noise at a given location will be short, as the installation vessel will only be present for a short period at any given location along the cable route. *Direct, short-term impacts* on benthic species are expected from mechanical/hydro-jet plow installation noise.

Helicopters may be used during construction of the Project for emergency transport and crew changes during installation of the WTGs. Underwater noise associated with helicopters is generally brief as compared with the duration of audibility in the air (Richardson et al., 1995). Because of this, direct impacts on benthic species from aircraft noise are not expected.

Benthic species in the vicinity of Project construction vessels may be affected by vessel noise but the duration of the disturbance will occur over a very short period at any given location in the RWF area or between ports and the RWF. ***Direct*** and ***short-term*** impacts on benthic species are expected due to vessel noise.

Direct impacts on benthic species may result from a temporary degradation of habitat quality due to elevated noise levels. The noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region and are not expected to substantially affect the existing underwater noise environment. Thus, overall noise impacts from vessels and aircraft are expected to be ***short-term***.

Discharges and Releases

Routine discharges of wastewater (e.g., gray water or black water) or liquids (e.g., ballast, bilge, deck drainage, stormwater) may occur from vessels, WTGs, or the OSS during construction and decommissioning; however, those discharges and releases are not anticipated to have impact because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations, such as the EPA and USCG requirements for discharges and releases to surface waters. In addition, compliance with applicable Project-specific management practices and requirements will minimize potential impacts to water quality and marine life.

Minor releases of hazardous materials, if they were to occur, could result in short-term, direct, and indirect impacts on benthic resources and shellfish. The impacts of spills are caused by either the physical nature of the material (e.g., physical contamination and smothering) or by its chemical components (e.g., toxic effects and bioaccumulation). Minor releases of hazardous materials could also result in indirect impacts on invertebrate species if the materials affect their eggs/larvae and food sources. Impacts would depend on the depth and volume of the spill, as well as the properties of the material spilled.

All vessels participating in the construction of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. BMPs for fueling and power equipment servicing will be incorporated into the Project's Emergency Response Plan and Oil Spill Response Plan (ERP/OSRP). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts are benthic resources and shellfish are not expected.

Marine Trash and Debris

The release of trash and debris into offshore waters potentially may occur from any on-water activities. Certain types of trash and debris could be accidentally lost overboard during construction, with subsequent effects on marine species. USCG and EPA regulations require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Also, BOEM lease stipulations require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. As such, measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on benthic resources and shellfish are not expected.

Operations and Maintenance

IPFs resulting in potential impacts on benthic resources and shellfish in the RWF area from the O&M phase are summarized in Table 4.3.2-7. Additional details regarding potential impacts on benthic resources and shellfish from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.3.2-7 IPFs and Potential Levels of Impact on Benthic and Shellfish Resources at the RWF During O&M

		Impact Characterization	
IFP	Project Activity	Sessile Species and Life Stages *Includes eggs and larvae of mobile species, as well as species with limited mobility*	Mobile Species and Life Stages
Seafloor Disturbance	Foundation	Direct, short-term	Direct, short-term
	IAC and OSS-Link Cable non-routine O&M	Direct, short-term	Direct, short-term,
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Habitat Alteration	Foundations RWF IAC and OSS-Link Cable	Direct, long-term	Direct, long-term
Sediment Suspension and Deposition	IAC and OSS-Link Cable non-routine O&M Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Noise	Vessel and aircraft noise	Direct, long-term	Direct, long-term
	WTG operational noise	Direct, long-term	Direct, long-term
EMF	IAC and OSS-Link Cable	Direct, long-term	Direct, long-term
Discharges and Releases	Hazardous materials spills Wastewater discharges	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term

Seafloor Disturbance and Habitat Alteration

Minimal impacts on benthic species are expected from operation of the IAC and OSS-Link Cable, as they will be buried beneath the seabed. However, seafloor disturbance during O&M of the RWF may occur during maintenance of bottom-founded infrastructure (e.g., foundations, scour protection, cable protection), non-routine maintenance of the OSS-Link Cable and IAC, and anchoring by maintenance vessels. During O&M, anchoring will be limited to vessels required to be onsite for an extended duration. These maintenance activities are expected to result in similar **direct** impacts on benthic resources and shellfish as those discussed for construction/decommissioning of the RWF, although the extent of disturbance would be limited to specific areas.

Once constructed, the RWF will result in localized changes to seafloor topography and hydrodynamics because of the presence of foundations, scour protection, and cable protection. The seafloor overlaying the majority of buried IAC and OSS-Link Cable (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected.

Presence of the foundations, associated scour protection, and cable protection may result in both negative and beneficial direct impacts on benthic species due to conversion of habitat from primarily soft-bottom to hard-bottom. Species that have life stages associated with soft-bottom habitats may experience long-term effects, as available habitat will be slightly reduced. Species and life stages that inhabit hard bottom habitats may experience a beneficial effect, depending on the quality of the habitat created by the foundations, scour protection, and cable protection, and the quality of the benthic community that colonizes that habitat. Habitat conversion is expected to cause a shift in species assemblages towards those found in rocky reef/rock outcrop habitat; this is known as the "reef effect" (Wilhelmsson et al., 2006; Reubens et al., 2013). This effect is also well known from other anthropogenic structures in the sea, such as oil platforms, artificial reefs piers, and shipwrecks (Claudet and Pelletier, 2004; Wilhelmsson et al., 2006; Seaman, 2007; Langhamer and Wilhelmsson, 2009).

The use of gravel, boulders, and/or concrete mats will create new hard substrate, and this substrate is expected to be initially colonized by barnacles, tube-forming species, hydroids, and other fouling species found on existing hard bottom habitat in the region. Mobile organisms, such as lobsters and crabs, may also be attracted to and occur in and around the foundation in higher numbers than surrounding areas. Monopiles attract a range of attached epifauna and epiflora, including barnacles and filamentous algae (Petersen and Malm, 2006). Jacket foundations (which may be used for the OSS) provide a more complex structure than monopile foundations and may increase habitat complexity through more suitable fouling surfaces and increased protection from predators (MMS, 2009). As these foundations extend from below the seafloor to above the surface of the water, there is expected to be a zonation of macroalgae from deeper growing red foliose algae and calcareous algae, to kelps and other species, including those that may grow in subtidal, intertidal, and splash zone areas. Foundations and cable protection typically also have crevices that increase structural complexity of the area and attract finfish and invertebrate species seeking shelter, including crabs and American lobster. Other species that may be beneficially affected include sea anemones and other anthozoans, bivalves such as horse mussel, green sea urchin, barnacles, hydrozoans, sponges, and other fouling organisms. There is expected to be a similar zonation of these species with depth, as well. Species that prefer softer bottom habitat, such as ocean quahog, waved and chestnut astarte clam, Atlantic surf clam, sand shrimp, channeled whelk, and horseshoe crab, may be impacted.

The foundations and scour protection are novel hard substrate habitats introduced to generally soft sediment areas. The increase in habitat heterogeneity and hard substrate may promote not only the growth of native epibenthic species, as discussed above, but also may potentially promote colonization by non-indigenous species and/or range-expanding species. The concept of offshore wind structures as "stepping stones" for these groups of species has been suggested and observed in other regions (as reviewed in Dannheim et al. 2019; e.g., De Mesel et al. 2015; Coolen et al. 2018). Non-indigenous species, including, although not limited to, crustaceans (e.g., the Asian shore crab (*Hemigrapsus sanguineus*)), molluscs (e.g., *Crepidula fornicate*), and tunicates (e.g., *Didemnum vexillum*) have the potential to colonize the foundations in this region, as observed in other regions (e.g., Kerckhof et al. 2016). The effects of the colonization of these types of species on the community assemblage and ecosystem function varies depending on the particular species and its abundance. Additionally, epibenthic species from southern regions, such as the

Mid-Atlantic, may utilize this novel habitat as their populations move northward as suitable environmental conditions shift northward in response to climatic drivers (i.e., range-expansion species).

Habitat conversion is expected to cause a ***direct*** and ***long-term*** impact because similar soft and hard bottom habitats are already present in and around the RWF (see Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any "reef effect" observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing the IAC and/or OSS-Link Cable. ***Direct*** and ***short-term*** impacts on benthic resources and shellfish resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase, but on a more limited spatial scale.

Noise

Impacts on benthic resources and shellfish from ship and aircraft noise during O&M of the RWF are expected to be similar to those discussed for the construction/decommissioning phase, though lesser in extent. Helicopters will be used during O&M for transport and O&M activities at the WTGs. The noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region and are not expected to substantially affect the existing underwater noise environment.

The WTGs will produce low-level continuous underwater noise (infrasound) during operation; however, there are no conclusive studies associating WTG operational noise with impacts on benthic resources and shellfish. Noise levels from operation of the RWF turbines are not expected to result in injury or mortality.

Electric and Magnetic Fields

Operation of the WTG does not generate EMF; however, once the IAC and OSS-Link Cable become energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded and buried beneath the seafloor. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012). Exposure to EMF could be short- or long-term, depending on the mobility of the species. Sessile species will be exposed for the entire duration that the cables are energized (U.K. Department for Business Enterprise and Regulatory Reform, 2008; Woodruff et al., 2012; Love et al., 2015, 2016). Compared to fish and elasmobranchs, relatively little is known about the response of marine invertebrates to EMF, and how this might impact migration, orientation, or prey identification. Aquatic crustaceans, a group that includes commercially important crab and lobster species, have been observed to use geomagnetic fields to guide orientation and migration, which suggests that this group of organisms is capable of detecting static magnetic fields (Ugolini and Pezzani, 1995; Cain et al., 2005; Boles and Lohmann, 2003; Lohmann et al., 1995). The ability to detect geomagnetic fields, however, is likely integrated with other environmental cues, including slope, light, currents, and water temperature. Furthermore, Project cables will produce AC magnetic fields, which differ from the static geomagnetic fields to which magneto-sensitive marine invertebrates are attuned; therefore, operation of the IAC and OSS-Link Cable is not expected to impact benthic invertebrate orientation or migration.

A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, OSS-Link Cable and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. That Appendix also summarized data from field studies conducted to assess impacts of EMF on marine organisms. These studies constitute the best source of evidence to demonstrate that impacts on benthic invertebrate behavior or distribution are not expected due to the presence of energized cables. Field surveys on the behavior of large crab species and lobster at submarine cable sites (Love et al., 2017; Hutchinson et al., 2018) indicate that the Project's calculated magnetic-field levels are not likely to impact the distribution and movement of large epibenthic crustaceans. Ancillary data and observations from these field studies also suggest that cephalopod behavior is similarly unaffected by the presence of 60-Hz AC cables. Based on the modeling results and existing evidence, the EMF associated with the cables will be below the detection capability of invertebrate species. Given that the calculated values are below the thresholds of detection reported in the scientific literature, behavioral effects and/or changes in species abundance and distributions are not expected. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016).

Discharges and Releases

As discussed for the construction/decommissioning phase, routine discharges of wastewater or liquids (e.g., ballast, bilge, deck drainage, stormwater) are not anticipated to have impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-specific management practices and requirements will minimize potential impacts on water quality and marine life.

The operation of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. The WTG and the OSS will be designed for secondary levels of containment to prevent accidental discharges of hazardous materials to the marine environment. Most maintenance will occur inside the WTGs, thereby reducing the risk of a spill, and no oils or other wastes are expected to be discharged during maintenance activities.

All vessels participating in O&M of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. BMPs for fueling and power equipment servicing will be incorporated into the Project's ERP/OSRP (Appendix D). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on benthic resources and shellfish are not anticipated.

Marine Trash and Debris

As discussed for construction/decommissioning, vessels will adhere to the USCG and EPA marine trash regulations, as well as BOEM guidance, and trash and debris generated during O&M of the RWF will be contained on vessels or at staging areas until disposal at an approved facility. Measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal.

Revolution Wind Export Cable – Outer Continental Shelf

Based on the IPFs discussed in Table 4.3.2-8, during construction and decommissioning of the RWEC-OCS, seafloor disturbance, habitat alteration, and sediment suspension/deposition are expected to affect sessile species and organisms with limited mobility, including early life stages (e.g., larvae and eggs) more than mobile species. However, these impacts, as well as impacts associated with construction noise, are expected to be temporary and cease when construction activity stops. During O&M and decommissioning of the RWEC-OCS, impacts on benthic resources and shellfish associated with seafloor disturbance, sediment suspension/deposition, and noise, are expected to be similar but lesser in extent compared to construction. Seafloor disturbance activities that result in the conversion of soft sediment habitats to hard bottom habitat associated with cable protection (e.g., concrete mattresses or rock berms) along portions of the RWEC-OCS routes are expected to have long-term beneficial impacts on benthic organisms that rely on complex, hard bottom habitats. Long-term impacts may occur as a result of habitat alteration, as benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels in disturbed areas (e.g., Guarinello and Carey 2020; AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Soft-sediment benthic species may experience ***long-term*** impacts caused by the conversion of soft bottom habitat to hard bottom habitat associated with the cable protection along portions of the RWEC-OCS route. Inadvertent discharges/releases, trash and debris, and EMF are expected to have minimal impacts on benthic and shellfish resources during construction, O&M and decommissioning of the RWEC-OCS. None of the IPFs are expected to result in population-level effects on benthic species, due to the limited scale and intensity of the Project activities, and the availability of similar habitat in the surrounding area. The impacts discussed in this section would vary slightly by habitat composition along the RWEC-OCS route.

Construction and Decommissioning

IPFs resulting in potential impacts on benthic resources and shellfish in the RWEC-OCS area from the construction and decommissioning phases are summarized in Table 4.3.2-8. Additional details regarding potential impacts on benthic resources and shellfish from the various IPFs during construction and decommissioning of the RWEC-OCS are described in the following sections. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted.

Table 4.3.2-8 IPFs and Potential Impact Characterization on Benthic and Shellfish Resources for the RWEC During Construction and Decommissioning

IFP	Project Activity	Impact Characterization	
		Sessile Species and Life Stages *Includes eggs and larvae of mobile species, as well as species with limited mobility*	Mobile Species and Life Stages
Seafloor Disturbance	Seafloor preparation	Direct, short-term	Direct, short-term
	RWEC installation	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Habitat Alteration	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Direct, long-term	Direct, long-term Indirect, long-term
Sediment Suspension and Deposition	Seafloor preparation RWEC installation Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Noise	Vibratory pile driving (cofferdam) *RWEC-RI only	Direct, short-term	Direct, short-term
	Vessel noise Construction equipment noise Aircraft noise	Direct, short-term	Direct, short-term
Discharges and Releases	Hazardous materials spills Wastewater discharge	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term

Seafloor Disturbance and Habitat Alteration

As discussed for the construction/decommissioning of the RWF, the potential impacts on benthic resources and shellfish from seafloor preparation and vessel anchoring for the RWEC-OCS are primarily associated with species and life stages that prefer the types of habitats that will be disturbed. Direct impacts on benthic resources and shellfish from seafloor preparation and vessel anchoring for the RWEC are expected to be similar to those discussed for the construction/decommissioning of the RWF. See Tables 4.3.2-2 and 4.3.2-3 for species that may occur in the areas and be affected by seafloor preparation.

Direct impacts on benthic resources and shellfish associated with the RWEC-OCS installation are expected to result in similar ***direct*** and ***short-term*** impacts as those for seafloor preparation. Long-term impacts on benthic resources and shellfish associated with the presence of cable protection along portions of the RWEC-OCS are discussed the O&M section.

As discussed for the construction/decommissioning of the RWF, in areas of sediment disturbance benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., Guarinello and Carey, 2020;, AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization rates of benthic habitats are driven by the benthic communities inhabiting the area surrounding the affected region. Communities well-adapted to disturbance within their habitats (e.g., sand sheets) are expected to quickly recolonize a disturbed area, while communities not well adapted to frequent disturbance (e.g., cobble and boulder habitats) may take upwards of a year to begin recolonization. Regardless, the time needed for benthic recovery would result in a ***direct*** and ***long-term*** impact on both mobile and sessile species and life stages. Mobile species may also be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be minimal given the availability of similar habitats in the area.

During decommissioning, other facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the structures during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWF (Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

As discussed for the construction and decommissioning of the RWF, seafloor-disturbing activities associated with RWEC-OCS installation will result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from Project cable burial activities. As summarized in Table 4.3.2-6, the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 1,542 ft (470 m) from RWEC-OCS centerline. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters it may occupy most of the water column due to the water depth. For the RWEC-OCS, predicted TSS concentrations above ambient for any single circuit installation do not persist in any given location for greater than 24 hours, though in most locations (>75 % of the affected area) concentrations return to ambient within 8 hours. This maximum was predicted to occur along a part of the route that will only see one circuit installation. The maximum duration above ambient along the portion of the RWEC where two circuits will be installed was predicted to be 14 hours per circuit. This corresponds to a total of 28 hours above ambient, however the two 14-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC-OCS burial may exceed 0.4 in (10 mm) of deposition up to 328 ft (100 m) from the cable centerline. This thickness of sedimentation could cover up to 1,020 ac (4,127,794 m^2) in federal waters. The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report Appendix J.

Direct impacts on benthic resources and shellfish from sediment suspension and deposition are expected to be ***direct and short-term*** for both sessile species and mobile species and similar to those discussed for construction/decommissioning of the RWF.

Noise

Direct impacts on benthic resources and shellfish resulting from vessel, construction equipment, and aircraft noise are expected to be similar to those discussed for construction and decommissioning of the RWF.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during construction or decommissioning of the RWEC-OCS are expected to be similar to those discussed for construction and decommissioning of the RWF.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for construction and decommissioning of the RWF.

Operations and Maintenance

IPFs resulting in potential impacts on benthic resources and shellfish in the RWEC-OCS area from the O&M phase are summarized in Table 4.3.2-9. Additional details regarding potential impacts on benthic resources and shellfish from the various IPFs during O&M of the RWEC-OCS are described in the following sections.

Table 4.3.2-9 IPFs and Potential Impact Characterization on Benthic and Shellfish Resources for the RWEC During O&M

IFP	Project Activity	Impact Characterization	
		Sessile Species and Life Stages *Includes eggs and larvae of mobile species, as well as species with limited mobility*	Mobile Species and Life Stages
Seafloor Disturbance	RWEC non-routine O&M	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Habitat Alteration	RWEC O&M	Direct, long-term	Direct, long-term
Sediment Suspension and Deposition	RWEC non-routine O&M Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term
Noise	Vessel and aircraft noise	Direct, long-term	Direct, long-term
Electric and Magnetic Fields	RWEC operations	Direct, long-term	Direct, long-term

IFP	Project Activity	Impact Characterization	
		Sessile Species and Life Stages *Includes eggs and larvae of mobile species, as well as species with limited mobility*	Mobile Species and Life Stages
Discharges and Releases	Hazardous materials spills Wastewater discharges	Not anticipated	Not anticipated
Marine Trash and Debris		Not anticipated	Not anticipated

Seafloor Disturbance and Habitat Alteration

Minimal impacts on benthic resources and shellfish are expected from operation of the RWEC-OCS, as it will be buried beneath the seabed. Seafloor disturbance during O&M of the RWEC-OCS will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection. These maintenance activities and associated vessel anchoring are expected to result in similar impacts on benthic resources and shellfish as those discussed for construction and decommissioning of the IAC and OSS-Link Cable, although the extent of disturbance would be limited to specific areas along the RWEC-OCS route.

Cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC-OCS. The introduction of engineered concrete mattresses or rock to areas of the seafloor can cause local disruptions to circulation, currents, and natural sediment transport patterns. Under normal circumstances these segments of the RWEC-OCS are expected to remain covered as accretion of sediment covers the cable and associated cable protection (where applicable). In non-routine situations, these segments may be uncovered, and re-burial might be required.

Direct impacts on benthic resources and shellfish associated with O&M activities for the RWEC-OCS are expected to result in similar impacts as those discussed for the IAC and OSS-Link Cable but will be limited in spatial extent. The protection of the cable with concrete mattresses (or rock) may result in the long-term conversion of soft-bottom habitat to hard-bottom habitat. Similar to the RWF foundations, the cable protection may have ***long-term*** impact on species associated with soft-bottom habitats and a long-term beneficial impact on species associated with hard-bottom habitats, depending on the quality of the habitat created by the cable protection, and the quality of the benthic community that colonizes that habitat.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during the O&M phase may result from vessel anchoring and routine and non-routine maintenance activities that require exposing portions of the RWEC-OCS. Direct impacts on benthic resources and shellfish resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase of the RWF, but on a more limited spatial scale.

Noise

Impacts on benthic resources and shellfish from ship and aircraft noise during O&M of the RWEC-OCS are expected to be similar to those discussed for the construction and decommissioning phase of the RWF, though lesser in extent.

Electric and Magnetic Fields

Once the RWEC-OCS becomes energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded and buried beneath the seafloor. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012). Exposure to EMF could be short- or long-term, depending on the mobility of the species. Sessile species will be exposed for the entire duration that the cables are energized (U.K. Department for Business Enterprise and Regulatory Reform, 2008; Woodruff et al., 2012; Love et al., 2015, 2016).

A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. That Appendix also summarizes data from field studies conducted to assess impacts of EMF on marine organisms. As discussed for the IAC and OSS-Link Cable in Table 3.1-2, behavioral effects and/or changes in species abundance and distributions due to EMF are not expected. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016).

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during O&M of the RWEC-OCS are expected to be similar to those discussed for construction and decommissioning of the RWF).

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for construction and decommissioning of the RWF.

Revolution Wind Export Cable – Rhode Island State Waters

Based on the IPFs discussed in Table 4.3.2-8, during construction and decommissioning of the RWEC-RI, seafloor disturbance, sediment suspension/deposition and habitat alteration are expected to affect sessile species and organisms with limited mobility, including early life stages (e.g., larvae and eggs) more than mobile species. However, these impacts, as well as impacts associated with construction noise, are expected to be temporary and cease when construction activity stops. During O&M of the RWEC-RI, impacts on benthic resources and shellfish associated with seafloor disturbance, sediment suspension/deposition, and noise are expected to be similar but lesser in extent compared to construction. Seafloor disturbance activities that result in the conversion of soft sediment habitats to hard bottom habitat associated with cable protection (e.g., concrete mattresses or rock berms) along portions of the RWEC-RI route are expected to have long-term beneficial impacts on benthic organisms that rely on complex, hard bottom habitats. ***Long-term*** impacts may occur as a result of habitat alteration, as benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels in disturbed areas (e.g., Guarinello and Carey 2020; AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Soft-sediment benthic species may experience ***long-term*** impacts caused by the conversion of soft bottom habitat to hard bottom habitat associated with the cable protection along portions of the RWEC-RI route. Inadvertent discharges/releases, trash and debris, and EMF are expected to have minimal impacts on benthic and shellfish resources during construction, O&M and decommissioning of the RWEC-RI. None of the IPFs are expected to result in population-level effects on benthic species, due to the limited scale and intensity of the Project activities, and the availability of similar habitat in the surrounding area. The impacts discussed in this section would vary slightly by habitat composition along the RWEC-RI route.

Construction and Decommissioning

IPFs resulting in potential impacts on benthic resources and shellfish in the RWEC-RI area from the construction and decommissioning phases are summarized in Table 4.3.2-8. Additional details regarding potential impacts on benthic resources and shellfish from the various IPFs during construction/decommissioning of the RWEC-RI are described in the following sections. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted.

Seafloor Disturbance and Habitat Alteration

Direct impacts on benthic resources and shellfish from seafloor preparation and vessel anchoring for the RWEC-RI are expected to be similar to those discussed for the construction and decommissioning of the RWEC-OCS, with the exception of shallower areas being affected as the RWEC-RI nears landfall. These shallower areas are expected to have slightly different species assemblages than the deeper offshore areas, particularly within Narragansett Bay (see Tables 4.3.2-2 and 4.3.2-3 for species that may occur in these areas). For example, as discussed in Section 4.3.2.1 and the Benthic Assessment Appendix X, the up-estuary stations sampled during the benthic survey conducted for the Project were generally characterized by finer substrate, dominated by soft-sediment fauna, higher turbidity, and more reduced sediments. The mid-bay stations were characterized by mussel and *Crepidula* beds with other attached organisms including barnacles, sponges, and macroalgae. The stations at the mouth of Narragansett Bay and the stations leading offshore to the 3-mile state water boundary were generally dominated by soft sediment infauna. Disturbance of this the mussel and *Crepidula* bed habitat in the mid-bay is not anticipated to result in population-level effects on these organisms, as only a small area would be affected, and similar habitat is common within the Bay.

Construction of the RWEC landfall would be accomplished with HDD methodology. A cofferdam may be used to allow for a dry environment during construction and manage sediment, contaminated soils, and bentonite (for HDD operations). Impacts associated with the installation of a cofferdam (if necessary) would be similar to those discussed for seafloor preparation, but on a smaller scale. The cofferdam will be a temporary structure used during construction only. Therefore, no conversion of habitat is expected, and the cofferdam will be removed prior to the O&M phase.

Direct impacts on benthic resources and shellfish associated with the RWEC-RI installation are expected to result in similar ***direct*** and ***short-term*** impacts as those for seafloor preparation. Long-term impacts on benthic resources and shellfish associated with the presence of cable protection along portions of the RWEC-RI are discussed the O&M section.

As discussed for the construction and decommissioning of the RWEC-OCS, in areas of sediment disturbance, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., Guarinello and Carey 2020; AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). This recovery time may result in a ***direct*** and ***long-term*** impact on both mobile and sessile species and life stages. Mobile species may also be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be minimal given the availability of similar habitats in the area.

During decommissioning, facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the structures during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWEC (Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

As discussed for the construction and decommissioning of the RWEC-OCS, seafloor-disturbing activities associated with RWEC-RI installation will result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from Project cable burial activities.

As summarized in Table 4.3.2-6, for the majority of the RWEC-RI, the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 4,528 ft (1,380 m) from the RWEC-RI centerline. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters, such as within Narragansett Bay, it may occupy most of the water column due to the water depth. For installation of one circuit of the RWEC-RI, predicted TSS concentrations above ambient do not persist in any given location for greater than 16.3 hours, though in most locations (>75 percent of the affected area) concentrations return to ambient within 4 hours). For installation of two circuits, the maximum plume exposure is doubled at 32.6 hours, however, the two 16.3-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC-RI burial may exceed 0.4 in (10 mm) of deposition up to 919 ft (280 m) from the cable centerline. This thickness of sedimentation could cover up to 1,126 ac (4,556,760 m^2). For the landfall, as summarized in Table 4.3.2-6, TSS concentrations exceeding ambient conditions by 100 mg/L could extend up 2,048 ft (624 m) from the centerline and plume concentrations above ambient could persist for 256 hours for the HDD installation. These durations are longer relative to the water jet assisted cable installation due to the slower installation rate of the activity and since the alternatives include both trenching and backfilling for two cable circuits. Sedimentation greater than 0.4 in (10 mm) may extend up to 572 ft (174 m) from the centerline and could cover up to 85 ac (343,983 m^2). The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report Appendix J.

Direct impacts on benthic resources and shellfish from sediment suspension and deposition are expected to be similar to those discussed for the construction and decommissioning of the RWEC-OCS.

Noise

The cofferdam at the RWEC-RI landfall, if required, may be installed as either a sheet piled structure into the seafloor or a gravity cell structure placed on the sea floor using ballast weight. Sheet pile installation would require the use of a vibratory hammer to drive the sidewalls and endwalls into the seabed, which may take approximately up to 3 days.

The effects of underwater noise on benthic invertebrates are not well understood, and sound exposure level criteria for assessing injury have not been established. However, because benthic species and shellfish lack gas-filled organs, they are likely to be less sensitive than finfish and marine mammals to sound pressure waves. Few marine invertebrates have the sensory organs to perceive sound pressure, but many can perceive particle motion (Vella et al., 2001). For exposed species, noise from vibratory pile driving may temporarily reduce habitat quality, result in behavioral changes, or cause mobile species to temporarily vacate the area. Noise impacts on benthic resources and shellfish from vibratory pile driving may result in ***short-term*** impacts, as the habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of the vibratory pile driving activity.

Direct impacts on benthic resources and shellfish resulting from vessel, construction equipment, and aircraft noise are expected to be similar to those discussed for construction/decommissioning of the RWEC-OCS.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during construction or decommissioning of the RWEC-RI are expected to be similar to those discussed for the construction and decommissioning of the RWF.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for the construction and decommissioning of the RWF.

Operations and Maintenance

IPFs resulting in potential impacts on benthic resources and shellfish in the RWEC-RI area from the O&M phase are summarized in Table 4.3.2-9. Additional details regarding potential impacts on benthic resources and shellfish from the various IPFs during O&M of the RWEC are described in the following sections.

Seafloor Disturbance and Habitat Alteration

Minimal impacts on benthic resources and shellfish are expected from operation of the RWEC-RI, as it will be buried beneath the seabed. As discussed for the RWEC-OCS, seafloor disturbance during O&M of the

RWEC will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection. These maintenance activities and associated vessel anchoring are expected to result in similar ***direct*** and ***short-term*** impacts on benthic resources and shellfish as those discussed for the RWEC-OCS.

As discussed for the RWEC-OCS, cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC-RI. The seafloor overlaying the majority of buried RWEC-RI (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected.

Direct impacts on benthic resources and shellfish associated with O&M activities for the RWEC-RI are expected to result in similar impacts as those discussed for the IAC, OSS-Link Cable, and RWEC-OCS, but will be limited in spatial extent. The protection of the cable with concrete mattresses (or rock) may result in the long-term conversion of soft-bottom habitat to hard-bottom habitat. Similar to the RWF foundations, the cable protection may have a ***direct*** and ***long-term*** impact on species associated with soft-bottom habitats and a long-term beneficial impact on species associated with hard-bottom habitats, depending on the quality of the habitat created by the cable protection, and the quality of the benthic community that colonizes that habitat.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during the O&M phase may result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC-RI. Impacts resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase, but on a more limited spatial scale.

Noise

Impacts on benthic resources and shellfish from ship and aircraft noise during O&M of the RWEC-RI are expected to be similar to those discussed for the construction and decommissioning phase, though lesser in extent.

Electric and Magnetic Fields

As discussed for the RWEC-OCS, a modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. Behavioral effects and/or changes in species abundance and distributions due to EMF associated with the RWEC-RI are not expected.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during O&M of the RWEC-RI are expected to be similar to those discussed for construction and decommissioning of the RWF.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for construction and decommissioning of the RWF.

4.3.2.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following environmental protection measures to reduce potential impacts on benthic resources and shellfish. These measures are based on protocols and procedures successfully implemented for similar offshore projects.

- The RWF and RWEC will be sited to avoid and minimize impacts to sensitive habitats (e.g., hard bottom habitats) to the extent practicable.
- To the extent feasible, installation of the IACs, OSS-Link Cable and RWEC will be buried using equipment such subsea cable trenchers such as jet trenchers or mechanical cutting trenchers, simultaneous lay and burial using a cable plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment.
- DP vessels will be used for installation of the IACs, OSS-Link Cable, and RWEC to the extent practicable.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. A Fisheries and Benthic Monitoring Plan is included as an Appendix Y.
- A preconstruction SAV survey will be completed to identify any new or expanded SAV beds. The Project design will be refined to avoid impacts to SAV to the greatest extent practicable.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP (Appendix D).
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species (e.g., lobster, crabs) in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.

4.3.3 Finfish and Essential Fish Habitat

This section describes the affected environment for finfish and EFH within offshore portions of the RWF, RWEC-OCS, and RWEC-RI (as defined in Section 1.1, Figure 1.1-1). Finfish evaluated include pelagic, demersal, and anadromous fish that inhabit the region. EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) as those waters (e.g., aquatic areas and their associated physical, chemical, and biological properties used by fish) and substrate (e.g., sediment, hard bottom, underlying structures, and associated biological communities) necessary for the spawning, feeding, or growth to maturity of managed fish species. A 0.5 mi (800 m) wide corridor around the RWEC-OCS and RWEC-RI was used for identifying species with EFH within the vicinity of the proposed cable corridor.

The Onshore Facilities are not discussed within this section given their location on land. The discussion of the affected environment for finfish and EFH resources is followed by an evaluation of potential Project-related impacts and a summary of environmental protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to these resources.

The description of the affected environment and assessment of potential impacts for finfish and EFH was evaluated by reviewing current public data sources related to finfish and EFH, including state and federal agency-published papers and databases, published journal articles, online data portals and mapping databases, and correspondence and consultation with federal and state agencies. A detailed EFH Assessment for designated species in the RWF and RWEC is provided as an Appendix.

4.3.3.1 Affected Environment

Regional Overview

The regional waters off the coast of Rhode Island and Massachusetts are transitional waters that separate Narragansett Bay and Long Island Sound from the OCS (BOEM, 2013). These waters straddle the Mid-Atlantic and New England regions and serve as the northern boundary for some Mid-Atlantic species and the southern boundary for some New England species. The species that may be found in the RWF and RWEC reflect the transitional nature of this regional area.

New England waters have diverse habitats that are defined by their temperature, salinity, pH, physical structure, biotic structure, depth, and currents. The unique combination of habitat characteristics shapes the community of fish and invertebrate species that inhabit the area. Habitat types determine species, distribution, and predator/prey dynamics. Each habitat structure supports a community of fish and invertebrate species that rely on the habitat to survive. Multiple factors directly affect spatial and temporal patterns of fish species. Major habitat types expected to be found within the RWF and RWEC are described in Section 4.3.2.

Benthic communities have experienced increased water temperatures in the region in the past several decades, and average pH is expected to continue to decline as seawater becomes more saturated with carbon dioxide (Saba et al., 2016). Acidification of seawater is associated with decreased survival and health of organisms with calcareous shells (such as the Atlantic scallop, blue clam, and hard clam), but less is known about direct effects of acidification on cartilaginous and bony fishes. The ranges of dozens of groundfish species in New England waters have shifted northward and into deeper waters in response to increasing water temperatures (Pinsky et al., 2013; Nye et al., 2009) and more species are predicted to follow (Selden et al., 2018; Kleisner et al., 2017). The black sea bass, identified as particularly sensitive to habitat alteration (Guida et al., 2017), has been increasing in abundance over the past several years, and is expected to continue its expansion in southern New England as water temperatures increase (Kuffner, 2018; McBride et al., 2018). Several pelagic forage species have been increasing in the region, including butterfish, scup, squid (Collie et al., 2008) and Atlantic mackerel (McManus et al., 2018). Perhaps counterintuitively, distributions of other species are reported to be shifting southward, including little skate *(Leucoraja erinacea)*, silver hake (*Merluccius bilinearis*) and spiny dogfish (*Squalus acanthias*) (Walsh et al., 2015). It has been suggested that the spiny dogfish may replace the Atlantic cod as a major predator in southern New England as the cod is driven north by warm waters that the spiny dogfish tolerates well (Selden et al., 2018). Further temperature increases in southern New England are expected to exceed the global ocean average by at least a factor of two, and ocean circulation patterns are projected to change (Saba et al., 2016). Distributional shifts are occurring in both demersal and pelagic species, perhaps mediated by changes in spawning locations and dates (Walsh et al., 2015). Southern species, including some highly migratory species such as mahi that prefer warmer waters, are expected to follow the warming trend and become more abundant in the area (Walsh et al., 2015; South Atlantic Fishery Management Council, 2003). Climate change may also be affecting the migrations of anadromous fish in the region. The herrings, shad, and sturgeon were identified as having high biological sensitivity to adverse effects of climate change (Hare et al., 2016). In addition to physiological effects of temperature and pH, anadromous fishes face a physical risk caused by flooding in their spawning rivers.

As summarized in BOEM's Revised Environmental Assessment (BOEM, 2013), finfish off the coasts of Rhode Island and Massachusetts include demersal, pelagic, and shark finfish assemblages. In addition, there are important shellfish (Section 4.3.2) and migratory pelagic finfish throughout the region. Demersal species (groundfish) spend at least part of their adult life stage on or close to the ocean bottom. Many groundfish species are considered to be high-value fish and are sought by both commercial and recreational anglers. Pelagic fishes are generally schooling fish that occupy the mid- to upper water column as juveniles and adults and are distributed from the nearshore to the continental slope and beyond. Some species are highly migratory and are reported to be present in the near-coastal and shelf surface waters of Southern New England waters in the summer, taking advantage of the abundant prey in the warm surface waters. Coastal migratory pelagics include fast-swimming schooling fishes that range from shore to the continental shelf edge and are sought by both recreational and commercial anglers. These fish use the highly productive coastal waters of the more expansive Mid-Atlantic Bight during the summer months and migrate to deeper and/or distant waters during the remainder of the year (BOEM, 2013). Pelagic sharks, large coastal sharks, and small coastal sharks also occupy this region.

Federal agencies are required by Section 7 of the ESA (Title 19 USC Part 1536(c)), as amended (1978, 1979, and 1982), to ensure that any actions authorized, funded, or carried out by the agencies do not jeopardize the continued existence of a federally listed threatened or endangered species, or result in the destruction or adverse modification of designated critical habitat for a federally listed species. Three federally listed fish species may occur in the vicinity of the RWF and RWEC: Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), giant manta ray (*Manta birostris*), and shortnose sturgeon (*Acipenser brevirostrum*). No critical habitat for any federally listed fish species is present in the Project Area. While all three species have ranges that include the Project Area, the Atlantic sturgeon is the only species whose occurrence is common enough that they may be exposed to impacts from Project activities. Therefore, only this species is included in the impact assessment (Section 4.3.3.2). Species information and justification for excluding the shortnose sturgeon and giant manta ray from this assessment are provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Revolution Wind Farm

Table 4.3.3-1 summarizes species of economic or ecological importance potentially present within the region of the RWF, generally characterized by their life stage and location in the water column. Finfish and EFH resources were evaluated within the Project Area as described in Section 1.1-1. Benthic and pelagic invertebrates are discussed in Section 4.3.2.

The species listed in Table 4.3.3-1 were selected based on literature review, agency correspondence, fish sampling results from the Block Island Wind Farm (BIWF), and EFH source document review. This table does not include every species that has the potential to occur in the Project Area, but focuses on those that are abundant, commercially or recreationally important, important prey species, or have designated EFH within the Project Area. The table delineates species characteristics, including habitat preference (demersal versus pelagic), early life stage presence, EFH designation, commercial/recreational importance, potential prey species, and seasonality in the region.

Groundfish are an important part of the ecosystem within the Project Area and have an important economic role in the broader region. Some demersal species are present year-round in the Project Area; however, there are distinct variations in local populations because of seasonal migrations and inter-annual population dynamics (declines and increases) (Malek, 2015). These migrations are often correlated with seasonal variation in water temperature. Demersal species such as Atlantic cod, black sea bass, scup, whiting, summer flounder, winter flounder, yellowtail founder, and winter skate are important to both the stability and resiliency of the local marine community and have a large impact on commercial fisheries (RI CRMC, 2010). For more information about the commercial and recreational fishing activity within the Project Area, see Section 4.6.5.

Atlantic cod has spawning habitat within localized regions near the RWF area. In southern New England, cod spawn in the winter, primarily from December through March (Dean et al., 2020; Langan et al., 2020). Tagging studies completed in other regions suggest that cod often demonstrate strong spawning site fidelity, returning to the same fine-scale bathymetric locations year after year (Hernandez et al., 2013; Siceloff and Howell, 2013). However, such homing behavior has not yet been documented amongst individual cod in southern New England, although conventional tagging studies suggest there is little dispersal during the winter spawning season (Cadrin et al., 2020). An active Atlantic cod spawning ground has been identified in a broad geographical area that includes Cox Ledge (Zemeckis et al., 2014a). There is currently a BOEM funded acoustic telemetry study to better understand the distribution and habitat use of spawning cod on and around Cox Ledge. Additionally, in a sampling effort on Cox Ledge by Kovach et al. (2010), the majority of Atlantic cod collected were in spawning condition. Atlantic cod were not among the consistently prevalent (top 25) species collected during multi-year sampling by otter trawl and beam trawl in areas that included Cox Ledge (Malek et al., 2014).

Coastal pelagic species typically inhabit the sunlit zone over the continental shelf, in waters up to about 655 ft (200 m) deep (NOAA Fisheries, 2018). Example coastal pelagic species that may be found in the Project Area include forage fish such as anchovy, shad, and menhaden, as well as the predatory fish that prey on them. Certain pelagic species are considered highly migratory species; they travel long distances and often cross domestic and international boundaries. These include oceanic pelagic species such as tunas, billfishes, and many sharks. Many species of finfish that have pelagic life stages within the region are considered commercially or recreationally important. Some pelagic fish species migrate seasonally to the Project Area.

Anadromous species are those which migrate between the ocean and lower-salinity riverine environments for spawning. Demersal species of anadromous fish potentially present within the Project Area include striped bass and Atlantic sturgeon, and potentially present pelagic species of anadromous fish include American shad, alewife, blueback herring, Atlantic menhaden, and Atlantic sea herring (BOEM, 2013; Scotti et al., 2010).

A summary of common habitat types for the finfish species that could potentially occur in the RWF is provided in Table 4.3.3-2. As described in Section 4.3.2, across the vast majority of the RWEC-OCS and the northern region of the RWF, the predominant habitat type was sand sheet, aside from a cluster of 4 stations in the northern center of the RWF that consisted of a variety of habitat types including patchy pebbles on sand with mobile gravel, patchy cobbles and boulders on sand, and sand with mobile gravel. Other regions of the RWF, such as the southwest region of the RWF and the central and southern portions of the RWF, tended to have more heterogeneous habitat types composed of patchy pebbles on sand with mobile gravel, patchy cobbles on sand, and patchy boulders on sand. As a result of the more heterogeneous physical composition and generally coarser substrates, these benthic environments harbored more diverse epifaunal assemblages compared to the northern region of the RWF and the RWEC-OCS stations.

Finfish species depend on a system of multiple trophic levels. Both demersal/benthic and pelagic fish species consume fish, invertebrates, planktonic organisms, and detritus. Shellfish, worms, copepods, and other invertebrates are predominant types of prey for finfish in New England. The most common vertebrate finfish prey species include alewife, Atlantic menhaden, northern sand lance, and whiting. Common prey of juvenile and adult finfish species that could potentially occur in the RWF are summarized in Table 4.3.3-3.

Within the RWF area 40 species of fish and invertebrates have designated EFH for various life stages (Table 4.3-4). These species and their EFH are described in detail in the EFH Assessment Appendix L.

As mentioned above, the federally listed Atlantic sturgeon could occur within the RWF area. The Atlantic sturgeon is an anadromous, subtropical species that can be found along the Atlantic coast from Labrador, Canada to Florida (Murdy et al., 1997; ASMFC, 2019b). The Atlantic sturgeon is a federally listed species with five distinct population segments (DPSs) (i.e., the New York Bight, Gulf of Maine, Chesapeake Bay, Carolina, and South Atlantic DPS), which are grouped by ranges according to designations published by NOAA Fisheries (77 *Federal Register* 5880; 77 *Federal Register* 5914). The DPS most likely to be found in the vicinity of the Project Area is the New York Bight DPS. Atlantic sturgeon migrate into freshwater rivers to spawn in the spring and early summer and migrate downriver in the summer or fall to reside in estuarine and marine waters (NOAA Fisheries, 2019a; Atlantic Sturgeon Status Review Team, 2007). Adult Atlantic sturgeon in the New York Bight DPS utilize spawning rivers along southern New England (e.g., Connecticut River), New York (e.g., Hudson River), and in the Delaware River (ASMFC, 1990, 2019b). Historically, Atlantic sturgeon also spawned in the Taunton River (Massachusetts), however, their current status in this river is unknown (ASMFC, 2019b). During the spawning season, most spawning age adults will be found in natal rivers. When not spawning, it is common for adult Atlantic sturgeon to migrate long distances from their spawning rivers; during this time period they generally inhabit shallow nearshore areas over silt, sand, clay, and gravel substrates (NOAA Fisheries, 2019a; ASMFC, 2015). They are benthic feeders, and typically consume benthic invertebrates such as crustaceans, worms, mollusks, as well as bottom-dwelling fish such as sand lance (NOAA Fisheries, 2019a).

Near the RWF area, many juvenile and adult Atlantic sturgeon have been captured in otter trawls and sink gill nets (Stein et al., 2004). Through an aggregation of commercial bycatch data, Stein et al. (2004) found the greatest occurrence of offshore Atlantic sturgeon in Massachusetts and Rhode Island waters to occur from November through May. Given this information, it is possible that adult Atlantic sturgeon may be present in the RWF during this time period. Additional discussion of Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix.

RWEC–OCS

Table 4.3.3-1 summarizes species of economic or ecological importance potentially present within RWEC-OCS, generally characterized by their life stage and location in the water column. Finfish and EFH resources were evaluated within the Project Area as described in Section 1.1-1 and within a 0.5 mile (800 m) wide corridor around the RWEC-OCS. The species present within the RWEC-OCS are expected to be very similar to those discussed above for the RWF.

A summary of common habitat types for the finfish species that could potentially occur in the RWEC-OCS is provided in Table 4.3.3-2. As described in Section 4.3.2, across the vast majority of the RWEC-OCS and the northern region of the RWF, the predominant habitat type was sand sheet.

Common prey of juvenile and adult finfish species that could potentially occur in the RWEC-OCS are summarized in Table 4.3.3-3.

Within the 0.5 mi (800 m) corridor around the RWEC-OCS centerline, 39 species of fish and invertebrates have designated EFH for various life stages (Table 4.3.3-4). These species and their EFH are described in detail in the EFH Assessment Appendix.

Atlantic sturgeon may be present along the RWEC-OCS corridor. Additional discussion of Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

RWEC–RI

Table 4.3.3-1 summarizes species of economic or ecological importance potentially present within RWEC-RI, generally characterized by their life stage and location in the water column. Finfish and EFH resources were evaluated within the Project Area as described in Section 1.1-1 and within a 0.5 mi (800 m) wide corridor around the RWEC-RI.

The species expected to be present within the RWEC-RI overlap substantially with the species described for the RWEC-OCS. However, within Narragansett Bay, the demersal fish community structure has been changing over the past six decades with some demersal species declining (e.g., winter flounder, whiting, and red hake), while others have increased (e.g., Atlantic butterfish, scup, and squid) (Collie et al., 2008). These population changes are thought to be related to overfishing, fishery closures, changes in food sources, and changes in habitat (ASMFC, 2019a). The abundance of coastal anadromous finfish, such as striped bass, American shad, and river herring (alewife and blueback herring), has declined substantially in Narragansett

Bay due to habitat loss and exploitation (NBEP, 2017). These species migrate between the ocean and lower-salinity riverine environments, typically undergoing their upstream migration in the spring.

A summary of common habitat types for the finfish species that could potentially occur in the RWEC-RI is provided in Table 4.3.3-2. In general, stations sampled along the RWEC-RI were low in environmental complexity, consisting mainly of sand sheet habitat type. The exceptions were stations located in central Narragansett Bay, which were characterized by the CMECS Biotic Subclass Attached Fauna and included the habitat types of mollusk bed (or shells) on mud and patchy cobbles on sand. Along the RWEC-RI there were spatial trends associated with the observed biological and physical features. The up-estuary stations were generally characterized by finer substrate, dominated by soft-sediment fauna, higher turbidity, and more reduced sediments. The mid-bay stations were characterized by mussel and *Crepidula* beds with other attached organisms including barnacles, sponges, and macroalgae. The stations at the mouth of Narragansett Bay and the stations leading offshore to the 3-mile state water boundary were generally dominated by soft sediment infauna.

Common prey of juvenile and adult finfish species that could potentially occur in the RWEC-RI are summarized in Table 4.3.3-3.

Within the 0.5 mi (800 m) corridor around the RWEC-RI centerline, 32 species of fish and invertebrates have designated EFH for various life stages (Table 4.3.3-4). These species and their EFH are described in detail in the EFH Assessment Appendix.

Atlantic sturgeon may be present along the RWEC-RI corridor. However, their presence is less likely within Narragansett Bay, as Atlantic sturgeon are not likely to utilize rivers feeding into Narragansett Bay for spawning. Additional discussion of Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Table 4.3.3-1 Economically and Ecologically Important Finfish Species in the RWF and RWEC

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
DEMERSAL/BENTHIC								
Atlantic cod (*Gadus morhua*) This species also has life stages that are pelagic.			•	•	X	X		Year-round, peak in winter and spring
Atlantic halibut (*Hippoglossus hippoglossus*) This species also has life stages that are pelagic.			•	•		X		Year-round
Atlantic herring (*Clupea harengus*) This species also has life stages that are pelagic.	•					X	X	Winter
Atlantic moonfish (*Selene setapinnis*)			•	•				Spring to fall
Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)			•	•				October to May
Black sea bass (*Centropristis striata*) This species also has life stages that are pelagic.			•	•	X	X		Spring to summer; summer to fall
Cunner (*Tautogolabrus adspersus*)			•	•			X	Year-round, hibernate in mud over winter
Fourspot flounder (*Paralichthys oblongus*)			•	•			X	Spring to fall
Haddock (*Melanogrammus aeglefinus*) This species also has life stages that are pelagic.			•	•	X	X		Winter and spring

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
Little skate (*Leucoraja erinacea)*			•	•	X	X		Year-round
Longhorned sculpin (*Myoxocephalus octodecemspinosus*)			•	•				Winter and spring
Monkfish (*Lophius americanus*) This species also has life stages that are pelagic.			RWEC*	•	X	X		Summer to fall
Northern sea robin (*Prionotus carolinus*)			•	•		X		Spring through fall
Ocean pout (*Macrozoarces americanus*)	•	•	•	•	X	X	X	Late summer to winter
Pollock (*Pollachius virens*)	•	•	•	•		X		Collected in November at BIWF
Red hake (*Urophycis chuss*) This species also has life stages that are pelagic.			•		X	X	X	September to December Collected from April to July at BIWF
Sand lance (*Ammodytes americanus*)	•	•	•	•			X	Year-round
Scup (*Stenotomus chrysops*)			•	•	X	X	X	Juveniles: winter to spring; Adults: October to December
Sea raven (*Hemitripterus americanus*)	•	•	•	•				Collected Year-Round at BIWF
Silver hake (*Merluccius bilinearis*) This species also has life stages that are pelagic.			•	•	X	X	X	Spring to fall
Smallmouth flounder (*Etropus microstomus*)			•	•			X	Spring to fall
Smooth Dogfish (*Mustelus canis*)			•	•				Fall to winter Collected spring through fall at BIWF

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
Spiny dogfish (*Squalus acanthias*)			•	•	X	X		Fall to winter Collected summer and fall at BIWF
Spotted hake (*Urophycis regia*)			•	•			X	Spring to fall
Striped bass (*Morone saxatilis*)			•	•		X		Spring to fall
Striped searobin (*Prionotus evolans*)			•	•			X	Year-round
Summer flounder (*Paralichthys dentatus*) This species also has life stages that are pelagic.			RWEC*	•	X	X		Winter to spring Collected year-round at BIWF
Tautog (*Tautoga onitis*)			•	•		X	X	Winter
Tilefish (*Lopholatilus chamaeleonticeps*)		•	•			X		Larvae: July to September; Juveniles: April to July
Windowpane flounder (*Scophthalmus aquosus*) This species also has life stages that are pelagic.			•	•	X	X	X	Summer to fall Collected year-round at BIWF
Winter flounder (*Pseudopleuronectes americanus*) This species also has life stages that are pelagic.		•	•	•	X	X	X	Larvae: winter to early spring; Juveniles and Adults: year-round
Winter skate (*Leucoraja ocellate*)			•	•	X	X		Summer and fall Collected year-round at BIWF
Wolffish (*Anarhichas lupus*)			•	•				November to June

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
Yellowtail flounder (*Limanda ferruginea*) This species also has life stages that are pelagic.			•	•	X	X	X	Year-round
PELAGIC								
Albacore tuna (*Thunnus alalunga*)			RWEC*		X	X		Summer to fall
Alewife (*Alosa pseudoharengus*)			•	•		X	X	Mid July to October Collected January to May at BIWF
American eel (*Anguilla rostrata*)		•	•	•		X		Juveniles or Adults: March through December. One adult collected in April at BIWF
American shad (*Alosa sapidissima*)			•	•		X		Spring to summer
Atlantic bonito (*Sarda sarda*)			•	•		X		Summer to fall
Atlantic butterfish (*Peprilus triacanthus*)	RWEC*	RWEC*	RWEC*	•	X	X	X	Eggs/Larvae: July to September; Juveniles/Adults: spring Adults: Collected in summer and fall at BIWF
Atlantic cod This species also has life stages that are demersal.	•	•			X	X	X	Winter and spring
Atlantic halibut This species also has life stages that are demersal.	•	•				X	X	Winter and spring

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
Atlantic herring This species also has life stages that are demersal.		•	•	•	X	X	X	Larvae: August to December; Juveniles/Adults: spring and fall Juveniles/Adults: Collected January to March at BIWF
Atlantic mackerel (*Scomber scombrus*)	•	RWEC*	•	•	X	X	X	Eggs/Larvae: April to June; Juveniles/Adults: late summer to fall Juveniles/Adults: Collected January through February at BIWF
Atlantic menhaden (*Brevoortia tyrannus*)			•	•		X	X	Spring to summer
Atlantic silverside (*Menidia menidia*)			•	•			X	Late fall to early spring
Basking shark (*Cetorhinus maximus*)			RWEC*	RWEC*	X			Summer to fall
Bay anchovy (*Anchoa mitchilli*)	RWEC	RWEC-RI	RWEC-RI	RWEC			X	Eggs and Larvae: spring, summer, fall Juveniles and Adults: year-round
Black sea bass This species also has life stages that are demersal.	•	•				X	X	July to September
Blueback herring (*Alosa aestivalis*)			•	•		X	X	Summer to winter Collected in the winter at BIWF
Bluefin tuna (*Thunnus thynnus*)		RWF*	•	•	X	X		Spring to winter
Bluefish (*Pomatomus saltatrix*)	•	•	•	•	X	X	X	Eggs: March to May; Larvae: June to August; Juveniles collected in September, October, and December at BIWF; Adults: August to September; Adults collected in September, October, November, and May at BIWF

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
Blue shark (*Prionace glauca*)			•	•	X			June to November
Common thresher shark (*Alopias vulpinus*)			•	•	X			June to December
Conger eel (*Conger oceanicus*)			•	•				Collected November to June at BIWF
Crevalle jack (*Caranx hippos*)			•	•		X		Summer and Fall
Dusky shark (*Carcharhinus obscurus*)			•		X			June to November
Haddock This species also has life stages that are demersal.	•	•			X	X	X	Winter and spring
Monkfish This species also has life stages that are demersal.	•	•			X	X	X	Summer to fall
Northern sea robin	•	•				X		Summer to fall
Red hake This species also has life stages that are demersal.	•	•			X	X	X	May to December
Sandbar shark (*Carcharhinus plumbeus*)			•	•	X			May to September
Sand tiger shark (*Carcharias taurus*)			RWEC*		X			May to September
Shortfin mako shark (*Isurus oxyrinchus*)			•	RWEC*	X			June to December
Silver hake This species also has life stages that are demersal.	•	•			X			Year-round
Skipjack tuna (*Katsuwonus pelamis*)				RWEC*	X	X		Year-round

Species	Eggs	Larvae	Juveniles	Adults	EFH	Commercial Recreational Importance	Forage Species	Potential Time of Year in Region Time of year information obtained from Sources listed below. When available, species presence based on survey information from the BIWF was provided from INSPIRE, 2018a.
Spot (*Leiostomus xanthurus*)			•	•		X		October to May
Summer flounder This species also has life stages that are demersal.	•	•			X	X	X	Fall
Tiger shark (*Galeocerdo cuvieri*)			•	RWF*				May to September
Weakfish (*Cynoscion regalis*)			•	•		X	X	Adults: June
White shark (*Carcharodon carcharias*)			RWEC*		X			Summer to fall
Windowpane flounder This species also has life stages that are demersal.	•	•			X	X	X	Spring
Winter flounder This species also has life stages that are demersal.		•			X	X	X	Winter to spring
Witch flounder	•	•			X	X	X	Year-round
Yellowfin tuna (*Thunnus albacares*)			RWEC*	RWEC*	X	X		Year-round
Yellowtail flounder This species also has life stages that are demersal.	•	•			X	X	X	March to August

Sources:

Bohaboy et al., 2010; Cargnelli et al., 1999a; Cargnelli et al., 1999b; Cargnelli et al., 1999c; Chang et al., 1999; Collette and Klein-MacPhee, 2002; Collie et al., 2008; Collie and King, 2016; Cross et al., 1999; Curtice et al., 2019; Demarest, 2009; Fahay et al., 1999a; Fahay et al., 1999b; Fairchild, 2017; Fisheries Hydroacoustic Working Group, 2008; Florida Fish and Wildlife Conservation Commission, 2019; Florida Museum of Natural History, 2017; GARFO, 2016; Gerry and Scott, 2010; Hasbrouck et al., 2011; INSPIRE 2018a; Jeffries and Terceiro, 1985; Johnson et al., 1999a; Johnson et al., 1999b; Knickel, 2018; Lipsky, 2014; Malek, 2015; Malek et al., 2010; Malek et al., 2014; Massachusetts Department of Energy and Environmental Affairs, 2019; MA EOEEA, 2015; McBride et al., 2002; McGuire et al., 2016; Morse et al., 1999; Morton, 1989; NBEP 2017; NEFMC, 2017; NEFSC, 2017; NOAA Fisheries, 2007, 2015, 2016, 2017; North Carolina Department of Environment and Natural Resources: Division of Marine Fisheries, 2019; Northeast Ocean Data, 2017; Packer et al., 1999, 2003a, 2003b, and 2003c; Pereira et al., 1999; Petruny-Parker et al., 2015; Popper et al., 2014; Reid et al., 1999;

RIDEM 2019; Rooker et al., 2007; Scotti et al., 2010; Siemann and Smolowitz, 2017; Steimle et al., 1999a, 1999b, 1999c, 1999d, Steimle and Shaheen, 1999; Studholme et al., 1999; USFWS, 2019; URI EDC, 1998a, 1998b; URI GSO, 2019; Wood et al., 2009

Notes: ● - denotes that the life stage is potentially present in the RWF, RWEC-OCS, and RWEC-RI. RWF* – denotes that the life stage is potentially present only in the RWF, according to EFH designations. RWEC* – denotes that the life stage is potentially present only in the RWEC, according to EFH designations and is present along both the RWEC-RI and RWEC-OCS. RWEC-RI denotes that the life stage is potentially present only in the RWEC-RI. EFH column – X indicates EFH is designated for at least one life stage within the RWF and/or RWEC. See Table 4.3-4 for detailed EFH designations by life stage.

Table 4.3.3-2 Common Habitat Types for Finfish Species Known to Occur in the Region

Species	Habitat Type by Life Stage
DEMERSAL/BENTHIC	
Atlantic cod	Juveniles: Cobble substrates both nearshore and offshore; wide temperature ranges. Adults: On or near the bottom along rocky slopes of ledges; depths between 131 and 426 ft (40 and 130 m) but also midwater.
Atlantic sea herring	Eggs: Spawned at depths of 131 to 262 ft (40 to 80 m) on George's Bank on gravel (preferred); sand, rocks, shell fragments, aquatic macrophytes, and lobster pot structures.
Atlantic sturgeon	Juveniles: In the wintertime, juveniles congregate in a deep-water habitat in estuaries. Most are found over clay, sand, and silt substrates. Adults: Primarily a marine species that is found close to shore; however, it does migrate long distances.
Black sea bass	Juveniles: Collected at depths of 65 to 787 ft (20 to 240 m) in channel environments. Adults: At depths of 98 to 787 ft (30 to 240 m) in shipwrecks, rocky and artificial reefs, mussel beds, and other structures along the bottom.
Cunner	All Life Stages: Coastal fish that prefers eel grass, rock pools, or pilings at depths 13 to 23 ft (4 to 7 m).
Haddock	Adults: Pebble gravel bottom at depths of 131 to 492 ft (40 to 150 m).
Little skate	All Life Stages: Sandy/gravely bottoms at a depth range of less than 233 to 298 ft (71 to 91 m).
Monkfish	Juveniles/Adults: Bottom habitat, sand/shell mix, gravel or mud along the continental shelf, depths 82 to 656 ft (25 to 200 m).
Northern sea robin	Juveniles and Adults: Smooth, hard-packed bottom.
Ocean pout	All Life Stages: Bottom habitats with rocky shelter from the intertidal continental shelf to 656 ft (200 m) deep.
Pollock	All Life Stages: Schooling fish living at various depths from near the surface to at least 600 ft (182 m) deep.
Red hake	Juveniles: Use of shells and substrate as shelter; found less than 393 ft (120 m) to low tide line.
Sand lance	All Life Stages: Throughout water column over sandy substrates.
Scup	Juveniles: Nearshore in sandy, silty-sand, mud, mussel beds, and eel grass at depths of 16 to 55 ft (5 to 17 m). Adults: Soft, sandy bottom, near structures (ledges, artificial reefs, mussel beds) at a depth range less than 98 ft (30 m).
Sea raven	All Life Stages: Prefer rocky ground; hard clay, pebbles, or sand from 300 to 630 ft (91 to 192 m) deep.
Silver hake	Eggs: Surface waters over continental shelf at depths of 164 to 492 ft (50 to 150 m). Larvae: Surface waters over the continental shelf at depths of 164 to 426 ft (50 to 130 m).

Species	Habitat Type by Life Stage
Smooth dogfish	All Life Stages: Mostly nearshore but some have a depth range of 870 to 990 ft (145 to 165 m); prefer bottom habitats.
Spiny dogfish	All Life Stages: Collected over sand, mud, and mud-sand transitions at depths ranging from 3 to 1,640 ft (1 to 500 m); do not travel to maximum depths in the fall.
Striped bass	All Life Stages: Open waters along rocky shores and sandy beaches.
Summer flounder	Adults: Prefer sandy habitats; captured from shoreline to 82 ft (25 m) deep.
Tautog	All Life Stages: Require complex, structured habitats with a hard bottom substrate; depths of 82 to 989 ft (25 to 30 m).
Tilefish	All Life Stages: 262- to 590-ft (80- to 180-m) depth along the outer part of the continental shelf to upper part of continental shelf.
Silver hake	Juveniles: Bottom habitats; all substrate types; depths of 65 to 885 ft (20 to 270 m). Adults: Bottom habitats; all substrate types; depths of 98 to 1,066 ft (30 to 325 m).
Windowpane flounder	Juveniles and Adults: Fine, sandy sediment; nearshore less than 246 ft (75 m) deep.
Winter flounder	Eggs: Nearshore; mud to sand or gravel. Emerging evidence that spawning occurs offshore. Larvae: Nearshore; fine sand to gravel. Juveniles: 59 to 88 ft (18 to 27 m) deep; mud or sand-shell. Adults: Mostly nearshore up to 98 ft (30 m) deep; mud, sand, cobble, rocks, or boulders substrate.
Winter skate	All Life Stages: Prefer sandy or gravelly substrates; spring depths from 3 to 984 ft (1 to 300 m); fall depths from 3 to 1,312 ft (1 to 400 m).
Wolffish	All Life Stages: Occupy complex habitats with large stones or rocks at a depth range of 131 to 787 ft (40 to 240 m).
Yellowtail flounder	Juveniles: Sand or sand and mud; depth range of 16 to 410 ft (5 to 125 m). Adults: Sand or sand and mud; depth range of 32 to 1,181 ft (10 to 360 m).
Pelagic	
Albacore tuna	All Life Stages: Deepwater habitats; depth range of 0 to 1,968 ft (0 to 600 m).
Alewife	Adults: Shorelines; shallower waters near estuaries.
American eel	Larvae: Drift with Gulf Stream toward Atlantic Coast. Juveniles: Glass eels and elvers migrate to brackish waters; some remain in marine waters. Adults: Freshwater, coastal, and marine waters.
American plaice	Eggs and Larvae: Open waters; depth maximum 328 ft (100 m). Juveniles and Adults: High concentrations around 328 ft (100-m) deep; prefer sand and gravel substrates.
American shad	Juveniles: Nearshore open waters. Adults: Open ocean.

Species	Habitat Type by Life Stage
Atlantic bonito	All Life Stages: Open waters both nearshore and offshore.
Atlantic butterfish	Eggs: Surface waters along the edge of the continental shelf to estuaries and bays. Larvae and Juveniles: Surface waters from continental shelf to bays. Adults: Surface waters from depths of 885 to 1,377 ft (270 to 420 m).
Atlantic cod	Eggs: Bays, harbors, offshore banks; float near water surface. Larvae: Open ocean and continental shelf area.
Atlantic halibut	Eggs: Offshore drift suspended in the water column. Larvae: Nearshore areas near the water surface.
Atlantic mackerel	Eggs: Shoreward side of the continental shelf; 32 to 1,066 ft (10 to 325 m) deep. Larvae: Offshore waters and open bays; 32 to 426 ft (10 to 130 m) deep. Juveniles: Nearshore areas; 164 to 229 ft (50 to 70 m) deep. Adults: Offshore, 32 to 1,115 ft (10 to 340 m) deep.
Atlantic menhaden	All Life Stages: Nearshore and offshore.
Atlantic sea herring	All Life Stages: High energy environments; gravel seafloors.
Atlantic silverside	Juveniles and Adults: Found at great depths offshore from late fall through early spring. In the summer, they are found along the shore, within a few ft of the shoreline along sandy or gravel shores.
Basking shark	All Life Stages: Coastal and offshore; sometimes enters inshore bays.
Bay anchovy	Eggs/Larvae: Eggs are found throughout the water column but tend to be concentrated near the surface. Larvae move upstream to lower salinity waters in the spring and then move to more saline waters in the fall. Juveniles and Adults: shallow and moderately deep offshore waters, nearshore waters off sand beaches, open bays, and muddy coves.
Black sea bass	Eggs: Coastal, upper water column. Larvae: Nearshore, mouths of estuaries, upper water column.
Blueback herring	Adults: High energy environments; gravel seafloors.
Bluefin tuna	All Life Stages: Nearshore and offshore.
Bluefish	Eggs: Across continental shelf; transported further offshore. Larvae: Near edge of continental shelf; associated with surface. Juveniles: Nearshore; associated with surface. Adults: Nearshore to offshore.
Blue shark	All Life Stages: Nearshore and offshore, surface dwelling, concentrated near fishing activity.
Common thresher shark	Juveniles: Shallower waters over the continental shelf (less than 656 ft [200 m] deep) in areas of upwelling or mixing. Adults: Present near and offshore, but more common nearshore, in areas of upwelling or mixing.

Species	Habitat Type by Life Stage
Conger eel	All Life Stages: Near the coastline to the edge of the continental shelf, 300 to 852 ft (91 to 260 m) deep.
Dusky shark	All Life Stages: Nearshore and offshore.
Haddock	Eggs: Near the surface of water column. Larvae: Depths of 32 to 164 ft (10 to 50 m) with a maximum depth of 492 ft (150 m).
Monkfish	Eggs: Surface waters in areas that have depths of 49 to 3,280 ft (15 to 1000 m). Larvae: Pelagic waters in areas that have depths of 49 to 3,280 ft (15 to 1000 m).
Northern sea robin	Eggs and Larvae: Pelagic waters of the continental shelf.
Red hake	Eggs: Water column within the inner shelf. Larvae: Coastal waters less than 656 ft (200 m) in depth.
Sandbar shark	All Life Stages: Waters on continental shelves, oceanic banks, and island terraces, but also found in harbors, estuaries, at the mouths of bays and rivers, and shallow turbid water. Mostly at 65 to 213 ft (20 to 65 m) deep.
Sand tiger shark	All Life Stages: Nearshore ranging in depths from 6 to 626 ft (2 to 191 m); inhabit surf zone, shallow bays, and rocky reefs, and deeper areas around the OCS.
Shortfin mako shark	All Life Stages: Various areas of the water column; ranging depths, maximum depth 2,427 ft (740 m).
Skipjack tuna	All Life Stages: Epipelagic, oceanic species.
Spot	All Life Stages: Coastal, nearshore, and offshore continental shelf areas.
Summer flounder	Eggs and Larvae: Nearshore areas within eel grass beds and pilings.
Tiger shark	All Life Stages: Coastal, nearshore, and offshore continental shelf areas.
Weakfish	All Life Stages: Nearshore, shallow waters along open sandy shores and estuaries.
White shark	All Life Stages: Nearshore and offshore, mostly spotted near the surface.
Windowpane flounder	Eggs and Larvae: Occupy multiple areas in water column less than 229 ft (70 m) depths.
Winter flounder	Larvae: Both nearshore and offshore.
Witch flounder	Eggs: Deep; pelagic waters 164 to 278 ft (50- to 85-m) depths. Larvae: 0- to 820-ft (0- to 250-m) depths.
Yellowfin tuna	All Life Stages: epipelagic, oceanic fish found in the upper 328 ft (100 m) of the water column.
Yellowtail flounder	Eggs: Pelagic - near-surface continental shelf waters. Larvae: Pelagic - mid-water column; movement limited to currents.

Sources: Auster and Stuart, 1986; Collette and Klein-MacPhee, 2002; Malek et al., 2016

Table 4.3.3-3 Common Prey Species of Juvenile and Adult Finfish Species

Species	Common Prey Species
DEMERSAL/BENTHIC	
Atlantic cod	Benthic invertebrates
Atlantic halibut	Silver hake, sand lance, ocean pout, and alewife
Atlantic sturgeon	Benthic invertebrates
Black sea bass	Invertebrates and zooplankton
Cunner	Pipefish, mummichog, and invertebrates
Haddock	Amphipods
Little skate	Sand lance, alewife, herring, cunner, silversides, tomcod, and silver hake
Monkfish	Sand lance and monkfish
Northern sea robin	Shrimp, crabs, amphipods, squid, bivalve mollusks, and segmented worms
Ocean pout	Sand dollars
Pollock	Herring and crustaceans
Red hake	Crustaceans
Sand lance	Plankton
Scup	Fish eggs and invertebrates
Sea raven	Herring, lance, sculpins, tautog, silver hake, and both sculpin and sea- raven eggs
Silver hake	Crustaceans
Smooth dogfish	Crustaceans, particularly lobsters
Spiny dogfish	Squid and fish
Striped bass	Menhaden, anchovy, spot, amphipods, and sand lance
Summer flounder	Windowpane, winter flounder, northern pipefish, Atlantic menhaden, bay anchovy, red hake, silver hake, scup, Atlantic silverside, American sand lance, bluefish, weakfish, mummichog, rock crabs, squid, and shrimp
Tautog	Copepods and shellfish
Tilefish	Crabs, squid, shrimp, shelled mollusks, annelid worms, sea urchins, sea cucumbers, and sea anemones
Windowpane flounder	Invertebrates
Winter flounder	Clams
Winter skate	Smaller skates, eels, alewife, blueback herring, menhaden, smelt, sand lance, chub mackerel, butterfish, cunner, sculpins, silver hake, and tomcod.

Species	Common Prey Species
Wolffish	Mollusks and shellfish
Yellowtail flounder	Invertebrates
PELAGIC	
Albacore tuna	Longfin and shortfin squid and crustaceans
Alewife	Herring, eels, sand lance, cunners, and alewife
American eel	Small fish of many varieties, shrimp, crabs, lobsters, and smaller crustacea
American plaice	Sand dollars
American shad	Various fish
Atlantic bonito	Mackerels, menhaden, and sand lance
Atlantic butterfish	Small fish, squid, and crustaceans
Atlantic mackerel	Copepods and crustaceans
Atlantic menhaden	Diatoms and crustaceans
Atlantic sea herring	Copepods
Atlantic silverside	Zooplankton, copepods, shrimp, amphipods, young squid, worms, insects, and algae
Basking shark	Small crustaceans
Bay anchovy	Mysid shrimp, copepods, small crustaceans and mollusks, and larval fish
Blueback herring	Zooplankton
Bluefin tuna	Herring and eels
Bluefish	Invertebrates and crustaceans
Blue shark	Herring, mackerel, spiny dogfish, and various others
Common thresher shark	Pelagic fish and squid
Conger eel	Butterfish, herring, eels, and invertebrates
Dusky shark	Various pelagic fish
Sandbar shark	Menhaden and crustaceans
Sand tiger shark	Small sharks, rays, squid, and lobster
Shortfin mako shark	Mackerels, tuna, and bonito
Skipjack tuna	Pelagic fish and invertebrates
Spot	Bristle worms, mollusks, crustaceans, and plant and animal detritus

Species	Common Prey Species
Tiger shark	Fish and squid
Weakfish	Crabs, amphipods, mysid and decapod shrimps, squid, shelled mollusks, and annelid worms, menhaden, butterfish, herring, scup, anchovies, silversides, and mummichog
White shark	Fish, rays, squid, other sharks, and marine mammals
Yellowfin tuna	Large pelagic fish and squid

Table 4.3.3-4 EFH Designations for Species in the RWF and RWEC

Species	Life Stages within RWF	Life Stages within RWEC-OCS	Life Stages within RWEC-RI
New England Finfish			
Atlantic cod (*Gadus morhua*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile Adult
Atlantic herring (*Clupea harengus*)	Larvae, Juvenile, Adult	Larvae, Juvenile, Adult	Larvae, Juvenile, Adult
Atlantic wolfish *(Anarhichas lupus)*	Egg, Larvae, Juvenile, Adult	-	-
Haddock (*Melanogrammus aeglefinus*)	Egg, Larvae, Juvenile	Larvae, Juvenile	-
Monkfish (*Lophius americanus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae
Ocean pout (*Zoarces americanus*)	Egg, Juvenile, Adult	Egg, Juvenile, Adult	Egg, Juvenile, Adult
Pollock (*Pollachius virens*)	Egg, Larvae, Juvenile	Egg, Larvae, Juvenile	Juvenile
Red hake (*Urophycis chuss*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Silver hake (*Merluccius bilinearis*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Adult
White hake (*Urophycis tenuis*)	Larvae, Juvenile	Larvae, Juvenile	Juvenile
Windowpane flounder (*Scophthalmus aquosus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Winter flounder (*Pseudopleuronectes americanus*)	Larvae, Juvenile, Adult	Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Witch flounder (*Glyptocephalus cynoglossus*)	Egg, Larvae	Egg, Larvae	-
Yellowtail flounder (*Limanda ferruginea*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Juvenile, Adult

Species	Life Stages within RWF	Life Stages within RWEC-OCS	Life Stages within RWEC-RI
Mid-Atlantic Finfish			
Atlantic butterfish (*Peprilus triacanthus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Atlantic mackerel (*Scomber scombrus*)	Egg, Larvae, Juvenile	Egg, Larvae, Juvenile	Egg, Larvae, Juvenile, Adult
Black sea bass (*Centropristis striata*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Bluefish (*Pomatomus saltatrix*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Juvenile, Adult
Scup (*Stenotomus chrysops*)	Juvenile, Adult	Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Summer flounder (*Paralichthys dentatus*)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Larvae, Juvenile, Adult
Invertebrates			
Atlantic sea scallop (Placopecten magellanicus)	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult	Egg, Larvae, Juvenile, Adult
Atlantic surfclam (Spisula solidissima)	-	Adult	Juvenile, Adult
Longfin inshore squid (Doryteuthis pealeii)	Egg, Juvenile, Adult	Egg, Juvenile, Adult	Egg, Juvenile, Adult
Northern shortfin squid (Illex illecebrosus)	Adult	-	-
Ocean quahog (Arctica islandica)	Juvenile, Adult	Juvenile, Adult	-
Highly Migratory Species			
Albacore tuna (*Thunnus alalunga*)	Juvenile, Adult	Juvenile, Adult	Juvenile
Bluefin tuna (*Thunnus thynnus*)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Skipjack tuna (*Katsuwonus pelamis*)	Juvenile, Adult	Adult	Adult
Yellowfin tuna (*Thunnus albacares*)	Juvenile, Adult	Juvenile, Adult	Juvenile
Skates			
Little skate (Leucoraja erinacea)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult

Species	Life Stages within RWF	Life Stages within RWEC-OCS	Life Stages within RWEC-RI
Winter skate (Leucoraja ocellata)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Sharks			
Basking shark (Cetorhinus maximus)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Blue shark (Prionace glauca)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Common thresher shark (Alopias vulpinus)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult
Dusky shark (Carcharhinus obscurus)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Sand tiger shark (Carcharias taurus)	Neonate, Juvenile	Neonate, Juvenile	Neonate, Juvenile
Sandbar shark (Carcharhinus plumbeus)	Juvenile, Adult	Juvenile, Adult	Juvenile, Adult
Shortfin mako shark (Isurus oxyrinchus)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	-
Smoothhound shark complex (Atlantic stock) (Mustelus canis)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult
Spiny dogfish (Squalus acanthias)	Sub-adult male, Sub-adult female, Adult male, Adult female	Sub-adult male, Sub-adult female, Adult male, Adult female	Sub-adult female, Adult male
White shark (Carcharodon carcharias)	Neonate, Juvenile, Adult	Neonate, Juvenile, Adult	Neonate

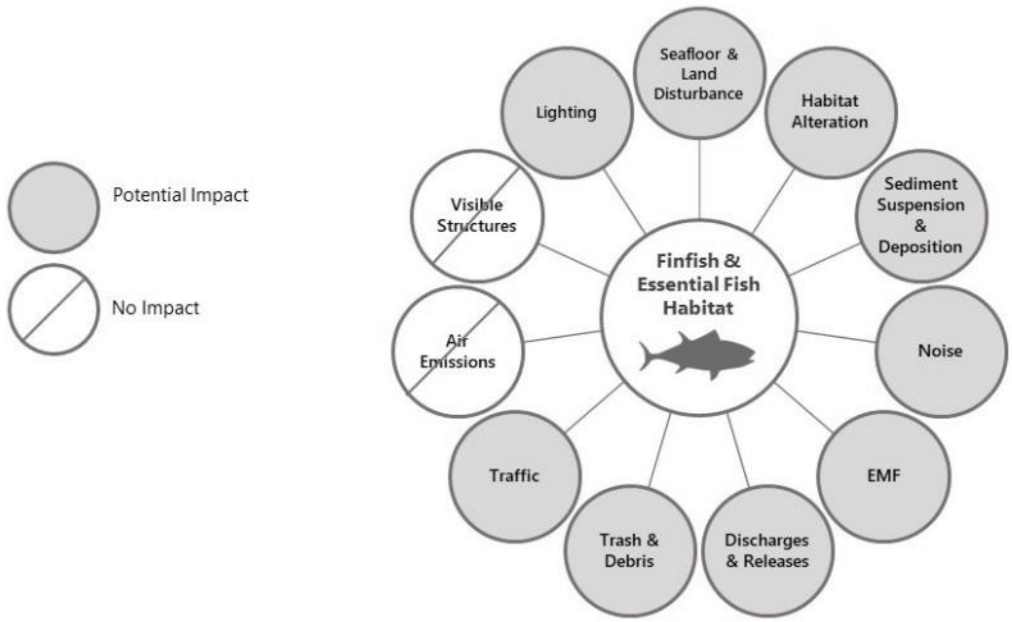
Sources: Auster and Stuart, 1986; Collette and Klein-MacPhee, 2002; Florida Fish and Wildlife Conservation Commission, 2019; Florida Museum of Natural History, 2017; Knickel, 2018; NOAA Fisheries, 2007; USFWS, 2019; URI EDC, 2017

4.3.3.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the finfish and EFH resources discussed above (Section 4.3.3.1). IPFs that may result in direct or indirect impacts to finfish and essential fish habitat are depicted in Figure 4.3.3-1. Impacts vary by habitat, species, and life stage, with some species/life stages being more vulnerable than others. All IPFs with potential to result in impacts on finfish and EFH are evaluated in this section.

The analysis of impacts on finfish and EFH are discussed separately for the RWF, RWEC-OCS, and RWEC-RI in the following sections. The IPFs are further defined for the construction and decommissioning phases of the Project and the O&M phase of the Project.

Figure 4.3.3-1 IPFs on Finfish and Essential Fish Habitat



Revolution Wind Farm

Based on the IPFs discussed in Tables 4.3.3-5 and 4.3.3-6, species with a completely pelagic lifestyle are generally expected to be less affected than demersal or benthic species. Overall, during construction, O&M, and decommissioning of the RWF, finfish and EFH species with benthic/demersal life stages are expected to be exposed to direct impacts from noise associated with impact pile driving and/or vibratory pile driving of foundations, other noise sources, seafloor disturbance, sediment suspension/deposition, and indirect impacts from habitat alteration. Finfish and EFH species with pelagic life stages are expected to be exposed to direct impacts from impact pile driving and/or vibratory pile driving noise and other construction/decommissioning noise sources, and indirect impacts from habitat alteration. Potential impacts from other IPFs are anticipated to be minimal. Potential long-term impacts may result from the conversion of soft-bottom habitat to hard-bottom habitat associated with the WTG foundations, scour protection, and secondary protection of the OSS-Link Cable and IAC. These long-term impacts would be reversed following decommissioning of the Project. None of the IPFs are expected to result in population-level effects on finfish and EFH species, due to the limited scale and intensity of the Project activities, the availability of similar habitat in the surrounding area, and the implementation of avoidance, minimization, and mitigation measures.

Construction and Decommissioning

IPFs resulting in potential impacts on finfish and EFH in the RWF area from the construction and decommissioning phases are summarized in Table 4.3.3-5. Additional details regarding potential impacts on finfish and EFH from the various IPFs during construction/decommissioning of the RWF are described in the following sections. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of the impacts associated with these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted.

Table 4.3.3-5 IPFs and Impact Characterization for Finfish and EFH Within the RWF During Construction and Decommissioning

		Impact Characterization for Finfish and EFH (Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.)			
IPF	Project Activity	Benthic/ Demersal Early Life Stages	Pelagic Early Life Stages	Benthic/ Demersal Late Life Stage	Pelagic Late Life Stages
Seafloor Disturbance	Seafloor preparation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Impact pile driving and/or vibratory pile driving/foundation installation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	IAC and OSS-Link Cable installation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Habitat Alteration	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	Indirect, short-term	Indirect, long-term	Indirect, long-term	Indirect, long-term

IPF	Project Activity	Impact Characterization for Finfish and EFH (Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.)			
		Benthic/ Demersal Early Life Stages	Pelagic Early Life Stages	Benthic/ Demersal Late Life Stage	Pelagic Late Life Stages
Sediment Suspension and Deposition	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Noise	Impact pile driving and/or vibratory pile driving	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Vessel noise, construction equipment noise, aircraft noise	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Discharges and Releases	Hazardous materials spills Wastewater discharge	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Traffic	See seafloor disturbance, noise, sediment suspension and deposition, and lighting IPFs.				
Lighting	Construction and vessel lighting	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term

Seafloor Disturbance and Habitat Alteration

Impacts on finfish and EFH associated with seafloor preparation will primarily be associated with species that have benthic/demersal early life stages, eggs and larvae (EFH Assessment, Appendix L) and later life stages, neonates, juveniles, and adults (Appendix L) and prefer the types of habitats that will be disturbed by seafloor preparation and vessel anchoring. These activities could cause injury or mortality to benthic/demersal species, affect their habitat, and disrupt their spawning. Similarly, seafloor-disturbing activities could result in a small loss of spawning habitat for Atlantic cod, as studies completed in other regions suggest that cod often demonstrate spawning site fidelity, returning to the same fine-scale bathymetric locations year after year to spawn (Hernandez et al., 2013; Siceloff and Howell, 2013; Zemeckis et al., 2014b). An active Atlantic cod winter spawning ground has been identified in a broad geographical area that includes Cox Ledge and surrounding locations (Zemeckis et al., 2014a; Dean et al., 2020). There is currently a BOEM funded acoustic telemetry study to better understand the distribution and habitat use of spawning cod on and around Cox Ledge. Given the availability of similar surrounding habitat, Project activities are not expected to result in measurable impacts on spawning Atlantic cod.

Non-lethal impacts on finfish and EFH are expected to be ***short-term,*** as the direct effects will cease after seafloor preparation is completed in a given area, and only a small portion of the available habitat in the area will be disturbed. Impacts on finfish and EFH species that have pelagic early and/or later life stages within the RWF are expected to be limited, as pelagic habitats will not be directly affected by seafloor preparation. However, these species may temporarily vacate the area of disturbance. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration.

Direct impacts on finfish and EFH associated with seafloor disturbance from impact pile driving and/or vibratory pile driving and installation of the foundations (WTG and OSS) and scour protection are expected to result in similar direct impacts on finfish and EFH as seafloor preparation. Impact pile driving and/or vibratory pile driving and foundation installation could crush benthic/demersal species, particularly eggs and larvae, but also less mobile older life stages that do not vacate the area. Minimal impacts on finfish and EFH are expected for pelagic species because they are not expected to be near the seafloor during work activities or subject to crushing or injury through placement of the piles and foundations or removal of the foundations during decommissioning.

Direct impacts on finfish and EFH associated with the IAC and OSS-Link Cable installation are expected to result in similar impacts as those for seafloor preparation, as the IAC will be installed in the same area that will have been disturbed during seafloor preparation. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration. Because of the slow speed of the cable installation equipment and limited size of the impact area, it is expected that most mobile benthic/demersal and pelagic finfish will leave the area; however, eggs, larvae, and other slower moving species may be subject to injury or mortality. Additionally, fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained during hydraulic dredging and jet trencher embedment of the IAC. Jet trencher and hydraulic dredging equipment uses seawater to circulate through hydraulic motors and jets during installation. Although this seawater is released back into the ocean, it is assumed that all entrained eggs, larvae, and zooplankton will be killed. These losses are expected to be low and ***short-term.*** A previous assessment conducted for the SFWF found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001% of the total zooplankton and ichthyoplankton abundance present in the study area, which encompassed a linearly buffered region of 15 km around the export cable and 25 km around the wind farm (INSPIRE Environmental, 2018b). Only early life stages may be affected by jet plow entrainment; later life stages will not be affected.

Limited research has been conducted on the potential impacts of hydraulic dredge entrainment, but because the volumes of water used by dredges are relatively small, the entrainment rates of ichthyoplankton are generally thought to be only a small proportion of the total local production (Reine and Clark, 1998; Reine et al., 1998). Egg and larval life stages are most likely to experience lethal impacts (Wenger et al., 2017), but later life stages could also be entrained by hydraulic dredging, with benthic species or species occurring in high densities having the highest risk (Drabble, 2012; Reine et al., 1998). However, the entrainment rates for mobile species are considered to be low, and mortality rates of entrained fish may also be low (Wenger et al., 2017; Drabble, 2012; Reine et al., 1998). Jet plow and hydraulic dredge entrainment losses are not expected to result in large losses of zooplankton, ichthyoplankton, or later life stages, and population-level impacts on EFH and finfish are not anticipated.

Impacts on finfish and EFH associated with boulder clearance and related seafloor preparation activities are expected to be ***direct*** and ***short-term***. Boulders relocated during seafloor preparation will be in new locations and may be in new physical configurations in relation to other boulders. Concerning these spatial and physical attributes, the boulders are not expected to return to pre-project conditions. However, relatively rapid (< 1 year) recolonization of these boulders is expected (Guarinello and Carey, 2020) and will return these boulders to their pre-project habitat function. Additionally, if relocation results in aggregations of boulders, these new features could serve as high value refuge habitat for juvenile lobster and fish as they may provide more complexity and opportunity for refuge than surrounding patchy habitat.

Immediately following impact-producing activities, finfish and EFH species are expected to move back into the area; however, in areas of sediment disturbance, demersal/benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). This recovery time may result in an ***indirect*** and ***long-term*** impact on finfish and EFH for species with benthic/demersal life stages. Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be small given the availability of similar habitats in the area. Other species may be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation, IAC and OSS-Link Cable installation, and vessel anchoring activities.

During decommissioning, foundations and other facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the structures during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWF (Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

Seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model, which is a three-dimensional model developed jointly with the USACE and the Environmental Research Development Center. SSFATE is a well-known model that has been successfully applied in projects around the globe to simulate the sediment transport from dredging, cable and pipeline burial operations, sediment dumping, dewatering operations, and other sediment-disturbing activities. SSFATE computes TSS concentrations released into the water column and predicts the transport, dispersion, and settling of the suspended sediment. RPS also performed hydrodynamic modeling using their 3-dimensional HYDROMAP modeling system to simulate water levels, circulation patterns, and water volume flux through the study area and to provide hydrodynamic input (spatially and temporally varying currents) for input into the sediment transport model. The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report Appendix J.

Several model simulations were run to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from cable burial activities. The grain size distributions used for modeling were based on samples collected during field studies performed for the Project (Fugro, 2020), which indicate the sediments are predominately coarse grained in the RWF. The sediment transport modeling results are summarized in Table 4.3.2-6. For the IAC, a representative segment of 7,392 ft (2,253 m) of installation was simulated and the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 853 ft (260 m) from the cable centerline. The plume is expected to be mostly contained within the bottom of the water column. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions in less than 4.8 hours following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial may exceed 0.4 in (10 mm) of deposition up to 197 ft (60 m) from the cable and could cover up to 47 ac (190,202 m^2). Sediment suspension and deposition associated with decommissioning activities are expected to be similar to those from cable burial, but slightly lower in magnitude.

Most marine species have some degree of tolerance to higher concentrations of suspended sediment because storms, currents, and other natural processes regularly result in increases in turbidity (MMS, 2009). However, these increases in sediment suspension and deposition may cause a temporary impact on benthic/demersal finfish and EFH. Direct impacts could include mortality, injury, or temporary displacement of the organisms living on, in, or near the seafloor. Sediment deposition on eggs or larvae may result in smothering, potentially resulting in mortality (MMS, 2007). Demersal/benthic early life stages in or near the area of disturbance would be most affected, but these impacts are not expected to result in population-level effects. Pelagic species could also be affected but are expected to temporarily vacate the area to avoid the disturbance and pelagic habitat quality is expected to quickly return to pre-disturbance levels.

Noise

To evaluate the levels of underwater noise likely to be generated during construction, modeling was conducted using JASCO's Marine Operations Noise model (MONM) and Full Wave Range Dependent Acoustic Model (FWRAM). These models combine the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate acoustic sound fields. For impact hammering of monopile foundations, the physical injury peak sound pressure threshold of 206 dB (re 1 µPa) for finfish, is predicted to be exceeded within a maximum range of 337 ft (115 m) from the sound source. Accumulated sound exposure levels of 187 dB (re 1 µPa2·sec) and 183 dB (re 1 µPa2·sec) were predicted to be exceeded within a maximum distance of 5.9 mi (9,464 m) and 7.9 mi (12,673 m), respectively. The finfish behavioral disturbance threshold of 150 dB (re 1 µPa RMS) is predicted to be exceeded within a maximum distance of 6.6 mi (10,664 m) from the sound source. Full modeling results are available in the Underwater Acoustic Modeling Analysis Appendix P3.

Sound exposure guidelines and regulations designed to protect finfish are described in terms of sound pressure levels, but the observable effects of high intensity noise sources on finfish may actually be caused by exposure to particle motion (Popper and Hawkins, 2018). However, the particle motion levels associated with a high intensity noise source are difficult to measure and isolate from sound pressure levels. There is currently very limited understanding of the potential effects of particle motion on finfish and invertebrates.

All fishes (including elasmobranchs) detect and use particle motion, even for those fishes that are also sensitive to sound pressure (Popper and Hawkins, 2019). Fishes that do not possess a swim bladder (sharks, mackerel, flatfish), as well as fishes with a swim bladder distant from the ear (salmon, tuna, most teleosts) are thought to primarily be sensitive to particle motion (Hawkins et al., 2020). Fishes with the swim bladder close to the ear (Atlantic cod, eels) or where the swim bladder is connected to the ear (herrings) are able to detect sound pressure as well as particle motion (Hawkins et al., 2020). In these finfish, the swim bladder and other gas-filled organs may act as a type of acoustic transformer, converting sound pressure into particle motion (Popper and Hawkins, 2018). The movement of these organs may indirectly stimulate the otolith structures such that fishes experience particle motion both from the noise source and from this indirect signal (Popper and Hawkins, 2018).

Potential impacts of noise on the federally listed Atlantic sturgeon are discussed in detail in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z. Impacts on Atlantic sturgeon from impact pile driving and/or vibratory pile driving are considered to be limited, considering they are an anadromous species that primarily utilize rivers, bays, estuaries, coastal, and shallow continental shelf waters. However, since Atlantic sturgeon are a demersal species that could potentially be present in the RWF area during impact pile driving and/or vibratory pile driving activities ***direct*** and ***short-term*** behavioral impacts could occur.

In response to noise associated with pile driving at the RWF, it is expected that finfish would temporarily relocate during construction and would not be in the areas of greatest acoustic stressors. Slow start (ramp up) of pile driving equipment would allow mobile species to move out of the area and not be subject to mortality or injury, but they may still experience some direct impact, such as behavioral responses. For exposed species, noise from impact pile driving and/or vibratory pile driving may temporarily reduce habitat quality. However, population-level impacts of impact pile driving and/or vibratory pile driving noise are not expected. Pile driving will be suspended during the winter months, thereby avoiding potential noise impacts that may disrupt the spawning activity of Atlantic cod. In conclusion, impact pile driving and/or vibratory pile driving is expected to result in a direct impact on finfish and EFH for both pelagic and demersal life stages, but this impact will be short-term as once pile driving is completed, the habitat suitability is expected to return to pre-pile driving conditions.

Short-term impacts on finfish and EFH could occur due to vessel noise, construction equipment noise, and/or aircraft noise during construction and decommissioning. Sounds created by mechanical/hydro-jet plows, vessels, or aircraft are continuous or non-impulsive sounds, which have different characteristics underwater and impacts on marine life. Limited research has been conducted on underwater noise from mechanical/hydro-jet plows. Generally, the noise from this equipment is expected to be masked by louder sounds from vessels. Also, as most noise generated by these pieces of equipment will be below the sediment surface and associated with the high-pressure jets, noise levels are not expected to result in injury or mortality to finfish and EFH species but may cause finfish to temporarily vacate the area. The duration of noise at a given location will be short, as vessels will only be present for a short period at any given location along the cable corridor.

Helicopters will be used for crew transfers between the WTGs and shore. Underwater noise associated with helicopters is generally brief as compared with the duration of audibility in the air (Richardson et al., 1995). .

Vessel noise may also cause finfish to temporarily vacate the area. Vessel sound source levels have been shown to cause several different effects in behavior, TTS, auditory masking, and blood chemistry. The most common behavioral responses are avoidance, alteration of swimming speed and direction, and alteration of schooling behavior (Vabø et al., 2002; Handegard and Tjøstheim, 2005; Sarà et al., 2007; Becker et al., 2013). These studies also demonstrated that the behavioral changes generally were temporary or that fish habituated to the noises. Finfish in the vicinity of Project vessels may be affected by vessel noise but the duration of the disturbance will occur over a very short period at any given location.

Direct impacts on finfish and EFH may result from a temporary degradation of habitat for species that vacate the area due to elevated noise levels. The noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region and are not expected to substantially affect the existing underwater noise environment.

Discharges and Releases

Routine discharges of wastewater (e.g., gray water or black water) or liquids (e.g., ballast, bilge, deck drainage, stormwater) may occur from vessels, WTGs, or the OSS during construction and decommissioning; however, those discharges and releases are not anticipated to results in impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal laws and regulations, such as the EPA and USCG requirements for discharges and releases to surface waters. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for adversely impacting water quality and marine life.

The construction/decommissioning of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. Minor releases of hazardous materials, if they were to occur, could result in direct and indirect, short-term impacts on finfish and EFH. The impacts of spills are caused by either the physical nature of the material (e.g., physical contamination and smothering) or by its chemical components (e.g., toxic effects and bioaccumulation). Minor releases of hazardous materials could also result in indirect impacts on finfish species if the spilled materials affect their eggs and food sources. Impacts would depend on the depth and volume of the spill, as well as the properties of the material spilled.

All vessels participating in the construction of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations, and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. BMPs for fueling and power equipment servicing will be incorporated into the Project's ERP/OSRP (Appendix D). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, impacts on finfish and EFH are not anticipated.

Trash and Debris

The release of trash and debris into offshore waters potentially may occur from any on-water activities. Certain types of trash and debris could be accidentally lost overboard during construction and decommissioning, with subsequent effects on finfish and EFH. USCG and EPA regulations require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Also, BOEM lease stipulations require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. As such, measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on finfish and EFH are not anticipated.

Traffic

Impacts associated with vessel traffic during RWF construction and decommissioning are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections.

For the federally listed Atlantic sturgeon, vessel strikes are considered to be an additional stressor associated with traffic. The factors contributing to the risk of Atlantic sturgeon vessel strikes are currently unknown, but may be related to the size and speed of vessels, navigational clearance (i.e., depth of water and draft of vessels), and the behavior of Atlantic sturgeon (e.g., foraging, migrating) in areas where vessels are operating (NOAA Fisheries, 2013). It is important to note that Atlantic sturgeon vessel strikes have only been identified as a significant concern in the Delaware and James

Rivers. Current data suggest that there may be unique geographic features of the Delaware and James Rivers (e.g., narrow migration corridors combined with shallow/narrow river channels) that increase the risk of interactions between vessels and Atlantic sturgeon (NOAA Fisheries, 2013). Construction and decommissioning of the RWF would result in a minor increase in vessel traffic, but most vessels would be slow-moving, and the effect would be small relative to existing traffic in the region. Additionally, because large numbers of Atlantic sturgeon are not expected to be present in areas of vessel activity, the likelihood of an interaction with a Project vessel is very low. For these reasons, vessel traffic associated with the RWF is not expected to negatively affect Atlantic sturgeon. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Lighting

Artificial lighting during construction/decommissioning at the RWF will be associated with navigational and deck lighting on vessels from dusk to dawn. The response of finfish species to artificial lights is highly variable and depends on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the prey aggregations. Other species may avoid artificially illuminated areas. Artificial lighting may disrupt the diel vertical migration patterns of fish and this may affect species richness and community composition (Nightingale et al., 2006; Phipps, 2001). It could also increase the risk of predation and disruption of predator/prey interactions and result in the loss of opportunity for dark-adapted behaviors including foraging and migration (Orr et al., 2013). Artificial lighting associated with construction and decommissioning would be temporary and limited relative to the surrounding areas. Lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Additionally, no underwater lighting is proposed. Artificial lighting is not expected to result in measurable impacts on finfish and EFH.

Operations and Maintenance

IPFs resulting in potential impacts on finfish and EFH in the RWF area from the O&M phase are summarized in Table 4.3.3-6. Additional details regarding potential impacts on finfish and EFH from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.3.3-6 IPFs and Impact Characterization for Finfish and EFH Within the RWF During O&M

IPF	Project Activity	Impact Characterization for Finfish and EFH			
		Benthic/ Demersal Early Life Stages	Pelagic Early Life Stages	Benthic/ Demersal Late Life Stages	Pelagic Late Life Stages
		Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.			
Seafloor Disturbance	Foundations (WTG and OSS)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	IAC and OSS-Link Cable non-routine O&M	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Habitat Alteration	Foundations IAC and OSS-Link Cable	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect, long-term
Sediment Suspension and Deposition	IAC and OSS-Link Cable non-routine O&M Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Noise	Vessel and aircraft noise	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term
	WTG operational noise	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term
Electric and Magnetic Fields	IAC and OSS-Link Cable	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term
Traffic	See seafloor disturbance, noise, sediment suspension and deposition, and lighting IPFs.				
Lighting	RWF operational lighting	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term
Discharges and Releases	Hazardous materials spills Wastewater discharge	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term

Seafloor Disturbance and Habitat Alteration

Seafloor disturbance during O&M of the RWF may occur during non-routine maintenance of bottom-founded infrastructure (e.g., foundations, scour protection, cable protection) and associated vessel anchoring activities. During O&M, anchoring will be limited to vessels required to be onsite for an extended duration. These maintenance activities are expected to result in similar ***direct*** and ***short-term*** impacts on finfish and EFH as those discussed for the construction/decommissioning phase, although the extent of disturbance would be limited to specific areas.

Once constructed, the RWF will result in changes to seafloor topography and hydrodynamics because of the presence of foundations, scour protection, and cable protection. In previous assessments, offshore structures have not been shown to change the strength or direction of regional oceanic currents that transport eggs and larvae of marine fishes (RI CRMC, 2010; DONG Energy et al., 2006). Larval recruitment of finfish and EFH species from the water column is not anticipated to be affected by the RWF structures because the vertical foundations represent a miniscule surface area within the surrounding waters, and recruitment is generally influenced by numerous environmental signals other than the presence of physical structure (including stage of larval development, temperature, prey availability, and chemical odor of conspecifics) (McManus et al., 2018; Pineda et al., 2007). Foundations have been hypothesized as serving as attachment sites for eggs of squid and herrings in the North Sea, but data so far are lacking (Vandendriessche et al., 2016). Planktonic life stages of finfish and EFH species would not be directly affected by the introduction of foundations and scour protection. The seafloor overlaying the majority of buried IAC and OSS-Link Cable (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected.

The presence of the foundations, associated scour protection, and cable protection may result in both negative and beneficial indirect impacts on finfish and EFH due to conversion of habitat from primarily soft-bottom to hard-bottom. Habitat conversion is expected to cause a shift in species assemblages towards those found in rocky reef/rock outcrop habitat; this is known as the "reef effect" (Wilhelmsson et al., 2006; Reubens et al., 2013). This effect is also well known from other anthropogenic structures in the sea, such as oil platforms, artificial reefs piers, and shipwrecks (Claudet and Pelletier, 2004; Wilhelmsson et al., 2006; Seaman, 2007; Langhamer and Wilhelmsson, 2009).

The use of gravel, boulders, and/or concrete mats will create new hard substrate, and this substrate is expected to be initially colonized by barnacles, tube-forming species, hydroids, and other fouling species found on existing hard bottom habitat in the region. Mobile organisms, such as lobsters and crabs, may also be attracted to and occur in and around the foundation in higher numbers than surrounding areas. Monopiles attract a range of attached epifauna and epiflora, including barnacles and filamentous algae (Petersen and Malm, 2006). Jacket foundations (which may be used for the OSS) provide a more complex structure than monopile foundations and may increase habitat complexity through more suitable fouling surfaces and increased protection from predators (MMS, 2009). As these foundations extend from below the seafloor to above the surface of the water, there is expected to be a zonation of macroalgae from deeper growing red foliose algae and calcareous algae, to kelps and other species, including those that may grow in subtidal, intertidal, and splash zone areas. Foundations and cable protection typically also have crevices that increase structural complexity of the area and attract finfish and invertebrate species seeking shelter.

Finfish and EFH species that have life stages associated with soft-bottom habitats may experience ***long-term*** impacts, as available habitat will be slightly reduced. Finfish and EFH species and life stages that inhabit hard bottom habitats may experience a beneficial effect, depending on the quality of the habitat created by the foundations and scour protection, and the quality of the benthic community that colonizes that habitat. Overall, habitat alteration is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWF (Appendix L), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any “reef effect” observed will be limited to the immediate vicinity of the individual structures. Given the availability of similar surrounding habitat and the limited area of habitat conversion, O&M of the RWF is not expected to result in measurable impacts on spawning Atlantic cod.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing the IAC and/or OSS-Link Cable. ***Direct*** and ***short-term*** impacts on finfish and EFH resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase, but on a more limited spatial scale.

Noise

Impacts on finfish and EFH from ship and aircraft noise during O&M of the RWF are expected to be similar to those discussed for the construction/decommissioning phase, though lesser in extent. The noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region and are not expected to substantially affect the existing underwater noise environment.

The underwater noise levels produced by WTGs are expected to be within the hearing ranges of fish, including Atlantic sturgeon. Depending on the noise intensity, these noises could disturb or displace fisheries species within the surrounding area or cause auditory masking (MMS, 2007). Noise levels from operation of the WTGs are not expected to result in injury or mortality, and finfish may become habituated to the operational noise (Thomsen et al., 2006; Bergström et al., 2014). Lindeboom et al. (2011) found no difference in the residency times of juvenile cod around monopiles between periods of WTG operation or when WTGs were out-of-order. This study also found that sand eels did not avoid the wind farm. In a similar study, the abundance of cod, eel, shorthorn sculpin, and goldsinny wrasse, were found to be higher near WTGs, suggesting that potential noise impacts from operation did not override the attraction of these species to the artificial reef habitat (Bergström et al., 2013). Based on the available literature, operational noise from the WTGs is expected to have minimal impacts on finfish, EFH, and Atlantic sturgeon. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species AppendixZ.

Electric and Magnetic Fields

Operation of the WTGs does not generate EMF; however, once the IAC and OSS-Link Cable become energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded and, where feasible, buried beneath the seafloor and will otherwise be protected. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012). Exposure to EMF could be short- or long-term, depending on the mobility of the species/life stage.

A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. That Appendix also summarizes data from field studies conducted to assess impacts of EMF on marine organisms. These studies constitute the best source of evidence to assess the potential impacts on finfish and invertebrate behavior or distribution in the presence of energized cables.

The available laboratory-generated research regarding the effects of 50- or 60-Hz on fish behavior do not indicate that produced fields will have adverse effects on magnetosensitive and electrosensitive species. Controlled laboratory studies conducted with eel and salmon (Richardson et al., 1976; Armstrong et al., 2015; Orpwood et al., 2015) support the conclusion that EMF produced by 50-75 Hz AC cables do not alter the behavior of magnetosensitive fish species, indicating that high frequency EMF is not easily detected by magnetosensitive migratory fish species. Laboratory studies assessing the EMF detection abilities indicate that the EMF detection ability of elasmobranchs decreases as the source frequency increases over 20 Hz and suggest that elasmobranchs are unlikely to easily detect electric fields produced by 50/60 Hz power sources (Andrianov et al., 1984; Kempster et al., 2013). In a laboratory study, demersal catshark were exposed to magnetic fields produced by a 50-Hz source and did not exhibit any significant behavioral changes (Orr, 2016). Field studies have also concluded that energized power cables neither attract nor repel elasmobranchs (Love et al., 2016). Based on the available information, EMF produced by 50/60 Hz power sources is unlikely to be detected by elasmobranchs and is unlikely to cause changes in elasmobranch behavior or distribution.

Love et al. (2016) conducted a series of surveys between 2010 and 2014 to track fish populations at both energized and unenergized 60-Hz submarine cables off the California coast. These studies were designed to assess whether EMF produced by the energized cable had any in situ effects on the distribution of marine species. Over three years of observations, no differences in fish communities at energized and unenergized cable sites were noted, indicating that EMF had no effect on fish distributions, although the physical structure of the unburied cables did attract a higher number of fish versus sediment bottoms, creating a “reef effect” (Love et al., 2016). Additionally, multiple fish surveys have been conducted at existing offshore windfarm sites. Results from these studies strongly indicate that operating windfarms and cables do not adversely affect the distributions of resident fish populations. Nearly 10 years of pre- and post-operational data from the Horns Rev Offshore Wind Farm site near Denmark indicate “no general significant changes in the abundance or distribution patterns of pelagic and demersal fish” (Leonhard et al., 2011), including species similar to those expected to inhabit the RWF. Researchers did note an increase in fish species associated with hard ground and vertical features, especially around WTG footings (Leonhard et al., 2011).

Based on the modeling results and existing evidence, EMF associated with the IAC and OSS-Link Cable is not expected to adversely affect the populations or distributions of finfish or EFH species in the Project Area. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that finfish and EFH will be measurably affected by EMF from the cables.

Discharges and Releases

As discussed for the construction/decommissioning phase, routine discharges of wastewater or liquids (e.g., ballast, bilge, deck drainage, stormwater) are not anticipated to result in impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for adversely impacting water quality and marine life.

The operation of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. Per the information requirements outlined in 30 CFR 585.626, a list of solid and liquid wastes generated, including disposal methods and locations, as well as federally regulated chemical products, is found in the Project's ERP/OSRP (Appendix D). The WTG and the OSS will be designed for secondary levels of containment to prevent accidental discharges of hazardous materials to the marine environment. Most maintenance will occur inside the WTGs, thereby reducing the risk of a spill, and no oils or other wastes are expected to be discharged during maintenance activities.

All vessels participating in O&M of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations, and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. BMPs for fueling and power equipment servicing will be incorporated into the Project's ERP/OSRP (Appendix D). Accidental releases will be minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on finfish and EFH are not anticipated.

Marine Trash and Debris

As discussed for the construction and decommissioning phase, vessels will adhere to the USCG and EPA marine trash regulations, as well as BOEM guidance, and trash and debris generated during O&M of the RWF will be contained on vessels or at staging areas until disposal at an approved facility. Measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, potential impacts from trash and debris on finfish and EFH are not anticipated.

Traffic

Impacts associated with vessel traffic during RWF O&M are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections.

As discussed for the construction and decommissioning phases, vessel strikes are considered to be an additional stressor that could affect Atlantic sturgeon. O&M of the RWF would result in a minor increase in vessel traffic, but most vessels would be slow-moving, and the effect would be small relative to existing traffic in the region. Additionally, because large numbers of Atlantic sturgeon are not expected to be present in areas of vessel activity, the likelihood of an interaction with a Project vessel is very low. For these reasons, vessel traffic is not expected to negatively affect Atlantic sturgeon. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Lighting

Artificial lighting during O&M will be associated with vessels, the WTGs, and the OSS for operational safety and security purposes. As discussed for the construction and decommissioning phase, the response of fish species to artificial lights is highly variable and depends on a number of factors such as the species, life stage, and the intensity of the light. Small organisms are often attracted to lights, which in turn attract larger predators to feed on the prey aggregations. Other species may avoid artificially illuminated areas. However, lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Because of the limited area that will have artificial lighting relative to the surrounding areas, and because no underwater lighting is proposed, overall impacts on finfish and EFH are expected to be minimal.

RWEC–OCS

Based on the IPFs summarized in Tables 4.3-7 and 4.3-8, finfish species with a completely pelagic lifestyle are generally expected to be less affected than demersal or benthic species. Overall, during construction, O&M, and decommissioning of the RWEC-OCS, finfish and EFH species with benthic/demersal life stages are expected to be exposed to direct impacts from seafloor disturbance, sediment suspension/deposition, and noise IPFs, and indirect impacts from habitat alteration. Finfish and EFH species with pelagic life stages are expected to be exposed to direct impacts from noise. Potential impacts from other IPFs are anticipated to be minimal. Potential ***long-term*** impacts may result from the conversion of soft-bottom habitat to hard-bottom habitat associated with the secondary protection of the RWEC. These long-term impacts would be reversed following decommissioning of the Project. None of the IPFs are expected to result in population-level effects on finfish and EFH species, due to the limited scale and intensity of the Project activities, the availability of similar habitat in the surrounding area, and the implementation of avoidance, minimization, and mitigation measures.

Construction and Decommissioning

IPFs resulting in potential impacts on finfish and EFH in the RWEC-OCS area from the construction and decommissioning phases are summarized Table 4.3.3-7. Additional details regarding potential impacts on finfish and EFH from the various IPFs during construction/decommissioning of the

RWEC are described in the following sections. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of the impacts associated with these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted.

Table 4.3.3-7 IPFs and Impact Characterization for Finfish and EFH for the RWEC During Construction and Decommissioning

IPF	Project Activity	Impact Characterization for Finfish and EFH Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.			
		Benthic/ Demersal Early Life Stages	Pelagic Early Life Stages	Benthic/ Demersal Late Life Stages	Pelagic Late Life Stages
Seafloor Disturbance	Seafloor preparation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	RWEC installation	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Habitat Alteration	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect, long-term
Sediment Suspension and Deposition	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Noise	Vibratory pile driving (cofferdam) *RWEC-RI only	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Vessel noise, construction equipment noise, aircraft noise	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Discharges and Releases	Hazardous materials spills Wastewater discharges	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term

IPF	Project Activity	Impact Characterization for Finfish and EFH Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.			
		Benthic/ Demersal Early Life Stages	Pelagic Early Life Stages	Benthic/ Demersal Late Life Stages	Pelagic Late Life Stages
Traffic	See seafloor disturbance, noise, sediment suspension and deposition, and lighting IPFs.				
Lighting	Vessel and construction lighting	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term

Seafloor Disturbance and Habitat Alteration

Direct impacts on benthic species and life stages from seafloor preparation, RWEC-OCS installation, and vessel anchoring are expected to be similar to those discussed for construction and decommissioning of the RWF. Seafloor preparation, RWEC-OCS installation, and vessel anchoring, and decommissioning are expected to have limited impacts on finfish and EFH species that have pelagic early or later life stages.

In addition, as described in the construction and decommissioning discussion for the RWF, fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained and killed during hydraulic dredging and jet trencher embedment of the RWEC-OCS. These losses are expected to be very low and ***short-term.*** A previous assessment conducted for the SFWF found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001 percent of the total zooplankton and ichthyoplankton abundance present in the study area, which encompassed a linearly buffered region of 15 km around the export cable and 25 km around the wind farm (INSPIRE Environmental, 2018b). Limited research has been conducted on the potential impacts of hydraulic dredge entrainment, but because the volumes of water used by dredges are relatively small, the entrainment rates of ichthyoplankton are generally thought to be only a small proportion of the total fish production (Reine and Clark, 1998; Reine et al., 1998). Jet plow and hydraulic dredge entrainment losses are not expected to result in large losses of zooplankton, ichthyoplankton, or later life stages, and population-level impacts on EFH and finfish are not anticipated.

As discussed for the construction/decommissioning of the RWF, in areas of sediment disturbance, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). This recovery time may result in an ***indirect*** and ***long-term*** impact on finfish and EFH species with benthic/demersal life stages. Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat for finfish and EFH species. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be very limited given the availability of similar habitats in the area. Other species may be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation, RWEC-OCS installation, and vessel anchoring activities.

During decommissioning, facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the cable protection (concrete mattresses or rock structures) during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWEC-OCS (Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

As discussed for the RWF, seafloor-disturbing activities associated with the RWEC-OCS will also result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from Project cable burial activities. The sediment transport modeling results are summarized in Table 4.3.2-6. The modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 1,542 ft (470 m) from the RWEC-OCS centerline. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters it may occupy most of the water column due to the water depth. For the RWEC-OCS, predicted TSS concentrations above ambient for any single circuit installation do not persist in any given location for greater than 24 hours, and in most locations (>75 % of the affected area) concentrations return to ambient within 8 hours. This maximum was predicted to occur along a part of the route that will only see one circuit installation. The maximum duration above ambient along the portion of the RWEC-OCS where two circuits will be installed was predicted to be 14 hours per circuit. This corresponds to a total of 28 hours above ambient, however the two 14-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC-OCS burial may exceed 0.4 in (10 mm) of deposition up to 328 ft (100 m) from the cable centerline. This thickness of sedimentation could cover up to 1,020 ac (4,127,794 m^2) in federal waters. The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report Appendix J. Sediment suspension and deposition associated with decommissioning activities are expected to be similar, but slightly lower in magnitude. Similar to the impacts discussed for the construction/decommissioning of the RWF, direct impacts on finfish and EFH from sediment suspension and deposition are expected to be similar to those discussed for construction of the RWF, with greater impacts on slow-moving benthic species/life stages compared to mobile and pelagic species/life stages.

Noise

Direct impacts on finfish and EFH resulting from vessel, construction equipment, and aircraft noise during construction and decommissioning are expected to be similar to those discussed for construction and decommissioning of the RWF.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during construction or decommissioning of the RWEC-OCS are expected to be similar to those discussed for the RWF.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for the RWF.

Traffic

Impacts associated with vessel traffic during RWEC-OCS construction and decommissioning are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections.

As discussed for the RWF, vessel strikes are considered to be an additional stressor that could affect Atlantic sturgeon. Construction and decommissioning of the RWEC-OCS would result in a minor increase in vessel traffic, but most vessels would be slow-moving, and the effect would be small relative to existing traffic in the region. Additionally, because large numbers of Atlantic sturgeon are not expected to be present in areas of vessel activity, the likelihood of an interaction with a Project vessel is very low. For these reasons, vessel traffic is not expected to negatively affect Atlantic sturgeon. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Lighting

During construction and decommissioning activities, navigational and deck lighting will be utilized from dusk to dawn on the vessels that will be installing or decommissioning the RWEC-OCS. Direct impacts on finfish and EFH from artificial lighting are expected to be short-term because the vessels are expected to pass quickly along the RWEC-OCS corridor during cable installation. As discussed for the RWF, artificial lighting associated with RWEC-OCS installation would be temporary and limited relative to the surrounding areas. Lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Additionally, no underwater lighting is proposed. Impacts on finfish and EFH due to artificial lighting are expected to be minimal.

Operations and Maintenance

IPFs resulting in potential impacts on finfish and EFH in the RWEC-OCS area from the O&M phase are summarized in Table 4.3.3-8. Additional details regarding potential impacts on finfish and EFH from the various IPFs during O&M of the RWEC-OCS are described in the following sections.

Table 4.3.3-8 IPFs and Impact Characterization for Finfish and EFH for the RWEC During O&M

IPF	Project Activity	Impact Characterization for Finfish and EFH Early life stages include eggs and larvae. Late life stages include neonates, juveniles, and adults.			
		Benthic/ Demersal Early Life Stages	Pelagic Early Life Stages	Benthic/ Demersal Late Life Stages	Pelagic Late Life Stages
Seafloor Disturbance	RWEC non-routine O&M	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
	Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Habitat Alteration	RWEC O&M	Indirect, long-term	Indirect, long-term	Indirect, long-term	Indirect, long-term
Sediment Suspension and Deposition	RWEC non-routine O&M Vessel anchoring (including spuds)	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Noise	Vessel and aircraft noise	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term
Electric and Magnetic Fields	RWEC O&M	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term
Discharges and Releases	Hazardous materials spills	Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Marine Trash and Debris		Direct, short-term	Direct, short-term	Direct, short-term	Direct, short-term
Traffic	See seafloor disturbance, noise, sediment suspension and deposition, and lighting IPFs.				
Lighting	Vessel lighting	Direct, long-term	Direct, long-term	Direct, long-term	Direct, long-term

Seafloor Disturbance and Habitat Alteration

Minimal impacts on finfish and EFH are expected from operation of the RWEC-OCS, as it will be buried beneath the seabed where feasible and will otherwise be protected. Seafloor disturbance during O&M of the RWEC-OCS will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection where present. These maintenance activities and associated vessel anchoring are expected to result in similar direct impacts on finfish and EFH as those discussed for construction/decommissioning, although the extent of disturbance would be limited to specific areas along the RWEC-OCS corridor.

Cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC-OCS. The introduction of engineered concrete mattresses or rock to areas of the seafloor can cause local disruptions to circulation, currents, and natural sediment transport patterns, though these impacts as expected to be minimal given the miniscule surface area associated with the cable protection compared to the surrounding waters. Under normal circumstances, these segments of the RWEC-OCS are expected to remain covered as accretion of sediment covers the cable and associated cable protection (where applicable). In non-routine situations, these segments may be uncovered, and re-burial might be required (for buried portions of the RWEC). The seafloor overlaying the majority of buried RWEC-OCS (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected.

Indirect impacts on finfish and EFH associated with O&M activities for the RWEC-OCS are expected to result in similar impacts as those discussed for the IAC and OSS-Link Cable but will be limited in spatial extent. The protection of the cable with concrete mattresses (or rock) may result in the long-term conversion of soft-bottom habitat to hard-bottom habitat. Similar to the foundations, this cable protection may have a long-term impact on finfish and EFH species associated with soft-bottom habitats and a long-term beneficial impact on finfish and EFH species associated with hard-bottom habitats, depending on the quality of the habitat created by the secondary cable protection, and the quality of the benthic community that colonizes that habitat.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during the O&M phase may result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC-OCS. Direct impacts on finfish and EFH resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase, but on a more limited spatial scale.

Noise

Impacts on finfish and EFH from ship and aircraft noise during O&M of the RWEC-OCS are expected to be similar to those discussed for the construction/decommissioning phase, though lesser in extent.

Electric and Magnetic Fields

Once the RWEC-OCS becomes energized, the cables will produce a magnetic field, both perpendicularly and in a lateral direction around the cables. The cable will be shielded and, where feasible, buried beneath the seafloor and will otherwise be protected. Shielded electrical transmission cables do not directly emit electrical fields into surrounding areas but are surrounded by magnetic fields that can cause induced electrical fields in moving water (Gill et al., 2012). Exposure to EMF could be short- or long-term, depending on the mobility of the species.

A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. That Appendix also summarizes data from field studies conducted to assess impacts of EMF on marine organisms. As discussed for the IAC and OSS-Link Cable, behavioral effects and/or changes in finfish and EFH species abundance and distributions due to EMF are not expected. These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that finfish and EFH will be measurably affected by EMF from the cables.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during O&M of the RWEC-OCS are expected to be similar to those discussed for the construction and decommissioning phase.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for the construction and decommissioning phase.

Traffic

Impacts associated with vessel traffic during RWEC-OCS O&M are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections.

As discussed for the construction and decommissioning phases, vessel strikes are considered to be an additional stressor that could affect Atlantic sturgeon. O&M of the RWEC-OCS would result in a minor increase in vessel traffic, but most vessels would be slow-moving, and the effect would be small relative to existing traffic in the region. Additionally, because large numbers of Atlantic sturgeon are not expected to be present in areas of vessel activity, the likelihood of an interaction with a Project vessel is very low. For these reasons, vessel traffic is not expected to negatively affect Atlantic sturgeon. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Lighting

Artificial lighting during O&M of the RWEC-OCS will be associated only with vessels. However, lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Because of the limited area that will have artificial lighting relative to the surrounding areas, and because no underwater lighting is proposed, overall impacts on finfish and EFH are expected to be minimal.

RWEC–RI

Based on the IPFs summarized in Tables 4.3-7 and 4.3-8, finfish species with a completely pelagic lifestyle are generally expected to be less affected than demersal or benthic species. Overall, during construction, O&M, and decommissioning of the RWEC-RI, finfish and EFH species with benthic/demersal life stages are expected to be exposed to direct impacts from seafloor disturbance, sediment suspension/deposition, and noise IPFs, and indirect impacts from habitat alteration. Finfish and EFH species with pelagic life stages are expected to be exposed to direct impacts from noise. Potential impacts from other IPFs are anticipated to be minimal. Potential ***long-term*** impacts may result from the conversion of soft-bottom habitat to hard-bottom habitat associated with the secondary protection of the RWEC. These long-term impacts would be reversed following decommissioning of the Project. None of the IPFs are expected to result in population-level effects on finfish and EFH species, due to the limited scale and intensity of the Project activities, the availability of similar habitat in the surrounding area, and the implementation of avoidance, minimization, and mitigation measures.

Construction and Decommissioning

IPFs resulting in potential impacts on finfish and EFH in the RWEC-RI area from the construction and decommissioning phases are summarized Table 4.3-7. Additional details regarding potential impacts on finfish and EFH from the various IPFs during construction/decommissioning of the RWEC are described in the following sections. At the end of the Project's operational life, the Project will be decommissioned in accordance with a detailed decommissioning plan to be developed in compliance with applicable laws, regulations, and BMPs at that time. All of the impacts associated with these activities are anticipated to be similar to or less than those described for construction, unless otherwise noted.

Seafloor Disturbance and Habitat Alteration

Direct impacts on benthic species and life stages from seafloor preparation, RWEC-RI installation, and vessel anchoring are expected to be similar to those discussed for construction and decommissioning of the RWEC-OCS, with the exception of shallower areas being affected as the RWEC-RI nears landfall. These shallower areas are expected to have slightly different finfish species assemblages than the deeper offshore areas, particularly within Narragansett Bay, where estuarine-dependent species are more prevalent (see Tables 4.3-1 and 4.3-4). For example, winter flounder eggs present in the shallow portions of the RWEC-RI corridor could be affected by seafloor disturbance if construction activities take place during the spawning period (generally December 15-May 31). As discussed in Section 4.3.2, the up-estuary stations sampled during the benthic survey conducted for the Project were generally characterized by finer substrate, dominated by soft-sediment fauna, higher turbidity, and more reduced sediments. The mid-bay stations were characterized by mussel and *Crepidula* beds with other attached organisms including barnacles, sponges, and macroalgae. The stations at the mouth of Narragansett Bay and the stations leading offshore to the 3-mile state water boundary were generally dominated by soft sediment infauna. The results of the benthic survey (Benthic Assessment Appendix) did not indicate the presence of beds for EFH shellfish species within the RWEC-RI corridor, however, the mussel and *Crepidula* beds could serve as foraging or nursery habitat for certain finfish species. Disturbance of this shellfish bed habitat is not anticipated to result in population-level effects on finfish or EFH species, as only a small area would be affected, and similar habitat is common within the Bay. Seafloor preparation, RWEC-RI installation, and vessel anchoring are expected to have limited impacts on finfish and EFH species that have pelagic early or later life stages. Decommissioning activities are expected to cause similar impacts as construction, but these impacts would be shorter in duration.

Construction of the RWEC-RI landfall would be accomplished with HDD methodology. A cofferdam may be used to allow for a dry environment during construction and manage sediment, contaminated soils, and bentonite. Impacts associated with the installation of a cofferdam (if necessary) would be similar to those discussed for seafloor preparation, but on a smaller scale. The cofferdam will be a temporary structure used during construction only. Therefore, no conversion of habitat is expected, and the cofferdam will be removed prior to the O&M phase.

In addition, as described in the construction and decommissioning discussion for the RWF, fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained and killed during hydraulic dredging and jet trencher embedment of the RWEC-RI. These losses are expected to be very low and ***short-term***. A previous assessment conducted for the South Fork Wind Farm found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001 percent of the total zooplankton and ichthyoplankton abundance present in the study area, which encompassed a linearly buffered region of 15 km around the SFEC and 25 km around the SFWF (INSPIRE Environmental, 2018b). Limited research has been conducted on the potential impacts of hydraulic dredge entrainment, but because the volumes of water used by dredges are relatively small, the entrainment rates of ichthyoplankton are generally thought to be only a small proportion of the total fish production (Reine and Clark, 1998; Reine et al., 1998). Jet plow and hydraulic dredge entrainment losses are not expected to result in large losses of zooplankton, ichthyoplankton, or later life stages, and population-level impacts on EFH and finfish are not anticipated.

As discussed for the construction/decommissioning of the RWEC-OCS, in areas of sediment disturbance, benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). This recovery time may result in an ***indirect*** and ***long-term*** impact on finfish and EFH species with benthic/demersal life stages. Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat for finfish and EFH species. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be very limited given the availability of similar habitats in the area. Other species may be attracted to the disruption and prey on dislodged benthic species or other species injured or flushed during seafloor preparation, RWEC-RI installation, and vessel anchoring activities.

During decommissioning, facilities will be removed to a depth of 15 ft (4.6 m) below the mudline, unless otherwise authorized by BOEM (30 CFR § 585.910(a)). Decommissioning would result in the reversal of beneficial effects for species and life stages that inhabited the cable protection (concrete mattresses or rock structures) during the life of the Project. Over time, the disturbed area is expected to revert to pre-construction conditions, which would result in a beneficial impact for species and life stages that inhabit soft bottom habitats. Overall, habitat alteration from decommissioning is expected to cause minimal impacts because similar soft and hard bottom habitats are already present in and around the RWEC corridor (Appendix X), and the conversion of a relatively small area of habitat is unlikely to result in substantial effects, as any effect observed will be limited to the immediate vicinity of the individual structures.

Sediment Suspension and Deposition

As discussed for the RWEC-OCS, seafloor-disturbing activities associated with the RWEC-RI will also result in temporary increases in sediment suspension and deposition. Sediment transport modeling was performed using RPS' SSFATE model to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from Project cable burial activities. The sediment transport modeling results are summarized in Table 4.3.2-6.

For the majority of the RWEC-RI, the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 4,528 ft (1380 m) from the RWEC-RI centerline. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters, such as within Narragansett Bay, it may occupy most of the water column due to the water depth. Turbidity plumes could serve as a temporary barrier to migration for coastal anadromous finfish species, such as striped bass, American shad, and river herring (alewife and blueback herring) if construction/decommissioning activities coincide with the spring upstream migration. However, the durations of the turbidity plumes are anticipated to be short, and measurable impacts on sensitive anadromous species are not expected.

For installation of one circuit of the RWEC-RI, predicted TSS concentrations above ambient do not persist in any given location for greater than 16.3 hours, and in most locations (>75 percent of the affected area) concentrations return to ambient within 4 hours. For installation of two circuits, the maximum plume exposure is doubled at 32.6 hours, however, the two 16.3-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC-RI burial may exceed 0.4 inch (10 mm) of deposition up to 919 ft (280 m) from the cable centerline. This thickness of sedimentation could cover up to 1,126 ac (4,556,760 m^2). For the landings, as summarized in Table 4.3.2-6, TSS concentrations exceeding ambient conditions by 100 mg/L could extend up 2,048 ft (624 m) from the centerline and plume concentrations above ambient could persist for 256 hours for the HDD installation. These durations are longer relative to the water jet assisted cable installation due to the slower installation rate of the activity and since the alternatives include both trenching and backfilling for two circuits. Sedimentation greater than 0.4 in (10 mm) may extend up to 572 ft (174 m) from the centerline and could cover up to 85 ac (343,983 m2). The models, inputs, and results are described in detail in the Hydrodynamic and Sediment Transport Modeling Report Appendix J. Sediment suspension and deposition associated with decommissioning activities are expected to be similar, but slightly lower in magnitude. Similar to the impacts discussed for the construction/decommissioning of the RWEC-OCS, direct impacts on finfish and EFH from sediment suspension and deposition are expected to be similar to those discussed for construction of the RWF, with greater impacts on slow-moving benthic species/life stages compared to mobile and pelagic species/life stages

Winter flounder eggs are a sensitive resource within Narragansett Bay. Previous experiments have shown that a viable hatching rate of winter flounder eggs is reduced when the eggs are buried by as little as one half of one egg diameter, approximately 0.05 centimeter of sediment (Berry et al., 2003). In other laboratory experiments, winter flounder eggs were found to be affected by a sedimentation level of 0.065 centimeters, and almost complete mortality was observed when deposition exceeded 0.25 centimeter (Berry et al., 2011), Winter flounder eggs could be affected by construction of the RWEC-RI if sedimentation is experienced in these shallow waters during the spawning period (generally December 15 to May 31). Given the high natural mortality that occurs during the early life history stages, adverse effects of burial at the population level are expected to be limited and only measurable in the immediate vicinity of the construction workspace. Revolution Wind will employ best management practices to minimize potential sedimentation impacts on winter flounder eggs in shallow waters. Revolution Wind will also coordinate with applicable regulatory agencies to define and comply with seasonal restrictions to minimize impacts on winter flounder and other sensitive finfish species.

Noise

The cofferdam at the RWEC-RI landfall, if required, may be installed as either a sheet piled structure into the sea floor or a gravity cell structure placed on the sea floor using ballast weight. Sheet pile installation would require the use of a vibratory hammer to drive the sidewalls and endwalls into the seabed, which may take approximately up to 3 days. Vibratory devices use oscillatory hammers or spinning counterweights that vibrate the pile and cause the sediment surrounding the pile to liquefy, allowing the pile to move easily into or out of the sediment. Vibratory pile driving is considered a continuous low-frequency noise source because the device continuously vibrates until the pile reached the desired depth. Vibratory devices generally have sound source levels 10 to 20 dB lower than impact hammers, and the sound level generated rises relatively slowly (California Department of Transportation, 2009). Vibratory pile driving associated with the cofferdam is not anticipated to result in exceedance of the injury threshold for fish, however, noise from vibratory pile driving may temporarily reduce habitat quality, result in behavioral changes, or cause mobile species to temporarily vacate the area. Noise impacts on finfish and EFH from vibratory pile driving may result in limited ***short-term*** impacts, as the habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of the pile driving activity. Due to the short duration of vibratory pile driving and the limited area of disturbance, impacts on migrating anadromous species are not anticipated.

Direct impacts on finfish and EFH resulting from vessel, construction equipment, and aircraft noise are expected to be similar to those discussed for construction and decommissioning of the RWEC-OCS.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during construction or decommissioning of the RWEC-RI are expected to be similar to those discussed for the RWF.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for the RWF.

Traffic

Impacts associated with vessel traffic during RWEC construction and decommissioning are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections.

As discussed for the RWEC-OCS, the likelihood of interaction of Atlantic sturgeon with Project vessels is very low and vessel traffic is not expected to negatively affect Atlantic sturgeon. Atlantic sturgeon may be present along the RWEC-RI corridor, but their presence is less likely within Narragansett Bay, as Atlantic sturgeon are not likely to utilize rivers feeding into Narragansett Bay for spawning. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Lighting

During construction and decommissioning activities, navigational and deck lighting will be utilized from dusk to dawn on the vessels that will be installing or decommissioning the RWEC-RI. Direct impacts on finfish and EFH from artificial lighting are expected to be short-term because the vessels are expected to pass quickly along the RWEC corridor during cable installation. As discussed for the RWEC-OCS, artificial lighting associated with RWEC-RI installation and decommissioning would be temporary and limited relative to the surrounding areas and impacts on finfish and EFH are expected to be minimal.

Operations and Maintenance

IPFs resulting in potential impacts on finfish and EFH in the RWEC-RI area from the O&M phase are summarized in Table 4.3-8. Additional details regarding potential impacts on finfish and EFH from the various IPFs during O&M of the RWEC-RI are described in the following sections.

Seafloor Disturbance and Habitat Alteration

Minimal impacts on finfish and EFH are expected from operation of the RWEC-RI, as it will be buried beneath the seabed where feasible and will otherwise be protected. As discussed for the RWEC-OCS, seafloor disturbance during O&M of the RWEC-RI will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection where present. These maintenance activities and associated vessel anchoring are expected to result in similar direct impacts on finfish and EFH as those discussed for the RWEC-OCS.

As discussed for the RWEC-OCS, cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC-RI. The seafloor overlaying the majority of buried RWEC-RI (where cable protection will not exist) is expected to return to pre-construction conditions over time and no long-term changes to sediment mobility and depositional patterns are expected.

Indirect impacts on finfish and EFH associated with O&M activities for the RWEC-RI are expected to result in similar impacts as those discussed for the IAC, OSS-Link Cable, and RWEC-OCS, but will be limited in spatial extent. The protection of the cable with concrete mattresses (or rock) may result in the long-term conversion of soft-bottom habitat to hard-bottom habitat. Similar to the foundations, this cable protection may have a long-term impact on finfish and EFH species associated with soft-bottom habitats and a long-term beneficial impact on finfish and EFH species associated with hard-bottom habitats, depending on the quality of the habitat created by the secondary cable protection, and the quality of the benthic community that colonizes that habitat.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during the O&M phase may result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC-RI. Direct impacts on finfish and EFH resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase, but on a more limited spatial scale.

Noise

Impacts on finfish and EFH from ship and aircraft noise during O&M of the RWEC-RI are expected to be similar to those discussed for the construction/decommissioning phase, though lesser in extent.

Electric and Magnetic Fields

As discussed for the RWEC-OCS, a modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the IAC, OSS-Link Cable, and RWEC was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. Behavioral effects and/or changes in finfish and EFH species abundance and distributions due to EMF are not expected. It is not expected that finfish and EFH will be measurably affected by EMF from the cables.

Discharges and Releases

Impacts associated with wastewater discharges or an inadvertent release of hazardous material during O&M of the RWEC-RI are expected to be similar to those discussed for the construction and decommissioning phase.

Marine Trash and Debris

Impacts associated with marine trash and debris are expected to be similar to those discussed for the construction and decommissioning phase.

Traffic

Impacts associated with vessel traffic during RWEC-RI O&M are identified under the Seafloor Disturbance, Noise, Sediment Suspension and Deposition, and Lighting sections.

As discussed for the RWEC-RI, vessel traffic during O&M is not expected to negatively affect Atlantic sturgeon. Additional discussion of potential impacts on Atlantic sturgeon is provided in the Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species Appendix Z.

Lighting

Artificial lighting during O&M of the RWEC-RI will be associated only with vessels. However, lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. Because of the limited area that will have artificial lighting relative to the surrounding areas, and because no underwater lighting is proposed, overall impacts on finfish and EFH are expected to be minimal.

4.3.3.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following environmental protection measures to reduce potential impacts on finfish and EFH.

- To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment.
- To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
- DP vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent practicable.
- A plan for vessels will be developed prior to construction to identify no-anchor areas to protect sensitive areas and other areas to be avoided.
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. A Fisheries and Benthic Monitoring Plan is included as Appendix Y.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).
- A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels

and structures, and mandates a yearly marine trash and debris awareness training and certification process.

4.3.4 Marine Mammals

This section describes the affected environment for marine mammals within the RWF, RWEC–OCS, RWEC–RI, and Onshore Facilities (collectively referred to as the Project Area, see Table 4.0-1 for definitions). The discussion of the affected environment for marine mammals is followed by an evaluation of potential Project-related impacts and a summary of environment protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to these resources.

The description of the affected environment and assessment of potential impacts to marine mammals were developed by reviewing current public data sources related to marine mammals including: the NOAA Northeast Fisheries Science Center's (NEFSC's) Atlantic Marine Assessment Program for Protected Species (AMAPPS) (Palka et al., 2017), the *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles* (Kraus et al., 2016), Remote Marine and Onshore Technology surveys for NYSERDA (Normandeau Associates Inc. [Normandeau] and APEM, 2019); a technical report for the OSAMP (Kenney and Vigness-Raposa, 2010); available marine mammal habitat density data available on the Northeast Ocean Data Portal (Curtice et al., 2019; Roberts et al., 2016, 2017, 2018; Roberts, 2018, 2020); NOAA stock assessment reports (Hayes et al., 2017, 2018, 2019, 2020); and relevant journal publications.

In support of this impact evaluation, Revolution Wind also completed a comprehensive underwater acoustic modeling effort (Appendix P3, Denes et al., 2020), which is summarized in Section 4.3.4.2 and in (Appendix Z). Marine mammal resources within the Project Area are briefly described in the following subsection; a more detailed description of marine mammal presence and distribution in the Project Area along with potential Project-related impacts with an emphasis on acoustic impacts, is provided in Appendix Z.

4.3.4.1 Affected Environment

Regional Overview

Thirty-six species of marine mammals inhabit the regional waters of the western North Atlantic OCS and may occur in the Project Area, including six mysticetes (baleen whales), 25 odontocetes (toothed whales, dolphins, and porpoise), four pinnipeds (earless or true seals), and one species of sirenian (manatees). All 36 species are protected under the MMPA; six species are also protected under the federal ESA. These include the fin whale (*Balaenoptera physalus*, Endangered), sei whale (Balaenoptera borealis, Endangered), blue whale (*Balaenoptera musculus*, Endangered), North Atlantic right whale (NARW) (*Eubalaena glacialis*, Endangered), sperm whale (Physeter macrocephalus, Endangered), and Florida manatee (*Trichechus manatus latirostris*, Threatened). Additionally, the fin whale, NARW, and humpback whale (Megaptera novaeangliae) are listed as Endangered, and the harbor porpoise (*Phocoena phocoena*) and harbor seal (*Phoca vitulina*) are considered Species of Greatest Conservation Need (SGCN) by the state of Rhode Island (RIDEM, 2020). Table 4.3.4-1 summarizes the marine mammal species potentially present within the Western North Atlantic OCS, including the relative occurrences for each species within the Project Area. The table also includes each species' conservation status, including the designation as a strategic or non-strategic stock, as defined by the MMPA. A strategic stock meets one or more of the following criteria: the population experiences a level of human-caused mortality that exceeds the potential biological removal (PBR) level; the population is declining and is likely to be listed as a threatened species under the ESA, based on the best available information; or the population is listed as a threatened marine mammal species under the ESA or is designated as depleted under the MMPA. A non-strategic stock is defined as any marine mammal stock that does not meet the strategic stock criteria.

Table 4.3.4-1 Marine Mammals Potentially Occurring Within the Regional Waters of the Western North Atlantic OCS and Project Area

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC-OCS	Relative Occurrence in the RWEC-RI	Best Abundance Estimate[1]
Order Cetacea							
Suborder Mysticeti (baleen whales)							
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic RI State Endangered	Common	Common	Common	7,418
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered MMPA Depleted and Strategic	Regular	Uncommon	Uncommon	6,292
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic	Rare	Not Expected	Not Expected	402
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	ESA Endangered MMPA Depleted and Strategic RI State Endangered	Common	Common	Common	428
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	MMPA Non-strategic	Common	Common	Common	24,202
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	MMPA Non-strategic RI State Endangered	Common	Common	Common	1,396

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC-OCS	Relative Occurrence in the RWEC-RI	Best Abundance Estimate[1]
Suborder Odontoceti (toothed wales, dolphins, and porpoises							
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered MMPA Depleted and Strategic	Common	Common	Regular	4,349
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	7,750
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	7,750
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	21,818
Mesoplodont beaked whales	*Mesoplodon* spp.	Western North Atlantic	MMPA Depleted	Rare	Rare	Rare	21,818
Killer whale	*Orcinus orca*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
False killer whale	*Pseudorca crassidens*	Western North Atlantic	MMPA Strategic	Rare	Rare	Rare	1,791
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	MMPA Strategic	Rare	Rare	Rare	28,924
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	MMPA Strategic	Common	Uncommon	Uncommon	39,215

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC-OCS	Relative Occurrence in the RWEC-RI	Best Abundance Estimate[1]
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Risso's dolphin	*Grampus griseus*	Western North Atlantic	MMPA Non-strategic	Common	Uncommon	Uncommon	35,493
Common dolphin	*Delphinus delphis*	Western North Atlantic	MMPA Non-strategic	Common	Common	Common	172,825
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	MMPA Non-strategic	Common	Common	Common	93,233
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	536,016
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	6,593
Clymene dolphin	*Stenella clymene*	Western North Atlantic	MMPA Non-strategic	Not Expected	Not Expected	Not Expected	Unknown
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	67,036
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	MMPA Non-strategic	Uncommon	Uncommon	Uncommon	39,921
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	4,102
Rough toothed dolphin	*Steno bredanensis*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	136

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC-OCS	Relative Occurrence in the RWEC-RI	Best Abundance Estimate[1]
Common bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic, offshore	MMPA Non-strategic	Common	Common	Common	62,851
		Western North Atlantic, Northern migratory coastal	MMPA Depleted and Strategic	Rare	Rare	Rare	6,639
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	MMPA Non-strategic RI State SGCN	Common	Common	Common	95,543
Order Carnovora							
Suborder Pinnipedia							
Harbor seal	*Phoca vitulina*	Western North Atlantic	MMPA Non-strategic RI State SGCN	Regular	Regular	Regular	75,834
Gray seal	*Halichoerus grypus*	Western North Atlantic	MMPA Non-strategic	Regular	Regular	Regular	27,131
Harp seal	*Pagophilus groenlandica*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
Hooded seal	*Cystophora cristata*	Western North Atlantic	MMPA Non-strategic	Rare	Rare	Rare	Unknown
Order Sirenia							
Florida manatee[2]	*Trichechus manatus latirostris*	-	ESA Threatened MMPA Depleted and Strategic	Rare	Rare	Rare	Unknown

1 Best abundance estimate from the Draft 2019 Marine Mammal Stock Assessment Report, published by NMFS on the Federal Register on 27 November 2019 (84 FR 65353).
2 Under management jurisdiction of United States Fish and Wildlife Service rather than National Marine Fisheries Service (USFWS, 2019).

Definitions: Common – Occurring consistently in moderate to large numbers; Regular – Occurring in low to moderate numbers on a regular basis or seasonally; Uncommon – Occurring in low numbers or on an irregular basis; Rare – Records for some years but limited; and Not expected – Range includes the Project Area but due to habitat preferences and distribution information species are not expected to occur in the Project Area although records may exist for adjacent waters.

Cetaceans are separated into two main groups, the mysticetes and odontocetes. The mysticetes possess large baleen filtration systems instead of teeth, which they use to sieve smaller prey out of the water or in some cases sediments. Their prey usually consists of zooplankton and small schooling fish. The odontocetes all possess teeth, and generally feed on fish and invertebrates. Both groups transit over large distances with mysticetes migrating seasonally between distinct feeding and breeding areas, and odontocetes following prey species with less distinct migratory behavior. Mysticetes are known to maintain small, unstable groups or remain as solitary individuals when not breeding (Wilson and Ruff, 1999). Odontocetes are generally found in large, stable pods throughout their lives. Larger odontocetes are capable of very deep and prolonged dives while the smaller dolphin and porpoise species generally dive to shallower depths for shorter periods of time.

The seal species (pinnipeds) inhabit the cooler waters of the northeast and frequent the waters and inland areas around Narragansett Bay. Pinnipeds are composed of three families: Odobenidae (the walrus), Otariidae (eared seals, including sea lions and fur seals), and Phocidae (earless seals). Phocidae are the only family of seal with the potential to occur within the Project Area. Seals haul out on isolated rock outcrops and beaches to escape predation, rest, molt, give birth to and rear their offspring (Montgomery et al., 2007). These animals primarily inhabit the waters ranging from Labrador to New Jersey, but tagging studies show they can travel as far south as North Carolina during spring (Waring et al., 2012). Arctic species, such as harp seals (*Pagophilus groenlandica*) and hooded seals (*Cystophora cristata*), are primarily found in Canadian waters between the Gulf of St. Lawrence and along the coast of Labrador up to Davis Strait and Baffin Bay. They are known to occasionally strand in United States waters between Maine and New Jersey, however these strandings are infrequent and these species are not considered regular visitors to the area (Hayes et al., 2020).

The one species of sirenian with a current range that includes the Project Area is the Florida manatee. Primary habitat for the manatee is in the southeastern United States, but during the summer they expand their range and have been seen as far north as Massachusetts (USFWS, 2019).

Marine mammals inhabit all the world's oceans, and can be found in coastal, estuarine, shelf, and pelagic habitats including the Project Area (Hayes et al., 2020). Of the 36 marine mammal species with geographic ranges that include the Project Area, 15 species, four of which are also listed under the ESA, can be reasonably expected to reside, traverse, or routinely visit the Project Area based on information from previous surveys conducted in the region, NOAA stock assessment reports, and other published literature. These 15 species are present in either annual or seasonal densities that are large enough to be considered susceptible to potential impacts from Project activities during one or more phases (construction, O&M, and decommissioning), and therefore, are considered *potentially affected species*. The 15 potentially affected species comprise three main marine mammal groups; mysticetes, odontocetes, and pinnipeds. Odontocetes are further separated into odontocete whales and odontocete dolphin and porpoises. The following potentially affected species are those that have a regular, common, or uncommon relative occurrence in the Project Area, or have a very wide distribution with limited distribution or abundance details, so it is possible they could occur within the Project Area:

- Mysticete whales
  - Fin whale (*Balaenoptera physalus*, Endangered)
  - Sei whale (*Balaenoptera borealis*, Endangered)
  - North Atlantic right whale (*Eubalaena glacialis*, Endangered)
  - Minke whale (Balaenoptera acutorostrata)
  - Humpback whale (Megaptera novaeangliae)
- Odontocete whales
  - Sperm whale (*Physeter macrocephalus*, Endangered)
- Odontocete dolphins and porpoises
  - Long-finned pilot whale (*Globicephala melas*)
  - Atlantic spotted dolphin (*Stenella frontalis*)
  - Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
  - Common dolphin (*Delphinus delphis*)
  - Risso's dolphin (*Grampus griseus*)
  - Common bottlenose dolphin (*Tursiops truncatus*)
  - Harbor porpoise (*Phocoena phocoena*)
- Pinnipeds
  - Harbor seal (*Phoca vitulina*)
  - Grey seal (*Halichoerus grypus*)

The species not expected or rare in the region (Table 4.3.4-1) are not anticipated to be present in or near the Project Area at densities that make them vulnerable to impact from Project activities. They are unlikely to be affected by the Project's IPFs discussed in Section 4.3.4.2 and are therefore are not carried forward in the following sections or the accompanying assessment provided in Appendix Z.

Species within each marine mammal group share similar distributions and behaviors which influence their expected presence and impact potential in the Project Area. More information for each of the potentially affected species and estimated densities for each species within the RWF and RWEC can be found in Appendix Z. The descriptions in the following sections are intended to provide a general overview of the anticipated distribution of potentially affected species of marine mammals throughout Project components (i.e., RWF, RWEC–OCS, RWEC–RI, and Onshore Facilities).

Revolution Wind Farm

Mysticete whales have been observed in all seasons in the RWF during visual and acoustic surveys conducted in the northeast region and Rhode Island-Massachusetts Wind Energy Area (RI-MA WEA)

(Kenney and Vigness-Raposa, 2010; Kraus et al., 2016; Palka et al., 2017; Davis et al., 2020). Increased presence was observed in the winter and spring, generally correlating with migratory patterns for these species. Species with more pelagic distributions such as the sei whale and blue whale have fewer observations in the RWF but may be encountered primarily during winter and spring months (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016; Davis et al., 2020). Deeper diving odontocete whales (i.e., the sperm whale) were less common in the RWF and were primarily observed during the summer and fall (Kraus et al., 2016; Palka et al., 2017).

Odontocete dolphin and porpoise species do not typically undergo extensive seasonal migrations like mysticetes. However, most display some seasonality in movements and some species such as the common bottlenose dolphin, Atlantic white-sided dolphin, and common dolphin have shown predictable migrations between the northeast and Mid-Atlantic regions (Hayes et al., 2019, 2020). Survey data suggests odontocete species could be present in the RWF year-round with a peak presence during the summer months when water temperatures in this region are higher (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016; Palka et al., 2017). Long-finned pilot whales, Risso's dolphins, and Atlantic spotted dolphins, are known to prefer deeper waters offshore, but have been sighted within the RI-MA WEA and waters off of Block Island so it is likely they will be encountered in the RWF, primarily in the spring (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016; Palka et al., 2017). Harbor porpoises are common in this region and are expected to occur predominantly in the winter and spring (Kenney and Vigness-Raposa, 2010).

Harbor and gray seals are known to occur in New England waters near New York, Rhode Island, and Massachusetts. The closest known pupping grounds are located are in Nantucket Sound at Monomoy and Muskeget Island east of the RWF (Hayes et al., 2020). Breeding for these species occur in open waters predominantly between spring and fall (Temte, 1994). These species have been sighted in Southern New England between Long Island, New York, and Vineyard Sound, Massachusetts and are known to inhabit this region year-round, with increased presence in winter and spring.

RWEC–OCS

Mysticete whales have been observed migrating through the RWEC–OCS area, and their densities vary seasonally. Both the NARW and humpback whale have well-documented migration patterns between breeding grounds in the South Atlantic and feeding grounds in the North Atlantic, and their migratory corridor includes the RWEC–OCS area (Hayes et al., 2020). Fin and minke whale migrations are less-well documented, but survey results indicate these species have been regularly observed around the RWEC–OCS area (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016). Seasonal occurrence is expected to be similar to that observed in the RWF area, in which mysticete species may be encountered year-round, with peak presence in the winter and spring. The sei and blue whale may be observed in deeper waters within the RWEC–OCS area, but are not expected to be as common as other mysticete species.

Distribution of smaller cetacean species in the RWEC–OCS area is also anticipated to be similar to the RWF area. Deeper water species like the long-finned pilot whale, Risso's dolphin, and Atlantic spotted dolphins are not anticipated to be as abundant in RWEC–OCS waters, and can be expected predominantly in the spring. Harbor porpoises show a preference for shallower, coastal waters and can be expected in the RWEC–OCS in the winter and spring (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016).

Seasonal occurrence similar to that of the RWF area is expected for the harbor and gray seal in the RWEC–OSC area.

RWEC–RI

Species densities will likely be lower in state waters for some groups relative to OCS waters, and a few of the more offshore species whose densities are already low, will not be expected in state waters. However, species composition within the RWEC–RI area is expected to be generally similar to species composition within the RWEC–OCS waters. Information regarding distances from shore for marine mammal migratory routes are not available for all species. Surveys suggest that some cetacean species, notably the NARW and humpback whale, can be found between 50 and 2,000 m from shore while migrating (Best et al., 1998; Hayes et al., 2020). Fin whales, humpback whales, NARWs, and minke whales have all been observed in the Rhode Island state waters associated with the RWEC and will be most abundant in the winter and spring (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016). Sei whales and blue whales are not expected to occur around the RWEC–RI. Sperm whales in this area have been observed in Rhode Island state waters near Block Island following prey species and may therefore be encountered in the RWEC–RI area during summer and fall (Cetacean and Turtle Assessment Program [CETAP], 1982; Kenney and Vigness-Raposa, 2010).

Common bottlenose dolphin, common dolphins, and Atlantic white-sided dolphins are the only dolphin species expected to occur with regularity in the RWEC–RI (Kenney and Vigness-Raposa, 2010; Hayes et al., 2020). Harbor porpoises are known to prefer shallower waters closer to shore and are likely to occur in Rhode Island state waters as they travel between their winter habitat in the Mid-Atlantic to their summer habitat in the Gulf of Maine (Kenney and Vigness-Raposa, 2010). They are predominantly expected in the winter and spring.

Historically, seals were rare in Rhode Island state waters, but since the passing of the MMPA in 1972 observations of harbor and gray seals have increased and they are most abundant in these waters from late fall until late spring (McLeish, 2016). Arctic species such as harp, hooded, and ringed seals have also been reported in Narragansett Bay, although sightings of these species are rare (Kenney and Vigness-Raposa, 2010). Harbor seals are the most frequently observed seal species throughout the coastal waters of Rhode Island and adjacent state waters (Kenney and Vigness-Raposa, 2010). Gray seals are less common in Rhode Island, but recovery of the Massachusetts and Canadian breeding populations has led to a recent increase in gray seal observations in New England waters (Kenney and Vigness-Raposa, 2010; Hayes et al., 2020). Both species are expected to occur in the RWEC–RI; harbor seals may be present year-round in lower densities, but peak presence of both species is likely to occur in late spring through early summer (Kenney and Vigness-Raposa, 2010).

Onshore Facilities

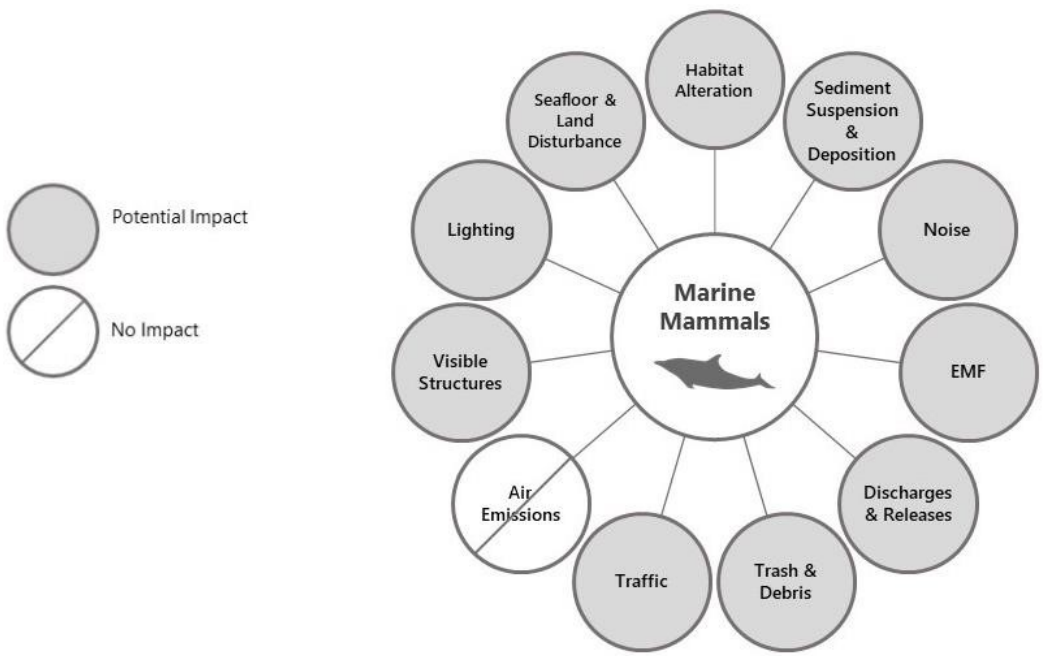
The only species of marine mammal that can regularly be found onshore are seals. There have been six identified haul-out sites in Narragansett Bay, with the most observations at the Dumplings off Conanicut Island and Rome Point in North Kingstown (Kenney and Vigness-Raposa, 2010). The nearest haul-out site to the proposed landfall at Quonset Point in North Kingstown, Rhode Island, is approximately 1.86 mi (3 km) away, making it unlikely seals will be encountered near the Onshore Facilities.

4.3.4.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the 15 potentially affected species of marine mammals discussed above (Section 4.3.4.1). As discussed in Section 4.3.4.1, seals are the only marine mammals that can be regularly found onshore; however, seals are unlikely to be encountered at the Onshore Facilities and, therefore, activities at this location will not be discussed further.

IPFs that may result impacts to these species are depicted in Figure 4.3.4-1. Impacts are characterized as short-term or long-term, and direct or indirect as defined in Section 4.0. All IPFs with the potential to impact marine mammals are evaluated in this section. More detailed information regarding potential impacts on marine mammals can be found in Appendix Z.

Figure 4.3.4-1 Impact Producing Factors on Marine Mammals



Revolution Wind Farm

Based on the IPFs discussed in Tables 4.3.4-2 and 4.3.4-8, during construction and decommissioning of the RWF, ***direct***, ***short-term*** impacts on marine mammals are expected to occur from seafloor disturbance, habitat alteration, sediment suspension/deposition, discharges and releases, trash and debris, lighting, noise, and vessel traffic. During O&M of the RWF, ***direct***, ***short-term*** and ***long-term*** impacts on marine mammals are expected to occur from seafloor disturbance, sediment suspension/deposition, EMF, visible structures, lighting, habitat alteration, noise, and vessel traffic. ***No impacts*** are expected to occur from visible structures during construction and decommissioning of the RWF; or from discharges and releases and trash and debris during O&M of the RWF. The potential impacts associated with each phase of the RWF are addressed in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on marine mammals in the RWF area from the construction and decommissioning phases are summarized in Table 4.3.4-2. Only IPFs with the potential to result in impacts on marine mammals are included. Additional details regarding these potential impacts from the various IPFs during construction/decommissioning of the RWF are described in the following sections.

Table 4.3.4-2 IPFs and Potential Levels of Impact on Marine Mammals at the RWF During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation; Foundation Installation and Removal; Vessel Anchoring and Jack-up; IAC and OSS-Link Cable Installation and Removal	Direct short-term
Habitat Alteration	Seafloor Preparation; Foundation Installation and Removal; Vessel Anchoring and Jack-up; IAC and OSS-Link Cable Installation and Removal	Direct short-term
Sediment Suspension and Deposition	Seafloor Preparation; Foundation Installation and Removal; Vessel Anchoring and Jack-up; IAC and OSS-Link Cable Installation and Removal	Direct short-term
Noise	Impact Pile Driving	Direct short-term
	DP Vessel Noise; Cable-laying Equipment Noise	Direct short-term
	Aircraft Noise	Direct short-term
	Geophysical Surveys	Direct short-term
Discharges and Releases/Trash and Debris	Construction and Decommissioning Vessels/Equipment	Direct short-term
Vessel Traffic	Vessel Strike	Direct short-term
Lighting	Navigational and Deck Lighting	Direct short-term

Seafloor Disturbance and Habitat Alteration

During construction, seafloor disturbances would be associated with seafloor preparation, foundation installation, vessel anchoring and jack-up, and IAC and OSS-Link Cable installation and removal. During each of these activities, some limited benthic habitat alteration will occur. As previously described, the RWF area is made up of a range of clays, sandy, silty sediment, gravel, and boulders (Section 4.2.3). The newly introduced subsea structures will produce a reef effect, in which the more heterogeneous hard bottom habitat created by the foundations, scour protection, and cable protection will attract a wider variety of species, both benthic and pelagic, compared to the existing sandy bottom habitat (Langhamer, 2012; Reubens et al., 2013; Wilhelmsson et al., 2006). However, long-term studies of artificial reefs in European seas indicate that it takes approximately five years before stable communities are established (Jensen et al., 2000; Petersen and Malm, 2006). Construction of the RWF is expected to occur over an approximate 18-month period and it is therefore unlikely species will colonize and establish themselves on the subsea structures during this period. It is more likely pelagic and benthic fish species present near the RWF during construction will avoid the area in which construction activities are occurring, and zooplankton species may face localized, temporary displacement around the RWF area.

Marine mammals occurring in the RWF would likely be transiting the area in search of prey species. Schooling fish and zooplankton (e.g., krill or copepods) are the predominant prey items for most marine mammals; however, some species will also forage for benthic fish and invertebrates. Multiple mysticete species have been observed feeding on sand lance (*Ammodytes* spp.) including the humpback, and minke whales, and humpbacks, in particular, are known to follow aggregations of this prey species while transiting (Friedlaender et al., 2009; NMFS, 2020a,b). Odontocete species such as Atlantic spotted dolphins, common bottlenose dolphins, and harbor porpoises have also been observed feeding on species on or near the seafloor (Halpin et al., 2009; NMFS, 2020c,d). Seals' diets primarily consist of fish, shellfish, and crustaceans and may also forage along the seafloor (NMFS, 2020e). Marine mammals foraging within in the RWF during construction may encounter a temporary reduction in foraging opportunities due to the displacement of prey species within the RWF. Seafloor preparation activities during construction are estimated to disturb approximately 3,110 ac (1,259 ha) of seafloor for the up to 100 WTG foundations, and 62.2 ac (25.2 ha) of seafloor for the up to two OSS foundations (Table 3.3-11), which makes up a relatively small area within the larger habitat available to marine mammals. Impacts would be limited to those few affected individuals or small groups, and not populations of marine mammals, and prey would still be available within the region outside the RWF. While potential impacts from seafloor disturbances and habitat alteration will result directly from construction activities, they are expected to only occur during the approximate 18-month construction period; therefore impacts are considered ***direct*** and ***short-term***.

During decommissioning of the RWF, the WTG foundations, IAC, and OSS-Link Cable will be completely removed (Section 3.0). Seafloor disturbances associated with decommissioning are expected to be the same as during construction, and potential impacts on marine mammals would be primarily due to the temporary displacement of prey species within the RWF area. However, the presence of the foundations during O&M could create an artificial reef habitat (see *Habitat Alteration* section in RWF O&M) that some marine mammals may use for foraging opportunities. Total removal of the structures during decommissioning would remove a source of food which might depend on the structures (Arnould et al., 2015; Hammar et al., 2010; Lindeboom et al., 2011). Based on behavioral observations around operational wind farms in Europe, it is likely some marine mammal species will be impacted differently than others. Dolphins and porpoises who are most commonly seen foraging around wind farm foundations would likely be impacted by the total removal of the structure, but there are currently no quantitative data on how large whale species utilize offshore wind farm structures so how they may respond to the artificial reef habitat is uncertain. No long-term studies exist to assess the impacts from removal of anthropogenic structural habitat on marine mammals. Additional research is needed to determine if an increase in habitat or food availability will lead to increased productivity of resource-limited populations. Without knowing the extent to which these structures increase habitat or food availability, it cannot be determined to what extent marine mammals will utilize these structures for foraging or to what extent removal of these structures will impact the marine mammals utilizing them.

Sediment Suspension and Deposition

As discussed in Section 4.1, seafloor preparation activities, foundation installation and removal, scour protection, vessel anchoring and jack-up, and IAC and OSS-Link Cable installation and removal will result in short-term, localized increases in sediment suspension near the seafloor and several feet up and outward into the water column. This suspended sediment would result in increased turbidity and would decrease visibility and water quality in the immediate area surrounding the RWF foundations, IAC, and OSS-Link Cable. However, the suspended sediments are anticipated to settle rapidly, and water column concentrations at any given location will return to pre-construction/decommissioning conditions within an approximate 17-hour period (RPS, 2020). Small numbers of marine mammals located near the construction activities may therefore experience ***direct*** and ***short-term*** impacts due to sediment suspension and deposition.

Noise

Underwater noise is a predominant construction-related IPF that could impact marine mammals if they are present within areas of elevated noise during RWF construction activities, in particular during impact pile driving. Acoustic modeling of construction-related underwater noise was completed by Revolution Wind to estimate the extent of noise produced by impact pile driving activities, as this activity is expected to produce the most noise during construction. Elevated underwater noise levels have the potential to cause physiological impacts or behavioral modifications in marine mammals; however, the occurrence and degree of impacts are uniquely dependent on many environmental, physiological, and contextual factors, as detailed in the Underwater Acoustic Analysis of Turbine Foundation and Cable Installation at Revolution Wind Farm (Denes et al., 2020) and Assessment of Impacts to Marine Mammals, Sea Turtles, and ESA-Listed Fish Species (Appendix Z).

Noise will be generated during the construction phase of the RWF by impact pile driving, cable-laying equipment, geophysical surveys, aircrafts, and vessels including both DP and non-DP vessels. Impact pile driving was identified as the activity that would likely have the greatest potential for impacts on marine mammals. Noise produced by cable laying equipment and non-DP vessels would be comparable to or less than the noise produced by DP vessels so impacts are also expected to be similar. Above water noise during construction would result in minimal impacts to marine mammals;

therefore, the potential for above water noise impacts to marine mammals is not discussed further in this section of the assessment.

Not all marine mammals have identical hearing capabilities or are equally susceptible to noise-induced hearing loss and disturbance. Therefore, marine mammals have been categorized into five hearing groups based on their similarities in hearing sensitivities (Southall et al., 2007; Finneran, 2016; NMFS, 2018). Regulatory hearing groups, as defined by NMFS (2018), are categorized as (1) low-frequency (LF) cetaceans, (2) mid-frequency (MF) cetaceans, (3) high-frequency (HF) cetaceans, (4) phocid pinnipeds in water (PPW), and (5) otariid pinnipeds in water (OW).

More recently, Southall et al. (2019) re-assessed these frequency weighting groups within the context of new research to better define the role frequency content plays in potential auditory injury when considering accumulated sound levels. In this assessment, Southall et al. (2019) kept the same frequency responses (hearing sensitivities) but re-categorize the LF, MF, and HF hearing groups. A comparison of the two categorical terminologies and general hearing ranges for each group are provided in Table 4.3.4-3.

These result in slightly different hearing group nomenclature from NMFS (2018) designations, but the thresholds of Southall et al. (2019) remain congruent with the current existing regulatory guidance (NMFS, 2018). Therefore, while the nomenclature currently used by NMFS (2018) is used in this impact assessment and the acoustic modeling conducted for the assessment to be consistent with regulatory standards.

Table 4.3.4-3 Marine Mammal Hearing Groups Expected in the Project Area.

NMFS (2018) Hearing Groups and Generalized Hearing Range[1]	Southall et al. (2019) Hearing Groups	Species or Taxonomic Groups (species potentially occurring in Project Area)
LF Cetacean (7 Hz to 35 kHz)	LF Cetacean	Baleen whales (e.g., fin whale, sei whale, NARW, minke whale, humpback whale)
MF Cetacean (150 Hz to 160 kHz)	HF Cetacean	Dolphins (e.g., Atlantic spotted dolphin, Atlantic white-sided dolphin, common dolphin, Risso's dolphin, common bottlenose dolphin) and toothed whales (e.g., sperm whale, long-finned pilot whale)
HF Cetacean (275 Hz to 160 kHz)	VHF Cetacean	True porpoises (e.g., harbor porpoise)
PPW (50 Hz to 86 kHz)	PCW	True seals (e.g., harbor seal, gray seal)

1 Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on an approximate 65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al., 2007) and PPW (approximation).

To provide some quantifiable and spatial context for determining whether marine mammals could be injured or disturbed by underwater noise introduced by Project activities, NMFS developed acoustic thresholds based on the received noise levels necessary to elicit the onset of a physiological effect (e.g., auditory injury) to or a behavioral response in marine mammals (NMFS, 2018). The thresholds for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) are used to help assess and quantify exposures from the proposed activities that could result in physiological effects or injury. Table 4.3.4-4 provides the underwater acoustic threshold levels for impulsive and non-impulsive sounds associated with PTS onset (physiological impacts) for marine mammals expected to occur in the Project Area (NMFS, 2018).

NMFS (2018) guidance recommends dual criteria for assessing potentially injurious exposures from impulsive sources due to the acoustic characteristics of these sources. These criteria include a zero-to-peak sound pressure level (PK) and sound exposure level over 24 hours (SEL_{24h}). For non-impulsive sources, only SEL_{24h} thresholds are defined. Frequency weighting functions are applied to account for different hearing capabilities of marine mammals resulting in separate threshold criteria for each hearing group. As explained further in CSA (2020), the SEL_{24h} criteria are used to assess potential impacts on marine mammals from impact pile driving because they consider duration of exposure which, coupled with animal movement, provide a more realistic estimation of potential impacts.

Table 4.3.4-4 Summary of NMFS (2018) Physiological Onset Acoustic Threshold Criteria for Impulsive and Non-Impulsive Sounds

Hearing Group	Impulsive Source	Non-impulsive Source
LF Cetacean	PK: 219 dB re 1 μPa SEL_{24h}: 183 dB re 1 μPa^2 s	SEL_{24h}: 199 dB re 1 μPa^2 s
MF Cetacean	PK: 230 dB re 1 μPa SEL_{24h}: 185 dB re 1 μPa^2 s	SEL_{24h}: 198 dB re 1 μPa^2 s
HF Cetacean	PK: 202 dB re 1 μPa SEL_{24h}: 155 dB re 1 μPa^2 s	SEL_{24h}: 173 dB re 1 μPa^2 s
PPW	PK: 218 dB re 1 μPa SEL_{24h}: 185 dB re 1 μPa^2 s	SEL_{24h}: 201 dB re 1 μPa^2 s

As with physiological threshold criteria, separate acoustic thresholds were established by NMFS (2019a) for behavioral impacts on marine mammals from impulsive and non-impulsive noise. Agency-adopted behavioral acoustic thresholds use root-mean-square sound pressure level (SPL) values that are not weighted by frequency, so criteria are assumed to apply to all marine mammal species and are not differentiated by hearing group. Table 4.3.4-5 outlines these acoustic threshold limits for marine mammal behavioral impacts. Although criteria are available from Wood et al. (2012) and were included for comparison in the acoustic modeling report (Denes et al., 2020), the frequency-weighted threshold ranges to the NMFS (2019a) threshold were used in the marine mammal impact assessment provided here and described further in Appendix Z. While it is acknowledged that weighted thresholds may be a more appropriate impact metric, the current review status for behavioral acoustic criteria and lack of regulatory basis for weighted values at this time warrants the use of the unweighted metrics for this analysis.

Table 4.3.4-5 Summary of NMFS (2019a) Behavioral Onset Acoustic Threshold Criteria for Impulsive and Non-Impulsive Sounds

Sound Source Type	Threshold Criteria[1]
Impulsive	SPL: 160 dB re 1 µPa
Non-impulsive	SPL: 120 dB re 1 µPa

1 Unlike physiological onset acoustic threshold criteria, behavioral onset threshold criteria were not developed for each marine mammal hearing group; criteria are assumed to apply to all marine mammal species.

The determination of how, when, and to what degree marine mammals are exposed to underwater noise that could result in a physiological and/or behavioral impact is complex. The analysis done in support of this impact evaluation considered many of the factors relevant to the problem including underwater sound propagation based on a several operational assumptions, marine mammal densities specific to the Project Area, marine mammal movements, and the context within which marine mammals may be exposed to Project-related noise. Due to the contextual nature of acoustic impacts, marine mammal species in the vicinity of the Project during noise-generating activity were not inexorably assumed to sustain exposures that would equate to an impact. Rather, potential physiological and behavioral impacts on marine mammals were assessed based on systematic methods using the best available data and modeling applicable to the situation as discussed below.

Impulsive Sound – Impact Pile Driving

Denes et al. (2020) provides modeled sound propagation distances based on expected construction scenarios associated with the RWF design envelope such as: hammer type, pile type, pile schedule (hammer energy/number of strikes/piling duration), season, geographic location, and implementation of noise mitigation (i.e., sound attenuation) measures. Appendix Z provides a summary of the results presented in Denes et al. (2020) and provides a more detailed impact assessment based not only on underwater sound characteristics but characteristics of marine environment which affect sound propagation, anticipated hearing sensitivities of at-risk species, mitigation factors, and animal behavioral responses to noise based on published literature.

Underwater noise generated by impact pile driving is considered the predominant IPF that could result in potential physiological and behavioral impacts on marine mammals due to the relatively high source levels produced by impact pile driving and the large distances over which the noise is predicted to propagate. The acoustic propagation model provided in Denes et al. (2020) incorporates operational variables which may influence how sound propagates in the water column including pile size and type, hammer energy, strike rate, and anticipated number of strikes. The propagation model produces the predicted sound fields for a 24-hour period, or scenario, which includes all hammer energies required to drive the pile from start to finish as well as the silent periods between two consecutive piles if applicable in the impact pile driving scenario and any proposed noise mitigation.

The acoustic ranges to acoustic thresholds assume an animal is stationary within the propagated sound field and thus accumulates noise levels for the full duration of the activity. When realistic animal behavior and movement are taken into account, the risk of exposure to accumulated noise levels that have the potential to cause a physiological or behavioral impact is lower for all marine mammals. Because marine mammals are not expected to be stationary in the area during construction, the exposure ranges distances are considered a more realistic prediction of distances to the acoustic threshold levels provided in Tables 4.3.4-4 and 4.3.4-5 compared to those estimated by the acoustic ranges. These exposure ranges, therefore, provide the basis for this impact assessment .

As evidenced by the variable seasonal presence of marine mammals in the Project Area (CSA, 2020), seasonality is also an important parameter when assessing exposures to and impacts from potentially harmful underwater noise. Additionally, Revolution Wind will employ noise attenuation devices, such as bubble curtains, during impact pile driving that will result in an estimated 10 dB broadband noise reduction and soft-start procedures which will reduce the likelihood of an animal being exposed to above-threshold noise. These environmental protection measures were incorporated into the propagation model to provide an accurate depiction of threshold ranges which may result from this project (Denes et al., 2020).

Mean exposure ranges to the SEL_{24h} physiological onset thresholds ranged from 1,916 to 3,794 m (6,286 to 12,448 ft) for LF cetacean species; 0 to 10 m (0 to 33 ft) for MF cetacean species; 1,865 to 3,690 m (6,119 to 12,106 ft) for HF cetacean species; and 195 to 1,068 m (640 to 3,504 ft) for PPW species for all pile types and scenarios with the 10 dB broadband attenuation applied. Exposure ranges for the PK threshold were <10 m (<33 ft) for all hearing groups except HF cetaceans whose ranges reached up to 260 m (853 ft).

Behavioral impacts on marine mammals are the predominant impact expected from impact pile driving. As discussed previously, behavioral thresholds are not differentiated by hearing group, and the SPL metric used for these criteria do not account for the duration of exposure like the SEL_{24h} metric. Therefore, exposure-based behavior threshold ranges are closer in value to the acoustic ranges for behavior thresholds. Results of the model indicate distances to the 160 dB behavioral onset threshold for all marine mammal species ranged from 3 to 4 km (1.86 to 2.49 miles). However, as discussed in Appendix Z, behavioral responses are highly contextual and exposure to noise above the threshold does not alone indicate an impact.

Individual species also have varying reactivity to acoustic sources (Southall et al 2019); therefore, providing a single impact determination must account for this variability. The exposure ranges for SEL_{24h} physiological onset thresholds (Denes et al., 2020) indicate LF and HF cetaceans may face a higher risk of exposure to noise sufficient to elicit physiological impacts compared to MF and PPW species. However, receiving sound levels that exceed thresholds does not equate to PTS, and auditory injury is not expected to occur from impact pile driving activities due to mitigation measures and predicted animal behavior. Implementation of environmental protection measures in the form of noise mitigation systems (NMS) and monitoring programs (Section 4.3.4.3) applied during impact pile driving will reduce the risk of physiological exposures. The most likely impact expected during impact pile driving is behavioral disturbances given the estimated threshold distances between 3 and 4 km (1.86 to 2.49 miles) for all marine mammal species. These distances reflect the 10 dB attenuation achieved using NMS (e.g., bubble curtains) employed by Revolution Wind, the implementation of soft-start procedures (Denes et al., 2020), and the variability in source levels as the pile reaches target penetration depth.

Seasonal increases in species' presence within the RWF (CSA, 2020) could increase the risk of exposure to noise levels that exceed physiological and behavioral disturbance thresholds. ESA-listed marine mammal species with already low population estimates would be most vulnerable to impacts during their corresponding peak presence periods. Depending on the species stock and the acoustic exposure characteristics, potential impacts could result in population-level consequences; however, impacts would be largely be stock-specific and not based solely on a species' listing status. In the case of NARWs, potential injury or significant behavioral disturbance (e.g., abandonment of feeding areas) are more likely to incur long-lasting effects on the population given their low abundances in the Western North Atlantic (Appendix Z); therefore, the risk of population-level impacts would be elevated for this species. ESA-listed species with more stable or increasing stocks and non-ESA listed species have a greater capacity to absorb and recover from potential impacts which may result in population-level effects. Impacts to these less-vulnerable groups could also result in injury or significant behavioral disturbance during peak seasonal density periods; however, these impacts, if they were to occur, would be limited to a small number of individual animals and are unlikely to result in any population-level consequences. Moreover, injury or significant behavioral disturbance is not expected for any marine mammal species, and the implementation of the environmental protection measures provided in Section 4.3.4.3 will further reduce the overall risk of exposure to noise above threshold levels. While impacts could occur as a result of sound propagated through the water from impact pile driving activities, this would only be expected during the approximate 18-month construction period in which impact pile driving will occur. Therefore, impacts on all marine mammal species are considered ***direct*** and ***short-term***.

Non-impulsive Sound – DP Vessel Noise

Project-related vessel traffic during construction and decommissioning will only slightly increase local and transiting traffic within the region, and the noise from Project-related vessel traffic is expected to be similar to existing vessel-related underwater noise levels in the area. Thus, it is presumed that individual or groups of marine mammals in the area are familiar with various and common vessel-related noises and will not be further impacted by Project-related vessel traffic. Cable-laying equipment used during installation of the IAC and OSS-Link Cable is expected to produce noise that is comparable to DP vessel noise.

The dominant underwater noise source from a DP vessel is due to cavitation on the propeller blades of the thrusters (Leggat et al., 1981). The noise power from the propellers is proportional to the number of blades, the propeller diameter, and the propeller tip speed. The noise from the DP thrusters is non-impulsive and typically more dominant than mechanical or hydraulic noises from the cable trenching equipment.

Acoustic modeling of non-impulsive sounds from DP thruster operations was not conducted for this Project given the low noise levels expected relative to impact pile driving. However, a qualitative assessment of DP vessels noise is provided in Denes et al. (2020).

Injuries to marine mammals from underwater noise from DP thrusters are unlikely to occur because of the non-impulsive nature of this source and the relatively short distances from the sound source to physiological onset thresholds. The risk of behavioral disturbance in marine mammals resulting from DP vessel noise is higher, given the lower acoustic thresholds for this source (Table 4.3.4-5). As is discussed in CSA (2020), behavioral responses are highly contextual and exposure to noise above the threshold does not alone indicate an impact. Seasonal increases in marine mammal presence within the RWF (CSA, 2020) may increase the risk of exposure to above-threshold noise, and for those very few individuals that may perceive the non-impulsive noise from Project DP vessels, impacts may be considered consequential if behavioral disruptions, short-term disruptions in communication, or temporary displacement from the ensonified area were to occur as this could result in the interruption of biologically significant behaviors. However, it is likely that other non-Project-related noises from vessel traffic would interfere or interact, making it very uncertain if marine mammals would experience behavioral impacts as a result of Project activities or other anthropogenic activities occurring in the region, and increasing the likelihood that animals in this region are habituated to vessel noise. Behavioral impacts on marine mammals due to underwater noise from DP vessels are therefore considered ***direct*** and ***short-term*** due to the relatively short duration anticipated for construction and decommissioning activities (approximately 18-months each).

Non-impulsive Sound – Aircraft Noise

Helicopters may be used for crew changes during construction of the RWF. Noise from helicopters has the potential to propagate through the water at amplitudes that are detectable by marine mammals and could cause behavioral responses in some species (Patenaude et al., 2002). However, helicopters used during Project activities will generally fly at altitudes above those that would potentially result in behavioral effects. In cases where the helicopter must fly below these altitudes to land, take off, or inspect Project components, any behavioral effects to marine mammals would be temporary, and no long-term effects to individuals or populations are expected. All aircraft activities will also comply with current approach regulations for any sighted NARWs or unidentified marine mammal. Given the environmental protection measures in place for all Project aircrafts, and the intermittent use of helicopters during the short, 18-month construction period, impacts are considered ***direct*** and ***short-term***.

Impulsive and Non-impulsive Sound – Geophysical Surveys

Intermittent geophysical surveys during the construction period will be conducted to identify any seabed debris or MEC/UXOs which may utilize equipment such as multi-beam echosounders, side-scan sonars, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers, ultra-short baseline positioning equipment, and marine magnetometers. The survey equipment to be employed will be comparable to those used during previous surveys conducted in the region which have been assessed for the potential for impact (CSA Ocean Sciences Inc., 2018, 2020; Feehan and Daniels, 2018). As discussed in Section 3.3.3.2, the likelihood of encountered MEC/UXO is low, and should any be confirmed during surveys the preferred approach is avoidance. However, should a situation occur in which avoidance is not possible, low-noise methods of removal or relocation will be used to reduce the risk of impact on marine life in the area, as well as Project crew. Additionally, a Risk Assessment with RARMS designed to evaluate and reduce risk in accordance with the ALARP risk mitigation principle will be implemented for any MEC/UXO identified in coordination with appropriate specialists and agencies to ensure the correct approach is being taken. Therefore, only noise from survey equipment was assessed as no explosive decommissioning is anticipated if any MEC/UXO are identified within the Project Area.

Results of these assessments indicate a low risk of physiological impact for any marine mammal species given the low estimated threshold ranges (<50 m for all equipment). Additionally, ranges to behavioral thresholds were estimated to be <200 m for all equipment and the implementation of environmental protection measures outlined in Section 4.3.4.2 would further reduce the risk of potential impact. Given the short duration of surveys that would occur during only a portion of the approximate 18-month construction period, impacts which may result from temporary changes in behavior are considered ***direct*** and ***short-term.***

Discharges and Releases/Trash and Debris

During construction and decommissioning of the RWF, sanitary and other waste fluids, trash, and miscellaneous debris will be generated from Project vessels and equipment, but properly managed in accordance with federal and state laws. Accidental discharges, releases, and disposal do represent a risk factor to marine mammals because they could potentially ingest or become entangled in debris, causing lethal or injurious impacts. As explained in Sections 4.1.5 and 4.1.6, the total quantities of hazardous and nonhazardous materials would be small and strictly managed. An OSRP (Appendix D) has been developed describing the procedures to be employed when responding to an oil spill, or the substantial threat of an oil discharge from any RWF component. Revolution Wind and its contractors will also maintain and follow SPCC plans during construction. Therefore, impacts on marine mammals from discharges, releases, trash, and debris are considered ***direct*** and ***short-term*** because of the low likelihood of such routine and accidental events and the relatively short duration of construction and decommissioning activities.

Vessel Traffic

Offshore construction will occur over an approximate 18-month period, during which time Project construction vessels will increase the volume of traffic in the Project Area. The largest vessels are expected during the WTG installation phase, with floating/jack-up crane barges, DP-equipped cable-laying vessels, and associated tugs and barges transporting construction equipment and materials. Up to 60 vessels may be utilized for construction across various components of the Project including installation of the foundations, WTGs, OSSs, IAC, and OSS-Link Cable (Table 3.3-26). While Project-related vessel traffic will slightly increase local and transiting traffic within the region, the number of Project vessels that will operate during RWF construction is expected to be a nominal addition to the normal traffic in the region (Appendix R). Vessel strikes with marine mammals are not uncommon, and if they were to occur, would likely result in animal injury or death.

Vessel strikes happen when either the animal or the vessel fails to detect one another in time to avoid the collision. Variables that contribute to the likelihood of a collision include vessel speed, vessel size and type, barriers to vessel detection by an animal (e.g. acoustic masking, heavy traffic, biologically focused activity) and in some cases mitigation measures. Most reports of collisions involve large whales, but collisions with smaller species have been reported (Evans et al., 2011; Van Waerebeek et al., 2007). Laist et al. (2001) provided records of the vessel types and speeds associated with marine mammal collisions. From these records, most severe and lethal marine mammal injuries involved large ships (≥80 m); but fast moving, small vessels also produced lethal injuries (Laist et al., 2001). Vessel speed was found to be a significant factor; 89 percent of the records involved vessels moving at ≥14 knots (Laist et al., 2001). Two well-documented NARW vessel strikes (incurred by marine mammal research vessels) demonstrated that, even with expert observation, ideal sea state conditions, and vigilant crews, the speed of the vessel combined with sometimes cryptic behavior of the whale presents a clear risk for vessel strikes (Wiley et al., 2016).

Whale species that are most frequently involved in vessel strikes include fin whale, NARW, humpback whale, minke whale, sperm whale, sei whale, gray whale, and blue whale (Dolman et al., 2006). Annual large whale mortality records include a ship strike assessment. In 2016, a high number of humpback whale mortalities prompted NMFS to declare an Unusual Mortality Event (UME) in January 2016 for Atlantic coast humpbacks (NMFS, 2020f) and in January 2017 for minke whales along the Atlantic coast (NMFS, 2020g). To date, 133 humpback whales and 97 minke whales were found dead between Maine and Florida. Of the carcasses that have been examined, approximately 50% of the humpback whales and several of the minke whales showed signs of human interaction including vessel strikes (NMFS, 2020f,g). The level of vessel strikes for humpback whales between 2016 and 2017 was over six times the 16-year average for this region (NMFS, 2020f). Between 2013 through 2017, there was 0.8 records of annual vessel strikes of fin whales, and 0.8 records annual vessel strikes of sei whales which resulted in serious injury or mortality (Hayes et al., 2020).

For NARW, vessel strikes pose a significant risk to the species' survival, mainly due to their small population size, behavioral characteristics, and habitat preferences that make them highly susceptible to vessel encounters. Vessel strike is consistently one of the most common causes of NARW mortality annually (Hayes et al., 2020). Records from 2013 through 2017 showed that the average reported human-caused mortality and serious injury to NARWs was 6.85 whales per year (Hayes et al., 2020). In June 2017, NOAA initiated a UME for NARWs (NMFS, 2020h) due to a significant increase in mortalities. Since 2017, 31 dead NARWs have been reported, and half of those able to be examined showed good evidence of vessel strike injuries (NMFS, 2020h). Some of the carcasses could not be examined or did not have clear cause of death while other reports are still pending (NMFS, 2020h). The endangered status and small population size for the NARW stock make it more vulnerable to impacts from the perspective of negative population consequences, particularly those resulting in possible injury or mortality which could result in removal of an individual from an already critically small stock. Potential impacts to a small population would likely be more consequential to that population than for other marine mammal species with larger population sizes, so it is considered more carefully in this assessment.

Most fast-moving cetacean species, including several delphinids such as the bottlenose and common dolphin actively approach vessels to swim within the pressure wave produced by the vessel's bow and because of their mobility and directed behavior regarding vessels are at lower risk of possible ship strike (Glass et al., 2009; Jensen and Silber, 2003; Laist et al., 2001; van der Hoop et al., 2015).

Construction vessel traffic will result in a relatively localized impact which will occur sporadically throughout the approximate 18-month time period of offshore construction around the RWF, temporarily increasing the volume and movement of vessels in the RWF. Large work vessels for foundation and WTG installation will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly over a short distance between work locations. Transport vessels will travel between several ports and the RWF over the course of the construction period. These vessels will range in size from smaller crew transport boats to tug and barge vessels. However, as previously discussed, the Project-related increase in vessel traffic will be nominal when compared to existing vessel operations within the area.

Project vessels perform operations with anchor lines, cables, and other equipment that has the potential to entangle marine mammals when left unattended in the water. Entanglement from Project vessel operations is extremely unlikely due to the fact that all ropes and lines will remain attached to vessels or equipment and most are under tension. In the event that a line or cable is lost, it could then present a higher risk to species entanglement. Such entanglements have the potential for a prolonged impact on the individual and may result in mortality. However, as discussed in the *Trash and Debris* section previously, good housekeeping practices will prevent loss of lines and cables and no entanglement is expected due to vessel activities during RWF construction.

As previously mentioned, not all marine mammal species are uniformly affected by the potential impacts resulting from vessel strikes. Some species face a higher risk of collision given their size, mobility, and surface behavior. Due to the low population estimates for Endangered whale species, vessel strikes that result in injury or mortality could have population-level impacts, particularly for NARWs where any impacts resulting in injury or mortality are more likely to have population-level effects. ESA-listed species with more stable or increasing stocks and non-ESA listed populations have a greater capacity to absorb and recover from potential impacts without incurring population-level effects. Therefore, in the unlikely event a strike was to occur which resulted in mortality or serious injury, impacts would result in the removal of that animal from the population; however, the consequences of a mortality in a population that is listed as Threatened or Endangered is countered by their overall resilience to population-level impacts. With the implementation of environmental protection measures outlined in Section 4.3.4.3, there remains a low risk of vessel strikes to all marine mammals. Due to the nominal addition of Project vessels to existing vessel traffic and the approximate 18-month duration each for construction and decommissioning activities, impacts from vessel traffic are considered ***direct*** and ***short-term***.

Lighting

Artificial lighting during RWF construction and decommissioning will be associated with navigational and deck lighting on vessels from dusk to dawn. It is likely that reaction of marine mammals to this artificial light is species-dependent and may include attraction or avoidance of an area. Artificial lighting may disrupt the diel migration of some prey species which may inadvertently influence marine mammal distribution patterns. Observations at offshore oil rigs showed dolphin species stayed for longer period of time around platforms which were lit where they were observed foraging near the surface (Cremer et al., 2009). The primary source of artificial lighting associated with the Project would likely originate from construction and decommissioning vessels used for foundation installation and removal, which are expected to transit to the RWF and remain there throughout the duration of construction and decommissioning. Because of the limited area associated with the artificial lighting used on Project vessels relative to the surrounding unlit areas, and the relatively short duration of construction and decommissioning activities (approximately 18-months each), impacts are considered ***direct*** and ***short-term*** for marine mammals.

Operations and Maintenance

IPFs resulting in potential impacts on marine mammals in the RWF area during the O&M phase are summarized in Table 4.3.4-6. Only IPFs with the potential to result in impacts on marine mammals are included. Additional details regarding these potential impacts from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.3.4-6 IPFs and Potential Levels of Impact on Marine Mammals at the RWF During O&M

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Vessel anchoring and Jack-up; IAC and OSS-Link Cable Maintenance	Direct short-term
Habitat Alteration	Presence of RWF Foundations, Scour Protection, and IAC and OSS-Link Cable Protection	Direct long-term
Sediment Suspension and Deposition	Vessel anchoring and Jack-up; IAC and OSS-Link Cable Maintenance	Direct short-term
Noise	WTG Noise	Direct long-term
	DP Vessel Noise	Direct short-term
	Aircraft Noise	Direct short-term
Electric and Magnetic Fields	IAC and OSS-Link Cable Operations	Direct long-term
Vessel Traffic	Vessel Strike	Direct long-term
Visible Structures	Presence of RWF Foundations	Direct long-term
Lighting	Navigational and Deck Lighting; WTG and OSS Lighting	Direct long-term

Seafloor Disturbance

Seafloor disturbance during O&M will primarily result from vessel anchoring and jack-up, and any maintenance activities that will require exposing the IAC or OSS-Link Cable. Both activities are expected to be non-routine events and not expected to occur with any regularity. While maintenance activities will occur throughout the 20 to 35 year life of the Project, impacts to the seafloor resulting from vessel activity during O&M are expected to be similar to vessel-related sediment suspension impacts described for the construction and decommissioning phases due to their intermittent nature: ***direct*** and ***short-term***.

Habitat Alteration

The presence of the RWF foundations, scour protection, and IAC and OSS-Link Cable protection will alter the existing habitat by creating a reef effect that results in colonization by assemblages of both sessile and mobile animals (Bergström et al., 2014; Coates et al., 2014; Wilhelmsson et al., 2006). Studies have shown that artificial structures can create increased habitat heterogeneity important for species diversity and density (Langhamer, 2012).

The foundations will extend through the water column, which may serve to increase settlement of meroplankton or planktonic larvae on the structures in both the pelagic and benthic zones (Boehlert and Gill, 2010). Fish and invertebrate species are also likely to aggregate around the foundations and scour protection which could provide increased prey availability and structural habitat (Boehlert and Gill, 2010; Bonar et al., 2015). The WTG foundations will have an estimated footprint of 70 ac (28.3 ha), and the OSS foundations have an estimated footprint of up to 2 ac (0.8 ha) (Table 3.3-11), providing up to 72 ac (72.2 ha) of heterogeneous habitat throughout the 20-35 year operational life of this Project. This can have a positive side effect creating a sanctuary area for trawled organisms where higher survival of larger fish species is an expected outcome that can extend to outer areas. A review by Langhamer (2012) indicated that the positive reef effect is dependent on the nature and the location of the reef and the characteristics of the native populations.

Data examining marine mammal distribution around wind farms are limited, focus primarily on foraging behavior, and show variable results. Studies examining harbor seal distribution around wind farms showed seal numbers inside the wind farm recovered after construction, but fewer seals were present on the nearby land sites (Vellejo et al., 2017; Snyder and Kaiser, 2009). Harbor porpoise activity around the Danish wind farm "Nysted" showed a significant decline in echolocation activity following construction that gradually increased but did not return to baseline levels (Hammar et al., 2010; Teilmann and Carstensen, 2012), but no change in activity was observed around the Danish wind farm "Rodsand II" after construction (Hammar et al., 2010). Any associated increase in the availability of prey species that are attracted to the physical structures may result in increased foraging opportunities for some marine mammals, particularly pinnipeds and MF cetaceans.

The effects of habitat alteration associated with the physical presence of the foundations and scour protections will not be universal across all marine mammal species. Numerous surveys at offshore wind farms, oil and gas platforms, and artificial reef sites have documented increased abundance of smaller odontocete and pinniped species attracted to the increase in pelagic fish and benthic prey availability (Arnould et al., 2015; Hammar et al., 2010; Lindeboom et al., 2011; Mikkelsen et al., 2013; Russell et al., 2014). It is likely the reef effect caused by habitat alteration in the RWF will provide *beneficial* foraging opportunities for some marine mammals in this region, although the number of species benefitting from this habitat and the significance of the benefit for these species remains uncertain (Bergström et al., 2014). Currently there are no quantitative data on how large whale species (i.e., mysticetes) may be impacted offshore windfarms (Kraus et al., 2019). Navigation through or foraging within the RWF impeded by the presence of the WTG and OSS foundations, which range in diameter 12 to 15 m with approximately 1.15 mi (1.8 km) spacing between foundations (Section 3.0). Additionally, wakes created by the presence of the foundations could alter the distribution of zooplankton within the water column, which would impact prey availability for some marine mammal species (Kraus et al., 2019). Wakes created by the foundations are not expected to affect pelagic fish or benthic species, so marine mammals foraging on these species are unlikely to be adversely affected.

Available information suggests the most likely impact on marine mammals would be the result of altered prey distribution, and while some species may be beneficially impacted due to the reef effect, the impact of altered prey distribution will not be universal across the 15 potentially affected species included in this assessment. Some species could experience adverse impacts from a shift in prey distribution and the presence of the foundations creating a hinderance to feeding activities. Given the scale and duration of potential habitat alteration that could result from the operation of up to 100 WTGs and two OSSs, effects from habitat alteration on marine mammals within the RWF area are considered ***direct*** and ***long-term***.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition which may increase turbidity and decrease water quality around the RWF during O&M will primarily result from vessel anchoring and jack-up, and any maintenance activities that will require exposing the IAC or OSS-Link Cable. Both activities are expected to be non-routine events and not expected to occur with any regularity. Sediment suspension and deposition impacts resulting from vessel activity during RWF O&M are expected to be similar to vessel-related sediment suspension and deposition impacts described for the construction and decommissioning phases due to their infrequent occurrence: ***direct*** and ***short-term***.

Noise

› **Non-Impulsive Sound – Wind Turbine Generator Noise**

Operating WTGs produce mechanical noise that can transmit in the water column through the foundations, resulting in continuous underwater noise. The frequency and sound level generated from operating WTGs depends on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions (Miller et al., 2010; HDR, 2019). Sound associated with a 6-MW operational WTG at Block Island Wind Farm (BIWF) was has been characterized as tonal noise typically at frequencies below 1,000 Hz (HDR, 2019). Thomsen et al. (2006) measured 1.5-MW WTG noise from a wind farm in Sweden between 20 and 1,000 Hz, with the highest SPL occurring at 50, 160, and 200 Hz. Pangerc et al. (2016) found the main signal associated with a 3.6-MW WTG operation was greatest at the 162 Hz 1/3 octave band. Acoustic moorings deployed at the BIWF as part of a BOEM monitoring study showed a 3 to 10 dB increase in the 1/3 octave bands below 100 Hz for WTG blades turning at maximum speed (12 rpm) (HDR, 2019). Measurements of operational noise for WTGs above 6-MW are not available in the published literature. Madsen et al. (2006) noted that there seems to be only a weak relationship between the size of the WTG and the emitted noise levels, but cautions that this may not be valid for large WTGs of several megawatts.

Although noise produced by operational WTGs is within the hearing range of marine mammals (Table 4.3.4-2), noise levels are unlikely to exceed the physiological onset thresholds for any marine mammal hearing group (Table 4.3.4-4) beyond 50 m (164 ft) (HDR, 2019), and may only exceed the behavioral threshold criteria for non-impulsive noise at higher wind speeds (Pangerc et al., 2016; HDR, 2019). Measurements at the BIWF were below the SPL 120 dB re 1 µPa behavioral threshold 50 m (164 ft) from the WTGs except at wind speeds greater than 13 m/sec (HDR, 2019), and at the Sheringham Shoal wind farm in the United Kingdom. Pangerc et al. (2016) measured SPL of 128 dB re 1 µPa 50 m (164 ft) from the WTGs at wind speeds of 10 m/sec. Other studies have measured SPL ranging from 90 and 115 dB re 1 µPa between 50 and 110 m (164 and 361 ft) from the WTGs (Thomsen et al., 2006; Miller and Potty, 2017).

Therefore, even with the larger WTGs proposed for the RWF, no physiological thresholds for any marine mammals are expected to be met and behavioral thresholds would not be expected beyond 50 to 100 m (164 to 328 ft) from any single WTG. However, the number of WTGs in RWF may present complex acoustic environments and potentially accumulative noise when assessed as a whole rather than as individual WTGs. Madsen et al. (2006) described noise propagated from wind farms may be audible to LF cetaceans up to 20 km (21.4 mi) away before the sound levels reach an ambient SPL of 90 dB re 1 µPa; but that such distances are only relevant areas with no influence from any shipping traffic. Ambient sound levels near the RWF region showed SPL ranging from 96 dB to 103 dB re 1 µPa in the 70.8 to 224 Hz frequency band, and the regional acoustic environment is influenced by shipping lanes (Kraus et al., 2016).

Notably, some marine mammal species (seals, MF cetaceans, HF cetaceans) may be attracted to operational wind farms for foraging and shelter (Hammar et al., 2010; Russell et al., 2014). The fact that these marine mammals will aggregate around operational wind farms may indicate noise levels produced are insufficient to elicit behavioral disturbances, or that the animals become habituated to the WTG noise (Teilmann and Carstensen, 2012). Madsen et al. (2006) noted that due to the low sound pressure levels from WTGs, operations were unlikely to cause hearing impairment to marine mammals; however, the noise produced by wind farms and potential impacts should be assessed within the context of the surrounding acoustic environment. There is no published literature assessing long term movement of baleen whales in and around offshore wind farms.

While operational WTG noise will be present throughout the 20-35 year life of the Project, the degree of potential impacts on marine mammals during O&M will be less than during the construction phase as there is no potential for physiological impacts due to WTG noise (Madsen et al., 2006; Scheidat et al., 2011). During O&M, anticipated impacts would be limited to audibility and perhaps some degree of behavioral response including changes in foraging, socialization or movement; or auditory masking, which could impact foraging and predator avoidance (MMS, 2007).

As discussed further in Appendix Z, feeding grounds have been identified for some LF cetacean species around the southern tip of Montauk, New York (west of the RWF) and around Martha's Vineyard, Massachusetts (east of the RWF). Should avoidance behaviors or abandonment of potential feeding grounds that intersect or are adjacent to the RWF occur, impacts to LF cetaceans could have consequences for the population by limiting available food resources. While this impact is not anticipated, the lack of documented activity by baleen whales around operational wind farms requires that such impacts be considered as a possibility.

Noise from operational wind WTGs is expected to be below all marine mammals' behavioral thresholds at less than 100 m (328 ft) from the source (Madsen et al., 2006; Thomsen et al., 2006; Pangerc et al., 2016; HDR, 2019) except at higher wind speeds (Thomsen et al., 2006; Pangerc et al., 2016; Miller and Potty, 2017; HDR, 2019). Likely impacts of operational noise would be limited to some degree of audibility and behavioral responses, which could be biologically significant if disruptions occur to foraging or socialization. As discussed previously under habitat alteration, marine mammal prey species are likely to aggregate around the foundations which may attract some marine mammal species (seals, HF and MF cetaceans) to the RWF due to increased food resources. There is uncertainty regarding the likely impacts to LF cetaceans which includes three ESA-listed species. Due to the potential for behavioral disturbance to this group combined with the long-term anticipated operation of the RWF (20-35 years), underwater noise during O&M is therefore anticipated to result in ***direct*** and ***long-term*** impacts on marine mammals.

› **Non-Impulsive Sound – DP Vessel Noise**

Throughout the 20- to 35-year operational life of the RWF, Project vessels which use DP thrusters will undergo routine maintenance trips between potential ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland and the RWF. Impacts from DP vessel use during O&M would be similar to those described for construction and decommissioning with DP vessels operating in station-keeping mode, which produce the greatest sound levels, used intermittently within the RWF. Impacts would affect those few individuals which may experience behavioral disruptions impacts may result in temporary interruption of important activities (e.g., feeding, communication), but due to infrequent nature of this activity are considered ***direct*** and ***short-term*** for all marine mammal species.

› **Non-impulsive Sound – Aircraft Noise**

Helicopters may be used for crew changes intermittently throughout the 20-35 year operational life of the Project. As discussed for construction and decommissioning, noise from helicopters has the potential to propagate through the water at amplitudes detectable by marine mammals and could result in behavioral responses in some species. However, all aircraft activities will also comply with current approach regulations for any sighted NARWs or unidentified marine mammal, and given the environmental protection measures in place for all Project aircrafts, and the intermittent use of helicopters during O&M, impacts are considered ***direct*** and ***short-term.***

Electric and Magnetic Field

The IAC and OSS-Link Cable will produce an EMF during operations as a result of the flow of electricity along the cable. A more detailed description of EMF produced by the Project cables can be found in Section 4.1. The magnetic fields will be strongest at the seafloor directly above the cable, rapidly decreasing with distance from the cables, and EMFs strong enough to potentially disturb marine life are not likely to extend more than a few feet into the water column (Section 4.1; Appendix Q1).

Evidence of use of geomagnetic fields in marine mammals is limited and primarily based on theoretical inferences. Marine mammals may be able to detect geomagnetic cues for navigation, based on reports of magnetite in the outer membrane of the brain and in the tongues and jawbones of some species (Normandeau, 2011). Studies of marine mammal strandings data from the United Kingdom and United States found that, in some cases, strandings were correlated with geomagnetic disturbances that occurred 1 to 2 days before the stranding. From these results, it was hypothesised that these cetaceans possess a sensitivity to the Earth's geomagnetic field and may at times rely on geomagnetic cues for navigation. However, other studies of strandings show no evidence of geomagnetic navigation by cetaceans (Brabyn and Frew, 1994; Hui, 1994).

Available evidence for marine mammals suggests these species may be sensitive to the magnetic fields associated with the Project's 60-Hz AC cables; however, surveys conducted at offshore windfarm sites indicate no adverse long-term impacts to these species, as species abundance recovered around the wind farms following construction activities (Edrén et al., 2010; Normandeau, 2011; Teilmann and Carstensen, 2012). A more detailed discussion about the potential impacts of EMF is provided in Appendix Q1. EMF is expected to be present near Project cables and animals feeding on benthic prey species would experience an increased potential for exposure, but the mobile nature and surfacing behavior in marine mammals would likely limit time spent near cables. Furthermore, the broad scale of marine mammal migrations and the generally low density of individuals within RWF area are also expected to lower the likelihood that individuals will regularly encounter the IAC and OSS-Link Cable and Project-associated EMF. This broad distribution and movement also means the RWF represents only a small portion of the available habitat for migratory or benthic feeding marine mammals, reducing the risk of exposure. Because EMF produced by the IAC and OSS-Link Cable will be present throughout the 20- to 35- year life of the Project, impacts are considered ***direct*** and ***long-term***.

Vessel Traffic

Vessels used during O&M of the RWF will generally be smaller than those used during construction and decommissioning. O&M vessels will primarily consist of DP service vessels and crew transfer vessels, except in the rare event in which major maintenance is required and larger jack-up vessels and barges may be used (Table 3.5-5). There will be fewer vessels used for routine maintenance trips than used for construction and decommissioning or non-routine maintenance, but they will occur over a longer period considering the 20-35 year operational life of the Project. Additionally, because annual routine maintenance will be required for the up to 100 WTGs and two OSSs proposed for this Project more trips are anticipated relative to construction and decommissioning. As discussed for construction, vessel impacts are not expected to result from the proposed activity; however, in the unlikely event that a vessel strike resulting in injury or mortality occurs, impacts could result in the removal of an individual from the population and thus would be a more severe impact than the expected impacts of an activity which results in no vessel strikes. If a strike were to occur which resulted in the removal of an individual from the population, the impact of that removal in a population that is listed as Threatened or Endangered is countered by their overall resilience to population-level impacts. Although the number of vessel transits will increase during O&M relative to construction and decommissioning, the majority of vessels will be smaller in size (length, width, and gross tonnage). O&M vessel traffic will not have the influx of a large number of vessels during a compressed time period that is seen during construction and decommissioning. The increased vessel transits during O&M do not represent a significant increase in the overall traffic volume or patterns in the region. Additionally, all vessels will implement vessel avoidance measures (NMFS, 2008), and adhere to the environmental protection measures (Section 4.3.5.3). Because vessel strikes are still a risk to marine mammals from O&M vessels over the duration of the RWF operation, vessel traffic impacts are considered ***direct*** and ***long-term***.

Visible Structures

Structural elements of the RWF will be present throughout the 20-35 year operational life of the Project. As discussed for the construction and decommissioning phases, if and how marine mammals perceive or respond to the physical presence of the structures is not well understood. It is likely some marine mammal species may be attracted to the structures for foraging opportunities (see *Habitat Alteration* section). Marine mammals transiting or foraging in the area could also face navigational impediments due to the presence of RWF foundations. However, given the location of the RWF on the OCS and the anticipated distance between foundations (Section 3.0), marine mammal migrations are unlikely to be substantially altered. Because visible structures associated with the RWF will be present throughout the 20-35 year operational life of the Project, impacts are considered ***direct*** and ***long-term*** for marine mammals.

Lighting

Artificial lighting during O&M will be associated with O&M vessels, the WTGs, and the OSS. Lighting on the WTG foundations and the OSS will be coordinated with the USCG to meet appropriate safety standards and to minimize potential impacts on marine organisms. It is likely that reaction of marine mammals to this artificial light is species-dependent and may include attraction or avoidance of an area similar to those discussed for construction. However, only a limited area associated with the artificial lighting used on Project vessels, the WTGs, and the OSS is expected relative to the surrounding unlit areas. Because lighting associated with the Project will be present throughout the 20-35 year life of the Project, the impacts are considered ***direct* and *long-term*** for marine mammals during O&M.

RWEC

Composition of marine mammal species and the operational context of Project activities are not likely to vary substantially between the RWEC–OCS and RWEC–RI. The only Project activity that will differ between the two RWEC areas is vibratory pile driving, which will occur in nearshore waters as the cable approaches the landfall at Quonset Point in North Kingstown, Rhode Island and therefore only be applicable to the RWEC–RI. Some marine mammal species show a preference for deeper waters and are less likely to occur in shallower state waters of the RWEC–RI (Section 4.3.4.1) which may reduce the risk for potential impacts from vibratory pile driving. Expected species distributions around the location of vibratory pile driving are discussed further in the *Non-impulsive Sound – Vibratory Pile Driving* subsection below and Appendix Z. All other Project activities will be similar between the RWEC–OCS and RWEC–RI, and the potential impacts discussed in the following subsections are therefore applied to both areas.

Based on the IPFs discussed in Tables 4.3.4-7 and 4.3.4-8, during construction and decommissioning of the RWEC ***direct*** and ***short-term*** impacts on marine mammals are expected from seafloor disturbance, habitat alteration, sediment suspension/deposition, discharges and releases, trash and debris, lighting, noise, and vessel traffic. During O&M of the RWEC, ***direct*** and both ***short-term*** and ***long-term*** impacts on marine mammals may occur from seafloor disturbance, habitat alteration, sediment suspension/deposition, EMF, noise, and vessel traffic. ***No impacts*** are expected to occur from visible structures construction and decommissioning of the RWEC; or from discharges and releases, trash and debris, visible structures, and lighting during O&M of the RWEC. The potential impacts associated with each phase of the RWEC are addressed in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on marine mammals in the RWEC area from the construction and decommissioning phases are summarized in Table 4.3.4-7. As previously discussed, the impacts discussed in this section apply to both the RWEC-OCS and RWEC-RI. Only IPFs with the potential to result in impacts on marine mammals are included. Additional details regarding potential impacts on marine mammals from the various IPFs during construction/decommissioning of the RWEC are described in the following section.

Table 4.3.4-7 IPFs and Potential Levels of Impact On Marine Mammals at the RWEC During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	RWEC Installation and Removal	Direct short-term
Habitat Alteration	RWEC Installation and Removal	Direct short-term
Sediment Suspension and Deposition	RWEC Installation and Removal	Direct short-term
Noise	Vibratory Pile Driving of Sheet Piles for Cofferdam[1]	Direct short-term
	DP Vessel Noise; Cable-laying Equipment Noise	Direct short-term
	Geophysical Surveys	Direct short-term
Discharges and Releases/Trash and Debris	Construction and Decommissioning Vessels/Equipment	Direct short-term
Vessel Traffic	Vessel Strike	Direct short-term
Lighting	Vessel Navigational and Deck Lighting	Direct short-term

1 Vibratory pile driving of sheet piles for cofferdam would only occur in the RWEC–RI; no vibratory pile driving is expected to occur in segments of the RWEC–OCS.

Seafloor Disturbance and Habitat Alteration

Seafloor disturbances associated with installation and removal of the RWEC may impact marine mammals by disrupting potential benthic prey species in the immediate area around the cable route. As described for the RWF, marine mammals occurring the area would likely be transiting in search of prey species, which may occasionally be benthic species. During installation of the RWEC, trenching of the cable route will temporarily alter the existing habitat and may temporarily displace benthic organisms. The RWEC will be buried to a target depth of 4 to 6 ft (1.2 to 1.8 m), and cable protection applied as determined necessary by a Cable Burial Feasibility Assessment. After installation of the cable is complete, the habitat and displaced benthic communities are expected to return to near baseline conditions over time. The total width of disturbance per cable is estimated to be up to 131 ft (40 m) along the 50 mi (80 km) long cable corridor, so very little habitat alteration is expected to occur along the RWEC corridor during construction and decommissioning, and the primary impact on marine mammals would be the result of seafloor disturbances temporarily reducing available habitat for marine mammals and displacing prey species. Not all marine mammals forage on benthic species, and habitat and prey would be available outside the proposed RWEC corridor. Due to the localized disturbances expected and the short duration of construction and decommissioning activities (approximately 8-months each), potential impacts from seafloor disturbance and habitat alteration are considered ***direct*** and ***short-term***.

Sediment Suspension and Deposition

Installation and removal of the RWEC may result in localized increases in suspended sediment and therefore decreased visibility and water quality around the RWEC. However, as with construction and decommissioning of the RWF, sediments are anticipated to settle rapidly, and water column concentrations within the majority of the RWEC area will return to pre-construction/decommissioning conditions within an approximate 8-hour period (Appendix J). Impacts to the few marine mammals that may be located near the RWEC installation activities that could be exposed to increased turbidity from sediment suspension during the approximate 8-month period for both construction and decommissioning are therefore considered ***direct*** and ***short-term***.

Noise

Noise will be generated during the construction and decommissioning phase of the RWEC by vibratory pile driving of the cofferdam, and vessels including both DP and non-DP vessels. Pinnipeds that may be present along the RWEC, particularly the RWEC–RI, could also be susceptible to in-air noise disturbance at haul out sites or pupping grounds, and in-air thresholds have been established by NMFS. However, as previously discussed, above water noise impacts pinnipeds are not expected to occur because the nearest known haul site for seals is approximately 3 km (1.86 mi) from the proposed location of the Onshore Facilities, and activities at this location are anticipated to produce relatively low levels of in-air noise compared to activities such as impact pile driving underwater (Section 4.1).

Non-impulsive Sound – Vibratory Pile Driving

Construction of a temporary cofferdam will be required for the nearshore RWEC connection to the TJBs and may utilize vibratory pile driving and subsequent vibratory removal of sheet piles. This construction method differs from the impact pile driving associated with the RWF foundations in several ways. The location is close to shore, the duration of the installation and removal is estimated to be short (approximately 3 days), and the source type is non-impulsive, compared to impulsive for the RWF impact pile driving. Predicting marine mammal exposure estimates from vibratory pile driving is complicated by the location, short duration of cofferdam installation, intermittent nature of the sound, large behavioral isopleths created by a low acoustic threshold, and static species density data that are not indicative of animals transiting the near shore environment.

Measurements of vibratory pile driving of sheet piles during construction of other projects indicated SPL of 155 dB re 1 μPa was measured 10 m (33 ft) from the source, while measurements taken 200 m (656 ft) away were approximately 15 dB lower (Illingworth & Rodkin, 2017). SEL over 1 second measured 10 m (33 ft) from the source were approximately 162 dB re 1 μPa^2 s (Buehler et al., 2015). No injury-level exposures are expected from vibratory pile driving due to the small isopleths in the case of MF cetaceans, HF cetaceans, and PPWs and due to the short duration of activity and low densities of LF cetaceans indicating that 24-hour duration exposures (required to meet the threshold) would not be achieved.

Ranges to behavioral thresholds are likely to be substantially larger than ranges to physiological thresholds due to the conservative, and likely outdated, regulatory SPL threshold of 120 dB re 1 μPa. This exaggerated isopleth suggests that all species within it will experience behavioral impacts from Project-related non-impulsive noise, which is very likely not the case and ignores the complexity of factors involved for a receptor or group of receptors to be exposed to any one sound source in the ocean (CSA, 2020). Marine mammal species perceive sound differently, and while these differences are accounted for in the physiological thresholds through the marine mammal hearing groups (NMFS, 2018), but for behavior one criteria is applied for all marine mammals (NMFS, 2019f).

Many of the potentially affected species of marine mammal that may be present in the region during construction are transient and prefer deeper waters offshore, limiting the time they spend in an ensonified area during the installation period (Section 3.3.3.2) in the nearshore area where the cofferdam will be installed (Appendix Z). The predominant species that may experience behavioral impacts during cofferdam installation would be limited to some dolphins, porpoises, and seals.

Additionally, the relatively low sound levels produced during vibratory pile driving make it likely this noise will be masked by other non-project-related sounds in the region, diminishing the likelihood that marine mammals would be exposed solely to vibratory hammer noises resulting in physiological or behavioral impacts. For those few individuals that may perceive the non-impulsive noise from the vibratory pile driving, they might experience short-term disruption of communication or echolocation from auditory masking; behavior disruptions; or limited, localized, and temporary displacement from ensonfied areas around the cofferdam (discussed further in Appendix Z). Because impacts from the sound produced by vibratory pile driving propagating through the water column during the approximate 3-day installation period, impacts on marine mammals are considered ***direct*** and ***short-term***.

Non-impulsive Sound – DP Vessel Noise

As described for the RWF IAC and OSS-Link Cable, cable-laying equipment used during installation of the RWEC is expected to produce similar noise to that produced by DP vessels. The likelihood of measurable impacts to marine mammals is considered very low because RWEC installation will occur over a relatively short timeframe, along a relatively narrow swath of ocean, and depending on the time of year of installation or removal, relatively few marine mammals could be expected in the region. As discussed for the RWF, the regulatory acoustic threshold that would be applied to DP vessels assumes an animal experiences accumulated noise above the threshold level for a 24-hour period, during which, when animal movement and behavior are taken into account, is unlikely to occur as animals are not expected to remain in the ensonified area for a full 24-hour period to experience physiological impacts.

Marine mammals may experience noise levels from DP vessel activity above the behavioral threshold criteria. The noise levels and spectral content of the DP vessels are likely similar to and potentially masked by other non-Project related vessel noise in the area. Additionally, as discussed in Appendix Z, behavioral responses are highly contextual and exposure to noise above the threshold does not alone indicate an impact. For those individuals experiencing behavioral disturbances, impacts could result in interruption of critical activities (e.g., feeding) that would have consequences for small numbers of individuals affected. Because DP vessels would only be operating during the relatively short duration of construction and decommissioning activities (approximately 8 months each), impacts resulting from DP vessel noise are considered ***direct*** and ***short-term***.

Impulsive and Non-impulsive Sound – Geophysical Surveys

As discussed previously for RWF construction, geophysical surveys will be conducted to identify any seabed obstructions or MEC/UXOs prior to cable-laying activities. Impacts during installation of the RWEC will be similar to those discussed for construction of the RWF, as any MEC/UXOs identified during the surveys will be removed or relocated using low-noise methods designed to avoid potential detonation of the device. Therefore, impacts would only occur due to noise produced by survey equipment, and given the relatively short, approximate 8-month installation period of the RWEC during which surveys would occur impact are considered ***direct*** and ***short-term***.

Discharges and Releases/Trash and Debris

As described for RWF construction and decommissioning, sanitary and other waste fluids, trash, and miscellaneous debris will be generated by Project vessels and equipment, but properly managed in accordance with federal and state laws. Accidental discharges, releases, and disposal do represent a risk factor to marine mammals because they could potentially ingest or become entangled in debris, causing lethal or injurious impacts. Impacts from routine and nonroutine discharges, releases, trash, and debris are considered ***direct*** and ***short-term*** due to the relatively short 8-month duration expected for both construction and decommissioning activities.

Vessel Traffic

The potential impacts of vessel traffic on marine mammals would be similar to those discussed above for the RWF; however, the occurrence of impacts would be less likely because fewer vessels are required for RWEC installation and decommissioning. Also, as the RWEC installation and decommissioning activities approach the landfall at Quonset Point in North Kingstown, Rhode Island, fewer marine mammals are expected in the area because of the shallow water. Vessel traffic during the activity is not expected to result in vessel strikes. In the unlikely event that a strike resulting in injury or mortality were to occur, impacts could result in removal of those individuals from the population. The impacts resulting from the removal of an individual from a population that is listed as Endangered is countered by their overall resilience to population-level impacts. Due to comparatively low species densities, and the implementation of avoidance measures, there is a low risk of impacts to occur. However, increased vessel traffic poses a strike risk for marine mammals over the course of

RWEC construction and decommissioning and impacts are considered ***direct*** and ***short-term*** due to the relatively short duration of installation and removal activities (approximately 8-months each).

Lighting

Artificial lighting during installation and removal of the RWEC will be associated with navigational and deck lighting on vessels from dusk to dawn. Only a limited area would be associated with the artificial lighting used on Project vessels relative to the surrounding unlit areas and the linear installation of the RWEC will cause the lit area to constantly move along the cable route. Because of the relatively short duration of installation and removal activities (approximately 8-months each), impacts are considered ***direct*** and ***short-term*** for marine mammals during construction and decommissioning, similar to those described for the RWF.

Operations and Maintenance

IPFs resulting in potential impacts on marine mammals in the RWEC area from the O&M phase are summarized in Table 4.3.4-8. As previously discussed, the impacts discussed in this section apply to both the RWEC-OCS and RWEC-RI. Only IPFs with the potential to result in impacts on marine mammals are included. Additional details regarding potential impacts on marine mammals from the various IPFs during O&M of the RWEC are described in the following sections.

Table 4.3.4-8 IPFs and Potential Levels of Impact on Marine Mammals at the RWEC During O&M

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Vessel Anchoring; Potential RWEC Maintenance	Direct short-term
Habitat Alteration	Potential RWEC Maintenance	Direct short-term
Sediment Suspension and Deposition	Vessel Anchoring; Potential RWEC Maintenance	Direct short-term
Noise	DP Vessel Noise	Direct short-term
Electric and Magnetic Fields	RWEC Operations	Direct long-term
Vessel Traffic	Vessel Strike	Direct long-term

Seafloor Disturbance and Habitat Alteration

Maintenance of the RWEC involving uncovering and reburial of the cable is considered a non-routine event and is not expected to occur with any regularity. Routine maintenance activities for the RWEC are not expected to result in seafloor disturbances. As discussed previously, the RWEC is not expected to significantly alter the existing habitat as it will be buried beneath the seafloor, except for locations where cable protection is deemed necessary by a Cable Burial Feasibility Assessment. The presence of the mattresses may provide some sporadic hard-bottom habitat along the RWEC corridor, but this is expected to be very similar to areas with high boulder density already present throughout the Project Area (Section 3.1). Species composition along the cable route is therefore not expected to change substantially following construction. The only potential impact on marine mammals would be the disruption of benthic prey species for marine mammals foraging on or near the seafloor. The availability of prey within the region around the RWEC is fairly ubiquitous and therefore impacts to marine mammals directly from loss of prey during RWEC is unlikely. Given the relatively small area of seafloor that would be disturbed if maintenance of the RWEC is required, and the intermittent nature of activities that may result in seafloor disturbance or habitat alteration, impacts on marine mammals during O&M are considered ***direct*** and ***short-term***.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during O&M of the RWEC will primarily result from vessel anchoring and any maintenance activities that will require exposing the RWEC. Both activities are expected to be nonroutine events and are not expected to occur with any regularity. Sediment suspension and deposition impacts resulting from vessel activity during O&M of the RWEC are expected to be similar to impacts described for the RWEC construction and decommissioning phases but at a smaller scale and will occur infrequently throughout the 20- to 35-year operational life of the Project (***direct*** and ***short-term***).

Noise

Direct impacts to marine mammals associated with noise during O&M of the RWEC may result from DP vessel noise during occasional maintenance trips. Impacts from DP vessel noise during O&M of the RWEC are expected to be similar to DP vessel noise impacts described for O&M of the RWF. Impacts from behavioral disruptions of critical activities (e.g., feeding) may occur to small numbers of individuals which are affected. However, DP vessels operating in a station-keeping mode which produce the greatest sound levels are expected to occur infrequently along the RWEC. These disruptions would be localized and temporary and are therefore considered ***direct*** and ***short-term***.

Electric and Magnetic Fields

The EMF produced by the RWEC is similar to that produced by the RWF, and so the impacts on marine mammals are expected to be similar to those described for the RWF IAC and OSS-Link Cable. Impacts may occur to a very small number of marine mammals in the area, as their habit of surfacing for air and the relatively narrow corridor occupied by the RWEC limits the potential for exposure. Because EMF produced by the RWEC will be present throughout the 20-35 year life of the Project, impacts to marine mammals relating to the EMF emitted from the RWEC are considered ***direct*** and ***long-term***.

Vessel Traffic

The potential impacts of vessel collisions and entanglement on marine mammals will be similar to those identified for O&M of the RWF where in the unlikely event a strike was to occur which resulted in potential injury or mortality, impacts result in removal of those individuals from the population. The impacts resulting from the removal of an individual in a population that is listed as Endangered is countered by their overall resilience to population-level impacts. Due to comparatively low species densities, and the implementation of avoidance and environmental protection measures (Section 4.3.4.3) there is a low risk of vessel strikes. An impact to marine mammals would only occur if there was a vessel strike during the O&M period. Because maintenance activities will occur throughout the 20- to 35-year life of the Project, impacts are considered ***direct*** and ***short-term***.

4.3.4.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following measures to avoid, minimize, and mitigate potential impacts on marine mammals. These measures are based on protocols and procedures successfully implemented for similar offshore projects.

- Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and vibratory pile driving activities.
- Environmental protection measures will be implemented for impact and vibratory pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, marine mammal and sea turtle monitoring protocols, the use of qualified and NOAA-approved protected species observers, and NMS such as bubble curtains, as appropriate.
- Vessels will follow NOAA guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions.
- All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness.
- Revolution Wind will require all construction and operation vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Feasibility Assessment.

4.3.5 Sea Turtles

This section describes the affected environment for sea turtles within the RWF, RWEC–OCS, RWEC-RI, and Onshore Facilities (collectively referred to as the Project Area, see Table 4.0-1 for definitions). The discussion of the affected environment for sea turtles is followed by an evaluation of potential Project-related impacts and a summary of environment protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to these resources.

The description of the affected environment of sea turtles within the Project Area, including documentation of regional occurrences and Project-related impact evaluation provided in this section, is based on the most recent literature and studies available that focus on renewable energy sites in the Mid-Atlantic and New England regions, including the MA WEA, RI-MA WEA, Rhode Island OSAMP area, and the New York Offshore Planning Area (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016; Normandeau and APEM, 2019; Palka, 2010, 2011, 2012, 2013, 2014, 2015; Palka et al., 2017). Available literature and published information from the USFWS was also used to characterize expected distributions and behavior relevant to this assessment.

In support of this impact evaluation, Revolution Wind also completed underwater acoustic modeling (Denes et al., 2020), which is summarized in Section 4.3.4.2 and in Appendix Z). Sea turtles resources within the Project Area are briefly described in the following subsection; a more detailed description of sea turtle presence and distribution in the Project Area along with potential Project-related impacts with an emphasis on acoustic impacts, is provided in Appendix Z.

4.3.5.1 Affected Environment

Regional Overview

There are four sea turtle species commonly found throughout the western North Atlantic which may occur within the Project Area. Consequently, these four species are considered *potentially affected species*. These species include the green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*). A fifth species, hawksbill sea turtle (*Eretmochelys imbricata*), may potentially occur within the region, but was not considered further in the impact assessment due to its use of tropical waters and coral reef habitats. Since this habitat is not present within the North Atlantic region, the presence of the hawksbill sea turtle would be extremely rare (NOAA Greater Atlantic Region Fisheries Office [GARFO], 2017). The four turtle species discussed in this section are listed as Endangered or Threatened under the ESA and are also listed as Endangered by the state of Rhode Island (RIDEM, 2020). USFWS and NMFS share the responsibility for sea turtle recovery under the authority of the ESA.

Table 4.3.5-1 lists the four potentially affected species of sea turtle that are likely to occur within the vicinity of the Project Area. Anticipated distribution within the Project components (i.e., RWF, RWEC–OCS, RWEC–RI, and Onshore Facilities) are discussed in the follow subsections. Appendix Z provides additional information on the distribution and ecology of listed turtle species relevant to this discussion and summarizes the results of the underwater acoustic propagation and animal movement modeling (Denes et al., 2020) completed in support of the impact assessment for marine mammals and sea turtles. Sea turtle density estimates derived by Denes et al. (2020) from the Strategic Environmental Research and Development Program spatial decision support system (SERDP-SDSS) NODE database (SERDP, 2020) are also provided in CSA (2020).

Table 4.3.5-1 Sea Turtles that Occur Within the Regional Waters of the Western North Atlantic OCS and Project Area

Common Name	Scientific Name	Stock	Current Population Status	Relative Occurrence in the RWF	Relative Occurrence in the RWEC–OCS	Relative Occurrence in the RWEC–RI
Green sea turtle	*Chelonia mydas*	North Atlantic DPS	ESA Threatened RI State Endangered	Uncommon	Uncommon	Uncommon
Kemp's ridley sea turtle	*Lepidochelys kempii*	-	ESA Endangered RI State Endangered	Uncommon	Regular	Regular
Loggerhead sea turtle	*Caretta caretta*	Northwest Atlantic Ocean DPS	ESA Threatened RI State Endangered	Common	Common	Common
Leatherback sea turtle	*Dermochelys coriacea*	-	ESA Endangered RI State Endangered	Common	Common	Common

Green sea turtles have a worldwide distribution and can be found in both tropical and subtropical waters (NMFS and USFWS, 1991; NatureServe, 2019). They are known to make long-distance migrations between their nesting grounds and pelagic feeding habitats occupied by hatchlings and the shallow water foraging habitat used by adults (Bjorndal, 1997; USFWS, 2018). Kemp's ridley do not have as wide a distribution as green turtles, but they show a similar transition between life history stages, which hatchlings located primarily offshore and adults spending their time in nearshore habitats (NMFS, USFWS, and SEMARNAT, 2011; USFWS, 2015). Kemp's ridley sea turtles have been observed in migratory pathways in the Gulf of Mexico at depths of less than 164 ft (50 m) (NMFS and USFWS, 2015).

Kemp's ridley sea turtles do not have as wide a distribution as green sea turtles, but they show a similar transition between life history stages, which hatchlings located primarily offshore and adults spending their time in nearshore habitats (NMFS, USFWS, and SEMARNAT, 2011; USFWS, 2015). Kemp's ridley sea turtles have been observed in migratory pathways in the Gulf of Mexico at depths of less than 50 m (164 ft) (NMFS and USFWS, 2015).

The leatherback sea turtle is the largest, deepest diving, most migratory, widest ranging, and most pelagic of all sea turtles (USFWS, 2015). It is primarily a pelagic species and is distributed in temperate and tropical waters worldwide. Adult leatherback sea turtles spend most of their time in shallow waters above the continental shelf feeding on soft-bodied prey such as jellyfish and salps (NMFS, 2020i) but they have also been known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae and floating seaweed (USFWS, 2015).

Loggerhead sea turtle distribution is likely influenced by water temperature and water depth (BOEM, 2012). Results from the CETAP aerial surveys found that 84 percent of loggerhead sea turtle sightings occurred in waters less than 80 m (262.5 ft) suggesting that they prefer shallow waters (CETAP, 1982). Loggerhead sea turtles, like green and Kemp's ridley sea turtles, transition from offshore habitats occupied by hatchlings to nearshore habitats occupied by adults, but both adult and juvenile loggerhead sea turtles are known to spend time in the open ocean as well as coastal estuaries. Loggerhead sea turtles feed primarily on mollusks and crustaceans (NMFS and USFWS, 2008).

All four species of sea turtles (loggerhead, green, Kemp's ridley, and leatherback) have recently been observed in waters off Rhode Island by the NYSERDA Digital Aerial Baseline Surveys and during surveys in the RI-MA WEA, predominantly in the summer and fall (Kraus et al., 2016; Normandeau and APEM, 2019).

Revolution Wind Farm

One confirmed green sea turtle sighting was reported, which was in March 2005, south of Long Island between the 40 and 50m (131- and 164-ft) isobaths (Kenney and Vigness-Raposa, 2010). One other confirmed green sea turtle sighting occurred during summer 2016 surveys off Long Island (Normandeau and APEM, 2019). Due to the few reported observations of green sea turtles in the RWF area, and their preferred habitat of high-energy oceanic beaches, pelagic convergence zones, and shallow protected waters (NMFS and USFWS, 1991), green sea turtles are not expected to occur in the RWF area.

Kemp's ridley sea turtles that occur in southern New England can be seen in Long Island Sound, along the Rhode Island coastline, and in Cape Cod Bay, Massachusetts (CETAP, 1982; Waring et al., 2012). They are more common in the New York Bight region and along the Long Island coastline, and there are little visual sighting data for Kemp's ridley turtles in the RWF area, attributed to their small size, making detections difficult during aerial surveys (Normandeau and APEM, 2019). However, Kenney and Vigness-Raposa (2010) reported 14 observations of Kemp's ridley sea turtles offshore Rhode Island around Block Island in the summer and fall, so they may be seasonally present in low densities in the RWF area.

Leatherback sea turtles were the most frequently sighted turtle species in the RI-MA WEA and were predominantly observed from summer through fall (Kraus et al., 2016). Leatherbacks were rarely detected around the RWF area in the spring and not detected at all during the winter. The greatest number of leatherback sea turtle detections in the RI-MA WEA occurred in August, and in the fall, there was a high concentration of sightings south of Nantucket (Kraus et al., 2016). The greatest anticipated abundances of leatherback sea turtles can therefore be expected in the RWF in the summer and fall (Kraus et al., 2016).

Loggerhead sea turtles are frequently seen in waters off the coast of Rhode Island and adjacent states. AMAPPS surveys reported loggerhead sea turtles as the most commonly sighted sea turtles in shelf waters from New Jersey to Nova Scotia, Canada (Palka et al., 2017). Kraus et al. (2016) reported that loggerhead sea turtle occurrence in the RI-MA WEA was highest during the summer and fall. During the NYSERDA Digital Aerial Baseline Surveys, sightings were dispersed across the continental shelf offshore of Long Island, with the greatest number of detections during summer 2017 surveys. Fewer individuals were observed during fall surveys, and no loggerhead sea turtles were detected during winter surveys (Normandeau and APEM, 2019). Reported sightings show a wide distribution seasonally throughout the RI-MA WEA and indicate that loggerhead sea turtles are most likely to be encountered within the RWF area during the summer and fall (Kraus et al., 2016; Palka et al., 2017).

RWEC–OCS

Sea turtle presence in the RWEC–OCS areas located in federal waters is expected to be similar to that of the RWF area, except for a few green turtles which may be present in shallower waters of the RWEC–OCS areas during the summer (Kenney and Vigness-Raposa, 2010).

RWEC–RI

The Northeastern United States coast, including waters off of Rhode Island, contains a variety of marine habitats that are suitable for these sea turtles, such as the shallow enclosed waters of the Peconic Bay and other bays in Long Island, the deeper waters of Long Island Sound and the Atlantic Ocean (Burke et al., 1993). With Rhode Island State Waters being located within three miles of shore, more suitable habitat for adult sea turtles would be available compared to areas farther offshore in the RWEC–OCS and RWF.

As previously described, green turtles utilize benthic foraging grounds in shallow protected waters where they primarily feed on seagrasses and algae (Bjorndal, 1997). Although adults are known to prefer nearshore habitats that would occur within the RWEC–RI, there are few records of green sea turtle sightings in Rhode Island State Waters. Only one confirmed green sea turtle sighting has been confirmed in the region located south of Long Island between the 40 and 50 m (131.23 and 164.04 ft) isobaths, and only two strandings have been reported in Rhode Island in the past 10 years (Kenney and Vigness-Raposa, 2010; NMFS, 2019b). Therefore, it is unlikely green sea turtles will be encountered within the RWEC–RI.

There are little visual sighting data for Kemp's ridley sea turtles in Rhode Island State Waters (Normandeau and APEM, 2019). This could be partly due to Kemp's ridley sea turtles' small size, making it difficult to detect during aerial surveys. In the summer, juvenile Kemp's ridley sea turtles are known to occupy the waters of the Long Island Sound and Peconic Bay to the west of the RWEC area (Morreale et al., 1992). They begin to migrate back into pelagic habitat in the fall, and those that are unable to migrate out of these waters are likely to become cold stunned and strand on Rhode Island and adjacent state beaches. However, stranding data show they are more commonly found in Massachusetts than in Rhode Island (NMFS, 2019b). Therefore, Kemp's ridley sea turtles may be present in low numbers primarily in the spring and summer in the RWEC–RI.

As previously discussed, aggregations of leatherback sea turtles have been observed around Block Island and south of Long Island, and leatherback sea turtles were the most commonly sighted turtle species during regional surveys (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016). Stranding data indicates they are relatively common along the Rhode Island coast, and they showed the highest number of reported strandings of the four sea turtle species within the past 10 years (NMFS, 2019b). Therefore, it is likely leatherback sea turtles will be encountered in the RWEC–RI.

Loggerhead sea turtles are frequently seen in waters off the coast of Rhode Island, Massachusetts, and New York. They are commonly observed in this area between summer and fall when sea temperatures begin to decrease and turtles migrate out of these areas (Shoop and Kenney, 1992). Stranding data also show these species are commonly reported in Rhode Island (NMFS, 2019b), and it is likely they will occur within the RWEC–RI.

Onshore Facilities

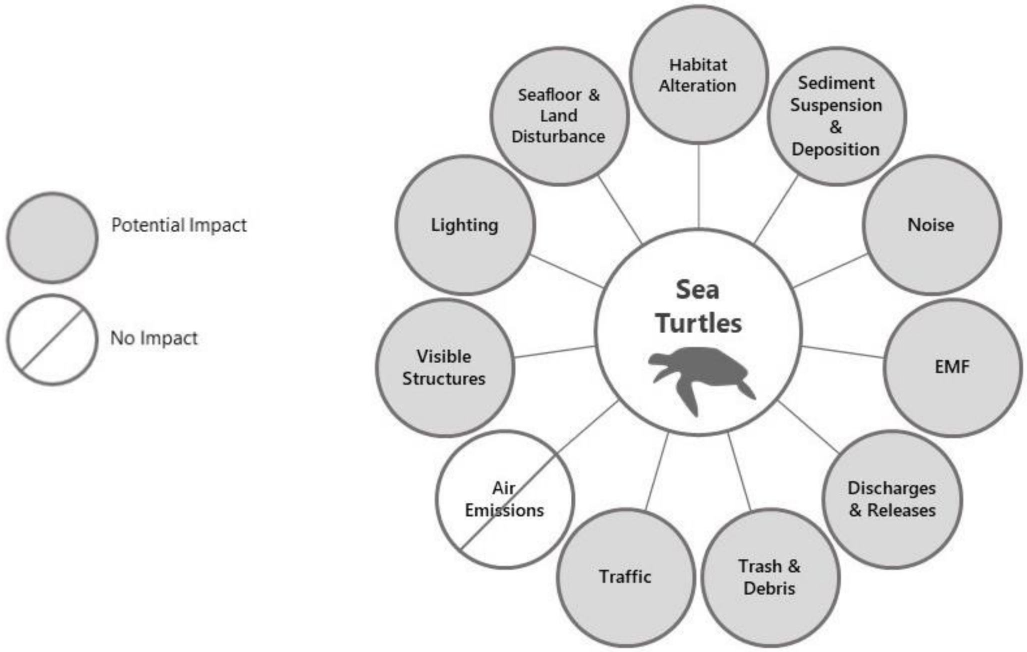
No sea turtle nesting events have been documented in Rhode Island so it is unlikely that any sea turtles would be encountered in or near the Onshore Facilities in North Kingstown, Rhode Island.

4.3.5.2 Potential Impacts

Section 4.1 discussed all the potential IPFs that could result during construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the four potentially affected species of sea turtle introduced in the previous section (Section 4.3.5.1). As discussed in Section 4.3.5.1, sea turtles are not expected to occur on or near the Onshore Facilities and, therefore, activities at this location will not be discussed further.

IPFs that may result in direct or indirect impacts to these species are depicted in Figure 4.3.5-1. Impacts are additionally characterized as short-term or long-term as defined in Section 4.1. All IPFs with potential to result in impacts on sea turtles are evaluated in this section. More detailed information regarding potential impacts on sea turtles can be found in Appendix Z.

Figure 4.3.5-1 Impact Producing Factors on Sea TurtlesImpact Producing Factors on Sea Turtles



Revolution Wind Farm

Based on the IPFs discussed in Tables 4.3.5-2 and 4.3.5-6, during construction and decommissioning of the RWF ***direct*** and ***short-term*** impacts on sea turtles are expected to occur from seafloor disturbance, sediment suspension/deposition, discharges and releases, trash and debris, lighting, habitat alteration, noise, and vessel traffic. During O&M of the RWF, ***direct*** and ***indirect***, ***short-term*** and ***long-term*** impacts on sea turtles may occur from seafloor disturbance, sediment suspension/deposition, noise, EMF, visible structures, lighting, habitat alteration, and vessel traffic. ***No impacts*** are expected to occur from visible structures during construction and decommissioning of the RWF; or from discharges and releases and trash and debris during O&M of the RWF. The potential impacts associated with each phase of the RWF are addressed in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on sea turtles in the RWF area from the construction and decommissioning phases are summarized in Table 4.3.5-2. Only IPFs with the potential to result in impacts on sea turtles are included. Additional details regarding these potential impacts from the various IPFs during construction/decommissioning of the RWF are described in the following sections.

Table 4.3.5-2 IPFs and Potential Levels of Impact on Sea Turtles at the RWF During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor Preparation; Foundation Installation and Removal; Vessel Anchoring and Jack-up; IAC and OSS-Link Cable Installation and removal	Direct short-term
Habitat Alteration	Seafloor Preparation; Foundation Installation and Removal; Vessel Anchoring and Jack-up; IAC and OSS-Link Cable Installation and removal	Direct short-term
Sediment Suspension and Deposition	Seafloor Preparation; Foundation Installation and Removal; Vessel Anchoring and Jack-up; IAC and OSS-Link Cable Installation and removal	Direct short-term
Noise	Impact Pile Driving	Direct short-term
	DP Vessel Noise; Cable-laying Equipment Noise	Direct short-term
	Aircraft Noise	Direct short-term
	Geophysical Noise	Direct short-term
Discharges and Releases/Trash and Debris	Construction and Decommissioning Vessels/Equipment	Direct short-term
Vessel Traffic	Vessel Strike	Direct short-term
Lighting	Navigational and Deck Lighting	Direct short-term

Seafloor Disturbance and Habitat Alteration

During construction and decommissioning seafloor disturbances will be associated with seafloor preparation, foundation installation and removal, vessel anchoring and jack-up, IAC and OSS-Link Cable installation and removal. Sea turtles occurring in the RWF will likely be transiting the area in search of prey species, some of which could be benthic species such as mollusks and crabs. Placement of the foundations, scour protection, and cable protection during construction of the RWF will also create a reef effect, in which the existing sandy bottom habitat is converted to a more heterogeneous hard bottom habitat which will attract numerous fish species and other prey items for sea turtles (Langhamer, 2012; Reubens et al., 2013; Wilhelmsson et al., 2006). However, as discussed for marine mammals, it may take up to five years before stable communities are established following construction activities (Petersen and Malm, 2006). As construction will only occur over an approximate 18-month period, it is unlikely the artificial habitat created by the foundations will substantially impact sea turtles within this time frame. Additionally, there is availability of prey outside the RWF. Potential impacts are therefore expected to be the result of temporary loss of habitat for benthic prey species, but given the short duration of this disruption and the relatively small area of disturbance relative to available habitat in the area (up to 3,110 ac [1,259 ha] for the WTG foundations and 62.2 ac [25.2 ha] for the OSS foundations [Table 3.3-1]), impacts on sea turtles from seafloor disturbances and habitat alteration during construction of the RWF are considered ***direct*** and ***short-term***.

The artificial reef habitat created by the presence of the RWF has the potential to attract sea turtles and provide foraging and sheltering habitat to sea turtles in this region (see Habitat Alteration section under RWF O&M for further details). Relatively high concentrations of sea turtles have been observed at offshore structures in the Gulf of Mexico where they are seen foraging and resting. Sea turtles using the habitat created by the RWF may also experience indirect impacts from increased fishing activity and susceptibility to cold stunning if they remain in the area longer than normal. Decommissioning of the RWF and subsequent removal of the foundations and scour protection would remove most of the altered habitat, potentially eliminating these impacts. Impacts from removal of the beneficial foraging and sheltering habitat are anticipated to be minimal since, with the loss of habitat, it is also likely that the sea turtles will discontinue use of the area as well. Some sea turtles may become dependent on this new habitat similar to how manatees become dependent on warm-water discharges from power plants in Florida (Laist, 2005; Sattelberger, 2017).

There is no information available in the scientific literature quantifying the use of offshore WTG foundations by sea turtles or concerning subsequent loss of introduced habitat after decommissioning. Ancillary data on the use of oil and gas structures by sea turtles indicate that introduced structures attract sea turtles (Gitschlag and Herczeg, 1994; Viada et al., 2008); however, quantitative studies are not available regarding either recruitment of sea turtles to structures or the resulting impacts to sea turtles from removal of these structures. Therefore, impacts from decommissioning WTG foundations are speculative. Given the propensity for sea turtles to utilize artificial habitats created by offshore structures and the current listing status of local sea turtles, and the removal of inadvertent impacts from fishing or cold stunning, and the potential negative impacts from expected loss of beneficial habitat due to decommissioning of the RWF are considered ***direct*** and ***short-term***.

Sediment Suspension and Deposition

RWF construction and decommissioning activities associated with seafloor preparation, foundation installation and removal, vessel anchoring and jack-up, IAC and OSS-Link Cable installation and removal will result in temporary, localized increases in sediment suspension in the water column which will increase turbidity, decrease visibility, and potentially impact the quality of the water column. However, the suspended sediments are anticipated to settle rapidly, and water column concentrations at any given location will return to pre-construction/decommissioning conditions within an approximate 17-hour period (Appendix J). Because of the relatively low anticipated densities of sea turtles in the RWF impacts are unlikely, would be limited to a small number of individuals, and would not have long lasting effects. Due to the temporary and localized increases in turbidity expected during construction and decommissioning, impacts are considered ***direct*** and ***short-term*** for the few sea turtles occurring near the seafloor within the RWF.

Noise

Sea turtles may be impacted by underwater sounds produced during the construction of the RWF which may result in physiological and behavioral effects. Impacts of sound on sea turtles are largely unknown because of a lack of information on hearing capabilities and behavioral responses to sound. However, the data available suggest that sea turtles can detect and behaviorally respond to acoustic stimuli (Dow Piniak et al., 2012a,b). A detailed explanation of underwater noise impacts on sea turtles is provided in Appendix Z, with an overview of the primary impacts presented in this section.

A few experimental studies have been conducted on the hearing capabilities of sea turtles. While general hearing sensitivities for all species are below 2 kHz, primary hearing frequency ranges vary per species and life stage (Bartol and Ketten, 2006; Bartol et al., 1999; Dow Piniak et al., 2012a,b; Martin et al., 2012; Piniak et al., 2016).

Limited research has been conducted on the physiological impacts of underwater sound on sea turtles, and very few data are available on the behavioral responses of sea turtles to noise. The few studies that are available only examine the behavioral responses of loggerhead and green sea turtles to underwater noise produced by seismic guns. Behavioral responses observed during seismic surveys included avoiding the source of the sound (O'Hara and Wilcox, 1990), startled reactions (DeRuiter and Doukara, 2012), and increased swimming speed (McCauley et al., 2000). Other possible behavioral responses could include increased surfacing time and decreased foraging. McCauley et al. (2000) reported that SPL between 166 and 175 dB re 1 μPa corresponded with observed behavioral reactions in sea turtles, and Blackstock et al. (2018) suggested 175 dB re 1 μPa was a more appropriate threshold given these response were observed in caged sea turtles.

As explained in the supplementary acoustic assessment in Appendix Z, BOEM and NOAA have adopted the injury thresholds based on the dual criteria of PK and SEL_{24h} reported by Popper et al. (2014), and behavior thresholds developed by the Fisheries Hydroacoustic Working Group (FHWG, 2008) and the United States Navy (Blackstock et al., 2018). Table 4.3.5-3 summarizes the agency-adopted acoustic thresholds for sea turtles, which are used to evaluate noise impacts to sea turtles from impulsive sounds from impact pile driving and non-impulsive sounds generated by DP vessel thrusters and vibratory pile driving.

Table 4.3.5-3 Physiological and Behavioral Threshold Criteria for Impulsive and Non-Impulsive Sounds for Sea Turtles

Faunal Group	Sound Source Type	Injury Criteria Metric	Physiological Threshold	Behavior Criteria Metric	Behavioral Threshold
Sea Turtles	Impulsive sounds	PK	207 dB re 1 μPa	SPL	175 dB re 1 μPa
		SEL_{24hr}	210 dB re 1 μPa^2 s		
	Non-impulsive sounds	SPL	180 dB re 1 μPa	SPL	175 dB re 1 μPa

Underwater acoustic modeling was conducted by Revolution Wind to estimate the impacts produced during impact pile driving activities for construction of the RWF, and a qualitative assessment of impacts that may result from activities such as vibratory pile driving, cable laying equipment, DP vessel thrusters, geophysical surveys, and aircraft noise was also performed. Dependent on many factors as detailed in the underwater acoustic modeling study (Denes et al., 2020) and sea turtle impact assessment (Appendix Z), elevated underwater noise levels may impact sea turtles. Impact pile driving was identified as the activities that will likely have the greatest potential for impacts on sea turtles. As discussed in the IPF section (Section 4.1), above-water noise resulting from Project Activities is not expected to be as intense as underwater noise. Additionally, while sea turtles do surface to breathe, they spend the majority of time submerged and are not expected to be exposed to above-water noise at levels that could result in biologically significant impacts. Therefore, the potential for above-water noise impacts to sea turtles is not discussed further in this assessment of impacts.

› **Impulsive Sound – Impact Pile driving**

Underwater noise from the impulsive sounds generated by impact pile driving is considered an important IPF in potential physiological and behavioral impacts on sea turtles. The assessment of potential acoustical impacts to sea turtles was completed based on the results of underwater acoustic and animal movement modeling studies specific to Project construction activities. Denes et al. (2020) provides predicted sound propagation distances based on key construction variables associated with the Project design envelope, such as: hammer type, pile type, pile schedule (hammer energy/number of strikes/piling duration), season, geographic location, and implementation of noise mitigation (i.e., sound attenuation) measures. Appendix Z summarizes the results of the models and provides an impact assessment based not only on underwater sound characteristics but aspects of the marine environment which influence sound propagation, autecological characteristics of at-risk species, mitigation factors, and sea turtle behavior.

Distances to the physiological and behavioral onset threshold were calculated using exposure-based modeling methods used for marine mammals (as described in Section 4.3.4.2) to account for animal movement over a 24-hour exposure period. Modeled impact pile driving at RWF with 10 dB attenuation resulted in a mean exposure ranges to the SEL_{24h} physiological onset threshold between 13 and 57 m (13 and 187 ft) for all pile types and scenarios. The exposure ranges for PK physiological onset thresholds represented a greater potential for injury to sea turtles out to 110 m (361 ft). However, this distance is based on the highest hammer energy which would be only be reached near the end of pile installation (Denes et al., 2020). Sea turtles are not expected to linger within the ensonified area around impact pile driving for durations necessary to elicit physiological impacts, and existing information regarding distribution of sea turtles in this region (Section 4.3.5.1) determined that seasonality is an important parameter when estimating exposures to potentially harmful underwater noise due to the variable monthly densities of animals in the Project Area. The placement of NMS creating a barrier around the pile being installed, general construction activities, and implementation of soft-start procedures (Section 4.3.5.3) further reduce the risk of sea turtles entering any of the impact areas and therefore no physiological exposures are expected for sea turtles from impact pile driving.

Modeled exposure ranges for behavioral thresholds ranged from 1,030 to 1,500 m (3,379 to 4,921 ft) for all pile types and scenarios (Denes et al., 2020). There is a likelihood of behavioral threshold exposure and general activity in the area that could result in sea turtles temporarily vacating the

RWF construction area. Exposures to acoustic thresholds are expected to be temporary and not biologically significant.

Based on the modeled exposure ranges to threshold criteria for sea turtles with 10 dB noise attenuation applied, and the additional proposed environmental protection measures (Section 4.3.5.3), impacts to sea turtles would be limited to behavioral disturbance to small numbers of individuals resulting from sound propagated through the water from impact pile driving. Impacts would only be expected during the approximate 18-month construction period during which impact pile driving would occur and are therefore considered ***direct*** and ***short-term***.

› **Non-impulsive Sound – DP Vessel Noise**

Commercial and recreational vessels can produce varying SPL dependent on the overall size, engine, propeller size, and configuration. These vessels can create LF noises that can be detected by turtles (Dow Piniak et al., 2012b). While the SPL created may not directly damage hearing, the presence of vessels within sea turtle habitat may mask important auditory cues (Dow Piniak et al., 2012b). The addition of noise from Project-related vessel traffic to the existing vessel-related underwater noise level is not expected to be substantial, and the presumption is that individual sea turtles in the RWF are familiar with various and common vessel-related noises, particularly within trafficked areas of the RWF and nearby shipping lanes.

The use of DP vessel thrusters for laying the IAC and OSS-Link Cable is the primary vessel noise source of concern to sea turtles. Cable-laying equipment is expected to produce comparable noise to DP vessels and impacts would therefore be similar. The cavitation on the propeller blades of the thrusters generate a continuous or non-impulsive noise (Leggat et al., 1981). The level of noise from the propellers is proportional to the number of blades, the propeller diameter, and the propeller tip speed. The noise from the DP vessel thrusters is expected to be more dominant than mechanical or hydraulic noises from the cable trenching equipment and therefore represents a greater potential for impacts.

If impacts occur to sea turtles from Project-related vessel noise, they are not expected to be biologically significant and would be limited to short-term disruption and displacement of individuals from localized areas around the vessels during construction and decommissioning activities. Therefore, impacts of underwater sound generated from most construction vessels on sea turtles are considered ***direct*** and ***short-term***.

› **Non-impulsive Sound – Aircraft Noise**

Helicopters may be used for crew changes during construction of the RWF. Noise from helicopters has the potential to propagate through the water at amplitudes may be detectable by sea turtles and could cause behavioral responses in some species (Patenaude et al., 2002). However, helicopters used during Project activities will generally fly at altitudes above those that would potentially result in behavioral effects. In cases where the helicopter must fly below these altitudes to land, take off, or inspect Project components, any behavioral effects to sea turtles would be temporary, and no long-term effects to individuals or populations are expected. All aircraft activities will also comply with current approach regulations for any sighted sea turtle. Given the environmental protection measures in place for all Project aircrafts, and the intermittent use of helicopters during the short, 18-month construction period, impacts are considered ***direct*** and ***short-term***.

- **Impulsive and Non-impulsive Sound – Geophysical Surveys**

  Intermittent geophysical surveys during the construction period will be conducted to identify any seabed debris or MEC/UXOs which may utilize equipment such as multi-beam echosounders, side-scan sonars, shallow penetration sub-bottom profilers, medium penetration sub-bottom profilers, ultra-short baseline positioning equipment, and marine magnetometers. The survey equipment to be employed will be comparable to those used during previous surveys conducted in the region which have been assessed for the potential for impact (CSA Ocean Sciences Inc., 2018, 2020; Feehan and Daniels, 2018). As discussed in Section 3.3.3.2, the likelihood of encountered MEC/UXO is low, and should any be confirmed during surveys the preferred approach is avoidance. However, should a situation occur in which avoidance is not possible, low-noise methods of removal or relocation will be used to reduce the risk of impact on marine life in the area, as well as Project crew. Additionally, a Risk Assessment with RARMS designed to evaluate and reduce risk in accordance with the ALARP risk mitigation principle will be implemented for any MEC/UXO identified in coordination with appropriate specialists and agencies to ensure the correct approach is being taken. Therefore, only noise from survey equipment was assessed as no explosive decommissioning is anticipated if any MEC/UXO are identified within the Project Area.

  Results of these assessments are only currently available for marine mammals; however, based on acoustic thresholds for sea turtles compared to marine mammals, there is a low risk of physiological impact for low estimated threshold ranges (<50 m for all equipment). Additionally, ranges to behavioral thresholds were estimated to be <200 m for all equipment and the implementation of environmental protection measures outlined in Section 4.3.4.2 would further reduce the risk of potential impact. Given the short duration of surveys that would occur during only a portion of the approximate 18-month construction period, impacts which may result from temporary changes in behavior are considered ***direct*** and ***short-term***.

Discharges and Releases/Trash and Debris

During construction and decommissioning of the RWF, sanitary and other waste fluids, trash, and miscellaneous debris will be generated by Project vessels and equipment but properly managed in accordance with federal and state laws. Accidental discharges, releases, and disposal do represent a risk factor to sea turtles because they could potentially ingest or become entangled in debris, causing lethal or injurious impacts. However, as explained in Sections 4.1.5 and 4.1.6, the total quantities of hazardous and nonhazardous materials will be small and strictly managed. An OSRP (Appendix D) has been developed describing the procedures to be employed when responding to an oil spill, or the substantial threat of an oil discharge from any RWF component. Revolution Wind and its contractors will also maintain SPCC plans during construction and decommissioning. Therefore, impacts on sea turtles from discharges, releases, trash, and debris are considered ***direct*** and ***short-term*** because of the low likelihood of such non-routine and accidental events and the relatively short duration of construction and decommissioning activities (approximately 18-months for each).

Vessel Traffic

Sea turtles swimming or feeding at or near the surface of the water can be vulnerable to vessel strikes as propeller and collision injuries to sea turtles from boats or vessels are not uncommon (NMFS and USFWS, 1991). It is estimated that approximately 50 to 500 turtle mortalities per year in WOTUS result from collisions with vessels (Plotkin, 1995). Vessel strikes happen when either the turtle or the vessel fails to detect one another in time to avoid the collision. Variables that contribute to the likelihood of a collision include vessel speed, vessel size and type, and visibility.

Sea turtle vessel strike injuries that result in mortality are often difficult to determine due to the nature of post-mortem injuries on recovered carcasses. A comprehensive assessment of sea turtle vessel strike mortality in Florida, that included pathological investigations, showed that 31 percent of all strandings had a definitive or probable vessel strike injury (Foley et al., 2019). The mean number of sea turtles stranded with a vessel strike injury was positively correlated to the number of annual vessel registrations and proximity to inlets, navigable waterways, and marinas (Foley et al., 2019).

Dependent on the time of year, Project-related vessel traffic will slightly increase within the area, but the number of vessels that operate for RWF construction is expected to represent a nominal addition to the normal traffic in the region. Construction vessel traffic will be relatively short-term and localized around the RWF where a concentrated increase in the volume and movement of vessels will occur. As discussed in Section 4.3.4.2, up to 60 vessels may be used for various components of the Project including installation and removal of the WTGs, OSSs, the IAC, and OSS-Link Cable. Large work vessels for foundation and WTG installation will generally transit to the work location and remain in the area until installation is complete. These large vessels will move slowly and over short distances between work locations. Transport vessels will travel between several potential ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland and the RWF over the course of the construction period. These vessels will range in size from smaller crew transport boats to tug and barge vessels.

Impingement of sea turtles in towed equipment and between vessels and equipment has been identified in seismic surveys (Nelms et al., 2016) and dredging operations (Dickerson et al., 2004). Similar hazards are present during RWF construction, and impingement would likely result in sea turtle injury or mortality. RWF construction vessels could also potentially collide with sea turtles, which could result in turtle injury or mortality. In the unlikely event that a strike occurs and results in injury or mortality, impacts would result in the removal of that animal from the population; however, the impacts resulting from the removal of an individual in a population that is listed as Threatened or Endangered is countered by their overall resilience to population-level impacts. Given the seasonal distribution of sea turtles in this region, the relatively low abundance of sea turtles in Rhode Island waters (Kenney and Vigness-Raposa, 2010; NMFS, 2019b) and the implementation of environmental protection measures (Section 4.3.5.3), there is a low strike or impingement risk for sea turtles from Project vessels. Impacts would only result if there was a strike or impingement of an individual during the approximate 18-month period each for construction and decommissioning, and impacts are therefore considered ***direct*** and ***short-term***.

Lighting

Artificial lighting during RWF construction and decommissioning will be associated with navigational and deck lighting on Project vessels from dusk to dawn. Reaction of sea turtles to this artificial light is dependent on species-specific and environmental factors that are impossible to predict but likely are to include attraction or avoidance of a lighted area. The primary source of artificial lighting associated with the Project would likely originate from construction and decommissioning vessels used for foundation installation and removal, which will generally transit to the RWF and remain there throughout the duration of construction and decommissioning. Because of the low anticipated density of sea turtles in the area, the limited area associated with the artificial lighting used on Project vessels relative to the surrounding unlit areas, and the relatively short duration of construction and decommissioning activities (approximately 18-months each), impacts are considered ***direct*** and ***short-term*** for sea turtles.

Operations and Maintenance

IPFs resulting in potential impacts on sea turtles in the RWF area during the O&M phase are summarized in Table 4.3.5-4. Only IPFs with the potential to result in impacts on sea turtles are included. Additional details regarding these potential impacts from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.3.5-4 IPFs and Potential Levels of Impact on Sea Turtles at the RWF During O&M

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Vessel anchoring and Jack-up; IAC and OSS-Link Cable Maintenance	Direct short-term
Habitat Alteration	Presence of the RWF Foundations, Scour Protection, and IAC and OSS-Link Cable Protection	Direct/indirect long-term
Sediment Suspension and Deposition	Vessel anchoring and Jack-up; IAC and OSS-Link Cable Maintenance	Direct short-term
Noise	WTG Noise	Direct long-term
	DP Vessel Noise	Direct short-term
	Aircraft Noise	Direct short-term
Electric and Magnetic Fields	IAC and OSS-Link Cable Operations	Direct long-term
Vessel Traffic	Vessel Strike	Direct long-term
Visible Structures	Presence of RWF Foundations	Direct long-term
Lighting	Navigational and Deck Lighting; WTG and OSS Lighting	Direct long-term

Seafloor Disturbance

Seafloor disturbance during O&M of the RWF will primarily result from vessel anchoring and jack-up, and any maintenance activities that will require exposing the IAC and OSS-Link Cable. Both activities are expected to be non-routine events and not expected to occur with any regularity. Although maintenance activities will occur throughout the 20- to 35-year life of the Project, seafloor disturbance resulting from vessel activity during RWF O&M are expected to be similar to, but on a smaller scale than vessel-related seafloor impacts described for the construction and decommissioning phases due to the intermittent nature of these activities. Impacts are therefore considered ***direct*** and ***short-term.***

Habitat Alteration

The presence of the RWF foundations, scour protection, and IAC and OSS-Link Cable protection will create three-dimensional hard-bottom habitats resulting in a reef effect that is expected to attract numerous species of algae, shellfish, finfish, and sea turtles to this site (Langhamer, 2012; Reubens et al., 2013; Wilhelmsson et al., 2006). The operational footprint of the WTG foundations is estimated to be up to 70 ac (28.3 ha), and the footprint of the OSS foundations is estimated to be up to 2 ac (0.8 ha), which would create up to 72 ac (29 ha) of heterogeneous habitat while the RWF is operational. Sea turtles have been observed within the vicinity of offshore structures, such as oil platforms (i.e., visible structures) foraging and resting under the platforms (Klima et al., 1988). High concentrations of sea turtles have been reported around these oil platforms (NRC, 1996) and during a surface survey at a platform off the coast of Galveston, Texas, approximately 170 sightings were reported (Gitschlag, 1990).

Artificial habitat created by these offshore structures can provide multiple benefits for sea turtles, including foraging habitats, shelter from predation and strong currents, and methods of removing biological build-up from their carapace (Barnette, 2017; NRC, 1996). It is estimated that offshore petroleum platforms in the Gulf of Mexico, provided an additional 2,000 mi^2 (5,180 km^2) of hard-bottom habitat (Gallaway, 1981). Wakes created by the presence of the foundations may influence distributions of drifting jellyfish aggregations; however, since other prey species available to sea turtles will not be affected by these wakes impacts on sea turtle foraging are not expected to be substantial (Kraus et al., 2019).

The increased fish aggregations around the foundations and scour protection is also expected to attract commercial and recreational fishing to the area, which could pose an inadvertent threat to sea turtles through entanglement or ingestion of fishing gear. Greater fishing effort around this site would increase the amount of equipment in the water increasing the risk of sea turtles ingesting or becoming entangled in this discarded equipment (Barnette, 2017). Turtles with increased habitat and foraging opportunities could potentially remain in the area longer than they typically would and become susceptible to cold stunning or death, although there is no quantitative evidence of this. Impacts would be expected during the entire 20-35 year operational life of the RWF. Impacts from the habitat created by the foundations and the range of potential effects, including habitat use by ancillary human activity, may result in impacts to sea turtles that are considered both ***direct*** and ***indirect,*** and ***long-term***.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during O&M will primarily result from vessel anchoring and jack-up, and any maintenance activities that will require exposing the IAC and OSS-Link Cable which may temporarily increase turbidity in water column. Both activities are expected to be non-routine events and not expected to occur with any regularity. Sediment suspension and deposition impacts resulting from vessel activity during RWF O&M are expected to be similar to vessel-related sediment suspension and deposition impacts described for the construction and decommissioning phases due to the intermittent nature of these activities and are therefore considered ***direct*** and ***short-term***.

Noise

- **Non-impulsive Sound – Wind Turbine Generator Noise**

Potential impacts on sea turtles from operational noise produced by the WTGs may include avoidance of the RWF, disorientation, and disruption of feeding behaviors (MMS, 2007). In contrast to the short-term duration of construction activities, noise generated during normal operation will persist over the operational life of the Project (i.e., approximately 20-35 years). Adults and juveniles have strong enough swimming abilities to avoid the operational noises of the RWF, but hatchlings passively traveling through the area on currents may not be able to actively leave, thus subjecting them to long-term exposure to WTG noise (MMS, 2007).

Available data on hearing sensitivities in sea turtles suggest they are able to detect low frequency noises below 1 or 2 kHz (Bartol and Ketten, 2006; Bartol et al., 1999; Dow Piniak et al., 2012a; Dow Piniak et al., 2012b; Martin et al., 2012; Piniak et al., 2016). Measurement of operational WTG noise show between 3 and 10 dB increases in SPL in frequencies below 100 Hz, and maximum SPL occurred at 50, 160, and 200 Hz (Thomsen et al., 2006; HDR, 2019). Given this information, it is likely sea turtles may be able to detect WTG noise. However, analysis of recent data collected for BIWF concluded that measured SPL were generally below 120 dB re 1 µPa 50 m (164 ft) from WTGs except at wind speeds greater than 13 m/sec (HDR, 2019). The current acoustic threshold for behavioral responses in sea turtles is an SPL of 175 dB re 1 µPa (Blackstock et al., 2018). Therefore, even if sea turtles are able to detect WTG noise, it is unlikely they will experience behavioral disturbances as a result.

Additionally, the presence of the RWF foundations is expected to create beneficial foraging and sheltering habitat (see *Habitat Alteration* section). While the impacts of long-term noise exposure on sea turtles is generally unknown, the sound levels produced during operation are expected to be less than the behavioral and physiological thresholds for sea turtles, so it is unlikely long-term avoidance of the RWF and surrounding area will occur. If such avoidance of the RWF occurs, impacts on sea turtles would be considered ***direct*** and ***long-term.***

- **DP Vessel Noise**

Throughout the 20-35 year operational life of the RWF, Project vessels will undergo routine maintenance trips between potential ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland and the RWF. It is not anticipated that all the vessels used for maintenance will use DP thrusters and noise produced by these vessels may be masked by other anthropogenic activity in the area. However, should vessels with DP thrusters be used, impacts would be similar to those described for construction and decommissioning of the RWF due to the intermittent use of these vessels expected: ***direct*** and ***short-term***.

› **Non-impulsive Sound – Aircraft Noise**

Helicopters may be used for crew changes intermittently throughout the 20-35 year operational life of the Project. As discussed for construction and decommissioning, noise from helicopters has the potential to propagate through the water at amplitudes may be detectable by sea turtles and could cause behavioral responses in some species. However, all aircraft activities will also comply with current approach regulations for any sighted sea turtle and given the environmental protection measures in place for all Project aircrafts and the intermittent use of helicopters during O&M, impacts are considered ***direct*** and ***short-term***.

Electric and Magnetic Fields

Sea turtles are highly migratory species and undergo trans-oceanic migrations during certain periods of their lives. Hatchlings swim from beaches into open ocean, juveniles migrate to and from seasonal habitats, and adults will leave feeding grounds to mate and migrate back to their natal beaches (Lohmann et al., 1999). To navigate and orient themselves, sea turtles are known to use the earth's magnetic fields. Sea turtles possess the ability to detect two different features of the geomagnetic field, including inclination angle and intensity (Lohmann and Lohmann, 1994). These fields vary across the earth's surface, and turtles can derive positional information from these fields.

It is theorized that sea turtles use these fields in two different ways (1) as a magnetic compass, for directional sense that enables them to establish a heading and maintain their course; and (2) for positional information, where turtles can approximate their position within the ocean (Lohmann and Lohmann, 1996). Multiple studies have demonstrated magneto-sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4,000 microteslas (μT) and 29.3 to 200 μT for loggerheads and green turtles, respectively (Normandeau, 2011).

Despite the potential for sea turtle orientation to be impacted by specific magnetic fields, available evidence for sea turtles does not indicate that these species are capable of detecting the magnetic fields associated with the Project's 60-Hz AC cables, or that their ability to navigate through the region would be substantially affected. Luschi et al. (1996) placed magnets on the head of sea turtles to mask the earth's magnetic fields from the sea turtles. Results showed that sea turtles with the magnets were still capable of returning home; however, their routes were less direct than the control group (Luschi et al., 1996; Normandeau, 2011). Appendix Q1 provides a more detailed discussion about the potential impacts of EMF on marine life.

Sea turtles could encounter EMF from the IAC and OSS-Link Cable if feeding on benthic organisms in the RWF at the sediment surface above the cable. Because these species must surface to breathe, such behavior is expected to limit time spent near cables. Furthermore, the broad scale of sea turtle migrations and the generally low density of individuals within a given area are also expected to lower the likelihood that individuals will regularly encounter Project-associated EMF. This broad distribution and movement also mean that the RWF represents a very small portion of the available habitat for migratory sea turtles. However, EMF produced by the IAC and OSS-Link Cable will be present throughout the entire 20- to 35-year life of the Project. The impact of EMF on sea turtles during O&M is therefore considered ***direct*** and ***long-term***.

Vessel Traffic

Vessels used during O&M of the RWF will generally be smaller than those used during construction and decommissioning. O&M vessels will primarily consist of DP service vessels and crew transfer vessels, except in the rare event major maintenance is required for any of the RWF components in which case larger jack-up vessels and barges may be used (Section 3.0). The number of vessels used for routine maintenance trips will be smaller than those used for construction and decommissioning or non-routine maintenance, but the activity will occur over a longer period considering the 20- to 35-year operational life of the Project. Annual maintenance will be required for the WTGs and foundations, and because up to 100 WTGs and two OSSs may be installed for the RWF, more trips are expected during O&M compared to construction and decommissioning. However, the implementation of vessel strike avoidance measures (NMFS, 2008) implemented for marine mammals will also serve to reduce the risk of collisions with sea turtles in the Project Area. In the unlikely event that a strike occurs injury or mortality would result in the removal of that animal from the population; however, the impacts resulting from the removal of an individual in a population that is listed as Threatened or Endangered is countered by their overall resilience to population-level impacts. With the implementation of environmental protection measures outlined in Section 4.3.4.3 there remains a low risk of vessel strikes to sea turtles. Due to the anticipated duration of the O&M period, impacts from vessel traffic are considered ***direct*** and ***long-term***.

Visible Structures

Structural elements of the RWF will be present for the 20-35 year operational life of the Project. As discussed for construction and decommissioning, if and how sea turtles perceive or avoid the physical presence of the structures is not well understood. However, only ***direct*** and ***long-term*** impacts on sea turtles due to the physical impediments to their movements during the O&M phase are expected.

Lighting

Artificial lighting during O&M will be associated with Project vessels, the WTGs, and the OSS. Lighting on the WTG foundations and the OSS will be coordinated with the USCG to meet appropriate safety standards and to minimize potential impacts on marine organisms. Similar to construction and decommissioning, it is likely that reaction of sea turtles to this artificial light is species-dependent and may include attraction or avoidance of an area. Additionally, only a limited area would be associated with the artificial lighting used on Project vessels, the WTGs, and the OSS relative to the surrounding unlit areas. Because lighting associated with the Project will be present throughout the 20- to 35-year life of the RWF, the impacts are considered ***direct*** and ***long-term*** for sea turtles during O&M.

Revolution Wind Farm Export Cable

Composition of sea turtle species and the operational context of Project activities are not likely to vary substantially between the RWEC–OCS and RWEC–RI. The only Project activity that will differ between the two RWEC areas is vibratory pile driving, which will occur in nearshore waters as the cable approaches the landfall at Quonset Point in North Kingstown, Rhode Island and therefore only be applicable to the RWEC–RI. As discussed in Section 4.3.5.1, nesting is not expected to occur near the Onshore Facilities and the distribution of sea turtle species is not likely to vary substantially between the RWEC–OCS and RWEC–RI. Potential impacts would, therefore, be the same between these two areas and the discussion provided in the following subsections applies to both.

Based on the IPFs discussed in Tables 4.3.5-5 and 4.3.5-6, during construction and decommissioning of the RWEC ***direct***, ***short-term*** impacts on sea turtles are expected to occur from seafloor disturbance, habitat alteration, sediment suspension/deposition, noise, discharges and releases, trash and debris, visible structures, lighting, and vessel traffic. During O&M of the RWEC, ***direct***, ***short-term*** and ***long-term*** impacts on sea turtles may occur from seafloor disturbance, habitat alteration, sediment suspension/deposition, noise, EMF, and vessel traffic. ***No impacts*** are expected from discharges and releases, trash and debris, visible structures, and lighting during O&M of the RWEC. The potential impacts associated with each phase of the RWEC are addressed in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on sea turtles in the RWEC area from the construction and decommissioning phases are summarized in Table 4.3.5-5. As discussed previously, the impacts discussed in this section apply to both the RWEC-OCS and RWEC-RI. Only IPFs with the potential to result in impacts on sea turtles are included. Additional details regarding potential impacts on sea turtles from the various IPFs during construction/decommissioning of the RWEC are described in the following section.

Table 4.3.5-5 IPFs and Potential Levels of Impact on Sea Turtles at the RWEC During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor	RWEC Installation and Removal	Direct short-term
Habitat Alteration	RWEC Installation and Removal	Direct short-term
Sediment Suspension and Deposition	RWEC Installation and Removal	Direct short-term
Noise	Vibratory Pile Driving of Sheet Piles for Cofferdam[1]	Direct short-term
	DP Vessel Noise; Cable-laying Equipment Noise	Direct short-term
	Geophysical Surveys	Direct short-term
Discharges and Releases/Trash and Debris	Construction and Decommissioning Vessels/Equipment	Direct short-term
Vessel Traffic	Vessel Strike	Direct short-term
Lighting	Navigational and Deck Lighting	Direct short-term

1 Vibratory pile driving of sheet piles for cofferdam would only occur in RI state waters; no vibratory pile driving is expected to occur in segments of the RWEC–OCS.

Seafloor Disturbance and Habitat Alteration

Seafloor disturbances associated with installation and removal of the RWEC may impact sea turtles by disrupting availability of benthic prey species which may also alter the existing habitat. The RWEC will be buried to a target depth of 4 to 6 ft (1.2 to 1.8 m), and cable protection applied as determined necessary by a Cable Burial Feasibility Assessment. Following installation or removal of the RWEC the environment is expected to return to near baseline conditions over time. The presence of the cable protection would result in minimal changes to the existing habitat, due to the up to 131 ft (40 m) wide disturbance footprint along the 50 mi (80 km) long corridor estimated per cable (Table 3.3-6), introducing some hard-bottom habitat along the RWEC corridor that would not extend into the water column and would be comparable to existing areas where boulders are present (Section 3.1). Impacts on sea turtles would result primarily from displacement of benthic prey species and temporary loss of habitat within the RWEC area during construction and decommissioning periods (approximately 8-months each) which are anticipated to be ***direct*** and ***short-term***.

Sediment Suspension and Deposition

Installation and removal of the RWEC may result in localized increases in suspended sediment and therefore decreased visibility and water quality around the RWEC. However, as with construction and decommissioning of the RWF, sediments are anticipated to settle rapidly, and water column concentrations within the majority of the RWEC area will return to pre-construction/ decommissioning conditions within an approximate 8-hour period (RPS, 2020). Impacts to the few transiting individual sea turtles in the region that could be exposed to sediment suspension and the resulting increases in turbidity during construction and decommissioning of the RWEC are expected to be ***direct*** and ***short-term***.

Noise

- **Non-impulsive Sound – Vibratory Pile Driving**

  Construction of a cofferdam will be required for the nearshore RWEC connection and will require vibratory pile driving of sheet piles (Section 3.3.3). This installation differs from the impact pile driving for RWF foundations because the location is close to shore, the duration of the installation is estimated to be short (up to 3 days), and the source type is non-impulsive. Both the propagation characteristics of vibratory pile driving of sheet piles and the threshold criteria for sea turtles are different than for the impact pile driving of the RWF foundations.

  No injury or mortality is expected, and behavioral exposures are considered unlikely. If behavioral exposures occur, behavioral responses are expected to be temporary, short-term, and would not affect the reproduction, survival, or recovery of Threatened or Endangered species. Impacts are limited to the sound produced and propagated through the water during vibratory pile driving only during the approximate 3-day installation period and are therefore considered ***direct*** and ***short-term.*** Vibratory pile driving noise may have no affect depending on the season in which this activity would take place. Winter and spring have relatively low densities of sea turtles in the area and would reduce the potential for exposure to noise above behavioral impact thresholds to near zero.

- **Non-impulsive Sound – DP Vessel Noise**

  As described for the RWF, the impacts of underwater noise generated by Project vessels are not anticipated to affect sea turtles, given the nominal contribution to existing vessel traffic and noise in the region. The use of DP vessels is the predominant noise producing activity during RWEC installation or removal that may impact sea turtles. Cable-laying equipment would produce similar noise to DP vessel activity and is therefore expected to result in similar impacts.

  The likelihood of sea turtles being exposed to potentially disruptive noise levels due to DP vessel activity decreases for sea turtles occurring in shallow waters as the cable laying operation enters Rhode Island waters due to the relatively low occurrence of sea turtles in Rhode Island (Kenney and Vigness-Raposa, 2010; NMFS, 2019b). The impact on sea turtles exposed to DP vessel noise would only occur while the limited number of DP vessels are operating during the period installation and removal activities (approximately 8-months each). The impact for DP vessel noise on sea turtles during RWEC construction and decommissioning is considered ***direct*** and ***short-term***.

- **Impulsive and Non-impulsive Sound – Geophysical Surveys**

  As discussed previously for RWF construction, geophysical surveys will be conducted to identify any seabed obstructions or MEC/UXOs prior to cable-laying activities. Impacts during installation of the RWEC will be similar to those discussed for construction of the RWF, as any MEC/UXOs identified during the surveys will be removed or relocated using low-noise methods designed to avoid potential detonation of the device. Therefore, impacts would only occur due to noise produced by survey equipment, and given the relatively short, approximate 8-month installation period of the RWEC during which surveys would occur impact are considered **direct** and **short-term**.

Discharges and Releases/Trash and Debris

The potential for sea turtle exposure and impacts from routine and non-routine discharges, releases, trash, and debris will be similar to those identified for the RWF (***direct*** and ***short-term***).

Vessel Traffic

The degree of potential impacts of vessel traffic on sea turtles during construction of the RWEC will be less than those discussed for the RWF because fewer anticipated vessels will be involved in RWEC construction and the activities will occur closer to shore as the RWEC approaches Rhode Island State Waters which will shorten the travel distance for Project vessels. In the unlikely event that a strike occurs and results in injury or mortality, impacts would result in removal of those individuals from the population. The impacts resulting from the removal of an individual in a population that is listed as Threatened or Endangered is countered by their overall resilience to population-level impacts. However, as previously discussed for the RWF, with the implementation of environmental protection measures (Section 4.3.5.3) and the relatively short duration of construction and decommissioning (approximately 8-months each), impacts on sea turtles are considered ***direct*** and ***short-term***.

Lighting

Artificial lighting during construction and decommissioning of the RWEC will be associated with navigational and deck lighting on vessels from dusk to dawn. Because of the limited area associated with the artificial lighting used on Project vessels relative to the surrounding unlit areas and the relatively short duration of installation and removal activities, the impacts will be similar to those from RWF construction and decommissioning and are considered ***direct*** and ***short-term***.

Operations and Maintenance

IPFs resulting in potential impacts on sea turtles in the RWEC area from the O&M phase are summarized in Table 4.3.5-6. As discussed previously, the impacts discussed in this section apply to both the RWEC-OCS and RWEC-RI. Only IPFs with the potential to result in impacts on sea turtles are included. Additional details regarding potential impacts on sea turtles from the various IPFs during O&M of the RWEC are described in the following sections.

Table 4.3.5-6 IPFs and Potential Levels of Impact on Sea Turtles at the RWEC During O&M

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Potential RWEC Maintenance	Direct short-term
Habitat Alteration	Potential RWEC Maintenance	Direct, short-term
Sediment Suspension and Deposition	Potential RWEC Maintenance	Direct, short-term
Noise	DP Vessel Noise	Direct, short-term
Electric and Magnetic Fields	RWEC Operations	Direct, long-term
Vessel Traffic	Vessel Strike	Direct, long-term

Seafloor Disturbance and Habitat Alteration

Maintenance of the RWEC which requires uncovering and reburial of the cable is considered a non-routine event and is not expected to occur with any regularity. Routine maintenance activities associated with the RWEC are not expected to result in seafloor disturbances during O&M. The RWEC will be buried beneath the sediment, except for locations where cable protection is deemed necessary by a Cable Burial Feasibility Assessment and is therefore not expected to significantly alter the existing habitat. As discussed for construction and decommissioning of the RWEC the only potential impact on sea turtles would be the disruption of benthic prey species and temporary loss of habitat. With the availability of habitat and prey within the region outside the RWEC area, no long-term impacts are expected by the localized disturbance. Given the relatively small area of seafloor that would be disturbed and the temporary nature of the alteration if maintenance of the RWEC is required impacts on sea turtles from seafloor disturbances during O&M are considered ***direct*** and ***short-term***.

Sediment Suspension and Deposition

Increases in sediment suspension and deposition during O&M of the RWEC will primarily result from vessel anchoring and any maintenance activities that will require exposing the RWEC. Both activities are expected to be non-routine events and not expected to occur with any regularity. Although maintenance activities would occur throughout the 20- to 35-year life of the Project, sediment suspension and deposition impacts resulting in increased turbidity from vessel activity during O&M of the RWEC are expected to be similar to vessel-related impacts described for the RWEC construction and decommissioning phases (i.e., ***direct*** and ***short-term***), but less frequent and at a smaller scale.

Noise

Direct impacts to sea turtles associated with noise during O&M of the RWEC may result from DP vessel noise during routine maintenance trips. However, due to relatively low sound levels produced by DP vessels (Denes et al., 2020) and relatively low densities of sea turtles expected in the Project Area (Appendix Z), it is unlikely sea turtles will experience behavioral disturbance due to DP vessel noise. DP vessels operating in a station-keeping mode which produce the greatest sound levels are expected to occur infrequently along the RWEC. Impacts from vessel noise during O&M of the RWEC are therefore expected to be similar to vessel noise impacts described for O&M of the RWF: ***direct*** and ***short-term***.

Electric and Magnetic Fields

The potential EMF impacts from the RWEC on sea turtles are similar to that described for the RWF IAC and OSS-Link Cable. There is a risk of impact because of the low density of sea turtles in the area, their habit of surfacing for air, and the relatively narrow corridor occupied by the RWEC. Impacts to sea turtles are considered ***direct*** and ***long-term,*** as EMF produced by the RWEC will be present throughout the entire 20- to 35-year life of the Project.

Vessel Traffic

The potential impacts of vessel collision will be similar to those identified for O&M of the RWF. Due to lower animal densities in the RWEC area, the limited, intermittent use of smaller vessels along the RWEC, and implementation of vessel strike avoidance measures and environmental protection measures (Section 4.3.5.3), there is a low risk of vessel strikes. An impact to sea turtles would only occur if there was a vessel strike during the O&M period. Because maintenance activities will occur throughout the 20-35 year operational life of the Project, impacts are therefore considered ***direct*** and ***long-term***.

4.3.5.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following measures to avoid, minimize, and mitigate potential impacts on sea turtles. These measures are based on protocols and procedures successfully implemented for similar offshore projects.

› Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and vibratory pile driving activities.

› Mitigation measures will be implemented for impact and vibratory pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, protected species monitoring protocols, and use of qualified and NOAA-approved protected species observers and NMS such as bubble curtains, as appropriate.

- Vessels will follow NOAA guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions.
- All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness.
- Revolution Wind will require all construction and operation vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (see Appendix D).
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Feasibility Assessment

4.3.6 Avian Species

This section provides an overview of the species of birds that have the potential to be affected by the offshore portions of the RWF, RWEC–OCS, RWEC–RI, and the Onshore Facilities. The Project Area discussed herein for the offshore portion of work includes the Project Lease Area, the RWEC–OCS, and the RWEC–RI. The Project Area for the onshore portion of work includes the Onshore Facilities (refer to Table 4.0-1 in Section 4.0 for Project Area definitions). The discussion of the affected environment for avian species is followed by an evaluation of potential Project-related impacts and a summary of environmental protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to these resources.

The description of the affected environment and assessment of potential impacts for avian species were determined by reviewing publications and public data sources. The primary sources used include, but are not limited to, the following: RIDEM RI WAP (RIDEM et al. 2015), The Natural Heritage Area data layer hosted on the RIDEM ERM (RIDEM 2019), USFWS Information for Planning and Consultation (IPaC) database (USFWS, 2019 and 2020), OSAMP surveys (RI CRMC 2010/2013), MDAT Marine Bird Abundance and Occurrence Models, Version 2 (Winship et al. 2018), Northwest Atlantic Seabird Catalog (managed by NOAA), and individual species tracking studies (diving birds [Spiegel et al. 2017]; sea ducks [multiple researchers]; falcons [DeSorbo et al. 2018b]; Red Knot [Loring et al. 2018]; Piping Plover [Loring et al. 2019a]; Roseate Tern [Loring et al. 2019a].

The following offshore sections summarize information from the Assessment of the Potential Effects of the RWF on Birds and Bats in Appendix AA and the onshore section summarizes information from the Onshore Natural Resources and Biological Assessment in Appendix K.

4.3.6.1 Affected Environment

Regional Overview

A broad group of avian species passes through the Lease Area and the surrounding region, including migrants (such as raptors and songbirds), coastal birds (such as shorebirds, waterfowl, and waders), and marine birds (such as seabirds and sea ducks). The diversity of marine bird species that use the Lease Area and surrounding region is due in part to location within the Mid-Atlantic Bight, a region where species that breed in both the Northern and Southern hemispheres overlap.

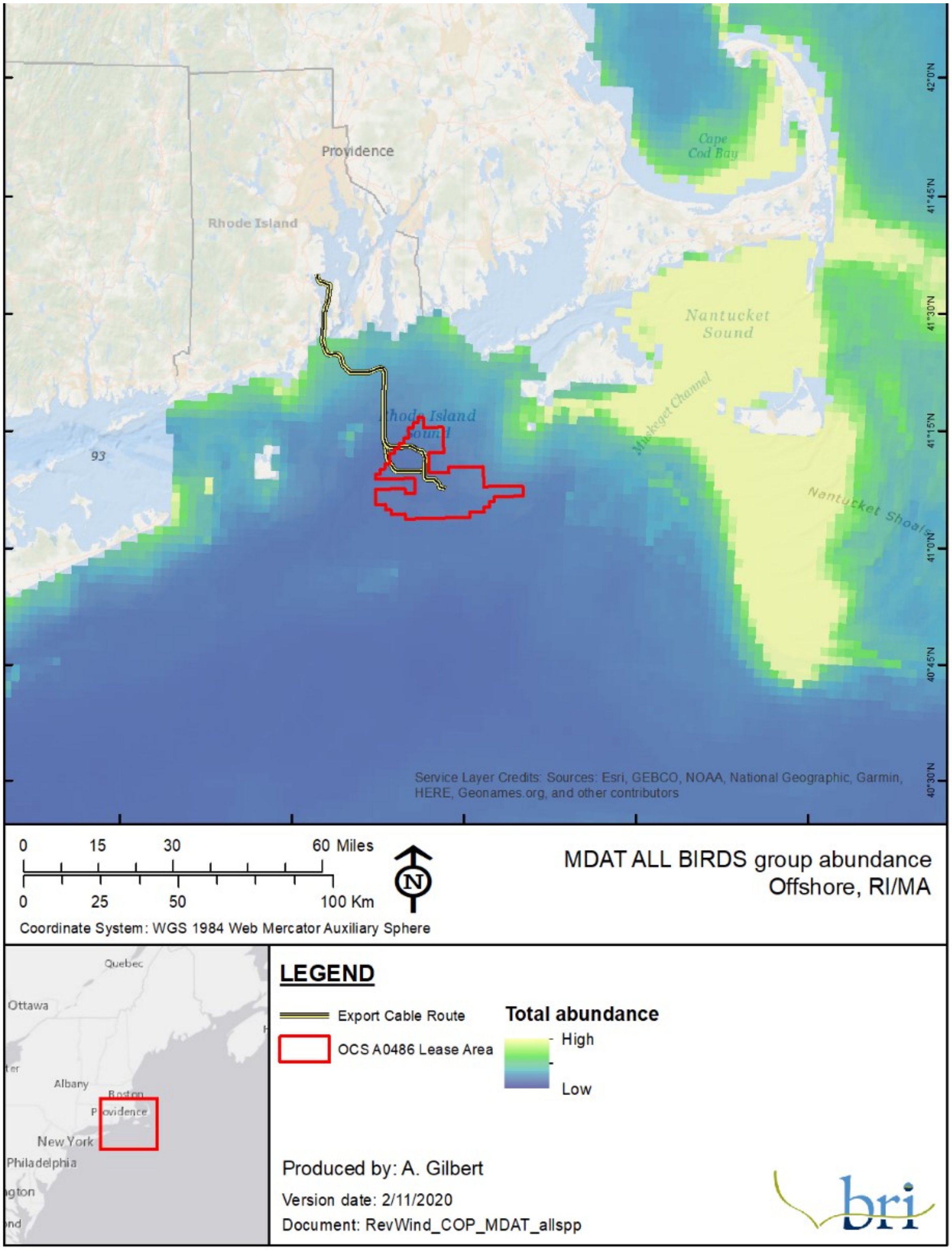
The Mid-Atlantic Bight is an oceanic region that reaches from Cape Cod, MA to Cape Hatteras, NC, and is characterized by a broad expanse of gently sloping, sandy-bottomed continental shelf. Within this region, the shelf extends up to 93 mi (150 km) offshore, where the waters reach about 650 ft (200 m) deep. Beyond the shelf edge, the continental slope descends rapidly to around ~10,000 ft (3,000 m). Most of the shallow coastal region is bathed in cool Arctic waters brought south by the Labrador Current. At the southern end of this region, around Cape Hatteras, these cool waters collide with the warmer waters of the Gulf Stream. The region exhibits a strong seasonal cycle in temperature, with sea surface temperatures spanning 37–86 °F (3–30 °C; Williams et al. 2015b). In general, seabird abundance is greater closer to shore and to the east of the Lease Area (Figure 4.3.6-1).

Many marine birds also make annual migrations up and down the eastern seaboard (e.g., gannets, loons, and sea ducks), taking them directly through the region in spring and fall. This results in a complex ecosystem where the community composition shifts regularly, and temporal and geographic patterns are highly variable. The region supports large populations of birds in summer, some of which breed in the area, such as coastal gulls and terns. Other summer residents, such as shearwaters and storm-petrels, visit from the Southern Hemisphere (where they breed during the austral summer). In the fall, many of the summer residents leave the area and migrate south to warmer regions and are replaced by species that breed further north and winter in the region.

Three species listed under the ESA occur in the region: Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus rufa*), and Roseate Tern (*Sterna dougallii*). The Atlantic population of Piping Plovers nests on beaches in the region and will also migrate (spring and fall) through the area to and from breeding sites. Red Knots winter in southern states or in Central or South America and pass through the region during migration in transit to and from Arctic breeding sites. Roseate Terns also fly through the area on their way to breeding sites in New England states and Atlantic Canada. One species proposed for listing under the ESA, the Black-capped Petrel, could potentially occur in the region, although they are generally associated with deeper waters and are usually observed beyond the shelf break.

The following subsections describe the affected environment for avian resources for the RWF, RWEC–OCS, RWEC–RI, and Onshore Facilities. For the purposes of the discussion that follows, 'offshore' is defined as waters beyond 3 nm (5.6 km) from land, and 'nearshore' is within 3 nm (5.6 km) of land.

Figure 4.3.6-1 Bird Abundance Estimates (All Species) from the MDAT Models



Revolution Wind Farm

Offshore waters provide foraging habitat for seabirds and transit areas for migratory birds. The RWF is proposed in deep water (approximately 20 mi (17.4 nm, 30 km) south of the coast of Rhode Island) where there are no shallow banks, but fish, crustaceans, and other zooplankton are available at different depths. Table 4.3.6-1 summarizes species present or potentially present within the RWF, based on observations made during the OSAMP surveys, and a review of the USFWS's IPaC database. While not confirmed during OSAMP surveys, Piping Plover and Red Knot may pass through the Lease Area during migration. Brief descriptions of potentially occurring federally protected species are provided below; refer to Appendix AA for further information on the variety of species listed in Table 4.3.6-1 below.

Table 4.3.6-1 Avian Species Recorded Offshore of Rhode Island

Taxonomic Group	Species	OSAMP Survey		Federal Status			State (RI) Status[3]
		Aerial	Boat	IPaC	BCC[1]	ESA[2]	
Ducks, Geese, and Swans							
Brant	*Branta bernicla*	•					
Canada Goose	*Branta canadensis*		•				
Mallard	*Anas platyrhynchos*		•				
Sea Ducks							
Black Scoter	*Melanitta americana*	•	•	•			
Common Eider	*Somateria mollissima*	•	•	•			
Long-tailed Duck	*Clangula hyemalis*		•	•			
Red-breasted Merganser	*Mergus serrator*		•	•			
Surf Scoter	*Melanitta perspicillata*	•	•	•			
White-winged Scoter	*Melanitta fusca*	•	•	•			
Grebes							
Red-necked Grebe	*Podiceps grisegena*		•				
Shorebirds							
Short-billed Dowitcher	*Limnodromus griseus*		•		•		
Semipalmated Plover	*Charadrius semipalmatus*		•		•		
Whimbrel	*Numenius phaeopus*		•				
Phalaropes							
Red Phalarope	*Phalaropus fulicarius*		•				
Red-necked Phalarope	*Phalaropus lobatus*		•				

Taxonomic Group	Species	OSAMP Survey		Federal Status			State (RI) Status[3]
		Aerial	Boat	IPaC	BCC[1]	ESA[2]	
Skuas and Jaegers							
Pomarine Jaeger	*Stercorarius pomarinus*		•	•			
South Polar Skua	*Stercorarius maccormicki*			•			
Auks							
Atlantic Puffin	*Fratercula arctica*		•	•			
Common Murre	*Uria aalge*	•		•			
Dovekie	*Alle alle*	•	•	•			
Razorbill	*Alca torda*	•	•	•			
Thick-billed Murre	*Uria lomvia*		•	•			
Small Gulls							
Bonaparte's Gull	*Chroicocephalus philadelphia*		•	•			
Medium Gulls							
Black-legged Kittiwake	*Rissa tridactyla*	•		•			
Laughing Gull	*Leucophaeus atricilla*	•					
Ring-billed Gull	*Larus delawarensis*		•	•			
Large Gulls							
Great Black-backed Gull	*Larus marinus*	•	•	•			
Herring Gull	*Larus argentatus*	•	•	•			
Medium Terns							
Common Tern	*Sterna hirundo*		•	•			
Roseate Tern	*Sterna dougallii*		•			E	SH
Loons							
Common Loon	*Gavia immer*	•	•	•			
Pacific Loon	*Gavia pacifica*		•				
Red-throated Loon	*Gavia stellata*	•	•	•	•		
Storm-Petrels							
Wilson's Storm-Petrel	*Oceanites oceanicus*	•	•	•			
Petrels and Shearwaters							
Cory's Shearwater	*Calonectris diomedea*	•		•			

Taxonomic Group	Species	OSAMP Survey		Federal Status			State (RI) Status[3]
		Aerial	Boat	IPaC	BCC[1]	ESA[2]	
Great Shearwater	*Ardenna gravis*	•		•	•		
Northern Fulmar	*Fulmarus glacialis*	•		•			
Sooty Shearwater	*Ardenna grisea*	•					
Manx Shearwater	*Puffinus puffinus*			•			
Gannets							
Northern Gannet	*Morus bassanus*	•	•	•			
Cormorants							
Great Cormorant	*Phalacrocorax carbo*		•				
Double-crested Cormorant	*Phalacrocorax auritus*			•			
Herons and Egrets							
Great Blue Heron	*Ardea herodias*		•				C
Raptors							
Merlin	*Falco columbarius*		•				
Passerines (perching birds, songbirds)							
Bank Swallow	*Riparia riparia*		•				
Barn Swallow	*Hirundo rustica*		•				
Blackpoll Warbler	*Setophaga striata*		•				
Chimney Swift	*Chaetura pelagica*		•				
Dark-eyed Junco	*Junco hyemalis*		•				C
Gray Catbird	*Dumetella carolinensis*		•				
Mourning Dove	*Zenaida macroura*		•				
Ruby-throated Hummingbird	*Archilochus colubris*		•				
Savannah Sparrow	*Passerculus sandwichensis*		•				
Snow Bunting	*Plectrophenax nivalis*		•				
Tree Swallow	*Tachycineta bicolor*		•				
Yellow-rumped Warbler	*Setophaga coronata*		•				

All species listed are protected by the Migratory Bird Treaty Act (MBTA)

1 BCC = Birds of Conservation Concern 2008; birds listed for Bird Conservation Region (BCR) 30

2 E = Endangered, T = Threatened, SC = Special Concern

3 SH = State Historical, C = Concern

- **Piping Plover:** The Piping Plover, a small shorebird, nests on beaches along the Atlantic coast, around the Great Lakes, and in the Midwestern plains (Elliott-Smith and Haig 2004), and winters in the coastal southeastern U.S. and the Caribbean (Elliott-Smith and Haig 2004, USFWS 2009, BOEM 2014). The Atlantic subspecies (C. m. melodus) is listed as Threatened under the ESA and is heavily managed to promote population recovery (Elliott-Smith and Haig 2004). Piping Plovers breed in Rhode Island and are present during spring and fall migratory periods (RIDEM et al. 2015).

- **Red Knot:** The Red Knot, a medium-sized shorebird, undertakes non-stop migratory flights of up to 5,000 mi (8,000 km; Baker et al. 2013). This species breeds in the High Arctic, wintering in the southeastern U.S., Caribbean, Northern Brazil, and Tierra del Fuego–Argentina (Baker et al. 2013). The Atlantic flyway subspecies (C. c. rufa) is listed as Threatened under the ESA, due to a significant decline (approx. 70% from 1981 to 2012) to less than 30,000 individuals (Burger et al. 2011, Baker et al. 2013)3. The Red Knot is present in Rhode Island only during migratory periods (BOEM 2014).

- **Eagles:** The Bald Eagle is broadly distributed and generally nests in association with water (lakes, rivers, bays) in both freshwater and marine habitats (Buehler 2000). The Golden Eagle is generally associated with open habitats, particularly in the western U.S., but satellite-tracked individuals wintering in the eastern U.S. show heavy use of forested regions (Katzner et al. 2012). The general wing morphology of both species, and their reliance on thermal updrafts, dissuades long-distance movements in offshore settings (Kerlinger 1985). Bald Eagles are present year-round in Rhode Island and have been slowly increasing in numbers over the last 30 years or so.

- **Black-capped Petrel:** The Black-capped Petrel, a pelagic seabird, breeds in small colonies on remote forested mountainsides of Caribbean islands (Simons et al. 2013). During their breeding season (Jan–Jun), Black-capped Petrels travel long distances to forage over the deeper waters (~650–6,500 ft; 200–2,000 m) of the southwestern North Atlantic, the Caribbean basin, and the southern Gulf of Mexico (Simons et al. 2013). Outside the breeding season, they regularly spend time in U.S. waters, along the shelf edge of the South Atlantic Bight, commonly as far north as Cape Hatteras and occasionally beyond (Jodice et al. 2015) but are rarely seen offshore of Rhode Island.

- **Roseate Tern:** The Roseate Tern, a small seabird, breeds colonially on coastal islands of the northeastern U.S. and Atlantic Canada, winters in South America, primarily eastern Brazil (USFWS 2010, Nisbet et al. 2014). The Northwest Atlantic population is listed as Endangered under the ESA. Roseate Terns generally migrate through the region to and from their northwest Atlantic breeding colonies. Following breeding, they move to coastal staging areas and forage up to 10 mi (16 km) from the coast, though most foraging activity occurs much closer to shore (Burger et al. 2011a). Migration routes appear to be primarily well offshore (Nisbet 1984, USFWS 2010, Burger et al. 2011a, Mostello et al. 2014, Nisbet et al. 2014).

3 https://www.fws.gov/verobeach/StatusoftheSpecies.html

RWEC–OCS

The following summary focuses on avian groups documented or expected to occur in portions of the RWEC–OCS. The RWEC–OCS is primarily a pelagic environment, and bird species composition, distribution, seasonality, and resource base are likely to be similar to that described for the RWF. The RWEC–OCS is within federal offshore waters where a variety of pelagic and/or migratory bird species may seasonally occur. There are over ten species groups, described above for the RWF, that will have varying degrees of abundance around the RWEC–OCS depending upon the distance from shore, but overall the proposed route of the RWEC–OCS does not pass through high bird concentration areas (Figure 4.3.6-1). There are no shoals in the RWEC–OCS that could provide high value foraging habitat; however, small fish and zooplankton in the water column and benthic organisms, such as mollusks and crustaceans, may provide foraging opportunities for birds.

RWEC–RI

Generally, the avian species composition along the RWEC–RI will be similar to the RWEC–OCS, as described above. As the RWEC–RI approaches the landfall location at Quonset Point in North Kingstown, Rhode Island, coastal marine birds will come to dominate the species assemblages. Coastal birds typically forage within sight of land, while offshore species feed out of sight of land but within the Atlantic OCS. Truly pelagic species forage at the frontal zone along or beyond the continental shelf break (Furness and Monaghan 1987, Schrieber and Burger 2001, Gaston 2004), and thus will generally not use coastal waters and are unlikely to occur around the RWEC–RI. Shallower waters within the RWEC–RI will provide foraging opportunities for terns, particularly the Roseate Tern (which feeds on sand lance), as well as sea duck, loons, gulls, and cormorants. Terns, including Roseate Terns, and related species will forage over shallow waters and sand spits near shore in pursuit of small prey fish (Nisbet et al. 2017). Shorebirds, including the ESA listed Piping Plover and Red Knot, are unlikely to forage within the RWEC-RI because they rely on invertebrates, small crustaceans, bivalve mollusks, small polychaete worms, insects, and talitrid amphipods in intertidal zones (Macwhirter et al. 2002).

Onshore Facilities

A wide variety of passerines and other land birds use areas along Narragansett Bay for stopover locations for refueling, sheltering, and/or breeding opportunities during migration and have the potential to use habitat intersected by the proposed Onshore Facilities. Avian species that may breed in the coastal area include locally nesting marsh and wading birds using nearby coastal wetlands and common swallows, thrushes, corvids, warblers, sparrows, and blackbirds using residential, backyard, and small field habitats proximate to the proposed Onshore Facilities (Table 4.3.6-2). The Onshore Facilities are proposed within or adjacent to several Key Habitats defined in the RIWAP that have the potential to support migratory and breeding birds: coastal beach/dune, tidal salt marsh, ruderal forested swamp, oak forest, ruderal grassland/shrubland, mixed oak/white pine forest, and pitch pine barren (RIDEM et al. 2015). These Key Habitats have the potential to support bird species that have been identified as SGCN within the RI WAP (RIDEM et al. 2015). For example, tidal salt marshes are known to support SGCN such as Nelson’s Sparrow (*Ammodramus nelson*) and Seaside Sparrow (*Ammodramus maritimus*). Onshore field investigations were performed for the Project in July, August, and September 2019. The following SGCN species within Key Habitats intersected by the Onshore Facilities were observed: Osprey

(*Pandion haliaetus*), Snowy Egret (*Egretta thula*), and Canada Goose (*Branta canadensis*) between the coastal beach and tidal salt marsh and Gray Catbird (*Setophaga striata*), Yellow-rumped Warbler (*Setophaga coronate*), and American Redstart (*Setophaga ruticilla*) within the ruderal forested wetland. For a complete list of Key Habitat types that are within or adjacent to the Onshore Facilities and SGCN that were observed or have the potential to occur in these habitats see Attachment B of the Onshore Natural Resources and Biological Assessment in Appendix K. Based on review of the ERM, there are no state-listed rare, threatened or endangered species recorded within or immediately adjacent to the Onshore Project Area.

Table 4.3.6-2 Timing, Distribution, and Status of Avian Species Groups Likely to Occur within or Proximate to the proposed Onshore Facilities

Avian Group	Seasonal Use	Peak/Primary Seasons	Peak/Primary Location	Status near Coastal Shore/Inland
Loons	Migrant, winter resident	Fall, Winter	Offshore, nearshore	Common
Grebes	Migrant, winter resident	Winter	Nearshore	Occasional
Gannets	Migrant, winter resident	Spring, fall	Offshore	Uncommon
Cormorants[a]	Summer breeder; winter resident	Summer, fall	Nearshore	Common (exc. Great Cormorant, occasional in winter)
Sea ducks	Winter resident	Winter	Offshore, nearshore	Common
Geese, bay ducks, dabblers[b]	Migrant, winter resident	Fall, winter	Offshore, nearshore	Common
Shorebirds[c]	Breeding, migrant, winter resident	Spring, summer, fall	Nearshore, onshore	Common
Wading birds[d]	Breeding, migrant, winter resident	Spring, summer	Nearshore, onshore	Common
Gulls[e]	Breeding, migrant, winter resident	Spring, summer	Offshore, nearshore, onshore	Abundant
Kittiwakes	Winter resident	Winter	Offshore	Occasional
Terns[e]	Breeding, migrant	Summer, fall	Nearshore, onshore	Common
Land birds[f]	Breeding, migrant, winter resident	Spring, summer	Onshore	Common

Sources: Paton et al., 2010; O'Connell et al., 2011; Tetra Tech and DeTect, 2012; Veit et al., 2016; Sussman and USGS, 2014; and land-based field investigations conducting during July, August, and September 2019

a Observed cormorants include Double-crested Cormorant and Great Cormorant
b Observed geese and duck species: Canada Goose, Mallard
c Observed shorebird species: Killdeer.
d Observed wading bird species: Snowy Egret
e Observed gull species: Herring Gull, Ring-billed Gull,
f Observed land birds include raptors, herons, doves, and passerines.

Official Species Lists were requested from USFWS in September 2019 and January 2020 to further assess the presence of species listed under the federal ESA and any associated Critical Habitat within the footprint of the Onshore Facilities.

Critical Habitat is defined as specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection (USFWS 2020). Based on this information received from USFWS, the federally-endangered Northwest Atlantic population of Roseate Tern has the potential to occur within the areas to be occupied by the Onshore Facilities. Critical Habitat, as defined by the USFWS, is not designated in areas proposed for the Onshore Facilities.

The Northwest Atlantic population of roseate tern breeds in scattered colonies in the temperate northern Atlantic (Cornell Lab of Ornithology; USFWS 2011). Ninety percent of the roseate tern population breeds in the Cape Cod-Long Island area on rocky coastal islands, outer beaches, or salt marsh islands with protective vegetation to conceal nests (Veit and Petersen 1993; USFWS 2001). The Landfall Work Area does not support suitable breeding habitat for the roseate tern, therefore it is unlikely for this species to occur within the limits of the Onshore Facilities.

The IPaC database was also used to generate lists of bird species protected under the Migratory Bird Treaty Act (MBTA) that have been designated Birds of Conservation Concern (BCC) within the proposed limits of the Onshore Facilities. BCC are those species that without additional conservation actions are likely to become candidates for listing under the ESA (USFWS 2019). Table 4.3.6-3 provides the list of BCC with the potential to occur within the limits of the Onshore Facilities and indicates which of these species were observed during field investigations. The Official Species Lists, with all migratory bird species with potential to occur within proximity to the proposed Onshore Facilities as identified by USFWS, is included in Appendix K and Table 4.3.6-3.

Table 4.3.6-3 Bird Species Designated BCC that have the Potential to Occur within or Proximate to Proposed Onshore Facilities

Common Name	Scientific Name	Level of Concern	Time of year most likely to be present within the Project Area	Observed during field investigations?
American Oystercatcher	*Haematopus palliatus*	BCC[1]	Early May	No
Bald Eagle	*Haliaeetus leucocephalus*	Non-BCC[2]	Late April	No
Black-billed Cuckoo	*Coccyzus erythropthalmus*	BCC[1]	May through mid-June	No
Buff-breasted Sandpiper	*Calidris subruficollis*	BCC[1]	Late August	No
Canada Warbler	*Cardellina canadensis*	BCC[1]	Mid-Late May	No
Common Eider	*Somateria mollissima*	Non-BCC[2]	Mid-January and Mid-May	No

Common Name	Scientific Name	Level of Concern	Time of year most likely to be present within the Project Area	Observed during field investigations?
Common Tern	*Sterna hirundo*	Non-BCC[2]	Late June to early July; Late August to early September	No
Double-crested Cormorant	*Phalacrocorax auritus*	Non-BCC[2]	Early January; Late March through Mid-September; October through November	Yes
Great Black-backed Gull	*Larus marinus*	Non-BCC[2]	Year-round	No
Herring Gull	*Larus argentatus*	Non-BCC[2]	Year-round	Yes
Least Tern	*Sterna antillarum*	BCC[3]	Late June to early July	No
Northern Gannet	*Morus bassanus*	Non-BCC[2]	Mid-April	No
Prairie Warbler	*Dendroica discolor*	BCC[1]	May through early July	No
Red-breasted Merganser	*Mergus serrator*	Non-BCC[2]	November through June	No
Red-throated Loon	*Gavia stellata*	BCC[1]	Mid-May	No
Ring-billed Gull	*Larus delawarensis*	Non-BCC[2]	Year-round	Yes
Rusty Blackbird	*Euphagus carolinus*	BCC[1]	Late November	No
Semipalmated Sandpiper	*Calidris pusilla*	BCC[1]	Mid-late August	No
Short-billed Dowitcher	*Limnodromus griseus*	BCC[1]	Early July	No
Surf Scoter	*Melanitta perspicillata*	Non-BCC[2]	Early July	No
White-winged Scoter	*Melanitta fusca*	Non-BCC[2]	Early January, Late December	No
Wood Thrush	*Hylocichla mustelina*	BCC[1]	May through early July	No

1 Bird of Conservation Concern

2 Although not a BCC, it warrants attention due to the Eagle Act or potential susceptibilities in offshore areas from certain types of development activities

3 A bird of conservation concern only in particular Bird Conservation Regions in the continental US.

4.3.6.2 Potential Impacts

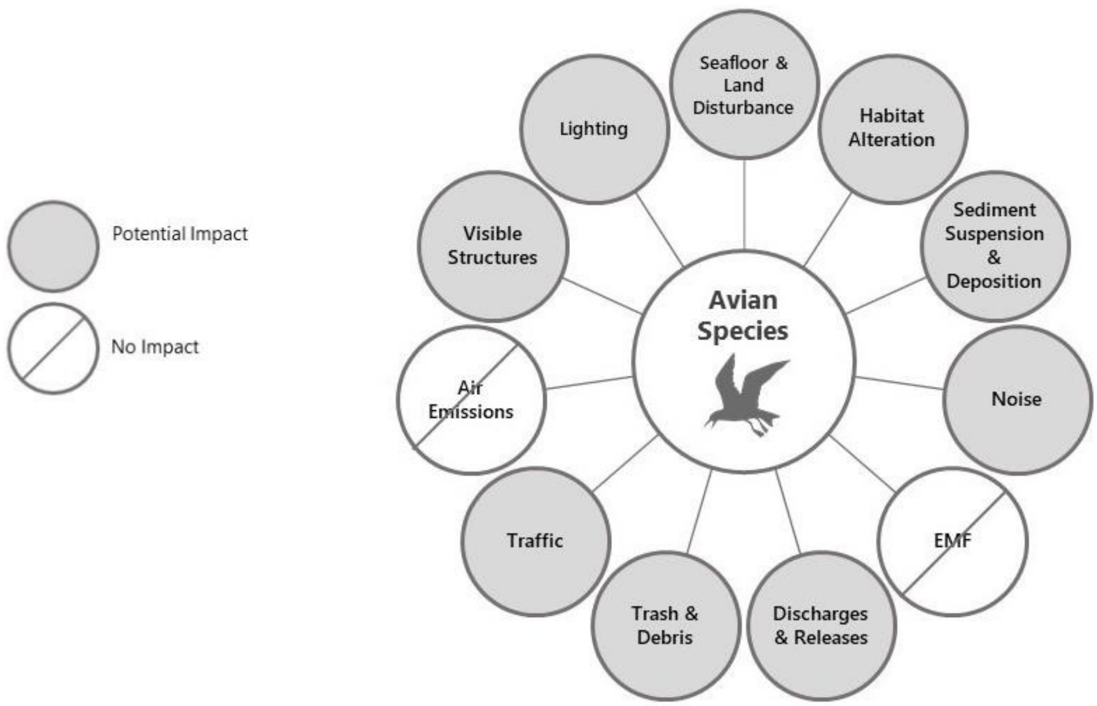
Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the variety of avian species that have the potential to occur within the Project Area, including migratory shorebirds, wading birds, raptors, songbirds, coastal waterbirds, and marine birds. This impact assessment uses a weight-of-evidence approach that includes an analysis of the exposure of birds to each specific

Project hazard (i.e., IPF), and behavioral vulnerability to the hazard. For protected species or species proposed for listing under the ESA, potential impacts were assessed individually for that species.

For the offshore Project Area, the primary IPF components that have the potential to affect birds relate to above water objects to be located within the Lease Area; these include vessels, lighting, WTGs, and OSSs. The primary potential effects of offshore wind farm construction and operation on birds are displacement from habitat and mortality from collision (Goodale and Milman 2016, Fox et al. 2019). Project activities below water, including but not limited to foundation and cable installation, are not expected to be a long-term hazard for birds (BOEM 2018) and are discussed briefly below.

IPFs that may result in direct or indirect impacts to avian species are depicted in Figure 4.3.6-2. Project activities that lead to mortality, injury (e.g., collision), or physical changes to food resources (e.g., seafloor disturbance) are considered direct impacts; while Project activities that lead to behavioral changes, changes in habitat use (e.g., displacement), or could affect fitness (e.g., ingestion of contaminants that reduce reproductive success) are considered indirect impacts. More detailed information regarding potential impacts on avian species offshore can be found in Appendix AA and onshore impacts are provided in Appendix K.

Figure 4.3.6-2 IPFs on Avian Species



Revolution Wind Farm

The IPFs associated with the RWF that could impact avian species include seafloor or land disturbance, habitat alteration, sediment suspension/deposition, noise, traffic, visible structures (i.e., WTGs), lighting, discharges/releases, and trash/debris. These IPFs have the potential to affect migratory birds (i.e., shorebirds, wading birds, raptors, songbirds, and coastal waterbirds), and marine birds (i.e., loons, sea ducks, petrels, shearwaters, storm-petrels, Northern Gannet, cormorants, gulls, skua, jaegers, terns, and auks), including potential impacts to listed or candidate species, including the Piping Plover (federally Threatened), Red Knot (federally Threatened), Least Tern (state Threatened), and Black-capped Petrel (candidate for federal listing). These species groups may breed, forage, and/or rest in the vicinity of the RWF. The potential impacts associated with these IPFs for each phase of the RWF are addressed separately in the following sections and each species group. This section summarizes the assessment of potential impacts on avian species presented in Appendix AA, which provides substantial back-up for the determinations.

Construction and Decomissioning

IPFs resulting in potential impacts on avian species in the RWF area from the construction and decommissioning phases are summarized in Table 4.3.6-4. Additional details regarding these potential impacts from the various IPFs during construction and decommissioning of the RWF are described in the following sections.

Table 4.3.6-4 IPFs and Potential Impact on Avian Species from the RWF During Construction and Decommissioning

Impact Producing Factor	Project Activity	Impact Characterization
Seafloor/Land Disturbance	WTG/OSS foundation and Inter-Array Cable/OSS Interconnector Cable installation	Direct, short-term
Habitat Alteration	WTG/OSS foundation and Inter-Array Cable/OSS Interconnector Cable installation	Direct, short-term
Sediment Suspension and Deposition	WTG/OSS foundation and Inter-Array Cable/OSS Interconnector Cable installation	Direct, short-term
Noise	Disturbance from pile driving and Inter-Array Cable/OSS Interconnector Cable installation	Direct/Indirect, short-term
Traffic	Disturbance from vessel activity	Direct/Indirect, short-term
Visible Structures / Lighting	Collision risk with construction vessels and equipment	Direct/indirect, short-term
Discharges/Releases	Mortality/decreased breeding success during construction activities associated with releases during WTG foundation and inter-array cable installation	Indirect, short-term
Trash/Debris	Mortality/injury from ingestion of trash caused by accidental disposals associated with WTG foundation and inter-array cable installation	Indirect, short-term

Seafloor Disturbance, Habitat Alteration, Sediment Suspension and Deposition

During construction, seafloor preparation, foundation installation, scour protection installation, vessel anchoring, and cable installation will result in seafloor disturbance, leading to temporary habitat alteration and sediment suspension and deposition. Construction activities will result in short-term, localized increases in turbidity close to the seafloor and in the water column (see Section 4.1.3). For foraging birds, this could reduce visibility and inhibit prey detection in the immediate vicinity of construction activities. The construction activities may also impact the prey bases of marine birds (e.g., bivalve communities foraged on by sea ducks, sand lance foraged on by terns, and menhaden foraged on by multiple taxonomic groups; (Fox and Petersen 2019). See Section 4.3.2 for further discussion of construction activity impacts on marine invertebrates and vertebrates. Any changes to prey base composition for marine birds during construction may result in the temporary loss of foraging opportunities. However, the small footprint of disturbance relative to the large expanse of similar habitat available within and adjacent to the Lease Area and in the broader region will allow birds to access comparable prey species outside the disturbance area associated with construction of the RWF. Therefore, the temporary impacts of potential changes to prey base composition and inhibited prey detection by marine birds from seafloor disturbance, habitat alteration, and sediment suspension and deposition are considered ***direct*** and ***short-term.*** Potential impacts of the cable landfall are discussed in the Onshore Facilities section below.

Noise

In-air and underwater noise generated by impact pile driving for WTG and OSS foundations could lead to the indirect effect of birds temporarily avoiding the RWF construction area (Fox and Petersen 2019). Since construction noise will be short-term, it is not likely to cause any permanent loss of habitat due to displacement nor bird injury or mortality. Potential impacts on avian species resulting from construction noise are considered ***direct***/***indirect*** and ***short-term***.

Traffic

Vessel traffic could also cause the indirect effect of some birds temporarily avoiding the area or being attracted to vessel traffic, or in rare cases, the direct effect of birds colliding with the vessels at night. However, construction traffic will be short-term and similar to normal non-Project-related vessel traffic and is not likely to cause any permanent loss of habitat due to displacement or significant collision mortality. Potential impacts on avian species resulting from construction traffic are considered ***direct*** (e.g. collisions with vessels)/***indirect*** (e.g. avoidance of vessels), ***short-term***.

Visible Structures and Lighting

During construction, visible structures and lighting have the potential to cause short-term direct and indirect impacts. The vertical structures of construction equipment and WTGs could be a collision hazard (direct impact); and the lighting of construction vessels and equipment may attract birds, increasing collision risk during poor weather (Fox et al. 2006). Brightly illuminated structures offshore, such as research platforms, pose a risk to birds migrating at night, particularly during rain or fog when birds can become disoriented by sources of artificial light (Hüppop et al. 2006). Since construction activities are short-term and are generally confined to good weather, potential impacts are considered minimal (Fox and Petersen 2019). Furthermore, lighting during construction activities will be limited to the minimum required for safety during construction activities to minimize bird attraction. Potential impacts are considered ***direct/indirect*** and ***short-term***.

Discharges and Releases

During construction of the RWF, sanitary and other waste fluids will be generated by equipment and support vessels. However, all wastes will be properly managed in accordance with applicable federal and state laws. Accidental discharges, releases, and disposal could indirectly affect marine birds (e.g., oiling of feathers, ingestion of toxins, which could reduce fitness), but risks will be avoided through implementation of the Project's ERP/OSRP (Appendix D) and associated BMPs. Section 4.1.6 describes further how discharges and releases will be managed. Potential impacts associated with discharges and releases are considered ***indirect*** and ***short-term***.

Trash and Debris

Trash and debris will be generated by construction and support vessels around the RWF but will be properly managed in accordance with federal and state laws. Accidental disposal of trash into the water does represent a risk factor to birds as they could potentially ingest or become entangled in debris. Ingestion of macroplastics and microplastics can indirectly affect birds by interfering with flight and foraging as well as reduced fitness, due to the plastics acting as a vector for other contaminants (Teuten et al. 2009, Yamashita et al. 2011, Tanaka et al. 2013, Roman et al. 2019). With proper waste management procedures (see Section 4.1.7), trash or debris lost overboard would be unlikely. Potential impacts associated with trash and debris are considered ***indirect*** and ***short-term***.

Operations and Maintenance

This section is a summary of the extensive assessment detailed in Appendix V, which provides analyses of the exposure (i.e., likelihood of occurrence defined as the extent of overlap between a species' seasonal or annual distribution and the Project footprint), vulnerability (i.e., defined as the degree to which a species is expected to be affected by the Project based on known effects at similar offshore wind energy developments), and risk to birds from the operating RWF. Exposure is discussed in the habitat alteration section below, along with displacement vulnerability; collision vulnerability is discussed in the Visible Structures and Lighting section below. Exposure and vulnerability were assessed on a scale of minimal to high and were used together to evaluate potential impacts (see Appendix V for full definitions of levels.)

For non-listed species, the assessment provides information for BOEM to make their impact determination at a population level, as has been done for recent assessments of Wind Energy Areas (BOEM 2016) and project-specific EISs (BOEM 2018). For federally protected species, this assessment provides information on an individual level because the loss of one individual from the breeding population has a greater likelihood of affecting a population than similar loss for non-listed species.

Table 4.3.6-5 summarizes the IPFs, including the potential level of impact, expected to occur to avian species during the O&M phase of the RWF. Additional details on potential impacts from the various IPFs are described in the following sections.

Table 4.3.6-5 IPFs and Potential Impact on Avian Species from the RWF During O&M

IPF	Project Activity	Impact Characterization
Habitat Alteration	Routine and non-routine maintenance; Displacement, based on presence of WTGs or OSS	Indirect, long-term
Noise	Disturbance from WTG operation and maintenance vessel activity	Indirect, long-term
Traffic	Disturbance from maintenance vessel activity	Direct/indirect, long-term
Visible Structures / Lighting	Collision risk with WTGs or OSS	Direct, long-term
Discharges/Releases	Maintenance vessel activity at WTGs or OSS	Indirect, short-term
Trash/Debris	Maintenance vessel activity at WTGs or OSS	Indirect, short-term

Habitat Alteration

The potential indirect effects of operating offshore wind energy projects on birds is habitat loss (i.e., habitat alteration) due to displacement (Fox and Petersen 2019). The primary hazard that can cause displacement is the operating WTGs. The potential for habitat loss/displacement is species dependent. Therefore, the potential effects of the RWF are discussed below for each major species group (non-marine and marine birds), with additional information on federally protected species. In this section, we discuss potential exposure of birds to the Lease Area, which also applies to the Visible Structures and Lighting section below.

Overall, displacement from the RWF is not expected to affect the populations of non-marine migratory birds (Table 4.3.6-6), because RWF is not primary habitat for these species and any avoidance behavior during migration is not likely to substantially increase energetics or reduce foraging opportunities (a detailed assessment is in Appendix AA). The Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species. Coastal birds, including shorebirds (e.g., sandpipers, plovers), waterbirds (e.g., cormorants, grebes), waterfowl (e.g., scoters, mergansers), wading birds (e.g., herons, egrets), raptors (e.g., falcons, eagles), and songbirds (e.g., warblers, sparrows), may occasionally forage in the Lease Area visit the area sporadically, or pass through on their spring and/or fall migrations. A summary of potential effects are as follows (a detailed assessment is in Appendix V):

› **Shorebirds:** Few shorebirds were observed offshore during the OSAMP surveys. As a result, shorebird exposure to RWF operation is considered to be minimal, thus a vulnerability and risk assessment was not conducted for non-ESA shorebird species.

› **Wading Birds:** Wading birds spend the majority of the year in freshwater aquatic systems and near-shore marine systems. In the OSAMP aerial surveys (Winiarski et al. 2012), there are few offshore observations of species within this group during all seasons, and none were observed in the Lease Area (Appendix AA). Thus, exposure to RWF operation is considered minimal for wading birds.

- **Raptors:** Raptor exposure to RWF operation is expected to be limited to falcons. The OSAMP surveys had no records of falcons within the Lease Area; however, individual tracking data indicates that falcons do fly in the vicinity of the Lease Area during migration. Like other terrestrial species, since use of the offshore environment is limited to migration, any avoidance behavior will not cause displacement from important habitat. Therefore, population-level impacts are unlikely because exposure is expected to be low and limited to migration.
- **Songbirds:** Songbird exposure during RWF operation is limited because they do not use offshore habitat, and there is little evidence of songbird use of the Lease Area outside of migratory periods. During the OSAMP surveys, some passerines were encountered in the Lease Area during migration periods, but in low numbers (Appendix AA). Since use of the offshore environment is limited to migration, any avoidance behavior will not cause displacement from important habitat.
- **Coastal Waterbirds:** Coastal waterbird exposure is expected to be limited because these species spend a majority of the year in freshwater aquatic systems and near-shore marine systems, and the OSAMP data indicates little use of the Lease Area (see maps in Appendix AA).

Overall, displacement from the RWF is not expected to affect the populations of marine birds (Table 4.3.6-6). Of the marine birds vulnerable to displacement, loons, sea ducks, and auks will be exposed to the RWF the most. A summary of potential effects are as follows:

- **Loons:** Loon exposure during RWF operation is considered low to medium (Appendix V) because loons may pass through the Lease Area during spring and fall migration, and Common Loons may use the area during the winter. Loons are consistently identified as being vulnerable to displacement (Garthe and Hüppop 2004, Furness et al. 2013, MMO 2018). Nonetheless, habitat loss due to displacement from the RWF is unlikely to impact population trends because of the relatively small size of the Lease Area in relation to available foraging habitat.
- **Sea Ducks:** Sea duck exposure during RWF operation is considered to be minimal to medium (Appendix AA) and is primarily limited to migration or travel between wintering sites. Sea ducks have been identified as being vulnerable to displacement (MMO 2018), although this may be temporary (Leonhard et al. 2013). Preliminary post-construction surveys at the Block Island Wind Farm reported lower densities of ducks within the turbine area than outside (Stantec 2018d). Overall, habitat loss due to displacement from the Project is unlikely to impact population trends because of the relatively small size of the Lease Area in relation to available foraging habitat.
- **Petrels, Shearwaters, and Storm-Petrels:** Exposure of petrels, shearwaters, and storm-petrels during RWF operation is considered minimal to low (Appendix AA) because, while the petrel group is commonly observed throughout the region during the summer months, they are typically found much farther offshore than the Lease Area. Petrels, shearwaters, and storm-petrels rank at the bottom of displacement vulnerability assessments (Furness et al. 2013). Therefore, population-level impacts from displacement are unlikely.
- **Gannets and Cormorants:** Northern Gannet exposure during RWF operation is considered minimal to low (Appendix AA). Studies have found that Northern Gannets avoid offshore wind

developments in Europe (Krijgsveld et al. 2011, Cook et al. 2012, Hartman et al. 2012, Vanermen et al. 2015, Dierschke et al. 2016, Garthe et al. 2017), indicating the species is vulnerable to displacement. While there is uncertainty on how displacement will affect individual fitness, population-level impacts are unlikely because of the low exposure. Cormorant exposure is considered minimal to low as few to no cormorants were observed within the Lease Area during the OSAMP surveys (Appendix V). Cormorants are considered to have little vulnerability to displacement, because they are attracted to WTGs (Krijgsveld et al. 2011, Lindeboom et al. 2011). Population-level impacts from displacement are unlikely due to their low vulnerability and exposure.

- **Gulls, Skuas, and Jaegers:** Skua and jaeger exposure during RWF operation is considered minimal, while gull exposure is minimal to medium depending on the species (see Appendix AA). However, most gull groups received a minimal to low exposure score and the medium exposure was limited to the fall for a few species groups. Gulls are generally considered to have little vulnerability to displacement (Furness et al. 2013); therefore, population-level impacts from displacement are highly unlikely.
- **Terns:** Tern exposure during RWF operation is considered low to medium (see Appendix AA), based on OSAMP surveys and individual tracking data. Terns may be vulnerable to displacement since they have been demonstrated to avoid small (660 kW) operating WTGs (Vlietstra 2007). While some individual terns will be exposed to the RWF, if displaced, will likely fly to alternative local foraging locations (see maps in the Appendix V); therefore, population-level impacts from displacement are unlikely.
- **Auks:** Auk exposure during RWF operation is expected to be minimal to medium (see Appendix AA). Auks are considered vulnerable to displacement. Due to sensitivity to disturbance from boat traffic and a high habitat specialization, many auks rank high in displacement vulnerability assessments (Furness et al. 2013, Dierschke et al. 2016, Wade et al. 2016). While there is uncertainty about how displacement may affect individual fitness, it is unlikely that displacement from the RWF area will result in population-level impacts given the relatively small size of the Lease Area relative to available foraging habitat in the broader region.

Table 4.3.6-6 Avian Species Exposure to RWF and Displacement Vulnerability

Group	Exposure	Displacement Vulnerability
Non-marine Migratory Birds		
Shorebirds	min	no further assessment
Wading Birds	min	no further assessment
Raptors (falcons)	low	min – low
Songbirds	min – low	min
Coastal Waterbirds	min	no further assessment

Group	Exposure	Displacement Vulnerability
Marine Birds		
Loons	low – med	high
Sea Ducks	min – med	med – high
Shearwaters, Petrels & Storm-Petrels	min – low	low – med
Gannets & Cormorants	min – low	low – med
Gulls	min – med	low – med
Terns	low – med	med – high
Auks	min – med	med – high
Listed Species		
Piping Plover	low – med	min
Red Knot	low – med	min
Eagles	min	min
Black-capped Petrel	min	low – med
Roseate Tern	min – low	med – high

Adapted from Appendix V.

Displacement from the RWF is not expected to affect listed species populations. A summary of potential effects are as follows (see Appendix AA for further details):

- **Piping Plover, Red Knot:** Piping Plover and Red Knot exposure to the Project is limited to spring and fall migration. Piping Plovers are not considered vulnerable to displacement because their feeding habitat is strictly coastal (Burger et al. 2011b); therefore, individual impacts from displacement is unlikely.
- **Eagles:** Bald Eagle and Golden Eagle exposure to RWF operation is limited because the Lease Area is not located along any likely or known eagle migration route. Eagles are also expected to have a little vulnerability to displacement because they tend not to actively forage in or fly through the offshore environment. Therefore, individual impacts from to eagles during operation of the RWF are unlikely.
- **Black-capped Petrel:** The Black-capped Petrel is extremely uncommon in areas not directly influenced by the warmer waters of the Gulf Stream (Haney 1987) and is generally found in coastal WOTUS only as a result of tropical storms (Lee 2000). Since they are extremely uncommon in coastal New England waters, individual impacts are highly unlikely.
- **Roseate Tern:** Roseate Tern exposure during RWF operation is considered minimal to low (see Appendix V), based on the OSAMP survey and individual tracking data. The OSAMP survey and records in the Northwest Atlantic Seabird Catalog (Appendix AA) have not confirmed Roseate Terns in the Lease Area, and an analysis of unknown tern observations in survey data indicate few,

if any, of these observations were likely Roseate Terns. A recent nanotag tracking study (Loring et al. 2019) indicates that eight (of 90 total) tracked Roseate Terns passed through the northern portion of the Lease Area. Roseate Terns may be vulnerable to displacement since terns have been demonstrated to avoid small (660 kW) operating WTGs (Vlietstra 2007). While some individual terns will be exposed to the RWF, if displaced, they will likely fly to alternative local foraging locations (see maps in the Appendix V); therefore, individual-level impacts are unlikely.

In summary, habitat alteration impacts associated with RWF operation are considered ***indirect*** and ***long-term*** depending upon the species group, although population-level impacts are not expected. Refer to Appendix AA for more details regarding the assessment of avian exposure and vulnerability to the RWF. While some species, such as loons and sea ducks, are documented to avoid wind farms, there is uncertainty on how this would affect individual fitness and energetics (see Appendix V for further discussion).

Noise

While the effects of WTG noise on birds is not well studied, noise from WTGs and OSSs may contribute to the indirect effect of some species of birds avoiding the RWF during the operation. The WTGs primarily produce two types of noise, aerodynamic blade and mechanical noise (MMS, 2007), and there is some evidence to indicate that there are lower densities of birds around operational versus stationary WTGs (Cook et al. 2018), perhaps partly due to the noise of the WTGs. However, avoidance of individual wind farms does not appear to substantially increase the distance birds have to travel (Masden et al. 2009) and is unlikely to affect individual fitness. Impacts from operational noise are considered ***direct***/***indirect*** and ***long-term***.

Traffic

Vessels and helicopters associated with maintenance have the potential to disturb seabirds and affect the distribution of birds foraging near the RWF (Fox and Petersen 2019), which have the potential to cause indirect effects (e.g., increased energy use as birds fly to alternate foraging areas), and in rare cases the direct effect of collisions. While some birds may be attracted to, or avoid maintenance vessels, these behavioral responses are unlikely to impact populations because research indicates that marine bird avoidance behavior only leads to a minor increase in overall distance traveled (Masden et al. 2009), and any collisions are expected to be rare events, impacting few individuals. If collisions occur with boats, they would be infrequent, and would likely only be a few individuals. Impacts from traffic are considered ***direct***/***indirect*** and ***long-term***.

Visible Structures and Lighting

The potential direct effect of operating offshore wind energy projects on birds is mortality due to collision (Drewitt and Langston 2006, Fox et al. 2006, Goodale and Milman 2016). The primary hazards that could pose a collision risk are the WTGs and the OSSs. For the WTGs, collisions may occur within the Rotor Swept Zone (RSZ), the WTG tower or the WTG hub (Refer to Figure 3.3-12.) Due to the operational cut-in and cut-out wind speed limitations, the WTGs may not be operating approximately 2 percent of the time during winter months, approximately 5 to 9 percent of the time during spring months, approximately 6 to 8 percent of the time during summer months, and approximately 2 to 5 percent during fall months. Avian species would be at less risk of collision when the blades are not spinning; however, collision with stationary WTG structures during periods of low visibility would still be considered a risk.

The potential for collisions to occur is species-dependent. Therefore, the potential effects of the RWF are discussed below for each major species group (non-marine and marine birds), with additional information on federally protected species. Exposure of birds to the Lease Area is discussed above in the habitat alteration section but is also the basis of this assessment of collision.

Overall, collisions with the RWF are not expected to affect the populations of non-marine migratory birds (Table 4.3.6-6) because the Lease Area is generally far enough offshore as to be beyond the range of most breeding terrestrial or coastal bird species (a detailed assessment is in Appendix V). See discussion above in the habitat alteration section. While falcons have some vulnerability to collision with WTGs (see detailed assessment is in Appendix V), population-level impacts are unlikely because exposure is expected to be low and will be limited to migration. Songbirds typically migrate at considerable height but can fly lower during inclement weather or headwinds. Overall, population-level impacts are unlikely because, while these birds have some vulnerability to collision, they have minimal to low exposure. A summary of potential effects are as follows (a detailed assessment is provided in Appendix AA):

Overall, collisions with the RWF are not expected to affect the populations of marine birds (Table 4.3.6-7). Tetra Tech conducted a beached-bird survey at Block Island Wind before construction, during construction, and post-construction from June 2015 to July 2017, and in 2019: there was not an increase in carcasses found post-construction as compared to baseline monitoring, and 2017 had the lowest bird carcass per search rate observed during the beached-bird survey period (Tetra Tech 2017). Of the marine birds vulnerable to collision, gulls will be exposed to the RWF the most. See details about exposure of marine birds above in the habitat alteration section. A summary of potential effects are as follows:

- **Loons, Sea Ducks, Petrels, Shearwaters, and Storm-Petrels:** Since loons demonstrate strong avoidance behavior, they are generally not considered to be vulnerable to collision (Wade et al. 2016). Sea ducks, petrels, shearwaters, and storm-petrels are generally not considered vulnerable to collision because they avoid turbines and fly primarily below the RSZ.
- **Gannets and Cormorants:** Vulnerability assessments indicate that if gannets do not avoid wind farms, they may have limited vulnerability to collision (Wade et al. 2016), but population-level impacts are unlikely due to low exposure. Cormorants are considered to have some vulnerability to collision because they are attracted to WTGs (Krijgsveld et al. 2011, Lindeboom et al. 2011) and often fly through RSZs. However, population-level impacts are unlikely due to their low exposure.
- **Gulls, Skuas, and Jaegers:** Some gulls are considered to be highly vulnerable to collision (Furness et al. 2013). In addition, gulls are known to be attracted to WTGs (Vanermen et al. 2015) and collision with WTGs has been documented (Skov et al. 2018). While these birds are likely to be exposed to the RWF and are vulnerable to collision, population-level impacts are unlikely because resident gull populations are robust and generally show high reproductive success (Good 1998, Pollet et al. 2012, Burger 2015, Nisbet et al. 2017).

- **Terns:** Terns rank in the middle of collision vulnerability assessments (Garthe and Hüppop 2004, Furness et al. 2013) and fly almost exclusively below the WTGs (Loring et al. 2019). While some individual terns will be exposed to the RWF, they are considered to have low collision vulnerability to larger WTGs (Appendix V); therefore, population-level impacts are unlikely.
- **Auks:** Auks are generally not considered vulnerable to collision ((Wade et al. 2016) because they primarily fly below the RSZ and demonstrate strong avoidance behavior.

Operation of the RWF is not expected to affect listed species populations. A summary of potential effects are as follows:

- **Piping Plover:** Piping Plovers generally migrate at flight heights above the RSZ (Loring et al. 2019), and they have good visual acuity and maneuverability in the air (Burger et al. 2011a). Thus, potential exposure to collisions with WTGs is also limited. Since exposure of Piping Plovers will be limited to migration, they have low vulnerability to collision, individual impacts are unlikely.
- **Red Knot:** Flight heights during migration are thought to be well above the RSZ for long-distance migrant Red Knots, but there is potential for exposure to collision for shorter-distance migrants that can traverse the Lease Area within the RSZ, particularly during the fall (Loring et al. 2018). Given that Red Knot exposure will be limited to migration and they show little vulnerability to both collision (Appendix V), individual impacts are unlikely.
- **Eagles:** Bald Eagle and Golden Eagle are also expected to have a little vulnerability to collision because they tend not to actively forage in or fly through the offshore environment. Therefore, impacts to eagles during operation of the RWF are unlikely.
- **Black-capped Petrel:** As discussed above in the habitat alteration section, since these birds are extremely uncommon in coastal New England waters, individual impacts are highly unlikely.
- **Roseate Tern:** Overall, compared to other seabirds, terns rank in the middle of collision vulnerability assessments (Furness et al. 2013), fly less than 13% of time between 66–492 ft (20–150 m; Cook et al. 2012), and avoid operating WTGs (Vlietstra 2007). Terns have also been documented to lower their flight altitude when approaching a wind development (Krijgsveld et al. 2011). The altitude at which Roseate Terns migrate offshore is still being researched but is thought to be higher than foraging altitudes or nearshore flight altitudes (likely hundreds to thousands of feet/meters; Perkins et al. 2004, [MMS] Minerals Management Service 2008). Therefore, due to limited exposure and low collision vulnerability, individual-level impacts are unlikely.

In summary, visible structure and lighting impacts associated with RWF operation are considered ***direct*** and ***long-term*** depending upon the species group, although population-level impacts are not expected. Refer to Appendix V for more details regarding the assessment of avian exposure and vulnerability to the RWF.

Table 4.3.6--7 Avian Species Exposure to RWF and Coliision Vulnerability

Group	Exposure	Collision Vulnerability
Non-marine Migratory Birds		
Shorebirds	min	no further assessment
Wading Birds	min	no further assessment
Raptors (falcons)	low	low – med
Songbirds	min – low	low – med
Coastal Waterbirds	min	no further assessment
Marine Birds		
Loons	low – med	min – low
Sea Ducks	min – med	min – low
Shearwaters, Petrels & Storm-Petrels	min – low	low
Gannets & Cormorants	min – low	low – med
Gulls	min – med	low – med
Terns	low – med	low
Auks	min – med	min
Listed Species		
Piping Plover	low – med	min – low
Red Knot	low – med	low
Eagles	min	min
Black-capped Petrel	min	low
Roseate Tern	min – low	low

Adapted from Appendix V.

Discharges and Releases

Impacts associated with discharges and releases are expected to be similar to those described above for construction. Operational discharges and releases impacts are considered ***indirect*** and ***short-term***, and any potential impacts will be minimized through the use of best practices.

Trash and Debris

Impacts associated with discharges and releases are expected to be similar to those described above for construction. Operational trash and debris impacts are considered ***indirect*** and ***short-term***, and any potential impacts will be minimized through the implementation of best practices.

Revolution Wind Export Cable

The IPFs associated with the RWEC that could impact avian species include seafloor or land disturbance, sediment suspension/deposition, noise, traffic, visible structures (i.e., vessels) and lighting, discharges/releases, and trash/debris. The potential impacts associated with these IPFs are addressed separately for each segment (i.e., RWEC–OCS and RWEC–RI) and phase (i.e., construction, O&M, and decommissioning) in the following sections.

RWEC–OCS

This subsection describes potential impacts associated with construction, O&M, and decommissioning of the 25-mi (40-km) segment of the RWEC that will be installed within federal waters on the OCS.

Construction and Decomissioning

IPFs resulting in potential impacts on avian species in the RWEC-OCS area from the construction and decommissioning phases are summarized in Table 4.3.6-8. Construction and decommissioning phases of the RWEC–OCS will have similar impacts. Additional details regarding potential impacts on avian species from the various IPFs during construction and decommissioning of the RWEC-OCS are described in the following sections.

Table 4.3.6-8 IPFs and Potential Impact on Avian Species from the RWEC During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor/Land Disturbance	Habitat loss/modification from cable installation	Direct, short-term
Habitat Alteration	Habitat loss/modification from cable installation	Direct, short-term
Sediment Suspension and Deposition	Habitat loss/modification from cable installation	Direct, short-term
Noise	Disturbance from HDD cable installation	Direct/indirect, short-term
Traffic	Disturbance from vessel and vehicle activity during cable installation	Direct/indirect, short-term
Discharges/Releases	Mortality/decreased breeding success during construction activities associated with cable installation	Indirect, short-term
Trash/Debris	Mortality/injury from accidental disposals associated construction activities associated with cable installation	Indirect, short-term

Seafloor Disturbance, Habitat Alteration, Sediment Suspension and Deposition

Impacts from construction activities related to the installation of the RWEC–OCS on marine birds are expected to be similar to those described within the construction and decommissioning section of the RWF in terms of the IPFs of seafloor disturbance, habitat alteration, and sediment suspension and deposition. The temporary impacts of potential changes to prey base composition and inhibited prey detection by marine birds from seafloor disturbance, habitat alteration, and sediment suspension and deposition are considered ***direct*** and ***short-term***.

Noise

Above and below water noise generated by cable installation that could lead to the indirect effect of birds temporarily avoiding the RWEC–OCS construction area (Fox and Petersen 2019). Since construction noise will be short-term, it is not likely to cause any permanent loss of habitat due to displacement nor bird injury or mortality. Potential impacts on avian species resulting from construction noise are considered ***indirect*** and ***short-term***.

Traffic

Vessel traffic could temporarily attract some birds and cause others to avoid the area, or in rare cases, the direct effect of birds colliding with the vessels at night. However, these impacts will be short-term and similar to normal non-Project-related vessel traffic and are not likely to cause any permanent loss of habitat or significant collision mortality. Potential impacts on avian species resulting from construction traffic are considered ***direct/indirect*** and ***short-term***.

Discharges and Releases

During construction of the RWEC–OCS, sanitary and other waste fluids will be generated by equipment and support vessels. However, all wastes will be properly managed in accordance with applicable federal and state laws. Accidental discharges, releases, and disposal could indirectly (spatially and temporally removed from the activity) affect marine birds (e.g., low levels of oiling of feathers and ingestion of toxins could reduce fitness), but risks will be avoided through implementation of the Project's ERP/OSRP (Appendix D) and associated BMPs. Section 4.1.6 describes further how discharges and releases will be managed. Potential impacts associated with discharges and releases are considered ***indirect*** and ***short-term***.

Trash and Debris

Trash and debris will be generated by construction and support vessels around the RWEC–OCS but will be properly managed in accordance with federal and state laws. Accidental disposal of trash into the water does represent a risk factor to birds as they could potentially ingest or become entangled in debris. Ingestion of macroplastics and microplastics can indirectly (spatially and temporally removed from the activity) affect birds by interfering with flight and foraging as well as reduced fitness, due to the plastics acting as a vector for other contaminants (Teuten et al. 2009, Yamashita et al. 2011, Tanaka et al. 2013, Roman et al. 2019). With proper waste management procedures (see Section 4.1.7), trash or debris lost overboard would be unlikely. Potential impacts associated with trash and debris are considered ***indirect* and *short-term***.

Operations and Maintenance

No impacts to birds are anticipated during routine O&M of the RWEC–OCS.

RWEC–RI

Composition of avian species and Project activities are not likely to vary substantially between RWEC–OCS and RWEC–RI. The potential impacts are expected to be similar to the RWEC–OCS, but the overall species composition will be dominated by coastal marine birds. Refer to Table 4.3.6-8 for a summary of IPFs resulting in potential impacts on avian species in the RWEC–OCS and RWEC–RI areas during construction and decommissioning phases. As with the RWEC–OCS, impacts to avian species are not anticipated during the O&M phase of the RWEC–RI.

Onshore Facilities

The IPFs associated with the Onshore Facilities that could impact avian species include land disturbance and habitat alteration, sediment suspension/deposition, discharges/releases, and trash/debris, traffic and air emissions, noise and lighting, and visible structures (i.e., the OnSS and ICF). These IPFs have the potential to affect avian species that utilize habitats that will be occupied by or adjacent to the proposed Onshore Facilities. The potential impacts associated with these IPFs for each phase of the Onshore Facilities are addressed separately in the following sections. This section summarizes the assessment of potential impacts on avian species presented in Appendix K.

Construction and Decomissioning

IPFs resulting in potential impacts on avian species in the Onshore Facilities from the construction and decommissioning phases are summarized in Table 4.3.6-9. Additional details regarding these potential impacts from the various IPFs during construction/decommissioning of the Onshore Facilities are described in the following sections.

Table 4.3.6-9 IPFs and Potential Impact on Avian Species from the Onshore Facilities During Construction and Decommisioning

IPF	Project Activity	Impact Characterization
Seafloor/Land Disturbance and Habitat Alteration	Vegetation clearing and grading, Construction at Landfall Work Area, Cable Installation, OnSS Construction	Direct/indirect, long-term/short-term
Sediment Suspension and Deposition	RWEC-RI connection to Landfall Work Area, Construction of Onshore Facilities	Direct, short-term
Discharges and Releases	General construction activities	Indirect, short-term
Trash and Debris	General construction activities	Indirect, short-term
Noise/Traffic	Construction-related traffic	Indirect/direct, short-term
Visible Structures/ Lighting	General construction activities	Direct/indirect, short-term

Land Disturbance and Habitat Alteration

Land disturbance and habitat alteration are discussed together because they are interrelated from a habitat perspective (i.e. land disturbance has the potential to result in habitat alteration). Potential direct impacts to avian species resulting from land disturbance and habitat alteration generated from construction of the Onshore Facilities include habitat conversion and loss and direct mortality/injury of individuals. The construction activities are expected to occur over an approximately one-year period. Vegetation clearing and grading for the OnSS, Interconnection ROW, ICF, and TNEC ROW construction will remove forested habitat that will be replaced with hard structures and early successional habitat. Early successional habitat will initially revegetate as a grass/forb and herbaceous cover, then will gradually transition to shrub and sapling cover. Habitat conversion or loss are not of concern within the Landfall Envelope or the Onshore Transmission Cable Route; the baseline habitat conditions of these areas are less complex and include developed areas, such as mowed lawn, parking lots, and roads.

Assessing the benefit of converting existing forest to early successional habitat is complicated when the change may be detrimental to species reliant on forest habitat (e.g. Eastern Towhee, Wood Thrush), but benefit other species that are more suited to the newly converted grassland/shrubland habitat (e.g. Gray Catbird, Common Yellowthroat). Historically, the occurrence and distribution of shrublands and other early successional cover types in the Northeast were largely influenced by humans. While there is some debate about the extent of Native American influence (Lorimer 2001, Foster and Motzkin 2003), there is widespread agreement that European settlers created a spike in grassland and other early successional cover types between the late 1600s and early 1900s by converting millions of acres of northeastern forests to farmland and pastures and by cutting forests for timber and fuel (Askins 2000, Foster and Motzkin 2003). The widespread abandonment of these farms in the early half of the 20th Century (Litvaitis 1993, Askins 2000), coupled with an increase in suburban development and human control of stochastic events such as fire, caused the amount of early successional cover types in the Northeast to consistently decline through most of the 20th Century (Litvaitis 1993, Litvaitis 2003, Brooks 2003). The decline of shrublands and other early successional cover types in the Northeast has contributed to the significant decline of shrubland-dependent bird species that require such cover types for breeding (Witham and Hunter 1992). Today, forest is the dominant cover type in New England, accounting for 81 percent of the total land area (Trani et al. 2001, Schlossberg and King 2007), while all early successional cover types together are estimated to comprise just 12 percent of the land area (Schlossberg and King 2007). With this understanding, the portion of forested habitat removal that will occur during construction will be small relative to the available forested habitat in the surrounding area. In addition, the conversion to early successional habitat may be beneficial to bird species that are specialized to this type of habitat. Impacts of habitat conversion resulting from habitat alteration and land disturbance are considered ***direct*** and ***long-term.***

The construction of the OnSS and ICF will not only result in habitat conversion in the areas surrounding these facilities and the associated Interconnection ROW and TNEC ROW, but it will also result in habitat loss for individual birds. Habitat loss is defined as when an area previously supporting wildlife is converted to non-habitat that lacks the natural resources to support occupancy for any species, such as paved areas. The operational footprint of the OnSS and ICF (less the managed perimeters and Interconnection ROW and TNEC ROW which will support shrubland habitat) will create habitat loss because it will result in hard structures with crushed gravel yards that are not capable of supporting plant life or wildlife. The OnSS will create a loss of up to 3.2 ac (1.3 ha) of mixed oak white pine forest and 2.7 ac (1.1 ha) of mixed oak white pine forest loss due to the construction of the ICF, which represent a relatively small loss within the overall contiguous habitat area of approximately 52 ac (21 ha) where the facilities are proposed. Therefore, the OnSS and ICF construction will result in ***direct*** and ***long-term*** impacts to create habitat loss, but the amount of habitat loss is small relative to the similar habitat that will remain unimpacted in the general region.

Land disturbance and habitat alteration from construction on the Onshore Facilities may result in the direct injury or mortality of avian species. Mobile individuals are able to temporarily vacate an area of disturbance and, therefore, are less susceptible to mortality or injury compared to less mobile stages of life, such as eggs and nestlings. Direct mortality and injury would only occur during the construction phase. Impacts on mortality and injury from the construction operations will be mitigated by observing time of year restrictions on vegetation removal that will avoid the breeding season. Further detail is provided in Section 4.3.6.3. Mortality and injury resulting from habitat alteration and land disturbance are considered ***direct*** and ***short-term*** impacts.

Potential indirect impacts to avian species resulting from land disturbance and habitat alteration generated from construction of the Onshore Facilities include reduction in habitat quality via the spread of invasive species and displacement of individuals. Potential vegetative clearing for construction of the OnSS, Interconnection ROW, ICF, and TNEC ROW will open the canopy which often gives invasive plant species competitive growth advantage over native plants because they are able to leaf out earlier than native plants (Hancock 2018). The baseline conditions of the impacted habitat and wetlands already support a high occurrence of invasive plant species and, thus, without mitigation it is expected that invasive species will persist in these habitats and potentially increase. Increased invasive species can further degrade habitat quality by affecting the biomass of invertebrates that many bird species use as a food source. Based on a study that examined the effects of nonnative plants on bird communities in suburban forest fragments, there is a significant positive relationship between the percentage of plants within a sampling area that are native and the biomass of invertebrates that were collected from that site (Conover 2011). Reduction in habitat quality is not a concern within the Landfall Envelope; baseline habitat conditions of these areas are less complex and minimal vegetation clearing will be necessary. The spread of invasive species will be managed in compliance with state and federal regulations. Habitat degradation via the spread of invasive species resulting from land disturbance and habitat alteration is considered an ***indirect*** and ***short-term*** impact.

Another potential indirect impact to avian species resulting from land disturbance and habitat alteration generated from construction of the Onshore Facilities includes displacement or avoidance behavior of individuals. Impacts from construction, such as vegetation removal and noise generated by construction equipment can create avoidance behavior in individual birds. Vegetation removal can affect habitat conditions, as previously discussed, and noise generated by construction has the potential to mask signals used by birds for (1) communication and mating, and (2) hunting, which can lead to a decrease in bird density of the affected area (Bottalico et al. 2015). Displacement and avoidance behavior are expected to only occur during construction and are therefore considered an ***indirect*** and ***short-term*** impact.

Sediment Suspension and Disposition

Sediment suspension and deposition in the intertidal area may result from the interconnection between the RWEC and the Landfall Work Area.

As with disturbance related to the installation of the RWEC–OCS and RWEC–RI, the interconnection with the RWEC to the Landfall Work Area will cause disturbances of the benthic and intertidal area that could potentially impact birds that forage in the nearshore area by temporarily displacing and/or obscuring their prey base (e.g. invertebrate foraged by shore birds and ducks) by reducing visibility and inhibiting prey-detection. Potential effects on prey species are expected to be temporary in nature (i.e., limited to a small area around the cable installation), and the birds will likely only need to fly a short distance to find available prey in similar habitat. Potential prey displacement and reduced prey detection from increased sediment suspension and deposition are expected to occur only during construction activities and are considered ***direct*** and ***short-term*** impacts.

Construction of the Onshore Facilities will be governed by several environmental permits including the RIPDES General Permit for Stormwater Discharges associated with Construction Activities, which requires the use of BMPs to minimize the opportunity for turbid discharges leaving a construction work area. Sediment suspension and deposition that may occur during construction of the Onshore Facilities is considered a ***direct*** and ***short-term*** impact.

Discharges and Releases

During construction of the Onshore Facilities, sanitary waste will be generated and other fluids such as gasoline and oil will be required for the refueling of construction equipment. However, all wastes will be properly managed in accordance with applicable federal and state laws. Accidental discharges, releases, and disposal could indirectly affect birds (e.g., ingestion toxins of which could reduce fitness), but risks will be avoided through compliance with the RIPDES General Permit for Stormwater Discharges associated with Construction Activities which requires the implementation of spill prevention and control measures. Section 4.3.6.3 describes further how discharges and releases will be managed. Potential impacts associated with discharges and releases are considered ***indirect*** and ***short-term***.

Trash and Debris

Trash and debris will be generated by construction of the Onshore Facilities, but all solid and liquid trash and debris will be stored in designated receptacles and will be disposed of at an appropriate facility per 30 CFR 585.626(b)(9). Accidental disposal of trash into the habitat surrounding the construction represents a risk factor to birds as they could potentially ingest or become entangled in debris. With proper waste management procedures (see Section 4.1.7), trash or debris discarded into habitats surrounding the construction areas of the Onshore Facilities would be unlikely. Potential impacts associated with trash and debris are considered ***indirect*** and ***short-term***.

Noise and Traffic

Noise and traffic will result from construction of the Onshore Facilities. As described within the Onshore Acoustic Assessment in Appendix L2 of the COP, long-term ambient sound measurements conducted within the proposed layout of the Onshore Facilities ranged from 44 to 45 dBA (Leq) at night (10:00 PM to 7:00 AM) and 49 to 50 dBA during the day (7:00 AM to 10:00 PM). Operation of construction equipment and construction-related traffic will increase the ambient noise between the typical construction hours of 7:00 AM and 6:00 PM during the approximate one-year construction period. The Onshore Facilities construction sources will include equipment used to support the HDD operations at the Landfall Work Area, trenching, and cable pulling; in addition to typical construction vehicles, for example, excavators, dump trucks, and paving equipment.

Potential direct impacts on avian species from traffic generated during construction of the Onshore Facilities include collisions with construction equipment. This would be a ***short-term*** impact, the occurrence of which is expected to be rare. Indirect impacts on avian species from traffic and traffic-generated noise during construction of the Onshore Facilities may include temporary avoidance of construction areas or disruption of normal behavior within the vicinity of the construction. A study that evaluated chronic anthropogenic noise generated from natural gas fields in New Mexico on adults and nestlings of three bird species demonstrated that multiple signs of chronic stress caused by noise pollution caused skewed stress hormone levels and reduced hatching success in one species (Kleist et al. 2018). Since the construction period is temporary, noise and traffic associated with the construction period of the Onshore Facilities are considered ***indirect*** and ***short-term*** impacts.

Visible Structures/Lighting

Visible structures within Onshore Facilities during construction include construction equipment and the construction of the OnSS, ICF, and structures within the TNEC ROW. Temporary lighting during certain phases of construction may be needed, though construction is expected to take place primarily during the daylight hours between 7:00 AM and 6:00 PM. Since most bird species are diurnal, the use of lighting during the day to aid construction operations is considered a ***direct*** and ***short-term*** impact.

As described within the land disturbance and habitat alteration impact analysis for the Onshore Facilities, construction on the OnSS, Interconnection ROW, ICF, and TNEC ROW will result in visible site disturbance, such as tree clearing, earth moving, and facility installation, all of which will temporarily alter the visual character of the landscape. After the these facilities have been installed the visual structure changes related to construction equipment operation and site alteration will cease. These changes in the visual landscape of onshore biological resources are an extension of the impacts related to land disturbance and habitat alteration. Mortality and injury related to vegetation clearing and collisions with construction equipment or the OnSS, Interconnection ROW, ICF, and TNEC ROW equipment are considered ***direct*** and ***short-term*** impacts. Habitat degradation and avoidance behavior during construction of the OnSS facilities are considered ***indirect*** and ***short-term*** impacts.

Operations and Maintenance

IPFs resulting in potential impacts on avian species in the Onshore Facilities during the O&M phase are summarized in Table 4.3.6-10. Additional details regarding these potential impacts from the various IPFs during O&M of the Onshore Facilities are described in the following sections.

Table 4.3.6-10 IPFs and Potential Impact on Avian Species from the Onshore Facilities During O&M

IPF	Project Activity	Impact Characterization
Discharges and Releases	Routine and non-routine maintenance of OnSS/ICF	Indirect, long-term
Noise/Traffic	Routine and non-routine maintenance of OnSS/ICF	Indirect, short-term
Visible Structures/ Lighting	Routine and non-routine maintenance of OnSS/ICF	Indirect, long-term

Discharges and Releases

The OnSS will require various oils, fuels, and lubricants to support its operation; SF_6 gas will also be used for electrical insulation purposes. Equipment will be mounted on concrete foundations with concrete secondary insulating fluid containment designed for 110 percent containment and in accordance with industry and local utility standards. As described above in the construction section, accidental discharges, releases, and disposal could indirectly affect birds, but risks will be avoided through implementation of the spill prevention and control measures and associated BMPs. Additionally, OnSS devices containing SF_6 will be equipped with integral low-pressure detectors to detect SF_6 gas leakages should they occur. Potential discharges and releases associated with the O&M of the OnSS are considered ***indirect*** and ***long-term*** impacts.

Noise and Traffic

According to the Onshore Airborne Sound Assessment within Appendix L2 of the COP, during O&M the proposed OnSS and ICF would introduce new sources of sound including transformers, shunt reactors, harmonic filters, cooling and ventilation associated with the outdoor substation equipment, as well as condensers, pumps, skids and auxiliary transformers associated with the synchronous condenser building. Operational sound from the OnSS and ICF is modeled to be 43.9 dBA (Leq) or less when measured at the nearest anthropogenic NSRs, which will fall within the ambient sound range measured at baseline conditions. Temporary noise and traffic may occasionally be generated for non-routine maintenance. In such cases, avoidance behavior and/or displacement of avian species may occur due to disruptions caused by noise and traffic which are considered ***indirect*** and ***short-term*** impacts.

Visible Structures and Lighting

The OnSS and ICF will be considered a visible structures that will create habitat conversion (the perimeter of the OnSS and ICF and the Interconnection and TNEC ROW will be maintained in shrub cover) and loss (hard structures, gravel yards) within a contiguous forested patch north of Camp Avenue. This change in the visible landscape presents a very minor risk of mortality or injury due to collision with the OnSS and the changes to the habitat conditions will cause birds to avoid the OnSS and ICF and may influence their habitat selection within the vicinity of these facilities (e.g. breeding habitat for some forest-dependent species may be less suitable). There will be no permanent lighting associated with the O&M of the OnSS, ICF, or other components of the Onshore Facilities, though temporary lighting may be required during non-routine maintenance. These impact risks will exist throughout the O&M phase of the Project. The potential for avian mortality or injury due to the low risk of collision with the OnSS, ICF, and structures within the TNEC ROW is a ***direct*** and ***long-term*** impact. The potential for avoidance behavior related to habitat conversion and loss from these facilities is an ***indirect*** and ***long-term*** impact.

4.3.6.3 Proposed Environmental Protection Measures

In general, exposure of bird populations has been avoided by siting the Project offshore in an offshore Wind Energy Area designated by BOEM. To minimize or mitigate the potential for bird strikes and habitat loss, the Project will use best practices identified in the *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* (BOEM 2016). These include:

- To the extent feasible, tree and shrub removal for Onshore Facilities will occur outside the avian nesting and bat roosting period between May 1 and August 15. If tree and shrub removal cannot avoid this season, Revolution Wind will coordinate with appropriate agencies to determine appropriate course of action.
- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian species to avoid individual WTGs and minimize risk of potential collision.
- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimizes impacts on avian species.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
- Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable.
- The Onshore Transmission Cables will be buried; therefore, avoiding the risk to avian and bat species associated with overhead lines.

- Revolution Wind is developing an Avian Post-Construction Monitoring Plan for the Project that will summarize the approach to monitoring; describe overarching monitoring goals and objectives; identify the key avian species, priority questions, and data gaps unique to the region and Project Area that will be addressed through monitoring; and describe methods and time frames for data collection, analysis, and reporting. Post-construction monitoring will assess impacts of the Project with the purpose of filling select information gaps and supporting validation of the Project's Avian Risk Assessment. Focus may be placed on improving knowledge of ESA-listed species occurrence and movements offshore, avian collision risk, species/species-group displacement, or similar topics. Where possible, monitoring conducted by Revolution Wind will build on and align with post-construction monitoring conducted by the other Orsted/Eversource offshore wind projects in the Northeast region. Revolution Wind will engage with federal and state agencies and environmental groups (eNGOs) to identify appropriate monitoring options and technologies, and to facilitate acceptance of the final plan.
- Revolution Wind will document any dead (or injured) birds found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and USFWS.

4.3.7 Bats

This section provides an overview of the species of bats that have the potential to be affected by the offshore portions of the RWF, RWEC–OCS, RWEC–RI, and the Onshore Facilities. The Project Area discussed herein for the offshore portion of work includes the Project Lease Area, the RWEC–OCS, and the RWEC–RI. The Project Area for the onshore portion of work includes the Onshore Facilities (refer to Table 4.0-1 in Section 4.0 for Project Area definitions). The discussion of the affected environment for bat species is followed by an evaluation of potential Project-related impacts and a summary of environmental protection measures Revolution Wind will implement to avoid, minimize, and mitigate potential impacts to these resources.

The description of the affected environment and assessment of potential impacts for bat species were determined by reviewing publications and public data sources. The primary sources used include, but are not limited to, the following: Coastal Rhode Island and Block Island acoustic monitoring 2010-2012 (Smith and McWilliams 2016), Acoustic surveys and nanotag tracking on Nantucket Island during 2015-2016 (Dowling and O'Dell 2018), and Acoustic monitoring at Block Island Wind farm and on vessels in the South Fork Wind Farm (Stantec 2018a, b).

The following offshore sections summarize information from the Assessment of Potential Effects of the Revolution Wind Offshore Wind Farm on Birds and Bats in Appendix AA and the onshore section summarizes information from the Onshore Natural Resources and Biological Assessment in Appendix K.

4.3.7.1 Affected Environment

Regional Overview

There are eight species of bats present in the State of Rhode Island, five of which are likely year-round residents (Table 4.3.7-1; Rhode Island Department of Environmental/Division of Fish and Wildlife 2019). These species can be divided into two major groups based on their wintering strategy: cave-hibernating bats and migratory tree bats. Both groups of bats are nocturnal insectivores that use a variety of forested and open habitats for foraging during the summer (Barbour and Davis 1969). Cave-hibernating bats are generally not observed offshore (Dowling and O'Dell 2018) and, in winter, migrate from summer habitat to hibernacula in the region (Maslo and Leu 2013). Migratory tree bats fly to southern parts of the United States in the winter and have been observed offshore during migration (Hatch et al. 2013, Stantec 2016, Stantec 2018b).

Table 4.3.7-1 Bat Species Present in Rhode Island and their Conservation Status

Common Name	Scientific Name	Type[1]	Federal Status	State (RI) Status
Eastern small-footed bat	*Myotis leibii*	Cave-Hibernating Bat	.	SGCN
Little brown bat	*Myotis lucifugus*	Cave-Hibernating Bat	.	SGCN
Northern long-eared bat	*Myotis septentrionalis*	Cave-Hibernating Bat	T	SGCN
Tri-colored bat	*Perimyotis subflavus*	Cave-Hibernating Bat	SR	SGCN
Big brown bat	*Eptesicus fuscus*	Cave-Hibernating Bat	.	SGCN
Eastern red bat	*Lasiurus borealis*	Migratory Tree Bat	.	SGCN
Hoary bat	*Lasiurus cinereus*	Migratory Tree Bat	.	SGCN
Silver-haired bat	*Lasionycteris noctivigans*	Migratory Tree Bat	.	SGCN

1 "Type" refers to two major life history strategies among bats in eastern North America; cave-hibernating bats roost in large numbers in caves during the winter (year-round residents), while migratory tree bats do not aggregate in caves and are known to migrate considerable distances.

E= endangered; T= threatened; SR = Status Review resulting from a petition for listing; SGCN= species of greatest conservation need.

One federally listed bat species is present in Rhode Island, the northern long-eared bat (*Myotis septentrionalis)* and has been documented in the vicinity of the Project. The range of the federally endangered Indiana bat (*Myotis sodalis*) does not include Rhode Island, and historical records of the Indiana bat demonstrate its presence only in Berkshire and Hampden counties in Massachusetts (last recorded in 1939; Mass.gov 2019). The Indiana bat is also not among species of bats documented offshore (Pelletier et al. 2013, Stantec 2016). For these reasons, this assessment will focus solely on the potential occurrence of northern long-eared bats within the RWF and Onshore Facilities areas of the Project.

Revolution Wind Farm

While there is uncertainty on the specific movements of bats offshore, bats have been documented using the marine environment in the United States (Grady and Olson 2006, Cryan and Brown 2007, Johnson et al. 2011, BOEM 2013, Hatch et al. 2013, Stantec 2016, Dowling and O'Dell 2018). Bats have been observed to temporarily roost on structures such as lighthouses on nearshore islands (Dowling et al. 2017) and there is historical evidence of bats, particularly eastern red bats, migrating offshore in the Atlantic (Hatch et al. 2013). In a mid-Atlantic bat acoustic study conducted during the spring and fall of 2009 and 2010 (86 nights), the maximum distance that bats were detected from shore was 13.6 mi (21.9 km) and the mean distance was 5.2 mi (8.4 km; Sjollema et al. 2014). In Maine, bats were detected on islands up to 25.8 mi (41.6 km) from the mainland (Peterson et al. 2014). In the mid-Atlantic acoustic study (Sjollema et al. 2014), eastern red bats comprised 78 percent (166 bat detections during 898 monitoring hours) of all bat detections offshore; this study also found that bat activity decreased as wind increased. In addition, eastern red bats were detected in the mid-Atlantic up to 27.3 mi (44 km) offshore by high resolution video aerial surveys (Hatch et al. 2013). Shipboard acoustic surveys conducted by Stantec in 2017 detected over 900 bat passes (primarily long-distance migratory tree bats) within the vicinity of the proposed South Fork Wind Farm and associated export cable. Eastern red bats (*Lasiurus borealis)* accounted for 69 percent of calls detected, while silver-haired bats (*Lasionycteris noctivigans)* accounted for 13 percent. All other species accounted for less than 5 percent of calls that were identified to species level. Peak detections for all species occurred during the month of August, suggesting that most offshore movement is associated with fall migration (Stantec 2018a).

› **Cave-hibernating bats:** Cave-hibernating bats hibernate regionally in caves, mines, and other structures, and primarily feed on insects in terrestrial and freshwater habitats. These species generally exhibit lower activity in the offshore environment than the migratory tree bats (Sjollema et al. 2014), with movements primarily occurring during the fall. In the mid-Atlantic, the maximum distance *Myotis* bats were detected offshore was 7.2 mi (11.5 km; Sjollema et al. 2014). A recent nanotag tracking study on Martha's Vineyard recorded little brown bat (*n*=3) movements off the island in late August and early September, with one individual flying from Martha's Vineyard to Cape Cod (Dowling et al. 2017). Big brown bats (*n*=2) were also detected migrating from the island later in the year (October-November; Dowling et al. 2017). These findings are supported by an acoustic study conducted on islands and buoys in the Gulf of Maine that indicated the greatest percentage of activity in July-October (Peterson et al. 2014).

  While limited research exists on the movements of northern long-eared bats over the ocean, a recent tracking study on Martha's Vineyard (*n*=8; July-October 2016) did not record any offshore movements despite the fact that the species is presumed to hibernate on the island (Dowling et al. 2017). Also, stationary acoustic detectors positioned on two WTGs within the operational Block Island Wind Farm did not detect any northern long-eared bat calls (Stantec 2018b). Shipboard acoustic sampling in the vicinity of the South Fork Wind Farm (adjacent to RWF) reported a single northern long-eared bat call, 21.1 mi (34 km) offshore (Stantec 2018a); however, there are limitations to positive identification of northern long-eared bat calls due to overlaps with species that have similar call signatures. Vessel-based surveys at the construction site of Block Island Wind in 2016 did not identify any Myotis species (Stantec 2016). Most other northern long-eared bat passes detected during these surveys were 3.1-8.7 mi (5–14 km) offshore (Stantec 2018a). The related little brown bat has been documented to migrate from Martha's Vineyard to Cape Cod, and northern long-eared bats may likewise migrate to mainland hibernacula from these islands in August-September (Dowling et al. 2017). Therefore, if northern long-eared bats were to migrate over water, most movements would likely be in close proximity to the mainland.

› **Migratory tree bats:** Migratory tree bats migrate south to overwinter and have been documented in the offshore environment (Hatch et al. 2013, Stantec 2018a, 2019). Eastern red bats have been detected migrating from Martha's Vineyard late in the fall, with one individual tracked as far south as Maryland (Dowling et al. 2017). These results are supported by historical observations of eastern red bats offshore as well as recent acoustic and survey results (Hatch et al. 2013, Peterson et al. 2014, Sjollema et al. 2014). While little local data are available, shipboard and stationary acoustic surveys recorded several observations of bats flying over the ocean, with detections of migratory tree bats in the vicinity of the Lease Area (Stantec 2018a). Tree bats may pass through the Lease Area during the migration period, as they have been detected in the offshore environment primarily during late summer and fall.

RWEC–OCS

Similar to the RWF, bats (primarily tree bats) are generally expected to occur in the RWEC–OCS only during migratory periods. During this migration offshore, bats may still forage and may also take advantage of artificial roosting structures, if available. See section above on the RWF and Appendix AA for additional details on bat exposure offshore.

RWEC–RI

Similar to the RWF and RWEC–OCS, bats (primarily tree bats) are generally expected to occur in the RWEC–RI only during migratory periods, though activity is likely to increase with proximity to shore. During this migration offshore, bats may still forage and may also take advantage of artificial roosting structures, if available. See section above on the RWF and Appendix AA for additional details on bat exposure offshore.

Onshore Facilities

The vicinity of the proposed Onshore Facilities likely provides suitable summer roosting habitat for the bat species that have potential to occur in the onshore Project Area. The summer habitat preferences of the federally threatened northern long-eared bat generally apply to the other species with the potential to occur within the Project Area. According to the most recent (2020) USFWS Summer Survey Guidelines (Guidelines) for northern long-eared bat and Indiana bat, suitable summer habitat for northern long-eared bat consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields, and pastures (USFWS 2020). Summer roosting habitat is typically occupied from mid-May through mid-August each year, with the pupping season (i.e. when young are birthed and raised by females in maternity roosting trees) occurring typically from early June through the end of July (USFWS 2020). The pupping season of the northern long-eared bat generally coincides with other bat species: According to Shump and

Shump (1982a), hoary bats typically birth young from mid-May to early July and the young are volant approximately 4 to 5 weeks after birth. Another study by Shump and Shump (1982b) of the eastern red bat recorded that most young are born in mid-June and are weaned and volant within 4 to 6 weeks after birth. Kunz (1982) studied the reproductive cycle of the silver-haired bat and determined that young are born in mid-June to early July and that the young and weaned and volant approximately 5 weeks after birth.

In July 2020, VHB performed bat-acoustic presence/absence surveys targeting the northern long-eared bat. Four survey sites were located along Onshore Transmission Cable Route and within the proposed OnSS parcels based on the presence of potentially suitable habitat. Automated and qualitative analysis of acoustic surveys did not identify the federally threatened northern long-eared bat or the tri-colored bat which is a candidate species for listing under the ESA. Call data were auto classified with Bat Call Identification East, Version 2.8b (BCID), which resulted the detection of the following species: big brown bat (*Eptesicus fuscus;* n=540 calls), eastern red bat (*Lasiurus borealis;* n=891 calls), hoary bat (*Lasiurus cinereus*; n=23 calls) and silver-haired bat (*Lasionycteris noctivagans*; n=130 calls). Qualitative analysis of unknown and species of concern[4] calls confirmed 11 big brown bat calls and 135 eastern red bat calls.

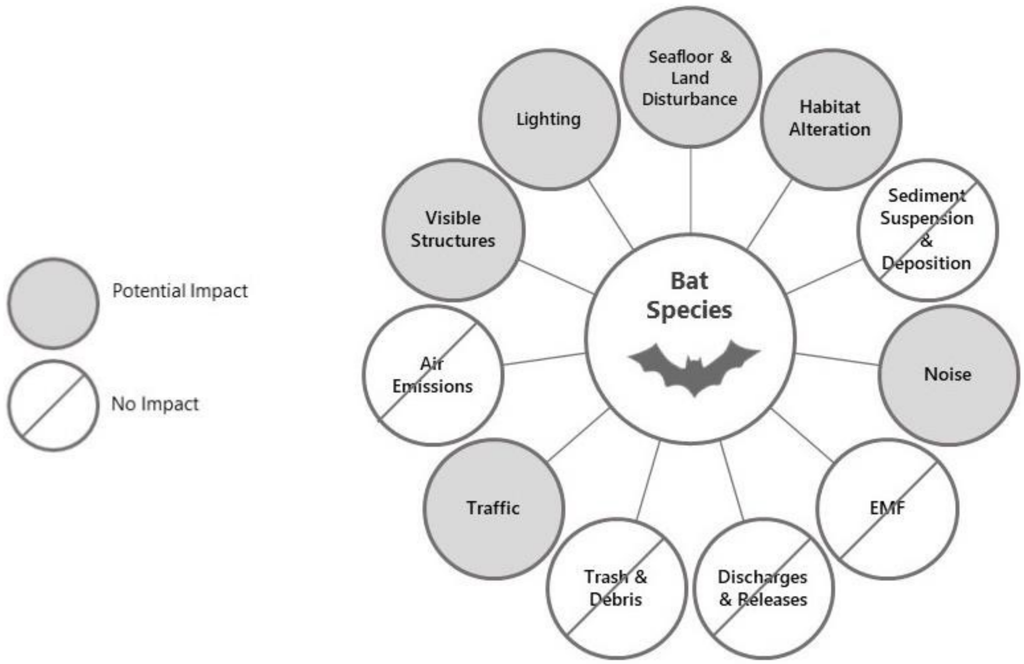
4.3.7.2 Potential Impacts

Section 4.1 summarizes all potential IPFs associated with construction, O&M, and decommissioning of the Project. This section focuses on those IPFs that have the potential to impact the eight potentially affected species of bats discussed above (Section 4.3.7.1). As discussed in Section 4.3.7.1, cave hibernating bats are generally not observed offshore and so have been considered in the onshore components of the Project and migratory tree bats are observed offshore during migration and are considered in both the onshore and offshore components of the Project.

IPFs that may result in direct or indirect impacts to these species are depicted in Figure 4.3.7-1. Note that seafloor & land disturbance apply only to the onshore portion of the Project. More detailed information regarding potential impacts on bat species offshore can be found in Appendix AA and onshore impacts are provided in Appendix K.

4 Any calls that were auto-classified by the software as northern long-eared bat or tri-colored were considered "species of concern" and were qualitatively analyzed for species-specific call characteristics by an experienced bat biologist to manually assign species identification.

Figure 4.3.7-1 IPFs on Bat Species



Revolution Wind Farm

The IPFs associated with the RWF that could impact bat species include noise, traffic, visible structures and lighting. The potential impacts associated with these IPFs for each phase of the RWF are addressed separately in the following sections.

Construction and Decomissioning

IPFs associated with the RWF construction and decommissioning phases are unlikely to impact bat species (Appendix V). Bats are expected to seasonally occur in the RWF while migrating, commuting, or foraging but will be unimpacted by seafloor disturbances during construction of the RWF due to a lack of roosting habitat in these areas. Collision-related impacts to bats are unlikely during construction because bats are expected to detect stationary structures. As bats are only anticipated to occur occasionally in the airspace of the RWF during migration, impacts associated with traffic and noise during construction are unlikely to impact bats. Bats are typically expected to forage for insects in flight (but may rarely take prey from the surface of the water); therefore, no impacts to bats from discharges or releases at the RWF are expected.

Operations and Maintenance

Table 4.3.7-2 summarizes the level of impacts expected to occur to bat species during the O&M phase of the RWF. Additional details on potential impacts from the various IPFs are described in the following sections.

Table 4.3.7-2 IPFs and Potential Impact on Bat Species from the RWF During O&M

IPF	Project Activity	Impact Characterization
Habitat Alteration	Displacement, based on presence of WTGs or OSS	Indirect, long-term
Visible Structures/Lighting	Collision risk with WTGs	Direct, long-term

Habitat Alteration

Based on available information, bats are more likely to be attracted to wind farm structures rather than displaced by them (Cryan et al. 2014). Limited research suggests that terrestrial wind farms can contribute to habitat loss and reduced foraging activity (Millon et al. 2018), though it is unlikely similar patterns would be observed in the offshore environment where bat activity is already scarce. Impacts to bats from displacement are considered ***indirect*** and ***long-term***.

Visible Structures and Lighting

During operation and maintenance of the RWF, injury or mortality from collision with WTGs represents the greatest potential risk to bats. At terrestrial wind farms in the United States, bat mortality is well-documented (Cryan and Barclay 2009, Hayes 2013, Smallwood 2013, Martin et al. 2017, Pettit and O'Keefe 2017, Allison et al. 2019). These fatalities, which predominantly affect migratory tree-roosting bats (Kunz et al. 2007), may occur when mating bats are attracted to WTGs (Cryan 2008). There is some evidence from Europe to suggest that bats foraging over the surface of the ocean increase their altitude when foraging around obstacles (i.e., lighthouses and WTGs; Ahlén et al. 2009). Lighting sources on the WTG decks and offshore substation may serve as an attractant to bats as they navigate, or bats may potentially be indirectly attracted to insect prey drawn to the lights. Additionally, bats were observed roosting aboard support vessels during the construction of the Block Island Wind Farm (Stantec 2016), suggesting the presence of artificial roosting structures may provide some benefit to bats in the offshore environment. The WTGs may also be lit with aviation lighting; however, aviation lighting has not been found to influence bat collision risk at onshore facilities in North America (Arnett et al. 2008).

In general, bats are not expected to regularly forage in the Lease Area, but some may be present during migration, particularly in the fall (BOEM 2012, Stantec 2018c). The exposure of cave-hibernating bats to the Lease Area is expected to be minimal to low and would likely be limited to migration. This is also consistent with The Vineyard Wind 1 Biological Assessment that concluded that "it is extremely unlikely northern long-eared bats would traverse offshore portions" of the project (BOEM 2019). Therefore, impacts to individuals and populations of cave-hibernating bats are unlikely. Migratory tree bats have the highest potential to pass through the Lease Area, but overall small numbers of these bats are expected in the Lease Area given its distance from shore (BOEM 2014). While evidence exists of bats visiting WTGs close to shore (2.5-4.3 mi [4-7 km]) in the Baltic Sea (Ahlén et al. 2009, Rydell and Wickman 2015) and bats are demonstrated to be vulnerable to collisions, a relatively low level of bat activity is expected in the Lease Area because of its distance from shore. The impacts to bats from collisions are considered ***direct*** and ***long-term;*** however, the RWF is unlikely to impact bat populations because the Project is located far from shore. Long-distance migratory bats are considered to be most at risk.

Due to the operational cut-in and cut-out wind speed limitations, the WTGs may not be operating approximately 2 percent of the time during winter months, approximately 5 to 9 percent of the time during spring months, approximately 6 to 8 percent of the time during summer months, and approximately 2 to 5 percent during fall months. Bats would be at little to no risk of collision when the blades are not spinning (and they would be expected to detect WTG stationary structures and generally avoid collision with them).

Revolution Wind Export Cable

Construction, O&M, and decommissioning of the RWEC (including both the RWEC–OCS and RWEC–RI segments) are not anticipated to result in impacts to bat species. The RWEC will be installed below the seafloor and boats are not expected to pose a hazard to bats.

Onshore Facilities

The IPFs associated with the Onshore Facilities that could impact bat species include land disturbance, habitat alteration, noise, traffic, visible structures and lighting. the potential impacts associated with these IPFs for each phase of the Onshore Facilities are addressed separately in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on bat species in the Onshore Facilities from the construction and decommissioning phases are summarized in Table 4.3.7-3. Decommissioning of the Onshore Facilities will have similar impacts to bats as during construction. Additional details regarding these potential impacts from the various IPFs during construction and decommissioning of the Onshore Facilities are described in the following sections.

Table 4.3.7-3 IPFs and Potential Impact on Bat Species from Onshore Facilities During Construction and Decomissioning

IPF	Project Activity	Impact Characterization
Seafloor/Land Disturbance and Habitat Alteration	Vegetation clearing and grading, Construction at Landfall Work Area, Cable Installation, OnSS/ICF Construction	Direct/indirect, long-term/short-term
Noise and Traffic	Construction-related traffic	Indirect, short-term
Visible Structures and Lighting	General construction activities	Direct/indirect, short-term

Land Disturbance and Habitat Alteration

The Landfall Work Area does not provide suitable roosting habitat, so land disturbance and habitat alteration are not a specific concern within this portion of the Project as it pertains to bats. Forested habitat within the OnSS and ICF parcels that will be cleared for construction will remove suitable summer roosting habitat for bats. The early successional habitat that will replace the cleared areas will not provide the same benefit to bats in terms of roosting and pupping habitat, however, it may provide new foraging opportunities since many species prefer traveling and foraging along edge habitats, such as tree lines, hedgerows, forest edges, and linear water features (Verboom 1998, Nelson and Gillam 2017). Changes in habitat composition which may affect roosting and foraging opportunities as a result of land disturbance and habitat alteration during construction of the OnSS, are considered ***direct*** and ***long-term*** impacts. Land disturbance and habitat alteration during construction also have the potential to cause mortality or injury to bat species that are less mobile (e.g. pre-volant pups). Impacts on mortality and injury from the construction operations will be mitigated by observing time of year restrictions on vegetation removal that will avoid the pupping season. Mortality or injury to bat species as a result of land disturbance and habitat alteration during construction are considered ***direct*** and ***short-term***.

The potential indirect impact concerning reduction in habitat quality via the spread of invasive species and the displacement of individuals described in the avian section also applies to bats. A study that evaluated ways to improve foraging opportunities for bats found that *Myotis sp*. activity was greater near waterways that included native plants and were clear of invasive species (Lintott et al. 2015). Invasive plants can clutter the understory of a forest, suppress native tree regeneration and physically reduce the amount of unobstructed subcanopy space where many bats prefer to forage (King 2019). However, as described above, invasive species are pervasive throughout the footprint of the proposed Onshore Facilities and will be managed in compliance with state and federal regulations. Habitat degradation via the spread of invasive species resulting from land disturbance and habitat alteration is considered an ***indirect*** and ***short-term*** impact.

Noise and Traffic

Noise and traffic resulting from construction of the Onshore Facilities may create indirect impacts on bat behavior. Construction activity for the Onshore Facilities will take place during the day[5] while bats are in torpor, during which their metabolism and body temperature drop over a short time period to allow them to conserve energy (Speakman and Thomas 2003, Geiser, 2004). To determine bat response to anthropogenic sound, a study evaluated the effect of noise on torpid bats by subjecting them to a series of playback sound files that included the following stimuli: bird noise, bat colony noise, vegetation noise, traffic noise at different distances from the edge of a highway, and silence (control). Response to these stimuli was measured by skin temperature as an indicator of their arousal from torpor (Lou et al. 2014). The results showed that bats responded most strongly to colony and vegetation noise, and most weakly to traffic noise (Lou et al. 2014). The study also documented evidence that torpid bats can rapidly habituate to repeated and prolonged noise disturbance, suggesting that traffic noise is less disturbing to torpid bats than colony or vegetation noise (Lou et al. 2014). Another study that assessed the impact of anthropogenic noise of bat foraging behavior found that bats avoided foraging areas subjected to strong noise impact (Schaub et al. 2008). This study suggests that foraging areas close to highways and other sources of intense, broadband noises, are degraded in their suitability as foraging areas for “passive listening” bats (Schaub et al. 2008).

5 If the HDD methodology is selected, then the HDD operations will occur continuously to minimize the risk of soil settlement and equipment failures and therefore will create noise during nighttime hours as well.

Since most construction activities will generally not be conducted during the active bat foraging period between twilight and sunrise, most noise generated from the construction activities is not expected to impact bat foraging behavior. The study by Lou et al. 2014 demonstrated that bat response to traffic noise was low relative to other stimuli (colony noise, vegetation) and that bats rapidly habituate to prolonged noise disturbance. Noise and traffic resulting from construction of the Onshore Facilities are considered ***indirect*** and ***short-term*** impacts.

Lighting and Visible Structures

Visible structures within Onshore Facilities during construction include construction equipment the OnSS, structures within the TNEC ROW, and the ICF. Temporary lighting during certain phases of construction may be needed. Most of the onshore construction will occur during the daylight hours, though some overnight lighting may occasionally be necessary. Potential indirect impacts on bats resulting from lighting generated by construction and decommissioning of the Onshore Facilities include temporary displacement of individuals or disruption of normal behavior (e.g. foraging, breeding). For example, illumination of bat foraging areas can potentially prevent or reduce foraging activity, causing bats to pass quickly through the lit area or avoid it completely (Polak et al, 2011). Additionally, lighting can disrupt the composition and abundance of insect prey (Davies et al. 2012) which may in turn reduce foraging opportunities for bats. Most construction activities will occur during the day when bats are in torpor. The impacts from lighting on bat displacement and behavior are considered ***indirect*** and ***short-term***.

Construction equipment and the construction of the OnSS, ICF, and TNEC ROW have the potential to create collision hazards for bats since these structures will remain in place during the bats' active period. Bats use echolocation to navigate by emitting high-frequency sounds and listening for echoes to determine the location of objects (Potenza 2017). Bats are then able to avoid obstacles and locate prey and water sources. However, some smooth, vertical surfaces such as glass and metal reflect the bats' high-frequency sounds away from the bat, not toward it (Potenza 2017), which may lead to collision resulting in injury or mortality. There is little evidence about the collision risk of bats with the onshore components of wind farms such as the OnSS, though there are documented bat mortalities in other onshore electric utilities, such as in transmission and powerline corridors (Manville II 2016). These mortalities suggest that the OnSS, ICF, the overhead transmission lines within the TNEC ROW, and associated construction equipment may create a collision risk for bats. Mortality and injury as a result of the construction of the Onshore Facilities are considered ***direct*** and ***short-term*** impacts.

Operations and Maintenace

IPFs resulting in potential impacts on bat species in the Onshore Facilities area during the O&M phase are summarized in Table 4.3.7-4. Additional details regarding these potential impacts from the various IPFs during O&M of the Onshore Facilities are described in the following sections.

Table 4.3.7-4 IPFs and Potential Impact on Bat Species from the Onshore Facilities During O&M

IPF	Project Activity	Impact Characterization
Noise/Traffic	Routine and non-routine maintenance	Indirect, short-term
Visible Structures/Lighting	Routine and non-routine maintenance	Direct/indirect, long-term

Noise and Traffic

According to the Onshore Acoustic Assessment within Appendix P2 of the COP, during O&M the proposed OnSS would introduce new sources of sound including transformers, shunt reactors, harmonic filters, cooling and ventilation associated with the outdoor substation equipment, as well as condensers, pumps, skids and auxiliary transformers associated with the synchronous condenser building. Operational sound from the OnSS and ICF is modeled to be 43.9 dBA (Leq) or less when measured at the nearest anthropogenic NSRs, which will fall within the ambient sound range measured at baseline conditions. Temporary noise and construction-related traffic may occasionally be generated due to non-routine maintenance. In such cases, these impacts could cause temporary avoidance behavior and/or displacement of bat species. Such impacts related to noise and traffic are considered ***indirect*** and ***short-term***.

Visible Structures and Lighting

As stated in the construction section above, the OnSS, ICF, and overhead transmission lines within the TNEC ROW will be considered visible structures. Changes to the habitat conditions will reduce potential roosting habitat which could potentially influence bat behavior in terms of roost selection in proximity of the OnSS, ICF, and TNEC ROW. These conditions will exist throughout the O&M phase of the Project. Mortality or injury due to risk of collision with these structures for bat species has little to no likelihood of occurrence. If bats collide with these structures, impacts are considered ***direct*** and ***long-term*** impacts. Bat avoidance and behavior change related to habitat conversion and loss are considered ***indirect*** and ***long-term*** impacts.

During the operation and maintenance of the OnSS and ICF, general yard lighting will be used for assessment of equipment. In general, the lighting will be off at night unless there is work in progress or lights are left on for safety and security purposes. As during construction of the Onshore Facilities, lighting at night has the potential to temporarily displace bats and/or disrupt normal behavior. The use of lighting at night is expected to be infrequent. The impacts lighting may have on temporary bat displacement and/or behavior are considered ***indirect*** and ***long-term***.

4.3.7.3 Proposed Environmental Protection Measures

In general, offshore exposure of bat populations has been avoided by siting the Project offshore in a Wind Energy Area designated by BOEM. To minimize or mitigate the potential for bat impacts and habitat loss, the Project will use best practices identified in the *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan* (BOEM 2016). The Project will comply with FAA and USCG requirements for lighting and, to the extent practical, using lighting technology that minimizes impacts on bat species.

Several environmental protection measures will reduce potential impacts to bat species, including but not limited to:

- Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations.
- To the extent feasible, tree and shrub removal for Onshore Facilities will occur outside the avian nesting and bat roosting period between May 1 and August 15. If tree and shrub removal cannot avoid this season, Revolution Wind will coordinate with appropriate agencies to determine appropriate course of action.
- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian and bat species to avoid individual WTGs and minimize risk of potential collision.
- Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian and bat species.
- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).
- An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
- Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable.
- The Onshore Transmission Cables will be buried; therefore, avoiding the risk to avian and bat species associated with overhead lines.
- Revolution Wind will document any dead (or injured) bats found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and USFWS.

4.4 Cultural Resources

4.4.1 Above Ground Historic Resources

This section describes the affected environment for above ground historic resources within offshore portions of the RWF, RWEC-OCS, and RWEC-RI and Onshore Facilities (as defined in Section 1.1, Figure 1.1-1). Above ground historic properties are defined as districts, buildings, structures, objects, or sites that are listed in, or determined eligible for listing in, the National Register of Historic Places (NRHP) or which have been designated as National Historic Landmarks (NHL). The identification of these resources and the evaluation of potential impacts involved the completion of desktop and field studies, which are detailed in Appendices U1 (Visual Impact Assessment and Historic Resources Visual

Effects Analysis - Revolution Wind Onshore Facilities) and U2 (Historic Resources Visual Effects Analysis - Revolution Wind Farm). Summaries of the findings of each study are presented in this section.

The evaluation of above-ground historic properties was coordinated with Visual Impact Assessments (VIAs) prepared for the Project (Appendices U1 and U3 Visual Impact Assessment - Revolution Wind Farm]). The VIAs contribute to the anticipated review of the RWF and RWEC's potential effects on above ground historic resources, which is required as part of BOEM's review under Section 106 and Section 110(f) of the NHPA and 36 CFR 800.10.

4.4.1.1 Affected Environment

The analysis herein considers historic properties within 40-mi (64.4-km) of the RWF and within 3 mi (4.8 km) of the Onshore Facilities (which include the proposed OnSS and ICF), collectively referred to as the Visual Study Area (VSA). The VSA for the RWF includes approximately 6,113 mi^2 (15,833 km^2) of open ocean, 1,488 mi^2 (3,854 km^2) of land (including inland water bodies), and over 1,008 linear miles (1,622 linear km) of shoreline in Rhode Island, Massachusetts, Connecticut, and New York. The VSA for the Onshore Facilities includes approximately 29.8 mi^2 (77.2 km^2) within the Town of North Kingstown and small portions of Warwick and East Greenwich, Rhode Island. Three miles is considered a reasonable and conservative VSA given the nature of the proposed technology associated with the OnSS and ICF and the nature of the screening features present in the regional landscape and directly adjacent to the Onshore Facilities. Additionally, the tallest features within the OnSS and ICF also have a very narrow profile, suggesting that atmospheric diminishment and human visual acuity will nearly completely eliminate visibility beyond a distance of 3 miles. In addition, the Onshore VSA includes a portion of the Narragansett Bay. Only a portion of the areas within the HRSA will have open views of the RWF and Onshore Facilities.

The Research Way O&M building is located in Setauket- East Setauket, New York and will utilize an existing building on a 4.5-acre site within an existing commercial business park. This existing building will be internally upgraded to establish office and warehouse space. The exterior of the building will be maintained and improved from its existing condition. Based the analyses discussed in Appendix U1, the O&M Facility will not result in adverse effects to any above-ground historic properties.

The final Area of Potential Effects (APE) will be formally determined by BOEM as part of the agency's NEPA process; this section refers to the Preliminary Area of Potential Effects (PAPE) to identify areas where potential visual impacts from Project activities. The process for identifying and evaluating visual effects to historic properties resulting from the construction and operation of the RWF and Onshore Facilities will involve consultation with BOEM, SHPOs, THPOs, and other consulting parties with a demonstrated interest in the historic properties (e.g., a local historical society). For the purposes of the COP, local or state designated properties are considered potentially NRHP-eligible pending consultation with BOEM, New York State Historic Preservation office (NYSHPO), Massachusetts Historical Commission (MHC), Rhode Island Historical Preservation and Heritage Commission (RIHPHC), Rhode Island Historical Cemetery Commission (RIHCC), and the Connecticut State Historic Preservation Office (CTSHPO) under Section 106 of the NHPA. Appendices U1 and U2 do not include the identification of new or previously unidentified above-ground historic properties that are potentially eligible for listing in the NRHP.

Revolution Wind Farm

Based on viewshed analysis within the RWF VSA, the PAPE, for visual effects to above-ground historic properties, was defined as all locations within New York, Connecticut, Rhode Island, and Massachusetts with potential views of one or more WTGs. Areas of RWF visibility were determined by performing several lidar viewshed analyses. These analyses delineated approximately 3 percent of lands within the VSA with potential views of some portion of the RWF, based on the availability of an unobstructed line of sight.

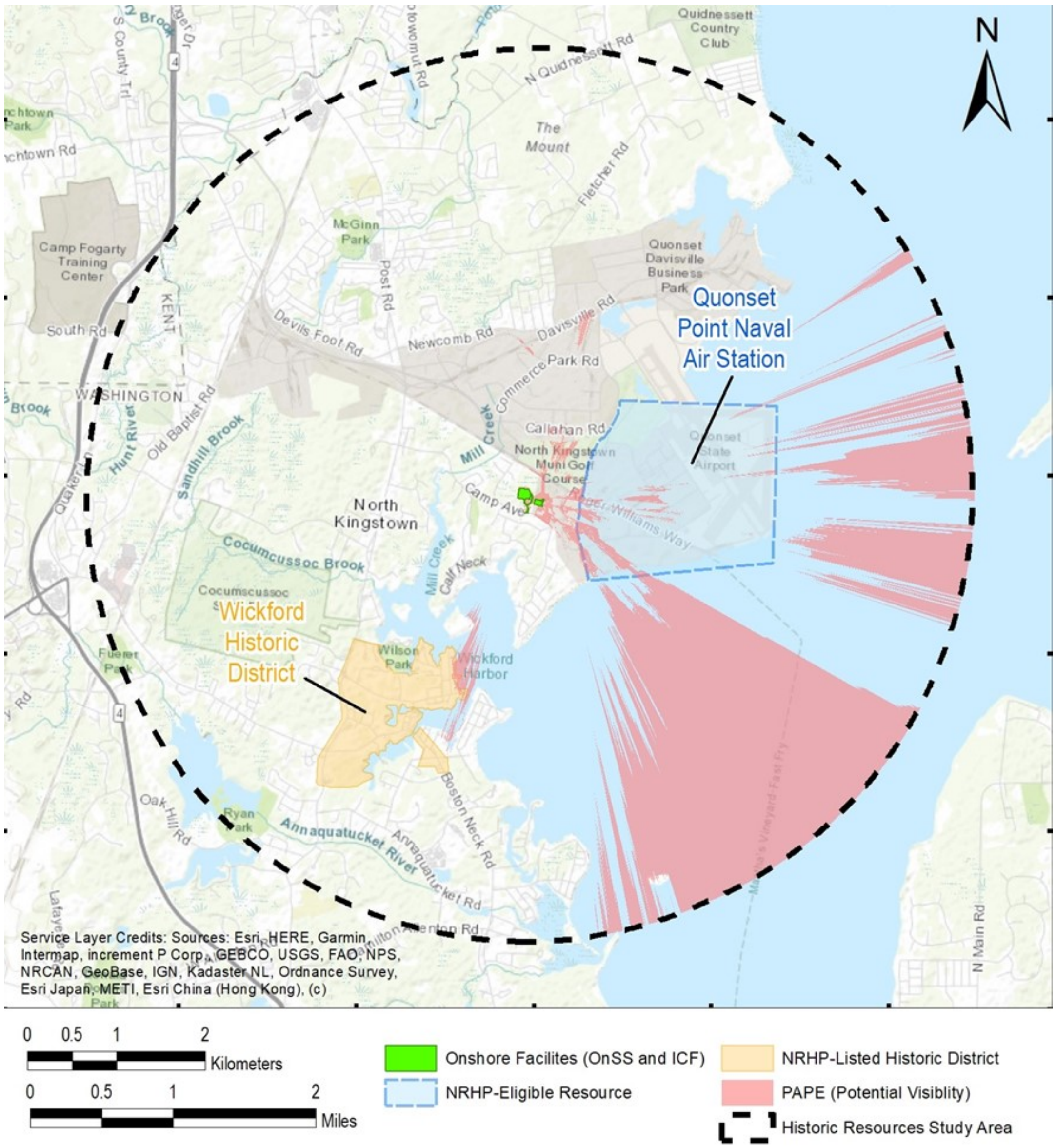
The RWF VSA includes 7,231 historic properties either designated as NHLs, NRHP- or state-listed, or NRHP- or state-eligible individual resources or districts, Traditional Cultural Properties (TCPs), or state-inventoried resources in New York, Connecticut, Rhode Island, and Massachusetts within the VSA. The viewshed analysis determined that the proposed offshore facilities would be visible from 552 of the 7,231 identified resources within the VSA (Appendix U2 [Attachment A]).

Onshore Facilities

The RWEC-RI will make landfall in the vicinity of Whitecap Drive in the Quonset Point Business Park in North Kingstown, Rhode Island where cables enter transition joint bays (TJBs) and become the Onshore Transmission Cable. From the TJBs, the cable will be buried beneath public roads for a distance of approximately 1 mi (1.6 km) where the Onshore Transmission Cable will terminate at the OnSS north of Camp Avenue. The Onshore Transmission Cable route crosses one previously identified historic property, the Quonset Point Naval Air Station.

The OnSS, ICF, and overhead interconnection circuits associated with the ICF (i.e., the TNEC Interconnection ROW) are the only onshore Project components that will be potentially visible from historic resources during operation. The Onshore Facilities will occupy approximately 8 acres of currently forested land in the Quonset Business Park, adjacent to the existing National Grid Davisville Substation. Based on a viewshed analysis, views of the proposed Onshore Facilities would be available from approximately 14.7 percent or 4.5 mi2 (7.2 km^2) of the Onshore VSA. The Onshore VSA contains 80 resources listed, eligible, or potentially eligible for listing on the state and NRHP. Of the 80 historic resources identified, a total of two above-ground historic properties are located within the PAPE. These properties include the Wickford Historic District and the Quonset Point Naval Air Station.

Figure 4.4.1-2 Previously Identified Historic Resources Within 3 Miles of the Onshore Facilities



4.4.1.2 Potential Impacts

Potential impacts on above-ground historic resources range from physical alteration, disturbance, or destruction of a historic property caused by construction activities to changes such as the introduction of new and incompatible visual elements or auditory effects that diminish the historically significant characteristics of a historic property. The Federal Regulations entitled "Protection of Historic Resources" (36 CFR 800) define potential impacts (adverse effects) on historic resources as follows:

- An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative (36 CFR 800.5[2]).

Additional considerations may be required when a federal undertaking affects a National Historic Landmark. Section 110 (f) of the NHPA states:

- (f) Prior to the approval of any Federal undertaking which may directly and adversely affect any National Historic Landmark, the head of the responsible Federal agency shall, to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to such landmark, and shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking (CFR, 2004).

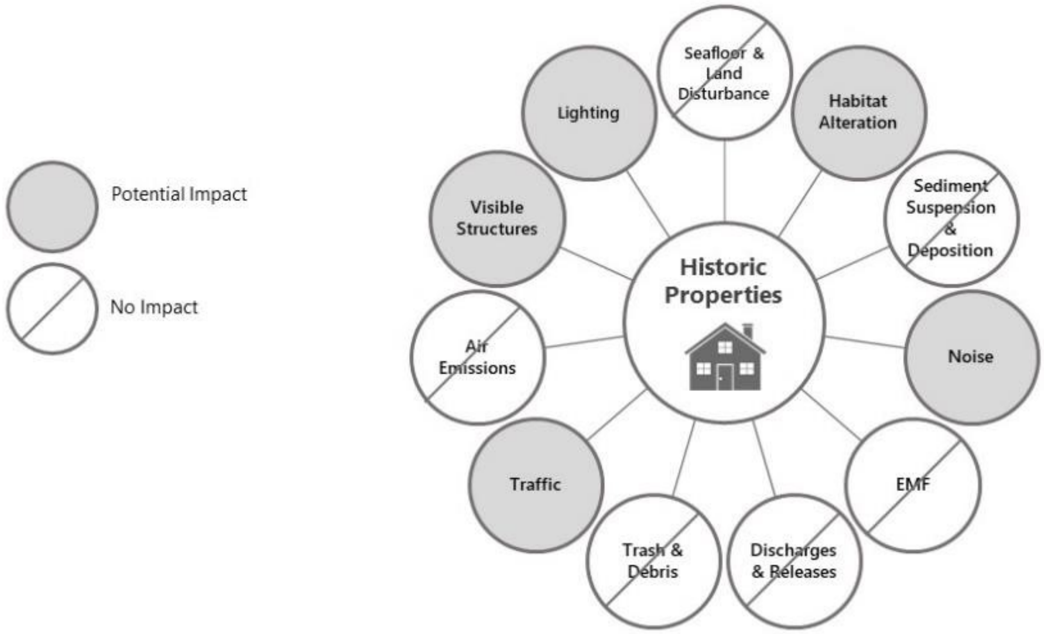
Additionally, the following criteria were included in determining properties that may actually be adversely impacted by the Project.

- Historic resources beyond 25 miles will not be adversely impacted by the Project due to minimal visibility resulting from curvature of the earth and diminishment of visibility over resulting from atmospheric interference.
- Single cells of visibility produced in the viewshed analysis represent approximately 96 square feet of space and may be considered erroneous or otherwise not representative of actual visibility. Therefore, historic properties with only one “cell” of visibility were not considered to have actual views of the Project.
- Potential views of five WTGs or less (i.e., 5 percent or less of the total number of turbines) have also been shown in recent historic resources visual effects analyses for offshore wind projects (EDR, 2019) to have limited visual effects on historic properties.

In addition, all lighthouses within the PAPE and one historic ocean vessel were included in the analysis even though they may exceed the thresholds described above due to their elevated views, location near the ocean or historic relationships with the open ocean waters. Application of these criteria resulted in the identification of 88 historic properties that may be adversely affected by the construction and operation of the RWF (Appendix U2 [Attachment A]).

The formal impacts (effects) determination for the Project will be completed through the Section 106 consultation process between BOEM, SHPOs, THPOs, and other interested parties, as applicable. The Historic Resource Visual Effects Analyses completed for the Project will be provided to SHPOs and THPOs to support this process.

Figure 4.4.1-1 IPFs on Above-Ground Historic Properties



Revolution Wind Farm

IPFs that could result in effects to historic properties during the construction, O&M, and decommissioning phases of the RWF are described below and summarized in Figure 4.4.1-1.

Construction and Decommissioning

There are no NHL, NRHP-listed, or NRHP-eligible above-ground historic properties within the PAPE that will be physically altered by construction of the RWF. However, during the construction and decommissioning period, it is likely that vessels such as jack up barges, cranes, and support vessels will be visible from onshore historic properties. The presence of these construction vessels along with the WTGs and OSS in varying stages of construction are likely to introduce discordant visual features on the horizon. Table 4.4.1-1 provides a summary of the IPFs and potential impacts associated with the construction and decommissioning of the RWF.

Table 4.4.1-1 IPFs and Potential Levels of Impact on Historic Structures Resulting from the RWF During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Visible Structures	WTGs and OSS	Short-term
Lighting	Offshore Construction and Decommissioning	Short-term
	Port Facilities	Short-term
Noise	Offshore Construction Vessels	Short-term
Traffic	Vessel and Air Traffic	Short-term

Visible Structures

No physical impacts to above-ground historic properties are anticipated as a result of construction of the RWF. Construction of the RWF will include use of existing port facilities for assembly and fabrication, and crew transfer and logistics. Visible structures at the existing port facilities associated with the project will include the temporary laydown and storage of large WTG components, cranes for positioning and loading of the Project components, vehicles and vessels associated with Project components and crew transportation, and temporary building associated with equipment storage and offices. These structures and activities are generally similar to other activities associated with working waterfront ports. In addition, these structures and activities will be temporary in nature. The relative concentration of equipment and support facilities associated with the construction of the RWF is anticipated to result in ***Short-term*** visual effects on historic resources.

Similar to the construction phase, decommissioning of the RWF will not result in physical impacts to above-ground historic properties. Activities associated with the decommissioning of the RWF would result in a ***Short-term*** visual impact on historic resources.

Lighting

Nighttime construction activities will likely require lighting associated with the barges and vessels within the Lease Area and Port Facilities. Nighttime construction activities are likely to be visible from onshore vantage points and will result in visual impacts due to the presence of direct light sources and skyglow in a previously dark seascape. However, the construction lighting would be temporary and impacts would be diminished by earth curvature and, at times, atmospheric conditions. Therefore, lighting associated with construction of the RWF result in a ***Short-term visual*** impact on historic resources.

Nighttime decommissioning activities will likely be similar in scale to the construction phase. The decommissioning support vessels and nighttime decommissioning activities are likely to result in light pollution visible from onshore vantage points and will result in visual impacts due to the presence of direct light sources and skyglow in a previously dark seascape. However, nighttime decommissioning would be temporary and impacts would be diminished by earth curvature and, at times, atmospheric conditions. Therefore, as with the construction phase, lighting associated with the decommissioning of the RWF result in a ***Short-term visual*** impact on historic resources.

Noise

Construction activities associated with the RWF will take place offshore at distances which would make noise impacts difficult to perceive from shore. Sound from the operation of the WTGs would be 27.3 dBA or less and operation of the audible nautical hazard prevention devices would be 15.1 dBA or less at the nearest shorelines (from all foghorns sounding together) and 12.1 dBA or less from an individual foghorn. Operational sound from the Project would comply with relevant federal, state, and local noise standards. Sound levels from pile driving during construction would be 11.2 dBA or less at the nearest shorelines and would comply with relevant federal, state, and local noise standards. There may be increased noise at onshore ports in support of construction activities. However, these activities will not be out of context with the working industrial seaports in which they will be located. An analysis of potential offshore airborne sound impacts is detailed in Appendix P1 (Offshore Airborne Sound Assessment - Revolution Wind Offshore Wind Farm). The effect of distance and the temporary nature of construction activities would result in a ***Short-term*** impact on historic resources.

Decommissioning of the RWF will involve work offshore at distances which would make noise impacts difficult to perceive from shore. There may be increased noise at onshore ports in support of decommissioning activities. However, these activities will not be out of context with the working industrial seaports in which they will be located. As with the construction phase, decommissioning activities would result in a ***Short-term*** impact on historic resources.

Traffic

Marine traffic associated with the Project will not have direct physical impacts to historic properties and is not anticipated to have significant visual impacts to historic properties located within the PAPE. During the construction phase, the increased flow of ships across the horizon could result in temporary visual impacts, drawing attention to the modern vessels as they move to and from the Project site. This would have the secondary effect of drawing attention toward the WTGs as they are being erected. However, the potential increases would be temporary in nature. Therefore, although there may be potential impacts during the construction of RWF, marine traffic would result in ***Short-term*** visual effect on historic resources.

Marine traffic associated with the decommissioning of RWF will not have direct physical impacts to historic properties and is not anticipated to have significant visual impacts to historic properties located within the PAPE. As the WTGs are removed, the increased flow of ships across the horizon could result in temporary visual impacts, drawing attention to the modern vessels as they move to and from the Project site. The visual impact may be mitigated as the WTGs are gradually removed from the ocean horizon. As with the construction phase, decommissioning activities would result in a ***Short-term*** visual impacts on historic resources

O&M

Of the three phases of the RWF, the O&M phase is expected to have the greatest impact on above-ground historic properties due to the potential visual intrusion of offshore facilities on the historic settings of shoreline properties. The sensitivity of individual historic properties located within the PAPE varies depending on the historical relationship of each property to maritime settings and views. The impacts are anticipated to persist for the period of operations and cease upon completion of decommissioning. Table 4.4.1-2 provides a summary of the IPFs and potential impacts associated with the RWF during the O&M phase.

Table 4.4.1-2 IPFs and Potential Levels of Impact on Historic Structures Resulting from the RWF During O&M

IPF	Project Activity	Impact Characterization
Visible Structures	WTGs and OSS	Long-term
Lighting	WTGs and OSS	Long-term
	Port Facilities	Short-term
Noise	Offshore Construction Vessels	Long-term
Traffic	Vessel and Air Traffic	Long-term

Visible Structures

To evaluate potential visual impacts during operation of the RWF, the HRVEA included a viewshed analysis of the potential visibility of the proposed WTGs and OSS, which represent the tallest proposed structures. Utilizing USGS lidar data, a highly detailed DSM of the visual study area was created. The DSM included the elevations of buildings, trees, and other objects large enough to be resolved by lidar technology. Additionally, a digital terrain model (DTM) was created, representing bare earth conditions. The analysis of potential visibility of the RWF was based on 98 points representing the proposed WTGs, each with an assumed maximum blade tip height of 873 feet (266 m); two points representing the OSS, with a maximum height of 223 ft (68 m); and an assumed viewer height of 5.5 ft (1.7 m). The viewshed analysis was conducted using ESRI ArcGIS PRO® software with the Spatial Analyst extension and considered curvature of the earth in the analysis.

Potential turbine visibility, as indicated by the viewshed analyses, is illustrated in Figure 1.3-1 and summarized in Table 1 of Appendix U2. Within the VSA, the lidar-based viewshed analysis indicates that approximately three percent of the land area could have potential views of some portion of the Project based on the availability of an unobstructed line of sight. Visibility will be eliminated in large portions of the VSA where buildings/structures and vegetation screens views toward the Project site. Forest land is the dominant land use within the mainland portions of the VSA (covering approximately 55 percent of the land within a 40-mi [64.4 km] radius of the Project) and will significantly reduce potential Project visibility throughout the area. In areas of concentrated human settlement, buildings will also significantly screen outward views. Considering the screening provided by structures, vegetation, and topography, potential Project visibility is largely restricted to the ocean shoreline and water bodies immediately inland of the shoreline (e.g., salt ponds and bays).

The RWF will be visible and will result in a change to the visual setting of some historic properties located along the shoreline. The proposed WTGs would be a new feature in the visual setting and views toward the ocean. Due to their scale and form, they are likely to attract viewer attention. In addition, due to the size and scale of the Project it will occupy relatively large portions of the visible horizon. The minimum distance separating above-ground historic properties from the proposed

WTGs is approximately 9.5 mi. The distance to shore from the proposed WTGs ranges from 8.2 mi (13.2 km), on the uninhabited Nomans Land Island, to 31.4 mi (50.5 km), in Montauk and Muskeget Island (Nantucket). A comprehensive visibility analysis is presented in Attachment A of the HRVEA (Appendix U2) that lists the historic properties within the VSA that have potential visibility of the Project, as determined by the viewshed analysis.

Depending on the viewer position relative to the Project and distance from the Project, some locations (such as Montauk and Mainland Rhode Island) are likely to experience minimal visibility. However, the Project is likely to occupy a large percentage of the vast horizon available due to its size and scale. Vantage points closer to the Project may experience a substantial change to the seascape and horizon resulting from the addition of the RWF.

Actual Project visibility will be limited by several other factors not specifically addressed in the visibility analyses conducted as part of the HRVEA for the Project, including weather conditions, waves on the ocean surface, humidity, and air pollution.

Weather conditions with diminish Project visibility over significant portions of a given year. A study completed by BOEM in 2017 used National Weather Service (NWS) data collected for a 10-year period to predict potential offshore visibility using a relational algorithm based on relative humidity. For data collected at Newport, visibility to 20 nm occurred approximately 61 percent of the year during daytime hours while visibility to 30 nm occurred approximately 35 percent of the year during daytime hours. Average daylight and nighttime visibility for clear conditions was 20 nm, with seasonal values ranging from 16 nm in summer to 24 nm in winter (Wood et al., 2017).

In addition, sky conditions will also affect a viewer's ability to detect the WTGs on the horizon. For example, overcast days will eliminate hard shadows on the WTGs created by direct sunlight, which will reduce contrast and minimize the ability to perceive the blades or recognize movement. Additionally, on overcast days the white sky color on the horizon will further reduce WTG visibility due to the lack of contrast against the background sky. Conversely, on clear days, when the WTGs are fully front lit or back lit, visibility may be higher. To predict the frequency of each of these conditions, the NCDC data was analyzed and broken down by cloud cover. The results of this analysis suggest that during daylight hours, clear sky conditions occurred approximately 42 percent of the time, partly cloudy conditions occurred during approximately 4 percent of daylight hours and overcast sky conditions occurred about 52 percent of the time (EDR, 2018).

Long-term impacts may occur to properties for which historic maritime settings and open-ocean views are important aspects of the property's significance. Visual effects to historic properties located within 25 mi of the Project with potential visibility are anticipated due to the large size and scale of the Project. The visibility of the proposed WTGs and OSSs relative to existing views is not necessarily greater from these properties than from other resource locations, but the relevant historic settings may be more expansive and inclusive of the wind farm. Historic lighthouses are the most prominent examples of such properties, as the historic location, function, and design of the properties are associated with distant seaward views. For these properties, the presence of visible twenty-first-century infrastructure on the ocean horizon would likely constitute a change in the historic settings. There are 34 historic lighthouses within the PAPE, including the Block Island Southeast Lighthouse on Block Island, and Montauk Lighthouse in Montauk, New York which are both National Historic

Landmarks. The Breakers, Marble House, Newport Historic District, Ocean Drive Historic District, and Bellevue Avenue Historic District in Newport, Rhode Island, the Battle of Rhode Island Historic District in Portsmouth, Rhode Island, and the Steamer *Sabino* in Mystic, Connecticut are also National Historic Landmarks and may also have an elevated sensitivity to visual impacts due to their location, historic architectural and landscape designs which embrace ocean views, or historic relationships with the open ocean waters. National Historic Landmarks are afforded additional considerations to minimize harm caused by federal undertakings in accordance with Section 110(f) of the NHPA and 36 CFR 800.10. Appendix U2 provides a detailed summary of individual historic property impact assessments.

TCPs associated with Native American communities are present within the study area, and such properties would potentially be sensitive to visual impacts from Project construction, O&M, or decommissioning. Revolution Wind has engaged with representatives from Native American communities to identify TCPs and assess potential Project impacts to such historic properties. Revolution Wind also recognizes that government-to-government consultation between BOEM and tribes under Section 106 will be necessary for the full consideration of such properties and potential Project impacts.

Lighting

The VIA (Appendix U3) and the HRVEA (Appendix U2) indicate that there is potential visibility of the WTGs, OSSs, and FAA lighting from the coastlines of New York, Connecticut, Rhode Island, and Massachusetts, resulting in *long-term visual impacts* to historic properties. The historic properties with the highest potential for visibility of the lighting associated with the RWF were those that were situated to take advantage of panoramic ocean views, such as the North Light and Block Island Southeast Lighthouse on Block Island, and Gay Head Lighthouse on Martha's Vineyard. These represent examples of historic properties that receive high public use/visitation in the region that will have at least some visibility of the RWF. Due to the size and scale of the RWF and its relative expansiveness across the ocean horizon, the aviation obstruction and USCG lighting associated with WTGs will have a long-term visual impact to historic resources areas along the coast. A comprehensive list of areas from which the RWF will be potentially visible within the PAPE are listed in Attachment A and depicted in Figure 3.1-1 of the HRVEA (Appendix U2). The VIA report in Appendix U3 provides further discussion of the visibility of the WTGs within the 40-mi (64.4-km) study area and the methods used to assess potential visual impacts from the RWF, including viewshed mapping, field reviews, and visual simulations.

Noise

Noise generated by WTGs will be minimal and would be generated at distances which would reduce audibility at any historic resource within the PAPE. Therefore, operational noise associated with the WTG will not impact onshore historic properties. Vessel and air traffic associated with the operational phase of the RWF will not be out of place given the proximity of the historic resources to multiple working ports and the abundance of existing vessels in the area. Therefore, it is anticipated that noise associated with traffic during the operation of the Project will result in ***long-term*** impacts on historic resources.

Traffic

Marine traffic is expected to be less frequent during operation of the RWF than during construction or decommissioning. Given the relative frequency of seagoing vessels on the horizon within the PAPE, it is not likely that traffic related to the RWF will be a noticeable change. Therefore, it is anticipated that traffic during the operation of the Project will result in ***long-term*** visual impact on historic resources.

Onshore Facilities

Construction and Decommissioning

Construction of the Onshore Facilities will occur adjacent to the existing TNEC Davisville Substation, in a lot surrounded by mature trees. The maximum area of land disturbance associated with all of the construction of the Onshore Facilities will be approximately 11 ac (4.5 ha). The operational footprint of the ICF will be 1.6 ac (0.6 ha); and the operational footprint of the OnSS will be up to 3.8 ac (1.5 ha). The OnSS and ICF construction will require extensive tree clearing, grading, and excavation over an approximate 1-year construction period. Once the construction of the Onshore Facilities is complete, the remaining disturbed areas will be stabilized and restored, including the installation of any proposed landscaping/screening.

The length of the Onshore Transmission Cable will be approximately 1 mi (1.6 km). The Onshore Transmission Cable will be constructed primarily within public roads and existing rights of way (ROW). Installation of the Onshore Transmission Cable will generally require excavation of an approximate 8-ft (2.4-m)-wide trench within a 25-ft (7.6-m)-wide temporary disturbance corridor; however, the disturbance area at the splice vaults will be 30 ft (9.1m) wide by 75 ft (22.8m)-long. The Onshore Transmission Cable will be installed within a duct bank, buried to a target depth of 3 to 6 ft (0.9 to 1.8 m) to top of duct bank and consistent with local utility standards. The splice vaults will be buried to a depth of up to 16 ft (5 m) to the bottom of the vault. The entire temporary disturbance corridor will be restored to pre-construction conditions following installation of the Onshore Transmission Cable.

Depending on the methods employed in the decommissioning of the Onshore Facilities and Onshore Transmission Cable, impacts may vary. If the below-ground cables are removed, then the excavation of the cable routes along the ROW will occur. This would involve work activities similar in nature and intensity to the construction phase and is considered the most conservative estimate. If the below-ground cables are abandoned, then there will be no impact from decommissioning. Table 4.4.1-1 provides a summary of the IPFs and potential impacts associated with the construction and decommissioning of the Onshore Facilities.

Table 4.4.1-2 IPFs and Potential Levels of Impact on Historic Structures Resulting from Onshore Facilities During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Visible Structures	Onshore Facilities	Short-term
	Onshore Transmission Cable	Short-term
Lighting	Onshore Facilities	Short-term
	Onshore Transmission Cable	Short-term
Noise	Onshore Facilities	Short-term
Traffic	Onshore Facilities	Short-term

Visible Structures

During construction and decommissioning of the Onshore Facilities, rigging and ground excavation equipment will be used on site, but will be mostly screened from existing historic resources by existing vegetation and structures. Therefore, it is anticipated that ***short-term impacts*** will occur during the construction and decomissioning phase of the Onshore Facilities.

Construction and decommissioning of the Onshore Transmission Cable will involve excavation of the existing roadways and other public ROWs over a distance of approximately 1 mi (1.6 km). However, because the construction is proposed along Whitecap Drive and Circuit Drive, it is anticipated that construction equipment will not appear out of place within this active industrial complex. Therefore, the visual effects to the Quonset Point Naval Air Station are anticipated to be ***short-term***.

Lighting

Construction of the Onshore Transmission Cable and Onshore Facilities will typically take place during daylight hours. However, nighttime safety and security lighting may be required during the construction of the Onshore Facilities. These lights would generally be screened by the existing vegetation and would not be a change from the existing lighting conditions in the vicinity. As a result, it is anticipated that construction lighting associated with the Onshore Facilities would result in ***short-term*** impacts to above-ground historic properties.

During the removal of the Onshore Facilities components a similar level of lighting would be employed for safety and security after work hours, or during work hours in low light levels. Depending on the methods used in decommissioning, there may be no lights used at all. It is anticipated that the most conservative assessment is that ***short-term*** impacts will occur during the decommissioning phase if the cables are removed.

Noise

Construction and decommissioning activities associated with the Onshore Facilities would result in noise generated from heavy equipment performing clearing, grading, excavation, the installation of foundations, and heavy lifting of substation components. However, this type of noise is not out of context with a working industrial park and will be temporary in nature. As such, ***short-term*** impacts are anticipated from noise associated with the construction and decommissioning of the Onshore Facilities.

Noise associated with the construction and decommissioning of the Onshore Transmission Cable components is anticipated to be similar to noise generated during typical municipal road works or utility repairs. By the most conservative assessment ***short-term*** impacts may occur during the construction and decommissioning of the Onshore Transmission Cable.

Traffic

During construction and decommissioning of the Onshore Facilities, vehicular traffic will increase, and construction equipment will be present along the proposed Onshore Facilities site which may result in short-term noise and vibration. Given the Onshore Facilities site is over 1,000 feet from the nearest historic resource, only ***short-term*** impacts would result from increased traffic associated with the construction and decommissioning of the Onshore Facilities.

Increased traffic associated with the construction and decommissioning of the Onshore Transmission Cable is not anticipated to result in impacts to historic structures due to the location of the activities within existing roads and ROWs in the industrial park.

O&M

Due to minimal anticipated visual intrusion of the Onshore Facilities on the historic setting of adjacent above-ground historic properties, the O&M phase is expected to have minimal visual impacts on above-ground historic properties. Any visual impacts are anticipated to persist for the period of operations and cease upon completion of decommissioning. Table 4.4.1-3 provides a summary of the IPFs and potential impacts associated with the of the Onshore Facilities during the O&M phase.

Table 4.4.1-3 IPFs and Potential Levels of Impact on Historic Structures Resulting from Onshore Facilities During O&M

IPF	Project Activity	Impact Characterization
Visible Structures	Onshore Facilities	Long-term
Lighting	Onshore Facilities	Long-Term
Noise	Onshore Facilities	Long-Term
Traffic	Onshore Facilities	Long-Term

Visible Structures

A lidar viewshed analysis was completed to determine the areas within the 3-mile RWEC VSA that may have visibility of the Onshore Facilities. Results of this analysis suggested that approximately 15 percent of the 3-mile (4.8-km) visual study area would have visibility of some portion of the Onshore Facilities. Of the 80 resources identified within the visual study area, two may have potential visibility of the facility. The Quonset Point Naval Air Station is an S/NRHP-Eligible Resource as determined by the RIHPHC and is an approximately 974-ac former United States Navy training facility built in 1941. The property consists of typical World War Two-era construction design concepts and modern building materials.

The Quonset Point Naval Air Station's historic significance is derived primarily from its strategic military function rather than any aesthetic characteristics. The Air Station is 0.25 mi from the Onshore Facilities and is situated in the Quonset Point Business Park, in the Town of North Kingstown. Visibility is generally restricted to small discrete corridors occurring between existing buildings associated with the facility. Additionally, two large warehouse buildings were erected after the collection of lidar data.

The NRHP-listed Wickford Historic District is located in the unincorporated village of Wickford in the Town of North Kingston and is located approximately 1.1 miles from the proposed Project. The historic district encompasses approximately 389.7 acres and is roughly bounded by Post Road to the west, Intrepid and Roosevelt Drives to the shoreline from Mill Cove at Newtown Avenue to the north, the shoreline of Wickford Cove down to Loop Drive on the east and south, and a portion along Boston Neck Road on the south shore of Wickford Cove. Although a majority of the buildings within the district date from 1785-1845, the oldest extant above-ground historic property within the district dates to 1750. Viewshed analysis indicates that the PAPE will be mostly confined to the area along the Main Street pier. The residential neighborhood along Sauga Point and the north shore of Fishing Cove is set in between the Project and the Wickford Historic District and would likely screen views to the Project from the Wickford Historic District.

Based on these results, it is anticipated that ***long-term*** visual effects to historic properties will result from the O&M of the Onshore Facilities.

Upon completion of the construction phase of the Onshore Transmission Cable, there will not be any visible components of the installed cable and therefore ***no visual impacts*** to historic structures.

Lighting

Operational lighting associated with the Onshore Facilities will be required for the safe and secure operation of the facility. However, the light sources are expected to be lower in profile than the maximum heights used in the viewshed analysis. As such, the lights associated with the Facility will have minimal visibility from historic structures. Due to the developed nature of this area, the lights associated with the Facility are not expected to contribute significantly to the existing sky glow resulting from existing light sources present in the area. Therefore, it is anticipated that the Facility lighting will have a ***long-term*** effect on historic structures.

The Onshore Transmission Cable routes will have ***no impact*** with respect to lighting during operations, since the cable will be buried beneath existing roads or within other public ROWs.

Noise

The proposed Onshore Facilities would introduce new sources of sound including transformers, shunt reactors, harmonic filters, cooling and ventilation associated with the outdoor substation equipment, as well as condensers, pumps, skids and auxiliary transformers associated with the synchronous condenser building. As such, there is potential for ***long-term*** impacts to historic structures resulting from operational noise. Sound from the substation would be 43.9 dBA or lower at the closest NSRs which would be below the EPA guideline for noise exposure (48.6 dBA Leq) and below the Town of North Kingston, Rhode Island nighttime noise ordinance limit for residential properties (50 dBA). Operational sound from the Onshore Facilities would also be below 50 dBA at the nearest residential property lines and below 70 dBA at the nearest commercial/industrial property lines which is below the noise ordinance noise limits. Therefore, the operation of the proposed Onshore Facilities would comply with relevant federal, state, and local noise limits and would be no operational noise impacts. An analysis of potential onshore airborne sound impacts is detailed in Appendix P2 (Onshore Airborne Sound Assessment - Revolution Wind Offshore Wind Farm). The OnSS and ICF will be located in a clearing within a forested area immediately adjacent to an existing substation. Noise generated by substations are minimal and will be difficult to perceive within the immediate industrial context of the OnSS's and ICF's location.

The Onshore Transmission Cables will have ***no impact*** with respect to noise during operations, since the cable will be buried beneath existing roads or within other public ROWs.

Traffic

O&M associated with the Onshore Facilities is expected to be similar to ongoing O&M of the existing TNEC Davisville Substation in the Town of North Kingstown. Given existing traffic within the Quonset Point Business Park, it is likely that no noticeable increase over existing traffic patterns will occur. Therefore, it is anticipated that the traffic will have a ***long-term*** impact on historic properties.

Onshore Transmission Cable route will have no regular maintenance, unless there is a failure or malfunction requiring exposure and repair of the cable. If any unforeseen maintenance is required, impacts to traffic from potential traffic detours might occur, but will result in ***no impacts*** to historic structures.

4.4.1.3 Proposed Environmental Protection Measures

Options for mitigating visual impacts of wind energy facilities of this type are limited, given the nature of offshore wind energy projects and their siting criteria. Because of these limitations, mitigation for impacts to historic properties typically consists of measures that directly benefit historic properties and/or the public's appreciation of them. Mitigation measures that have been proposed for other wind energy projects in states within the visual study area have included activities such as cultural resources studies, monetary contributions to historic property restoration projects, development of heritage tourism promotional materials, development of educational materials and lesson plans, and development of public history materials, such as roadside markers.

If the NEPA review process determines that nighttime mitigation is required, the Project is willing to utilize Aircraft Detection Lighting Systems (ADLS) technology to mitigate/reduce potential nighttime visual impacts if the technology is feasible in an offshore setting and approved by BOEM. ADLS reduces potential nighttime visual impacts by allowing aviation obstruction lighting to be active only as necessary when aircraft are approaching and within the airspace of the wind farm. A study completed by Capital Airspace Group (CAG) suggests that based on past aviation activity in the region, the aviation obstruction lights associated with the RWF, would be activated for a total of approximately 3.5 hours over a one-year period if ADLS is employed. The maximum monthly activation time would occur in August when past slight data suggests activation times would increase to approximately 50 minutes over the entire month. January had the lowest activation frequency with just six seconds of aviation obstruction light activation over the course of the month. Considering the low frequency of light activation, nighttime visual effects to historic structures associated with the aviation obstruction lights would become negligible and intermittent in nature.

Revolution Wind is willing to consider additional financially reasonable and technically feasible mitigation measures, including by applying ADLS, night lighting impacts to historic structures can be substantially reduced or limited. The Applicant is willing to utilize ADLS to mitigate nighttime impacts if the technology is feasible in an offshore setting and approved by BOEM.

Considering the Onshore Facilities, due to the relatively small size and modest height, views from historic resources have largely been avoided.

The following proposed environmental protection measures will reduce potential impacts to historic resources.

- Revolution Wind will use Aircraft Detection Lighting System (ADLS) (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval.
- RWF WTGs will have uniform design, speed, height, and rotor diameter.
- The WTGs will be painted Pure White (RAL 9010) to Light Grey (RAL 7035) as recommended by BOEM and the FAA. Turbines of this color white generally blend well with the sky at the horizon and eliminates the need for daytime warning lights or red paint marking of the blade tips.
- The Onshore Facilities will be located adjacent to an existing substation on a parcel zoned for commercial and industrial/utility use.
- Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise.

4.4.2 Marine Archaeological Resources

This section provides an assessment of marine archaeological resources within the Offshore Envelope (inclusive of the RWF Envelope, RWEC-OCS Envelope, and RWEC-RI State Waters Envelope; see Figure 1.1-1). The RWF and RWEC-OCS are located on the Outer Continental Shelf in federal waters, while the RWEC-RI is located in the state waters of Rhode Island. Onshore Facilities are not discussed in this section given their location on land; refer to Section 4.4.3 for a discussion of terrestrial archaeological resources. The Project constitutes a federal undertaking with the potential to cause effects to submerged historic properties, and it is therefore subject to consultation under Section 106 of the NHPA (Title 54 U.S.C). The marine archaeological resources assessment was developed to assist BOEM and the Rhode Island state regulatory authorities with their compliance to the NHPA, NEPA, and other applicable laws and regulations.

A phased approach was used to identify documented marine archaeological resources and to evaluate the Offshore Envelope APE (APE) for its potential to contain undocumented archaeological resources that might be eligible for listing on the NRHP. The phased approach consisted of two components: (1) literature review and background research to establish an environmental, pre-contact, and historic context to inform data interpretation and assess the archaeological sensitivity of the Project Area; and (2) a full marine archaeological analysis that included processing, analysis, and interpretation of data collected during HRG survey and geotechnical investigations. The background research, methodology, results and recommendations summarized in this section is documented more fully the Marine Archaeological Resource Assessment (MARA), which is included as Appendix M.

The Project's Qualified Marine Archaeologist (QMA) consulted public and proprietary databases to identify previously documented archaeological resources within the RWF, RWEC – OCS, and RWEC – RI, including:

- BOEM Archaeological Resource Information Database
- Global GIS Data Services, LLC, Global Maritime Wrecks Database (GMWD)
- NOAA Automated Wreck and Obstruction Information System (AWOIS)
- NOAA Electronic Navigation Charts (ENC) Database
- Data received from the RIHPHC

Project-specific marine archaeological analysis included a full assessment of gradiometer, side-scan sonar, sub-bottom profiler (CHIRP and sparker), and multibeam echosounder datasets. Revolution Wind's marine survey contractor (MSC) collected HRG data over several campaigns from 2017 through 2020, with the vast majority of the data collection occurring during the 2019/2020 survey campaign. A small subset of data was collected in 2017 and 2018 in association with the proposed development of an adjacent offshore renewable energy project. In its role as the QMA and as required under Lease Stipulation 2.1.2, SEARCH assisted with creation of the COP Survey Plan to ensure that the technologies and methodologies employed during the HRG survey, conducted by the MSC, met BOEM 2017 archaeological guidelines. The HRG survey design incorporated parallel survey lines spaced 30 m (98 ft) apart with perpendicular tie lines spaced 500 m (1,640 ft) apart throughout the RWF, RWEC-OCS, and RWEC-RI. Coordination on the survey plan included pre-survey meetings during which input was solicited from BOEM and the affected tribes to ensure the HRG survey and geotechnical investigations complied with regulatory prescriptions.

An evaluation of all data was used to identify potential submerged cultural resources. The archaeological information derived from site-specific surveys was used to identify archaeological areas of interest (targets) and geological features with pre-contact period archaeological potential. For historic resources, evaluation relied heavily on magnetometer data and side-scan sonar imagery, while pre-contact resources are commonly identified using sub-bottom profiler imagery and geotechnical investigations. Final development of the geological ground model was a valuable resource for identifying large-scale geological trends throughout the APE, which can be helpful in detecting landforms with pre-contact period archaeological potential. The QMA also selected areas within the RWF and RWEC possessing potential geomorphic features of archaeological interest for collection of additional vibracores, analysis of which was used to supplement development of a regional paleolandscape reconstruction. Review of other datasets not publicly available, including those available through the RIHPHC, will be conducted to supplement the information presented in the datasets listed above when consultations are initiated. The Project's QMA conclusions and recommendations based on this comprehensive review of the site-specific data are reported in the MARA (Appendix M).

4.4.2.1 Affected Environment

Regional Overview

The offshore components of the Project are located within federal waters on the OCS and Rhode Island state waters. The APE for direct impacts to marine archaeological resources is defined as the area encompassing all proposed seabed disturbance or other alteration associated with the offshore components of the Project. Pursuant to a programmatic agreement between BOEM, the State Historic Preservation Offices of Massachusetts and Rhode Island, interested Tribes, and the Advisory Council on Historic Preservation, the area of consideration for Section 106 review is defined, in part, as "the depth and breadth of the seabed that could potentially be impacted by seafloor/bottom-disturbing activities associated with the undertakings (e.g. core samples, anchorages and installation of meteorological towers and buoys)" (BOEM, 2012). The formal determination of the APE per 36 CFR 800.4(a)(1) will occur once BOEM accepts the Project's COP consistent with 30 CFR 585 et seq.

Marine archaeological resources from both the pre-contact and post-contact periods are expected within the Project Area. Archaeological resources from the pre-contact period include potentially archaeologically sensitive landscapes, now submerged, that would have supported human occupation when subaerially exposed since the Last Glacial Maximum (LGM). Meltwater from the glacier began to create large glacial lakes and the areas surrounding these glacial lakes and their associated drainage systems may have provided a resource procurement area for human populations as a freshwater source and productive hunting and fishing/shellfishing grounds. Based on traditional knowledge and oral histories shared by the tribes (e.g. RI CRMC, 2010), ancient settlements and places of ceremony may also have been established in parts of the OCS prior to marine transgression. By 15,000 years ago, the glacial lakes drained and sea levels began to rise rapidly, transforming the former lake beds into estuaries and fringing marshlands. Submerged pre-contact cultural resources within the area might include shell middens, extraction camps, megafauna butchering sites, fishing locales, and places of ceremony. Recorded Paleo-Indian sites on land in the area tend to be identified near freshwater sources, such as major river systems and ephemeral streams (Merwin 2010). When subaerially exposed, these resource-rich environments would have played a vital role in the survival of local populations.

The southern New England shoreline is estimated to have migrated through the Lease Area by 9000 cal BP (calendar years before present). Except for potential Paleo-Indian sites, the submersion of the Lease Area approximately 9,000 years ago excludes occupation of the landscape during most pre-contact (e.g. Early-Late Archaic, Woodland) and post-Contact periods (Oakley and Boothroyd 2012), yet sites occupied by these later cultural groups may be encountered along the RWEC (Engelhart et al. 2011). Additionally, use of the landscape in which the Project now falls is not limited to terrestrial habitation. For example, Native peoples harvested whales, both shore-stranded animals as well as those hunted offshore, with the seagoing craft of various cultures. Remains of Native whaling craft or other indigenous watercraft could also occur within the broader Project Area, although such vessels are unlikely to exist intact on the seabed.

Native American usage of the OCS, including whaling practices, overlap with historical Colonial period maritime activities in the region. This activity increased dramatically following European exploration and development of New England waterways. The post-contact period generally begins with the first visit of Giovanni da Verrazano to present-day Narragansett Bay in 1524. In the roughly five centuries since, these waters have been plied by myriad vessels, such as merchant ships, fishing boats, workboats, and pleasure craft, to name but a few.

The maritime historical context of the region results in a potential for historic submerged cultural resources to exist within the APE. Early European exploration that may have crossed the APE employed relatively small, wooden-hull sailing vessels. Increased maritime activity in the region during the seventeenth and eighteenth centuries included larger ocean-going ships and coastal traders. Indigenous maritime practices did not end with European settlement. Many Native men plied the New England waters in the seventeenth, eighteenth, and nineteenth centuries as skilled pilots, skippers, harpooners, fishermen, and hands. The introduction of steam vessels in the region presents a new category of potential shipwreck in the nineteenth century. The twentieth-century workboat is another category of shipwreck that should be expected in the region, as well as modern recreational vessels. The database review identified 58 shipwrecks within 1 mi (1.6 km) of the RWF, RWEC-OCS, and RWEC-RI, although this total may contain duplicates due to inconsistency among databases.

Revolution Wind Farm

No confirmed pre-contact archaeological sites exist within the Lease Area; however, the theorized migration of First Americans offers the potential for undiscovered archaeological sites to exist on the OCS. Recent data and studies suggest that the habitation of North America may predate 13,000 cal BP. Rising sea levels following the end the Last Glacial Maximum (LGM) (~22,000 years ago) inundated the coastal and proximal inland areas previously available for occupation. The QMA's refined paleoshoreline model indicates a progressive submersion of the Lease Area by approximately 10,000 years ago, limiting the scope of potential pre-contact sites that may be located within the RWF to those from the Paleo-Indian period (Oakley and Boothroyd 2012). Marine transgression is an erosive process, destroying much of the previous subaerial landscapes throughout the RWF. Preservation of these landscapes is typically limited to areas that underwent rapid inundation. Evidence for Native American use of the Lease Area after marine transgression for fishing, whaling, and navigation might include remnants of fishing/whaling gear or preserved watercraft.

The sub-bottom and seismic imagery indicate the RWF was incised by two major fluvial systems prior to inundation. The deeper channels are interpreted by the MSC to represent sub-glacial tunneling, and therefore possess no archaeological potential. The shallower fluvial system is likely the Pleistocene drainage that dominated the landscape following the LGM. The QMA identified five geomorphic features of archaeological interest within the RWF based on its interpretation of the sub-bottom profiler imagery, seismic data, and geologic ground model. The geomorphic features are interpreted as probable buried relict channels dating to the late Pleistocene/early Holocene. These channels possess associated features (i.e., floodplains, levees, etc.) representing potential preserved paleolandscapes that could have been inhabited or traversed by pre-contact communities.

In the northern portion of the Lease Area, the geomorphic feature of archaeological interest most likely represents a tributary of the main channel observed in the central and southern portion of the Lease Area. These features comprise a largely discontinuous fluvial system that would have dominated the landscape of the RWF during the late Pleistocene and potentially early Holocene. Marine transgression has truncated many of the channels, completely removing areas of previously habitable land. The spatial extents of the five features are representative of the areas of potential preservation of habitable land surfaces. As such, the features should be considered archaeologically sensitive and potentially possessing submerged cultural resources dating to the pre-contact period.

Historic-period archaeological resources that may be located within the RWF include shipwrecks from all eras. The databases consulted during background research contain 25 previously reported shipwrecks within 1 mi of the RWF. The OSAMP noted the rich maritime heritage associated with Rhode Island and its waters offshore, which includes military, fisheries, recreational, commercial, and energy-related contexts (RI CRMC, 2011).

RWEC–OCS

Much of the area through which the RWEF – OCS runs was similarly inundated by approximately 10,000 cal BP, with the entirety submerged no later than 8,000 cal BP. As such, potential pre-contact archaeological resources that may be located within the RWEC – OCS corridor are likewise generally restricted to Paleo-Indian period sites. However, the possibility of encountering sites from subsequent pre-contact periods increases as the corridor progresses northward. Sites occupied later in time, such as those used during the Archaic and Woodland periods, may be encountered along the Project RWEC – OCS corridor as it nears Rhode Island state waters (Engelhart et al. 2011).

Potential historic-era marine archaeological resources within the RWEC – OCS will also typically mirror those potentially found within the RWF. One exception is the potential to encounter recreational vessels, as those craft would be expected at increasingly higher densities as the distance to shore decreases. The databases consulted during background research reported 7 shipwrecks within one mile of the RWEC – OCS. The QMA did not identify any potential historic-period archaeological resources within the RWEC – OCS through its analysis and interpretation of the HRG data.

RWEC–RI

Marine archaeological resources that may be affected within the RWEC – RI include both pre-contact and historical era resources. A handful of nearshore submerged pre-contact sites have been found and excavated along the edge of Massachusetts Bay, west shore of Block Island, and Greenwich Cove, which suggest the potential for finding other such sites in offshore settings.

The potential for encountering historic-period archaeological resources can be expected to increase within the RWEC – RI. Although it encompasses the least area among the three offshore Project components, 26 shipwrecks have been previously reported within one mile of the RWEC – RI according to the databases consulted.

4.4.2.2 Potential Impacts

The IPFs that may affect marine archaeological resources are depicted below (Figure 4.4.2-1). Impacts to marine archaeological resources are most likely to occur during construction and decommissioning of the various Project components. The activities associated with O&M of Project infrastructure are not expected to significantly impact extant resources. The purpose of the following discussions is to identify the expected IPFs and provide general context for how these may affect marine archaeological resources.

Figure 4.4.2-1 IPFs on Marine Archaeological Resources

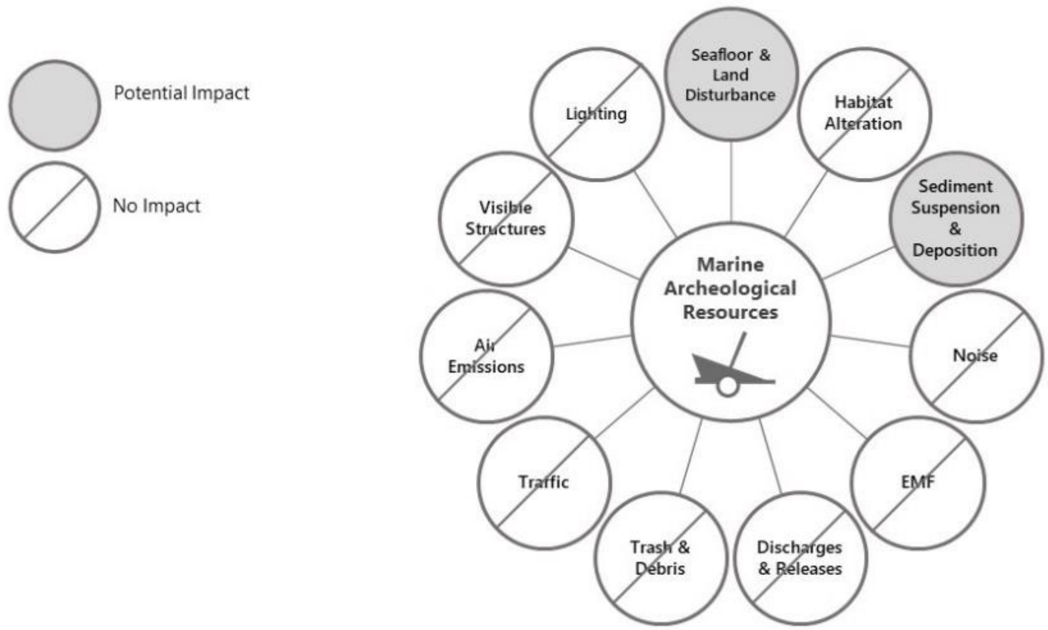


Table 4.4.2-1 IPFs for Marine Archaeological Resources for RWF, RWEC-OCS, and RWEC-RI During Construction and Decommissioning

IPF	Applicable Resource	Project Activity	Impact Characterization
Seafloor Disturbance	Pre-Contact and Historic	Construction of Offshore Facilities	***Long-term, direct***
Sediment Suspension & Deposition	Historic	Construction of Offshore Facilities	***Short-term, indirect***

Construction and Decommissioning

Multiple natural and man-made features were identified in the HRG survey data during analysis. Natural features imaged in the data include areas of hard-bottom and bedrock outcrops and numerous boulders throughout the RWF – both as individual occurrences and in boulder fields. Anthropogenic features identified in the RWF include commercial fishing equipment, trawling scours, and historic-era resources, such as shipwrecks.

Seafloor Disturbance

Revolution Wind Farm

Installation of the WTGs, OSSs, and IACs will introduce direct bottom impacts to this environment. Previously identified shipwrecks and unidentified cultural resources (pre-contact and historic) may be impacted directly by installation or indirectly by other associated bottom disturbance activities. Preparation of the seafloor for installation of foundations and cables may include sandwave leveling and the clearance of debris, boulders, and other objects. The excavation of a sub-surface trench in which to lay the cables would impact resources located within or adjacent to the trench during its excavation. These activities would impact archaeological resources located within the area of seafloor preparation.

The WTG and OSS foundations will require deep seabed disturbance that may potentially impact submerged cultural resources. The installation and removal of foundations for the WTG and OSSs could directly disturb resources located within the foundation placement areas or within those areas where the vessels installing the foundations are anchored or spudded. The vertical depth of impact associated with foundation installation could affect both historic and pre-contact archaeological resources.

Archaeological resources from the pre-contact period include potentially archaeologically sensitive landscapes, now submerged, that would have supported human occupation when subaerially exposed since the Last Glacial Maximum. Meltwater from glacial retreat formed lakes, and the areas surrounding these glacial lakes and their associated drainage systems may have provided a resource procurement area for human populations as a freshwater source, as well as productive hunting and fishing/shellfishing grounds. Traditional knowledge and oral histories shared among regional Native American tribes suggest ancient settlements and places of ceremony also may have been established on portions of the Outer Continental Shelf prior to marine transgression. By 15,000 years ago, the glacial lakes drained and sea levels began to rise rapidly, transforming the former lake beds into estuaries and fringing marshlands. Submerged pre-contact cultural resources within the area might include shell middens, extraction camps, megafauna butchering sites, fishing locales, and places of ceremony.

Using predictive models for shoreline migration, archaeologists can correlate dates and cultural periods with geological features on the submerged paleolandscape. Certain environmental factors are weighed when considering archaeological probability. Proximity to sources of fresh water, and thus the fauna that were drawn to them, was a significant determinant in the choice of pre-contact settlement locations (Gillam and Gillam 2016). Paleochannel terraces and floodplains may exist intact on the OCS as a result of sediment burial events linked to large-scale flooding events by nearby water sources and therefore retain the highest probability of containing intact pre-contact cultural resources (Joy 2018). Additionally, low-lying areas (e.g., estuaries) require low energy sea level rise to become inundated; rapid sea level rise would have submerged these environments quickly and deeply, possibly burying intact terrestrial soils. Therefore, these types of areas may possess a greater preservation potential than higher elevations, which are more likely to be affected by marine transgression and shoreface erosion.

The sub-bottom and seismic imagery indicate the RWF was incised by two major fluvial systems prior to inundation. The deeper channels are interpreted by the MSC to represent sub-glacial tunneling, and therefore possess no archaeological potential. The shallower fluvial system is likely the Pleistocene drainage that dominated the landscape following the LGM. The QMA identified five geomorphic features of archaeological interest within the RWF based on its interpretation of the sub-bottom profiler imagery, seismic data, and geologic ground model. The geomorphic features are interpreted as probable buried relict channels dating to the late Pleistocene/early Holocene. These channels possess associated features (i.e., floodplains, levees, etc.) representing potential preserved paleolandscapes that could have been inhabited or traversed by pre-contact communities.

In the northern portion of the RWF, the geomorphic feature of archaeological interest most likely represents a tributary of the main channel observed in the central and southern portion of the Lease Area. These features comprise a largely discontinuous fluvial system that would have dominated the landscape of the RWF during the late Pleistocene and potentially early Holocene. Marine transgression has truncated many of the channels, completely removing areas of previously habitable land. The spatial extents of the five features are representative of the areas of potential preservation of habitable land surfaces. As such, the features should be considered archaeologically sensitive and potentially possessing submerged cultural resources dating to the pre-contact period and which could be impacted by seafloor disturbance.

SEARCH identified 16 potential historic-period archaeological resources within the RWF during its analysis and interpretation of the HRG data. One relatively intact shipwreck and six debris scatters were identified in the RWF through interpretation of the HRG data. The debris scatters were located in varying proximity to the reported locations of other shipwrecks recorded in the databases consulted by the QMA. Seven of the potential submerged archaeological resources were identified through interpretation of their magnetic signatures. The magnetic contours of each exhibit characteristics resembling those of previously identified shipwrecks and they were also in some proximity to previously reported wrecks. The remaining two potential resources were identified through a combination of their magnetic signatures and associated acoustic imagery. The QMA recommends avoidance of all 16 potential marine archaeological resourced identified in the RWF by a distance of 50 m (164 ft). Strict observance of the avoidance buffer during construction and decommissioning would avoid impacts to these resources.

Three of the geomorphic features of archaeological sensitivity identified in the RWF are located in areas that might be impacted by seafloor disturbance during construction. One of the features may be impacted during both WTG foundation installation and IAC construction; one feature is in or near the proposed routing for the RWEC and IAC; and one geomorphic feature is within a proposed route for the IAC. Revolution Wind is assessing options to avoid impacts to these pre-contact resources. The two remaining geomorphic features of archaeological interest observed within the RWF are currently not located in an area where impacts to the resource are expected.

Revolution Wind understands that TCPs associated with Native American communities may be present in the RWF. The TCPs may potentially be impacted by seafloor disturbance during construction of the various components that are proposed in the RWF. Revolution Wind coordinated with the THPOs of affected tribes to determine which sites or paleolandforms may contain cultural or religious significance to Native American communities. Although coordination between the tribes and

Revolution Wind revealed that TCPs in the RWF are not expected to be impacted, Revolution Wind recognizes the value of government-to-government consultation for assessing potential impacts during the during the Section 106 process.

Activities associated with Construction and Decommissioning have the potential to create ***direct*** and ***long-term*** impacts to marine archaeological resources in the RWF. Revolution Wind intends to site and construct/decommission infrastructure (WTGs, OSSs, IACs, and RWEC) within the RWF to avoid impacts to marine archaeological resources and TCPs. Nevertheless, the potential for unanticipated impacts to submerged cultural resources through seafloor disturbance does exist.

RWEC-OCS

The RWEC will be installed within a proposed 400-m (1,312 ft) corridor extending from the RWF to landfall at Quonset Point, Rhode Island. As noted above, installation of cables associated with the RWEC may include sandwave leveling and the clearance of debris, boulders, and other objects. The excavation of a sub-surface trench in which to lay the cables would impact resources located within or adjacent to the trench during its excavation. These activities would impact archaeological resources located within the area of seafloor preparation.

As sea levels continued to rise and the paleoshoreline transgressed northward, the area comprised by the RWEC-OCS would have been submerged by 8,000 cal BP. Given that, potential pre-contact archaeological resources within the RWEC-OCS would, like the RWF, also date back to the Paleo-Indian period, especially in the southern portions of the RWEC. The northern section of the RWEC-OCS holds potential to possess sites dating from more recent Native American cultural periods, such as the Archaic and Woodland periods.

The QMA identified one geomorphic feature of archaeological interest within the RWEC-OCS based on its interpretation of the sub-bottom profiler imagery, seismic data, and geologic ground model. The geomorphic feature is interpreted as a probable buried relict channel dating to the late Pleistocene/early Holocene. This channel possesses associated features (i.e., floodplains, levees, etc.) representing potential preserved paleolandscapes that could have been inhabited or traversed by pre-contact communities. As such, the feature should be considered archaeologically sensitive and potentially possessing submerged cultural resources dating to the pre-contact period.

The QMA did not identify any potential historic-period archaeological resources within the RWEC-OCS through its analysis and interpretation of the HRG data. This may be a function of the relatively small area comprised by the RWEC-OCS. Nevertheless, database research yielded evidence of several reported shipwrecks within one mile of the RWEC-OCS so the potential remains that historic-period resources might be impacted during seafloor disturbance.

Revolution Wind understands that TCPs associated with Native American communities may be present in the RWEC-OCS. The TCPs may potentially be impacted by seafloor disturbance during installation of the RWEC-OCS. Revolution Wind coordinated with the THPOs of affected tribes to determine which sites or paleolandforms may contain cultural or religious significance to Native American communities. Although coordination between the tribes and Revolution Wind revealed that TCPs in the RWEC-OCS are not expected to be impacted, Revolution Wind recognizes the value of government-to-government consultation for assessing potential impacts during the during the Section 106 process.

Activities occurring during Construction and Decommissioning in the RWEC-OCS have the potential to create ***direct*** and ***long-term*** impacts to marine archaeological resources, although the decreased extent of vertical impacts should be considered a limiting factor, as compared to the deeper impacts associated with installation of the WTGs and OSSs in the RWF. Revolution Wind intends to site and construct/decommission the RWEC to avoid impacts to marine archaeological resources and TCPs. Nevertheless, the potential for unanticipated impacts to submerged cultural resources through seafloor disturbance does exist.

RWEC-RI

THE RWEC-RI extends from the state/federal water boundary to the proposed landfall site at Quonset Point, Rhode Island. Potential marine archaeological resources in the RWEC-RI that might be impacted by seafloor disturbance include pre-contact and historic resources. As with the RWF and RWEC-OCS, sandwave leveling and the clearance of debris, boulders, and other objects during cable installation may create impacts to resources. Similarly, the sub-surface trench within which the RWEC will be installed runs throughout the RWEC-RI and resources located within or adjacent to the trench could be impacted during excavation. These activities would impact archaeological resources located within the area of seafloor preparation.

The QMA identified two geomorphic features of archaeological interest within the RWEC-RI based on its interpretation of the sub-bottom profiler imagery, seismic data, and geologic ground model. The geomorphic features are interpreted as probable buried relict channels dating to the late Pleistocene/early Holocene. The features represent potential preserved paleolandscapes that could have been inhabited or traversed by pre-contact communities. As such, the features should be considered archaeologically sensitive and potentially possessing submerged cultural resources dating to the pre-contact period. The 400-m (1,312-ft) right-of-way proposed for the RWEC will afford flexibility for siting the RWEC such that impacts can be avoided or minimized during seafloor disturbance.

SEARCH identified three potential historic-period archaeological resources within the RWEC-RI through its analysis and interpretation of the HRG data. The resources identified in the HRG data include one probable shipwreck based on the associated acoustic imagery. The remaining two resources include one debris scatter and one potential resource identified solely through its magnetic signature.

Revolution Wind understands that TCPs associated with Native American communities may be present in the RWEC-RI. On-going consultations for other offshore wind projects in the region indicate some submerged landforms have traditional cultural significance to multiple Native communities. Such TCPs may potentially be impacted by seafloor disturbance during installation of the RWEC-RI. Revolution Wind coordinated with the THPOs of affected tribes to determine which sites or paleolandforms may contain cultural or religious significance to Native American communities. Although coordination between the tribes and Revolution Wind revealed that TCPs in the RWEC-RI are not expected to be impacted, Revolution Wind recognizes the value of government-to-government consultation for assessing potential impacts during the during the Section 106 process.

Activities occurring during Construction and Decommissioning in the RWEC-RI have the potential to create ***direct*** and ***long-term*** impacts to marine archaeological resources, although the decreased extent of vertical impacts should be considered a limiting factor, as compared to the deeper impacts associated with installation of the WTGs and OSSs in the RWF. Revolution Wind intends to site and construct/decommission the RWEC to avoid impacts to marine archaeological resources and TCPs. Nevertheless, the potential for unanticipated impacts to submerged cultural resources through seafloor disturbance does exist.

Sediment Suspension and Deposition

RWF

Construction and decommissioning activities occurring within the RWF will cause the suspension and deposition of sediments found near and adjacent to the areas of seafloor disturbance. Sediment suspension and deposition will primarily affect cultural resources exposed above the seafloor, such as shipwrecks, and the potential impacts. The suspension of sediment covering previously buried elements of the resource may expose those sections to further impacts, such as an increased threat of corrosion. The suspension and deposition of sediments is not expected to impact more deeply-buried submerged cultural resources, such as pre-contact archaeological resources that may be buried several meters below the seafloor. Additionally, the avoidance buffer surrounding identified submerged cultural resources will limit the amount of sediment suspension and deposition near the resource. Therefore, potential impacts to marine archaeological resources within the RWF from sediment suspension and deposition should be considered ***short-term*** and ***indirect***.

RWEC-OCS

Impacts occurring from construction and decommissioning within the RWEC-OCS should be considered consistent with those that may be experienced by marine archaeological resources within the RWF, which would be restricted to historic-period resources. The QMA did not identify potential historic-period resources during its review and analysis of the HRG data collected within the RWEC-OCS. Nevertheless, the potential that unidentified resources within the RWEC-OCS does exist. Potential impacts to marine archaeological resources within the RWEC-OCS from sediment suspension and deposition should be considered ***short-term*** and ***indirect***.

RWEC-RI

Impacts occurring from construction and decommissioning within the RWEC-RI should be considered consistent with those that may be experienced by marine archaeological resources within the RWF, which would be restricted to historic-period resources. Four potential historic-period resources were identified during review and analysis of HRG data that could be impacted from sediment suspension and deposition, although the avoidance buffers surrounding each identified potential resource should restrict or eliminate those impacts. Potential impacts to marine archaeological resources within the RWEC-RI from sediment suspension and deposition should be considered ***short-term*** and ***indirect***.

Operations and Maintenance

Table 4.4.2-2 IPFs for Marine Archaeological Resources for RWF, RWEC-OCS, and RWEC-RI During Operations & Maintenance

IPF	Applicable Resource	Project Activity	Impact Characterization
Seafloor Disturbance	Pre-Contact and Historic	Construction of Offshore Facilities	*Long-term, direct*
Sediment Suspension & Deposition	Historic	Construction of Offshore Facilities	*Short-term, indirect*

Seafloor Disturbance

RWF

While the marine environment will be most affected during the construction and decommissioning phase of the Project, the O&M phase may also affect these environments. Impacts to marine archaeological resources through seafloor disturbance that can be reasonably anticipated to arise during O&M are those associated with anchoring or spudding of vessels conducting routine or non-routine maintenance. Non-routine maintenance might also include the uncovering or reburial of the export cable following a fault or failure. This process would likely disturb the seafloor and thereby impact nearby resources. The maritime archaeological resources potentially impacted by the O&M phase of the Project would include all those resources potentially impacted by the construction and decommissioning phase, however, unless bottom disturbance is required due to repairs outside of previously disturbed areas. Any avoidance or mitigation measures implemented for construction and decommissioning would likely eliminate impacts from seafloor disturbance during O&M. Nevertheless, seafloor disturbance in the RWF has the potential to create ***long-term***, ***direct*** impacts to marine archaeological resources.

RWEC-OCS

Potential impacts to marine archaeological resources from seafloor disturbance within the RWEC-OCS will be similar to those associated with O&M in the RWF. Therefore, seafloor disturbance may potentially result in ***long-term***, ***direct*** impacts to marine archaeological resources within the RWEC-OCS.

RWEC-RI

Potential impacts to marine archaeological resources from seafloor disturbance within the RWEC-RI will be similar to those associated with O&M in the RWF. Therefore, seafloor disturbance may potentially result in ***long-term***, ***direct*** impacts to marine archaeological resources within the RWEC-RI.

Sediment Suspension and Deposition

RWF

Impacts to marine archaeological resources in the RWF from sediment suspension and deposition during the O&M phase may occur, although impacts are less likely than during construction and decommissioning. The suspension of sediments wholly or partially covering a submerged cultural resource may expose that resource to damage from environmental factors to which it may not have been previously subjected. For example, components or sections of an historic shipwreck that are newly exposed to an aerobic environment may be impacted through corrosion or by organisms not found in anaerobic environments. The avoidance buffer surrounding identified resources would significantly limit those potential impacts, however. Therefore, activities associated with O&M within the RWF should be considered as having potential to create only ***short-term***, ***indirect*** impacts.

RWEC-OCS

Potential impacts to marine archaeological resources from sediment suspension and deposition during O&M activities in the RWEC-OCS will be similar to those associated with O&M activities in the RWF. Therefore, seafloor disturbance may potentially result in ***short-term***, ***indirect*** impacts to marine archaeological resources within the RWEC-OCS.

RWEC-RI

Potential impacts to marine archaeological resources from sediment suspension and deposition during O&M activities in the RWEC-RI will be similar to those associated with O&M activities in the RWF. Therefore, seafloor disturbance may potentially result in ***short-term***, ***indirect*** impacts to marine archaeological resources within the RWEC-RI.

4.4.2.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following environmental protection measures to avoid, minimize, and mitigate potential impacts to marine archaeological resources.

- The RWF and RWEC will be sited to avoid or minimize impacts to potential submerged cultural sites and paleolandforms, to the extent practicable.
- Native American tribes were involved, and will continue to be involved, in marine survey protocol design, execution of the surveys, and interpretation of the results.
- A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.
- An Unanticipated Discovery Plan will be implemented that will include stop-work and notification procedures to be followed if a potentially significant archaeological resource is encountered during construction.

4.4.3 Terrestrial Archaeological Resources

This section describes the affected environment for terrestrial archaeological resources and provides an assessment of potential impacts to such resources during construction, O&M, and decommissioning of the Project. Terrestrial archaeological resources evaluated in this section include Traditional Cultural Properties (TCPs), which may encompass a variety of above- and below-ground elements. TCPs are defined generally as historic properties that are eligible for inclusion in the National Register due to their association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King 1998). Non-TCP related archaeological sites are those that are potentially significant for: their association with events making a substantial contribution to broad patterns of our history; association with persons significant in our past; that embody the distinctive characteristics of a time, type or period; and/or that have yielded or may yield information important in "prehistory" or history (36 CFR 60). This section summarizes the terrestrial archaeological resources assessment provided in Appendix N.

For the purposes of this assessment, a preliminary Area of Potential Effects (APE) was determined based on the maximum spatial limits of ground disturbance associated with the Onshore Facilities. The RWF and offshore segments of the RWEC are not considered part of the preliminary APE for terrestrial archaeological resources given their location in the marine environment; refer to Section 4.4.2 for a discussion of marine archaeological resources.

Archaeological investigations of the Onshore Facilities are being conducted in accordance with the Rhode Island Historical Preservation and Heritage Commission's *Performance Guidelines and Standards for Archaeology in Rhode Island* (RIHPHC, 2015). These guidelines establish a phased approach to identification and evaluation of archaeological resources. Investigations summarized in this section include a literature review and background research of information maintained by the RIHPHC and The Public Archaeology Laboratory, Inc. (PAL). The RIHPHC inventory includes NRHP-eligible and -listed properties and sites, historic districts, previously recorded archaeological sites and districts, cemeteries, and areas subject to previous archaeological investigations. PAL maintains records of cultural resource surveys conducted throughout Rhode Island from 1983 to the present. Revolution Wind will consult with RIHPHC and Native American tribes to determine an appropriate approach to identification and protection of deeply-buried archaeological or other cultural resources that may be present within the preliminary APE, consistent with the RIHPHC guidelines.

4.4.3.1 Affected Environment

Regional Overview

Late Archaic through Woodland Period resources are the most commonly reported terrestrial archaeological resources in southeastern Rhode Island, with far less evidence for occupations older than 5,000 years. The South Wind Site (RI 1006), located approximately 0.6 mi (0.9 km) west of the preliminary APE is a rare example of potential Paleo-Indian and Early Archaic period finds in local archaeological records. Several pre-contact shell middens have been identified along the Mill Creek drainage and present-day shorelines or former tidal creeks may retain additional examples of this site type.

Areas to the west of the proposed OnSS, particularly near the Route 4/Route 102 Interchange, were the focus of intensive Narragansett Indian settlement, trade, and ceremony. Numerous sites associated with late pre-contact and Contact Period Narragansett communities have been identified in western sections of North Kingstown and Charlestown. The early seventeenth-century English trading post at Cocumscussoc (also known as Smith's Castle) was located 0.8 mi (1.4 km) west of the preliminary APE and Contact Period Narragansett settlements were likely clustered in proximity to this property (Rubertone, 1994). Two Narragansett burial grounds, the Lischio Site (RI 1000) and the Devil's Foot Cemetery (RI 694) are located more than 1-mi (1.6 km) west of the preliminary APE. These cemeteries and the Devil's Foot Rock Traditional Cultural Property, situated just west of Post Road (Route 1), indicate a close association of the surrounding landscape with the Narragansett Indian Tribe. Previous research and consultations with the Narragansett Indian Tribal Historic Preservation Office for surveys conducted in the area to the west of the preliminary APE indicate the pattern of intensive settlement may also have extended along Quonset Point and Wickford Harbor. The limited archaeological data for Quonset Point, itself, is attributable to lack of survey and investigations prior to large scale development of the area during World War II. Archaeological investigations of the former naval facilities to the north and east of the preliminary APE indicate very few intact remnants of the pre-development landscape survived construction, operations, demolition, and subsequent redevelopment of the Quonset Point military facilities.

Onshore Facilities

Based on archival research, potential archaeological resources within the preliminary APE for Onshore Facilities might include pre-contact Native American sites with lithic debris (stone flakes) and or stone tools, ceramics, and possible shell or bone food refuse. Background research identified a total of 16 archaeological sites within 1 mile (1.6 km) of the Onshore Facilities; none of these sites are located within the preliminary APE. These previously documented archaeological sites are detailed in Appendix N.

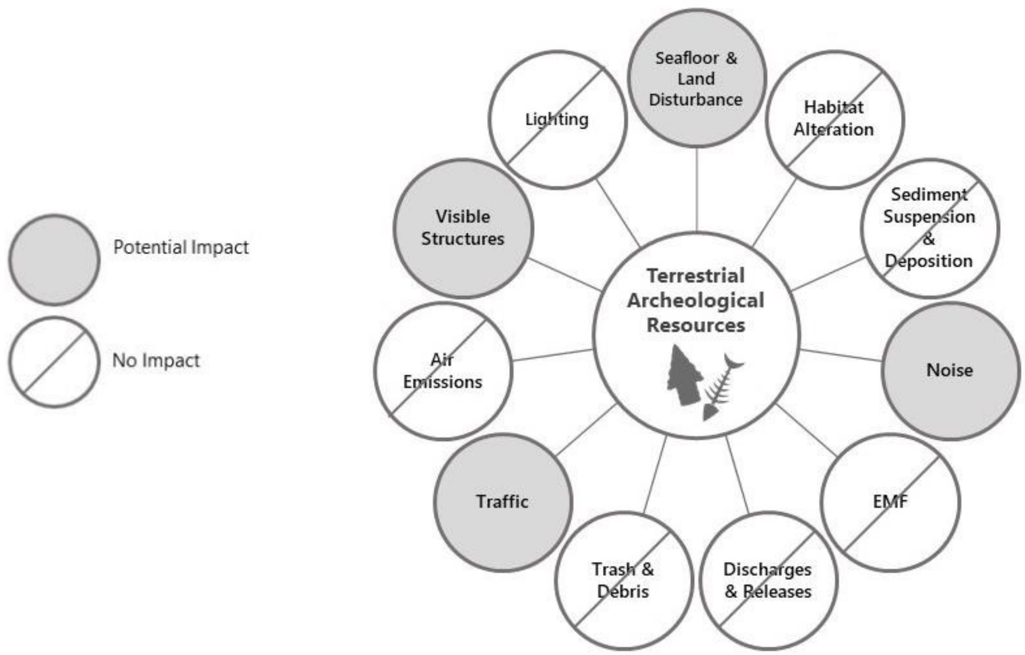
Post-contact Native American or Euro-American domestic sites reflecting a mixture of small households and large farms dating from the eighteenth century and nineteenth centuries and dense mid-to late-twentieth century residential development associated with the former naval facilities characterized much of the preliminary APE. From the 1940s through the 1960s the OnSS site was used by the Navy as a general dump. Remediation activities in the late 1990s included the removal of several hundred tons of debris and soil from the area. Ground disturbance associated with the military activities at Davisville/Quonset Point was wide-spread and affected most of the landscape within and adjacent to the preliminary APE. For example, the Seaview Site (RI 1886), identified during surveys for the existing TNEC Davisville Substation in 1990 (Leveillee et al, 1990), was determined ineligible for listing in the National Register of Historic Places due to prior ground disturbance and a loss of contextual integrity. Large scale regrading of former residential properties and associated roadways and removal of underground storage tanks and other buried utilities following the Navy's use of Quonset Point affected the areas along present-day Circuit Avenue and Whitecap Drive. Demolition of the naval facilities and former residential housing developments and redevelopment of local roads and commercial parcels within the preliminary APE caused additional disturbance.

The geologic context of the preliminary APE and review of historical topographic mapping of the vicinity suggests a low potential for deeply buried archaeological deposits. No deep Holocene-age alluvial deposits are indicated by previous soil mapping and sources of natural sedimentation that might have buried archaeological sites are lacking. It is possible that intact wetland soils remain buried beneath the former landfill at the OnSS site; however, such areas are expected to have a low potential to contain archaeological deposits due to poor drainage. In general, conditions within the preliminary APE are expected to be comparable to those assessed within the former Naval Construction Battalion Davisville properties to the north, where undisturbed and potentially archaeologically sensitive soils were found to account for less than 5% of 909 acres evaluated (Environment and Ecology, 1994: 8-1 to 8-3). A detailed review of historical mapping, aerial surveys, and recent soil survey data indicates one area of potentially intact, natural soils within the preliminary APE that may retain archaeological deposits. This area is roughly parallel to the existing shoreline. Aerial and satellite imagery indicate minor grading and landscaping activities have affected portions of the potentially intact soils. Geotechnical investigations will provide additional information on soil conditions throughout the terrestrial preliminary APE. Refer to Appendix N for additional detail regarding archaeological sensitivity of the preliminary APE.

4.4.3.2 Potential Impacts

IPFs associated with Onshore Facilities that could result in impacts to terrestrial archaeological resources are indicated in Figure 4.4.3-1. IPFs applicable to non-TCPs include land disturbance while IPFs applicable to TCPs include land disturbance, noise, traffic and visible structures as TCPs may be sensitive to visual, auditory, or atmospheric impacts (effects) that do not typically pose a risk to the integrity of archaeological resources. The construction phase is expected to pose the highest risk of impacts to terrestrial archeological resources; any resources encountered during O&M and decommissioning of the Onshore Facilities will have already been managed according to tribal, federal, and state expectations and requirements prior to or during construction activities.

Figure 4.4.3-1 IPFs on Terrestrial Archaeological Resources (including TCPs)



Onshore Facilities

Construction and Decommissioning

IPFs with the potential to affect terrestrial archaeological resources during construction and decommissioning are summarized in Table 4.4.3-1. Archaeological resources encountered during decommissioning of the Onshore Facilities will have already been managed according to tribal, federal, and state expectations and requirements prior to or during construction activities; therefore, impacts during decommissioning are not anticipated.

Table 4.4.3-1 IPFs for Terrestrial Archaeological Resources for Onshore Facilities During Construction and Decommissioning

IPF	Applicable Resource	Project Activity	Impact Characterization
Seafloor and Land Disturbance	Non-TCPs and TCPs	Construction of Onshore Facilities	Long-term, direct
Noise	TCPs only	Construction of Onshore Facilities	Short-term, indirect
Traffic	TCPs only	Construction of Onshore Facilities	Short-term, indirect

Land Disturbance

Land disturbance associated with construction of Onshore Facilities is quantified in Section 4.1.1 (Table 4.1-5). Construction of the OnSS and Onshore Transmission Cable will have maximum disturbance depths of 60 ft (18.3 m) and 16 ft (5 m), respectively. At the Landfall Work Area, the onshore segment of the RWEC will have a maximum disturbance depth of 66 ft (20 m). These land disturbances have the potential to uncover buried resources.

No archaeological resources are currently known from within the preliminary APE. Generally, given the existing level of disturbance within the preliminary APE, the likelihood of documenting significant archaeological resources is considered low; therefore, impacts to such resources are also considered unlikely. Nonetheless, the potential exists for archaeological resources to be discovered during construction. Although construction activities have the potential impacts for ***long-term*** and ***direct impacts*** to archaeological resources the onshore archaeological assessments indicate a low probability of intact resources in the preliminary APE. Further analyses of geotechnical data are underway to refine the archaeological assessment. Implementation of an Unanticipated Discovery Plan including consultations and avoidance measures, if appropriate and feasible, will further reduce the potential for post-review impacts.

Noise and Traffic

Construction noise and traffic are considered potential IPFs for TCPs only and are discussed together because they are interrelated from the perspective of potential impacts to such resources. TCPs may be sensitive to visual, auditory, or atmospheric effects resulting from the construction equipment and vehicles. The Onshore Facilities are located over 1 mi (1.6 km) east of the Devil's Foot Rock TCP, which was previously determined NRHP-eligible (FHWA & RIDOT, 1995). While construction noise and traffic are not expected to result in impacts to the Devil's Foot Rock TCP, additional TCPs may be identified during tribal consultations. Potential impacts to TCPs resulting from these IPFs are conservatively assessed as ***short-term*** and ***indirect*** pending tribal consultations.

Operations and Maintenance

IPFs with the potential to affect terrestrial archaeological resources during O&M are summarized in Table 4.4.2-2. IPFs associated with O&M are applicable only to TCPs as these correspond to visual, auditory, and atmospheric effects. As noted above, any non-TCP archaeological resources encountered during O&M will have already been managed according to tribal, federal, and state expectations and requirements prior to or during construction activities.

Table 4.4.3-2 IPFs and Potential Levels of Impact on Terrestrial Archaeological Resources for Onshore Facilities During O&M

IPF	Applicable Resource	Project Activity	Impact Characterization
Noise	TCPs only	Operation and Maintenance of Onshore Facilities	Short-term, indirect
Traffic	TCPs only	Operation and Maintenance of Onshore Facilities	Short-term, indirect
Visible Structures	TCPs only	Operation of OnSS	Long-term, indirect

Visible Structures, Noise, and Traffic

Visible structures, noise, and traffic are considered potential IPFs for TCPs only and are discussed together because they are interrelated from the perspective of potential impacts to such resources. TCPs may be sensitive to visual, auditory, or atmospheric effects resulting from operational noise and traffic associated with the Onshore Facilities. However, noise and traffic during O&M will be minimal and will not exceed background levels. In the event that tribal consultations result in the identification of a TCP with specific sensitivities to noise and traffic effects, such impacts would be considered ***long-term, indirect***.

The onshore segment of the RWEC and Onshore Transmission Cable will be buried and therefore will not result in visual, auditory, or atmospheric effects to TCPs. The OnSS and ICF are located over 1 mi (1.6 km) east of the Devil's Foot Rock TCP, which was previously determined NRHP-eligible (FHWA & RIDOT, 1995). Based on the viewshed analyses conducted as part of the HRVEA (Appendix Q1), views of the proposed OnSS from the Devil's Foot Rock will be screened by existing vegetation and buildings. However, additional TCPs may be identified during tribal consultations. Therefore, potential impacts to TCPs resulting from visible structures are conservatively assessed as ***long-term*** and ***indirect*** pending tribal consultations.

4.4.3.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following environmental protection measures to reduce potential impacts to terrestrial archaeological resources.

- Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable.
- Onshore Facilities will be sited to avoid or minimize impacts to potential terrestrial archeological resources, to the extent practicable.
- Native American Tribal representatives were involved, and will continue to be involved, in terrestrial survey protocol design, execution of the surveys, and interpretation of the results.
- An Unanticipated Discovery Plan will be implemented that will include stop-work and notification procedures to be followed if a cultural resource is encountered during installation.

4.5 Visual Resources

4.5.1 Visual Resources

This section addresses the visibility and potential visual impact associated with the construction, O&M, and decommissioning of the Project. This section summarizes details of the Visual Impact Assessments (VIAs) prepared for the RWF and Onshore Facilities (Appendices U1 and U3). The purpose of these studies was to analyze potential Project visibility and determine its potential effect on scenic quality and the use/enjoyment of the landscape by viewers. The RWEC, IAC, OSS-Link Cable, and Onshore Transmission Cable will be located underwater/underground and will not have a visual impact; however, construction of these components will result in some temporary visual effects.

Based on experience on the Block Island Wind Farm (BIWF), and guidance provided by BOEM and other involved agencies and tribes, the VIA utilized standard visibility assessment techniques, including viewshed analysis, cross section analysis, and field verification. The Project's visual impact was evaluated through the preparation of representative visual simulations and use of the USACE Visual Resource Assessment Procedure (VRAP) (Smardon et al., 1988). The VRAP defines discrete landscape similarity zones (LSZs) within the visual study area, characterizes the baseline scenic quality/sensitivity of each LSZ, and then determines if the Project exceeds the threshold of acceptable visual change through a quantitative rating process conducted by a panel of visual professionals. The methodology and results for all visual analyses conducted for the Project are described in detail in the full text of the VIA report, in Appendix U3.

4.5.1.1 Affected Environment

Based on the height of the proposed WTGs, previous analyses conducted for the BIWF, guidance from BOEM, and the desire to address potential Project visibility from sensitive resources in New York, Rhode Island, Massachusetts, and Connecticut, a 40-mile (64.4-km) radius around the proposed WTG array was defined as the Visual Study Area (VSA). The VSA also approximates the theoretical limits of Project visibility based on the maximum height of the WTGs, the screening effect of curvature of the earth, and atmospheric affects associated with distance.

The VSA includes approximately 6,113 mi^2 (15,833 km^2) of open ocean (i.e., 80.4 percent of the VSA), 1,488 mi^2 (3,854 km^2) of land (including inland water bodies), and over 1,008 linear miles (1,622 km) of shoreline in New York, Rhode Island, Massachusetts, and Connecticut. The proposed VSA includes all or portions of 28 towns in Rhode Island, 33 towns in Massachusetts, six towns in Connecticut, and two towns in New York. The location and extent of the VSA is illustrated in Figure 1.2-1 of the VIA, in Appendix U3. However, within the VSA, only a relatively small portion of the onshore locations would have open views toward the Project. To further refine and accurately define an inclusive and reasonable PAPE, the potential geographic areas of Project visibility were identified by running a preliminary lidar viewshed analysis within the VSA.

The viewshed model considered vegetation, buildings/structures, and the curvature of the earth in order to delineate those areas that may have potential views of the highest portions of the proposed WTGs (i.e., blade tips in the upright position). The viewshed analysis results indicated that 44.9 mi^2 (116 km^2) of the land area within the VSA could have potential views of the Project from ground-level vantage points. For the purpose of the VIA, the PAPE was used to define those areas where further analyses of Project visibility and visual impact was warranted.

Within the PAPE for the Project, 17 different LSZs were defined in accordance with the VRAP methodology (see Section 1.2.4 of Appendix U3). The sensitivity of each LSZ was classified by the rating panel as a means of defining their sensitivity to visual change. The definitions of the five distinct resource management classifications are detailed in Table 2.2-1 of the VIA, as is the process used to assign these classifications (Appendix U3).

Viewers within the VSA/PAPE include residents, through travelers, tourists/vacationers, and the fishing community. The sensitivity of these viewers to visual change is variable, but many are assumed to be sensitive to changes in views they value and/or are familiar with. In addition, the PAPE includes 625 visually sensitive public resources that have been identified by national, state, or local governments, organizations, and/or Native American tribes as important sites which are afforded some level of recognition or protection. A comprehensive inventory of the visually sensitive resources identified during the study is included in the VIA (Appendix U3). A summary of the types of sensitive resources included in the Project PAPE is presented in Section 1.2.6 of Appendix U3, and the locations of these resources within the VSA are illustrated in Figure 1.2-3 of Appendix U3.

Onshore Facilities

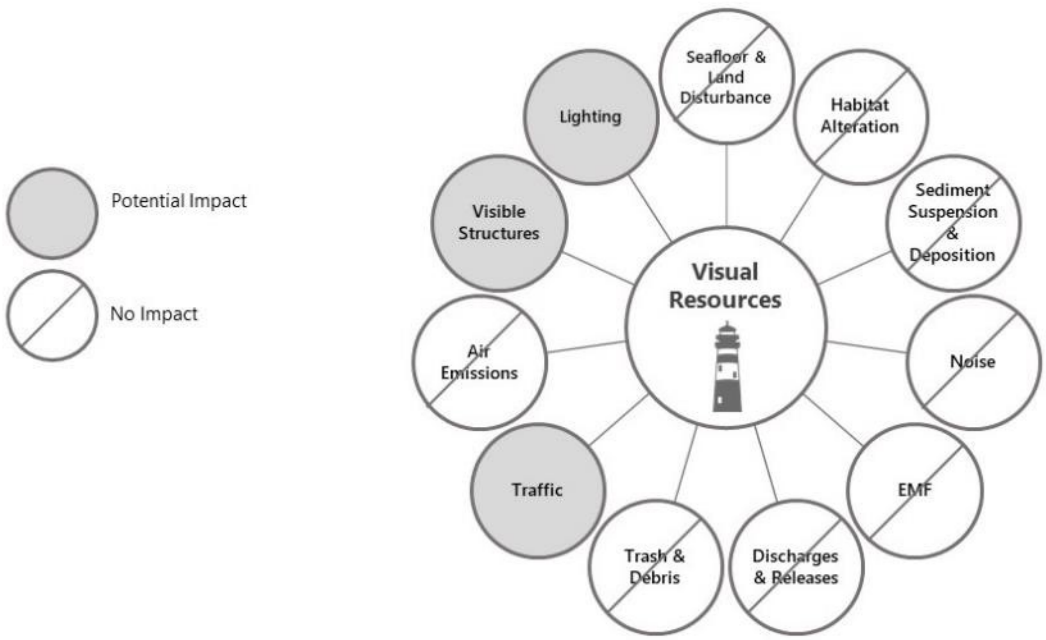
The Onshore Facilities are located in Quonset Business Park in the Town of North Kingstown, Rhode Island. The VSA for the OnSS and ICF extends 3 mi (4.8 km) around the proposed limit of disturbance. According to the USGS National Landcover Dataset (NLCD), the VSA associated with the Onshore Facilities primarily consists of approximately 35 percent open water, 30 percent developed land (including the industrial uses in the business park), 26 percent forested land, and 8 percent open space associated with recreation, stormwater management, or managed vacant land. The remaining 2 percent of land is classified as barren land (beach), wetland, crops, and pastureland. Generally, the Onshore Facilities' sites are bordered to the south by residential development, to the east by forest land and high density residential development, to the north by forest land and State Route 403, and to the east by light industrial buildings associated with the Quonset Business Park. Visually sensitive resources associated with the Onshore Facilities are included in Appendix U1, Table 1.2-1.

The Research Way O&M building is located in Setauket/East Setauket, New York and will utilize an existing building on a 4.5-acre site within an existing commercial business park. This existing building will be internally upgraded to establish office and warehouse space. The exterior of the building will be maintained and improved from its existing condition. Based the analyses discussed in Appendix U1, the O&M Facility is likely to result in visual benefits to the area within the PAPE.

4.5.1.2 Potential Impacts

Impacts to visual resources may occur when a project compromises the scenic quality or public enjoyment of a Visually Sensitive Resource (VSR). In order for visual impact to occur, the Project must first be visible. To establish the PAPE and define areas of visibility, a viewshed analysis was used. To determine the potential for visual impacts to VSRs within the PAPE, a baseline scenic quality and a visual impact threshold was established using the VRAP MCS rating system. This rating system was also used to determine the scenic quality of the individual resources with the Project in place through the use of visual simulations. IPFs that could result in impacts to visual resources during the construction, O&M, and decommissioning phases of the Project are shown in Figure 4.5.1-1.

Figure 4.5.1-1 IPFs on Visual Resources



Revolution Wind Farm

IPFs that could result in visual impacts during the construction, O&M, and decommissioning phases of the RWF are described below. A summary of the IPFs that could result in visual impacts are shown in Figure 4.5-1-1.

Construction and Decommissioning

During the construction and decommissioning period, it is likely that vessels such as jack up barges, cranes, and support vessels will be visible from onshore visual resources. The presence of these construction vessels along with the WTGs and OSSs in varying stages of construction are likely to introduce discordant visual features on the horizon. Table 4.5.1-1 provides a summary of the IPFs and potential impacts associated with the construction and decommissioning of the RWF.

Table 4.5.1-1 IPFs and Potential Levels of Impact to Visual Resources Resulting from the RWF During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Visible Structures	WTGs and OSSs	Short-term
Lighting	Offshore Construction	Short-term
Traffic	Vessel and Air Traffic	Short-term

- **Visible Structures:** During the construction and decommissioning period, it is likely that vessels such as jack up barges, cranes, and support vessels will be visible from onshore VSRs. The presence of these construction vessels along with the WTGs and OSSs in varying stages of construction are likely to introduce discordant visual features on the horizon. As such, ***short-term*** impacts to visual resources associated with RWF construction and decommissioning are anticipated.
- **Lighting:** Construction activities occurring at nighttime will likely require substantial lighting which may result in light pollution associated with the barges and vessels within the lease area. Nighttime construction activities are likely to be readily visible from onshore vantage points and could result in visual impacts due to the presence of direct light sources and skyglow in a previously dark seascape. However, the visibility will be temporary in nature and at times, will be obscured from view due to atmospheric conditions or curvature of the earth. Therefore, lighting associated with construction of the RWF result in ***short-term*** impacts to visual resources.
- **Traffic:** Marine traffic associated with the project construction is not anticipated to have significant visual impacts. During the construction phase, the increased flow of ships across the horizon could result in temporary visual impacts, drawing attention to the modern vessels as they move to and from the Project site. This would have the secondary effect of drawing attention toward the WTGs as they are being erected. However, the potential impacts would be temporary in nature. Therefore, the increase in marine traffic would result in ***short-term*** visual impacts.

O&M

Of the three phases of the RWF, the construction and O&M phases are expected to have the greatest potential visual impact to onshore resources within the VSA. The visibility and visual impact associated with construction and operations of the RWF will be variable and will depend on the existing visual quality of the resources (sensitivity to change), the distance from the Project, visibility of the Project, and geographic footprint of the Project.

Table 4.5.1-2 IPFs and Potential Levels of Impact to Visual Resources Resulting from the RWF During the O&M Phase

IPF	Project Activity	Impact Characterization
Visible Structures	WTGs and OSSs	Long-term
Lighting	WTGs and OSSs	Long-term
Traffic	Vessel and Air Traffic	Long-term

- **Visible Structures:** To evaluate potential visual impacts during operation of the RWF, the VIA included a viewshed analysis of the potential visibility of the proposed WTGs and OSSs, which represent the tallest proposed structures. Utilizing USGS lidar data, a highly detailed DSM of the visual study area was created. The DSM included the elevations of buildings, trees, and other objects large enough to be resolved by lidar technology. Additionally, a digital terrain model (DTM) was created, representing bare earth conditions. The analysis of potential visibility of the RWF was based on 98 points representing the proposed WTGs, each with an assumed maximum blade tip height of 873 ft (266 m); two points representing the OSSs, with a maximum height of

223 ft (68 m); and an assumed viewer height of 5.5 ft (1.7 m). The viewshed analysis was conducted using ESRI ArcGIS PRO® software with the Spatial Analyst extension and considered curvature of the earth in the analysis.

Blade tip viewshed analysis results are summarized in Table 4.5.1-3 below. Viewshed mapping demonstrated that the WTGs have the potential to be visible from a relatively small portion of the VSA. The LIDAR-based viewshed analysis indicates that approximately 3 percent of the land within the study area (the PAPE) could have potential views of some portion of the Project WTGs, based on the availability of an unobstructed line of sight. Open Water/Ocean is the dominant LSZ within the study area and, in most areas, offers an unobstructed line of sight toward the RWF. Other LSZs identified by the viewshed analysis as offering potential views of the RWF include Shoreline Beaches and Bluffs, Coastal Dunes, Coastal Scrub/Shrub Forest, Salt Ponds/Tidal Marsh, Shoreline Residential, and Maintained Recreational Areas. Visibility will be eliminated in large portions of the visual study area where topography, buildings/structures, and vegetation screen views toward the WTGs. Forest land, which covers approximately 55 percent of the land within the study area, will significantly reduce potential visibility of the RWF throughout the inland portions of the study area. Considering the screening provided by buildings/structures, vegetation, and topography, potential visibility of the RWF is largely restricted to the ocean shoreline and water bodies immediately inland of the shoreline.

Viewshed results (Table 4.5.1-3, below) suggest some minor areas of potential RWF visibility in inland portions of the visual study area. These areas typically extend inland from undeveloped and unvegetated shorelines, especially along barrier beaches backed by salt marshes and ponds. Additionally, some areas of inland visibility occur at topographic highpoints that are devoid of dense vegetation and buildings/structures (Appendix U3, Figure 3.1-1).

Table 4.5.1-3 Blade Tip – Land Area Viewshed Results Summary

Distance from the RWF	40-Mile Radius Study Area (Units in Square Miles)		
	Total Land Area	Land Area with Potential Visibility (PAPE)	Percent of VSA
0 to 10 Miles	1.0	1.0	100
10 to 20 Miles	149.3	24.3	16.3
20 to 30 Miles	475.4	11.8	2.5
30 to 40 Miles	862.3	7.8	0.9
Total 40 Mile Landward Study Area	1488.0	44.9	3.0

Field review confirmed the results of the lidar viewshed analysis. Much of the inland portions of the visual study area were found to be screened from view of the RWF by vegetation and buildings/structures. Open views toward the RWF, as indicated by visibility of the ocean, were concentrated within 1 mi (1.6 km) of the shoreline, and were largely restricted to beaches, bluffs, dunes, open fields, salt ponds, road corridors, and cleared residential yards, where lack of foreground trees allowed for unscreened views of the ocean.

- From Block Island, views of the RWF were largely restricted to beaches and bluffs along the south shore of the island. No views were documented from beaches and bluffs along the western and northern shorelines or the village/town center area of New Shoreham. Similarly, views toward the RWF were not available from most interior roads. However, potential views were documented from beach areas along the eastern shoreline, the northwest side of Great Salt Pond, and the Block Island Ferry in transit. Although private roads, yards, and homes could generally not be accessed, many of these locations on the southern portion of the island and on areas of higher ground are also likely to have at least partial views of the RWF.
- Views from Long Island were available from within Montauk State Park and Camp Hero State Park on the eastern edge of the South Shore, mainly from bluff overlooks along hiking trails or at designated bluff overlook parking areas. Views toward the RWF further inland were completely obscured by topography and/or vegetation.
- From Conanicut and Aquidneck Islands, views towards the RWF are restricted to the south-facing shorelines, including Beavertail State Park, Brenton Point State Park, the Newport Cliff Walk, Sachuest Beach, and Sachuest Point National Wildlife Refuge (NWR). As the viewer moves inland, views toward the RWF are blocked by buildings/structures and vegetation, with the exception of topographic highpoints, such as Hanging Rock at Normans Bird Sanctuary and the inland portions of Brenton Point State Park.
- In the Elizabeth Islands chain, Cuttyhunk Island will have open views toward the RWF along the southern and western shores, as well as from the topographic high point in the central portion of the island. This high point offers the potential for views of the full height of the WTGs, whereas shoreline views from the island toward the RWF would be partially screened by curvature of the earth.
- Views from Martha's Vineyard were also generally restricted to the shoreline and bluffs on the western and southern sides of the island. The southern beaches of Martha's Vineyard, such as Lucy Vincent Beach and Squibnocket Beach, had partially or fully screened views, respectively. Screening at these locations was provided by the western headlands of Martha's Vineyard and intervening vegetation. Visibility was noted as far east as Wasque Point in Edgartown. Inland views on Martha's Vineyard were located at the Peaked Hill Reservation, which is located atop a topographic high point. Other open views from inland locations will generally be partially screened, tightly enclosed, and/or of short duration due to the abundant screening provided by topography, vegetation, and buildings/structures.
- Open views from the mainland were available along the shoreline from Westerly, Rhode Island to Falmouth, Massachusetts. These views were generally restricted to the immediate shoreline and, based on the calculated effects of curvature of the earth, will typically only include the upper one-third to one-half of the WTGs. Throughout the extent of the visual study area, views toward the RWF were screened by vegetation, dunes, and buildings/structures.

Visually sensitive public resources with open views toward the WTGs included several historic sites, lighthouses, state parks/beaches, wildlife refuges, designated scenic areas, and a National Recreation Trail. The historic resources with the highest potential for visibility of the RWF were those that were situated to take advantage of panoramic ocean views. No open views toward the site were documented from any mainland parks, historic sites, designated scenic areas, conservation lands, or village/town center areas that were over a mile inland from the ocean.

Moreover, open views toward the RWF do not necessarily equate to actual visibility. A variety of other factors will limit visibility, including weather conditions, waves on the ocean surface, humidity, and air pollution.

A study completed by BOEM in 2014 (Wood et. al., 2014) evaluated atmospheric limitations to visibility at distances of 10, 20 and 30 nautical miles (nm) using the observed visibility out to 10 miles and a relational algorithm based on relative humidity. Considering daytime visibility, this study calculated the number of days per season/year during which visibility exceeded 10, 20 and 30 nm during at least 50 percent and 75 percent of the daylight hours. Considering the 50 percent threshold (i.e., 50 percent of the observations confirmed visibility at a given distance), data from Newport, Rhode Island suggest that daytime visibility to 20 nm (23.0 miles, 37.0 km) would occur over approximately 112 days per year (31 percent of the year). Using the same 50 percent threshold, visibility to 30 nm (34.5 miles, 55.6 km) would occur during daylight hours over approximately 29 days of a given year (7.9 percent of the year). The average summertime visibility associated with this meteorological station was reported to be 11 nm (12.7 miles, 20.4 km) and the average annual visibility extends to 15 nm (17.3 miles, 27.8 km). Given the typical atmospheric conditions in the vicinity of KOPs such as Brenton Point State Park, Newport Cliff Walk, Sachuest Point NWR, Sachuest (Second) Beach, Hanging Rock, and Easton's Beach, all of which are approximately 30 miles (26.1 nm, 48.3 km) from the nearest RWF WTG, these locations would only experience minimal to moderate visual impacts between approximately 7.9 percent and 31 percent of a given year. During the peak of the summer tourism season, the average hourly visibility does not extend beyond 11 nm (12.7 miles, 20.4 km), suggesting that the RWF would be completely obscured from view, and therefore would not result in any visual impacts, during typical summertime conditions.

The same study was completed from Martha's Vineyard and, assuming the 50 percent threshold, suggests that daytime visibility to 20 nm (23.0 miles, 37.0 km) occurs over 113 days (31 percent of the year) and visibility to 30 nm (34.5 miles, 55.6 km) occurs during 32 days of a given year (8.8 percent of the year). From Martha's Vineyard, summertime visibility averages 10 nm (11.5 miles, 18.5 km) and annual visibility averages 14 nm (16.1 miles, 26.0 km). The average distance to the RWF from the nine KOPs on Martha's Vineyard is 15.7 miles (25.3 km) and ranges from 13.5 miles (21.7 km) to 24.6 miles (39.6 km). This suggests that during average conditions, including the peak of the summer tourism season, the RWF would be completely obscured from view and would not result in any visual impacts. Considering the clear conditions presented in the majority of the visual simulations from Martha's Vineyard, the level of impact reported in the VIA is likely to occur during approximately 31 percent of a typical year for RWF WTGs within 20 miles of the Martha's Vineyard shoreline.

Visibility from Nantucket extends to 20 nm (23.0 miles, 37.0 km) during 80 days of the typical year (22 percent) and visibility to 30 nm (23.0 miles, 55.6 km) occurs during 14 days of the year (4 percent) (both calculations consider the 50 percent threshold). During the summertime, daytime visibility from Nantucket averages approximately 10 nm and the average annual daytime visibility extends to 12 nm (13.8 miles, 22.2 km) (Wood et. al., 2014). The visual simulation from Madaket Beach, Nantucket is 34.4 miles (55.3 km) from the nearest RWF WTG. Based on BOEM's assessment of past weather conditions, it is likely that the WTGs would be visible from this location during only approximately 4 percent of a given year. Given the minimal potential visual impacts observed by the rating panel, it is anticipated that the RWF will result in insignificant visual impacts to viewing locations in Nantucket.

Regional analysis of each of the meteorological stations used in the BOEM study suggested that cloudy conditions reduce the average visibility to 12 miles (19.3 km), ranging from 10 nm (11.5 miles, 21.3 km) in summer to 16 nm (18.4 miles, 29.6 km) in winter. Rainy, hazy, and foggy conditions result in an average visibility of 8, 4, and 3 nm respectfully. These visibilities were consistent throughout the year. In addition, sky conditions will also affect a viewer's ability to detect the WTGs on the horizon. For example, overcast days will eliminate hard shadows on the WTGs created by direct sunlight, which will reduce contrast and minimize the ability to perceive the blades or recognize movement. Additionally, on overcast days the white or gray sky color on the horizon will further reduce WTG visibility due to their lack of color contrast against the background. Conversely, on clear days, when the WTGs are fully front lit or back lit, visibility will generally be higher. To predict the frequency of each of these conditions, National Climatic Data Center (NCDC) data were analyzed and broken down by cloud cover. The results of this analysis suggest that during daylight hours, clear sky conditions occur approximately 42 percent of the time, partly cloudy conditions occur during approximately 4 percent of daylight hours and overcast sky conditions occur about 52 percent of the time during a given year (see Table 3.2-80). Although the rating panel results suggest the potential for appreciable visual impacts to a number of onshore visual resources, the conditions presented in the visual simulations illustrate above average visibility/viewing conditions. Based on the atmospheric conditions model, these visibility/viewing conditions would occur during only 31 percent of the year in Newport, 31 percent of the year on Martha's Vineyard, and 4 percent of the year on Nantucket. Results of the VIA also support the conclusion that visual impacts resulting from the RWF are likely to be reduced during less than ideal viewing conditions. This is evidenced by rating panel results from the Aquinnah Overlook in which a light haze partially obscured the turbines as compared to a nearby view from Edwin D. Vanderhoop Homestead which illustrated clear viewing conditions. The Aquinnah Overlook received a score reduction of 0.8 points with the Project in place and remained within the Retention class. By comparison, the Edwin D. Vanderhoop Homestead received a reduction of 2.8 points and dropped from Retention class to Partial Retention. Considering both views had a similar baseline scenic quality and visibility of the RWF, the change in score is largely attributable to atmospheric conditions and the associated diminishment of Project visibility.

To evaluate the visual impact of the RWF, a total of 37 visual simulations were prepared from 28 selected key observation points (KOPs) throughout the PAPE (28 unique daytime views, five sunset views, and four nighttime views). These KOPs were identified based on studies prepared by BOEM (2012a and 2012b) that identified visually and culturally sensitive sites with views toward offshore lease areas along the entire Atlantic coast, including all of the coastline that falls within the visual study area. Final KOPs were selected based upon the following criteria:

1. They were identified as KOPs by federal, state, local, or tribal officials/agencies as important visual resources, either in prior studies or through direct consultation.
2. They provide clear, unobstructed views toward the WTGs (as determined through field verification).

3. They illustrate the most open views available from historic sites, designated scenic areas, and other visually sensitive resources within the visual study area.
4. They are representative of a larger group of candidate KOPs of the same type or in the same geographic area.
5. They illustrate typical views from LSZs where views of the WTGs are most likely to be available.
6. They illustrate typical views of the RWF that will be available to representative viewer/user groups within the visual study area.
7. They illustrate typical views from a variety of geographic locations and under different lighting conditions to illustrate the range of visual change that could occur with the WTGs in place.

Information regarding each selected viewpoint is detailed in the full text of the VIA in Appendix U3. Additionally, graphic depictions showing locations of the selected KOPs are illustrated in Appendix U3, Figure 2.2-1.

Visual simulations of RWF views from the selected KOPs were prepared, as illustrated in Appendix C of the VIA (Appendix U3). The methodology for visual simulations is also described in Appendix U3. These simulations illustrate the full range of distances, lighting conditions, and landscape settings from which the RWF will be viewed. However, all photos used for the development of simulations illustrate high visibility conditions where the proposed WTGs would not be significantly obscured by atmospheric haze or fog. All of the selected KOPs offered the most open, unobstructed views available toward the RWF from each KOP. Consequently, the simulations from these viewpoints can be considered "worst case" representations of potential WTG visibility within the study area.

Evaluation of these simulations by a panel of visual professionals was conducted using the USACE VRAP. The evaluation process, which is described in detail in the VIA, indicated that the RWF's overall contrast with the visual/aesthetic character of the area will be variable, with the most substantial visual impact documented at KOPs that are relatively close to the RWF, offer largely unobscured views of the proposed WTGs, and include few other man-made/developed features. Impact evaluation results indicated relatively minor impact on mainland/more distant KOPs, where the WTGs are barely perceptible on the horizon. The difference between the aesthetic quality of the existing views and the same views with the RWF in place (Rating Panel Impact Scores) varied by viewpoint and individual rating panel member. Individual scores for specific KOPs ranged from minus 6.7 (indicating a strong adverse visual impact) to plus 1 (indicating a slight increase in visual quality). Composite scores (i.e., the average score of all four rating panel members) for individual viewpoints ranged from minus 2.8 to 0 (indicating no visual impact) and averaged minus 1.1 across all of the views. Overall, five simulations received an average score of 0, indicating that, with the RWF in place, the view was unaffected. The clear conditions simulations that received an impact score of zero, included Montauk Point State Park (daytime and nighttime), Watch Hill Lighthouse, and Madaket Beach. Each of these simulations illustrate the project at or over a distance 24.1 mi, suggesting that visual impacts are unlikely to occur at or beyond these distances under the clear conditions presented in the simulations. In addition, the view from Peaked Hill also received a rating score of zero. However, an additional sunset simulation from the same location resulted in an impact rating of minus 1.2, which suggests that atmospheric conditions will result in varying degrees of visibility and visual impact. Six views received an average score of minus 0.3 to minus 0.5. Generally, the more distant views on the islands and mainland, where the WTGs were barely perceptible on the horizon, received the lowest impact scores. The highest impact scores (lowest numerical scores) were received by Southeast Light (Nighttime), Moshup Beach, North Light, Moshup Beach (Sunset), Edwin DeVries Vanderhoop Homestead, and Aquinnah Overlook (Sunset) which scored between minus 2.0 and minus 2.8. Generally, the higher impacts relate to the distance from the viewpoint to the RWF. However, existing sensitivity and scenic quality also influenced scores within similar distance zones. The aforementioned KOPs with the highest average impact ratings occur within 13 to 17 mi from the RWF.

Simulations of the proposed Project indicate that the daytime visibility and visual contrast of the WTGs will be variable. From eight KOPs, the WTGs were very difficult to perceive due to their distance from the viewer and screening provided by curvature of the earth as indicated by their assignment of a VTL of 1. Four simulations received a VTL of 2, suggesting that the WTGs were either very difficult to perceive or faint in appearance. Eight simulations received a VTL of three which indicates that the WTGs were easily detected by casual observers but lacked sufficient scale contrast to compete with seascape/landscape elements. Nine simulations received a VTL of 4 which suggests the RWF would compete with other landscape/seascape elements but would not strongly attract visual attention. Eight simulations received a VTL of 5, suggesting the RWF will become the major focus of viewer attention when viewed during high contrast conditions such as clear weather and strong backlighting or during clear nighttime conditions. One simulation from Nomans Land Island received a VTL of 6 which suggests the RWF would be prominent from this location and would detract noticeably from views of other landscape/seascape elements. Evaluation of the proposed Project by a panel of visual professionals revealed that the most appreciable visual impact generally occurred at viewpoints that were closest to the Project, provided an elevated view, offered largely unobscured views of the proposed WTGs, and included few other man-made/developed features. Views in which strongly front-lit WTGs were viewed against a darker sky or strongly back-lit WTGs were viewed against a light sky tended to receive higher impact and VTL scores, suggesting that time of day and visibility conditions will strongly influence potential visual impact and visual prominence. Such viewpoints are generally on the southern shoreline of Block Island, western bluffs of Martha's Vineyard, and the southern shores of mainland Rhode Island. In these higher impact viewpoints, the turbines' contrast with water resources (open ocean), user activity (residential and tourist-related), land use (undeveloped land and ocean), and/or appreciation of other cultural or aesthetic features generally were the greatest contributors to Project impact. However, impact evaluation results indicated no appreciable impact on the majority of mainland/more distant viewpoints.

Given the fact that the simulations generally represent ideal viewing conditions, it can be anticipated that visual impacts will be reduced when considering the effects of atmospheric haze, cloud cover, and fog. As such it is anticipated that the O&M of the RWF will result in ***long-term*** impacts to visual resources.

› **Lighting:** The proposed WTGs will be equipped with both aviation obstruction warning lights on top of each nacelle and USCG navigation warning lights on the platform near the tower base. To evaluate the potential visibility and visual impact of these new lights, the VIA included a viewshed analysis based on the anticipated height and locations of the aviation warning lights, as well as nighttime visual simulations from selected KOPs where the aviation warning lights were anticipated to be visible.

The nighttime viewshed analysis was conducted in the same manner as the daytime analysis but was based on a height of 530 ft (161.5 m), where the aviation warning lights would be mounted on the nacelles. The nighttime viewshed analysis suggests that aviation lighting will be visible from approximately 2.1 percent of the land area in the 40-mi (64.4-km) visual study area (Table 4.5.1-4). This reduction in visibility can be attributed to the lower height of the aviation warning lights (relative to the WTG blade tips), combined with the screening effects of curvature of the earth. Areas in which the aviation warning lights are screened by curvature of the earth include Montauk Point and Ditch Plains Beach on Long Island, the south-central and southeastern beaches on Martha's Vineyard, and all the shoreline in the Town of Westerly, Rhode Island, on the mainland. In each of these areas, the blade tip analysis indicated potential visibility, but the nighttime viewshed indicated lack of visibility.

Table 4.5.1-4 Aviation Warning Light – Land Area Viewshed Results Summary

Distance from the RWF	40-Mile Radius Study Area (Units in Square Miles)		
	Total Land Area	Land Area with Potential Visibility	Percent of VSA
0 to 10 Miles	1.0	1.0	100
10 to 20 Miles	149.3	19.5	13.1
20 to 30 Miles	475.4	8.0	1.7
30 to 40 Miles	862.3	3.4	0.4
Total 40 Mile Landward Study Area	1,488.0	31.9	2.1

Nighttime visual simulations were prepared for five of the selected KOPs, as indicated in Table 4.5.1-5.

Table 4.5.1-5 Viewpoints Selected for Nighttime Visual Simulations

Viewpoint Number	Viewpoint Name	Viewpoint Location	Viewing Distance in Mi (Km)
BI04	Nighttime View – Southeast Light	Southeast Lighthouse, Town of New Shoreham, Rhode Island	15.5 (24.9)
AI01	Brenton Point State Park Nighttime	Brenton Point State Park, Town of Newport, Rhode Island	16.9 (27.1)
MV07	Aquinnah Overlook Nighttime	Circle Drive, Aquinnah, Massachusetts	13.9 (22.3)
LI04	Montauk Point State Park Nighttime	Montauk Point State Park, East Hampton, New York	31.7 (51.0)

To prepare nighttime simulations, data on the proposed aviation obstruction warning lights were collected from the Draft Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development, which provides guidelines for the lighting of WTGs (BOEM, 2019). In addition, views of the operational BIWF were documented to determine the appearance of the aviation warning lights at night at distances beyond 20 mi (32.2 km). Computer modeling and camera alignment for the nighttime photos were prepared in the same manner described for the daytime simulations. It was assumed that all lights will flash in a synchronized manner, as currently recommended by FAA guidelines. The lights will consist of two L-864 medium intensity red lights mounted on the nacelle and up to three L-810 low intensity red lights mounted on the midsection of the WTG tower at a height of approximately 312 ft (95 m). All lights will have a synchronous flash rate of 30 flashes per minute (FPM). Nighttime simulations therefore show all WTGs with their lights on. Due to the effects of the curvature of the earth and refraction, USCG warning lights on the WTGs were only considered in views that had a direct line of sight to the foundation transition, which is approximately where the USCG lights will be located.

As with daytime viewpoints, the rating panel's evaluation of nighttime visual impacts was variable depending on what other sources of lighting are present in the view, the extent of screening provided by buildings/structures and trees, and nighttime viewer activity/sensitivity. Composite scores for nighttime simulations ranged from minus 2.0 to 0.0 and averaged minus 1.1. These composite scores were generally higher than the daytime scores and exceeded the threshold for visual impacts from Southeast Light on Block Island. While night lighting will likely have an effect on residents and vacationers in settings where they currently experience dark nighttime skies, in many places nighttime visibility/visual impact will be limited due to: 1) the abundance of trees that screen all or portions of the Project from the majority of homes within the VSA; 2) the existing shoreline and offshore light sources that already impact nighttime ocean views; 3) the distance of the Project from mainland viewpoints; and 4) the concentration of residences in villages, town centers, and neighborhoods, or along highways, where existing lights already compromise dark skies and compete for viewer attention. Therefore, lighting associated with the operation and maintenance of the RWF is likely to result in ***long-term indirect*** impacts to visual resources.

- **Traffic:** Marine traffic is expected to be less frequent during operation of the RWF than during construction or decommissioning. Given the relative frequency of seagoing vessels on the horizon within the PAPE, it is not likely that traffic related to the RWF will be a noticeable change. Therefore, it is anticipated that traffic during the operation of the Project will not result in impacts to visual resources.

Onshore Facilities

Construction and Decommissioning

Since the construction of the RWEC and Onshore Transmission Cable will occur over a relatively short period of time and will occur within public roads and ROWs utilizing relatively light construction equipment, no significant visual impacts are anticipated. Therefore, the only portion of the Onshore Facilities considered in this analysis will be the OnSS and ICF.

The Visual Resource Assessment conducted by EDR illustrated that being within the Onshore Facilities viewshed does not necessarily indicate that the Onshore Facilities will result in visual impacts to the VSR present within the VSA. In fact, for the majority of these resources, Onshore Facilities visibility will only include the upper portions of a few proposed transmission structures. As the line of sight cross sections indicate from Wickford Historic District and Wickford Harbor/Wickford Village State Scenic Area, Narragansett Bay and the Quonset Point Naval Air Station, the Onshore Facilities will be barely perceptible amongst the buildings and vegetation present in the Quonset Business Park. This is particularly the case for viewpoints and viewers located greater than 1 mile from the Onshore Facilities

The Onshore Facilities may be potentially visible from approximately 15% of the entire VSA and five of the 95 (5%) identified VSRs within the VSA. However, field review suggested that Onshore Facilities visibility would likely be significantly less than suggested by the viewshed analysis due to the presence of landscape vegetation present along roadways, which was not considered in the viewshed analysis.

Where visible at near foreground distances, the proposed Onshore Facilities would introduce new industrial/utility structures into the landscape. At a maximum height of 80 ft (24.4 m), the proposed Onshore Facilities will not be out of scale or character with the existing types of development currently present in the vicinity, such as the existing Davisville Substation, or the structures at nearby Quonset Business Park. As such, it is anticipated that the Onshore Facilities will result in visual impacts to the public resources present in the VSA. Some Camp Avenue residences are likely to experience limited visual impacts as a result of the vegetative clearing associated with the Onshore Facilities and associated driveways, access road and transmission line ROWs. While these impacts are expected to alter the existing views experienced by the residents directly adjacent to the Onshore Facilities, they are generally localized and can be minimized through the use of mitigation, such as visual screening.

Table 4.5.1-6 provides a summary of the IPFs and potential impacts associated with the construction and decommissioning of the Onshore Facilities.

Table 4.5.1-6 IPFs and Potential Levels of Impact to Visual Resources Resulting from the Construction and Decommissioning of the OnSS and IPF

IPF	Project Activity	Impact Characterization
Visible Structures	Onshore Facilities	Short-term
Lighting	Onshore Facilities	Short-term
Traffic	Onshore Facilities	Short-term

› **Visible Structures:** Construction of the Onshore Facilities will occur adjacent to the existing TNEC Davisville substation, in lots surrounded by mature trees. Construction activities associated with the Onshore Facilities is expected to take approximately 1 year and includes clearing and grading, excavation, and the installation of foundations, and construction of the facility. None of the identified VSRs within the 3-mi VSA will experience adverse visual impacts. However, the construction will likely be visible to residential neighborhoods immediately adjacent to the Onshore Facilities' sites and therefore may result in ***short-term visual*** impacts.

- **Lighting:** Construction and decommissioning of the Onshore Facilities will typically involve work during daylight hours and the installation of temporary security and safety lighting at night. As a result, it is anticipated that lighting associated with construction and decommissioning activities would result in ***short term impacts*** to visual resources.
- **Traffic:** Construction and decommissioning of the OnSS will result in increased vehicular traffic patterns. It is anticipated that ***short term impacts*** will result from increased traffic during the construction and decommissioning phase of the OnSS.

O&M

Table 4.5.1-7 provides a summary of the IPFs and potential impacts associated with the Onshore Facilities during the O&M phase. The visual analysis considers a 3-mile VSA, and visibility is determined through a viewshed analysis which considers the tallest structures. The tallest onshore structures are the up to 80 ft overhead transmission poles located within the TNEC Interconnection ROW. Within the OnSS and ICF, the lightning masts have a slender profile, making them difficult to see from distances greater than one mile. The OnSS and ICF is proposed to be located in a wooded lot adjacent to the existing TNEC Davisville Substation. Generally, publicly accessible visual resources will have minimal visibility of the Onshore Facilities and in most cases where visibility is available, it will only include views of the lightning masts. However, a residential area exists directly adjacent to the Onshore Facilities and some residences may have intermittent views through the remaining vegetative buffer along Camp Avenue and into the OnSS site from distances of 150 ft or more. Given the proximity to a large industrial installation, it is likely that the Onshore Facilities will result in minor visual impacts to these residences.

Table 4.5.1-7 IPFs and Potential Levels of Impact to Visual Resources Resulting from the OnSS During the O&M Phase

IPF	Project Activity	Impact Characterization
Visible Structures	Onshore Facilities	Long-term
Lighting	Onshore Facilities	Long-term
Traffic	Onshore Facilities	Long-term

- **Visible Structures:** A lidar viewshed analysis was completed to determine the areas within the 3-mi RWEC VSA that may have visibility of the Onshore Facilities. Results of this analysis suggested that only 15 percent of the 3-mi (4.8-km) VSA would have visibility of some portion of the OnSS and/or ICF. Of the 15 VSRs identified in the VSA, three occur with the PAPE. Table 4.5.1-8 provides a summary of the VSRs with potential visibility of the Onshore Facilities.

Table 4.5.1-8 Visually Sensitive Resources with Potential OnSS Visibility

Visually Sensitive Resource	Distance to the Onshore Facilities in miles (km)
Quonset - Martha's Vineyard Ferry	1.5 (2.4)
Narraganset Bay	0.6 (1.0)
Wickford Harbor/Wickford Village	1.0 (1.6)
John H. Chafee Rome Point Preserve, Rome Point	2.8 (4.5)
Bissel Cove/Rome Point	2.0 (3.2)

Three of the 15 identified VSRs may have visibility of some portion of the OnSS and/or ICF. These include the Wickford Village/Harbor State Scenic Area, the Quonsett-Martha's Vineyard Ferries, John H. Chafee Rome Point Preserve, Bissel Cove/Rome Point, and the Narraganset Bay. These resources range in distance from 0.6 to 2.8 mi away and are typically fleeting in nature. For example, the Wickford Village/Harbor State Scenic Area, at a distance of 1 mi from the proposed Onshore Facilities, has small spires of potential visibility, suggesting that only the upper portions of the OnSS and/or ICF lightning masts or transmission structures may be visible through existing vegetation and development in the area. At this distance, it is unlikely viewers will even notice the introduction of the Onshore Facilities to the landscape.

Where visible at near foreground distances, the proposed Project would introduce new industrial/utility structures into the landscape. At a maximum height of 80 ft (24.2 m), the proposed Project will not be out of scale or character with the existing types of development currently present in the vicinity, such as the existing Davisville Substation, or the structures at nearby Quonset Point Business Park. As such, it is anticipated that the Onshore Facilities will result in negligible visual impacts to the public resources present in the VSA. As mentioned previously, some Camp Avenue residences are likely to experience limited visual impacts as a result of the vegetative clearing associated with the Project. While these ***long-term*** impacts are expected to alter the existing views experienced by the residents directly adjacent to the Project, they are generally localized and can be minimized through the use of mitigation, such as vegetative screening.

› **Lighting:** Facility lighting will be required for the safe and secure operation of the Onshore Facilities. However, the light sources are expected to be lower in profile than the maximum heights used in the viewshed analysis. As such, the lights associated with the Onshore Facilities will have minimal visibility from VSRs. Due to the developed nature of this area, the lights associated with the Facility are not expected to contribute significantly to the existing sky glow resulting from existing light sources present in the area. Therefore, it is anticipated that the Facility lighting will have a ***long-term,*** impacts on visual resources.

› **Traffic:** O&M associated with the Onshore Facilities is expected to be similar to ongoing O&M of the existing TNEC Davisville Substation in the Town of North Kingstown. Given existing traffic within the Quonset Point Business Park, it is likely that no noticeable increase over existing traffic patterns will occur. Therefore, it is anticipated that the traffic will not impact visual resources.

4.5.1.3 Environmental Protection Measures

Although visual impacts cannot be completely avoided, the following mitigation measures have been incorporated into RWF design to minimize visual impacts:

- Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval.
- RWF WTGs will have uniform design, speed, height, and rotor diameter.
- The WTGs will be painted Pure White (RAL 9010) to Light Grey (RAL 7035) as recommended by BOEM and the FAA. This color white of the turbines generally blends well with the sky at the horizon and eliminates the need for daytime warning lights or red paint marking of the blade tips.

If the NEPA review process determines that nighttime mitigation is required, the Project is willing to utilize Aircraft Detection Lighting Systems (ADLS) technology to mitigate reduce potential nighttime visual impacts if the technology is feasible in an offshore setting and approved by BOEM. ADLS reduces potential nighttime visual impacts by allowing aviation obstruction lighting to be active only as necessary when aircraft are approaching and within the airspace of the wind farm. A study completed by Capital Airspace Group (CAG) suggests that based on past aviation activity in the region, the aviation obstruction lights associated with the RWF, would be activated for a total of approximately 3.5 hours over a one-year period if ADLS is employed. The maximum monthly activation time would occur in August when past flight data suggests activation times would increase to approximately 50 mins over the entire month. January had the lowest activation frequency with just six seconds of aviation obstruction light activation over the course of the month. Considering the low frequency of light activation, nighttime visual impacts associated with the aviation obstruction lights would become negligible and intermittent in nature.

Although the results of the VIA concluded that no additional visual mitigation is required, Revolution Wind is willing to consider additional financially reasonable and technically feasible mitigation measures, including ADLS. By applying ADLS, night lighting impacts to onshore communities can be substantially reduced or limited. The Applicant is willing to utilize ADLS to mitigate nighttime visual impacts if the technology is feasible in an offshore setting and approved by BOEM.

While it is possible to control the activation of the aviation warning lights through ADLS, the navigation warning lights mandated by the USCG are required to be continuously active, as they are considered mapped aids to navigation. Due to the minimal visibility of the marine navigation lights from shore, no mitigation is considered necessary to reduce the visibility of these lights to onshore communities.

Proposed environmental protection measures associated with the Onshore Facilities are:

- The Onshore Transmission Cables and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties.
- Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce visibility and noise.

- Non-reflective paints and finishes will be used to the extent practicable on Onshore Facilities to minimize reflected glare.
- Lighting at the OnSS and ICF will be kept to a minimum and turned on only as needed by manual switch.

4.6 Socioeconomic Resources

This section describes the socioeconomic resources that could be affected by construction, operation, and decommissioning of the Project; discusses impact-producing factors associated with the Project relative to these resources; and identifies the proposed means to avoid and/or minimize effects on these resources. Socioeconomic resources discussed in this section include population, economy, and employment; housing and property values; public services; recreation and tourism; commercial and recreational fishing; commercial shipping; coastal land use and infrastructure; other marine uses; and environmental justice.

Regions of influence (ROIs) were defined to evaluate socioeconomic resources for the Project. These generally include the states, counties, and communities that may be impacted by potential Project activities. The primary ROI for overall socioeconomic resources includes the States of Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Virginia; the Counties of New London (Connecticut), Baltimore (Maryland), Bristol (Massachusetts), Gloucester (New Jersey), Kings (i.e., Brooklyn) (New York) Suffolk (New York), Providence (Rhode Island), and Washington (Rhode Island); and the City of New London (New London County), Sparrow's Point/Edgemere (Baltimore County), New Bedford (Bristol County), Paulsboro (Gloucester County), New York City (which includes Kings County) Montauk (Suffolk County), Port Jefferson (Suffolk County), City of Providence (Providence County), Towns of Narragansett and North Kingstown (Washington County), and City of Norfolk (Virginia). The primary ROI includes existing ports that are being evaluated to support construction and O&M of the Project (Section 3.3.9). Table 4.6-1 additionally highlights those specific states and counties considered for potential impacts on housing and property values, as well as recreation and tourism. Their inclusion in an expanded ROI was informed by their location within the potential viewshed of the RWF (Section 4.5).

Table 4.6-1 States, Counties, and Communities within the Socioeconomic Region of Influence

ROIs				
Primary (Overall Socioeconomic)	Expanded (Property Value/Tourism)	State	County	Communities or Shoreline
•	•	Connecticut	New London	New London
•		Maryland	Baltimore	Sparrow's Point (Edgemere)[1]
	•	Massachusetts	Barnstable	Southern and western shoreline
•	•	Massachusetts	Bristol	Southern shoreline, New Bedford

ROIs				
Primary (Overall Socioeconomic)	Expanded (Property Value/Tourism)	State	County	Communities or Shoreline
	●	Massachusetts	Dukes	Southern and western shoreline
	●	Massachusetts	Nantucket	Northern, southern, and western shoreline
	●	Massachusetts	Plymouth	Southern shoreline
●		New Jersey	Gloucester	Paulsboro[2]
●		New York	Kings	Borough of Brooklyn,[3] New York City
●	●	New York	Suffolk	Eastern and southeastern shoreline, Montauk, Port Jefferson Village
	●	Rhode Island	Bristol	Eastern and southeastern shoreline
	●	Rhode Island	Kent	Eastern shoreline
	●	Rhode Island	Newport	Southern shoreline
●	●	Rhode Island	Providence	City of Providence
●		Rhode Island	Washington	Quonset Point/Town of North Kingstown
●		Rhode Island	Washington	Villages of Galilee and Point Judith/Town of Narragansett
	●	Rhode Island	Washington	Southern shoreline of coast and Block Island
●		Virginia	Norfolk	Norfolk[4]

1 Edgemere, Maryland is the (geographically) closest residential area to Sparrow's Point. This area is an unincorporated community and census-designated place in Baltimore County.

2 This study used the Borough of Paulsboro for census data. The Borough of Paulsboro includes the community of Billingsport.

3 Kings County and the Borough of Brooklyn are coterminous and within New York City. Different than other jurisdictions, the municipality (New York City) is larger than the county (Kings County).

4 This study used the City of Norfolk and Norfolk International Terminals (NIT) as the locations for this community and port, respectively.

4.6.1 Population, Economy, and Employment

4.6.1.1 Affected Environment

This section describes the affected environment relative to population, economic, and employment characteristics. It presents this information for the RWF, the RWEC, and Onshore Facilities collectively, as the primary and expanded ROIs represent a broad area inclusive of all Project components.

Population

Table 4.6.1-1 summarizes United States Census Bureau (USCB) data on population and population trends for the states, counties, and communities within the primary ROI. Among the counties within this ROI, Kings County (Brooklyn) has by far the highest population in 2017 (2,635,121), followed by Suffolk County, and among the municipalities, New York City has by far the largest population (8,560,072), followed by the City of Norfolk (245,752) (USCB, 2017a). New York City has by far the highest population density with 28,251 persons per square mile, followed by the City of Providence, with 9,973 persons per square mile (sq mi). The City of New London, Connecticut, City of New Bedford, Massachusetts, and City of Norfolk, Virginia are also fairly dense, each with between 4,500 and 5,000 persons per sq mi. The median age ranges from a low of 30 in the Cities of Providence and Norfolk to a high of 56 in Montauk.

Table 4.6.1-1 Population Characteristics within the Region of Influence

Entity	Land Area (sq mi)	Decennial Census Population Count (2000)	Decennial Census Population Count (2010)	ACS Population Estimate (2017)	Population Density (2017)	Population Change (2000-2017)	ACS Median Age (2017)
Connecticut	4,842	3,405,565	3,574,097	3,594,478	742	6%	41
New London County	665	259,088	274,055	270,772	407	5%	41
City of New London	6	25,671	27,620	27,147	4,525	6%	31
Maryland	9,707	5,296,486	5,773,552	5,996,079	618	13%	39
Baltimore County	598	754,292	805,029	828,637	1,386	10%	39
Sparrow's Point (Edgemere)	11	9,248	8,669	8,732	794	-6%	47
Massachusetts	7,800	6,349,097	6,547,629	6,678,319	856	5%	39
Bristol County	553	534,678	548,285	557,016	1,007	4%	41
New Bedford	20	93,768	95,072	95,125	4,756	1%	38
New Jersey	7,354	8,414,350	8,791,894	8,960,161	1,218	6%	40
Gloucester County	895	254,673	288,288	291,372	326	14%	40
Borough of Paulsboro	2	6,160	6,097	5,970	2,985	-3%	39
New York	47,126	18,976,457	19,378,102	19,798,228	420	4%	38
Kings County (Brooklyn)	71	2,465,326	2,504,700	2,635,121	37,144	7%	35
New York City	303	8,008,278	8,175,133	8,560,072	28,251	7%	36

Entity	Land Area (sq mi)	Decennial Census Population Count (2000)	Decennial Census Population Count (2010)	ACS Population Estimate (2017)	Population Density (2017)	Population Change (2000-2017)	ACS Median Age (2017)
Suffolk County	912	1,419,369	1,493,350	1,497,595	1,642	6%	41
Montauk	18	3,851	3,326	3,662	203	-5%	56
Port Jefferson Village	3	7,837	7,750	7,833	2,611	0%	45
Rhode Island	1,034	1,048,319	1,052,567	1,056,138	1,021	1%	40
Providence County	410	621,602	626,667	633,704	1,546	2%	37
City of Providence	18	173,618	178,042	179,509	9,973	3%	30
Washington County	329	123,546	126,979	126,190	384	2%	44
Town of Narragansett	14	16,361	15,868	15,601	1,114	-5%	44
Town of North Kingstown	43	26,326	26,486	26,178	609	-1%	45
Virginia	39,490	7,078,515	8,001,024	8,365,952	212	18%	38
Norfolk	54	234,403	242,803	245,752	4,551	5%	30

Sources: U.S. Census Bureau, 2000, 2010, 2017a, 2018
ACS = American Community Survey

From a trend perspective, the percent change between the decennial census taken in 2000 and the 2013-2017 ACS 5-Year Estimates is provided in Table 4.6.1-1. Since 2000, the change in population within the primary ROI ranges from a low of -6 percent in Sparrow's Point (Edgemere) to a high of 18 percent in Virginia as a whole.

Economy

This section characterizes overall economic conditions by describing the gross domestic product (GDP) of each state, its contribution to the overall national GDP, and the distribution of the civilian workforce by major industry sector. In addition to state-level information, data are presented for the subset of coastal counties that BOEM identified as potentially vulnerable to the impacts of offshore wind development in the RI-MA WEA (ICF, 2012), as well as additional areas that may be involved in the Project. As the overall economy is influenced by property values and recreation/tourism, in addition to the primary ROI, this section also presents data for the expanded ROI.

Overall Economy

The GDP represents the market value of goods and services produced by the labor and property located within a geography and is influenced to a large degree by size (geographic area). GDP serves as a relative indicator of the size of the economies within the region, particularly when viewed as a percentage of the overall national economy. Table 4.6.1-2 summarizes the GDP for Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Virginia for the third quarters of 2019 and 2020.

Table 4.6.1-2 Current-Dollar Gross Domestic Product by State for the Third Quarters of 2019 and 2020

	GDP (in Millions of Dollars Seasonally Adjusted at Annual Rates)			Percent to the U.S.	
	2019	2020	2019-2020 % Change	2019	2020
United States	21,540,325	21,170,252	-1.7	--	--
Connecticut	288,493	283,603	-1.7	1.3	1.3
Maryland	428,650	427,616	-0.2	2.0	2.0
Massachusetts	600,545	590,307	-1.7	2.8	2.8
New Jersey	638,364	625,659	-2.0	3.0	3.0
New York	1,779,740	1,705,127	-4.2	8.3	8.1
Rhode Island	61,769	61,081	-1.1	0.3	0.3
Virginia	560,808	557,986	-0.5	2.6	2.6

Source: BEA, 2020

Within the primary and expanded ROIs, New York has the highest GDP with approximately $1.8 trillion in the third quarter of 2019 and $1.7 trillion in the third quarter of 2020, representing a decrease of about 4 percent year-over-year (BEA, 2020). New York comprises 8.1 percent of the national GDP (BEA, 2020). In the third quarter of 2020, the GDP of Connecticut was approximately $283 billion (representing just over 1 percent of the national GDP); the GDP of Maryland was approximately $427 billion (representing 2 percent of the national GDP); the GDP of Massachusetts was approximately $590 billion (representing just under 3 percent of the national GDP); the GDP of New Jersey was approximately $625 billion (representing 3 percent of the national GDP); the GDP of Rhode Island was approximately $61 billion (representing just 0.3 percent of the national GDP); and the GDP of Virginia was approximately $558 billion (representing 2.6 percent of the national GDP) (BEA, 2020).

Table 4.6.1-3 demonstrates that despite their geographic distribution, the economies of the counties in the primary and expanded ROIs are similar. Based on the *2013-2017 ACS 5-Year Estimates*, between 19 and 32 percent of the civilian population in each geography is employed in the educational services, and health care and social assistance industry (USCB, 2017b). Five other categories of employment are important industries, representing as much as 16 percent of employment in each geography: retail trade; professional, scientific, and management, and administrative and waste management services; arts, entertainment, and recreation, and accommodation and food services; manufacturing; and construction. Compared to New London County, Connecticut, the other counties within the primary and expanded ROIs have relatively high percentages of persons employed in the finance and insurance, and real estate and rental and leasing industry (between 6 and 9 percent). These county percentages are reflective of their respective states, while the percent for New London County (4 percent) is lower than Connecticut as a whole (9 percent). The agriculture, forestry, fishing and hunting, and mining industry employs just 1 percent or less of the civilian workforce in each geography.

Recreation and Tourism Economy

BOEM's Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development: Impacts of Offshore Wind on Tourism and Recreation Economies identified the coastal areas by county for each WEA by their potential to encounter both beneficial and detrimental socioeconomic impacts from each phase (planning, construction, and deconstruction) of wind facility development (ICF, 2012). Factors included:

- Ocean recreation and tourism account for a sizable percentage of the location's tourism economy;
- Ocean recreation and tourism account for a sizable percentage of the location's marine economy;
- Tourism accounts for a sizable percentage of the location's economy;
- The location has many establishments related to coastal and water recreation;
- The location has a high percentage of natural or historic and cultural areas; and
- The location has significant development along the coast (ICF, 2012).

Of the 113 geographic areas assessed by BOEM, four were in Connecticut, eight were in Massachusetts, eight were in New York, and five were in Rhode Island; Block Island was additionally incorporated as a "hotspot" for its unique economic, social, or physical characteristics that distinguishes it from Washington County, Rhode Island, overall (ICF, 2012). All counties within the primary expanded ROIs were included in BOEM's assessment, with exception to Baltimore County, Maryland; Gloucester County, New Jersey; and the City of Norfolk, Virginia. Based on the methodology of the ICF report, the recreation and tourism industries in these counties are less likely to have sensitivity to offshore wind development as compared to those included in BOEM's assessment.

BOEM's report tabulated the recreation and tourism industry employment. Because the Bureau of Economic Analysis (BEA) does not have a single North American Industry Classification System (NAICS) code for the tourism industry, it compiled those coastal industries that play a significant role in providing services that cater to tourists.

Table 4.6.1-4 summarizes the significance of tourism, including ocean-related tourism, to each geography assessed by BOEM within the expanded ROI. Ocean jobs related to tourism ranged from a low of 40 percent (Bristol County, Massachusetts) to a high of 99 percent in Nantucket County, Massachusetts. The number of employees per ocean-related establishment was far higher in New London County (approximately 30) than in the other counties within the expanded ROI (ranging from approximately eight in Dukes County to 18 in Kent County) (ICF, 2012).

Table 4.6.1-3 Distribution of Civilian Employed Population (16 Years and Over) by Industry

Industry	CT	New London County, CT	MA	Barnstable County, MA	Bristol County, MA	Dukes County, MA	Nantucket County, MA	Plymouth County, MA	MD	Baltimore County, MD	NJ	Gloucester County, NJ	NY	Kings County, NY	Suffolk County, NY	RI	Bristol County, RI	Kent County, RI	Newport County, RI	Providence County, RI	Washington County, RI	VA	Norfolk, VA
Agriculture, forestry, fishing and hunting, and mining	<1%	1%	<1%	1%	<1%	3%	2%	1%	1%	<1%	<1%	1%	<1%	<1%	1%	<1%	<1%	<1%	1%	<1%	1%	1%	<1%
Construction	6%	6%	6%	9%	7%	12%	14%	7%	7%	6%	6%	7%	6%	5%	8%	5%	5%	6%	7%	5%	6%	7%	7%
Manufacturing	11%	13%	9%	4%	11%	4%	3%	7%	5%	5%	8%	8%	6%	4%	7%	11%	9%	11%	7%	12%	10%	7%	7%
Wholesale trade	3%	2%	2%	2%	3%	2%	2%	3%	2%	2%	3%	4%	2%	2%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Retail trade	11%	11%	11%	13%	13%	12%	14%	12%	10%	11%	11%	12%	11%	10%	12%	12%	9%	12%	10%	13%	10%	11%	12%
Transportation and warehousing, and utilities	4%	4%	4%	4%	4%	3%	4%	5%	5%	5%	6%	6%	5 %	6%	6%	4%	3%	4%	3%	4%	3%	4%	5%
Information	2%	2%	2%	2%	2%	1%	2%	2%	2%	2%	3%	2%	3%	4%	3%	2%	2%	2%	1%	2%	1%	2%	2%
Finance and insurance, and real estate and rental and leasing	9%	4%	7%	6%	6%	7%	8%	9%	6%	8%	9%	7%	8%	7%	7%	7%	7%	8%	7%	7%	6%	6%	6%
Professional, scientific, and management, and administrative and waste management services	12%	9%	14%	12%	9%	14%	12%	11%	15%	13%	13%	11%	12%	13%	12%	10%	10%	9%	12%	10%	10%	15%	11%
Educational services, and health care and social assistance	27%	25%	28%	25%	27%	20%	19%	26%	24%	27%	24%	27%	28%	28%	27%	28%	32%	27%	27%	27%	28%	22%	24%
Arts, entertainment, and recreation, and accommodation and food services	9%	16%	9%	12%	9%	11%	12%	10%	8%	8%	8%	8%	10%	10%	7%	11%	11%	10%	13%	10%	13%	9%	13%
Other services, except public administration	5%	4%	4%	5%	4%	7%	5%	4%	5%	5%	4%	4%	5%	5%	4%	5%	4%	4%	5%	5%	4%	5%	5%
Public administration	4%	5%	4%	5%	4%	4%	5%	5%	11%	8%	4%	4%	5%	4%	5%	4%	4%	5%	5%	4%	4%	9%	9%

Source: USCB, 2017b

Table 4.6.1-4 Summary of Ocean-related Tourism Indicators[a]

State and Communities	Ocean Jobs Related to Tourism, 2010	Tourism-related Establishments, 2010	Ocean-related Establishments/ Employment, 2009	Tourism Expenditures, 2010 (in millions)
Connecticut				
New London County	41%	824	489 / 14,779	$761
Massachusetts				
Barnstable County	97%	1,351	1,287/14,240	$813
Bristol County	40%	1,436	512 / 6,471	$384
Dukes County	97%	179	165 / 1,398	$112
Nantucket County	99%	147	126/1,122	$140
Plymouth County	86%	1,261	557/7,477	$5
New York				
Kings County (Brooklyn)	89%	4,582	2,346 / 16,910	N/A
Suffolk County	82%	4,115	2,021 / 23,825	N/A
Rhode Island				
Bristol County	71%	159	160/2,145	--
Kent County	98%	549	317/5,595	--
Newport County	75%	447	462 / 7,616	$790
Providence County	96%	1,733	496 / 7,175	N/A
Washington County	62%	574	469 / 7,500	$751
Block Island, Washington County	N/A	58	N/A	$259

Source: ICF, 2012
a Portions of the counties summarized in this table are within the viewshed of the RWF.
N/A = not available

Employment

Employment characteristics in the primary ROI for overall socioeconomic resources are summarized in Table 4.6.1-5. Among the counties, Kings County (Brooklyn) has the largest labor force with approximately 1.211 million workers , followed by Suffolk County with approximately 778,000 workers (as of 2018), while Washington County has the smallest labor force with approximately 69,000 workers (BLS, 2019a-e). The unemployment rate is low throughout, with the highest rate in Providence County (4.4 percent). Per capita personal income in 2017 was lowest in Norfolk at $40,094 and highest in Suffolk County at $65,758 (BEA, 2018; BLS 2019a-e).

Table 4.6.1-5 Employment Characteristics in the Primary Region of Influence

Entity	Labor Force (2018)	Employment (2018)	Unemployment (2018)	Unemployment Rate (2018)	Per Capita Personal Income (2017)
CONNECTICUT	1,898,000	1,819,000	79,000	4.1%	$71,823
New London County	137,463	132,032	5,431	4.0%	$56,725
MARYLAND	3,184,000	3,051,000	132,000	4.2%	$60,847
Baltimore County	450,366	432,164	18,202	4.0%	$59,130
MASSACHUSETTS	3,823,000	3,693,000	130,000	3.4%	$67,630
Bristol County	302,918	289,955	12,963	4.3%	$51,298
NEW JERSEY	4,418,000	4,232,000	186,000	4.2%	$64,537
Gloucester County	147,175	140,940	6,235	4.2%	$52,506
NEW YORK	9,542,000	9,147,000	395,000	4.1%	$64,540
Kings County (Brooklyn)	1,211,721	1,160,501	51,220	4.2%	$48,758
Suffolk County	777,784	747,832	29,952	3.9%	$65,758
RHODE ISLAND	557,000	534,000	23,000	4.1%	$52,786
Washington County	69,005	66,529	2,476	3.6%	$62,357
Providence County	325,587	311,259	14,328	4.4%	$46,470
VIRGINIA	4,352,000	4,224,000	127,000	2.9%	$55,105
Norfolk	111,524	107,496	4,028	3.6%	$40,094

Source: BEA, 2018; BLS 2019a–e; Connecticut Department of Labor, 2018; Rhode Island Department of Labor and Training, 2019a, 2019b, and 2019c.

4.6.1.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the Project have the potential to impact population, economy, and employment resources, as presented in Figure 4.6-1.

Figure 4.6.1-1 IPFs on Population, Economy, IPFs on Population, Economy, and Employment

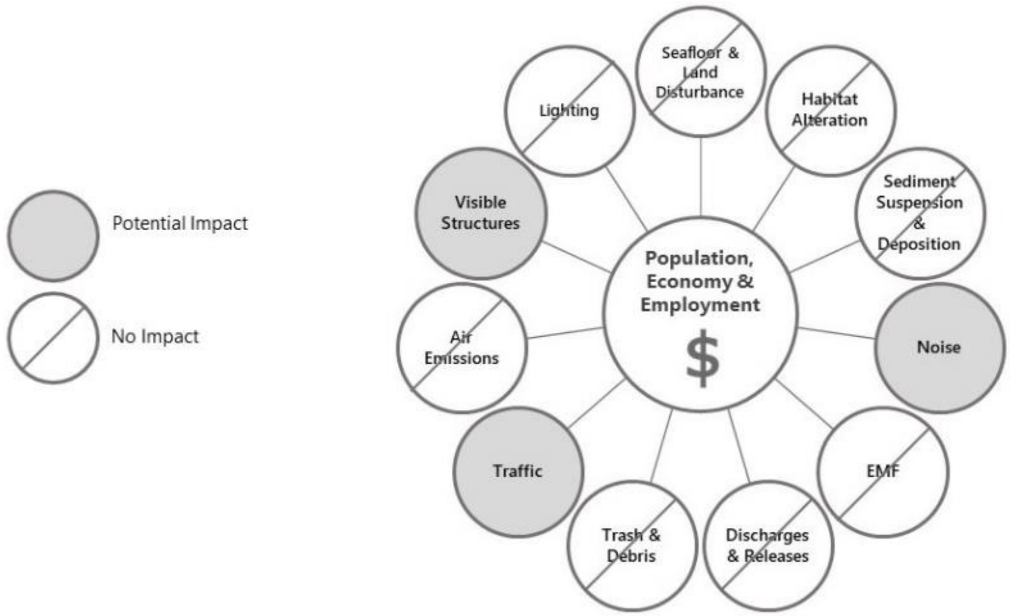


Table 4.6.1 identifies the local communities, counties, and states within the primary ROI. Impacts to population, economy and employment resources in these areas will result from the need for varying levels of local and non-local workers, goods, and services during each phase. Further, local economies within the expanded ROI dependent on recreation and tourism could be impacted by visible structures.

In October 2020, Guidehouse Inc. prepared an assessment to assist with the evaluation of economic development and jobs that will result from the Project (Appendix BB). Based on this evaluation, the value added in the entire United States from the RWF and RWEC would be approximately $652.9 million in the construction phase (starting in 2022) and approximately $85.0 million on an annual basis in the operations phase (in 2020 dollars) (Guidehouse, 2020). The Project will support an estimated 5,290 local job-years[6] during the construction phase and approximately 365 additional local annual jobs during the operations phase. A summary of jobs and investment impacts in the United States is provided in Table 4.6.1-6. Additional details, including state-specific information, are provided in Appendix BB, *Advisory Opinion on the Economic Development Benefits of the Proposed Revolution Wind Project* (Guidehouse, 2020).

6 Job-years during the construction phase are defined as full-time equivalent (FTE) jobs multiplied by the number of construction years.

Table 4.6.1-6 Summary of Jobs and Investment Impacts in the United States[a]

Project Phase	Impact Categories	Jobs	Earnings (Millions USD)	Output (Millions USD)	Value Added (Millions USD)
Construction	Direct	1,410	$124.0	$148.9	$129.8
	Indirect	2,146	$187.0	$747.3	$343.1
	Induced	1,734	$109.8	$343.0	$180.1
	Total	5,290	$420.8	$1,239.1	$652.9
Operations (Annual)	Direct	58b	$4.9	$4.9	$4.9
	Indirect	39	$3.2	$57.4	$48.2
	Induced	268	$18.9	$58.9	$31.9
	Total	365	$27.1	$121.2	$85.0

Source: Guidehouse, 2020

a Earnings, Output and Value-Added figures are in millions of 2020 dollars. Construction job figures are in job years, which are full-time equivalent (FTE) jobs multiplied by the number of construction years. Operations jobs are FTEs for a period of one year. The analysis does not include impacts associated with spending of wind farm profits. Totals may not add up due to independent rounding.

B Orsted estimated 32 FTE direct jobs in Rhode Island in the operations phase while the JEDI model projected 58 FTE.

Revolution Wind will hire local workers to the extent practical for RWF, RWEC, and the interconnection facility management, fabrication, and construction. Non-local construction personnel typically include mariners, export cable manufacturing personnel, and other specialists who may temporarily relocate during the construction and decommissioning.

Expected job creation from development of the offshore wind industry in the Northeast was also recently described in the report, *United States Job Creation in Offshore Wind*, that was prepared for the NYSERDA. This report reflected collaboration with representatives of the Massachusetts Department of Energy Resources, the Mass Clean Energy Center, and the Rhode Island Office of Energy Resources (BVG Associated Limited, 2017).

Population impacts to the communities in the primary ROI could result mainly from the short-term influx of construction personnel. The total population change will equal the total number of non-local construction workers plus any accompanying family members. Due to the short duration of construction activities, however, it is unlikely that non-local workers will relocate families to the area.

Tables 4.6.1-7a, 4.6.1-7b, and 4.6.1-7c summarize the potential impacts to population, economy, or employment during the construction, O&M, and decommissioning phases of the RWF, RWEC, and Onshore Facilities that are described in further detail in the following sections.

Revolution Wind Farm

Construction and decommissioning activities may result in ***direct*** and ***indirect,*** and ***short-term impacts*** to the population and local economies. There is the potential for ***direct*** and ***long-term impacts*** from noise and visible structures during O&M. Section 4.1.3 discusses noise that could be generated and Section 4.1.7 discusses marine vessel and land traffic that could be generated.

Table 4.6.1-7a RWF Population, Economy and Employment Impact Summary

Entity	Population	Economy	Recreation and Tourism Economies	Employment
RWF				
Construction/ Decommissioning	Direct, Short-term	Direct and Indirect, Short-term	Direct, Short-term	Direct, Short-term
O&M	Direct, Long-term	Direct and Indirect, Long-term	Direct, Long-term	Direct, Long-term

Construction

- **Noise and Traffic:** Noise and traffic are considered jointly in this section since these potential impacts are directly related to use of equipment, vehicles, and vessels for construction activities. ***Direct*** and ***short-term*** impacts to the population from noise during construction could occur; however, these impacts will be limited to activities at the construction port facilities and construction of the O&M facilities described in Section 3 above. There will be increased marine vessel (e.g., tugs and barges transporting construction materials and smaller support vessels carrying supplies and crew) and vehicular traffic (e.g., delivery trucks carrying construction equipment and supplies, and automobiles used for daily commuting to various work sites). It is anticipated that all large Project components (e.g., WTG blades, foundation segments, nacelle, etc.) will be transported at sea and not overland; therefore, such activities would not impact land-based traffic. The number of additional trips during the construction phase of the RWF and associated impacts to the population and economy would result in ***direct*** and ***short-term*** impacts but are expected to be minimal relative to the existing conditions.
- **Visible Structures:** ***Direct*** and ***indirect,*** and ***short-term*** impacts to the economy and employment of the region are anticipated because of the size of the non-local construction workforce relative to existing conditions and because the RWF will be constructed using multiple ports and access locations in different states (Table 4.6-1). Section 4.5 characterizes the visible structures associated with construction of the RWF. Visibility of the WTG construction activities will generally be limited to those recreating or working offshore, which is not expected to impact the overall population, economy, or employment. Construction of the O&M facilities are not anticipated to change existing visual resources in a measurable fashion since they will be situated within existing port areas. Depending on the timing and location of the staging and

construction activities, there could be ***direct*** and ***short-term*** impacts on the local economies dependent on recreation and tourism.

Operations and Maintenance

- **Noise and Traffic:** There would be periodic ***direct*** and ***long-term impacts*** to the population from support O&M activities at the staging ports used for significant maintenance activities.
- **Visible Structures:** ***Direct*** and ***long-term impacts*** to economy and employment will result from a limited number of staff and goods and services needed to operate and maintain the RWF. The O&M facilities are not expected to impact the local economies dependent on recreation and tourism because it is assumed such facilities will be sited and designed to be consistent with adjacent land uses to minimize the visible structures seen by visitors.

Decommissioning

Decommissioning of the RWF would have similar ***direct*** and ***indirect short-term*** impacts as construction in terms of increased employment, traffic, noise, and visible structures impacts.

Revolution Wind Export Cable

Construction and decommissioning activities may result in ***direct*** and ***short-term impacts*** to the population and local economies from noise, traffic, and visible structures. No O&M impacts are anticipated. Section 4.1.3 discusses noise that could be generated, and Section 4.1.7 discusses marine vessel and land traffic that could be generated.

The RWEC-OCS and RWEC-RI impacts are anticipated to be similar and are included together in the following section.

Table 4.6.1-7b RWEC Population, Economy, and Employment Impact Summary

Entity	Population	Economy	Recreation and Tourism Economies	Employment
RWEC-OCS				
Construction/ Decommissioning	Direct, Short-term	Direct and Indirect, Short-term	Direct, Short-term	Direct, Short-term
O&M	Direct, Long-term	Not Anticipated	Not Anticipated	Direct, Long-term
RWEC-RI				
Construction/Decommissioning	Direct, Short-term	Direct and Indirect, Short-term	Direct, Short-term	Direct, Short-term
O&M	Direct, Long-term	Not Anticipated	Not Anticipated	Direct, Long-term

RWEC-OCS and RWEC-RI

Construction

- **Noise:** Impacts from noise are expected to be ***direct*** and ***short-term,*** resulting from vessel traffic and construction equipment near the construction areas, primarily within the West Passage of Narragansett Bay, the East Passage of Narragansett Bay, and along the Bay's western shore near Quonset Point to the Town of Narragansett, Rhode Island. ***Direct*** and ***short-term*** impacts to the population and local tourism and recreation economies from noise during construction could occur; however, these impacts will be local to the vicinity of the landfall location. There may be ***direct*** and ***short-term*** impacts associated with construction depending on the duration and timing of these activities with the local tourism season and the location of the landing site.
- **Traffic:** ***Direct*** and ***short-term*** impacts to the population may occur from increases in traffic during construction of the RWEC because of the size of the non-local construction workforce relative to existing conditions. Section 4.1.7 discusses marine vessel traffic that could be generated by the RWEC-OCS and RWEC-RI construction. There will be increased marine vessel (e.g., tugs and barges) transporting construction materials, export cable laying barges, and smaller support vessels carrying supplies and crew. A full list of anticipated vessels is provided in Section 3.
- **Visible Structures:** ***Direct*** and ***indirect,*** and ***short-term*** impacts to the economy and employment of the region are anticipated because of the size of the non-local construction workforce relative to existing conditions.

Operations and Maintenance

No long-term noise, traffic and visible structure impact on the population, economy, and employment will result from O&M because limited maintenance activities are expected.

Decommissioning

Decommissioning of the RWEC-OCS and RWEC-RI could have similar noise, traffic and visible structure impacts as construction, depending on the duration and timing of these activities with the local tourism season and location of the landing site.

Onshore Facilities

The Onshore Facilities includes the segment of the RWEC between the mean high-water line and the TJBs, Landfall Work Area, Onshore Transmission Cable, and the OnSS. The Onshore Facilities are expected to have ***direct*** and ***indirect,*** and ***short-term*** impacts on population, economy, and employment during construction or decommissioning; however, there may be the potential for limited ***direct*** and ***long-term*** impacts from noise and visible structures associated with O&M at the OnSS. Section 4.1.7 discusses marine vessel and land traffic that could be generated; and Section 4.1.10 discusses visible structures.

Table 4.6.1-7c RWF, RWEC and Onshore Facilities Population, Economy, and Employment Impact Summary

Entity	Population	Economy	Recreation and Tourism Economies	Employment
Onshore Facilities				
Construction/ Decommissioning	Direct, Short-term	Direct, Short-term	Direct, Short-term	Direct, Short-term
O&M	Direct, Short- and Long-term	Direct, Long-term	Direct, Long-term	Direct, Long-term

Construction

- **Noise:** There will be ***direct*** and ***short-term*** impacts from noise during construction of the Onshore Facilities. Except as needed for specific activities, construction will not exceed parameters set by local ordinances and construction is anticipated to occur Monday through Friday between the hours of 7:00 am to 6:00 pm to minimize noise disturbance. It may be necessary for construction to occur outside of these hours to complete necessary projects. Construction noise is discussed extensively in Section 4.1.3.
- **Traffic:** There will be ***direct*** and ***short-term*** impacts from construction of the Onshore Facilities. Implementation of environmental protection measures as noted in Section 4.6.1.3 influences the size of the non-local construction workforce relative to existing conditions, construction detours, and increased vehicular traffic (e.g., delivery trucks carrying construction equipment and supplies, construction and export cable-laying equipment such as an excavator, and automobiles used for daily commuting to various work sites). The scale of these impacts will depend on the overall construction schedule and whether construction is timed to avoid traffic associated with summer tourism.
- **Visible Structures:** Depending on the timing of the construction activities associated with construction of the Onshore Facilities, impacts from visible structures would be ***direct*** and ***short-term***. The scale of these impacts will depend on whether construction is timed to avoid impacts on the local economies dependent on recreation and tourism.

Operations and Maintenance

- **Noise:** There may be ***direct*** and ***long-term*** impacts to the population from the limited amount of noise generated from the OnSS. This noise, however, is not expected to cause a significant increase in sounds levels above the existing levels of the current TNEC Davisville Substation.
- **Traffic:** There are no anticipated maintenance needs associated with the Onshore Facilities. However, if any unforeseen maintenance is required, impacts to traffic will be ***direct*** and ***short-term*** resulting from potential traffic detours and a slight increase in traffic from construction/maintenance workers.

- **Visible Structures:** Impacts from visible structures during O&M would have similar impacts as construction (Section 4.5).

Decommissioning

- **Noise:** Decommissioning of the Onshore Facilities would have similar noise disturbance impacts as construction (Section 4.1.3).
- **Traffic:** Decommissioning of the Onshore Facilities would have similar traffic impacts as construction (Section 4.1.7).
- **Visible Structures:** Decommissioning of the Onshore Facilities would have no impact as the Impact Producing Factor would be removed during decommissioning (Section 4.5).

4.6.1.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to population, economy, and employment.

- Where possible, local workers will be hired to meet labor needs for Project construction, O&M, and decommissioning.
- The Onshore Facilities construction schedule will be designed to minimize and mitigate impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day.
- Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise.
- Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.

4.6.2 Housing and Property Values

4.6.2.1 Affected Environment

This section discusses existing housing statistics and property values based on the 2013-2017 ACS 5-Year Estimates. It presents these data for the RWF, the RWEC-OCS, RWEC-RI, and Onshore Facilities collectively, as the primary and expanded ROIs represent a broad area inclusive of all Project components.

Housing

The vacancy status of the region's housing serves as a good indicator of the housing market and whether non-local construction workers will be able to find short-term accommodations. The USCB defines a housing unit as "a house, an apartment, a mobile home, a group of rooms or a single room that is occupied (or, if vacant, intended for occupancy) as separate living quarters" (USCB, 2017c). Boats, recreational vehicles (RVs), vans, tents, and other similar quarters are only included if they are occupied as a current place of residence.

Table 4.6.2-1 summarizes the total number of housing units, vacant units, vacancy rates for rentals and ownership, as well as their corresponding median value or gross rent for the primary ROI for overall socioeconomic resources. Homeowner vacancy rates in this ROI are low, between less than 1 percent (Paulsboro and Montauk) and 3.1 percent (City of Providence). Meanwhile, rental vacancy rates are generally higher and more varied, ranging from less than 1 percent (Paulsboro, Port Jefferson, and Town of Narragansett) to 49.7 percent (Montauk). The Montauk rental vacancy value seems to be an outlier, however, as it is likely reflective of Montauks' seasonal housing. The next highest rental vacancy rate is 7.6 percent (City of Providence) (USCB, 2017d).

Table 4.6.2-1 Housing Characteristics Within the Region of Influence

Entity	Total Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value (dollars)	Median Gross Rent (dollars)
CONNECTICUT	1,507,711	145,956	1.9%	6.6%	$270,100	$1,123
New London County	122,599	15,406	2.6%	5.1%	$238,900	$1,071
City of New London	12,420	1,436	2.8%	5.3%	$177,100	$950
MARYLAND	2,427,014	245,921	1.7%	6.3%	$296,500	$1,311
Baltimore County	336,358	23,499	1.6%	6.0%	$249,600	$1,224
Sparrow's Point (Edgemere)	3,505	246	1.2%	2.1%	$262,700	$1,312
MASSACHUSETTS	2,864,989	279,274	1.1%	4.0%	$352,600	$1,173
Bristol County	233,550	17,647	1.3%	4.7%	$280,400	$855
New Bedford	43,393	3,902	1.1%	6.0%	$211,500	$802
NEW JERSEY	3,595,055	395,944	1.7%	5.5%	$321,100	$1,249
Gloucester County	112,516	7,706	1.3%	6.3%	$213,800	$1,134
Borough of Paulsboro	2,762	416	0%	0%	$113,600	$1,009
NEW YORK	8,255,911	953,201	1.7%	4.3%	$293,000	$1,194
Kings County (Brooklyn)	1,028,383	83,733	1.8%	3.4%	$623,900	$1,314
New York City	3,455,117	312,712	1.8%	3.4%	$538,700	$1,340
Suffolk County	574,342	85,014	1.4%	5.3%	$379,400	$1,646
Montauk	4,579	3,051	0.6%	49.7%	$871,300	$2,048
Port Jefferson	3,268	275	2.1%	0%	$514,200	$1,581

Entity	Total Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate	Median Value (dollars)	Median Gross Rent (dollars)
RHODE ISLAND	466,670	54,642	1.8%%	5.8%	$242,200	$957
Providence County	265,807	27,342	2.2%%	6.6%	$214,400	$923
City of Providence	72,605	10,548	3.1%%	7.6%	$181,100	$949
Washington County	63,450	13,842	1.6%	3.0%	$320,600	$1,086
Town of Narragansett	9,962	3,223	2.7%	0.4%	$393,400	$1,297
Town of New Kingstown	11,374	1,074	1.1%	2.6%	$335,200	$1,007
Virginia	3,466,921	361,285	1.6%	5.8%	$255,800	$1,166
Norfolk	96,700	9,451	3.0%	6.9%	$194,800	$1,003

Source: USCB, 2017d

Table 4.6.2-2 summarizes the 2017 vacancy status in the primary ROI by type for those units that could be available to non-local construction workers, that is, units not already rented or sold. It illustrates the key role that "seasonal, recreational, or occasional use" and "other vacant" units play in the local housing supply. Among the counties in the primary ROI, these two uses comprise more than half of the vacant units, moreover, they comprise over 90 percent of the vacant units in Washington County and over 85 percent of the vacant units in Suffolk County (USCB, 2017e). Both "seasonal, recreational, or occasional use" and "other vacant" are associated with seasonal tourism or secondary vacation homes, with other vacant units often used by a caretaker or janitor. The availability of seasonal units would typically be quite limited during peak summer construction periods.

For the portions of the primary ROI with the most Project elements (Rhode Island), of the 941 vacant units noted in Table 4.6.2-2 for the Town of North Kingstown, 68 were reported "for rent," 85 units were "for sale," and the balance were split between "seasonal, recreational, or occasional use" and "other vacant" housing, as well as "for rent" and "sold, not occupied" (USCB, 2017e). Similarly, of the 3,223 vacant units in the Town of Narragansett, only 9 were reported "for rent," 125 units were "for sale," and the balance were split between "seasonal, recreational, or occasional use" and "other vacant" housing, as well as "for rent" and "sold, not occupied" (USCB, 2017e).

Other housing options will be short-term accommodations, which for purposes of this COP, are defined as hotel and motel rooms, and sites for RVs. Only a limited need for these short-term housing units is anticipated, primarily near the staging ports since much of the RWF workforce will be housed offshore.

Table 4.6.2-2 Vacant Housing Characteristics Within the Region of Influence

Entity	Total Vacant Units	For Rent	For Sale Only	For Seasonal, Recreational, or Occasional Use	For Migrant Workers	Other Vacant
CONNECTICUT	132,703	32,585	17,516	29,381	89	53,132
New London County	14,603	1,949	1,900	5,100	0	5,654
New London County % Distribution	--	13%	13%	35%	0%	39%
City of New London	1,397	388	115	166	0	728
MARYLAND	230,149	48,903	25,216	59,716	247	96,067
Baltimore County	21,448	6,950	3,298	1,282	31	9,887
Baltimore County % Distribution	--	32%	15%	6%	<1%	46%
Sparrow's Point (Edgemere)	223	15	31	31	0	146
MASSACHUSETTS	253,765	41,228	17,268	125,179	109	69,981
Bristol County	16,386	4,020	1,836	2,859	21	7,650
Bristol County % Distribution	--	25%	11%	17%	<1%	47%
New Bedford	3,737	1,501	185	192	0	1,859
NEW JERSEY	369,822	67,326	35,870	134,723	219	131,684
Gloucester County	7,002	1,470	1,068	165	0	4,299
Gloucester County % Distribution	--	21%	15%	2%	0%	61%
Borough of Paulsboro	336	-	-	-	0	336
NEW YORK	872,635	152,540	68,033	339,543	2,033	310,486
Kings County (Brooklyn)	72,585	23,326	5,173	9,095	28	34,963
Kings County % Distribution	--	32%	7%	13%	<1%	48%
New York City	274,430	76,255	19,167	71,703	937	106,368
Suffolk County	80,690	5,496	5,629	52,039	354	17,172
Suffolk County	--	7%	7%	64%	<1%	21%

Entity	Total Vacant Units	For Rent	For Sale Only	For Seasonal, Recreational, or Occasional Use	For Migrant Workers	Other Vacant
% Distribution						
Montauk	3,051	195	8	2,794	0	54
Port Jefferson	222	-	45	-	0	177
RHODE ISLAND	50,769	10,306	4,559	18,077	0	17,827
Providence County	24,938	8,011	2,889	1,418	0	12,620
Providence County % Distribution	--	32%	12%	6%	0%	51%
City of Providence	9,798	3,364	689	413	0	5,332
Washington County	13,423	412	597	10,854	0	1,560
Washington County % Distribution	--	3%	4%	81%	0%	12%
Town of Narragansett	3,223	9	125	2,877	0	159
Town of New Kingstown	941	68	85	354	0	434
VIRGINIA	326,909	65,735	33,377	89,956	460	137,381
Norfolk	8,753	3,726	1,165	438	0	3,424
Norfolk % Distribution	--	43%	13%	5%	0%	39%

Source: USCB, 2017e

Property Values

As shown in Table 4.6.2-1 above, median home values in the communities within the primary and expanded ROI range from $113,600 in Paulsboro to $871,300 in Montauk County. At $181,100, the City of Providence's median home value is similar to that of the City of New London, while the Towns of Narragansett and North Kingstown's median home values are about double that of the City of New London. New Bedford and Norfolk had similar but slightly higher median home values compared to the City of Providence and the City of New London (USCB, 2017d). Kings County ($623,900) and New York City ($538,700) had the highest median home values in these communities, other than Montauk. These trends were similar with regard to median gross rent, with Montauk having the highest value ($2,048) and New Bedford the lowest value ($802). The Cities of Providence ($949) and New London ($950) also have similar values, and the Towns of Narragansett ($1,297) and North Kingstown ($1,007) have higher values (USCB, 2017d). Kings County ($1,314) and New York City ($1,340) had the highest median gross rent in these communities, other than Suffolk County, Montauk, and Port Jefferson, although the differences weren't as pronounced as they were for median home values.

Table 4.6.2-3 summarizes the number of owner-occupied housing units across the region, and the percent distribution of their corresponding housing values in 2017. Among the counties within the primary and expanded ROI, each has between 1 percent and 8 percent of their owner-occupied housing unit values under $99,999. Norfolk Virginia has 9 percent of its owner-occupied housing unit values under $99,999 (USCB, 2017f). On the other hand, the percentage of units valued at $500,000 or greater ranged from 3 percent in Gloucester County NJ to 89 percent in Nantucket County, Massachusetts (USCB, 2017f). At the state level, Massachusetts and New York both have about a quarter of their owner-occupied housing unit values at greater than $500,000; Maryland, New Jersey, and Virginia have about a fifth of their owner-occupied housing unit values at greater than $500,000; and Connecticut and Rhode Island have 16 percent and 10 percent of their units valued at greater than $500,000, respectively (USCB, 2017f).

Table 4.6.2-3 Housing Values within the Expanded Region of Influence

	CT	New London County, CT	MD	Baltimore County, MD	MA	Barnstable County, MA	Bristol County, MA	Dukes County, MA	Nantucket County, MA	Plymouth County, MA	NJ	Gloucester County, NJ	NY	Kings County, NY	Suffolk County, NY	RI	Bristol County, RI	Kent County, RI	Newport County, RI	Providence County, RI	Washington County, RI	VA	Norfolk, VA
Total Number of Owner-Occupied Housing Units	906,798	71,447	1,456,758	205,962	1,612,329	74,862	135,144	4,770	2,438	139,821	2,052,073	83,431	3,942,483	283,752	393,065	247,291	13,466	48,648	21,973	126,847	36,357	2,055,073	37,854
Less than $99,999	6%	7%	8%	6%	4%	2%	5%	1%	1%	4%	6%	8%	16%	4%	4%	6%	3%	7%	4%	7%	4%	13%	9%
$100,000 to $124,999	4%	5%	3%	4%	2%	1%	2%	0%	0%	1%	3%	5%	6%	1%	1%	4%	1%	5%	1%	5%	2%	5%	8%
$125,000 to $149,999	5%	5%	4%	5%	2%	1%	2%	1%	0%	1%	3%	8%	5%	1%	1%	6%	1%	6%	1%	8%	1%	6%	10%
$150,000 to $174,999	8%	11%	6%	9%	4%	2%	5%	0%	0%	3%	5%	13%	6%	1%	2%	10%	2%	13%	3%	14%	3%	7%	13%
$175,000 to $199,999	7%	10%	5%	8%	4%	2%	6%	0%	0%	3%	5%	11%	4%	1%	2%	9%	4%	14%	3%	11%	4%	6%	13%
$200,000 to $249,999	14%	17%	13%	17%	11%	8%	18%	1%	1%	11%	11%	18%	7%	3%	7%	17%	13%	18%	11%	19%	15%	11%	17%
$250,000 to $299,999	13%	15%	12%	13%	11%	13%	18%	1%	1%	14%	12%	14%	7%	3%	11%	13%	16%	12%	13%	13%	16%	10%	9%
$300,000 to $399,999	17%	16%	19%	16%	22%	27%	23%	11%	3%	26%	21%	15%	13%	10%	29%	17%	26%	14%	22%	14%	27%	14%	9%
$400,000 to $499,999	9%	7%	11%	9%	14%	16%	11%	12%	4%	14%	12%	4%	11%	12%	18%	7%	14%	5%	13%	5%	12%	9%	5%
$500,000 to $749,999	9%	5%	12%	8%	16%	16%	7%	34%	19%	14%	14%	2%	14%	28%	16%	6%	12%	4%	16%	3%	11%	11%	5%
$750,000 to $999,999	3%	2%	4%	2%	5%	6%	1%	24%	20%	4%	5%	0%	6%	16%	5%	2%	4%	1%	5%	1%	3%	4%	2%
$1,000,000 to $1,499,999	2%	1%	2%	1%	3%	3%	1%	7%	22%	2%	2%	0%	3%	11%	2%	1%	2%	0%	3%	0%	2%	2%	1%
$1,500,000 to $1,999,999	1%	0%	1%	0%	1%	1%	0%	3%	8%	1%	1%	0%	1%	4%	1%	0%	1%	0%	1%	0%	1%	0%	0%
$2,000,000 or more	2%	0%	1%	0%	1%	1%	0%	6%	20%	1%	1%	0%	2%	5%	1%	1%	2%	0%	2%	0%	1%	0%	0%
Greater than $500,000	16%	8%	19%	12%	26%	27%	9%	74%	89%	21%	21%	3%	25%	64%	26%	10%	20%	6%	29%	5%	17%	18%	8%

Source: USCB, 2017f

4.6.2.2 Potential Impacts

Impacts to housing and property values were evaluated based on the pressure on housing resources that could result from an influx of non-local employees. During construction and decommissioning, housing for the offshore workforce will be available on some of the offshore vessels. In addition, because of the availability of vacant housing as shown in Table 4.6.2-2, there should be adequate housing available within the primary ROI.

Based on the findings of Section 4.5, visibility of the RWF will be limited to approximately 3 percent of the land area within the 40-mi Visual Study Area. Meanwhile, approximately 8.7 percent of 2.6 sq mi (6.7 sq km) of the OnSS Visual Study Area would have visibility of the proposed facility.

In locations where views of the RWF may be available from land, the Project will be approximately 13 mi (20.9 km) south of mainland Rhode Island; 13 mi (20.9 km) southwest of Martha's Vineyard, Massachusetts; 14 mi (22.5 km) south of mainland Massachusetts; and 15 mi (24.1 km) east of Block Island, Rhode Island. This suggests that the Project will be visible to a casual observer under clear conditions, but not the focus of attention (Sullivan et al., 2013). BOEM notes that degrading the natural resources that draw tourists and recreational users can result in negative economic impacts, particularly because of a change in the public's perception of the aesthetics of a location. However, this change in public perception is highly site-specific and can be negative, positive, or a mix of both (ICF, 2012).

Recent studies in the United States vary, with most finding that study participants do not expect impacts to property values or substantial changes in coastal visitation. Several studies (e.g., Jensen et al., 2018) from around the world suggest that offshore wind farms as distant from shore as RWF present little negative impact on housing prices. Summaries of several relevant examples are included below:

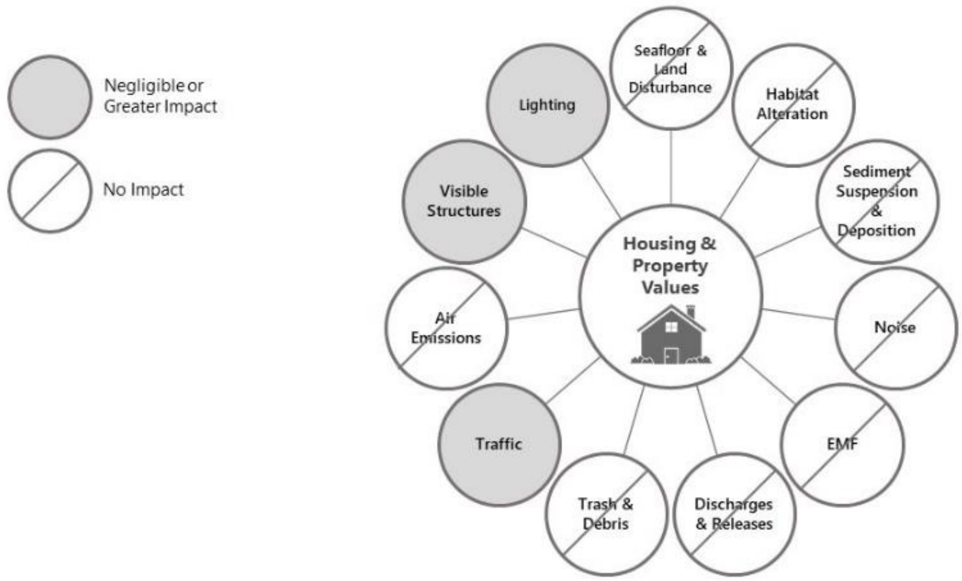
- In 2009 and 2013, the Lawrence Berkeley National Laboratory published research regarding the property value effects of utility-scale wind energy developments. As part of its work, the organization collected data on home sales within 10 mi of existing wind facilities in the United States. The findings of these research studies demonstrated no statistically observable impact (Hoen, et al., 2009; Hoen, et al., 2013).
- A study of approximately 1,000 respondents assessed the potential impact of offshore wind on property rentals in New Jersey (Schulman and Rivera, 2009). The majority of those responding, 76 percent, indicated that a wind facility would not impact rental properties, 13 percent thought it would be harder to rent properties while 10 percent believed it would be easier to rent properties with an offshore wind facility in the vicinity (Schulman and Rivera, 2009).
- A Goucher Poll of 671 Maryland residents conducted from September 14 to 17 of 2017 had similar results. It asked whether seeing wind turbines on the horizon from the beach in Ocean City make visitors less likely to vacation in Ocean City, more likely to vacation in Ocean City or no difference. Three-quarters, 77 percent, of these residents said that seeing wind turbines on the horizon would "make no difference" to them (Goucher, 2017).

- Another study conducted a choice experiment with individuals that recently rented vacation properties along the North Carolina coastline to assess the impacts of a utility-scale wind farm on their rental decisions (Lutzeyer et al., 2017). Their findings indicated that rental value losses of up to 10 percent are possible if a utility-scale wind farm is placed within 8 mi (12.8 km) of shore. Their results also indicated there is not a scenario where respondents would be willing to pay more to rent a home with turbines in view, and a substantial portion of the survey population would change their vacation destination if wind farms were placed within visual range of the beach.
- A recent BOEM report (2018) documented an effort to estimate the potential impact of offshore wind power on recreational beach use on the East Coast of the United States. Respondents fell into three groups: those unimpacted, those reporting that a project would have made their experience worse, and those reporting that a project would have made their experience better. The results indicated that, generally, the closer the wind power project was to shore, the more respondents reported that their experience would have been worsened. People were questioned about their reaction to wind power projects from distances ranging from 2.5 to 20 mi (4.0 to 32.2 km) offshore. At 12.5 mi (20.1 km) offshore, 20 percent of the respondents reported that their experience would have been worsened by the turbines,13 percent reported that it would have been improved, and 67 percent reported no impact. At 20 mi (32.2 km), the shares were 10 percent worse, 17 percent better, and 73 percent no impact. The dominant reason reported for why an offshore wind power project would have made a beach experience worse was the visual disruption of the seascape. The dominant reason for why it would have made a beach experience better was knowing something good was being done for the environment.

While the findings in the Lutzeyer et al. (2017) study indicated that rental value losses are possible if a utility-scale wind farm is placed reasonably close to the shoreline, the RWF will be approximately 13 mi (20.9 km) south of mainland Rhode Island; 13 mi (20.9 km) southwest of Martha's Vineyard, Massachusetts; 14 mi (22.5 km) south of mainland Massachusetts; and 15 mi (24.1 km) east of Block Island, Rhode Island. Further, the color planned for the turbines generally blends well with the sky at the horizon and eliminates the need for daytime FAA warning lights or red paint marking of the blade tips. This color, which will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey, is consistent with BOEM and FAA guidelines (BOEM 2019). In addition, Revolution Wind will use an ADLS (or similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. This system would be installed to illuminate the turbines, when aircraft enter a defined buffer area around the turbines. Based on initial analyses conducted, this ADLS (or similar) system would be activated for approximately three hours and 39 mins over the course of a year.

Project-related activities and infrastructure that could potentially result in direct or indirect impacts to housing and property values were identified as part of the IPF analysis in Section 4.1. Those IPFs that could result in impacts to housing and property values are indicated on Figure 4.6.2-1 and include noise, traffic and visible structures.

Figure 4.6.2-1 IPFs on Housing and Property Values IPFs on Housing and Property Values



Revolution Wind Farm, Revolution Wind Export Cable, and Onshore Facilities

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to housing and property values. O&M would result in no impact on housing and ***direct*** and ***long-term*** impacts on property values. The potential impacts on housing and property values are summarized in Table 4.6.2-4. The results of the IPF analysis for Section 4.1.10 and the results of the visual resources assessment in Section 4.5 were used as a basis of the property value impact assessment.

Table 4.6.2-4 RWF and RWEC Housing and Property Values Impact Summary

Resource Area	Housing	Property Values
RWF		
Construction and Decommissioning	Direct, Short-term	Direct, Short-term
O&M	Not Anticipated	Direct, Long-term
RWEC-OCS/Rhode Island		
Construction and Decommissioning	Direct, Short-term	Direct, Short-term
Onshore Facilities		
Construction and Decommissioning	Direct, Short-term	Direct, Short-term
O&M	Not Anticipated	Direct, Long-term

Housing

Based on plans to house most of the non-local construction and decommissioning workforce in short-term accommodations offshore (Section 3), sufficient short-term housing is available in each of the port options to meet the balance (Table 4.6.2-2). Therefore, impacts on the housing of the region would be ***direct*** and ***short-term*** during construction and decommissioning of the RWF. Similarly, the operation of the RWF, RWEC, and Onshore Facilities will require a small, full-time, onshore staff over the 35-year life of the RWF. The housing needs of these staff are small relative to the overall size of the housing market in the primary ROI; therefore, the Project is not expected to impact the housing stock of the region during operation.

Property Values

As discussed, the potential for impacts to property values from the RWF are limited by its distance from coastal residential properties and associated potential visibility. The RWF will be approximately 13 mi (20.9 km) south of mainland Rhode Island; 13 mi (20.9 km) southwest of Martha's Vineyard, Massachusetts; 14 mi (22.5 km) south of mainland Massachusetts; and 15 mi (24.1 km) east of Block Island, Rhode Island – which already has the Block Island Wind Farm (BIWF) within its viewshed. Studies have demonstrated different potential impacts on property values from offshore wind turbines (BOEM, 2018a), with several studies from around the world suggesting that offshore wind farms as distant from shore as RWF present little negative impact on housing prices (e.g., Jensen et al., 2018). Onshore wind turbines have been documented to have minimal impacts on prices of houses in Rhode Island (Marine Affairs Institute, Roger Williams University School of Law (Thompson, Jourdan and Read Porter), 2019) (Lang and Opaluch, 2013), while BIWF has been suggested to have had a positive impact on Airbnb™ nightly reservations, occupancy rates, and monthly revenues during July and August and no effect the rest of the year (Carr-Harris and Lange, 2019). The RWF will be farther from private property than either of these examples. Therefore, the overall impact of the RWF visible structures on property values is also expected to be minimal to beneficial and determined to be ***direct*** and ***long-term*** in all phases. Activities at the construction and O&M port facilities will be consistent with existing conditions, and therefore, are also expected to have a ***direct*** and ***long-term*** on adjacent property values.

Similar ***direct*** and ***short-term*** impacts are possible from the construction and decommissioning of the Onshore Facilities for those residential properties adjacent to proposed activities in the Town of North Kingstown. ***Direct*** and ***long-term*** impacts are possible to the property values of those residential properties near the OnSS due to the potential for limited visibility of the infrastructure and associated lighting.

4.6.2.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to housing and property values.

- Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. This measure will limit the time the turbines are illuminated to only when aircraft are in a defined buffer area around the turbines, estimated to be three hours and 39 mins over the course of the year.

- The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties.
- The Onshore Facilities construction schedule will be designed to minimize and mitigate impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day.
- Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise.
- Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.

4.6.3 Public Services

4.6.3.1 Affected Environment

This section summarizes public services for the communities potentially impacted by the construction, O&M, and decommissioning of the RWF, RWEC-OCS, RWEC-RI, and Onshore Facilities. It focuses on hospitals, fire protection services, emergency medical services (EMS), and law enforcement services that will support the construction and O&M facilities and ports (Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Virginia, and Maryland being considered).

The following multi-hazard mitigation plans, or strategies, were also referenced to identify the public service providers for the region:

- Public services for the State Pier are characterized in the Hazard Mitigation Plan Update Annex for the City of New London (New London and Milone, 2017).
- Public services for the Sparrow's Point port facility are characterized in Baltimore County Government Emergency Operations (Baltimore County Government, 2019).
- Public services for the New Bedford Marine Commerce Terminal are characterized in City of New Bedford Local Multi-Hazard Mitigation Plan Update (City of New Bedford, 2016).
- Public services for the Paulsboro Marine Terminal are characterized in Gloucester County, New Jersey Multi-Jurisdictional Hazard Mitigation Plan (Gloucester County Office of Emergency Management, 2009) and New Jersey Sate Hazard Mitigation Plan 2019 (State of New Jersey Office of Emergency Management, 2019)
- Public services for the Port of Brooklyn (Kings County), New York City are characterized in *NYC's Risk Landscape: A Guide to Hazard Mitigation* (NYC Emergency Management 2019).
- Public services for the Port of Montauk port facility are characterized in Suffolk County Comprehensive Emergency Management Plan (Suffolk County Department of Fire Rescue and

Emergency Services, 2018) and will be further defined in a forthcoming Town of East Hampton hazard mitigation plan (Town of East Hampton, 2019a,b).

- Public services for the Port Jefferson port facility are characterized in in Suffolk County Comprehensive Emergency Management Plan (Suffolk County Department of Fire Rescue and Emergency Services, 2018).
- Public services for the Port of Providence facility are characterized in Strategy for Reducing Risks from Natural, Human-Caused and Technologic Hazards in Providence, Rhode Island: A Multi-Hazard Mitigation Plan (PLHMC and Horsley, 2019).
- Public services for the Port of Davisville and Quonset Point port facility are characterized in the Town of North Kingstown's A Multi-Hazard Mitigation Strategy 2013 – 5-Year Update, which was developed with input from a stakeholder committee that included the Harbormaster and a member of the Quonset Development Corporation (North Kingstown and RIEMA, 2013).
- Public services at Port of Galilee (Point Judith) in Strategy for Reducing Risks from Natural Hazards in Narragansett, Rhode Island: A Multi-Hazard Mitigation Strategy (Town of Narragansett, 2019a).
- Public services for the Port of Norfolk port facility are characterized in Hampton Roads Hazard Mitigation Plan (Hampton Roads Planning District Commission, 2017).

Multiple hospitals serve the communities in the ROIs. Table 4.6.3-1 identifies those facilities either closest to Project construction and O&M activities, or those serving as trauma centers for emergency response purposes. State Pier in New London is served by Lawrence and Memorial Hospital that has 252 beds (American Hospital Directory, 2019). The closest hospital to Sparrow's Point is the Johns Hopkins Bayview Medical Center in Baltimore that has 415 beds. The New Bedford Marine Commerce Terminal is served by Saint Luke's Hospital which reports 867 beds which is combined with the nearby Charlton Memorial Hospital in Fall River, MA for reporting purposes. Paulsboro Marine Terminal's closest hospital is Inspira Medical Center Woodbury in Woodbury, which has 253 beds. Brooklyn is served by several hospitals, with the closest to port facilities in Brooklyn being NYU Langone Hospital – Brooklyn, which has 388 beds. The closest hospital to Montauk is in Southampton: Stony Brook Southampton Hospital with 94 beds. Port Jefferson is served by Saint Charles Hospital with 243 beds. The Quonset Business Park – Port of Davisville port facility is primarily served by the Kent County Memorial Hospital in Warwick and has 343 beds. Meanwhile, the Port of Providence is served by Rhode Island Hospital, which offers 691 beds, and South County Health is closest to Port of Galilee (Point Judith) in the Town of Narragansett and has the lowest number of staffed beds among the hospitals included in Table 4.6.3-1. Norfolk is served by several hospitals, with the closest to the port being Sentara Norfolk General Hospital with 527 beds (American Hospital Directory, 2019).

Table 4.6.3-1 Hospitals Closest to Project Construction and O&M Activities: Selected Statistics

Port	Hospital	Address	Phone	Staffed Beds	Total Discharges
Port of New London, New London, CT	Lawrence and Memorial Hospital	365 Montauk Avenue New London, CT 06320	860-442-0711	252	13,022
Sparrow's Point, MD	Johns Hopkins Bayview Medical Center	4940 Eastern Avenue Baltimore, MD 21224	410-550-0100	415	19,646
New Bedford Marine Commerce Terminal, New Bedford, MA	Saint Luke's Hospital	101 Page Street New Bedford, MA 02740	508-997-1515	867 [a]	32,582[a]
Paulsboro Marine Terminal, Paulsboro, NJ	Inspira Medical Center Woodbury	509 North Broad Street Woodbury, NJ 08096	856-845-0100	253	8,125
Port of Brooklyn, Kings County, NY	NYU Langone Hospital - Brooklyn	150 55th Street Brooklyn Brooklyn, NY 11220	718-630-7000	388	23,168
Montauk, NY	Stony Brook Southampton Hospital	240 Meeting House Ln. Southampton, NY 11968	631-726-8200	94	4,318
Port Jefferson, NY	Saint Charles Hospital	200 Belle Terre Road Port Jefferson, NY 11777	631-474-6000	243	9,315
Port of Galilee, Narragansett, RI	South County Health	100 Kenyon Avenue Wakefield, RI 02879	401-782-8000	79	5,804
Port of Davisville and Quonset Point, North Kingstown, RI	Kent County Memorial Hospital	455 Tollgate Road Warwick, RI 02886	401-737-7000	343	14,196
Port of Providence, Providence, RI	Rhode Island Hospital	593 Eddy Street Providence, RI 02903	401-444-4000	691	30,561
Norfolk, VA	Sentara Norfolk General Hospital	600 Gresham Drive Norfolk, VA 23510	757-388-3000	527	24,099

Source: American Hospital Directory, 2019

a Statistics for Saint Luke's Hospital are combined with statistics for Charlton Memorial Hospital in Fall River, MA.

Fire and EMS services specific to the potential construction and O&M facilities and ports are summarized in Table 4.6.3-2. For the Rhode Island Ports where the primary Project elements will be, in Port of Galilee (Point Judith), such services are provided by the Narragansett Fire Department – Station 2, while the Narragansett Police Department provides law enforcement services. The Narragansett Police Department is comprised of 43 officers of various ranks, including the Chief of Police, as well as a harbor master; the department is sustained by dispatchers and other support staff (Town of Narragansett, n.d.). Fire and EMS services for the Port of Davisville and Quonset Point are provided by the Town of North Kingstown under a memorandum of agreement with Quonset Development Corporation. The North Kingstown Police Department maintains a staff of approximately 48 sworn personnel along with civilian support staff, and is also supported by a part-time Harbormaster, part-time Harbor Clerk, and two part-time Assistant Harbormasters (North Kingstown PD, 2019). The Port of Providence, Rhode Island is operated by Waterson Terminal Services (WTS), which is responsible for general management and safety. Because of it being a maritime port, WTS has a security plan for the Port of Providence with detailed procedures, while the Providence Fire Department and Police Department provide emergency response services (WTS, 2019). The New London State Pier is managed by Gateway Terminal, formerly managed by Logistec (Turmelle, 2019). Port security is the responsibility of the facility operator and is facilitated by a security plan meeting Maritime Transportation Security Act requirement (Connecticut and Milone, 2015); the New London Fire and Police Departments provide emergency response services.

Table 4.6.3-2 Fire, EMS, and Law Enforcement Services Associated with Construction and O&M Ports

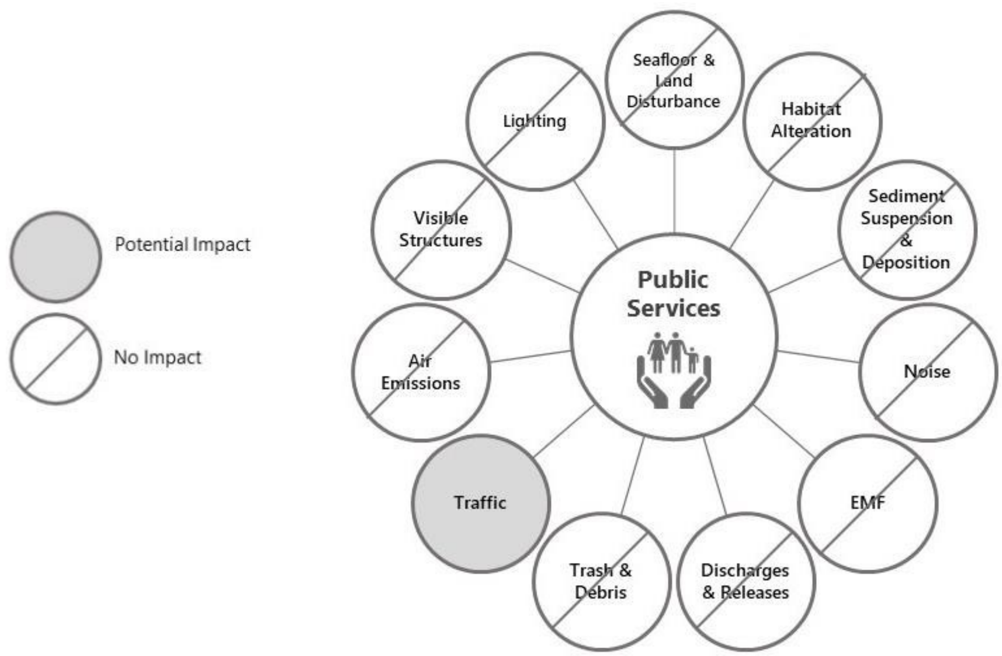
Port	Local Government	Provider of Fire Services	Provider of EMS Services	Provider of Law Enforcement Services
Port of New London	New London, CT	New London Fire Department, North Station	New London Fire Department	New London Police Department
Sparrow's Point, MD	Baltimore County, MD	Baltimore County Fire Department - Sparrow's Point - Station 57	Baltimore County Fire Department – Sparrow's Point - Station 57	Baltimore County Police Department – Precinct 12
New Bedford Marine Commerce Terminal	New Bedford, MA	New Bedford Fire Department	New Bedford EMS	New Bedford Police Department
Paulsboro Marine Terminal	Paulsboro, NJ	Paulsboro Fire Department	Gloucester County EMS BLS 16	Paulsboro Police Department
Port of Brooklyn	New York City, NY	Fire Department of the City of New York	Fire Department of the City of New York EMS Team	New York Police Department
Port of Montauk	Town of East Hampton, NY	Montauk Fire Department	Montauk Fire Department, East Hampton Village Ambulance Association	East Hampton Town Police Department – Montauk Precinct
Port Jefferson, NY	Port Jefferson, NY	Port Jefferson Fire Department	Port Jefferson EMS	Suffolk County Police
Port of Galilee	Narragansett, RI	Narragansett Fire Department, Point Judith Station/Station 2	Narragansett Fire Department	Narragansett Police Department
Port of Providence	Providence, RI	Providence Fire Department, Broad Street Station	Providence Fire/EMS	Providence Police Department
Port of Davisville and Quonset Point	North Kingstown, RI	North Kingstown Fire Department, Station 6	North Kingstown Fire Department	North Kingstown Police Department
Port of Norfolk	City of Norfolk, VA	Norfolk Fire-Rescue, Navy Region Mid-Atlantic Fire & Emergency Services Station 4	Norfolk Fire-Rescue	Virginia Port Authority Police Department

Sources: New London Firefights Union, 2019

4.6.3.2 Potential Impacts

Potential impacts on public services are discussed in this section with impacts driven by the potential for an increased demand for emergency response services because of the construction of the RWF, RWEC-OCS, RWEC-RI, and Onshore Facilities and by the presence of non-local workers in the region. IPFs that could result in impacts to public services are indicated on Figure 4.6.3-1. Of these, only the traffic (vessels, vehicles, and air) IPF was evaluated for public services. Section 4.1.7 discusses marine vessel and land traffic that could be generated by construction, which could include earthmoving equipment for the onshore transmission cable installation, small materials delivery trucks, and commuter vehicles.

Figure 4.6.3-1 IPFs on Public ServicesIPFs on Public Services



Revolution Wind Farm

Table 4.6.3-3a RWF Public Services Impact Summary

Resource Area	Public Services
RWF	
Construction and Demolition	Not Anticipated
O&M	Direct, Long-term

Construction would result in no impacts to public services. There is the potential for ***direct*** and ***long-term*** impacts during O&M due to traffic. Section 4.1.7 discusses traffic that could be generated.

Construction

Traffic during construction of the RWF is not expected to impact the level of public services provided in the region given that public services are offered at each of the potential port facilities and most non-local workers will be housed in short-term accommodations offshore. Therefore, no impacts on public services of the region are anticipated during construction of the RWF.

O&M

The operation of the RWF will require a full-time, onshore staff over its anticipated 35-year lifespan. The needs of these staff will result in ***direct*** and ***long-term impacts*** in the form of a demand for public services. However, such demand would be small relative to the overall size of the population within the primary ROI given the limited number of staff required.

Decommissioning

Similar to construction, traffic during decommissioning of the RWF is not expected to impact the level of public services provided in the region.

RWEC-OCS

The RWEC-OCS and RWEC-RI impacts are anticipated to be similar and are included together in the following table.

Table 4.6.3-3b RWEC-OCS/RI Public Services Impact Summary

Resource Area	Public Services
RWEC-OCS/RI	
Construction and Decommissioning	Not Anticipated
Operations and Maintenance	Direct, Long-term

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to the public services from traffic and demand. Impacts to public services during O&M would be ***Direct*** and ***short-term*** impacts. Section 4.1.7 discusses marine vessel and land traffic that could be generated.

Construction

While construction of the RWEC-OCS is expected to generate marine vessel or vehicular traffic, this increase is not expected to generate the need for additional public services in the region nor interrupt existing services. Similarly, by providing short-term accommodations offshore for the workforce, the demand for additional local public services are not expected to be a measurable increase in the demand for additional local public services is not expected.

Operations and Maintenance

The RWEC-OCS is not expected to have maintenance needs unless a fault or failure occurs. Export cable failures are only anticipated because of damage from outside influences, such as unexpected digs from other parties. If repair is needed, spare submarine export cable and splice kits will be used to replace the impacted area. Therefore, public services are not expected to be impacted during O&M unless repairs are needed. Such repairs would be periodic throughout the lifespan of the Project, and therefore, constitute ***direct*** and ***long-term*** impacts on public services.

Decommissioning

Traffic impacts relative to public services during decommissioning of the RWEC-OCS would be similar during construction and would therefore be ***direct*** and ***short-term.***

RWEC-RI

Impacts from the RWEC-RI are anticipated to be the same as for the RWEC-OCS.

Construction

Traffic impacts relative to public services during construction of the RWEC-RI would be similar during construction of the RWEC-OCS and would therefore be ***direct*** and ***short-term***.

Operations and Maintenance

Traffic impacts relative to public services during O&M of the RWEC-RI would be similar during O&M of the RWEC-OCS and would therefore be ***direct*** and ***long-term***.

Decommissioning

Traffic impacts relative to public services during decommissioning of the RWEC-RI would be similar during construction and decommissioning of the RWEC-OCS and would therefore be ***direct*** and ***short-term***.

Onshore Facilities

Table 4.6.3-3c Onshore Facilities Public Services Impact Summary

Resource Area	Public Services
Onshore Facilities	
Construction and Decommissioning	Direct, Short-term
O&M	Direct, Long-term

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to the public services from traffic. Section 4.1.7 discusses marine vessel and land traffic that could be generated

Construction

There may be a short-term increase in truck and construction equipment traffic on routes used for construction of the Onshore Facilities as well as a limited number of non-local workers. In addition, local police will likely control traffic through detours and road closures and be present during construction activities. Therefore, there may be ***direct*** and ***short-term*** impacts on public services such as EMS or police during construction.

Operations and Maintenance

O&M of the OnSS and ICF is expected to be similar to ongoing O&M of the existing TNEC Davisville Substation in the Town of North Kingstown, and there is no regular maintenance for the underground Onshore Transmission Cables, unless there is a failure or malfunction requiring exposure and repair of the cable. Such repairs would be periodic throughout the lifespan of the Project, and therefore, constitute ***direct*** and ***long-term*** impacts on public services.

Decommissioning

Traffic impacts relative to public services during decommissioning of the Onshore Facilities would be similar during construction and would therefore be ***direct*** and ***short-term***.

4.6.3.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to public services.

- The Onshore Facilities construction schedule will be designed to minimize and mitigate impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day.
- Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.
- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Project website, public notices to mariners and vessel float plans, and a fisheries liaison. Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities.

4.6.4 Recreation and Tourism

4.6.4.1 Affected Environment

This section describes existing recreation and tourism opportunities, including both onshore activities, such as beach visitation and wildlife viewing, and offshore activities from or on a boat. As

Section 4.6.1 discusses, the value of tourism among the counties within the WEA is sizable and are often critical components of local economies.

Data that support this section largely derives from BOEM's *Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development: Impacts of Offshore Wind on Tourism and Recreation Economies*, which identified the coastal areas (that is, counties) for each WEA by their potential to encounter both beneficial and detrimental socioeconomic effects from each phase (planning, construction, and deconstruction) of wind facility development (ICF, 2012). As reported earlier, all counties within the primary ROI and expanded ROI were included in BOEM's assessment, with exception to Baltimore County, Maryland; Gloucester County, New Jersey; and the City of Norfolk, Virginia. Based on the methodology of this report, the recreation and tourism industries in these counties are less likely to have sensitivity to offshore wind development as compared to those included in the assessment (ICF, 2012). Accordingly, this section focuses only on those counties within the primary ROI and expanded ROI that were included in the assessment.

The primary ROI and expanded ROI represent a broad area; therefore, the following discussions do not differentiate between the RWF, RWEC-OCS, RWEC-RI, or Onshore Facilities.

Onshore Recreation and Tourism

Table 4.6.4-1 provides a summary of the major features that contribute to the identity of communities within the expanded ROI as recreation and tourism destinations, including major tourist attractions and festivals. Martha's Vineyard, part of Dukes County, is the community closest to the RWF. Martha's Vineyard is accessible only by air or boat. Ferry access to Martha's Vineyard is available from Woods Hole, Falmouth, Massachusetts; Hyannis, Massachusetts; New Bedford, Massachusetts; Nantucket, Massachusetts; Quonset, Rhode Island; and New York City, New York (Martha's Vineyard Online, 2019).

Block Island, part of Washington County, is also close to the RWF. Like Martha's Vineyard, Block Island is accessible only by air or boat. Ferry access to Block Island is available from the City of New London; Montauk, East Hampton, Long Island, New York; City of Newport; Port of Galilee (Point Judith), Rhode Island (ICF, 2012; Block Island Ferry, 2019a).

Newport County, located on the eastern side of the entrance to Narragansett Bay from Rhode Island Sound, is world-renowned as a sailing and yachting destination, as well as for its jazz and folk music festivals. Further to the west, Suffolk County is the outermost county on Long Island with multiple summer vacation destinations including Montauk and the Hamptons. Montauk is most easily accessed by ferry from the north from the Cities of Bridgeport and New London, as well as to Block Island, from Montauk and Bay Shore-Fire Island, New York.

Table 4.6.4-1 Summary of Recreation and Tourism Resources Within the Expanded ROI

Geography	Resources	Festivals
Connecticut		
New London County	Lengthy, sand-beached coastline (parts industrial), Foxwoods and Mohegan Sun Casinos, Olde Mystic Village, Mystic Seaport/Museum of America and the Sea, U.S.S. Nautilus Museum	Sailfest, Sea Music Festival
Massachusetts		
Barnstable County	Lengthy, sand-beached coastline, Pilgrim Monument, Kennedy Compound, numerous lighthouses, Woods Hole Oceanographic Institute, Cape Code National Seashore, Mashpee and Monomoy NWRs	Cape Cod Maritime Days Festival, Bourne Scallop Festival
Bristol County	Coastline along both the Narragansett and Buzzards Bays, New Bedford Whaling Museum, Battleship Cove/USS Massachusetts, New Bedford Whaling National Historical Park	Whaling City Festival, Feast of the Blessed Sacrament
Dukes County	Lengthy coastline almost entirely remote sand beach, historic lighthouses, unique architecture, Noman’s Land Island NWR	Striped Bass and Bluefish Derby, Oak Bluffs Monster Shark Tournament, JawsFest
Nantucket County	Lengthy coastline comprised mostly of publicly accessible beach, historic district along the harbor, Nantucket Whaling Museum, Maria Mitchell Association, historic lighthouses, Nantucket NWR	Boston Pops on Nantucket, Nantucket Sandcastle Day
Plymouth County	Lengthy, sand-beached coastline, Mayflower II, Plymouth Rock, Plymouth Plantation, World’s End, Massasoit NWR	Plymouth Waterfront Festival, Marshfield Fair, Annual Cranberry Harvest Celebration
New York		
Kings County (Brooklyn)	Minimal coast and beach tourism, tends to attract local visitors; Coney Island Beach and associated amusement park, New York Aquarium, minor league baseball stadium, and boardwalk; Brighton Beach; Manhattan Beach; Jamaica Bay Wildlife Refuge visible from King’s County shore	Red Hook Waterfront Arts Festival
Suffolk County	Shores of predominantly white sand beach along the Long Island Sound and Atlantic Ocean; Montauk Point Lighthouse; Vanderbilt Museum; historic districts (Yaphank and Blydenburgh Farm and New Mill); Fire Island National Seashore; Amagansett, Conscience Point, Elizabeth Alexandra Morton, Seatuck, and Wertheim NWRs	Seafood Festival and Craft Fair

Geography	Resources	Festivals
Rhode Island		
Bristol County	Attractive boat haven, Herreshoff Marine Museum, Bristol Waterfront, Colt State Park	Warren Quahog Festival, oldest Fourth of July Celebration in the country
Kent County	New England Wireless and Steam Museum, the North-South Trail, Warwick Light	East Greenwich Art Festival, Portuguese Holy Ghost Festival
Block Island	Undeveloped and sandy beaches, New Shoreham waterfront	Block Island Race Week, Block Island Music Festival, 15k Run Around the Block, Lion's Clam Bake
Newport County	Lengthy coastline that is mostly rocky and wooded, Newport Mansions/Bellevue Avenue Historic District, Fort Adams State Park, Fort Hamilton, Fort Barton Woods and Revolutionary War Redoubt, Christopher Columbus Statue and Monument, Sachuest Point NWR	Newport Kite Festival, Black Ships Festival, Newport Folk and Jazz Festivals, multiple boating races
Providence County	Roger Williams Park, Waterplace Park, First Baptist Church of Providence, Roger Williams National Memorial	Waterfire
Washington County	Lengthy coastline – almost entirely of uninterrupted sandy beach; Block Island; Westerly Armory Museum; Smith's Castle; historic lighthouses; Block Island, John Chafee, Ninigret, and Trustom Pond NWRs	Wickford Art Festival, Block Island Race Week, Americas Cup World Series Races

Source: ICF, 2012; NPS, 2019; USFWS, 2019

Table 4.6.4-2 provides a summary of the major resources each community offers to attract and support its recreation and tourism economy. There is a total of 350 public beaches within the expanded ROI – 80 percent of which are distributed between Massachusetts and Rhode Island. In Massachusetts, there are 150 public beaches in Barnstable County. In Rhode Island, public beaches are prevalent on Block Island (Washington County) and in Newport County, which has a major tourism industry based on its beaches and sailing and yachting reputation.

Table 4.6.4-2 Summary of Recreation and Tourism Resources by Community Within the Expanded ROI

	Harbors	Marinas	Yacht Clubs	Public Beaches	National Parks	Description
Connecticut-portion of expanded ROI	5	30	5	10	0	--
New London County	5	30	5	10	0	Boating (both offshore and along the Thames River); Beaches with boardwalks, lockers, cafes and food courts, rides, and playgrounds; and Mystic Village

	Harbors	Marinas	Yacht Clubs	Public Beaches	National Parks	Description
Massachusetts-portion of expanded ROI	49	77	24	202	5	--
Barnstable County	30	40	4	150	3	550 mi of coastline ideal for sunbathers, walkers, snorkelers, and windsurfers and surfers (south- and west-facing beaches); national parks account for approximately 58,000 acres of protected land
Bristol County	2	20	5	5	1	Mostly private beach; while parts of the shore are rocky, approximately half is sand beach and caters to activities such as sunbathing and beachcombing
Dukes County	5	2	3	15	0	Popular activities include swimming, beachcombing, and sunbathing; surfing, diving, and boat- and shore-fishing. Several wooded trails for biking and hiking, as well as several areas (including two wildlife refuges) for bird and nature watching
Nantucket County	2	4	2	22	1	110 mi of shoreline; 80 mi of beach open to the public
Plymouth County	10	11	10	10	0	250 mi of coastline; most beaches are private; the Massasoit National Wildlife Refuge protects 195 ac of coastline
New York-portion of expanded ROI	20	72	38	60	2	--
Suffolk County	20	72	38	60	2	980 mi (1,577 km) of coastline; the majority is white sand beach for sunbathing, swimming, and beachcombing; popular among sportsmen and surfers
Kings County (Brooklyn)	6	10	6	2	0	Minimal coastline and limited beach tourism, tends to attract local visitors; beaches are very crowded in the summer for walking, volleyball, basketball, sunbathing, and swimming.

	Harbors	Marinas	Yacht Clubs	Public Beaches	National Parks	Description
Rhode Island-portion of expanded ROI	9	51	17	78	2	--
Bristol County	1	4	1	4	0	35 mi of mostly wooded and rocky coastline; Herreshoff Marine Museum is a popular tourist attraction; Bristol Waterfront is listed on the NRHP; Colt State Park provides for picnicking, bike rides, and coastline walk throughs
Kent County	0	12	4	6	0	45 mi of mostly private coastline; New England Wireless and Steam Museum, North-South Trail, and Warwick Light are popular tourist attractions
Block Island*	2	2	0	10	0	Aquatic activities include swimming, surfing, snorkeling, and parasailing; fishing, sailing, and boating; wildlife viewing; kayaking along the beaches and through the tidal zones. Onshore activities include hiking, horseback riding, and bicycling on 32 mi (51.5 km) of hiking trails.
Newport County	4	13	3	18	1	Beaches for sunbathing, walking, and swimming. Tourism draw is boating and yachting.
Providence County	0	6	3	0	1	Coastal recreation is minimal because the industrial waters of the inner bay provide for poor swimming and ocean recreation activities; adjacent parkland and East Bay Bicycle Path.
Washington County	4	16	6	50	0	Kayaking, sailing, and harbor cruises in Narragansett Bay; and sunbathing, beachcombing, swimming, and surfing on the Atlantic coast
Total in expanded ROI	83	230	84	350	5	--
Distribution by State						
Connecticut	6%	13%	6%	3%	0%	--
Massachusetts	59%	33%	29%	58%	56%	--

	Harbors	Marinas	Yacht Clubs	Public Beaches	National Parks	Description
New York	24%	31%	45%	17%	22%	--
Rhode Island	11%	22%	20%	22%	22%	--

Source: ICF, 2012
* Block Island counts are included for reference and are already represented in the Washington County counts.

Offshore Recreation and Tourism

Offshore recreation within Rhode Island Sound and further offshore near the RWF are described in detail in the OSAMP and the 2012 Northeast Recreational Boater Survey (RI CRMC, 2010 and Starbuck et al., 2013). The 2012 Northeast Recreational Boater Survey characterized the boating patterns and economic activity of the 373,766 qualified registered boaters from coastal counties and towns in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, and New York, and included maps from the survey of 5,114 boating routes and 4,635 activity points (Starbuck et al., 2013). The survey estimated approximately 907,400 boating trips in ocean and coastal waters during 2012 for the registered and documented marine boaters of the six Northeast states. The vast majority of these trips, or 90.1 percent, were made by vessels registered in one of the four states in the expanded ROI. Of the 817,368 estimated boating trips in the *2012 Northeast Recreational Boater Survey* study area, 15.6 percent were made by vessels registered in Connecticut, 32.1 percent in Massachusetts, 42.5 percent in New York, and 8.0 percent in Rhode Island (Starbuck et al., 2013). Over half (52 percent) of boating trips documented by Starbuck et al. occurred within 1 mi (1.6 km) of the coastline with higher levels of boating activity occurring in semi-protected bays and harbors near major cities, such as Narragansett Bay (Starbuck et al., 2013).

The OSAMP provides offshore recreational maps of the Rhode Island Sound based on stakeholder feedback, USCG event permits, and racing event instructions (RI CRMC, 2010). Rhode Island Sound and adjacent waters provide a wide range of marine recreation and tourism opportunities (Table 4.6.4-2). Specifically, these waters are used for a variety of boat-based activities such as recreational boating, offshore sailboat racing, offshore diving, and offshore wildlife viewing.

As described in Section 4.6.7**,** the Rhode Island Sound experiences a substantial amount of activity of which sailing is only one component. According to data from the Northeast Boater Survey (Starbuck et al., 2013), numerous recreational boater routes either transect or are near the RWF and RWEC - Offshore. These routes along with their associated densities are presented in Figure 4.6.4-1.

Table 4.6.4-3 provides a characterization of the sailboat, distance, and buoy races that generally occur in the vicinity of the RWF and RWEC-OCS and RI. Most of the races occur from May to September and have under 100 participants. The largest event is the Newport to Bermuda Yacht Race, which occurs in June and can have over 250 participants. The Off Soundings Club Spring Race Series often hosts up to 150 participants at its event in June off Block Island (ICF, 2012). The New York Yacht Club hosts multiple large race events each year, including its Annual Regatta, Race Week, and an Annual Cruise. Distance sailing races in the vicinity of the RWF and RWEC-OCS and RI are depicted in Figure 4.6.4-1.

Table 4.6.4-3 Sailboat, Distance, and Buoy Races in or Near Rhode Island Sound

Event	Organizer	Month	Frequency	Course Description	Avg. No. of Vessels	Avg. Vessel Length (feet /meters)
Block Island Race Week	Storm Trysail Club (odd years); Ted Zuse (even years)	June	Annual	Week of buoy races west of Block Island [a]	100+	30-90 / 9-27
New York Yacht Club Annual Regatta	New York Yacht Club	June	Annual	Buoy races south of Brenton Point	110	30-90 / 9-27
New York Yacht Club Invitational Cup	New York Yacht Club	Sept.	Biennial	Buoy races south of Brenton Point	20	42 / 12.8
New York Yacht Club Race Week	New York Yacht Club	Sept.	Biennial	Buoy races south of Brenton Point	150	30-90 / 9-27
Swan 42 National Championship	New York Yacht Club	July	Annual	Buoy races south of Brenton Point	20	42 / 12.8
Sail Newport Coastal Living Newport Regatta	Sail Newport	July	Annual	Buoy races south of Brenton Point	Varies	Varies
World championship regattas (vary) [b]	Various	Sept.	Annual	Buoy races south of Brenton Point	Varies	Varies
Annapolis to Newport Race	Annapolis Yacht Club	June	Biennial	Annapolis, MD, to Newport	61	34+ / 10.3+
Bermuda One- Two	Goat Island Yacht Club and Newport Yacht Club	June	Biennial	Singlehanded (one crew member): Newport to Bermuda; Doublehanded (two crew members): Bermuda to Newport	38	28-60 / 8.5-18.2
Block Island Race	Storm Trysail Club	May	Annual	Stamford, CT, around Block Island and back to Stamford	60	30-75 / 9.1-22.8
Corinthians Stonington to Boothbay Harbor Race	Corinthians Association, Stonington Harbor Yacht Club, and Boothbay Harbor Yacht Club	July	Biennial	Stonington, CT, to Boothbay, ME	14	N/A

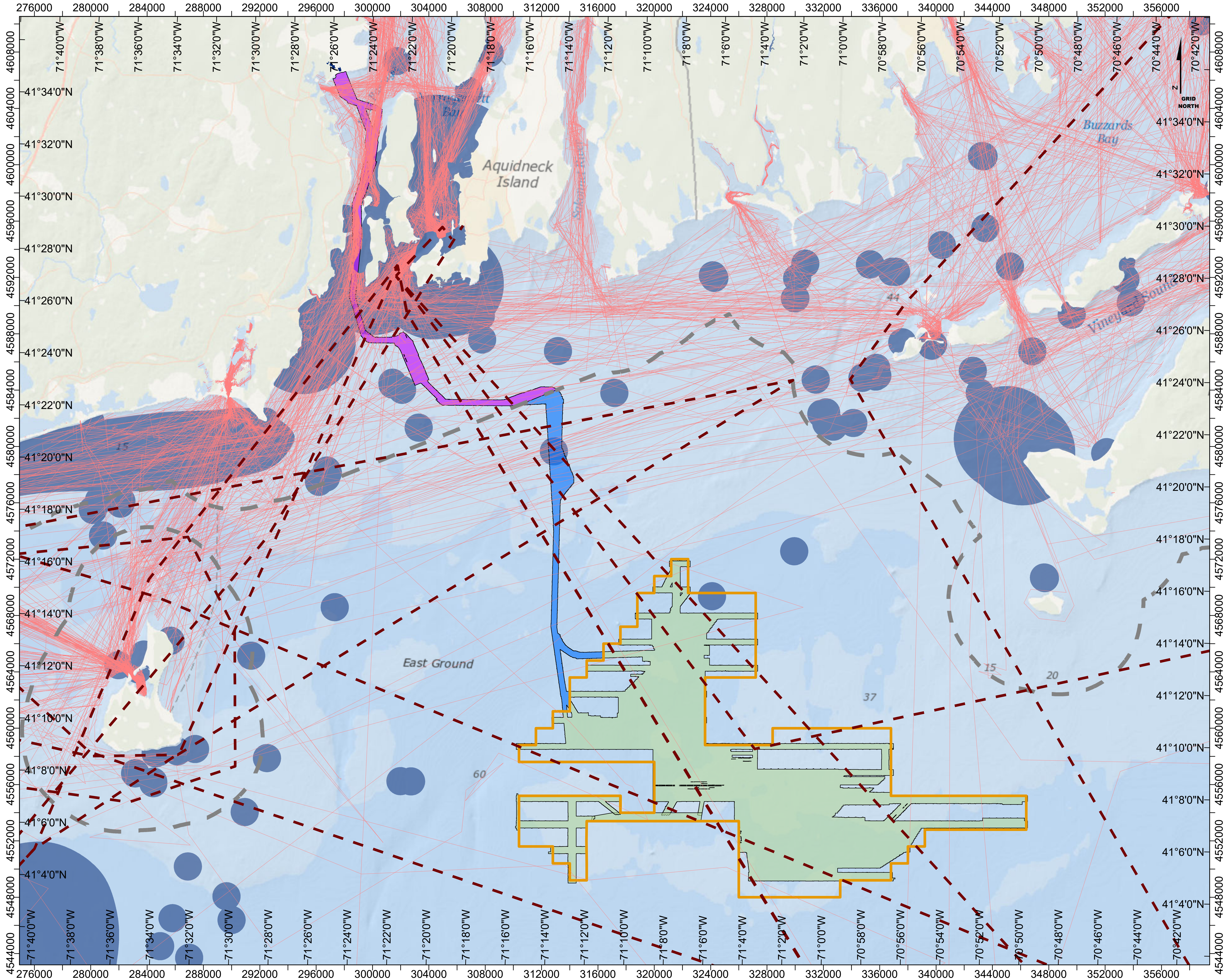
Event	Organizer	Month	Frequency	Course Description	Avg. No. of Vessels	Avg. Vessel Length (feet /meters)
Earl Mitchell Regatta	Newport Yacht Club	Oct.	Annual	Newport to Block Island	15	30-50 / 9.1-15.2
Ida Lewis Yacht Club Distance Race	Ida Lewis Yacht Club	August	Annual	Multi-legged course through Rhode Island Sound and adjacent offshore waters	40	30-90 / 9.1-27.4
Marion to Bermuda Cruising Yacht Race	Marion-Bermuda Cruising Yacht Race Association	June	Biennial	Marion, MA, to Bermuda	48	32-80 / 9.7-24.3
New England Solo-Twin Championships	Newport Yacht Club and Goat Island Yacht Club[b]	July	Annual	Multi-legged course through Rhode Island Sound and adjacent offshore waters; starts and ends in Newport	35	24-60 / 7.3-18.2
Newport Bucket Regatta	Bucket Regattas/ Newport Shipyard	July	Annual	Three multi-legged courses off Brenton Point	19	68-147 / 20.7-44.8
Newport to Bermuda Race	Cruising Club of America	June	Biennial	Newport to Bermuda	265	30-90 / 9.1-27.4
New York Yacht Club Annual Cruise	New York Yacht Club	August	Annual	Varies	100	30-90 / 9.1-27.4
Offshore 160 Single-Handed Challenge	Newport Yacht Club and Goat Island Yacht Club	July	Biennial	Multi-legged course through Rhode Island Sound and adjacent offshore waters; starts and ends in Newport	15	28-60 / 8.5-18.2
Off Soundings Club Spring Race Series	Off Soundings Club	June	Annual	Day 1: Watch Hill to Block Island Day 2: Around Block Island	120-150	23-62 / 7-18.8
Owen Mitchell Regatta	Newport Yacht Club	May	Annual	Newport to Block Island	31	24-44 / 7.3-13
Stamford Vineyard Race	Stamford Yacht Club	Aug./Sept.	Annual	Stamford, CT, to entrance of Vineyard Sound and back to Stamford	77	30-90/ 9.1-27.4
Volvo Ocean Race	N/A	Oct. - June	Triennial	Alicante, Spain to Gothenburg, Sweden with a stopover in Newport	N/A	N/A

Event	Organizer	Month	Frequency	Course Description	Avg. No. of Vessels	Avg. Vessel Length (feet /meters)
Whaler's Race	New Bedford Yacht Club	Sept.	Annual	City of New Bedford, around Block Island, to Noman's Island, and back to New Bedford	22	25+ / 7.6+

Source: RI CRMC, 2010; SeaPlan, 2015a
Note: Races start and/or end in Newport unless otherwise noted.
a Event may also include one around-the-island race.
b The Newport sailing community hosts at least one "world championship" regatta each September. In Meter World Cup and the Twelve Meter World Championships.
c Course varies widely; event is held within the OSAMP area waters approximately 3 out of every 5 years.

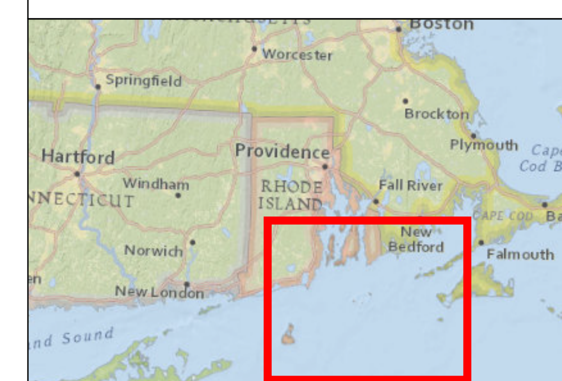
The OSAMP identified 12 offshore recreational dive sites within the SAMP study area. None of these areas are near the RWF, but two, including the Neptune and PT Teti sites, are near the RWEC - Offshore (RI CRMC, 2010). Figure 4.6.4-1 depicts additional SCUBA diving areas near the RWEC - Offshore, as identified by SeaPlan, Surfrider, and Point 97 (2015b). One such area, the Wooden Sailing Vessel site, is within the RWF. Offshore wildlife viewing near the region includes whale watching (peak season in June and August) and bird watching (year-round but particularly after storm events).

Revolution Wind
Figure 4.6.4-1
Offshore Recreation Features



Legend
RWF Boundary Lease Area OCS-A 0486
Offshore Envelope
RWF Envelope
RWEC-OCS Envelope
RWEC-RI State Waters Envelope
Recreational SCUBA Diving Areas
Recreational Boater Routes
Distance Sailing Races
3-Nautical Mile State Water Boundary

Service Layer Credits: World Ocean Reference: NOAA OCS, Esri, DeLorme
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World_Ocean_Base: Esri, DeLorme, NaturalVue



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 2500 5000 7500 Meters

0 8,000 16,000 24,000 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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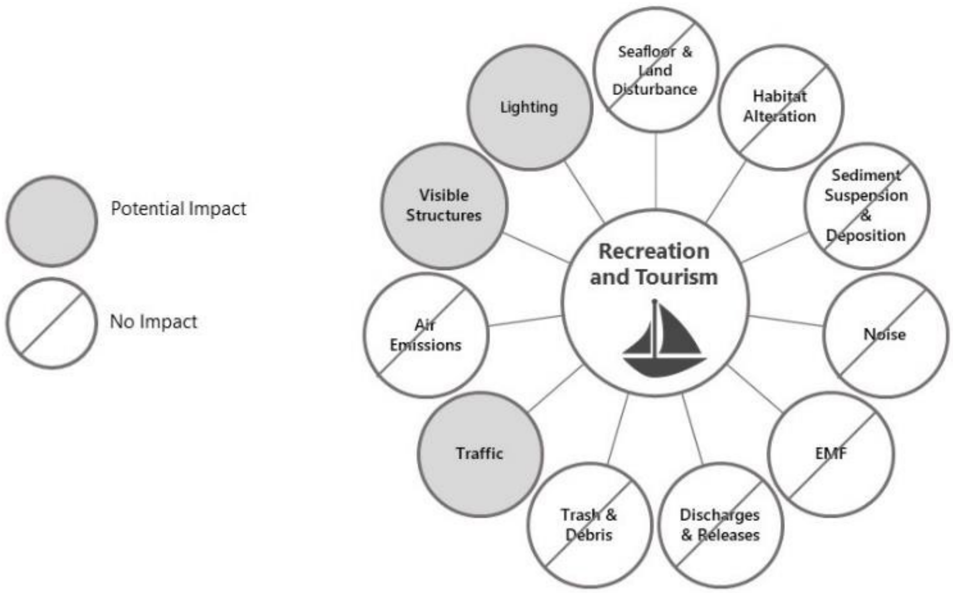
4.6.4.2 Potential Impacts

IPFs that could result in impacts to recreation and tourism values are indicated on Figure 4.6.4-2. Potential impacts of the RWF, RWEC-OCS, RWEC-RI, and Onshore Facilities on recreation and tourism are evaluated in this section.

Figure 4.6.4-2 IPFs on Recreation and Tourism



The potential for impacts from these IPFs results from changes to the natural resources (e.g., altered fishing, scuba diving, or sight-seeing conditions) or from the public perception of offshore wind facilities (e.g., interest in facility tours and preference for undeveloped landscapes) (ICF, 2012). As discussed in Section 4.6.2, the scale of these impacts varies widely and can be positive or negative. Potential negative impacts could cause tourists to avoid a destination, such as a state park, or could provide a new source of coastal tourism and draw new visitors, as demonstrated by Block Island. The Block Island Ferry offers an hour-long narrated tour of the BIWF for $20 per adult and $10 per child (ages 5 to 11) (Block Island Ferry, 2019b). The literature about potential and existing offshore wind projects also suggested that the anticipated impacts do not necessarily correspond with actual impacts (ICF, 2012).

Relative to the waters around Block Island, a multi-year study of recreational boating near the BIWF was performed before, during, and after construction (INSPIRE, 2016, 2017, and 2018). A preconstruction recreational boating survey was conducted in the summer of 2015, a 2016 survey represented conditions during construction, and a 2017 study represented conditions after construction. These surveys were designed to determine whether recreational boating intensity in the study's area of potential effects (the area within 0.58 mi of the BIWF wind turbine generators) would be affected by the presence of the wind turbine generators. The results "suggest that the distribution of boating intensity returned to pre-construction patterns after construction and during operations" (INSPIRE, 2018).

Revolution Wind Farm

Table 4.6.4-4a RWF Recreation and Tourism Impact Summary

Resource Area	Recreation and Tourism
RWF	
Construction and Decommissioning	Direct, Short-term
Operations and Maintenance	Direct, Long-term

The potential impacts on recreation and tourism resources from the construction and decommissioning of the RWF will be limited to the vessel/vehicle traffic, visible structures, and lighting of these activities both onshore and offshore. Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to recreation and tourism from traffic and visible structures/ lighting. Impacts to tourism and recreation from O&M are expected to be ***direct*** and ***long-term*** from traffic and visible structures/ lighting. Section 4.1.3 discusses noise that could be generated; Section 4.1.7 discusses marine vessel and land traffic that could be generated; and Section 4.1.10 discusses visible structures.

Construction

- **Traffic:** ***Direct*** and ***short-term*** onshore traffic impacts could be experienced adjacent to the ports selected for the RWF construction. ***Direct*** and ***short-term*** offshore impacts could be experienced by those recreating near the RWF and by boaters traversing Rhode Island Sound as well as vessels traveling to/from the RWF for construction. As discussed in the *Revolution Wind Farm Navigation Safety Risk Assessment (*Appendix R*)*, it is anticipated that the Coast Guard will implement a safety zone around construction-related vessels and activities (. Revolution Wind's commitment to implement a communication plan and coordinate with relevant agencies and local stakeholders as presented in Section 3, would minimize these impacts. The Project will coordinate its construction activities with potentially impacted recreational events (e.g., organized sailboat races).
- **Visible Structures / Lighting:** USCG-approved navigation lighting is required for all vessels, for the Offshore Substation (OSS) platform, and for WTGs during construction and O&M so that the vessels and structures are visible to other vessels. Impacts relative to visible structures and lighting during construction of the RWF are considered ***direct*** and ***short-term***.

Operations and Maintenance

- **Traffic:** Traffic impacts during O&M would be ***direct*** and ***long-term*** and could possibly result in a slight increase in traffic to the RWF from tourism (e.g., boat tours to see RWF). In addition, no permanent navigation exclusion areas are planned for vessels, which would restrict boat traffic for recreational uses (e.g., fishing) and tourism.

- **Visible Structures/Lighting:** ***Direct*** and ***long-term*** impacts from navigational lighting and visible structures (i.e., WTGs) on recreation and tourism during O&M are expected. However, no navigation exclusion areas are planned for vessels and the area being impacted is relatively small compared to the expansive surrounding waters of the Rhode Island Sound and the OCS.

RWEC-OCS

The RWEC-OCS and RWEC-RI impacts are anticipated to be similar and are included together in the following section.

Table 4.6.4-4b RWEC-OCS/RI Recreation and Tourism Impact Summary

Resource Area	Recreation and Tourism
RWEC - OCS /RI	
Construction and Decommissioning	Direct, Short-term
Operations and Maintenance	Direct, Long-term

Potential impacts on recreation and tourism resources from the RWEC-OCS will generally be limited to construction and decommissioning and could be minimized by scheduling of most of the activity to avoid the peak tourist season. Construction and decommissioning activities O&M may result in ***direct*** and ***short-term impacts*** to recreation and tourism from traffic and ***direct*** and ***short-term*** impacts to recreation and tourism from visible structures/ lighting. O&M activities may result in ***direct*** and ***long-term*** impacts from traffic and visible structures/ lighting. Section 4.1.3 discusses noise that could be generated; Section 4.1.7 discusses marine vessel and land traffic that could be generated; and Section 4.1.10 discusses visible structures.

Construction

- **Traffic**: Impacts from traffic during construction of the RWEC-OCS can occur from increased vehicular traffic from workers to ports and increased vessel traffic to construction locations. Such increases in traffic are expected to result in ***direct*** and ***short-term*** impacts.
- **Visible Structures / Lighting:** Impacts to recreation and tourism during construction of the RWEC-OCS will relate to the lighting of these activities, which could represent an impact to the offshore natural resources (e.g., altered fishing, scuba diving or sight-seeing conditions). Therefore, impacts could be ***direct*** and ***short-term***.

Operations and Maintenance

- **Traffic:** The RWEC-OCS is not expected to have maintenance needs unless a fault or failure occurs. Export cable failures are only anticipated because of damage from outside influences, such as unexpected digs from other parties. If repair is needed, spare submarine export cable and splice kits will be used to replace the impacted area. Therefore, traffic is not expected to be impacted during O&M unless repairs are needed. Such repairs would be periodic throughout the lifespan of the project, and therefore, constitute ***direct*** and ***long-term*** impacts.

- **Visible Structures/Lighting:** Impacts from visible structures/lighting would be similar to traffic and would only occur in the event of a fault or failure. As such, impacts would be ***direct*** and ***long-term*** impacts, and would result from vessels and construction activities during repairs.

Decommissioning

- **Traffic:** Impacts relative to traffic during decommissioning would be the same or similar during construction and would therefore be ***direct*** and ***short-term*** (Section 4.1.7)
- **Visible Structures/Lighting:** Impacts relative to visible structures/lighting during decommissioning would be the same or similar during construction and would therefore be ***direct*** and ***short-term*** (Section 4.1; Section 4.5).

RWEC-RI

Impacts for the RWEC-RI generally would be the same as for the RWEC-OCS.

Construction

- **Traffic:** Impacts relative to traffic during construction of the RWEC-RI would be the same as during construction of the RWEC-OCS (Section 4.1.7).
- **Visible Structures/Lighting:** Impacts relative to visible structures/lighting during construction of the RWEC-RI would be the same as during construction of the RWEC-OCS (Section 4.1.10).

Operations and Maintenance

- **Traffic:** Impacts relative to traffic during O&M of the RWEC-RI would be the same as during O&M of the RWEC-OCS (Section 4.1).
- **Visible Structures/Lighting:** Impacts relative to visible structures/lighting during O&M of the RWEC-RI would be the same as during O&M of the RWEC-OCS (Section 4.1.10; Section 4.5).

Decommissioning

- **Traffic:** Impacts relative to traffic during decommissioning of the RWEC-RI would be the same as during decommissioning of the RWEC-OCS (Section 4.1.7).
- **Visible Structures/Lighting:** Impacts relative to visible structures/lighting during decommissioning of the RWEC-RI would be the same as during decommissioning of the RWEC-OCS (Section 4.1.10; Section 4.5*)*.

Onshore Facilities

Table 4.6.4-4c Onshore Facilities Recreation and Tourism Impact Summary

Resource Area	Recreation and Tourism
Onshore Facilities	
Construction and Decommissioning	Direct, Short-term
Operations and Maintenance	Direct, Long-term

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to recreation and tourism from traffic and ***direct*** and ***short-term*** impacts to recreation and tourism from visible structures/ lighting. O&M activities may result in ***direct*** and ***long-term*** impacts from traffic. Section 4.1.7 discusses marine vessel and land traffic that could be generated and Section 4.1.10 discusses visible structures.

Construction

- **Traffic:** There will be ***direct*** and ***short-term*** impacts from construction of the Onshore Facilities because of the size of the non-local construction workforce relative to existing conditions, construction detours, and increased vehicular traffic (e.g., delivery trucks carrying construction equipment and supplies, construction and export cable-laying equipment (such as excavators), and automobiles used for daily commuting to various work sites). The onshore portion of the Project is not located in a major tourist area, so tourist resources would not be directly impacted by construction traffic. Any impacts to local populations would be minimized and mitigated by measures such as traffic and communications plans.
- **Visible Structures:** Construction activities associated with construction of the Onshore Facilities would result in ***direct*** and ***short-term*** impacts from visible structures. The scale of these impacts will depend on the use of Port of Galilee (Point Judith) as a logistics or O&M facility. To the extent practicable, timing of construction will avoid impacts to recreation and tourism in this area. Further details on anticipated timing, subject to change, are presented in Section 3. Other Project facilities onshore are not sited in locations frequented by tourists or recreational enthusiasts.

Operations and Maintenance

- **Traffic:** O&M of the OnSS is expected to be similar to ongoing O&M of the existing TNEC Davisville Substation in the Town of North Kingstown, and there is no regular maintenance for the underground Onshore Transmission Cables, unless there is a failure or malfunction requiring exposure and repair of the cable. If any unforeseen maintenance is required, impacts to traffic from potential traffic detours might occur as well as a slight increase in traffic from construction/maintenance workers. Depending on the time of year, this might occur during tourism season. Such repairs would be periodic throughout the lifespan of the project, and therefore, constitute ***direct*** and ***long-term*** impacts on recreation and tourism.

- **Visible Structures:** Impacts from visible structures during O&M would have similar impacts as construction (Section 4.1.10; Section 4.5). Impacts from the RWF O&M facilities onshore are not expected because they would be located and designed to be consistent with adjacent uses.

Decommissioning

- **Traffic:** Decommissioning of the Onshore Facilities would have similar traffic impacts as construction (Section 4.1.7 Traffic (Vessels, Vehicles, Air)).
- **Visible Structures:** Decommissioning of the Onshore Facilities would have similar visible structure impacts as construction (Section 4.1.10; Section 4.5).

4.6.4.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to recreation and tourism.

- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Project website, public notices to mariners and vessel float plans, and a fisheries liaison. Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities.
- The Onshore Facilities construction schedule will be designed to minimize and mitigate impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day.
- Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.

4.6.5 Commercial and Recreational Fishing

Commercial and recreational fishing are an important part of the cultural and economic history of the Southern New England region, tracing from Native American tribes that followed annual fish runs, colonial settlers who developed a whaling industry, up to the modern fishing fleet (NOAA Fisheries, 2019a). Many commercial and recreational fisheries (e.g., lobster, sea scallops, crab, and a variety of fish) are important contributors to the regional economy. Several recent reports provide some key characteristics of the fishing industry:

- In 2015, New England landings revenue totaled approximately $1.2 billion and commercial fisheries landed approximately 599 million pounds of finfish and shellfish (NOAA Fisheries, 2017a). Recreational fishing, be it from shore, a private vessel, or a for-hire vessel, is also important to coastal economies and key to coastal communities' cultural heritage.
- According to a NOAA report on marine recreational bait and tackle retail stores, independent bait and tackle retail shops in coastal communities generated an estimated $854 million in total

sales of marine bait, tackle, and related equipment (Hutt et al., 2015). These sales also support other top industry sectors such as service, retail and wholesale trade, and manufacturing.

- Recreational fisheries were a key economic driver in 2015 and supported 439,000 full-time or part-time jobs nationwide, supported directly or indirectly by purchases made by anglers (NOAA Fisheries, 2019b). The NOAA report on the Economic Contribution of Marine Angler Expenditures (Lovell et al., 2016) states that saltwater anglers spent an estimated $4.4 billion on trip-based expenditures such as ice and fuel, and another $19 billion on durable goods and fishing equipment such as boats and fishing rods.
- In 2017, New Bedford, MA, was the top port for commercial fisheries value ($327 million) and among the top ports by volume (107 million pounds; NOAA Fisheries, 2018).

Species that are targeted for commercial and recreational fishing in Southern New England are managed through Fishery Management Plans (FMPs) by the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council (50 CFR 600.105), the Atlantic States Marine Fisheries Commission, or some combination of these (NOAA Fisheries, 2017b). Some FMPs include multiple species because they share habitat and are often fished using the same gear type. Commercial fisheries that target certain species can be grouped into broad categories by the gear used – mobile-gear, which is used while the vessel is in motion, such as trawls and dredges; and fixed-gear, which is set and retrieved later, such as lobster pots and gill nets. Recreational fishing activity can be categorized by fishing mode (charter boat, party boat, private boat, or shore) and by fishing location (inland, state territorial sea [shore to 3 nm {5.5 km}], and federal Exclusive Economic Zone [more than 3 nm {5.5 km}]) (NOAA Fisheries, 2019b).

Vessels originating from New England and Mid-Atlantic states catch a diverse range of pelagic, demersal, and benthic species using various types of gear. Commercially and recreationally valuable saltwater species populations are highly dynamic, both spatially and temporally. Many species undertake seasonal migrations, which are often correlated with seasonal variation in water temperature and prey availability. Interannual fluctuations in population sizes can occur in response to climate change, fishing, and other ecological pressures. Fish and macroinvertebrate populations supporting commercial and recreational fisheries along the Northeast Continental Shelf are diverse (Malek et al., 2014). Some fisheries are experiencing a regional decline and others an increase (Collie et al. 2008), whereas the location of some fisheries has shifted to the northeast in association with climate-related changes (Friedland et al. 2018).

The information presented in this section summarizes data detailed in the Commercial & Recreational Fisheries Appendix CC. This assessment makes use of public data sources available at the time of publication. Multiple state and federal fisheries data resources for commercial and recreational fishing in the region were reviewed and are referenced in this section (Table 4.6.5-1). This regional approach to characterize fishing activity was based on data sources that were designed to be used at a regional scale, rather than at the small spatial and physical scale of the RWF. In addition, a regional approach recognizes that fish populations shift geographically by season and between years and cannot be effectively summarized using a spatially and temporally narrow window.

By analyzing data from multiple sources, the fisheries most likely to be affected by the RWF and RWEC were specified based on the gear used, the species that are targeted, and the landing ports. Although no single dataset can illustrate the complete picture of how fisheries operate in the region, this section incorporated the best available data that are reported to state and federal resource management agencies. These data sources are described in detail in the Commercial & Recreational Fisheries Appendix CC.

Revolution Wind also is implementing an ongoing fisheries outreach effort to maintain communication with the regional fishing community and use their extensive knowledge of fishery resources. Revolution Wind has established an experienced team of Fisheries Liaisons and Fisheries Representatives to facilitate a two-way process of communication through individual outreach via email, text message, or in person, and that also includes, but is not limited to, public presentations, listening sessions, Notices to Mariners, and updates to websites and social media.

Table 4.6.5-1 Data Sources Used to Characterize Fisheries in the RWF and RWEC

Affected Environment	Commercial Fishing Activity	Recreational Fishing Activity	Aquaculture
RWF	Federal Vessel Trip Report (VTR) Data Federal Vessel Monitoring System (VMS) Data Stakeholder Engagement	Marine Recreational Information Program (MRIP) Data Published Reports Stakeholder Engagement	Marine Cadastre
RWEC-OCS and RWEC-RI	Federal VTR Data State VTR Data Federal VMS Data Stakeholder Engagement	MRIP Data Published Reports Stakeholder Engagement	Marine Cadastre Published Reports

Two primary sources of information for commercial fisheries were incorporated into this analysis. Federal VTR and federal VMS data were the best available sources to understand which commercial fisheries may be affected by the RWF and RWEC.

- The federal VTR data set has the advantage of providing a "census" of almost all commercial fisheries that are active on the Atlantic coast, from Maine to North Carolina. VTR data can provide a reasonable estimation of fishing activity, and can be examined through the landing port, the landed species, and the gear type used.
- VMS data also are valuable because they provide precise vessel locations; however, fishing locations are estimates based on data filtered by vessel-speed to isolate fishing locations from the vessel's path of transit. As with VTR data, VMS data can provide a reasonable estimation of important fishing locations and can be examined for specific fisheries that were required to report to the VMS program. One caveat is that VMS data do not provide complete coverage for all FMPs; i.e., there is not 100 percent reporting for some FMPs for some years. For instance, from 2017 to 2019, the percentage of FMPs using VMS ranged from 24 percent (American

lobster) to 95 percent (Mackerel/Squid/Butterfish) (Douglas Christel, NOAA Fisheries, pers. comm., 5/18/2020).

In addition, the state VTR data source is useful because federal VTR data describe most commercial fishing activity in both state and federal waters by vessels that have a federal permit or both a state and federal fishing permit. However, those vessels that only have state commercial fishing permits are not included in the federal VTR data set. State-permitted vessels must report their catch, including the federal statistical area within which fishing occurred (Commercial & Recreational Fisheries Appendix CC). State VTR data were assessed for Connecticut, Massachusetts, New York and Rhode Island. Landing permits allow a vessel from a particular state to fish in another state's waters and land catch in the home state. Connecticut, Massachusetts, and New York were included in the state VTR analyses because Revolution Wind may be using New London and multiple Rhode Island ports for O&M activities. Vessels leaving and returning to these ports to support construction/decommissioning activities potentially will be transiting through waters of these states. An expanded port plan (see Section 3) includes New Jersey, Virginia, and Maryland. The state VTR data were obtained for fishing activity within and around the immediate vicinity of the RWEC fisheries study corridor, which is 46-mi (74-km)-long and 6.2-mi (10-km) wide, where infrastructure will be located and long-term vessel activity will occur. Impacts associated with transit to and from remote ports will be limited to short-term use of these ports during the construction phase only, therefore project-generated transit will not add much traffic beyond existing levels. Fishing activity was characterized in terms of landed pounds of target species, the landing port, and the gear category. Data reported to the Connecticut Department of Energy and Environmental Protection (CT DEEP), Massachusetts Division of Marine Fisheries (MADMF), NYSDEC, and Rhode Island Department of Environmental Management (RIDEM) were requested as VTR data from the Atlantic Coastal Cooperative Statistics Program (ACCSP, 2019) for fishermen who fish only in state waters. Results of an analysis of commercial fisheries data for the years 2011 through 2016, as reported by RIDEM (RIDEM, 2017) were also reviewed. The complete results of the state VTR data analyses are provided in the Commercial and Recreational Fisheries Appendix CC.

4.6.5.1 Affected Environment

Regional Overview

Benthic communities have experienced increased water temperatures in the region in the past several decades, and average pH is expected to continue to decline as seawater becomes more saturated with carbon dioxide (Saba et al., 2016). Acidification of seawater is associated with decreased survival and health of organisms with calcareous shells (such as the Atlantic scallop, blue clam, and hard clam), but less is known about direct effects of acidification on cartilaginous and bony fishes. The ranges of dozens of groundfish species in New England waters have shifted northward and into deeper waters in response to increasing water temperatures (Pinsky et al., 2013; Nye et al., 2009) and more species are predicted to follow (Selden et al., 2018; Kleisner et al., 2017). The black sea bass, identified as particularly sensitive to habitat alteration (Guida et al., 2017), has been increasing in abundance over the past several years, and is expected to continue its expansion in southern New England as water temperatures increase (Kuffner, 2018; McBride et al., 2018). Several pelagic forage species have been increasing in the region, including butterfish, scup, squid

(Collie et al., 2008) and Atlantic mackerel (McManus et al., 2018). Perhaps counterintuitively, distributions of other species are reported to be shifting southward, including spiny dogfish, little skate, and silver hake (Walsh et al., 2015). It has been suggested that the spiny dogfish may replace the Atlantic cod as a major predator in southern New England as the cod is driven north by warm waters that the spiny dogfish tolerates well (Selden et al., 2018). Further temperature increases in southern New England are expected to exceed the global ocean average by at least a factor of 2, and ocean circulation patterns are projected to change (Saba et al., 2016). Distributional shifts are occurring in both demersal and pelagic species, perhaps mediated by changes in spawning locations and dates (Walsh et al., 2015). Southern species, including some highly migratory species such as mahi that prefer warmer waters, are expected to follow the warming trend and become more abundant in the area (Walsh et al., 2015; South Atlantic Fishery Management Council, 2003). Climate change may also be affecting the migrations of anadromous fish in the region. The herrings, shad, and sturgeon were identified as having high biological sensitivity to adverse effects of climate change (Hare et al., 2016). In addition to physiological effects of temperature and pH, anadromous fishes face a physical risk caused by flooding in their spawning rivers.

The affected environment for commercial and recreational fishing includes a region defined by the ports with vessels that fish at or near the RWF and RWEC. The RWF and RWEC will physically occupy a relatively small space in state and federal waters (offshore portions, as defined in Section 1.1, Figure 1.1-1). This regional approach used a representative sample of the fisheries activity in the region that may be affected by the Project. Fishing vessel activity for ports in Connecticut, New York, Rhode Island and Massachusetts are examined as well as fishing activity in the following federal statistical areas: 537, 538, 611, and 613.

The affected environment was characterized based on several types of data to determine which fisheries, as defined by landing port, landed species or FMP, and gear, potentially will be affected by the RWF and/or RWEC. Aquaculture activity was characterized near the RWEC fisheries study corridor using data accessed from the Northeast Regional Ocean Council (NROC, 2019) and the RIDEM Division of Fish and Wildlife, Marine Fisheries Section (RIDEM, 2019).

Commercial and recreational fisheries are spatially and temporally dynamic because the targeted fish and invertebrate populations change in abundance and distribution seasonally and from year to year. For this reason, the regional overview (as it relates to commercial and recreational fisheries) refers broadly to the area encompassing the RWF and the RWEC (including both the RWEC – OCS and the RWEC – RI). The commercial and recreational fishing described herein includes activity in state and federal waters, as reported to the federal VTR program. Activity in the RWEC – RI area includes fisheries active in Rhode Island state waters spanning the Atlantic Ocean east of Point Judith, through Narragansett Bay to Quonset Point in North Kingstown, Rhode Island. Activity in federal waters, which may occur in or near the RWEC – OCS and the RWF, was described for fisheries that span from the state waters of Rhode Island to approximately 30 miles (48 km) offshore, which is approximately the southern boundary of the RWF project area. The regional overview is meant to reflect the interconnectivity of commercial and recreational fisheries in the area.

Commercial fisheries in regional state waters are characterized by gear type, species/FMP, and fishing ports, and are described below and summarized in Table 4.6.5-2. The potential impacts of the RWF on the affected fisheries, including both negative and potential beneficial impacts, are discussed in detail in Section 4.6.5.2.

Connecticut ports that earned the greatest revenue from vessels permitted to fish in Connecticut state waters were Stonington, Old Saybrook, New London, Guilford, and Clinton (Table 4.6.5-2). The top ports where fishermen landed their catch from fishing in all Massachusetts state waters were Chatham, New Bedford, Edgartown, and Falmouth. For the state of New York, the category "unknown" for a port designation claimed the highest landings of total statewide landings. Among known ports, Oceanside had the highest average annual landings followed by Shinnecock Indian Reservation, Mattituck, East Hampton and Greenport. The top ports where fishermen landed their catch from fishing in Rhode Island state waters were Point Judith, Little Compton, Newport, Bristol, and North Kingstown (local name Wickford). According to the VMS data as analyzed in RI DEM (2017), over the years 2011 to 2016, New Bedford, Massachusetts earned a total of $2.9 million in revenue, with the greatest landings in the year 2014 (more than $969,000). For the same set of years, Point Judith, Rhode Island earned more than $2 million total in revenue, with the greatest earnings in 2013 (more than $594,000). The greatest landings revenue from fishing in the RI-MA WEA were generated by otter bottom trawl, sink gill net, and scallop dredge gear (RIDEM, 2017). According to VMS data, the FMPs that earned the most landings revenue from fishing in the RI-MA WEA during 2011 through 2016 include sea scallops, monkfish, and Northeast multispecies (RIDEM, 2017).

There are few data sources available that describe recreational fishing activity. Data from the Marine Recreational Information Program (MRIP) were used to summarize recreational angler-trips from surrounding states; however, this dataset does not include fishing locations, so it can only be used to characterize the relative intensity of fishing activity among states and over time. To characterize recreational fishing activity in the RWF and RWEC, the number of angler trips leaving from the four surrounding states: New York, Connecticut, Rhode Island, and Massachusetts (Commercial & Recreational Fisheries Appendix CC), was summarized using the last 5 years of available recreational angler-trip data (2014 to 2018). Intercept-surveys with fishing-area data missing were recorded as fishing in "unknown" locations but provided information as to whether the trip was on a charter or private vessel. Over this 5-year period, the greatest number of angler-trips to federal waters left from New York, with an average of more than 681,652 estimated trips per year (Commercial & Recreational Fisheries Appendix CC). In terms of the percent of total angler trips at the state level, most trips leaving from each of the four states were in private vessels (Commercial & Recreational Fisheries Appendix CC). Connecticut has the greatest proportion of charter-boat angler trips among the four states (14 percent of all angler- trips out of Connecticut), and Massachusetts and New York had the greatest proportion of shore-based angler trips among the four states (89 percent).

Recreational fishing trips from Connecticut, Massachusetts, New York, and Rhode Island peaked during July and August for fishing from shore as well as for trips to state and federal waters (Commercial & Recreational Fisheries Appendix CC). The recreational trips departing from Connecticut, Massachusetts, Rhode Island, or New York to federal waters on private or charter vessels are within a reasonable travel distance for a fishing trip to the RWF.

Most of recreational fishing effort from the four states occurred from shore (Commercial & Recreational Fisheries Appendix CC) during summer months (May/June through

September/October). Shore fishing also occurred during the shoulder months of March/April and November/December when there was limited fishing effort by private or for-hire vessels in either state or federal waters. The MRIP data demonstrated that trips to federal waters occurred primarily on private vessels (86 to 89 percent of all federal trips across the four states) from 2014 through 2018.

Table 4.6.5-2 Summary of State VTR Data

State	Gears	Species	Landing Port
Connecticut	Pots and traps Otter trawls Lobster pots and traps	Conch Menhaden Lobster Scup Horseshoe crabs Summer flounder American shad	Stonington Old Saybrook New London Guilford Clinton
Massachusetts	Dredge Pots and traps Hook and line	Brachyuran crabs Ocean quahog Channeled whelk Northern quahog clam Scup Striped bass	Chatham Westport New Bedford Edgartown Falmouth
New York	Pots and traps Otter trawls Other fixed nets Gill nets Dredge	Atlantic surf clam Striped bass Jonah crab Menhaden Scup Bluefish Lobster Horseshoe crab	Oceanside Shinnecock Indian Reservation Mattituck East Hampton Greenport
Rhode Island	Pots and traps Fixed nets Hook and line Otter trawls	Scup Channeled whelk Summer flounder Menhaden Striped bass	Point Judith Little Compton Newport Bristol North Kingstown

Source: State VTR data filed with CT DEEP, MADMF, NYSDEC, RIDEM and provided by ACCSP (2019).

Revolution Wind Farm

Commercial fisheries active in the RWF encompass a wide range of gears, species, and landing ports. Table 4.6.5-3 summarizes those elements that define the fisheries that may be affected by the RWF, based on federal fisheries data (Commercial & Recreational Fisheries Appendix CC). Based on these data sources, the biggest commercial fisheries near the RWF in terms of revenue and pounds landed include both mobile gear types (bottom trawl, mid-water trawl, and dredge) and fixed gear types (sink gill net and pots), as well as harvest by hand. The top species-groups reported on VTRs by federally permitted vessels in terms of average annual revenue were lobster, flounders, hakes, Atlantic herring, scup, squid, black sea bass, channeled whelk, and Atlantic mackerel. Vessels originating from Rhode Island, Massachusetts, New York, and Connecticut conducted the most federally permitted fishing activities within the RWF.

Fishing occurs throughout the RWF area and variation in intensity of fishing activity by location is challenging to accurately and precisely categorize with available data sources. VMS data for several commercial fisheries indicate respective levels of intensity of vessel traffic and fishing activity in the RWF. The location of the fishing effort varied based on the species or species assemblage that was targeted. Maps that depict the federal VMS data provided a qualitative estimate of fishing location for a particular gear type or target species. The available data suggest that most fisheries do not have expansive areas of high relative fishing intensity within the RWF compared with nearby waters (Commercial & Recreational Fisheries Appendix CC). Fisheries that had the most activity in the RWF included Atlantic herring, surfclam/ocean quahog, sea scallop, squid/mackerel/butterfish, monkfish, and groundfish (large-mesh multispecies or northeast multispecies FMPs). Very-high density vessel activity within the RWF was reported for pelagic species (herring/mackerel/squid) in a small area in the northern portion of the RWF and for the surf/clam quahog fishery in the western portion of the RWF. Fisheries with high-density vessel activity within the northern portion of the RWF included groundfish, Atlantic herring, pelagic species (herring, mackerel, squid), surfclam/ocean quahog, squid. Fisheries with high-density vessel activity within the western portion of the RWF included groundfish and monkfish. The eastern portion of the RWF experienced high fishing vessel intensity for monkfish. High fishing vessel traffic for sea scallops was recorded for the southern edge of the RWF.

Table 4.6.5-3 Commercial Fisheries Most Active in the RWF

Location	Gears	Species	Landing State
RWF	Mobile Gears: Bottom trawl Mid-water trawl Dredge Fixed Gears: Pot Sink gill net By hand	Lobster Flounders Hakes Atlantic herring Scup Squid Black sea bass Channeled whelk Atlantic mackerel	Rhode Island Massachusetts New York Connecticut

Source: Federal VTR Data

RWEC-OCS

Table 4.6.5-4 summarizes commercial fisheries most active along the RWEC (OCS and RI) fisheries study corridor by gear type, species and landing state from federal VTR data, which were not reported at a scale sufficient to distinguish between the RWEC-OCS and the RWEC-RI. However, federal VMS vessel intensity maps (Commercial & Recreational Fisheries Appendix CC) can be used to locate areas of relatively high vessel intensity by fishery type. Among the commercial fisheries that were active within the RWEC fisheries study corridor (Commercial & Recreational Fisheries Appendix CC), the top fisheries reported on VTRs by federally permitted vessels by revenue used the following gear types: bottom trawl, mid-water trawl, pot, sink gill net, dredge, and by hand (Table 4.6.5-4). Top species in terms of revenue were Atlantic herring, lobster, squid, flounders, scup, butterfish, hakes, black sea bass, and spiny dogfish. The top states reported by federally permitted vessels for revenue sourced from within the RWEC fisheries study corridor were Rhode Island, Massachusetts, and Maine.

Fisheries that had the most activity in the RWEC (OCS and RI) fisheries study corridor included Atlantic herring, surfclam/ocean quahog, sea scallop, squid/mackerel/butterfish, monkfish, and groundfish (large-mesh multispecies or northeast multispecies FMPs). The RWEC-OCS traverses an area of high-density vessel activity for surfclam/ocean quahog upon exiting the RWF (Commercial & Recreational Fisheries Appendix CC).

RWEC-RI

Table 4.6.5-4 summarizes commercial fisheries most active along the RWEC (OCS and RI) fisheries study corridor by gear type, species and landing state from federal VTR data, which were not reported at a scale sufficient to distinguish between the RWEC-OCS and the RWEC-RI. Among the commercial fisheries that were active within the RWEC fisheries study corridor (Appendix CC), the top fisheries reported on VTRs by federally permitted vessels by revenue used the following gear types: bottom trawl, mid-water trawl, pot, sink gill net, dredge, and by hand (Table 4.6.5-4). Top species in terms of revenue were Atlantic herring, lobster, squid, flounders, scup, butterfish, hakes, black sea bass, and spiny dogfish. The top states reported by federally permitted vessels for revenue sourced from within the RWEC fisheries study corridor were Rhode Island, Massachusetts, and Maine.

Very-high density vessel activity along the RWEC-RI fisheries study corridor was reported for groundfish, (Appendix CC), Atlantic herring, pelagic species (herring, mackerel, squid), monkfish, and squid. For groundfish, Atlantic herring, pelagic species, and squid, the location of very-high fishing vessel density along the RWEC-RI was near Point Judith, whereas the very-high fishing vessel intensity for the monkfish fishery was located near landfall for the RWEC-RI. High-density vessel intensity also was recorded along the RWEC-RI for the monkfish fishery south of Quonset Point in North Kingstown, Rhode Island (Appendix CC).

Aquaculture in Rhode Island waters includes the cultivation of oysters, kelp, hard-shell clams, and mussels. Oysters are the main crop, with nearly 296 acres under cultivation and worth more than 5.7 million dollars in 2017 (Liberman, 2018). Locations of Rhode Island aquaculture sites were mapped based on data accessed from the Northeast Regional Ocean Council (NROC, 2019) and from the RIDEM Division of Fish and Wildlife, Marine Fisheries Section (RIDEM, 2019). Aquaculture sites occur along the Rhode Island shoreline, Block Island, and throughout Narragansett Bay (Appendix CC). The RWEC-RI fisheries study corridor to Quonset Point in North Kingstown, Rhode Island overlaps several aquaculture sites in Narragansett Bay; however, the RWEC centerline does not intersect any of these sites (Appendix CC). The closest aquaculture site to the RWEC-RI centerline is located on the western shoreline of Conanicut Island, approximately 1,427 feet (435 m) from the RWEC-RI route centerline (Appendix CC).

Table 4.6.5-4 Commercial Fisheries Most Active in the RWEC (OCS and RI)

Location	Gears	Species	Landing State
RWEC (OCS and RI)	Mobile Gears: Bottom trawl Mid-water trawl Dredge Fixed Gears: Pot Sink gill net By hand	Atlantic herring Lobster Squid Flounders Scup Butterfish Hakes Black sea bass Spiny dogfish	Rhode Island Massachusetts Maine

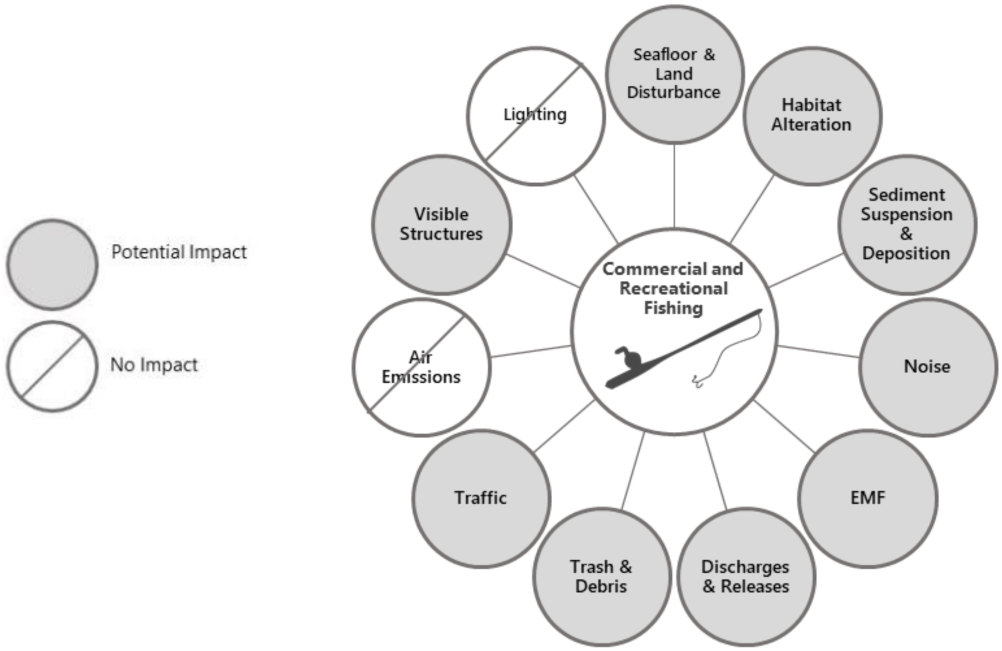
Source: Federal VTR Data

4.6.5.2 Potential Impacts

Potential impacts are characterized as direct or indirect and as either short-term or long-term by Project phase. Different impact-producing factors (IPFs) may result in varying levels of impact on commercial and recreational fisheries. IPFs that could impact commercial and recreational fisheries include seafloor disturbance, habitat alteration, sediment suspension and deposition, noise, EMF, discharges and releases, trash and debris, traffic, and visible structures. Habitat alteration may result in beneficial effects for certain recreational fisheries. An overview of IPFs for all activity phases for the RWF and RWEC that may impact fisheries is summarized in Figure 4.6.5-1. IPFs associated with the construction, O&M, and decommissioning phases for the RWF and RWEC are described in Section 4.1.

Direct impacts were characterized as those caused by the IPFs that disrupted commercial and/or recreational fishing activity, as described in Section 4.1. Indirect impacts on fishing activity are those impacts caused by IPFs on benthic resources, shellfish, and finfish species that are important to commercial and recreational fisheries species, for instance as a prey resource or habitat feature used as shelter. The RWF and RWEC are not expected to have substantial long-term impacts on finfish and invertebrate fishery resources (Section 4.3.2 and Section 4.3.3). The following sections are separated into the RWF, the RWEC-OCS, and the RWEC-RI, although the impacts may vary based on fishing activity.

Figure 4.6.5-1 IPFs on Commercial and Recreational Fisheries



Revolution Wind Farm

Construction and decommissioning activities are generally expected to have short-term impacts on access to fishing activity because of an expected 500-yard-radius safety zone established around locations where the RWF components will be installed, and long-term impacts because of habitat modification that would impact some commercially and recreationally targeted species and their prey. O&M activities are expected to have short and long-term, direct and indirect impacts on commercial fisheries and may have beneficial effects on recreational fisheries. It is likely that offshore structures will enhance, rather than diminish, recreational fishing opportunities in the WTG and OSS areas. Increased structure may also enhance the availability of species in the WTG and OSS areas that inhabit hard-bottom habitat (black sea bass, scup, hakes, cod, etc.). The foundations and scour protection may serve as artificial reef habitat when sessile benthic organisms and algae settle upon the surfaces. This typically happens rapidly as the materials used in these structures are completely benign. As offshore petroleum facilities have in the Gulf of Mexico, these structures will attract marine life, enhancing fisheries and contributing to recreational fishing. Additional details on potential impacts to commercial and recreational fisheries from the various IPFs at the RWF are described below and in the Commercial and Recreational Fisheries Technical Report.

Construction and Decommissioning

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWF area from the construction and decommissioning phases are summarized in Table 4.6.5-5. Additional details regarding potential impacts on commercial and recreational fisheries from the various IPFs during construction/decommissioning of the RWF are described in the following sections.

Table 4.6.5-5 IPFs and Characterization of Potential Impacts on Commercial and Recreational Fisheries at the RWF During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor preparation Impact pile driving and/or vibratory pile driving/foundation installation RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	Direct and Indirect, Short-term
Habitat Alteration	Seafloor preparation Pile driving/foundation installation RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	Indirect, Long-term
Sediment Suspension and Deposition	Seafloor preparation Impact pile driving and/or vibratory pile driving /foundation installation RWF IAC and OSS-Link Cable installation Vessel anchoring (including spuds)	Indirect, Short-term
Noise	Impact pile driving and/or vibratory pile driving Vessel noise, construction equipment noise, aircraft noise	Indirect, Short-term
Discharges and releases	Hazardous materials spills Wastewater discharge	Direct, Short-term
Marine trash and debris		Direct, Short-term
Traffic		Direct, Short-term
Visible Structures		Direct, Short-term

- **Seafloor Disturbance and Habitat Alteration:** Seafloor preparation, impact pile driving and/or vibratory pile driving /foundation installation, IAC and OSS-Link Cable installation, and vessel anchoring during construction is expected to result in short-term disruption of access to fishing areas for commercial and recreational fisheries. Fishing activity will be temporarily restricted within a 500-yard-radius safety zone established around construction operations. This restriction would result in a direct, short-term, impact on commercial and recreational fisheries as fishing activities relocate to avoid construction areas. During decommissioning, all facilities will be removed to a depth of 15 ft (4.6 m) below the mudline resulting in a short-term disruption to access to fishing areas due to a temporary restriction on fishing activity in the immediate vicinity of decommissioning activities.

  Indirect impacts on fisheries may occur as a result of the impacts of seafloor preparation, impact pile driving and/or vibratory pile driving/foundation installation, IAC and OSS-Link Cable installation, vessel anchoring, and decommissioning on fishery resources. Impacts on fishery resources associated with these activities will primarily be associated with species that have benthic/demersal life stages and prefer the types of habitats that will be disturbed by seafloor preparation. These activities could cause injury or mortality to benthic/demersal species. Impacts are expected to be short-term as the effects will cease after seafloor preparation is completed in a given area and limited as they will disturb a small portion of the available habitat in the area. Impacts on fishery resources that have pelagic early and/or later life stages are expected to be minimal, as pelagic habitats will not be directly affected by seafloor preparation. However, these species may temporarily vacate the area of disturbance.

In areas of sediment disturbance, demersal/benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be minimal given the availability of similar habitats in the area. These habitat alterations and recovery time periods would result in a limited, long-term loss of productivity in the disturbed area and a subsequent ***indirect*** and ***long-term*** impact on commercial and recreational fisheries.

- **Sediment Suspension and Deposition:** Seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition and may result in indirect and short-term impacts on commercial and recreational fisheries due to impacts on fishery species that have preferred habitat in the RWF. As discussed in Section 4.3.3.2, sediment transport modeling was conducted to evaluate the concentrations of suspended sediments, spatial extent and duration of sediment plumes, and the seafloor deposition resulting from cable burial activities. As summarized in Table 4.3.2-6, for the RWF IAC, a representative segment of 7,392 ft (2,253 m) of installation was simulated and the modeling results indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 853 feet (260 m) from the cable centerline. The plume is expected to be mostly contained within the bottom of the water column. The model estimated that the elevated TSS concentrations would be of short duration and expected to return to ambient conditions in less than 4.8 hours following the cessation of cable burial activities. The modeling results indicate that sedimentation from IAC burial may exceed 0.4 in (10 mm) of deposition up to 197 ft (60 m) from the cable and could cover up to 47 ac (190,202 m^2). Increases in sediment suspension and deposition associated with construction/decommissioning may cause short-term, limited impacts on benthic species and species with limited mobility and are not expected to have measurable impacts on pelagic species. Commercial fisheries that target species affected by sediment suspension and deposition may experience ***indirect*** and ***short-term*** impacts due to losses in productivity.
- **Noise:** Short-term, indirect impacts on commercial and recreational fisheries could occur due to avoidance behavior of fishery resources caused by impact pile driving and/or vibratory pile driving noise, vessel noise, construction equipment noise, and/or aircraft noise impacts on fishery resources.

Impact pile driving and/or vibratory pile driving noise may temporarily reduce habitat quality, result in behavioral changes, or cause mobile species to temporarily vacate the area. As a result, impact pile driving and/or vibratory pile driving noise impacts may result in short-term, indirect impacts on fisheries. However, habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of the pile driving activity.

Sounds created by mechanical/hydro-jet plows, vessels, or aircraft are continuous or non-impulsive sounds, which have different characteristics underwater and impacts on marine life. The noise from mechanical/hydro-jet plows is expected to be masked by louder sounds from vessels. The duration of construction equipment and vessel noise at a given location will be short, as the installation vessel will only be present for a short period at any given location along the cable route. Underwater noise associated with helicopters is generally brief as compared with the duration of audibility in the air (Richardson et al., 1995). Because of this, impacts on fishery resources from aircraft noise are expected to be ***short-term*** impacts.

Overall, impact pile driving and/or vibratory pile driving activities will be short in duration, and the noise generated by vessel and aircrafts will be similar to the range of noise from existing vessel and aircraft traffic in the region. These activities are not expected to substantially affect the existing underwater noise environment and noise impacts on commercial and recreational fisheries are expected to be ***indirect*** and ***short-term*** limited impacts.

- **Discharges and Releases:** Routine discharges of wastewater (e.g., gray water or black water) or liquids (e.g., ballast, bilge, deck drainage, stormwater) may occur from vessels, WTGs, or the OSS during construction and decommissioning; however, those discharges and releases are not anticipated to have impacts on commercial and recreational fisheries because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for impacting water quality and marine life.

  The construction of the RWF is not anticipated to lead to any spills of hazardous materials into the marine environment. All vessels participating in the construction and decommissioning of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. Best management practices (BMPs) for fueling and power equipment servicing will be incorporated into the Project's Emergency Response Plan and Oil Spill Response Plan (Appendix D). Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on commercial and recreational fisheries are ***not anticipated***.

- **Marine Trash and Debris:** Vessels will adhere to USCG and EPA regulations that require operators to develop waste management plans, to post informational placards, to manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Also, BOEM lease stipulations require adherence to Notice to Lessee (NTL) 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, which requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. As such, measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on commercial and recreational fisheries are ***not expected***.

- **Traffic:** Commercial and recreational fisheries may experience ***direct*** and ***short-term*** impacts due to increased vessel traffic during the construction phases of the RWF, as fisherman may avoid areas of increased vessel activity. Potential impacts on navigation are discussed in the NSRA (Appendix R). Primary conclusions of the NSRA included that vessel traffic near the project area is light, recreational/pleasure vessels represent the greatest proportion of vessel tracks in the study area, and deep draft vessel traffic in the wind farm area is expected to be limited to emergency circumstances.
- **Visible Structures:** The physical presence of installation vessels and RWF components may affect fishing activity because there will be a minimum safety perimeter around installation vessels and locations where the RWF components will be installed. This temporary restricted area will consist of a 500-yard (457 m) safety zone and, therefore, access to fishing within this zone may be restricted. These impacts are expected to be ***direct and short-term***.

Operations and Maintenance

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWF area from the O&M phase are summarized in Table 4.6.5-6a. Additional details regarding potential impacts on commercial and recreational fisheries from the various IPFs during O&M of the RWF are described in the following sections.

Table 4.6.5-6a IPFs and Characterization of Potential Impacts on Commercial and Recreational Fisheries within the RWF During O&M

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Foundations (WTG and OSS) RWF IAC and OSS-Link Cable non-routine O&M Vessel anchoring (including spuds)	Direct and Indirect, Short-term
Habitat Alteration	Foundations (WTG and OSS) RWF IAC and OSS-Link Cable	Direct and Indirect, Long-term
Sediment Suspension and Deposition	RWF IAC and OSS-Link Cable non-routine O&M Vessel anchoring (including spuds)	Indirect, Short-term
Noise	Vessel and aircraft noise	Indirect, Short-term
	WTG operational noise	Indirect, Long-term

IPF	Project Activity	Impact Characterization
Electric and magnetic fields	RWF IAC and OSS-Link Cable	Indirect, Long-term
Discharges and releases	Hazardous materials spills Wastewater discharges	Direct, Short-term
Marine trash and debris		Direct, Short-term
Traffic		Direct, Long-term

- **Seafloor Disturbance and Habitat Alteration:** Seafloor disturbance during O&M of the RWF will be limited to non-routine maintenance of bottom-founded infrastructure (e.g., foundations, scour protection, cable protection). These maintenance activities, and associated vessel anchoring, may result in direct, short-term impacts on fishing activity, as fishing access would be temporarily disrupted. However, the extent of the disturbance would be limited to specific areas. During O&M, anchoring will be limited to vessels required to be onsite for an extended duration.

  Seafloor-disturbing maintenance activities are expected to result in similar ***indirect*** and ***short-term*** impacts on fisheries as those discussed for the construction/decommissioning phase, as fishery resources would be temporarily affected. However, the extent of disturbance would be limited to specific areas and impacts are expected to be limited.

  Minimal impacts on commercial and recreational fisheries are expected from operation of the IAC and OSS-Link Cable themselves, as they will be buried beneath the seabed. The USCG's stated policy is that "in the United States vessels will have the freedom to navigate through [wind farms], including export cable routes." (See Coast Guard Navigation and Vessel Inspection Circular 01-19 dated 1 August 2019.) Therefore, commercial fishermen will have the freedom to continue to fish within the Lease Area and near cable routes. Further, the NSRA prepared for the Project, which is based on a very conservative potential layout (i.e., up to 144 WTGs), did not identify major areas of concern regarding safe marine navigation through the RWF. The Project's 1.15 mi (1 nm) by 1.15 mi (1 nm) layout allows for safe navigation by fishing vessels, and, therefore potential impacts on fishing grounds are considered ***direct*** and ***long-term***. Commercial fisheries using mobile gear (e.g., surfclam/ocean quahog and scallop fisheries) potentially may lose a limited fishing ground if additional cable protection is needed in areas that are fished.

  Presence of the foundations, associated scour protection, and cable protection may result in both negative and beneficial effects on commercial and recreational fisheries due to conversion of primarily soft-bottom habitat to hard-bottom habitat and the subsequent effects on fishery resources. Fishery resources associated with soft-bottom habitats may experience long-term impacts, as available habitat will be slightly reduced. Fishery resources that inhabit hard bottom habitats may experience a beneficial effect, depending on the quality and type of habitat created by the foundations, scour protection, and cable protection, and the quality and type of the benthic community that colonizes that habitat. Commercial fisheries that target species with limited mobility may have indirect, long-term impacts from the presence of the WTG foundations (due to the impact on benthic and demersal species such as ocean quahog clam, Atlantic surfclam, and Atlantic sea scallop). A beneficial effect of the WTGs' physical presence is that the new structures may attract recreationally important species. During operations, the physical presence of these structures may result in benefits to recreational fisheries due to the WTG marking the location with a hardened structure and attracting fishermen. While identifying productive fishing destinations is a potentially beneficial effect of the WTGs for the greater recreational fishing population, it also may be considered a negative impact for those individual recreational fishermen who previously utilized the area as a secluded fishing location. In addition, increased fishing pressure on fish aggregations at the WTGs may result in increased recreational fishing mortality rates. If these circumstances arise, then ***indirect, long-term*** impacts are expected.

- **Sediment Suspension and Deposition:** Increases in sediment suspension and deposition during the O&M phase may result from vessel anchoring and non-routine maintenance activities that require exposing the IAC and/or OSS-Link Cable. ***Indirect*** and ***short-term*** impacts on commercial and recreational fisheries resulting from sediment suspension and deposition during the O&M phase are expected to be similar to those discussed for the construction and decommissioning phase, but on a much more limited spatial scale.

- **Noise**: Impacts on commercial and recreational fisheries from ship and aircraft noise during O&M of the RWF are expected to be similar to those discussed for the construction/decommissioning phase, but to a lesser extent during O&M. The noise generated by vessels and aircraft will be similar to the range of noise from existing vessel and aircraft traffic in the region and is not expected to substantially affect the existing underwater noise environment.

  The underwater noise levels produced by the WTGs are expected to be within the hearing ranges of fish. Depending on the noise intensity, these noises could cause avoidance of the RWF area for some fishery species or their prey. However, noise levels from operation of the RWF WTGs are not expected to result in injury or mortality, and finfish may become habituated to the operational noise (Thomsen et al., 2006; Bergström et al., 2014). Lindeboom et al. (2011) found no difference in the residency times of juvenile cod around monopiles between periods of WTG operation or when WTGs were out-of-order. This study also found that sand eels did not avoid the wind farm. In a similar study, the abundance of cod, eel, shorthorn sculpin, and goldsinny wrasse, were found to be higher near WTGs, suggesting that potential noise impacts from operation did not override the attraction of these species to the artificial reef habitat (Bergström et al., 2013). Based on the available literature, operational noise from the WTGs is expected to have an ***indirect*** and***, long-term*** impact on commercial and recreational fisheries.

- **Electric and Magnetic Fields**: A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the RWF IAC and OSS-Link Cable was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. These modeling results were compared to existing scientific literature on the sensitivity of marine species to EMF. Based on the modeling results and existing evidence, behavioral effects and/or changes in species abundance and distributions are not expected (see Section 4.3.3.2 for additional discussion). These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that fishery resources will be measurably affected by EMF from the cables, and thus impacts on commercial and recreational fisheries are expected to be ***indirect*** and ***long-term***.

- **Discharges and Releases:** As discussed for the construction/decommissioning phase, routine discharges of wastewater or liquids (e.g., ballast, bilge, deck drainage, stormwater) are ***not anticipated*** to result in impacts because all vessel waste will be offloaded, stored, and disposed of in accordance with all applicable local, state and federal regulations. In addition, compliance with applicable Project-specific management practices and requirements will minimize the potential for impacting water quality and marine life.

  The operation of the RWF is not anticipated to introduce spills of hazardous material into the marine environment. Per the information requirements outlined in 30 CFR 585.626, a list of solid and liquid wastes generated, including disposal methods and locations, as well as federally regulated chemical products, is found in the OSRP (Appendix D). The WTGs and OSS will be designed for secondary levels of containment to prevent accidental discharges of hazardous materials to the marine environment. Most maintenance will occur inside the WTGs, thereby reducing the risk of a spill, and no oils or other wastes are expected to be discharged during maintenance activities.

  All vessels participating in O&M of the RWF will comply with USCG requirements for management of onboard fluids and fuels, including maintaining and implementing SPCC plans. Vessels will be navigated by trained, licensed vessel operators who will adhere to navigational rules and regulations and vessels will be equipped with spill handling materials adequate to control or clean up an accidental spill. BMPs for fueling and power equipment servicing will be incorporated into the Project's Emergency Response Plan and Oil Spill Response Plan (Appendix D). Accidental releases are minimized by containment and clean-up measures detailed in the OSRP. Given these measures and the very low likelihood of an inadvertent release, potential impacts of a hazardous material spill on commercial and recreational fisheries and fishery resources are ***not expected***.

- **Marine Trash and Debris:** As discussed for the construction and decommissioning phase, vessels will adhere to the USCG and EPA marine trash regulations, as well as BOEM guidance, and trash and debris generated during O&M of the RWF will be contained on vessels or at staging areas until disposal at an approved facility. Measures will be implemented prior to and during construction to avoid, minimize, and mitigate impacts related to trash and debris disposal. Given these measures, impacts from trash and debris on commercial and recreational fisheries are ***not expected***.

- **Traffic:** Impacts associated with traffic during O&M are expected to be similar to, but less frequent than, those discussed in the construction phase and may result in ***direct*** and ***long-term*** impacts.

RWEC-OCS

RWEC-OCS installation and decommissioning activities are generally expected to have ***short-term, localized*** impacts on access to fishing grounds because of safety restrictions on entering the area (Appendix E), and because of habitat modification that may affect some commercially and recreationally targeted species and their prey. O&M activities are expected to have some ***long-term, limited*** impacts on commercial fisheries and may have ***limited*** impacts on recreational fisheries. Additional details on potential impacts on commercial and recreational fisheries from the various IPFs are described in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWEC area from the construction and decommissioning phases are summarized Table 4.6.5-6b. Additional details regarding potential impacts on commercial and recreational fisheries from the various IPFs during construction/decommissioning of the RWEC are described in the following sections.

Table 4.6.5-6b IPFs and Characterization of Potential Impacts on Commercial and Recreational Fisheries for the RWEC During Construction and Decommissioning

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	Seafloor preparation RWEC installation Vessel anchoring (including spuds)	Direct and Indirect, Short-term
Habitat Alteration	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Indirect, Long-term
Sediment Suspension and Deposition	Seafloor Preparation RWEC installation Vessel anchoring (including spuds)	Indirect, Short-term
Noise	Vessel noise, construction equipment noise, aircraft noise Vibratory pile driving (cofferdam) *RWEC-RI only	Indirect, Short-term
Discharges and releases	Hazardous materials spills Wastewater discharge	Direct, Short-term
Marine trash and debris		Direct, Short-term
Traffic		Direct, Short-term

- **Seafloor Disturbance and Habitat Alteration:** As discussed for construction and decommissioning of the RWF, the potential direct, short-term, limited impacts on commercial and recreational fisheries from seafloor preparation for the RWEC-OCS are primarily associated with temporary disruption of access to fishing areas for commercial and recreational fisheries. In federal waters, the top fisheries use bottom trawls, mid-water trawls, and pots, with Atlantic herring, lobster, and squid the highest landed species by pound. Vessel intensity for the Atlantic herring and squid fisheries was medium-high to very high along portions of the RWEC-OCS route, therefore these fisheries are most likely to be affected by seafloor preparation for the RWEC-OCS.

Impacts on commercial and recreational fisheries associated with RWEC installation and vessel anchoring are expected to result in similar ***indirect*** and ***short-term*** impacts as those discussed for the RWF IAC and OSS-Link Cable.

In areas of sediment disturbance, demersal/benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). Recolonization of sediments by epifaunal and infaunal species and the return of mobile fish and invertebrate species will allow this area to continue to serve as foraging habitat. Pelagic species/life stages may be indirectly affected by the temporary reduction of benthic forage species, but these impacts are expected to be ***minimal*** given the availability of similar habitats in the area. These habitat alterations and recovery time periods would result in a long-term loss of productivity in the disturbed area and a subsequent ***indirect*** and ***long-term*** impact on commercial and recreational fisheries.

- **Sediment Suspension and Deposition:** Seafloor-disturbing activities will result in temporary increases in sediment suspension and deposition. Sediment transport modeling results (summarized in Table 4.3.2-6) indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 1,542 feet (470 m) from the RWEC-OCS centerline. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters it may occupy most of the water column due to the water depth. For the RWEC-OCS, predicted TSS concentrations above ambient for any single circuit installation do not persist in any given location for greater than 24 hours, though in most locations (>75 percent of the affected area) concentrations return to ambient within 8 hours. This maximum was predicted to occur along a part of the route that will only see one circuit installation. The maximum duration above ambient along the portion of the RWEC where two circuits will be installed was predicted to be 14 hours per circuit. This corresponds to a total of 28 hours above ambient, however the two 14-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC-OCS burial may exceed 0.4 in (10 mm) of deposition up to 328 ft (100 m). This thickness of sedimentation could cover up to 1,020 ac (4,127,794 m^2). Increases in sediment suspension and deposition associated with construction/decommissioning may cause ***short-term*** impacts on benthic species and species with limited mobility, and ***short-term*** impacts on pelagic species. Commercial fisheries that target species affected by sediment suspension and deposition may experience ***indirect*** and ***short-term*** impacts due to losses in productivity.
- **Noise:** Indirect impacts on commercial and recreational fisheries resulting from vessel, construction equipment, and aircraft noise are expected to be ***indirect*** and ***short-term*** impacts, and similar to those discussed for construction and decommissioning of the RWF IAC and OSS-Link Cable.

- **Discharges and Releases:** Impacts associated with wastewater discharge or an inadvertent release of hazardous material during construction or decommissioning of the RWEC-OCS are ***not expected***, for reasons similar to those discussed for the RWF.
- **Marine Trash and Debris:** Impacts associated with marine trash and debris are ***not expected***, for reasons similar to those discussed for the RWF.
- **Traffic:** Direct impacts on commercial and recreational fisheries resulting from vessel traffic during RWEC-OCS construction and decommissioning are expected to be ***direct*** and ***short-term*** and similar to those discussed for the RWF.

Operations and Maintenance

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWEC-OCS area from the O&M phase are summarized in Table 4.6.5-6c. Additional details regarding potential impacts on commercial and recreational fisheries from the various IPFs during O&M of the RWEC-OCS are described in the following sections.

Table 4.6.5-6c IPFs and Characterization of Potential Impacts on Commercial and Recreational Fisheries at the RWEC During O&M

IPF	Project Activity	Impact Characterization
Seafloor Disturbance	RWEC non-routine O&M Vessel anchoring (including spuds)	Direct and Indirect, Short-term
Habitat Alteration	RWEC O&M	Indirect, Long-term
Sediment Suspension and Deposition	RWEC non-routine O&M Vessel anchoring (including spuds)	Indirect, Short-term
Noise	Vessel and aircraft noise	Indirect, Long-term
Electric and magnetic fields	RWEC operations	Indirect, Long-term
Discharges and releases	Hazardous materials spills Wastewater discharge	Direct, Short-term
Marine trash and debris		Direct, Short-term
Traffic		Direct, Long-term

- **Seafloor Disturbance and Habitat Alteration:** Seafloor disturbance during O&M of the RWEC-OCS will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection. These maintenance activities, and associated vessel anchoring, may result in ***direct*** and ***short-term*** impacts on fishing activity, as fishing access would be temporarily disrupted. However, the extent of the disturbance would be limited to specific areas along the cable route. During O&M, anchoring will be limited to vessels required to be onsite for an extended duration.

  Impacts on commercial and recreational fisheries associated with maintenance activities and vessel anchoring are expected to result in similar ***indirect*** and ***short-term*** impacts as those discussed for the RWF IAC and OSS-Link Cable, as fishery resources would be temporarily affected if benthic prey are disturbed, however the extent of disturbance would be limited to specific areas.

Commercial and recreational fisheries are expected to experience minimal impacts from the presence of the RWEC-OCS because it will be buried beneath the seabed. The USCG's stated policy is that "in the United States vessels will have the freedom to navigate through [wind farms], including export cable routes." (See Coast Guard Navigation and Vessel Inspection Circular 01-19 dated 1 August 2019.) Therefore, commercial fishermen will have the freedom to continue to fish within the Lease Area and near cable routes. In fished areas where the substrate type necessitates additional cable protection, it is possible that mobile-gear commercial fisheries (e.g., surfclam/ocean quahog and scallop fisheries) potentially may lose a small amount of fishing ground in association with the altered seabed structure. (e.g., surfclam/ocean quahog and scallop fisheries) potentially may lose a small amount of fishing ground in association with the altered seabed structure.

Cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC-OCS. As discussed for O&M for the RWF IAC and OSS-Link Cable, the presence of the cable protection may result in both negative and beneficial indirect effect on commercial and recreational fisheries due to conversion of primarily soft-bottom habitat to hard-bottom habitat and the subsequent effects on fishery resources. The cable protection may have a long-term impact on fishery resources associated with soft-bottom habitats and a long-term beneficial effect on species associated with hard-bottom habitats, depending on the quality of the habitat created by the cable protection, and the quality of the benthic community that colonizes that habitat. After recolonization, the cable protection locations may provide beneficial effects to recreational fisheries if they choose to target recreational species that may favor these hard-bottom habitats, depending on the quality and type of habitat created by the cable protection, and the quality and type of benthic community that colonizes that habitat.

› **Sediment Suspension and Deposition:** Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC. Impacts on commercial and recreational fisheries resulting from sediment suspension and deposition during the O&M phase are expected to be similar to the ***indirect*** and ***short-term*** impacts discussed for the O&M of the RWF IAC and OSS-Link Cable.

› **Noise:** Impacts to commercial and recreational fishery resources are expected to be similar to, but less frequent than those described for the construction and decommissioning phase.

› **Electric and Magnetic Fields:** A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the RWEC-OCS was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment AppendixQ1. These modeling results were compared to existing scientific literature on the sensitivity of marine species to EMF. Based on the modeling results and existing evidence, behavioral effects and/or changes in species abundance and distributions are not expected (see Section 4.3.3.2 for additional discussion). These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is not expected that fishery resources will be measurably affected by EMF from the cables. Indirect impacts on commercial and recreational fisheries are expected to be ***indirect*** and ***long-term***.

- **Discharges and Releases:** Impacts associated with wastewater discharge or an inadvertent release of hazardous material during O&M of the RWEC-OCS are expected to be similar to those discussed for the construction and decommissioning phase.
- **Marine Trash and Debris:** Impacts associated with marine trash and debris are expected to be similar to those discussed for the construction and decommissioning phase.
- **Traffic:** Traffic during the O&M of the RWEC-OCS is expected to have similar impacts on commercial and recreational fisheries as those described for the RWF. During O&M, vessel traffic will be limited to routine maintenance visits and nonroutine maintenance as needed. Limited crew and supply runs using smaller support vessels will be required. Vessel traffic during O&M will be lower than traffic occurring during construction due to fewer operating vessels. Service operation vessels also will be in operation in the Project Area.

RWEC-RI

Like the RWEC-OCS, RWEC-RI cable installation and decommissioning activities are generally expected to have ***short-term limited*** impacts on access to fishing grounds because of safety restrictions on entering the area (Appendix E), and because of habitat modification that may affect some commercially and recreationally targeted species and their prey. O&M activities are expected to have some ***direct*** and ***long-term, limited*** impacts on commercial fisheries and may have beneficial effects on recreational fisheries. Additional details on potential impacts on commercial and recreational fisheries from the various IPFs are described in the following sections.

Construction and Decommissioning

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWEC-RI area from the construction and decommissioning phases are summarized Table 4.6.5-6c. Additional details regarding potential impacts on commercial and recreational fisheries from the various IPFs during construction/decommissioning of the RWEC-RI are described in the following sections.

- **Seafloor Disturbance and Habitat Alteration:** As discussed for construction and decommissioning of the RWEC-OCS, the potential ***direct*** and ***short-term, limited*** impacts on commercial and recreational fisheries from seafloor preparation for the RWEC-RI are primarily associated with temporary disruption of access to fishing areas for commercial and recreational fisheries. In Rhode Island State Waters fishing activity primarily used pots and traps, followed by fixed nets, and the top species landed were scup, channeled whelk and summer flounder. Vessel intensity for the Atlantic herring, pelagic species (herring, mackerel, squid), monkfish, and squid fisheries was medium-high to very high along portions of the RWEC-RI route, therefore these fisheries are most likely to be affected by seafloor preparation for the RWEC-RI.

Construction of the RWEC-RI landfall will be accomplished with via HDD methodology. A cofferdam may be used to allow for a dry environment during construction and manage sediment, contaminated soils, and bentonite. Impacts associated with the installation of a cofferdam (if necessary) would be similar to those discussed for seafloor preparation of the RWEC-OCS, but on a smaller scale. The cofferdam will be a temporary structure used during construction only. Therefore, no conversion of fisheries habitat is expected, and the cofferdam will be removed prior to the O&M phase.

Impacts on commercial and recreational fisheries associated with RWEC-RI installation and vessel anchoring are expected to result in similar ***indirect*** and ***short-term, limited*** impacts as those discussed for the RWF IAC and OSS-Link Cable.

As discussed for the RWEC-OCS, in areas of sediment disturbance, demersal/benthic habitat recovery and benthic infaunal and epifaunal species abundances may take up to 1 to 3 years to recover to pre-impact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF, Inc. et al., 2012; Germano et al., 1994; Hirsch et al., 1978; Kenny and Rees, 1994). These habitat alterations and recovery time periods may result in a minimal, long-term loss of productivity in the disturbed area and a subsequent ***indirect*** and ***long-term, limited*** impact on commercial and recreational fisheries.

› **Sediment Suspension and Deposition:** As discussed for the RWEC-OCS, seafloor-disturbing activities associated with the RWEC-RI will also result in temporary increases in sediment suspension and deposition. For the majority of the RWEC-RI, sediment transport modeling results (summarized in Table 4.3.2-6) indicate that sediment plumes with TSS concentrations exceeding the ambient conditions by 100 mg/L could extend up to 4,528 feet (1,380 m) from the RWEC-RI centerline. The plume is expected to be mostly contained within the bottom of the water column, though in shallower waters, such as within Narragansett Bay, it may occupy most of the water column due to the water depth. For installation of one circuit of the RWEC-RI, predicted TSS concentrations above ambient do not persist in any given location for greater than 16.3 hours, though in most locations (>75 percent of the affected area) concentrations return to ambient within 4 hours). For installation of two circuits, the maximum plume exposure is doubled at 32.6 hours, however, the two 16.3-hour periods will likely be separated by time. The modeling results indicate that sedimentation from RWEC-RI burial may exceed 0.4 in (10 mm) of deposition up to 919 ft (280 m) from the cable centerline. This thickness of sedimentation could cover up to 1,126 ac (4,556,760 m^2). For the landings, TSS concentrations exceeding ambient conditions by 100 mg/L could extend up 2,048 ft (624 m) from the centerline and plume concentrations above ambient could persist for 256 hours for HDD installation. These durations are longer relative to the water jet assisted cable installation due to the slower installation rate of the activity and since the alternatives include both trenching and backfilling for two circuits. Sedimentation greater than 0.4 in (10 mm) may extend up to 572 ft (174 m) from the centerline and could cover up to 85 ac (343,983 m^2). Increases in sediment suspension and deposition associated with construction/decommissioning may cause ***short-term, limited*** impacts on benthic species and species with limited mobility and are not expected to have measurable impacts on pelagic species. Commercial fisheries that target species affected by sediment suspension and deposition may experience ***indirect*** and ***short-term*** impacts due to losses in productivity.

- **Noise:** The cofferdam at the RWEC-RI landfall, if required, may be installed as either a sheet piled structure into the sea floor or a gravity cell structure placed on the sea floor using ballast weight. Sheet pile installation would require the use of a vibratory hammer to drive the sidewalls and endwalls into the seabed, which may take approximately up to 3 days. For fishery resources exposed, noise from vibratory pile driving may temporarily reduce habitat quality, result in behavioral changes, or cause mobile species to temporarily vacate the area. As a result, noise impacts may result in ***indirect*** and ***short-term, limited*** impacts on commercial and recreational fisheries. However, habitat suitability is expected to return to pre-pile driving conditions shortly after cessation of the pile driving activity.

  Impacts on commercial and recreational fisheries resulting from vessel, construction equipment, and aircraft noise are expected to be ***indirect*** and ***short-term*** impacts similar to those discussed for construction and decommissioning of the RWEC-OCS, RWF IAC, and OSS-Link Cable.

- **Discharges and Releases:** Impacts associated with wastewater discharge or an inadvertent release of hazardous material during construction or decommissioning of the RWEC-RI are expected to be similar to those discussed for the RWF.

- **Marine Trash and Debris:** Impacts associated with marine trash and debris are expected to be similar to those discussed for the RWF.

- **Traffic:** Impacts on commercial and recreational fisheries resulting from vessel traffic during RWEC-RI construction and decommissioning are expected to be similar to those discussed for the RWEC-OCS.

Operations and Maintenance

IPFs resulting in potential impacts on commercial and recreational fisheries in the RWEC-RI area from the O&M phase are summarized in Table 4.6.5-6c. Additional details regarding potential impacts on commercial and recreational fisheries from the various IPFs during O&M of the RWEC-RI are described in the following sections.

- **Seafloor Disturbance and Habitat Alteration:** As discussed for the RWEC-OCS, seafloor disturbance during O&M of the RWEC-RI will be limited to non-routine maintenance that may require uncovering and reburial of the cables, as well as maintenance of cable protection where present. These maintenance activities and associated vessel anchoring are expected to result in similar ***direct*** and ***short-term, limited*** impacts on fishing activity as those discussed for the RWEC-OCS.

  Indirect impacts on commercial and recreational fisheries associated with maintenance activities and vessel anchoring are expected to result in similar short-term impacts as those discussed for the RWEC-OCS, as fishery resources may be temporarily affected if benthic prey are disturbed, however the extent of disturbance would be limited to specific areas.

Commercial and recreational fisheries are expected to experience limited impacts from the presence of the RWEC-RI because it will be buried beneath the seabed. The USCG's stated policy is that "in the United States vessels will have the freedom to navigate through [wind farms], including export cable routes." (See Coast Guard Navigation and Vessel Inspection Circular 01-19 dated 1 August 2019.) Therefore, commercial fishermen will have the freedom to continue to fish within the Lease Area and near cable routes.

Cable protection (e.g., concrete mattresses) may be placed in select areas along the RWEC-RI. As discussed for O&M for the RWEC-OCS, the presence of the cable protection may result in both negative and beneficial indirect effects on commercial and recreational fisheries due to conversion of primarily soft-bottom habitat to hard-bottom habitat and the subsequent effects on fishery resources. The cable protection may have a long-term impact on fishery resources associated with soft-bottom habitats and a long-term beneficial effects on species associated with hard-bottom habitats, depending on the quality of the habitat created by the cable protection, and the quality of the benthic community that colonizes that habitat. After recolonization, the cable protection locations may provide beneficial effects to recreational fisheries if they choose to target recreational species that may favor these hard-bottom habitats, depending on the quality and type of habitat created by the cable protection, and the quality and type of benthic community that colonizes that habitat.

- **Sediment Suspension and Deposition:** Increases in sediment suspension and deposition during the O&M phase will result from vessel anchoring and non-routine maintenance activities that require exposing portions of the RWEC-RI. Direct and indirect impacts on commercial and recreational fisheries resulting from sediment suspension and deposition during the O&M phase are expected to be similar to the ***short-term*** impacts discussed for the RWEC-OCS.
- **Noise:** Impacts from vessel and aircraft noise during O&M of the RWEC-RI are expected to be similar to, but less frequent than those described for the construction phase.
- **Electric and Magnetic Fields:** A modeling analysis of the magnetic fields and induced electric fields anticipated to be produced during operation of the RWEC-RI was performed and results are included in the Offshore Electric- and Magnetic-Field Assessment Appendix Q1. These modeling results were compared to existing scientific literature on the sensitivity of marine species to EMF. Based on the modeling results and existing evidence, behavioral effects and/or changes in species abundance and distributions are not expected (see Section 4.3.3.2 for additional discussion). These conclusions are consistent with the findings of a previous comprehensive review of the ecological impacts of marine renewable energy projects, where it was determined that there has been no evidence demonstrating that EMF at the levels expected from marine renewable energy projects will cause an effect (negative or positive) on any species (Copping et al., 2016). Moreover, a 2019 BOEM report that assessed the potential for AC EMF from offshore wind facilities to affect marine populations concluded that, for the southern New England area, no negative effects are expected for populations of key commercial and recreational fish species (Snyder et al., 2019). Based on this information, it is ***not expected*** that fishery resources will be measurably affected by EMF from the cables.

- **Discharges and Releases:** Impacts associated with wastewater discharge or an inadvertent release of hazardous material during O&M of the RWEC-RI are expected to be similar to those discussed for the construction and decommissioning phase.
- **Marine Trash and Debris:** Impacts associated with marine trash and debris are expected to be similar to those discussed for the construction and decommissioning phase.
- **Traffic:** Traffic during the O&M of the RWEC is expected to have similar impacts on commercial and recreational fisheries as those described for the RWF.

4.6.5.3 Proposed Environmental Protection Measures

Revolution Wind will implement the following environmental protection measures to reduce potential impacts on commercial and recreational fishing.

- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations.
- To the extent feasible, installation of the Inter-Array Cable, OSS Interconnector Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment.
- To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment
- As appropriate and feasible, BMPs will be implemented to minimize impacts on fisheries, as described in the *Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM, 2015).
- Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. The Project's Fisheries and Benthic Monitoring Plan is included as an Appendix Y.
- Each WTG will be marked and lit with both USCG and approved aviation lighting. An Automatic Identification System will be installed at the RWF marking the corners of the wind farm to assist in safe navigation.

- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.
- Accidental spill or release of oils or other hazardous materials will be managed through the OSRP.
- All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
- Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication and Outreach Plan.
- Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and United States Department of Defense command headquarters.
- Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and DoD command headquarters.
- RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable.
- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG).

For information related to minimizing impacts to finfish and EFH resources, see Section 4.3.3, and for impacts to benthic resources, see Section 4.3.2.

4.6.6 Commercial Shipping

This section discusses the commercial shipping activities that may be impacted by the construction, O&M, or decommissioning of the proposed RWF and offshore segments of the RWEC (i.e., the RWEC-OCS and RWEC-RI). Unless otherwise noted, it draws from the NSRA, included as Appendix R. This document reviewed existing conditions for the entire Lease Area (see Figure 1-2 of the NSRA).

In addition to the information presented in this section, the NSRA includes a detailed analysis of marine traffic, possible interference with navigation, and assessment of risk of collision with other vessels, or allision with fixed structures such as WTGs. Although the NSRA addresses all types of vessel traffic, this section focuses on the findings specific to commercial shipping. The NSRA was prepared in accordance with USCG guidance for Offshore Renewable Energy Installations, as noted in the *Navigation and Vessel Inspection Circular* (NVIC) 01-19. Consultations were also held with USCG and marine transportations stakeholders.

4.6.6.1 Affected Environment

Commercial shipping within the region includes cargo vessels transiting to or from ports in the Narragansett Bay, Buzzards Bay, and Long Island Sound area. It also includes vessels transiting between a variety of other ports including the Port of New York and New Jersey, the Port of Boston, and other ports located on the east coast or abroad (RI CRMC, 2010). Because similar data and maps will be used to describe the impacted environment for the RWF and offshore segments of the RWEC, they are described together in this section.

A range of vessel types and activities characterize marine transportation in the Block Island and Rhode Island Sounds region. Commercial shipping involves the transport of goods (e.g., petroleum products, coal, and cars) through this area, while passenger ferries and cruise ships transport passengers between proximate coastal communities. Critical support to commercial vessel operations are provided by pilot boats, government enforcement vessels, and search and rescue vessels; they also facilitate safe navigation (RI CRMC, 2010).

For the purposes of this section, commercial shipping refers to the activity of deep draft commercial vessel traffic (i.e., cargo/carriers and tankers), passenger vessels (i.e., ferries and cruise ships), tugs, and “other” vessel types (e.g., research vessels, “special” vessels, and drill ships). Vessels proximate to the RWF and RWEC that fall under other categories are discussed in the detailed NSRA for the Project (Appendix R) and in the following sections of the COP:

› Recreation and Tourism – Section 4.6.4

› Commercial and Recreational Fishing – Section 4.6.5

› Other Marine Uses – Section 4.6.8

Designated Commercial Shipping Lanes

The RWF is located south-southeast of the entrance to Narragansett Bay and due south of the entrance to Buzzards Bay. There are two main traffic separation schemes located west of the RWF. These include the Narragansett Bay Traffic Separation Scheme (commercial traffic transiting north-south) and the Buzzards Bay Traffic Separation Scheme (commercial traffic transiting southwest-northeast). The Narragansett Bay Traffic Separation Scheme is more than 4.6 mi (8.0 km) from the RWF, while the Buzzards Bay Traffic Separation Scheme is 1.4 mi (2.2 km) from the RWF. Traffic separation schemes are routing measures aimed at the separation of opposing streams of traffic by the establishment of shipping lanes, shipping zones, recommended routes, and precautionary areas (United States Department of Homeland Security, 2010). The North Lease area, including the RWF, was defined by BOEM to avoid these shipping lanes and other marine space-use.

Vessel traffic and navigation in the area may at times be impacted by restrictions. The RWF and RWEC are primarily within the Narragansett Bay Special Operating Area (OPAREA) Complex boundary, within which national defense training exercises are routinely conducted (NOAA, 2018); the OPAREA includes Block Island Sound and Rhode Island Sound, and extends seaward to the south. The RWF also lies within a seasonal North Atlantic right whale speed-restriction area, which requires seasonal vessel speed reductions (November 1 through April 30) (NOAA, 2019).

From the RWF, but before it enters the Narragansett Bay along the West Passage, the RWEC bisects the middle of the Buzzards Bay traffic separation zone and its associated inbound and outbound lanes. It then crosses the precautionary area at the northern end of the Narragansett Traffic Separation Scheme at the entrance of Narragansett Bay.

Vessel Traffic

As presented in the RWF NSRA, marine traffic patterns in the area were assessed using Automatic Identification System (AIS) data. AIS data on vessel traffic are collected by a variety of sources, including the USCG, through a navigation safety device that transfers large vessel information in real time. Title 33, Code of Federal Regulations, Part 164, lists the vessel types required to carry an AIS, which include but are not limited to all self-propelled vessels of 65 ft or more in length engaged in commercial service.

AIS data provide a quantifiable and reliable method to determine the primary traffic patterns and analyze the size, speed, and movements of vessels in the region. Data presented in the RWF NSRA included all AIS entries with a timestamp from '2018-07-01 00:00' and '2019-06-30 23:59' Coordinated Universal Time (UTC) LAT between 40.79041 and 41.64521 and LON between -71.73783 and -70.52470. AIS data allow the traffic to be converted into vessel tracks that are conducive to a quantitative analysis.

The AIS data presented in the RWF NSRA show that traffic is most dense through Rhode Island Sound and along the traffic separation zones. Commercial traffic transits north-south along the Narragansett Bay traffic separation zone west of the RWF and southwest-northeast along the Buzzards Bay traffic separation zone northwest of the RWF. Traffic continues past the RWF along the traffic separation zones through defined precautionary areas; the southern precautionary area of the Narragansett Bay Traffic Separation Scheme is common to the Buzzards Bay Traffic Separation Scheme.

The RWF NSRA indicates that the traffic density shows relatively low AIS point density in the RWF. In line with the calculated vessel tracks, there are areas of higher density north of the Lease Area. The East Passage has areas of high density that continue through the pilot boarding area and the north-south Narragansett Bay Traffic Separation Zone.

Deep draft commercial vessels (cargo/carriers and tankers) transit the main shipping routes following the designated traffic separation zones as is expected (see Figure 2-6 of the RWF NSRA). Deep draft vessels predominantly transit three main courses, primarily outside of the RWF, including: 1) south-north via the Narragansett Bay Traffic outbound and inbound lanes, west of the Lease Area; 2) east-west from/to Buzzards Bay to/from Narragansett Bay, north of the Lease Area; and 3) west-east from/to Block Island Sound to the Narragansett Bay Traffic outbound and inbound lanes, northwest of the Lease Area. In the vicinity of the RWF, cargo vessels show greatest traffic density following the Narragansett Bay Traffic Separation Scheme into Narragansett Bay. Some deep draft commercial vessel traffic traverses the RWF; however, this occurs with relatively low frequency.

Passenger vessels (including ferries and cruise ships) tend to follow established routes, primarily along the coast and using the Narragansett Bay Traffic Separation Scheme (see Figure 2-21 of the RWF NSRA). This route transits to the west of the RWF and diverges south after the defined precautionary area, which consists of vessels operating between Narragansett Bay or Buzzards Bay. A smaller percentage of the passenger traffic transits southwest-northeast along the recommended vessel route through Buzzards Bay.

The AIS tracks for tugs are concentrated primarily to the northwest of the RWF (see Figure 2-24 of the RWF NSRA). Most tug and tow vessel traffic is reported to track closer to the coasts of the nearby coastal states and does not enter the Lease Area.

AIS tracks for “other” vessel types, which include AIS vessel subcategories that do not successfully fit into other defined categories, such as research vessels, “special vessels,” and drill ships. From the data set, these vessels appear to rely less on defined shipping channels but still occasionally transit Narragansett Bay inbound and outbound lanes to the west of the RWF Project area (see Figure 2-25 of the RWF NSRA). Areas of tracks are present that indicate systematic vessel movements, which typically indicate movements of a research/survey vessels likely working for other wind energy projects.

As noted, the offshore segments of the RWEC crosses both the Narragansett Traffic Separation Scheme and the Buzzards Bay Traffic Separation Scheme. Accordingly, it will traverse areas where dense commercial vessel traffic is expected, primarily including deep draft commercial vessels and passenger vessels transiting north-south via the Narragansett Bay inbound and outbound lanes to/from the East Passage and southwest-northeast along the recommended vessel route through Buzzards Bay. The RWEC is also expected to cross tug traffic as it moves closer to the coastline.

Vessel Statistics

The analysis in the RWF NSRA shows the distribution of vessel types that transit near the Lease Area using cross-sections of major marine routes. Most of the cross-sections have low traffic levels of less than 10 vessels per day (less than 3,650 transits per year). Two cross-sections (i.e., at the entrance of Narragansett Bay via East Passage and Point Judith) have higher annual traffic count with an average of 13,000 transits per year. These routes with the higher annual traffic do not cross through the Lease Area.

Vessel Size

This section describes the average vessel sizes by vessel type. For deep draft commercial vessels, the AIS-recorded size is likely close to reality. For smaller vessels, AIS may overestimate their average sizes because, typically, only the largest vessels are equipped with AIS transponders.

Table 4.6.6-1 presents the average dead-weight tonnage (DWT), length overall (LOA), and beam for the vessel types within the study area of the RWF NSRA. Tankers (with hydrocarbon cargo) are the largest in terms of DWT, LOA, and beam.

Table 4.6.6-1 Average DWT, LOA, and Beam for Vessel Types in the RWF NSRA Study Area

Vessel Type	Average DWT (metric tons)	Average LOA (feet / meters)	Average Beam (feet / meters)
Tanker – Oil Product	46,315	606 / 185	100 / 31
Cargo/Carrier	25,602	598 / 182	98 / 30
Tanker	18,963	476 / 145	80 / 24
Fishing	742	83 / 25	24 / 7
Passenger	584	172 / 52	40 / 12
Other/Undefined	518	125 / 38	32 / 10
Tug/Service	421	83 / 25	25 / 8
Pleasure	172	55 / 17	16 / 5

Source: DNV GL, 2019

Traffic Speed

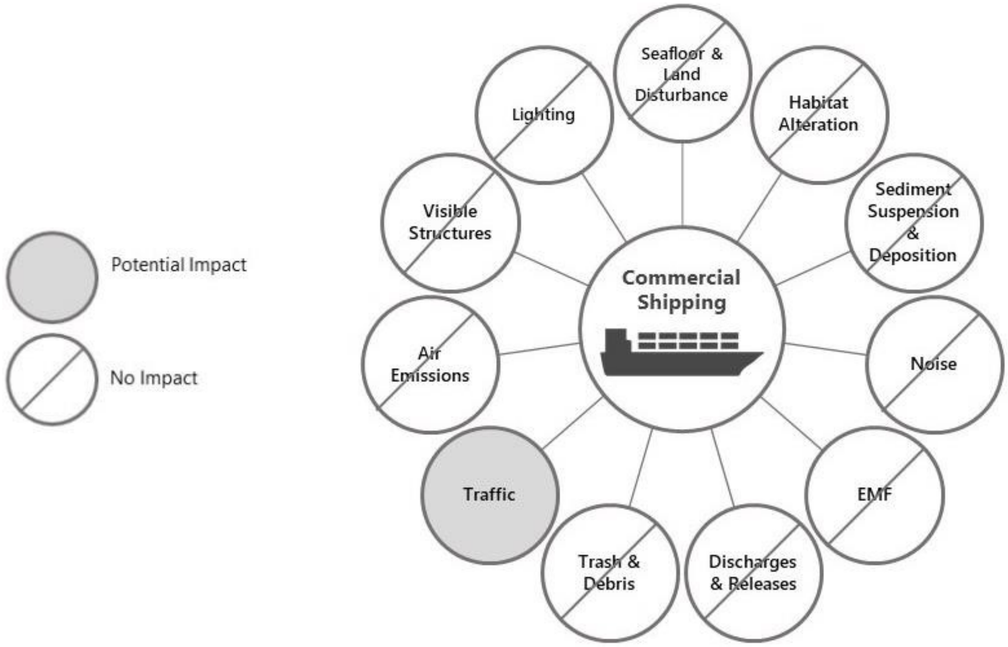
The RWF NSRA presents the speed profile based on the AIS data (see Figure 2-39 of the RWF NSRA). Most vessel transits were calculated to be between 5 and 15 knots (between approximately 6 and 17 miles per hour).

4.6.6.2 Potential Impacts

Construction, O&M, and decommissioning activities associated with the Project have the potential to cause direct and indirect impacts on commercial shipping activity as discussed in the following sections. IPFs associated with the Project phases are described in Section 4.1.

An overview of the potential impacts on commercial vessel activity due to Project activities is presented on Figure 4.6.6-1.

Figure 4.6.6-1 IPFs on Commercial Shipping



Revolution Wind Farm

Table 4.6.6-2a RWF Commercial Shipping Impact Summary

Resource Area	Commercial Shipping
RWF	
Construction and Decommissioning	Direct, Short-term
O&M	Direct and Indirect, Long-term

Construction and decommissioning activities may result in ***direct short-term*** impacts from traffic on commercial shipping. There is the potential for ***direct*** and ***indirect,*** and ***long-term*** impacts from O&M activities on commercial shipping, related to traffic. Section 4.1.7 discusses marine vessel and land traffic that could be generated.

The NSRA did not identify major areas of concern regarding the RWF impact on marine navigation. The RWF is located in open water over 1.4 mi (2.2 km) from high-density deep draft commercial shipping lanes (i.e., the Inbound Buzzards Bay Traffic Lane) and approximately 13 mi (20.1 km) from the closest land mass (south of mainland Rhode Island and southwest of Martha's Vineyard, Massachusetts). The NSRA is based on a very conservative potential layout (i.e., 144 WTG) compared to the currently proposed layout that is presented in Section 3, with up to 100 WTGs. Therefore, the actual anticipated impacts are likely to be less than those presented in the following sections. The modeled WTG layout includes a minimum separation distance of 0.7 mi (0.4 km) with each having a diameter of about 33 ft (10 m) at and near sea level (i.e., the collision cross section is 10 m).

Construction

- **Traffic:** Given the Project location relative to major commercial shipping lanes (not including commercial fishing), there is not expected to be a significant disruption of the normal traffic patterns during the construction or installation of the RWF. The number of vessels that will operate during the RWF construction phase is expected to result in a ***direct*** and ***short-term*** impact and risk addition to normal traffic patterns.

  RWF construction is anticipated to take place in work windows for specific construction activities that will limit the number of vessels introduced to local traffic at one time. Potential tasks to be completed in a work window, either individually or simultaneously for efficiency purposes, include foundation installation, offshore cable line installation, and final WTG installation. The vessels that are anticipated to be present during construction of the RWF include, but may not be limited to, construction barges, heavy lift vessels, trenching vessels, guard vessels, survey vessels, support tugs, jack-up rigs, supply/crew vessels, and cable laying vessels. These vessels will also be present in the region during decommissioning of the RWF.

  Offshore construction activities could be a hazard and Project construction vessels could experience hazards from passing vessels. As presented in Section 3, this risk is mitigated by safety zones around construction activity that is anticipated to be implemented by USCG during construction operations (Section 4.6.6.3). In addition, the Project has committed to providing mariner updates; updates will be provided to mariners online and via twice-daily updates on Very High Frequency (VHF) channels.

  Informal consultation conducted with the Northeast Marine Pilots Association as part of the evaluation of the SFWF project suggests that the RWF may have a ***direct*** and ***short-term*** impact on commercial traffic in the region during construction. This potential impact could occur occasionally when vessels, primarily passenger vessels, would request to deviate from the north-south traffic separation zone and request to transit to the southeast to reach Boston. During construction of the RWF, the pilotage association would assess the requests on a case-by-case basis to determine whether the vessel can safely transit southeast around or through the RWF.

Operations and Maintenance

- **Traffic:** Safety/exclusion zones are not anticipated during Project operation. Therefore, vessels are free to navigate within, or close to, the RWF. It is expected that mariners, including RWF service vessels, would strictly adhere to all the International Regulations for Preventing Collisions at Sea 1972 (COLREGs) and be aware of the prevailing environment and situation to avoid unsafe situations. The WTG layout at the RWF provides sufficient sea room for most vessels to transit between WTGs if the risks have been considered and a vessel is transiting at a safe speed per COLREGs. In addition, it is expected that deep draft and commercial vessels (excluding commercial fishing vessels) will not choose to transit through or near the wind farm because the Narragansett Bay Traffic Separation Scheme is more than 4.6 mi (8.0 km) from the RWF and the Buzzards Bay Traffic Separation Scheme is 1.4 mi (2.2 km) from the RWF.

  Assessment of collision, allision, and grounding annual frequency was conducted for current traffic conditions ("Base Case") and for traffic conditions after operation of the RWF ("Future

Case"). The NSRA concluded there is a small risk increase, 1.4 incidents per year, from the Base Case to the Future Case. This increase is largely attributable to the potential for allisions with WTGs present and the introduction of extra wind farm pleasure tour transits. This small risk increase in traffic incident frequency represents a ***direct*** and ***indirect,*** and ***long-term*** impact on commercial shipping.

The NSRA (Appendix R) also analyzed the impact of the RWF on visual navigation and potential impacts on collision avoidance. The USCG reported that the largest concern would be the ability of mariners to see through the RWF to the traffic on the other side. Analyses concluded that the RWF would not significantly obscure view of other vessels, ATON, or the coastline. Further, Project structures may serve as information navigation aids for mariners, particularly at night because they will be lit and marked on navigation charts.

Revolution Wind's informal consultation with the Northeast Marine Pilots Association as part of the RWF Project suggests that the Association does not expect the Project to have a significant impact on commercial traffic in the region during O&M. A potential ***direct*** and ***long-term*** impact could occur occasionally when vessels, primarily passenger vessels, would request to deviate from the north-south traffic separation zone and request to transit to the southeast to reach Boston. During O&M of the RWF, the pilotage association would assess requests for determining vessel transit around or through the RWF.

The NSRA also evaluated the impact the RWF could have on normal operations, including anchorage areas. As described in the NSRA, the RWF is expected to have no impact on vessel anchorage operations.

Decommissioning

Decommissioning of the RWF is expected to have similar impacts on commercial shipping as those described for the construction phase. Ultimately, commercial shipping activity in the RWF area is expected to return to pre-Project conditions, subject to evolving marine patterns and traffic levels, when the facility is decommissioned.

RWEC-OCS and RWEC-RI

The RWEC-OCS and RWEC-RI impacts are anticipated to be similar and are included together in the following section.

Table 4.6.6-2b RWEC-OCS/RI Public Services Impact Summary

Resource Area	Commercial Shipping
RWEC-OCS/RI	
Construction and Decommissioning	Direct, Short-term
Operations and Maintenance	Not Anticipated

Construction and decommissioning activities O&M are expected to result in ***direct short-term*** impacts to commercial shipping from traffic, while impacts are ***not anticipated*** from O&M activities. Section 4.1.7 discusses marine vessel and land traffic that could be generated by the Project.

Construction

- **Traffic:** Traffic-related impacts on commercial shipping during construction of the RWEC are expected to be similar to those described for the RWF construction phase. Given the Project location relative to major commercial shipping lanes (not including commercial fishing), no significant disruption of the normal traffic patterns during the construction of the RWEC is expected. The number of vessels that will operate during the RWF construction phase is expected to result in a ***direct*** and ***short-term*** impact and risk addition to normal traffic patterns. .

  In addition, based on informal consultation with the Northeast Marine Pilots Association as part of the evaluation of the RWF Project, no impacts or issues on navigation are anticipated as a result of the RWEC.

Operations and Maintenance

- **Traffic:** Impacts associated with traffic during O&M are expected to be similar to, but less frequent than, those discussed in the construction phase. Due to this reduced frequency, the Project is ***not expected*** to result in an impact to normal traffic patterns.

  The impact of the presence of the RWEC on anchorage areas was evaluated in the NSRA . The RWEC does not cross any anchorage area, the closest such area is the Brenton Point Anchorage Ground. The Project is not expected to have any effect on vessel anchorage operations.

Decommissioning

Decommissioning of the RWEC is expected to have similar impacts on commercial shipping as described for the construction phase. Ultimately, the RWEC is expected to return to pre-Project conditions, with the export cable anticipated to be removed.

4.6.6.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to commercial shipping.

- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations.
- Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation.
- Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.

- Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP (Appendix D).
- Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and DoD command headquarters.
- RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable.
- A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG).
- Revolution Wind will consult with USCG, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts.

4.6.7 Coastal Land Use and Infrastructure

4.6.7.1 Affected Environment

This section characterizes existing coastal land uses and infrastructure within the vicinity of the various Project components based on publicly available land use and zoning data. In general, existing coastal land uses in the primary ROI consist of the developed and undeveloped coastlines of Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Virginia. The coastal areas closest to the Project include Martha’s Vineyard in Massachusetts as well as Block Island and the Narragansett Bay shoreline in Rhode Island.

The affected environment for coastal land use and infrastructure includes the onshore portions of the primary ROI that will support the Project. This specifically includes the onshore segment of the RWEC, Landfall Work Area, Onshore Transmission Cable, OnSS, ICF, and potential construction and O&M facilities and ports, together referred to as the Onshore Facilities. Beyond these Onshore Facilities, there are no existing coastal uses or infrastructure associated with the RWF, including within the Lease Area in which it will be located, or along the offshore RWEC route. Accordingly, the offshore components of the Project are not applicable to or included in this discussion.

Onshore Facilities

The proposed landing site for the RWEC is within the Landfall Envelope that is generally bound by Whitecap Drive to the west and Burlingham Avenue to the east; and Circuit Drive on the north (see Figure 4.6.7-1). The route for the RWEC/Onshore Transmission Cable will generally run north from the MHHW to Circuit Drive, and then follow Circuit Drive in a northerly direction until it reaches Camp Avenue. The proposed route will follow Camp Avenue in a westerly direction before turning north to the OnSS. As shown in Figure 4.6.7-1, an alternative route cuts across an industrial property along Circuit Drive (135 Circuit Drive) prior to the intersection of Circuit Drive and Camp Avenue to reach Camp Avenue. Similar to the proposed route, the alternative route follows Camp Avenue in a westerly direction before turning north to the OnSS.

Based on the Town of North Kingstown's Assessors' Data (2019), the segment of the RWEC from the MHWL to the TJBs, Landfall Work Area, and Onshore Transmission Cable are located within an area that is predominantly industrial but also includes some large business commercial, low-medium residential (including single family and two-family residences), and undeveloped land uses. The property hosting the OnSS and ICF is surrounded by low-medium residential, medium-high density residential, utility (i.e., the existing TNEC Davisville Substation), and undeveloped land uses. Figure 4.6.7-1 depicts land uses in the vicinity of the onshore components of the Project.

Based on the Town of North Kingstown's Zoning Ordinance (2018), zoning at and in the vicinity of the Onshore Facilities includes Quonset Business Park District (QBPD) in areas along Whitecap Drive and Circuit Drive, Village Residential (VR) north of Blue Beach, Institutional/Office (I/O) at a single parcel north of Camp Avenue and south of the existing TNEC Davisville Substation, and Planned Village District (PVD) to the west of the OnSS.

The Study Area is predominately situated within the former Davisville Naval Air Station, which operated at Quonset Business Park between the 1940s and the 1970s. During the Naval occupation, land usage and disposal of contaminates and contaminated material was unregulated by any state or federal laws. Consequently, the Study Area experienced a period of land management that resulted in the discharge of numerous now-known contaminants to the environment.

As part of its due diligence, Revolution Wind performed a Phase I Environmental Site Assessment ("Phase I ESA") in general accordance with the American Society for Testing and Materials ("ASTM") Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process ("ASTM Designation: E1527-13"), All Appropriate Inquiry ("AAI"). The Phase I ESA identified the following sites within the Onshore Study Area as having the potential to contain contaminated materials on or below the ground surface:

- Camp Avenue Dump
- Blue Beach Disposal Area
- Kiefer Park Tank Farm
- Small Arms Range and Burial Area
- Falvey Realty, LLC
- Davisville Substation
- Vantage Properties, LLC
- Goldline Properties, LLC
- Blue Beach Walking Path/ Red Maple Swamp

Most of these sites are controlled by an ELUR, executed with RIDEM and recorded in the municipal Land Evidence Records, which limits public exposure to identified contaminants. Some of the properties have not reached this controlled status due to ongoing monitoring or inability to execute an ELUR with RIDEM. Table 4.6.7 provides a summary of property data obtained during as RIDEM file review conducted as part of the Phase I ESA.

Table 4.6.7 Summary of Contaminated Properties within Onshore Study Area

Property	Property ID	ASTM Regulatory Status	Contaminants of Concerns
Camp Avenue Dump	AP 179 Lots 1 and 30; a portion of AP 179 Lot 5	Controlled Recognized Environmental Condition ("CREC")	Solid waste UXO/MEC Metals polynuclear aromatic hydrocarbons ("PAHs") polychlorinated biphenyls ("PCBs") volatile organic compounds ("VOCs") pesticides
Blue Beach Disposal Area	AP 185/Lot 20 and AP 179/Lot 28 and Lot 25	Recognized Environmental Condition ("REC")	petroleum constituents present as dissolved constituents in the groundwater and as Light Non-Aqueous Phase Liquid ("LNAPL") VOCs Pesticides PCBs metals
Kiefer Park Tank Farm	AP 179, Lot 25 and a portion of the current AP 185, Lot 9	CREC	LNAPL
Small Arms Range and Burial Area	Associated with Keifer Park and the vicinity of Whitecap Drive	REC	UXO/MEC
Falvey Realty, LLC	AP 185, Lot 20	CREC	LNAPL Arsenic benzo(a)pyrene naphthalene lead selenium cadmium
TNEC Davisville Substation	AP 179, Lot 5	REC	PCBs association with the former Camp Avenue Dump Releases of non-PCB MODF
Vantage Properties, LLC	AP 185 Lots 8 and 21	CREC	Potential LNAPL Total Petroleum Hydrocarbons VOCs
Goldline Properties, LLC	AP 179 / Lots 28, 29 AP 179 / Lots 25, 26, 27	CREC	PCBs

Property	Property ID	ASTM Regulatory Status	Contaminants of Concerns
Blue Beach Walking Path/ Red Maple Swamp	AP 179 Lots 22 and 24	CREC	dissolved-phase petroleum compounds VOCs

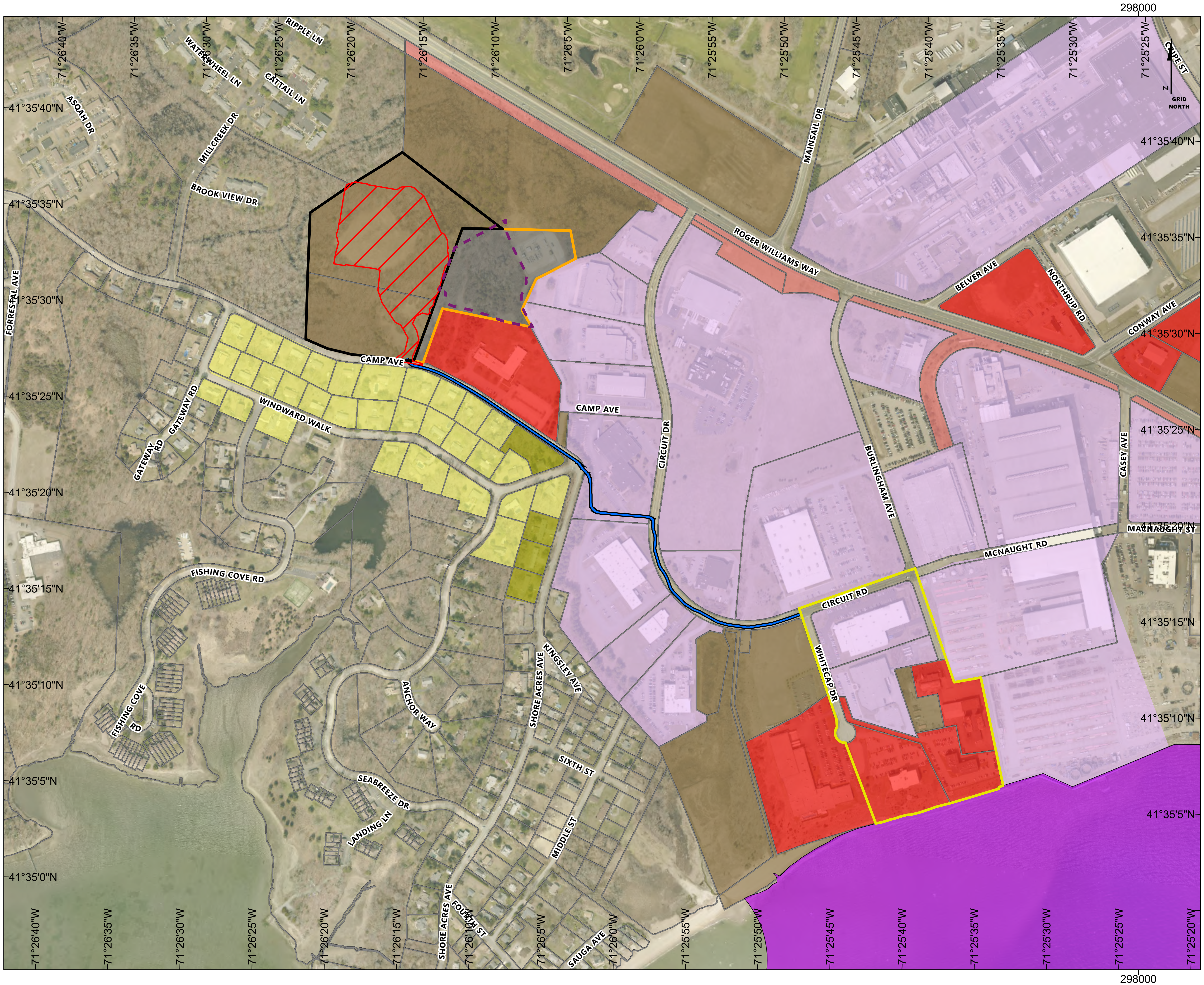


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Figure 4.6.7-1
Existing Land Uses at Davisville Landing Site and along the RWEC – Onshore
NORTH KINGSTOWN, RI

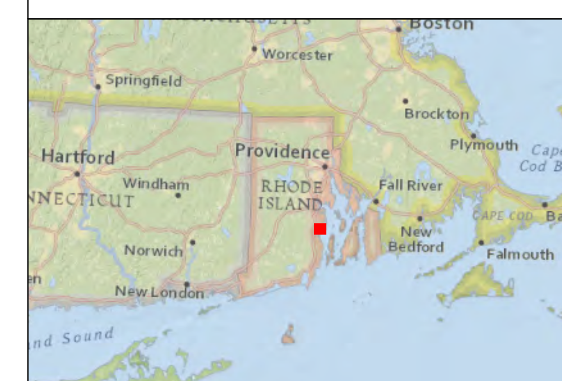
Legend

- Onshore Transmission Cable
- RWEC-RI State Waters Envelope
- Landfall Envelope
- Substation Limit of Work
- ICF Limit of Work
- Parcel 179-030 & 179-001
- Parcel 179-005

Surrounding Land Use

- Industrial
- Commercial
- Residential - Single Family
- Residential - Two Family
- Vacant
- Utility
- Transportation
- Recreation

Service Layer Credits: RIDEM/Tax_Parcels: RI State, 37 Towns
National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
Rhode Island Aerial Photographs (Spring 2018; State Plane):



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 60 120 180 Meters

0 250 500 750 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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Connecticut

Port of New London, New London County, Connecticut

The Port of New London is a container terminal located at the mouth of the Thames River in the City of New London. According to the Plan of Conservation and Development by the New London Planning and Zoning Commission (2017), the land on which the port is situated is zoned for industrial activity. The Port of New London and adjacent property are currently used primarily for the storage and distribution of lumber, steel products, and other neo-bulk products arriving by ship and the nearby freight rail line, and then redistributed by truck (State of Connecticut, 2019).

Additional industrial and light industrial businesses lie adjacent to the Port of New London, such as NorthEast Electrical Distributers and BellSimmons Companies. The port is well-connected to Interstate I-95, the Cross Sound Ferry, and the aforementioned freight rail line. Area surrounding the port primarily consist of residential of various densities and some municipal services, such as the New London Solid Waste Transfer Station.

Massachusetts

New Bedford Marine Commerce Terminal, City of New Bedford, Massachusetts

The New Bedford Marine Commerce Terminal is a 29-ac facility of the New Bedford Port Authority, managed by the Massachusetts Clean Energy Center (MassCEC). Formerly known as New Bedford's South Terminal, Massachusetts developed the facility to support offshore wind projects and other large specialty marine operations, converting the site from an abandoned industrial facility between 2013-2015 (MassCEC, 2020a, b) (Port of New Bedford, 2020a, b, c).

According to the City of New Bedford Zoning Map, the site and surrounding areas are all zoned for various industrial uses. There are areas zoned for mixed and residential uses south of Cove Street and west of John F. Kennedy Memorial Highway. The site is currently occupied by marine logistics infrastructure. Adjacent uses include a variety of industrial and warehousing uses, including several related to seafood, such as North Coast Seafoods immediately to the southwest (City of New Bedford, 2015).

Maryland

Sparrow's Point, Baltimore County, Maryland

Sparrow's Point is a peninsula southeast of Baltimore, Maryland with a long industrial history as the site of a Bethlehem Steel Company steel mill until 2012. The site is currently undergoing an industrial redevelopment, led by a private coalition called Tradepoint Atlantic, across its 3,250 ac. The initial plans call for utilization of transportation assets, including deep water berths and rail and interstate highway access for manufacturing and logistics businesses. The master plan also includes environmental clean-up (Tradepoint Atlantic, 2019).

According to Baltimore County, the entire peninsula is zoned for heavy manufacturing. The peninsula currently contains a mix of abandoned industrial land and new distribution, logistics, and warehousing uses, interspersed with road and rail infrastructure. Specific facilities include a FedEx

Ground facility, an Amazon fulfillment center, and an Under Armour distribution house located along the northern edge of the peninsula, with Interstate 695 located immediately north of those facilities. Adjacent areas are also zoned for heavy manufacturing or business maritime marina uses (Baltimore County, 2019).

New Jersey

Paulsboro Marine Terminal, Paulsboro, New Jersey

The Paulsboro Marine Terminal is located directly across (south of) the Delaware River from Philadelphia International Airport between Mantua Creek to the east, a railroad ROW to the south, and Mantua Avenue and the residential community of Billingsport to the west. The current marine terminal covers 200 ac and has three berths, with a depth of 45 ft, along with two harbor cranes, and 21,000 ft of rail track. The terminal is operated by Holt Logistics, which completed Phase I of a port redevelopment plan in 2017 to convert the area from a petroleum tank farm to an omniport. Phase II is currently underway, in coodination with the South Jersey Port Corporation (SJPC) and Gloucester County Improvement Authority (Holt Logistics, 2019; Gloucester County, 2019a; South Jersey Port Corporation, 2020).

According to Gloucester County, the entire area of the port is zoned for industrial use under the Marine Industiral Business Park (MIBP) designation. West of the Port are residentially-zoned areas, along with one small commercial area in the Billingsport community. These areas include the Billingsport Elementary School and the Billingsport Little League fields. The area south of the Port and south of the railroad ROW is also zoned for commercial and residential uses, including downtown Paulsboro. West of the Port, across Mantua Creek are areas zoned for manufacturing uses in West Deptford (Gloucester County, 2019b).

New York

Port of Brooklyn, Kings County, New York City, New York

The Port of Brooklyn is located along the western shore of the Borough of Brooklyn in New York City, New York. West of the port is the Upper Bay of New York Harbor, and south of the Upper Bay are the Narrows and Lower Bay of New York Harbor. Immediately east, south, and north of the port area are areas of predominately industrial & manufacturing and transportation & utility land uses, with a few isolated areas of other land uses interspersed (e.g., commercial & office buildings, public facilities & institutions, others). Farther east and south of the port are mixed-use and residential neighborhoods (NYC DCP, 2021).

According to the New York City Department of City Planning (DCP), the area and its surroundings are zoned as manufacturing districts and Industrial Business Zones (IBZs). To the south and east area areas zoned for residential uses, with commercial overlays (NYC DCP, 2021).

Port of Montauk, Montauk, New York

The Port of Montauk is located on the western side of the inlet to Lake Montauk, towards the end of the South Fork of Long Island in the Town of East Hampton, New York. North of the port is Long Island Sound, and south and west of the Port are residential neighborhoods. The Port area includes a mixture of small scale commercial and marine establishments, including marinas and parking facilities. These include the Montauk-Block Island ferry dock. Across Lake Montauk is the USCG Station-Montauk.

According to the Town of East Hampton, the area is mostly zoned as a Waterfront District for commercial uses. South and west of the port are residential-zoned areas (Town of East Hampton, 2010, 2016, 2019c). Current land uses in the Port area include commercial, industrial, and transportation uses, with two vacant parcels (Town of East Hampton, 2018).

Port Jefferson, Port Jefferson, New York

Port Jefferson is located on the north side of Long Island, at roughly the midpoint of the island. The port is located at the end of Port Jefferson Harbor and includes a mix of commercial, industrial, and transportation establishments. The Bridgeport-Port Jefferson ferry dock is located in the middle of the port. On the western side of the port are marine and industrial establishments, including Miller Marine Services, Northville Industries, and Port Jefferson Generating Station. There are residential areas west, south, and east of the Port, along with Port Jefferson High School and St. Charles Hospital, south of the Port.

According to Suffolk County, current land uses around the Port include commercial, recreation and open space, and industrial (Suffolk County, 2019). The latest Port Jefferson comprehensive plan included recommendations for the waterfront area and mentioned community concerns over waterfront commercial development and interests in improving connections to the waterfront (Port Jefferson Village, 2014).

Rhode Island

Port of Providence, City of Providence, Rhode Island

The Port of Providence encompasses 115 ac located at the convergence of Narragansett Bay and the Providence River. This port is one of two deep water ports in the New England region, which ships utilize to import products to/from around the world. According to the City of Providence Zoning Ordinance, the Port of Providence's underlying zoning, where Project staging, logistics, and O&M activities will take place, is largely Port/Maritime Industrial Waterfront District (W-3), which seeks to promote maritime industrial and commercial uses within the area of Providence's waterfront, protect the waterfront as a resource for water-dependent industrial uses, and facilitate the renewed use of a vital waterfront (City of Providence, 2014). All uses within a W-3 zoning district must be part of a marine enterprise or dependent on access to the waterfront. Additional uses adjacent to the Port of Providence include Mixed-Use Waterfront District (W-2), Educational Institutional District (I-2), and General Industrial District (M-2) (City of Providence, 2019). The surrounding land uses include mixed-use industrial, light industrial, residential, and some commercial.

Port of Davisville and Quonset Point, Town of North Kingstown, Rhode Island

Quonset Point is a small peninsula in Narragansett Bay in the Town of North Kingstown. It is zoned as the Quonset Business Park District (QBPD), a multimodal business park consisting of marine terminal facilities, an airport, and mixed commercial and industrial uses (Town of North Kingstown, 2018). The QBPD is home to approximately 200 companies and 11,000 employees (Quonset Business Park, 2019). The surrounding land uses around Quonset Point include mixed residential and industrial.

According to the Quonset Business Park Master Land Use Plan (2018), existing subdistricts within the QBPD include:

- The Airport District, which includes the Quonset State Airport and the Providence Jet Center - a military, general aviation, and corporate facility with a 7,500-ft runway and a staffed control tower;
- The Commerce Park, which is home to the Ocean State Job Lot world headquarters and other medium- and small-businesses;
- The Gateway, which is a mixed-use center along the Route 1 commercial corridor;
- Kiefer Park, which is a subdistrict that houses several high tech and light industrial companies such as Hexagon Manufacturing Intelligence, Kennedy Incorporated, and Supfina Machine Company, Inc.;
- Quonset, which is a subdistrict with commercial tenants such as Electric Boat/General Dynamics, Toray Plastics America, and Senesco Marine;
- The Port of Davisville along the Davisville Waterfront, which is one of the top ten auto importers in North America;
- North Davisville, which consists of several development sites ranging from approximately 1.5 to 12.5 ac and dedicated to light industrial uses; and
- West Davisville, which is the westernmost subdistrict of the QBPD and is home to several medium and small businesses and provides opportunities for a wide range of new industrial activities related to office, manufacturing facilities, and warehouse/distribution operations.
- Port of Galilee, Town of Narragansett, Rhode Island

The Port of Galilee is located within Point Judith on Point Judith Pond. Point Judith generally includes the southern portions of the Town of Narragansett on the western side of Narragansett Bay, where it opens out onto the Rhode Island Sound. The Port of Galilee is home to many commercial and charter fishing vessels, sightseeing tours, and ferry service to Block Island in the Town of New Shoreham (Town of Narragansett, 2019b). The primary existing coastal land uses at the Port of Galilee consist of commercial services, commercial fisheries, residential – mostly low-density, single-family homes – and undeveloped forested areas and wetlands that are publicly accessible (Town of Narragansett, 2003).

Virginia

Port of Norfolk, Norfolk, Virginia

Operated by the Virginia Port Authority and Virginia International Terminals, LLC, the Port of Norfolk is located in the northwest corner of Norfolk along the Elizabeth River, just north of the

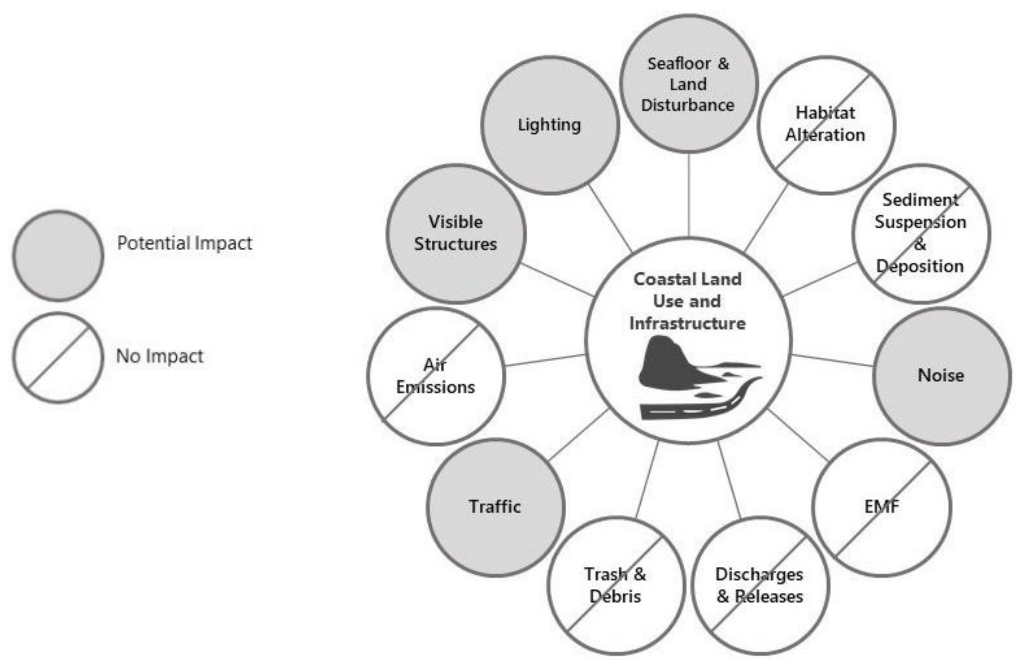
Lafayette River in Hampton Roads, Virginia. The Norfolk International Terminals (NIT) cover 567 ac, of which 378 are used for operations. There are two berths and six ship-to-shore cranes in the North Terminal and four berths and eight ship-to-shore cranes in the South Terminal. The Port has access to Interstates 64 and 564 via Routes 372 and 406, as well as 18,000 linear feet of rail track (Virginia Port Authority, 2019).

According to the City of Norfolk, the entire port area is zoned for industrial use, with military-zoned areas north and east of the port. These areas are currently occupied by the Norfolk Naval Station and associated facilities. There is one small area zoned for residential and commercial uses east of the port on the opposite site of Hampton Boulevard and another area zoned for commercial and residential uses southeast of the port on the opposite side of railroad right-of-way (City of Norfolk, 2019). The Hampton Roads Planning District Commission and Hampton Roads Transportation Planning Organization land use map reflect the same land uses as the zoning, along with parks, open spaces, and greenways also interspersed north and south of the Port (Hampton Roads Planning District Commission and Hampton Roads Transportation Planning Organization, 2011).

4.6.7.2 Potential Impacts

The IPFs associated with the construction, O&M, and decommissioning phases for the RWF and RWEC are defined in Section 4.1 and illustrated on Figure 4.6.7-2.

Figure 4.6.7-2 IPFs on Coastal Land Uses and Infrastructure



Onshore Facilities

Table 4.6.7-1 Onshore Facilities Coastal Land Use and Infrastructure Impact Summary

Resource Area	Coastal Land Use and Infrastructure
Onshore Facilities	
Construction and Decommissioning	Direct, Short- and Long-term
Operations and Maintenance	Direct, Long-term

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts on coastal land use and infrastructure from land disturbance, noise, and traffic. There may be ***direct*** and ***long-term*** impacts from visible structures/lighting during construction. O&M are anticipated to have ***direct*** and ***short-term*** impacts from traffic and visible structures/lighting. Section 4.1.3 discusses noise that could be generated; Section 4.1.7 discusses marine vessel and land traffic that could be generated; and Section 4.1.10 discusses visible structures.

Construction

- **Land Disturbance:** The RWEC – Onshore as well as the Onshore Transmission Cable will be constructed entirely underground and predominately within existing ROWs owned by Quonset Development Corporation (QDC) and the Town of North Kingstown, and other land owned by the QDC. The OnSS will be constructed on leased public land (QDC), on a combination of parcels that are primarily wooded and contain the existing TNEC Davisville Substation in the Town of North Kingstown's QBP district. The ICF will be constructed on an adjacent parcel owned by TNEC. Construction-related land disturbance to uses within, adjacent, or proximate to the Onshore Facilities is expected to be ***direct*** and ***short-term***. As noted in Section 3.3.2.2, construction of the Onshore Facilities would take up to 18 months.
- **Noise:** Impacts coastal land use and infrastructure from noise will be ***direct*** and ***short-term***, generally resulting from traffic or construction equipment. Construction noise will be limited to the construction areas at the Landfall Work Area along the RWEC–Onshore and the Onshore Transmission and Cable routes, and near the OnSS and ICF construction sites. As noted in the *Onshore Acoustic Assessment*, construction noise levels are expected to meet all applicable construction noise federal, state, and local noise policy, guideline, and ordinance criteria (Appendix P2).
- **Traffic:** Impacts to local roadways and public pathways are anticipated to be ***direct*** and ***short-term*** during construction of the Onshore Facilities. It is expected that there would be temporary increases in truck and construction equipment traffic on area roadways during construction and decommissioning phases. Periodic traffic restrictions will be in place for public and Project worker safety reasons but impacts on traffic are not expected to be permanent and result in changes to roadways.
- **Visible Structures / Lighting:** As indicated by the *Visual Impact Assessment and Historic Resources Visual Effects Analysis (*Appendix U1*)*, the physical presence of the OnSS and ICF would

result in ***direct*** and ***long-term*** impacts from the new infrastructure introduced to the area. The new OnSS and ICF replaces a primarily wooded area; however, the addition of the OnSS and ICF is consistent with surrounding land uses and would not constitute an incongruous alteration in local land use patterns. As a result, construction of the OnSS and ICF is not anticipated to result in significant changes to the existing visual character or scenic quality of the area.

There may be ***direct*** and ***short-term*** impacts from lighting on coastal land use and infrastructure during construction and decommissioning, depending on the duration and timing of these activities at the Landfall Work Area along the RWEC – Onshore and the Onshore Transmission Cable routes, and near the OnSS and ICF.

Operations and Maintenance

- **Land Disturbance:** O&M of the Onshore Transmission Cable would alter land cover (i.e., physical surface), but would not alter established land uses, as the cables will be located entirely underground and no ongoing land disturbance is expected. The Onshore Transmission Cable will not impact present or future planned uses.

  O&M of the OnSS and ICF will be consistent with the existing land use at the adjacent, existing TNEC Davisville Substation and is ***not expected*** to have impacts on current land uses.

- **Noise:** Because there is no permanent noise-generating equipment associated with the Onshore Transmission Cable, operational noise of the underground cables is expected have no impacts to current land uses. The OnSS and ICF, as designed, will generate sound similar to or below existing ambient sound levels; therefore, operational noise levels are expected to be ***direct*** and ***long-term***.
- **Traffic:** During Onshore Facilities O&M, ***direct*** and ***long-term*** impacts to the local transportation system would result when maintenance is required, and the underground cable must be exposed. However, once inspection or maintenance is completed, no impacts to infrastructure would be expected.
- **Visible Structures / Lighting:** The visible presence of the OnSS and ICF is expected to have ***direct*** and ***long-term*** impacts to current land uses within, adjacent, or proximate to the existing TNEC Davisville Substation. However, the only visible structure associated with Onshore Facilities will be the OnSS and ICF, and the presence of the OnSS and ICF will not alter surrounding land uses but will add to the existing TNEC Davisville Substation and utility uses of the immediate area (Appendix U1).

Decommissioning

Potential impacts to coastal land use and infrastructure during decommissioning of the RWEC would be similar to those described for construction activities.

4.6.7.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce potential impacts to coastal land use and infrastructure.

- Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable.
- Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.
- An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.

4.6.8 Other Marine Uses

4.6.8.1 Affected Environment

This section describes the other marine uses, including military (United States Navy), in the general vicinity of the RWF and offshore segments of the RWEC not previously described in Section 4.6.4; Section 4.6.5; and Section 4.6.6.

The location of the RI-MA WEA was selected based on extensive pre-screening conducted by BOEM. One of the primary objectives of the pre-screening was to minimize conflicts with other marine uses. The screening utilized the wide array of data sources and marine spatial planning completed by both state governments and BOEM, including the OSAMP and the Massachusetts Ocean Management Plan. In addition, BOEM conducted extensive stakeholder outreach and public meetings to further define potential conflicts with other marine uses.

Military uses (United States Navy and other services, including Homeland Security [USCG]) span the RWF, RWEC-RI, and RWEC-OCS. Such uses exist largely because of the proximity to Naval Station Newport, Newport Naval Undersea Warfare Center (Rhode Island), Naval Submarine Base New London, and USCG Academy (City of New London) (BOEM, 2013; RI CRMC, 2010). The United States Atlantic Fleet conducts training and testing exercises in the Narraganset Bay OPAREA, as the Newport Naval Undersea Warfare Center routinely performs testing in the area (BOEM, 2013).

Other marine uses as presented in this section are defined below. Where present, these uses are shown on Figure 4.6.8-1.

Aids to Navigation

ATONs are structures intended to assist a navigator in determining position or safe course, or to warn of dangers or obstructions to navigation. This data set includes lights, signals, buoys, day beacons, and other ATONs.

Alternative Energy Facilities

Alternative energy facilities are projects or lease areas that support or are expected to support the production and transmission of alternative energy. The Block Island Wind Farm, a 30-MW offshore wind farm located approximately 3 mi (5 km) southeast of Block Island, is the only active alternative energy facility in the region. The RI-MA WEA also includes an area covering the proposed South Fork Wind Farm (SFWF) – a project with up to 15 wind turbine generators with a nameplate capacity of 6 to 12 MW per turbine.

Anchorage Areas

An anchorage area is a location at sea where vessels can lower their anchors and moor the vessel. The locations usually have conditions for safe anchorage, providing protection from poor weather conditions and other hazards. They can also be used as a mooring area for vessels waiting to enter a port or for the short-term staging area for barges containing construction materials.

Artificial Reefs

The artificial reefs within the region are generally created from obsolete materials, such as small steel boats and other marine vessels, surplus armored vehicles, tires, and concrete pipes, and are used to provide critical habitat for numerous species of fish in areas devoid of hard-bottom (BOEM, 2013).

Refuges, Rookeries and Sanctuaries

Wildlife refuges are typically a contiguous area of land and water managed by the USFWS for the conservation and, where appropriate, restoration of fish, wildlife and plant resources and their habitats for the benefit of present and future generations of Americans. Rookeries are groups or colonies of birds that nest together. National marine sanctuaries are protected areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational or esthetic qualities. There were no refuges, rookeries, or sanctuaries identified within the Project Area (USFWS, 2020; RIDEM, 2020; NOAA 2020). Harbor seals are regularly observed around coastal areas throughout Rhode Island. While there are no known pupping grounds in this area, six haul-out sites have been identified in Narragansett Bay. They are most commonly observed at the Dumplings off Jamestown at Rome Point in North Kingstown, Rhode Island (Kenney and Vigness-Raposa, 2010). Nearly all the haul-outs within Narragansett Bay are rocky ledges or isolated rocks with the exception of Spar Island, which is a man-made dredge spoil (Kenney and Vigness-Raposa, 2010). Haul-out sites are discussed further in Section 4.3.4 and in Appendix Z.

The Narragansett Bay National Estuarine Research Reserve (NBNERR) is one of 29 National Estuarine Research Reserves located around the country. The National Estuarine Research Reserves were established to provide long-term protection of coastal lands and serve as platforms for research, education and recreation. The NBNERR is supported and administered by the National Oceanic and Atmospheric Administration and managed by the RIDEM. The NBNERR protects and manages approximately 4,400 acres of land and water including Prudence, Patience, Hope and Dyer Islands.

Habitats within the Reserve include salt marsh, eelgrass beds, rocky intertidal zone, pine barren, deciduous forest and coastal meadow. The NBNERR is not within the Project Area.

Passenger Ferry Routes

Passenger ferries are commercial vessels used to carry passengers and their property from one shoreline to another. Such services in the region connect a variety of mainland (e.g., Newport, Point Judith) and island destinations (e.g., Block Island and Martha's Vineyard) within and adjacent to this area.

High-Frequency Radar Locations

Preliminary modeling results and studies from Europe incorporating typical offshore wind farm configurations have indicated that wind turbines may have a negative impact on HF radar systems. Presently, however, there are no proposed metrics to develop specific mitigation measures to address HF radar interference.

There are three civilian-operated HF radar stations in the region. These HF radar stations are shown on Figure 4.6.8-1 and include:

› HF radar on Block Island (two radars operated by University of Rhode Island and Rutgers University);

› HF radar on Martha's Vineyard (operated by Rutgers University); and,

› HF radar on Nantucket Island, Massachusetts (operated by Rutgers University).

Ocean Disposal Sites

As shown in Figure 4.6.8-1, there are several ocean disposal sites in the region, which the EPA designates and manages under the Marine Protection, Research and Sanctuaries Act (MPRSA). Most of these designated sites are for the disposal if dredged materials.

Non-energy Mineral Exploration

No existing or proposed offshore oil and gas platforms or marine aggregate mining has been identified in the region.

Offshore Scientific Assessments

Government managed fisheries surveys, both state and federal, occur within the region at varying times of year. As an example, through the Ecosystems Surveys Branch, NOAA Fisheries collects fishery-independent data using standardized research vessel surveys from Cape Hatteras to the Scotian shelf. The data is used for assessment, management, and a wide variety of research programs (NOAA Fisheries 2018). NOAA Fisheries' seasonal survey locations vary and are randomly selected, stratified by depth. Due to the depths and acreage in the region, there is a likelihood of sample survey locations being placed within the RWF and waters along the RWEC. It is likely that other surveys conducted by academic institutions and non-governmental organizations occur within the region.

Pilot Boarding Areas

Pilot boarding areas are locations at sea where pilots who are familiar with local waters board incoming vessels to navigate their passage to a destination port. Pilotage is required by law for foreign vessels and United States vessels under register in foreign trade with specific draft characteristics. Pilot boarding areas are represented by a 0.5-nautical-mi (0.9-km) radius around a coordinate point unless the coast pilot specifically designates a different radius or boarding area boundary.

Submarine Cables and Cable Areas

There are existing submarine cables (i.e., electrical cables – communications or power - laid on the seafloor) that run through the regional waters. Most of which passthrough Green Hill, Rhode Island. In addition, there are NOAA nautical chart cable and pipeline areas that denote where such infrastructure may be located. The existence of these areas does not necessarily mean that actual cables or pipeline are present (BOEM, 2013).

Unexploded Ordnance and Munitions and Explosives of Concern

UXO/MEC is explosive weapons (e.g., bombs, bullets, shells, grenades, mines, torpedoes) that did not explode when they were deployed and still pose a risk of detonation. As noted, the United States Atlantic Fleet conducts training and testing exercises in the Narraganset Bay OPAREA, which includes Rhode Island and Block Island Sounds. In the past, the United States Navy established testing ranges for torpedo, depth charge, and mine testing in these waters. Today, UXO is a historically significant component of the seafloor landscape of these sounds.

Munitions and Explosives of Concern (MEC) and Unexploded Ordnance (UXO) Risk Assessment with Risk Mitigation Strategy (Appendix G) classifies the Project into three zones based on the likelihood of encountering UXO/MEC: Zone 1 – Export Cable corridor within the nearshore from the landfall to just after the Jamestown Bridge, and an offshore section of the Export Cable; Zone 2 - an area and buffer zone where the Export Cable corridor enters the firing fans of one or more of the small forts, and there is a hazard of US sea mines from a historic mine lay and a 5 km zone around an unexploded ordinance dump within the RWF; and Zone 3 - offshore Export Cable between Zone 1 above and the RWF (Ordtek, 2020). A Risk Assessment was performed based information gathered about potential UXO/MEC and a review of historic data related to military activity in the Project vicinity.

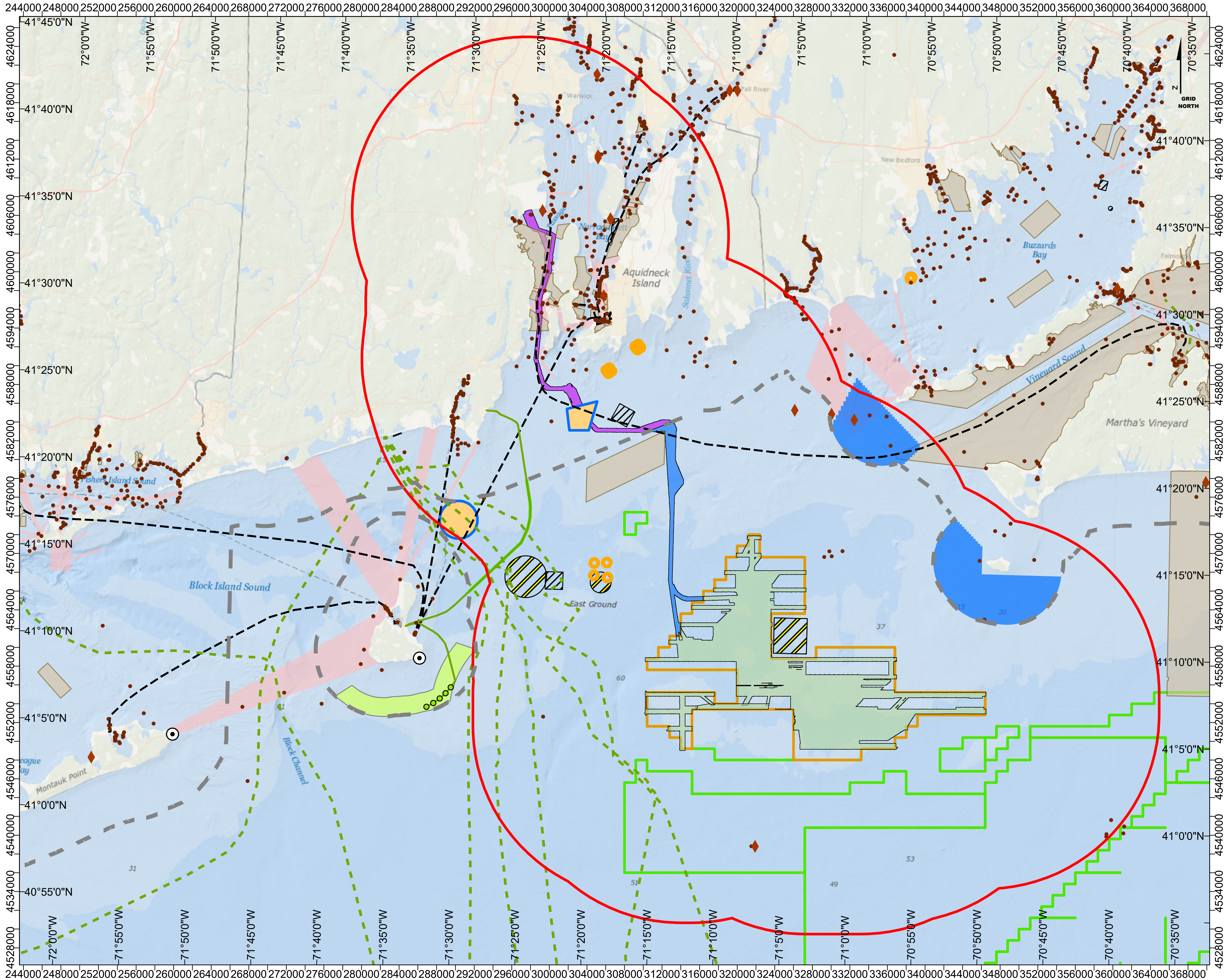
The results of this risk assessment show that the MEC risk levels within the Study Area mostly vary from ‘Low’ to ‘Low-Moderate’, depending on the Project activity being undertaken. However, the risk level rises to ‘Moderate’ or even to ‘Moderate-High’ when some larger net explosive quantity items are considered.

Ordtek recommended a Mitigation Strategy based on the requirement to lower risk as necessary for both human safety and environmental protection in conformance with both the Health & Safety

Executive and “as low as reasonably practicable” (ALARP) principle. The MEC risk can be reduced to the ALARP threshold by implementing the MEC Risk Mitigation Strategy, namely undertaking acoustic survey across the Site with enhanced high-resolution magnetometer surveys in noted high hazard areas (Zone 2).

Revolution Wind

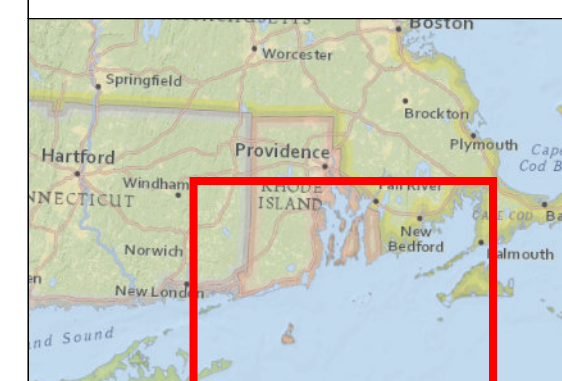
Figure 4.6.8-1
Other Marine Uses



Legend

- RWF Boundary Lease Area OCS-A 0486
- Offshore Envelope
  - RWF Envelope
  - RWEC-OCS Envelope
  - RWEC-RI State Waters Envelope
- 10-Mile Project Facility Buffer
- Other Lease Areas
- 3-Nautical Mile State Water Boundary
- Submarine Cable
- Block Island Transmission Cables
- RI Ferry Route
- Block Island Wind Farm Turbine
- High Frequency Radar
- Bouy Location
- Aid To Navigation
- Artifical Reef
- Block Island Renewable Energy Zone
- MA Wind Energy Areas
- Anchorage Areas
- Ocean Disposal Sites
- Unexploded Ordnance Areas
- Pilot Boarding Areas
- Cable Area

Service Layer Credits: World Ocean Reference: NOAA OCS, Esri, DeLorme National Geographic World Map: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
World_Ocean_Base: Esri, DeLorme, NaturalVue



Reference system: NAD83 (2011)
Projection: UTM Zone 19N

0 4000 8000 12000 Meters

0 16,030 32,060 48,090 Feet

Date: 05/19/2020
Document no:

Created by: S. PELLETIER
Checked by: S. MOBERG
Approved by: STEPW

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The following sections identify the presence of the above discussed other marine uses within the RWF, RWEC-RI, and RWEC-OCS. Several databases were researched to identify these uses, including NOAA nautical charts for the region and GIS websites published by the Northeast Ocean Data Portal Collaborative (Northeast Regional Ocean Council, 2019) and the Mid-Atlantic Regional Council on the Ocean (MARCO, 2019).

RWF

There are no other marine uses, as identified above, within the RWF.

RWEC-OCS

Table 4.6.8-1 lists other marine uses that intersect or are otherwise near (i.e., within 10 mi) the Project within the RWEC-OCS. These uses are depicted in Figure 4.6.8-1**.** Though not listed or shown, similar uses may be present in the vicinity of the ports of origin or otherwise between these sites and the RWEC-OCS (see Table 4.6-1). Unless otherwise discussed under Section 4.6.8.2, the level of impact to these uses is anticipated to be less given the extent of activities emanating from the ports.

Table 4.6.8-1 Other Marine Uses Within 10 Miles of the Project, RWEC-OCS

Marine Use Type	Specific Details	Closest Approx. Distance and Direction from the RWF	Closest Approx. Distance and Direction from the RWEC
ATONs	WHOI Lighted Buoy V	1.3 mi northeast	9.6 mi east
	WHOI Lighted Buoy W	2.0 mi northeast	Outside 10 mi buffer
	WHOI Lighted Buoy X	1.6 mi northeast	Outside 10 mi buffer
	WHOI Lighted Buoy Z	2.5 mi northeast	Outside 10 mi buffer
	Narragansett-Buzzards Bay Approach Lighted Whistle Buoy A	6.8 mi southwest	Outside 10 mi buffer
	USACE Block Island Lighted Research Buoy 154	6.7 mi south	Outside 10 mi buffer
Alternative Energy Facilities	Commercial Lease OCS-A 0487	1.5 mi south	9.3 mi southeast
	Commercial Lease OCS-A 0500	1.0 mi southeast	Outside 10 mi buffer
Anchorage Areas	Brenton Point Anchorage Area is located within Rhode Island Sound	7.2 mi northwest	Intersects export cable route 10.8 mi from start of route at RWF
Artificial Reefs	Four sites near East Ground	5.4 mi northwest	3.7 mi southwest
Passenger Ferry Routes	Interstate Navigation: Point Judith - Block Island (Year-Round)	Outside 10 mi buffer	14.1 mi southwest
	Interstate Navigation: Newport - Block Island (Seasonal)	Outside 10 mi buffer	8.0 mi from land point of export cable route

Marine Use Type	Specific Details	Closest Approx. Distance and Direction from the RWF	Closest Approx. Distance and Direction from the RWEC
	Rhode Island Fast Ferry: Quonset - Martha's Vineyard (Seasonal)	5.5 mi north	23.8 mi from land point of export cable route
Ocean Disposal Areas	Rhode Island Sound Disposal Site (Use Status - "Available")	7.1 mi northwest	6.6 mi southwest
Submarine Cables and Cable Areas	Seven cables (three active and four inactive); Two sites (one cable, one pipeline) within the West Passage in Narragansett Bay	2.3 mi west	Cables: 6.3 mi west
			Cable Areas: Intersects export cable route 14 mi from start of route at RWF
UXO[1]	Eight sites in OCS waters	0.2 mi east	1.2 mi east

1 UXO occurrence reported herein is based upon NOAA navigational chart information. Additional data is presented in *Munitions and Explosives of Concern (MEC) and Unexploded Ordnance (UXO) Risk Assessment with Risk Mitigation Strategy* (Ordtek, 2020) (Appendix G).

RWEC-RI

Table 4.6.8-2 lists the other marine uses that intersect or are otherwise near (i.e., within 10 mi) the Project within the RWEC-RI. These uses are depicted in Figure 4.6.8-1. Though not listed or shown, similar uses may be present in the vicinity of the ports of origin or otherwise between these sites and the RWEC-RI (see Table 4.6-1). Unless otherwise discussed under Section 4.6.8.2, the level of impact to these uses is anticipated to be less given the extent of activities emanating from the ports.

Table 4.6.8-2 Other Marine Uses Within 10 Mi of the Project, RWEC-RI

Marine Use Type	Specific Details	Closest Approx. Distance and Direction from the RWF	Closest Approx. Distance and Direction from the RWEC
ATONs	Misc. sites at the mouth of and within Narraganset Bay and the Sakonnet River	Outside 10 mi buffer	0.1 mi at closest point
Alternative Energy Facilities	Martha's Vineyard Wind Energy Area	4.6 mi northeast	Outside 10 mi buffer
	Gosnold Wind Energy Area	7.4 mi northeast	Outside 10 mi buffer
Anchorage Areas	Anchorage E Anchorage Area	8.9 mi northeast	Outside 10 mi buffer
	Misc. sites within Narraganset Bay[1]	Outside 10 mi buffer	0.05 mi at closest point
Artificial Reefs	Two reefs (Sheep Point and Gooseberry Island) near Newport Neck	Outside 10 mi buffer	2.5 mi northeast

Marine Use Type	Specific Details	Closest Approx. Distance and Direction from the RWF	Closest Approx. Distance and Direction from the RWEC
Passenger Ferry Routes	Interstate Navigation: Point Judith - Block Island (Year-Round)	Outside 10 mi buffer	6.3 mi southwest
	Interstate Navigation: Newport - Block Island (Seasonal)	Outside 10 mi buffer	12.8 mi from land point of export cable route
	Interstate Navigation: Fall River - Newport - Block Island (Seasonal)	Outside 10 mi buffer	3.2 mi east
	Rhode Island Fast Ferry: Quonset - Martha's Vineyard (Seasonal)	5.5 mi north	2.5 mi from land point of export cable route
Ocean Disposal Areas	Disposal Area (Use Status – "Unknown")	Outside 10 mi buffer	0.2 mi north
Pilot Boarding Areas	Brenton Reef Pilot Station[2]	Outside 10 mi buffer	Intersects export cable route 14.4 mi from start of route at RWF
Submarine Cables and Cable Areas	Seven cables (three active and four inactive); Two sites (one cable, one pipeline) within the West Passage in Narragansett Bay	2.3 mi west	Cables: 7.9 mi west
			Cable Areas: Intersects export cable route 6.3 mi from start of route at RWF
UXO[3]	One site within Rhode Island State Waters	0.2 mi east	0.3 mi east

1 The West Passage of Narragansett Bay contains seven Federally-designated anchorages (H, I, J, K, L, M, N) codified at 33 CFR 110.145. These are general-purpose anchorages with no special regulations or restrictions, open to all vessels. These anchorages were last revised in 1967, and are generally considered well under-utilized, especially since the U.S. Navy's warship fleet departed Newport permanently in the late 1980s or early 1990s. Over the past several years the only notable use of these anchorages has been by vessels associated with the wind farm industry, usually vessels seeking shelter from storms (personal communication with USCG Sector Southeastern New England, April 2020).

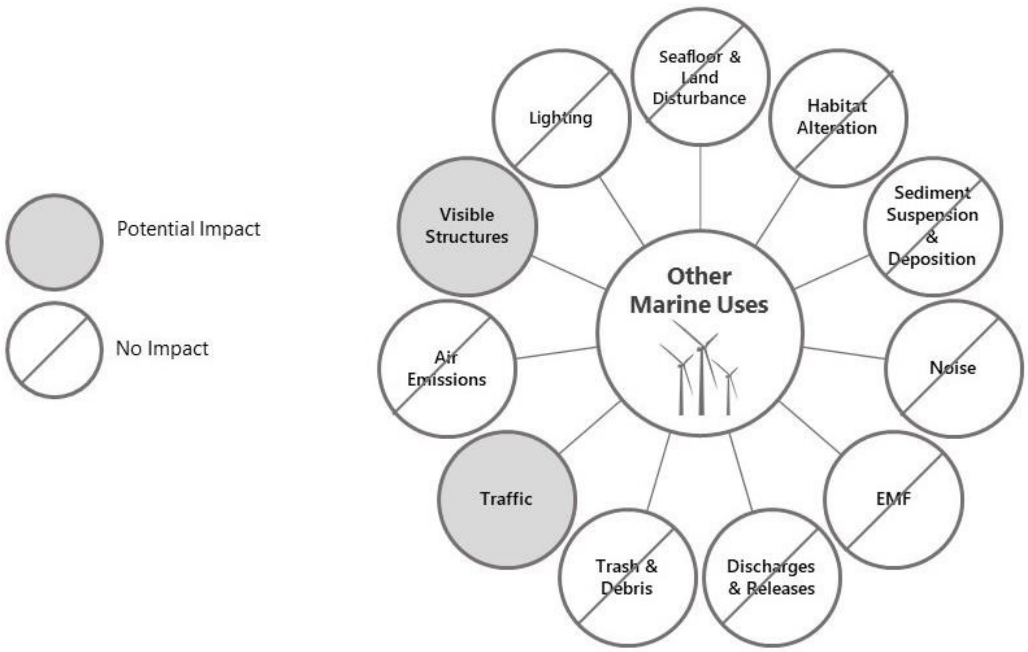
2 Within the past two decades there are no documented cases of any vessel anchoring in the pilot boarding area, nor is there a recollection among the USCG or the Northeast Marine Pilots of any vessels anchoring there (personal communication with Capt. P. Costabile, April 2020).

3 UXO occurrence reported herein is based upon NOAA navigational chart information. Additional data is presented in Munitions *and Explosives of Concern (MEC) and Unexploded Ordnance (UXO) Risk Assessment with Risk Mitigation Strategy* (Ordtek, 2020) (Appendix G).

4.6.8.2 Potential Impacts

Project-related IPFs that could potentially result in impacts to other marine uses during the construction, O&M, and decommissioning phases of the RWF and RWEC are described in this section. Impacts to other marine industries and activities are addressed in Section 4.6.4 and Section 4.6.6. The IPFs that are discussed in this section that may impact other marine uses are traffic and visible structures. For the Onshore Facilities, there are no other marine use conflicts because there were no other marine uses identified that have not already been addressed in other sections (i.e., Section 4.6.4, and Section 4.6.7). A summary of IPFs and the potential impacts to other marine uses associated with the RWF and RWEC is presented on Figure 4.6.8-2.

Figure 4.6.8-2 IPFs on Other Marine Uses



Revolution Wind Farm

The RWF, RWEC-OCS, and RWEC-RI impacts are anticipated to be similar and are included together in the following table.

Table 4.6.8-3 RWF/RWEC-OCS/RWEC-RI Other Marine Uses Impact Summary

Resource Area	Other Marine Uses
RWF/RWEC-OCS/RWEC/RI	
Construction and Decommissioning	Direct, Short-term
Operations and Maintenance	Direct, Long-term

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to other marine uses from traffic. There is the potential for ***direct*** and ***long-term*** impacts from O&M on other marine uses from traffic and visible structures. Section 4.1.7 discusses marine vessel and land traffic that could be generated, and Section 4.1.10 discusses visible structures.

Construction

- **Traffic:** Project-related vessel traffic impacts on commercial shipping was discussed in Section 4.6.6. Anticipated impacts to other marine uses, such as passenger ferry service or military operations, from RWF construction vessel traffic are anticipated to be ***direct*** and ***short-term*** impacts. For instance, depending on the ports of origin (see Table 4.6-1) and destination, time of year, and time of day, RWF vessel traffic may cross and/or impact passenger ferry service routes such as the Point Judith - Block Island Ferry and the Cape May – Lewes Ferry at the entrance to the Delaware Bay. Although RWF marine vessels and passenger ferry routes may overlap during all Project phases, potential impacts to passenger ferries are anticipated to be the highest during the construction phase because Project-related vessel traffic will be the greatest during this period. Timely communication and notices will be issued to mariners informing them of construction activities and areas designated as off-limits.

Operations and Maintenance

- **Traffic:** Impacts to other marine uses from vessel traffic are expected to be ***direct*** and ***long-term***. However, minimal vessel traffic is anticipated during the RWF O&M phase.
- **Visible Structures:** No other marine uses are identified within the RWF. However, the WTGs and OSS visible structures are expected to have a ***direct, long-term*** impact because there would be some displacement of other marine uses in the areas around the RWF.

  The presence of the WTGs for the duration of the O&M phase may interfere with the operation of the three HF radar stations in the region. Given there is now operational offshore wind turbines at the BIWF, BOEM has completed a study through the Office of Renewable Energy Programs Environmental Studies Program that assessed the impact of offshore wind farms to the U.S. HF Radar Network (BOEM, 2018b). The key findings of the BOEM study are that offshore wind turbines interfere with the operation of HF radars; interference can be simulated; and mitigation techniques range from insufficient to effective. The study determined that effective wind turbine interference mitigation techniques utilize wind turbine rotation rate estimates to remove Doppler spectrum signals. However, the study also indicated that further research and study are needed to advance the proposed mitigation approaches to operational status. Lessons learned from this program will be applied to the RWF.

Decommissioning

Potential impacts to other marine uses during decommissioning of the RWF would be similar to those described above for construction activities assuming that RWF Project components are removed using similar vessels, equipment, and methods. After decommissioning of the RWF, the lighting would be removed.

RWEC-OCS

Construction and decommissioning activities and O&M impacts for the RWEC-OCS are anticipated to be similar or less than impacts from the RWF.

Construction

- **Traffic:** Construction vessel traffic for the RWEC-OCS could result in similar impacts to passenger ferry service and military operations as described under the RWF. The RWEC-OCS crosses the Brenton Reef Pilot Boarding Area and could impact local pilot boarding and navigation of vessels. Coordination with the Northeast Marine Pilots Association will be required during construction to preserve the function and safety of these operations.

Operations and Maintenance

No impacts are expected during O&M unless there is a failure or malfunction of the RWEC-OCS requiring exposure and repair of the cable. In this nonroutine, infrequent situation, any potential impacts (e.g., related to lighting, visible structures, traffic) to other marine uses would be expected to be ***direct*** and ***short-term***.

- **Traffic:** Impacts associated with traffic during O&M are expected to be similar to, but less frequent than, those discussed in the construction phase.

Decommissioning

Potential impacts to other marine uses during decommissioning of the RWEC-OCS would be similar to those described above for construction activities in the event the RWEC-OCS is removed by similar vessels, equipment, and methods.

RWEC-RI

Construction and decommissioning activities and O&M may result in ***direct*** and ***short-term*** impacts to other marine uses from visible structures. Section 4.1.10 discusses visible structures.

Construction

- **Traffic:** Construction vessel traffic for the RWEC-RI could result in similar impacts to passenger ferry service and military operations as described under the RWF and RWEC-OCS. Installation of the RWEC by either a mechanical cutter, mechanical plow (which may include a jetting system), and/or jet plow will cross seven existing submarine cable areas. These cable areas are within the Narragansett Bay and, as previously noted, the existence of these areas does not necessarily mean that actual cables or pipeline are present (BOEM, 2013).
- **Visible Structures:** Crossing of existing and operational cables poses the risk of damage to these existing facilities during RWEC installation. However, Revolution Wind will coordinate with cable owners to identify methods to cross cables in agreement with the cable owners that will mitigate risk of damage. Once installed, the RWEC will not be visible or interfere with the operation of the existing, functioning cables because of the shielded construction of the RWEC cable itself. Therefore, ***direct*** and ***short-term*** impacts to existing submarine cables are anticipated.

Operations and Maintenance

No impacts are expected during O&M unless there is a failure or malfunction of the RWEC-RI requiring exposure and repair of the cable. In this nonroutine, infrequent situation, any potential impacts (e.g., related to lighting, visible structures, traffic) to other marine uses would be expected to be ***direct*** and ***short-term***.

- **Traffic:** Impacts associated with traffic during O&M are expected to be similar to, but less frequent than, those discussed in the construction phase.
- **Visible Structures: *Direct*** and ***short-term*** impacts are expected during the O&M of the RWEC-RI to the existing submarine cables at the points of crossing. Any RWEC repairs near the crossings will need to be conducted in agreement with existing submarine cable owners.

Decommissioning

Potential impacts to other marine uses during decommissioning of the RWEC-OCS would be similar to those described above for construction activities in the event the RWEC-OCS is removed by similar vessels, equipment, and methods.

4.6.8.3 Proposed Environmental Protection Measures

Similar to the environmental protection measures discussed in Section 4.6.4; Section 4.6.5; and Section 4.6.6, Revolution Wind will minimize conflicts with the other marine uses described in this section.

- Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations.
- Revolution Wind will consult with USCG, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts.
- Each WTG will be marked and lit with both USCG and approved aviation lighting. An Automatic Identification System will be installed at the RWF marking the corners of the wind farm to assist in safe navigation

4.6.9 Environmental Justice

Executive Order (EO) 12898 requires that federal agencies take steps to identify and address disproportionately high and adverse health or environmental impacts of federal actions on minority and low-income populations as well as populations who principally rely on fish or wildlife for subsistence. In response to EO 12898, the Council on Environmental Quality (CEQ) developed guidelines to assist federal agencies in remaining in compliance with Environmental Justice during the NEPA process. The guidelines include six principles, which should be utilized when conducting an Environmental Justice analysis (EPA, 2016).

- Consider the composition of the affected area to determine whether low-income, minority or tribal populations are present and whether there may be disproportionately high and adverse human health or environmental effects on these populations;
- Consider relevant public health and industry data concerning the potential for multiple exposures or cumulative exposure to human health or environmental hazards in the affected population, as well as historical patterns of exposure to environmental hazards;
- Recognize the interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed action;
- Develop effective public participation strategies;
- Assure meaningful community representation in the process, beginning at the earliest possible time; and
- Seek tribal representation in the process.

According to the CEQ environmental justice guidance under NEPA (CEQ, 1997), minorities are those groups that include American Indian or Alaskan Native; Asian or Pacific Island; Black, not of Hispanic origin; or Hispanic. Minority populations are defined where either (a) the population of the impacted area exceeds 50 percent or (b) the population of the impacted area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ, 1997). Low-income populations are defined using annual statistical poverty thresholds from the U.S. Census Bureau (CEQ, 1997).

The Rhode Island Department of Environmental Management *Policy for Considering Environmental Justice in the Review of Investigation and Remediation of Contaminated Properties* provides for the proactive consideration of environmental justice relative to site investigations and property site remediation projects to enable all communities to have meaningful input in environmental decision-making regardless of race, income, national origin or English language proficiency (RIDEM, 2009). As part of this policy, RIDEM is to map the locations of communities of concern, or Environmental Justice Focus Areas, which provide the basis for minimum notice requirements for the investigation and clean-up of contaminated sites; the policy notes that supplemental outreach may be necessary to provide for meaningful community participation. The other states in the ROI and expanded ROI also have specific environmental justice polices and/or offices.

4.6.9.1 Affected Environment

This section presents the demographic analysis used to determine the presence or absence of minority and low-income populations in the communities within the primary ROI (Table 4.6.9-1). To do so, the communities are compared to their corresponding counties for the purposes of the geographic analysis. It presents this information for the RWF, the RWEC, and Onshore Facilities collectively, as the primary ROI represents a broad area inclusive of all Project components.

The following communities, as presented in Table 4.6.9-1, have the potential for environmental justice populations. This was determined based on them either exceeding 50 percent or being significantly higher than their corresponding county of comparison for this analysis.

- Fifty-five percent of the population of the City of New London are minorities, significantly higher than the 24 percent and 32 percent minority populations of New London County and Connecticut, respectively.
- Twenty-eight percent of the population of the City of New London have incomes below the poverty level, significantly higher than that of New London County (10 percent) and Connecticut as a whole (10 percent).
- Thirty-Seven percent of the population of the New Bedford are minorities, significantly higher than the 17 percent and 27 percent minority populations of Bristol County and Massachusetts, respectively.
- Twenty-three percent of the population of New Bedford have incomes below the poverty level, significantly higher than that of Bristol County (12 percent) and Massachusetts as a whole (11 percent).
- Twenty-eight percent of the population of Paulsboro have incomes below the poverty level, significantly higher than that of Gloucester County (8 percent) and New Jersey as a whole (11 percent).
- Sixty-four percent of the population of Kings County (Brooklyn) and 68 percent of New York City are minorities.
- Sixty-six percent of the population of the City of Providence are minorities, significantly higher than the 27 percent minority population in Rhode Island as a whole; Providence County's minority population (38 percent) is also significantly higher than the state.
- Twenty-seven percent of the population of the City of Providence have incomes below the poverty level, significantly higher than that of Providence County (17 percent) and Rhode Island as a whole (13 percent).
- Fifty-six percent of the population of the Norfolk are minorities, significantly higher than the 37 percent minority populations of Virginia.
- Twenty-one percent of the population of Norfolk have incomes below the poverty level, significantly higher than that of Virginia as a whole (11 percent).

Additionally, RIDEM has mapped the entirety of the Quonset Business Park and some adjacent areas as an Environmental Justice Focus Area.

Table 4.6.9-1 2017 Income and Minority Population Levels

Entity	Population for whom Poverty is Determined [a]	% of Population			
		With Income Below Poverty Level	Hispanic or Latino	Minority not Hispanic or Latino	Total Minority
CONNECTICUT	3,486,033	10	1	17	32
New London County	258,574	10	10	14	24
City of New London	23,432	2	33	22	55
MARYLAND	5,856,088	10	10	39	48
Baltimore County	807,987	9	5	36	41
Sparrow's Point (Edgemere)	8,732	7	3	9	13
MASSACHUSETTS	6,552,347	11	11	16	27
Bristol County	541,142	12	7	10	17
New Bedford	93,392	23	20	17	3
NEW JERSEY	8,783,989	11	20	24	44
Gloucester County	287,292	8	6	15	21
Borough of Paulsboro	5,970	28	6	23	29
NEW YORK	19,285,448	15	19	25	44
Kings County (Brooklyn)	2,611,506	22	19	45	64
New York City	8,422,006	20	29	39	68
Suffolk County	1,468,577	7	19	13	32
Montauk	3,645	5	11	3	14
Port Jefferson Village	7,561	7	10	12	22
RHODE ISLAND	1,015,923	13	15	12	27
Providence County	608,324	17	22	16	38
City of Providence	166,058	27	42	24	66
Washington County	120,153	10	3	6	9
Town of Narragansett	15,576	18	3	3	6
Town of North Kingstown	25,928	8	2	6	8

Entity	Population for whom Poverty is Determined [a]	% of Population			
		With Income Below Poverty Level	Hispanic or Latino	Minority not Hispanic or Latino	Total Minority
VIRGINIA	8,116,130	11	9	28	37
Norfolk	220,044	21	8	49	56

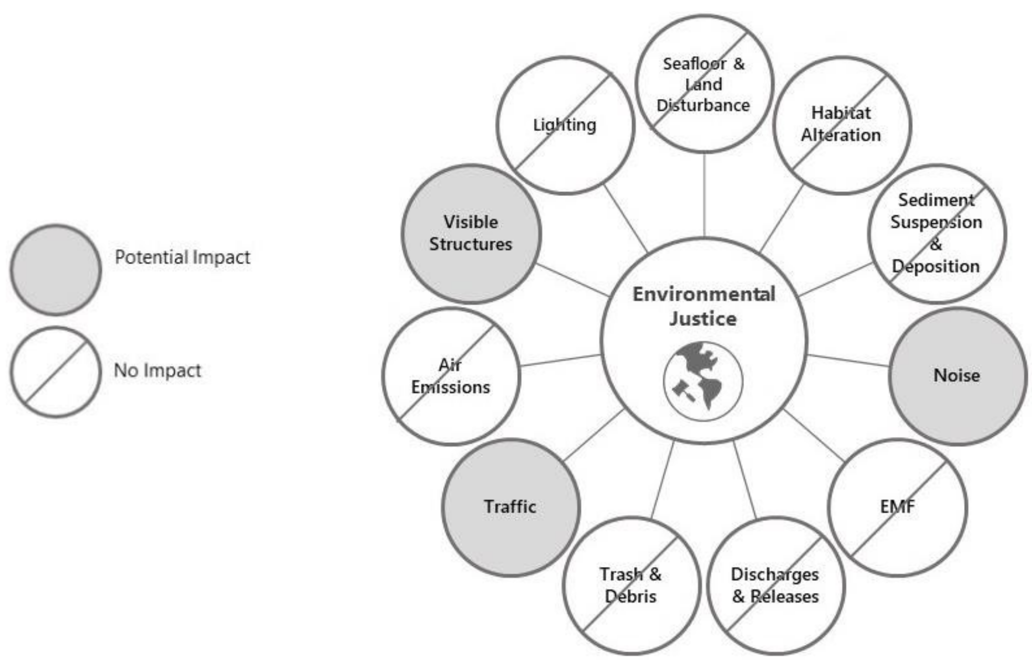
Source: USCB, 2017g and 2017h
a Poverty status was determined for all people except institutionalized people, people in military group quarters, people in college dormitories, and unrelated individuals under 15 years old.

4.6.9.2 Potential Impacts

As noted in the revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities for the RI-MA WEA, the WEA is 12 mi (19.3 km) or more from the nearest coastline; thus, offshore Project activities would not have disproportionally high or adverse environmental or health impacts on minority or low-income populations (BOEM, 2013). Only onshore activities associated with the port options and the Onshore Facilities will have the potential to impact minority or low-income populations (ESS Group, 2016). However, the potential for impacts is generally low and limited to the ports because of the location of the other onshore Project components and the short duration of the construction activities.

IPFs that could result in short-term or long-term impacts to environmental justice communities are indicated on Figure 4.6.9-1. The noise, traffic, visible structures and land disturbance IPFs have potential to result in ***direct*** and ***short-term*** impacts; thus, are briefly evaluated in this section.

Figure 4.6.9-1 IPFs on Environmental Justice



Revolution Wind Farm

Table 4.6.9-2a RWF Environmental Justice Impact Summary

Resource Area	Environmental Justice
RWF	
Construction and Decommissioning	Direct, Short-term
Operations & Maintenance	Not Anticipated

Construction and decommissioning activities may result in ***direct*** and ***short-term*** impacts to the environmental justice communities. Impacts are not anticipated from O&M.

Construction

- **Noise, Traffic, and Visible Structures:** The RWF has the potential to result in ***direct*** and ***short-term*** impacts to the environmental justice communities. Most of the construction activities for the RWF will occur at the ports listed in Table 4.6-1. Because of the existing industrial nature and uses of these ports, the relatively short duration of these activities, and Project-specific environmental protection measures (Section 4.6.9.3), the potential is low for disproportionally high or adverse environmental or health impacts for minority or low-income populations.

Operations and Maintenance

- **Noise, Traffic, and Visible Structures:** O&M of the RWF will be conducted by Project technicians operating out of the O&M facilities over the anticipated 25-plus year operation life of the RWF. Due to the nature of this work and proximate land uses, which would be consistent with O&M operations, environmental justice impacts are not anticipated.

Decommissioning

- **Noise, Traffic, and Visible Structures:** The decommissioning activities for the RWF would be similar in location and nature to the activities for construction. Therefore, impacts are anticipated to be similarly ***direct*** and ***short-term***.

RWEC-OCS and RWEC-RI

The RWEC-OCS and RWEC-RI impacts are anticipated to be similar. Because construction activities for the RWEC will occur in unpopulated areas over open water, there will be no impacts to environmental justice from construction, O&M, or decommissioning of the RWEC-OCS and RWEC-RI.

Onshore Facilities

Table 4.6.9-2b Onshore Facilities Environmental Justice Impact Summary

Resource Area	Environmental Justice
Onshore Facilities	
Construction and Decommissioning	Direct, Short-term
Operations and Maintenance	Direct, Short-term

Onshore activities associated with construction, O&M, or decommissioning of the Onshore Facilities would have ***direct*** and ***short-term*** impacts to environmental justice communities. They are not anticipated to be significant, however, because of the short duration of these activities, compliance with State regulations, and the implementation of mitigation measures.

4.6.9.3 Proposed Environmental Protection Measures

Several environmental protection measures will reduce impacts to potential environmental justice populations:

› Where possible, local workers will be hired to meet labor needs for Project construction, O&M, and decommissioning.

› The Onshore Facilities construction schedule will be designed to minimize and mitigate impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day.

› Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.

› Investigation and remediation of contaminated soil and groundwater must be carried out in accordance with RIDEM's regulations and policies regarding Environmental Justice Focus Areas including enhanced stakeholder outreach.

4.7 Summary of Potential Impacts and Environmental Protection Measures

This section provides a summary of the potential impacts associated with activities described in this COP and provides a summary of the proposed environmental protection measures that will be implemented to avoid or minimize these potential impacts. The information presented in Section 4.0 was developed and presented to support review under NEPA and, as appropriate, the ESA, MMPA, MBTA, CZMA, NHPA, and the MSFCMA.

The scopes of the resource characterizations and impact assessments presented in Section 4.0 were based upon the requirements set forth in 30 CFR 585.627 but also guided by input from federal and state agencies and other public and private stakeholders in the region. Physical, biological, cultural, visual, and socioeconomic resources were characterized based upon extensive desktop studies, targeted field studies, predictive modeling, and data analysis. These assessments provided a detailed background on the condition of these resources in the affected environment. Desktop studies included literature reviews; examination of publicly available datasets; direct communication with academic and government science researchers; and consultation with state and federal government entities. The OSAMP and the Massachusetts Ocean Management Plan provided important insight on environmental conditions and existing human activities in and near the RWF and RWEC. The resource characterizations also relied on the material published in recent BOEM NEPA documents, such as the Final Programmatic Environmental Impact Statement (PEIS) for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (BOEM, 2007).

As demonstrated by the impact evaluations presented throughout Section 4.0, the type and degree of potential impacts from Project activities varies based on the characteristics of the resource (e.g., presence/absence, conservation status, abundance) and the IPF that may affect each resource. Potential impacts are discussed separately for the RWF, RWEC, and Onshore Facilities. Where relevant and distinct, potential impacts for different segments of the RWEC (i.e., RWEC – OCS and RWEC – RI) are discussed separately. Potential impacts were identified as direct or indirect and short-term or long-term. If measures are proposed to avoid and minimize potential impacts, the impact evaluation included consideration of these environmental protection measures.

Table 4.7-1 details the resources identified within the affected environment and whether impacts are anticipated as a result of activities described in this COP. Table 4.7-2 describes the corresponding environmental protection measures that Revolution Wind will adopt to minimize these potential impacts. These tables provide a summary of the information discussed in each resource section throughout Section 4.0.

The Project was sited, planned, and designed to avoid and minimize impacts. Most potential impacts to affected physical, biological, cultural, visual and socioeconomic resources will be mitigated. Resources that may be impacted by the RWF, RWEC and Onshore Facilities are expected to recover given that impacts will be limited temporally and/or spatially. Post-construction environmental monitoring of various resources will take place and will include, at a minimum, coordination and data sharing with regional monitoring efforts. Monitoring plans will be developed in coordination with the relevant agencies prior to construction.

Table 4.7-1 Summary of the Evaluation of Impact-producing Factors Associated With the Revolution Wind Farm and Revolution Wind Export Cable and Affected Physical, Biological, Cultural and Socioeconomic Resources

	Physical Resources				Biological Resources							Cultural Resources				Socioeconomic Resources								
Impact Producing Factor	Air Quality	Water Quality & Water Resources	Geological Resources	Physical Oceanography & Meteorology	Coastal Habitat	Benthic & Shellfish Resources	Finfish & Essential Fish Habitat	Marine Mammals	Sea Turtles	Avian Species	Bat Species	Above Ground Historic Resources	Marine Archaeological Resources	Terrestrial Archaeological Resources	Visual Resources	Population, Economy, & Employment	Housing & Property Values	Public Services	Recreation & Tourism	Commercial & Recreational Fishing	Commercial Shipping	Coastal Land Use & Infrastructure	Other Marine Uses	Environmental Justice
Impact Evaluation Section Number	*4.2.1.2*	*4.2.2.2*	*4.2.3.2*	*4.2.4.2*	*4.3.1.2*	*4.3.2.2*	*4.3.3.2*	*4.3.4.2*	*4.3.5.2*	*4.3.6.2*	*4.3.7.2*	*4.4.1.2*	*4.4.2.2*	*4.4.3.2*	*4.5.2*	*4.6.1.2*	*4.6.2.2*	*4.6.3.2*	*4.6.4.2*	*4.6.5.2*	*4.6.6.2*	*4.6.7.2*	*4.6.8.2*	*4.6.9.2*
Seafloor and Land Disturbance	\	P	P	P	P	P	P	P	P	P	P	\		P	\	\	\	\	\	P	\	P	\	\
Habitat Alteration	\	\	\	\	P	P	P	P	P	P	P	\	\	\	\	\	\	\	\	P	\	\	\	\
Sediment Suspension and Deposition	\	P	P	P	P	P	P	P	P	P	\	\		\	\	\	\	\	\	P	\	\	\	\
Noise	\	\	\	\	\	P	P	P	P	P	P	P	\	P	\	P	P	\	\	P	\	P	\	P
Electric and Magnetic Fields	\	\	\	\	\	P	P	P	P	\	\	\	\	\	\	\	\	\	\	P	\	\	\	\
Discharges and Releases	\	P	\	\	P	P	P	P	P	P	\	\	\	\	\	\	\	\	\	P	\	\	\	\
Trash and Debris	\	P	\	\	P	P	P	P	P	P	\	\	\	\	\	\	\	\	\	P	\	\	\	\
Traffic	\	\	\	\	\	\	P	P	P	P	P	P	\	P	P	P	P	P	P	P	P	P	P	P
Air Emissions	P	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\	\
Visible Structures	\	\	\	P	\	\	\	P	P	P	P	P	\	P	P	P	P	\	P	P	\	P	P	P
Lighting	\	\	\	\	\	\	P	P	P	P	P	P	\	\	P	\	\	\	P	\	\	P	\	\

Notes:
P = Potential Impact
\ = No Impact

Table 4.7-2 Summary of Potential Impacts and Environmental Protection Measures, by Resource

Resources	Potential Impacts by IPF	Environmental Protection Measures
Air Quality	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: No Impact › Air Emissions: Potential Impact › Visible Structures: No Impact › Lighting: No Impact	› Vessels providing construction or maintenance services will use low sulfur fuel, where possible. › Vessel engines will meet the appropriate EPA air emission standards for NO_X emissions when operating within Emission Controls Areas. › Onshore Facilities equipment and fuel suppliers will provide equipment and fuels that comply with the applicable EPA or equivalent emission standards. › Marine engines with a model year of 2007 or later and non-road engines complying with the Tier 3 standards (in 40 CFR 89 or 1039) or better will be used to satisfy BACT or LAER.
Water Quality	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: No Impact	› To the extent feasible, installation of the IACs, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› At the landfall location, drilling fluids will be managed within a contained system to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
Geological Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: No Impact	› IAC, OSS-Link Cable, and RWEC will avoid identified shallow hazards to the extent practicable. › To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › DP vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent possible. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
Physical Oceanographic and Meteorological Conditions	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact	› No environmental protection measures to address physical oceanographic and meteorological conditions are proposed.

Resources	Potential Impacts by IPF	Environmental Protection Measures
	› Traffic: No Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: No Impact	
Coastal and Terrestrial Habitat	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: No Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: No Impact	› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › At the landfall location, drilling fluids will be managed within a contained system to be collected for reuse as necessary. An HDD Contingency Plan will be prepared and implemented to minimize the potential risks associated with release of drilling fluids. › Compliance with the RIPDES General Permit for Stormwater Discharges associated with Construction Activities which requires the implementation of an SESC Plan and spill prevention and control measures. › The operator must implement the site-specific SESC Plan and maintain it during the entire construction process until the entire worksite is permanently stabilized by vegetation or other means. The measures employed in the SESC Plan use BMPs to minimize the opportunity for turbid discharges leaving a construction work area. › The spill prevention and control measures mandate that the operator identify all areas where spills can occur and their accompanying drainage points. The operator must also establish spill prevention and control measures to reduce the chance of spills, stop the source of spills, contain and clean-up spills, and dispose of materials contaminated by spills. Spill prevention and control training will be provided for relevant personnel. › The perimeter surrounding Onshore Facilities will be managed to encourage the growth of native grasses, ferns, and low growing shrubs. The management strategy will include the removal of invasive plants in compliance with state and federal regulations (e.g. herbicide use will not be permitted within regulated wetlands).

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› In accordance with Section 2.9(B)(1)(d) of the Freshwater Wetland Rules, the Onshore Facilities will be designed to avoid and minimize impacts to freshwater wetlands to the maximum extent practicable. Any wetlands that will be impacted as a result of the Project will be mitigated via the federal and state permitting process in accordance with Section 404 of the CWA and the Freshwater Wetland Rules. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities. › The documented sickle-leaved golden aster population on the OnSS parcel will be protected during construction.
Benthic and Shellfish Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: Potential Impact	› The RWF and RWEC will be sited to avoid and minimize impacts to sensitive habitats (e.g., hard bottom habitats) to the extent practicable. › To the extent feasible, installation of the IACs, OSS-Interlink Cable, and RWEC will be buried using equipment such subsea cable trenchers such as jet trenchers or mechanical cutting trenchers, simultaneous lay and burial using a cable plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. › DP vessels will be used for installation of the IACs, OSS-Link Cable, and RWEC to the extent practicable. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-

Resources	Potential Impacts by IPF	Environmental Protection Measures
		construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › A preconstruction submerged aquatic vegetation (SAV) survey will be completed to identify any new or expanded SAV beds. The Project design will be refined to avoid impacts to SAV to the greatest extent practicable. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the area prior to the commencement of pile driving activities. › Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Finfish and Essential Fish Habitat (EFH)	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impacts › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: No Impact › Lighting: Potential Impact	› To the extent feasible, installation of the IAC, OSS-Link Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. › DP vessels will be used for installation of the IAC, OSS-Link Cable, and RWEC to the extent practicable. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources. › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › A ramp-up or soft-start will be used at the beginning of each pile segment during impact pile driving and/or vibratory pile driving to provide additional protection to mobile species in the vicinity by allowing them to vacate the

Resources	Potential Impacts by IPF	Environmental Protection Measures
		area prior to the commencement of pile driving activities. › Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process.
Marine Mammals	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and vibratory pile driving activities. › Environmental protection measures will be implemented for impact and vibratory pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, marine mammal and sea turtle monitoring protocols, the use of qualified and NOAA-approved protected species observers, and noise attenuation systems such as bubble curtains, as appropriate. › Vessels will follow NOAA guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions. › All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness. › Revolution Wind will require all construction and operation vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP.

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
Sea Turtles	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emission: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Exclusion and monitoring zones for marine mammals and sea turtles will be established for impact and vibratory pile driving activities. › Mitigation measures will be implemented for impact and vibratory pile driving activities. These measures will include seasonal restrictions, soft-start measures, shut-down procedures, marine mammal and sea turtle monitoring protocols, the use of qualified and NOAA-approved protected species observers, and noise attenuation systems such as bubble curtains, as appropriate. › Vessels will follow NOAA guidelines for marine mammal and sea turtle strike avoidance measures, including vessel speed restrictions. › All personnel working offshore will receive training on marine mammal and sea turtle awareness and marine debris awareness. › Revolution Wind will require all construction and operation vessels to comply with regulatory requirements related to the prevention and control of spills and discharges.

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment.
Avian Species	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› To the extent feasible, tree and shrub removal for Onshore Facilities will occur outside the avian nesting and bat roosting period; May 1 through August 15. If tree and shrub removal cannot avoid this season, Revolution Wind will coordinate with appropriate agencies to determine appropriate course of action. › Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian species to avoid individual WTGs and minimize risk of potential collision. › Construction and operational lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations.

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimizes impacts on avian species. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities. › Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › The Onshore Transmission Cables will be buried; therefore, avoiding the risk to avian and bat species associated with overhead lines. › Revolution Wind is developing an Avian Post-Construction Monitoring Plan for the Project that will summarize the approach to monitoring; describe overarching monitoring goals and objectives; identify the key avian species, priority questions, and data gaps unique to the region and Project Area that will be addressed through monitoring; and describe methods and time frames for data collection, analysis, and reporting. Post-construction monitoring will assess impacts of the Project with the purpose of filling select information gaps and supporting validation of the Project's Avian Risk Assessment. Focus may be placed on improving knowledge of ESA-listed species occurrence and

Resources	Potential Impacts by IPF	Environmental Protection Measures
		movements offshore, avian collision risk, species/species-group displacement, or similar topics. Where possible, monitoring conducted by Revolution Wind will build on and align with post-construction monitoring conducted by the other Orsted/Eversource offshore wind projects in the Northeast region. Revolution Wind will engage with federal and state agencies and eNGOs to identify appropriate monitoring options and technologies, and to facilitate acceptance of the final plan. › Revolution Wind will document any dead (or injured) birds/bats found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and USFWS.
Bat Species	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Construction and operational lighting will be limited to the minimum necessary to ensure safety and to comply with applicable regulations. › To the extent feasible, tree and shrub removal for Onshore Facilities will occur outside the avian nesting and bat roosting period; May 1 through August 15. If tree and shrub removal cannot avoid this season, Revolution Wind will coordinate with appropriate agencies to determine appropriate course of action. › Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This wide spacing of WTGs will allow avian and bat species to avoid individual WTGs and minimize risk of potential collision. › Revolution Wind will comply with FAA and USCG requirements for lighting while using lighting technology (e.g., low-intensity strobe lights) that minimize impacts on avian and bat species. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › The Onshore Transmission Cables will be buried; therefore, avoiding the risk to avian and bat species associated with overhead lines. › Revolution Wind will document any dead (or injured) birds/bats found incidentally on vessels and structures during construction, O&M, and decommissioning and provide an annual report to BOEM and USFWS.
Above-Ground Historic Properties	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. › RWF WTGs will have uniform design, speed, height, and rotor diameter, thereby mitigating visual clutter. › The WTGs will be painted Pure White (RAL 9010) to Light Grey (RAL 7035) as recommended by BOEM and the FAA. This color white of the turbines generally blends well with the sky at the horizon and eliminates the need for daytime warning lights or red paint marking of the blade tips. › The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties. › The Onshore Facilities will be located adjacent to an existing substation on a parcel zoned for commercial and industrial/utility use. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise.
Marine Archaeological Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Negligible › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact	› The RWF and RWEC will be sited to avoid or minimize impacts to potential submerged cultural sites and paleo landforms, to the extent practicable. › Native American Tribal representatives were involved, and will continue to be involved, in marine survey protocol design, execution of the surveys, and interpretation of the results. › A plan for vessels will be developed prior to construction to identify no-anchorage areas to avoid documented sensitive resources.

Resources	Potential Impacts by IPF	Environmental Protection Measures
	› Air Emissions: No Impact › Visible Structure: No Impact › Lighting: Potential Impact	› An Unanticipated Discovery Plan (UDP) will be implemented that will include stop-work and notification procedures to be followed if a potentially significant archaeological resource is encountered during construction.
Terrestrial Archaeological Resources	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact (Traditional Cultural Properties [TCPs] only) › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact (TCPs only) › Air Emissions: No Impact › Visible Structures: Potential Impact (TCPs only) › Lighting: No Impact	› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › Onshore Facilities will be sited to avoid or minimize impacts to potential terrestrial archeological resources, to the extent practicable. › Native American Tribal representatives were involved, and will continue to be involved, in terrestrial survey protocol design, execution of the surveys, and interpretation of the results. › An UDP will be implemented that will include stop-work and notification procedures to be followed if a cultural resource is encountered during installation.
Visual Resources	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. › RWF WTGs will have uniform design, speed, height, and rotor diameter. › The WTGs will be painted Pure White (RAL 9010) to Light Grey (RAL 7035) as recommended by BOEM and the FAA. This color white of the turbines generally blends well with the sky at the horizon and eliminates the need for daytime warning lights or red paint marking of the blade tips. › The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise. › Non-reflective paints and finishes will be used to the extent practicable on Onshore Facilities to minimize reflected glare.

Resources	Potential Impacts by IPF	Environmental Protection Measures
		› Lighting at the OnSS and ICF will be kept to a minimum and turned on only as needed by manual switch.
Population, Economy, and Employment	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: No Impact	› Where possible, local workers will be hired to meet labor needs for Project construction, O&M, and decommissioning. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.
Property Values	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Revolution Wind will use ADLS (or a similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. › The Onshore Transmission Cable and ICF Interconnection ROW will be buried, minimizing potential impacts to adjacent properties. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Screening will be implemented at the above-ground Onshore Facilities to the extent feasible, to reduce potential visibility and noise. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion).

Resources	Potential Impacts by IPF	Environmental Protection Measures
		In addition, traffic will be temporary and will not impact long term property values.
Public Services	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air emissions: No Impact › Visible Structures: No Impact › Lighting: No Impact	› The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values. › A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Project website, public notices to mariners and vessel float plans, and a fisheries liaison. Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities.
Recreation & Tourism	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Project website, public notices to mariners and vessel float plans, and a fisheries liaison. Revolution Wind will submit information to the USCG to issue Local Notice to Mariners during offshore installation activities. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be

Resources	Potential Impacts by IPF	Environmental Protection Measures
		constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values.
Commercial and Recreational Fishing	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: Potential Impact › Sediment Suspension and Deposition: Potential Impact › Noise: Potential Impact › EMF: Potential Impact › Discharges and Releases: Potential Impact › Trash and Debris: Potential Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: No Impact	› Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations. › To the extent feasible, installation of the Inter-Array Cable, OSS Interconnector Cable, and RWEC will occur using equipment such as mechanical cutter, mechanical plow, or jet plow. The feasibility of cable burial equipment will be determined based on an assessment of seabed conditions and the Cable Burial Risk Assessment. › To the extent feasible, the RWEC, IAC, and OSS-Link Cable will typically target a burial depth of 4 to 6 ft (1.2 to 1.8 m) below seabed. The target burial depth will be determined based on an assessment of seabed conditions, seabed mobility, the risk of interaction with external hazards such as fishing gear and vessel anchors, and a site-specific Cable Burial Risk Assessment. › As appropriate and feasible, BMPs will be implemented to minimize impacts on fisheries, as described in the Guidelines for Providing Information on Fisheries Social and Economic Conditions for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM, 2015). › Revolution Wind is committed to collaborative science with the commercial and recreational fishing industries pre-, during, and post-construction. Fisheries and benthic monitoring studies are being planned to assess the impacts associated with the Project on economically and ecologically important

Resources	Potential Impacts by IPF	Environmental Protection Measures
		fisheries resources. These studies will be conducted in collaboration with the local fishing industry and will build upon monitoring efforts being conducted by affiliates of Revolution Wind at other wind farms in the region. › Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › All vessels will comply with USCG and EPA regulations that require operators to develop waste management plans, post informational placards, manifest trash sent to shore, and use special precautions such as covering outside trash bins to prevent accidental loss of solid materials. Vessels will also comply with BOEM lease stipulations that require adherence to NTL 2015-G03, which instructs operators to exercise caution in the handling and disposal of small items and packaging materials, requires the posting of placards at prominent locations on offshore vessels and structures, and mandates a yearly marine trash and debris awareness training and certification process. › Communications and outreach with the commercial and recreational fishing industries will be guided by the Project-specific Fisheries Communication Plan (Appendix EE). › Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and DoD command headquarters. › RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable. › A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel

Resources	Potential Impacts by IPF	Environmental Protection Measures
		movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG).
Commercial Shipping	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structures: Potential Impact › Lighting: Potential Impact	› Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations. › Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation. › Revolution Wind will require all construction and operations vessels to comply with regulatory requirements related to the prevention and control of spills and discharges. › Accidental spill or release of oils or other hazardous materials offshore will be managed through the OSRP. › Project construction, O&M, and decommissioning activities will be coordinated with appropriate contacts at USCG and DoD command headquarters. › RWEC was sited to avoid conflicts with DoD use areas and navigational areas identified by the USCG, as applicable. › A comprehensive communication plan will be implemented during offshore construction to inform all mariners, including commercial and recreational fishermen, and recreational boaters of construction activities and vessel movements. Communication will be facilitated through a Fisheries Liaison, Project website, and public notices to mariners and vessel float plans (in coordination with USCG). › Revolution Wind will consult with USCG, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts.

Resources	Potential Impacts by IPF	Environmental Protection Measures
Coastal Land Use & Infrastructure	› Seafloor and Land Disturbance: Potential Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Onshore Facilities will be sited within previously disturbed and developed areas to the extent practicable. › Revolution Wind will coordinate with local authorities during construction of Onshore Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values. › An SESC Plan, including erosion and sedimentation control measures, will be implemented to minimize potential water quality impacts during construction and operation of the Onshore Facilities.
Other Marine Uses	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: No Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact › Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: Potential Impact	› Revolution Wind is committed to an indicative layout scenario with WTGs sited in a grid with approximately 1.15 mi (1 nm) by 1.15 mi (1 nm) spacing that aligns with other proposed adjacent offshore wind projects in the RI-MA WEA. This layout has been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This layout will also provide a uniform, wide spacing among structures to facilitate search and rescue operations. › Revolution Wind will consult with USCG, the Northeast Marine Pilots Association and regional ferry service operators to avoid or reduce use conflicts. › Each WTG will be marked and lit with both USCG and approved aviation lighting. AIS will be installed at the RWF marking the corners of the wind farm to assist in safe navigation.
Environmental Justice	› Seafloor and Land Disturbance: No Impact › Habitat Alteration: No Impact › Sediment Suspension and Deposition: No Impact › Noise: Potential Impact › EMF: No Impact › Discharges and Releases: No Impact › Trash and Debris: No Impact	› Where possible, local workers will be hired to meet labor needs for Project construction, O&M, and decommissioning. › The Onshore Facilities construction schedule will be designed to minimize impacts to the local community during the summer tourist season, generally between Memorial Day and Labor Day. › Revolution Wind will coordinate with local authorities during construction of Onshore

Resources	Potential Impacts by IPF	Environmental Protection Measures
	› Traffic: Potential Impact › Air Emissions: No Impact › Visible Structure: Potential Impact › Lighting: No Impact	Facilities to minimize local traffic impacts; further, these Project components will be constructed in compliance with applicable regulations related to environmental and community concerns (e.g., traffic and erosion). In addition, traffic will be temporary and will not impact long term property values. › Investigation and remediation of contaminated soil and groundwater must be carried out in accordance with RIDEM regulations and policies regarding Environmental Justice Focus Areas including enhanced stakeholder outreach.

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Marine Mammals and Sea Turtles

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