Public Service Company of New Hampshire
Seacoast Reliability Project

Madbury, Durham, Newington & Portsmouth, NH

New Hampshire Department of Environmental Services
Application for Water Quality Certification

Prepared For:
Public Service Company of New Hampshire
d/b/a Eversource Energy
780 North Commercial Street
Hooksett, NH 03106

Submitted:
April 12, 2016

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Bedford, NH 03110

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APPLICATION FOR WATER QUALITY CERTIFICATION

Water Division
Water Quality Certification Program

RSA: 485-A:12

Date of Request April 12, 2016

Date Request Received by NHDES ____________________

I. Applicant Information

Principal Place of Business of the Applicant Public Service Company of New Hampshire d/b/a Eversource Energy, Inc.	
Mailing Address [Street, PO Box, RR, etc.] 13 Legends Drive	
City/Town and Zip Code Hooksett, NH 03106	
Telephone No. 603 634-3256	Email Address kurt.nelson@eversource.com
Name and Title of Signatory Official Responsible for the Activity for which Certification is Sought (e.g., President, Administrator) Kurt Nelson, Project Siting and Permitting Specialist	

II. Project Information

Name of Project Seacoast Reliability Project
Name of Town and County that contains the Project Madbury and Durham in Strafford County, and Newington and Portsmouth, Rockingham County.
Name of Receiving Waterbody and Drainage Basin Drainage Basins: Oyster River, Lower Lamprey River, Great Bay, Portsmouth Harbor. Receiving Waters: Oyster River, Little Bay
Summary of Activity (e.g., construction, operation, or other practice or action) Public Service of New Hampshire (PSNH) , is proposing to construct a new 115 kilovolt (kV) transmission line between the existing Madbury and Portsmouth substations. Additional information is provided in the attached narrative.

III. Additional Submittal Information

PLEASE SUBMIT AS MUCH INFORMATION AS POSSIBLE IN ELECTRONIC FORMAT

Please provide an individual response to each bullet, below. If applicable information is contained in the application materials, please provide a reference to the specific section in the application materials that will represent the response to the individual bullets below.

- Type of activity (e.g., construction, operation, other action such as water withdrawal) and the start and end dates of the activity.
- The characteristics of the activity: Whether the activity is associated with a discharge and/or water withdrawal and whether the discharge and/or withdrawal is proposed or occurring.
- The characteristics of the discharge and/or withdrawal
  - Flow rate (cfs)
  - Potential chemical, physical, biological constituents
  - Frequency (e.g., daily, hourly,)
  - Duration
  - Temperature (Celsius)
  - Latitude and longitude (dd:mm:ss)

- The existing and designated use(s) that are potentially affected by the proposed activities. (Designated Uses are listed in the NHDES Consolidated Assessment and Listing Methodology).
- The provision(s) of surface water quality standards (Env-Wq 1700) that are applicable to the designated uses affected by the proposed activities.
- A pollutant loading analysis to show the difference between predevelopment and post-development pollutant loads for a typical year. The objective of the loading analysis is to show post-development pollutant loads do not exceed pre-development pollutant loads. Loading analysis guidance and a simple spreadsheet model will be provided by NHDES. The loading analysis will be used to determine appropriate stormwater management measures, which must be effectively designed, installed, and maintained to ensure compliance with surface water quality standards.
- A description of any other aspect of associated with construction and operation of the activity that would affect the chemical composition, temperature, flow, or physical aquatic habitat of the surface water.
- An original or color copy/reproduction of a United States Geological Survey Quadrangle Map that clearly shows the location of the activity and all potential discharge points.
- A copy of the final complete federal permit application or federal license application, including the federal permit, license, or project number.
- A copy of the NHDES wetlands permit (RSA 482-A:3), if necessary.
- A copy of the NHDES alteration of terrain permit (RSA 485-A:17), if necessary.
- The name(s) and address(es) of adjoining riparian or littoral abutters.
- A plan showing the proposed activities to scale including:
  - The location(s) and boundaries of the activities;
  - The location(s), dimension(s), and type(s) of any existing and/or proposed structures; and
  - The location(s), name(s), identification number(s), and extent of all potentially affected surface water bodies, including wetlands.
- For projects that involve a new surface water withdrawal, provide the following:

  - a copy of the water conservation plan (WCP) submitted to the NHDES Water Conservation Program and the status of NHDES approval, or
  - a copy of a waiver approved by the NHDES Water Conservation Program that waives the requirement to submit a WCP prior to or in conjunction with the application for water quality certification.

  [Pursuant to Env-Wq 2101, and unless a waiver is applied for and granted by NHDES, all applicants for water quality certification are required to submit a water conservation plan (WCP) for projects that involve a new withdrawal from a surface water prior to or in conjunction with this application. Contact the NHDES Water Conservation Program for guidance related to drafting a WCP and the review and approval process. Information regarding the WCP, including contact information, may be found at http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/index.htm

- If the project is located within ¼ (one quarter) mile of a designated river, as defined under RSA 483 (the Rivers Management and Protection Act), provide documentation showing that the Local River Management Advisory Committee (LAC) has been provided with a copy of this complete application. A list and map of the designated rivers, as well as contact information, may be found at http://des.nh.gov/organization/divisions/water/wmb/rivers/desigriv.htm

Signature – MUST BE SIGNED AND DATED BY APPLICANT

To the best of my knowledge, the data and information described above, which I have submitted to the New Hampshire Department of Environmental Services, is true and correct. I understand that an approval of the requested water quality certification based upon incorrect data may be subject to revocation of the certification. I have complied with all local regulations or ordinances relative to the proposed activity and have obtained or will obtain, prior to the commencement of any work, all other approvals that may be required.

Signed: ______________________

Date: 4-5-2016

1.0 Introduction

1.1 Purpose and Need for the Project

Public Service of New Hampshire (PSNH), is proposing to construct a new 115 kilovolt (kV) transmission line between the existing Madbury and Portsmouth substations. The Seacoast Reliability Project (SRP) will be located in the Towns of Madbury, Durham and Newington as well as the City of Portsmouth, in Strafford and Rockingham Counties, New Hampshire.

The new 115 kV transmission line will be approximately 12.9 miles long, including a 0.9 mile long crossing under Little Bay (Figure 1). The entire line will be constructed within existing electric corridors, with minor adjustments to corridor position and width in several locations. The project corridor ranges from approximately 50 to 300feet wide, but is predominantly 100 feet wide. The mapped cable crossing corridor in Little Bay is approximately 1000 feet wide. For most of the length of the SRP, a mowed corridor approximately 60 feet in width has been maintained by PSNH in support of the existing electric distribution line. The edges of the project corridor (approximately 20 feet on either side of the existing power line) are unmaintained and support other land uses, including forest which will need to be cleared for the SRP.

This Project is proposed as a part of PSNH's continued effort to provide high-quality service to the customers of New Hampshire and to meet reliability and other applicable benchmarks. It has been approved by ISO-NE as part of Eversource's Seacoast Reliability Solution. It is one of seven projects in the Solution; the other six are relatively minor in nature, including line upgrades, line uprates, and substation improvements.

1.2 Regulatory Jurisdiction and Permit Applications

Permanent and temporary wetland impacts are proposed, along with temporary impacts to streams and tidal areas. Multiple meetings with state and federal regulatory agencies have occurred as the Project design has progressed. The purpose of the meetings was to inform agency personnel of the Project design, discuss pertinent issues and respond to concerns and questions. An initial pre-application meeting to review the wetland, stream and wildlife resources was held on January 6, 2015 with the NHDES, NHF&G, NHNHB, USACE, USEPA, USFWS, and NMFS. Additional agency pre-application meetings have included one to introduce the Project to the NHDES project manager on February 25, 2015. A second meeting to discuss resources and Project activities in Little Bay was held on March 3, 2015 with NHDES, USACE, USEPA, and NMFS; a meeting describing the project and potential impacts was held on May 7, 2015 with NHF&G environmental review team; and an additional pre-application meeting was held on June 10, 2015 with NHDES and USACE. NHF&G held a meeting on September 17, 2015 to specifically provide information to, and address concerns of, oyster aquaculturists. Additional communications to individual regulators occurred to ask or answer questions regarding the Project, including USACE, NHDES, NHF&G, USFWS and NHNHB. A final multi-agency pre-application meeting was

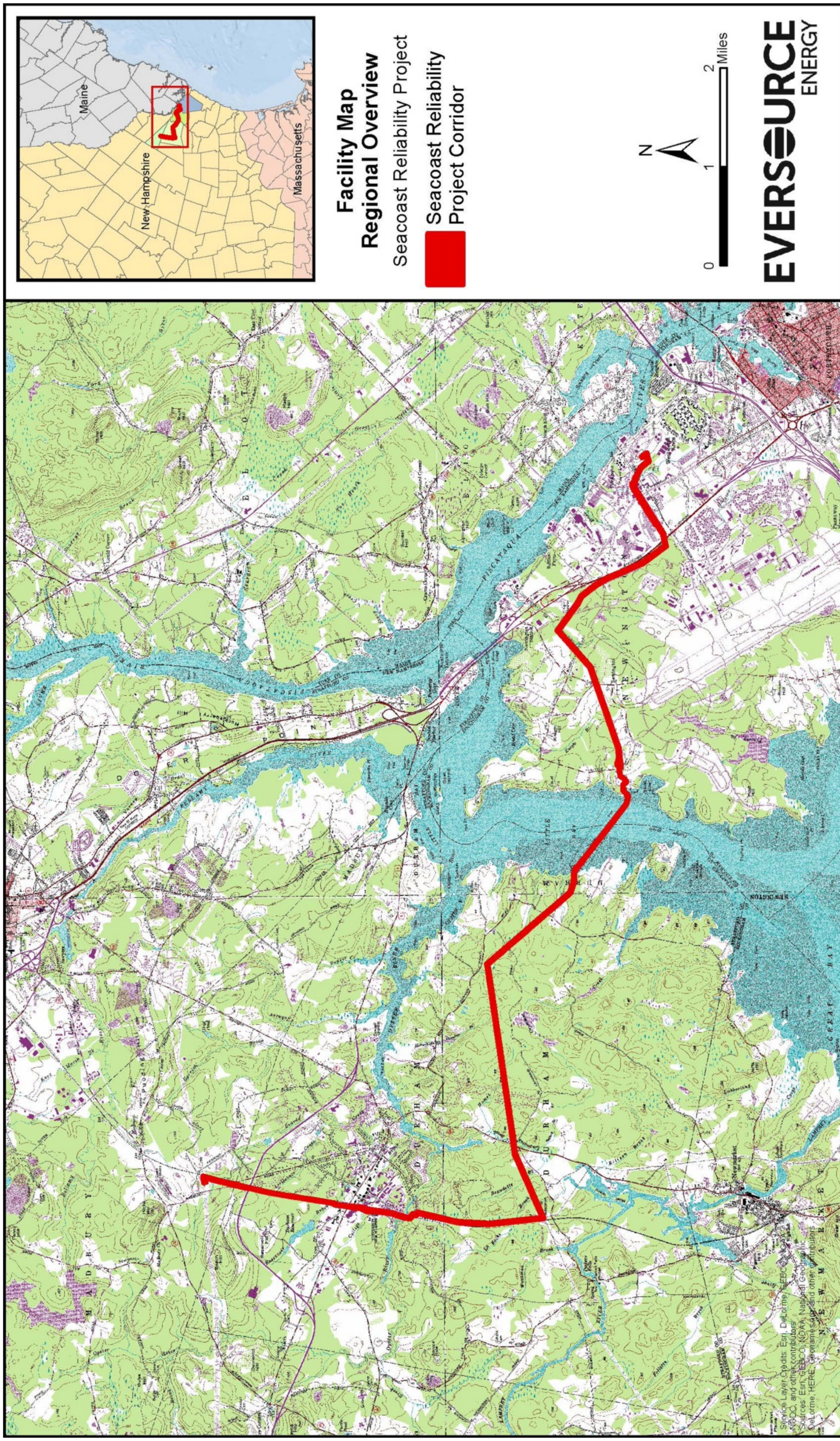


Figure 1. USGS map depicting SRP route and cable crossing on Little Bay.

held January 12, 2016 with state and federal agencies. Attendees included DES Wetlands Bureau, Alteration of Terrain, and Water Quality staff, NHNHB; USACE; USEPA; USFWS and NMFS. The purpose of this meeting was to present the final permitting design, describe the project community outreach efforts, and request any outstanding agency concerns.

In the course of pre-application meetings, the USACE confirmed that approval under the NH Programmatic General Permit (General Permit No: NAE-R-2012-00339) would be appropriate because of the low amount of permanent wetland impact. As such, the Water Quality Certification under Section 401 of the Federal Clean Water Act (33 USC 1341) is granted under WQC #2012-404P-002 (PGP WQC), provided the applicant obtains the required state wetlands permit and complies with the PGP conditions. Condition E-2 of the PGP WQC states that PGP activities shall be subject to NHDES review to determine whether additional conditions or an individual 401 certification application are necessary to ensure compliance with the surface water quality standards. Because of the sensitivity of the resources involved, and the potential temporary exceedances of water quality standards in Little Bay during construction, this individual water quality certification application was prepared to facilitate NHDES's review.

This application addresses in detail the proposed submarine cable installation in Little Bay. Because of the low potential for water quality standard exceedances in other elements of the project for which a wetland permit application has been submitted, it is assumed that the wetland application adequately addresses surface water quality concerns for those elements. Proposed impacts to the Oyster River are limited to bank clearing and are described in the NHDES wetland application. These activities are not anticipated to result in water quality standard exceedances, and so are not addressed in detail in this application.

2.0 Additional Submittal Information

2.1 Type of Activity

Type of activity (e.g., construction, operation, other action such as water withdrawal) and the start and end dates of the activity.

The scope of work for the entire SRP includes:

1. Installation of new 115kv structures, conductors and associated foundations and guy wires,
2. Installation of new underground and submarine cables and associated vaults,
3. Existing distribution structure removal,
4. Re-location of transmission structures, and
5. Minor substation work within the existing substation footprints.

All work will take place within the existing project corridor; however clearing will be necessary to expand the existing corridor from its current use as a distribution right-of-way (approximately 60 feet wide) to the width needed to accommodate the new 115kV transmission line and to meet all associated requirements and standards for tree clearances (typically 100 feet wide).

Permanent wetland impacts total approximately 6,128 square feet (0.14 acres). The majority (approximately 5,336 square feet) of the permanent impacts result from the potential need for concrete mattresses if intertidal ledge prohibits burial of the cable to its full depth of 3.5 feet. The remaining 792 square feet of impact results from the placement of structures within, or partially within, freshwater wetland areas.

There will be no permanent impacts to streams. The majority of streams will be crossed using temporary mat bridges, with matting placed parallel to, but outside of each bank, and other matting placed perpendicular to these and over the stream. Two streams are located within work pad areas, and may need temporary culverts during construction activities. Temporary culverts will be sized based on appropriate guidelines to accommodate flows. These areas will be inspected and maintained throughout construction by an Environmental Monitor and the temporary culverts will be removed when no longer needed.

Additionally, one perennial stream in Durham, College Brook (DS74), is proposed to be crossed with an open trench associated with underground line construction. A short section of this stream will be temporarily relocated using coffer dams to divert water around the impact area during construction. The underground electrical conduit will be installed and the impacted portion of the channel will be reconstructed with native material and stream flow will be restored to its original channel. The area will be stabilized as needed to support the disturbed banks. No vernal pools occur within the Project corridor.

Temporary wetland impacts will occur where wetlands need to be crossed to access proposed structure locations for construction, or existing distribution structure locations for removal. On land, temporary impacts will also occur within designated “work pad” areas around proposed structures necessary to safely construct the project as designed. Within Little Bay the proposed underground and underwater cables will be installed below grade in temporary trenches using several methods including jet plow technology (mechanical installation using a combination of water pressure and a steel blade) within the bay, diver burial and an excavator in the nearshore intertidal zone. Timber mats (approximately 4 feet by 16 feet) will be used for wetland crossings and work pads where necessary.

Construction for the project is proposed to start in the first half of 2017 and to be completed in mid-2018. The submarine cable installation is proposed for the fall of 2017.

2.2 Characteristics of the Activity

The characteristics of the activity: Whether the activity is associated with a discharge and/or water withdrawal and whether the discharge and/or withdrawal is proposed or occurring.

2.2.1 Overhead and Underground

The majority of the SRP will be constructed aboveground on overhead structures, most of which will be directly embedded monopoles and H-frame structures. Drilled pier foundations will be necessary for monopoles on corners or requiring more support.

Sections of the line will go underground at UNH (approximately 2,100 linear feet) and in Gundalow Landing in Newington (approximately 1,100 linear feet). Best management practices will be employed to control sediments and any dewatering that could be needed during the structure and underground installations. These will be identified and refined during the final design and construction specification stages.

An issue that may require special attention is the potential presence of "emerging contaminants" in the vicinity of the former Pease Air Force Base (Pease). Pease is currently conducting sampling in groundwater and surface waters on and surrounding the base for perfluorinated compounds, considered emerging contaminants by the US Environmental Protection Agency (USEPA). The levels of perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) have been stable and are well below USEPA's Provisional Health Advisory levels for many on-base wells, but have been elevated in some locations on and adjacent to the base. Results from a large-scale sampling effort in the fall of 2015 have not been released to the public, but preliminary samples indicate a spring near Pickering Brook in Newington has elevated PFOS levels. The project will continue to coordinate with Pease to determine if the groundwater in the vicinity of the proposed route requires special handling. Should special handling be required, the Project will consult with NHDES and USEPA to select the correct treatment method.

2.2.2 Submarine

To cross Little Bay, PSNHproposes to bury the line at the shoreline and under the bay bottom. Two in-water installation methods will be used for the Project, jet plowing across the majority of the crossing and diver-assisted hand-jetting nearshore. Jet plowing will be used for the majority of the crossing. Jet plowing simultaneously trenches and buries the cables to the required depth (3.5 feet nearshore and 8 feet in the channel). Burial by divers using handheld water jets will occur at either end of the cable lay as it approaches the shoreline. Very close to both shores, the submarine cable will be buried using an excavator working from timber mats in the Project corridor as the cable transitions to land.

Jet plowing will require the withdrawal of approximately 1,000 m3/hr of water from Little Bay to operate the jets. East of Little Bay, the three cables will be merged back into a single line that will remain underground until it crosses Little Bay Road in Newington, after which it will transition back to an overhead line until it terminates at the Portsmouth substation. In most locations, the existing distribution line will be co-located on the new structures and the existing distribution structures will be removed. In several locations, the existing distribution line will be relocated outside of the project corridor and the new structures will carry the new transmission cables only. A short portion of an existing transmission line will need to be relocated to accommodate the new SRP alignment at the Crossings at Fox Run Mall in Newington. Substation improvements in Madbury and Portsmouth will be confined to the existing substation footprints. No other substation modifications are proposed.

The installation of the three cables in Little Bay is anticipated to cause a temporary discharge of suspended sediments and displacement of benthic material. The predicted suspended sediment and deposition of resettled sediments is described in detail in Appendix A, or SEC Appendix 35.

The SRP submarine power cables under Little Bay will be installed and buried beneath the seafloor by jet plow. The three cables will be spaced approximately 30 feet apart to minimize risk of damage during installation. Jet plow burial depths will be 3.5 feet on the tidal flats and 8 feet in the deeper channel (Figure 2).

The jet plow blade will be constructed for the PSNH project with two water pressure chambers equipped with high volume water nozzles along the leading edge of the plow blade. The water nozzles inject a high volume of water into the soils immediately ahead of the blade. The water injection fluidizes the soils immediately ahead of the plow blade facilitating the cable installation while allowing for a reduced towing tension of the cable plow behind the installation barge. As the plow moves forward, the cable is laid through the bottom of the blade. As the plow advances, the cable is left embedded in the sea floor; as the fluidized soils settle back into place, burial of the cable is achieved with minimal disturbance to the seabed.

The purpose of using a multi chambered blade with two water chambers (upper and lower) is to minimize turbidity in the surrounding water column. Higher volumes of water are pumped through the nozzles in the lower chamber, while lower volumes are pumped through the upper chamber; this keeps seafloor particulate suspension to a minimum.

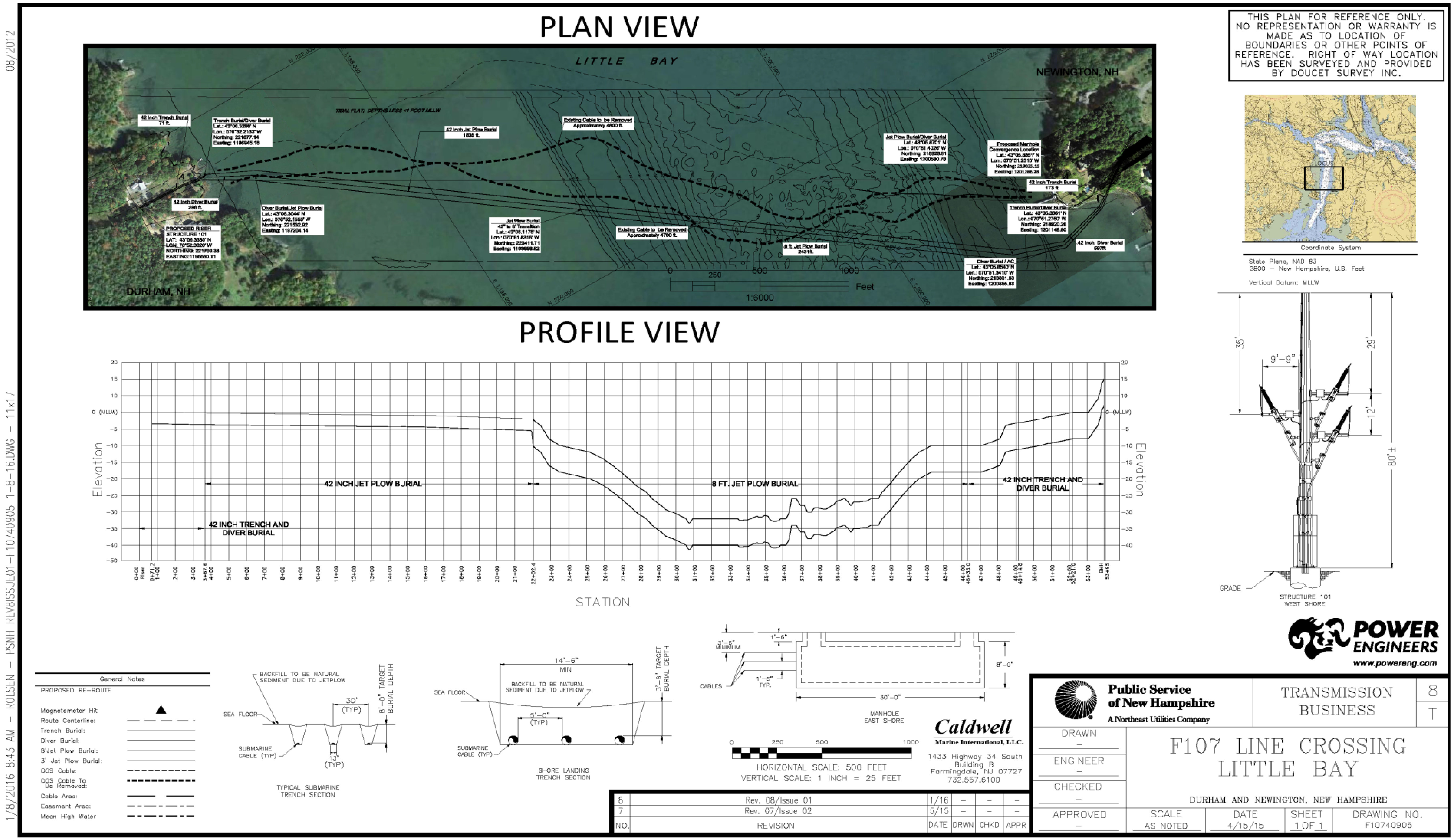
Diver burial (work done by hand by divers using a jet hose) will be necessary near the shorelines where the jet plow cannot access, for approximately 200 feet on the western shore and 600 feet on the eastern shore (Figure 2). The cable will be buried approximately 3.5 feet deep in these sections.

In the nearshore intertidal, the burial will be performed using an excavator on timber mats for approximately 75 feet on the western shore and 175 feet on the eastern shore (Figure 2). Again, the cable will be buried approximately 3.5 feet in these sections.

2.3 Characteristics of the discharge and/or withdrawal

2.3.1 Flow rate (cfs)

The flow rate of the discharge is determined by the pumps used in jet plow. The technology uses high pressure hoses to fluidize the substrate. The jet plows use two pumps that draw, in total, approximately 1,000 m^3/hour, or 9.8 ft^3/s from Little Bay. Total volume to be withdrawn and discharged into the substrate will be approximately 96 x 103 m^3 (25.3 x 106 gallons).


PLAN VIEW
LITTLE BAY
NEWINGTON, NH
DURHAM, NH
PROFILE VIEW
Elevation
STATION
42 INCH JET PLOW BURIAL
8 FT. JET PLOW BURIAL
42 INCH TRENCH AND DIVER BURIAL
THIS PLAN FOR REFERENCE ONLY. NO REPRESENTATION OR WARRANTY IS MADE AS TO LOCATION OF BOUNDARIES OR OTHER POINTS OF REFERENCE. RIGHT OF WAY LOCATION HAS BEEN SURVEYED AND PROVIDED BY DOUCET SURVEY INC.
Coordinate System
State Plane, NAD 83
2800 – New Hampshire, U.S. Feet
Vertical Datum: MLLW
GRADE
STRUCTURE 101 WEST SHORE
POWER ENGINEERS
www.powereng.com
General Notes
PROPOSED RE-ROUTE
Magnetometer Hit
Route Centerline:
Trench Burial:
Diver Burial:
8'Jet Plow Burial:
3' Jet Plow Burial:
OOS Cable:
OOS Cable To Be Removed:
Cable Area:
Easement Area:
Mean High Water
BACKFILL TO BE NATURAL SEDIMENT DUE TO JETPLOW
SEA FLOOR
SUBMARINE CABLE (TYP)
TYPICAL SUBMARINE TRENCH SECTION
8'-0" TARGET BURIAL DEPTH
SHORE LANDING TRENCH SECTION
3'-6" TARGET BURIAL DEPTH
CABLES
MANHOLE EAST SHORE
HORIZONTAL SCALE: 500 FEET
VERTICAL SCALE: 1 INCH = 25 FEET
Caldwell Marine International, LLC.
1433 Highway 34 South Building B Farmingdale, NJ 07727 732.557.6100
8 Rev. 08/Issue 01 1/16
7 Rev. 07/Issue 02 5/15
NO. REVISION DATE DRWN CHKD APPR
Public Service of New Hampshire
A Northeast Utilities Company
TRANSMISSION BUSINESS
DRAWN
ENGINEER
CHECKED
APPROVED
F107 LINE CROSSING LITTLE BAY
DURHAM AND NEWINGTON, NEW HAMPSHIRE
SCALE AS NOTED
DATE 4/15/15
SHEET 1 OF 1
DRAWING NO. F10740905

2.3.2 Potential chemical, physical, biological constituents

Discharge in Little Bay will consist solely of seabed material suspended in ambient water. Seabed sediment texture was characterized based on data collected for the Project in June and August 2013, as described in the Sediment Dispersion Report. Grain size distribution from a transect located 600 feet south of the proposed cable burial was interpolated to determine grain sizes for the cable route. Medium and fine sand with some silt dominated in the channel, while the western tidal flat consisted of predominantly silt with clays and fine sand. These data were supported by project-specific incidental samples for thermal capacity and benthic organisms.

The Natural Resource Impact Assessment report prepared by Normandeau Associates for the project reviewed existing data for Little Bay sediments, and found that contaminant levels in sediments that will be disturbed by cable installation are likely to be low. Therefore, there is a low risk that use of the jet plow will result in dispersal of contaminants to other parts of the estuary.

2.3.3 Frequency (e.g., daily, hourly,) and Duration

Installation of the each of the three cables is expected to occur in the fall of 2017 (after Labor Day) and will be completed before air temperatures fall below 32˚F, a point at which the cables become too inflexible to handle. The jet plow portion of each cable installation will take approximately 13 hours with a week of mobilization between cables. Jet plowing will always be initiated on the western tidal flat and, because of the shallow water depths encountered there, it will have to start at slack high water, or the beginning of the ebb tide. Rate of advance of the jet plow is predicted to be 100 m/hr (328 ft/hr).

The jet plow will not be able to access the upper intertidal area on either the west or the east shorelines. Cables will be laid on the substrate surface in these areas initially and when jet plowing is complete, divers will return to use hand jets to bury the cables. Hand jetting is a much slower process than jet plowing and will take up to 90 days to complete (working only in the four-hour window around slack high tide in the shallows).

The nearshore burial by excavator is expected to be completed within a single tidal cycle on each side of the bay. The speed at which the work proceeds could be slowed by ledge or boulders within the burial depth. If ledge is encountered, the burial depth will be attempted using a rock hammer to break the rock into maneuverable pieces. If this process is unsuccessful, protective concrete mattresses may be necessary to provide adequate cover for the cables.

2.3.4 Temperature (Celsius)

Temperature of the discharge will match the ambient temperature of the water and substrate in Little Bay. No increases in temperature or thermal effects are anticipated to occur. The jet plow technology uses water withdrawn from Little Bay and jetted under pressure into the substrate to create a temporary trench.

2.3.5 Latitude and longitude

The proposed project covers a 12.9 mile route. The crossing at Little Bay is located between 70°52'10.807" W 43°6'18.869" N and 70°51'12.894" W 43°5'51.583" N. The Oyster River crossing is located at 70°56'17.481" W 43°7'48.525" N.

2.4 The existing and designated use(s) that are potentially affected by the proposed activities

Assessment Units are segments or portions of waterbodies used for reporting the results of all water quality assessments. The cable burial in Little Bay is proposed to occur in two Assessment Units:

- NHEST600030904-06-19, "Upper Little Bay," and
- NHEST600030904-06-10 010600030904, "Adams Point Mooring Field Sz, Prohibited/Safety Zone, Closed, 227.811 Acres."

Designated uses in Little Bay are described in the 2012 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (NHDES, January, 2014). Those uses are: Aquatic Life, Fish Consumption, Shellfish Consumption, Drinking Water Supply after Adequate Treatment, Primary Contact Recreation, Secondary Contact Recreation, and Wildlife. Of these designated uses, it is anticipated that Aquatic Life and Shellfish Consumption are existing uses in Little Bay that may be affected temporarily by turbidity and benthic deposition. Given the relatively short duration of the impact, it is not anticipated that Fish Consumption will be affected.

The Natural Resource Impact Assessment details potential impacts to aquatic life that may be incurred in Little Bay. Marine species that may be affected include benthic organisms, bivalves such as oysters, softshell clams, and razor clams (an oyster aquaculture operation currently operates at the eastern end of the cable burial area); non-bivalves such as hermit crabs and mud snails; horseshoe crabs and American lobsters; and several species of fish. All impacts are predicted to be temporary and ephemeral from the suspended sediment plume and the minor deposition as the suspended sediments resettle to the bottom.

2.5 The provision(s) of surface water quality standards (Env-Wq 1700) that are applicable to the designated uses affected by the proposed activities

It is anticipated that the provisions of the surface water quality standards that are applicable to the designated uses that will potentially be affected (Aquatic Life and Shellfish Consumption) are Env-Wq 1703.08 Benthic Deposits and Env-Wq 1703.11, Turbidity. The waters that are proposed to be affected are Class B waters under NH RSA 485-A:8.

2.5.1 1703.08 Benthic Deposits

Env-Wq 1703.08 states "(b) Class B waters shall contain no benthic deposits that have a detrimental impact on the benthic community, unless naturally occurring." The proposed activity will displace benthic sediments such that they will resettle at varying thicknesses depending on the distance from the jet plow. The Sediment Dispersion Report modeled sediment deposition in terms of contours with modeled deposition thicknesses. The model predicted that, as a result of installation of the three cables using a jet plow, sediments redeposited on the bay floor would cover a 5.9-acre area (1.5 times the footprint of the trenches), including the trenches themselves, in a layer 0.2 to 0.4 inches (5 to 10 mm) thick. RPS ASA predicted that deposition of sediments 0.004 to 0.2 inch (0.1 to 5 mm) thick could extend over an additional area of up to 139 acres, but deposition over most of that area (about 88 acres) would be 0.02 inch (0.5 mm) or less.

The Sediment Dispersion Report suggests that a percentage of the freshly deposited sediment will probably be resuspended by currents and potentially dispersed from the area. A measure of the stability of deposited sediments to the seabed is a function of the erosion velocity for each grain size in the sediment. Since the freshly deposited sediment is unconsolidated the fine grains (clay and silt) and sand are eroded at a velocity of about 20 cm/s (0.4 knot). This minimum speed is exceeded across most of Little Bay except in the shallows very near the shore. Thus, some of the sediment will be resuspended on each flood or ebb and dispersed from the areas initially affected by deposition.

Tidal currents are lower on the tidal flats , so the likelihood of resuspension near the shore is reduced and accumulation is more likely unless wind-induced waves occur. The Natural Resource Existing Conditions Report (Appendix B, or SEC Appendix 7) notes that that rain events and ice scour are also important factor in resuspension of fine grained sediments on tidal flats in the Great Bay system. All of these factors are likely to contribute to post-installation reworking of the sediments on the tidal flat.

In the areas where diver burial of the cables will take place within silt curtains, the suspended sediments will ultimately be redeposited within the entire enclosure forming a layer of unconsolidated material averaging approximately 1.2 (west) to 1.4 (east) inches thick although deposition will be greater directly over the trenches and thinner closer to the silt curtains. Sediments suspended by divers in the unprotected area will be deposited most thickly (up to 2 inches thick) in the immediate vicinity of the work area and more thinly with distance from the work area. Over time, the newly deposited, unconsolidated sediment particles will likely be re-distributed by tidal currents and wave action to restore original bottom contours.

Potential impacts to the benthic community are detailed in the Natural Resource Impact Assessment (Appendix C, or SEC Appendix 34). Long-term impacts related to benthic deposition are anticipated to be negligible. Mobile benthic organisms are expected to recolonize sediments once they have become stable, and less mobile species are expected to repopulate sediments the following spring via spawning and settlement. Eelgrass, macroalgae, and shellfish are not likely to be adversely affected by sediment deposition associated with this project. It is anticipated that some species such as lobster, crabs, and some bottom-feeding fish species may benefit from the disturbance to the benthic environment because of increased scavenging opportunities.

Post-construction monitoring is proposed to assess the effects of the cable installation on benthic infauna and bathymetry (Appendix D).

2.5.2 1703.11 Turbidity

Env-Wq 1703.11 states: “(b) Class B waters shall not exceed naturally occurring conditions by more than 10 NTUs.” The Sediment Dispersion Report characterized the dispersion and re-deposition of these sediments resulting from jet plowing using an assumed advance rate of 330 ft/hr (100 m/hr). At that rate, each crossing is likely to generate suspended sediment plumes that range in concentration from 10 to 5,000 mg/L above ambient concentrations. Concentrations in the majority of the plume will be very low (about 10-20 mg/L above ambient), with the highest concentrations occurring directly over the trench. Cumulatively, over the approximately 13-hour installation process for one cable, the plume (10 to > 5,000 mg/L) will affect about 400 acres, although the maximum extent of the plume at any given time will be 15 to 55 acres. The plume will be controlled by the tide stage, and centered in the vicinity of the jet plow at any given time. Maximum plume concentrations are expected to drop below 100 mg/L above ambient within about two hours and below 20 mg/L within about three hours. The model indicates the plume will be entirely dispersed within six hours of passing a given point on the route. Once the jet plow stops operating, no additional sediment will be suspended and the residual plume will completely dissipate in less than two hours.

The Natural Resource Impact Assessment (Appendix C, or SEC Appendix 34) details anticipated impacts to aquatic life that will be incurred by the suspended sediments. Suspended sediments are not anticipated to affect eelgrass or macroalgae, because of the short duration of the plume and the fact that eelgrass will be senescing/dormant during the proposed work period. Studies of fish exposed to excess sediments indicate that they generally respond with avoidance or sublethal effects such as reduced feeding.

An aquaculture operation immediately downstream (on the northeast side, within the cable right of way) of the proposed cable route will be potentially exposed to excess suspended sediments ranging from 10-20 mg/L above ambient levels for several hours. Based on research which exposed caged oysters to total suspended sediment concentrations as high as 710 mg/L for three weeks and found no discernable response, it is anticipated that there will be no response by the oysters to the suspended sediment plume from jet plowing. If oysters do continue filtering during the jet plowing, subsequent exposure to normal ambient seawater will allow oysters to cleanse excess sediment from their tissues.

Construction monitoring is proposed to assess the effects of the cable installation on turbidity levels in Little Bay (Appendix D).

2.6 A pollutant loading analysis to show the difference between pre-development and post-development pollutant loads for a typical year

It is assumed that for the purposes of this water quality certification, no pollutant loading analysis is necessary. The project proposes no increase in impervious surfaces and thus no changes in pollutant loading.

2.7 A description of any other aspect of the activity that would affect the chemical composition, temperature, flow, or physical aquatic habitat of the surface water

The Natural Resource Impact Assessment (Appendix C, or SEC Appendix 34) details potential effects to aquatic life that may occur due to the jet plowing process. The jet plow uses high pressure pumps that cycle seawater to create the cable trench, therefore entrainment of planktonic organisms, and of larval forms of American oysters, softshell clams, and American lobster is likely to occur. Because the total volume of water that will be pumped through the jet plow mechanism is 0.004-0.006% of the volume of upper Little Bay, it is assumed that the loss due to entrainment will be insignificant.

2.8 An original or color copy/reproduction of a United States Geological Survey Quadrangle Map that clearly shows the location of the activity and all potential discharge points

A USGS map depicting the cable crossing location is provided in Figure 1. More detailed mapping is included with the NHDES Wetland Application for this project.

2.9 A copy of the final complete federal permit application or federal license application, including the federal permit, license, or project number

The SRP is being reviewed by the US Army Corps of Engineers as a Section 404/10 New Hampshire General Permit, therefore no separate federal application has been prepared.

2.10 A copy of the DES wetlands permit (RSA 482-A:3), if necessary

A NHDES Wetland Permit Application is being submitted concurrently. A copy is provided as SEC Appendix 13.

2.11 A copy of the DES alteration of terrain permit (RSA 485-A:17), if necessary

A NHDES Alteration of Terrain Application is being submitted concurrently. A copy is provided as SEC Appendix 16..

2.12 The name(s) and address(es) of adjoining riparian or littoral abutters

Per, Env-Wt 501.01(c) abutter notification is not required for projects in utility ROWs; therefore abutter notification has not been completed for the portions of the Project located in existing and/or proposed utility ROW areas.

It should be noted that the Project has conducted and will continue to conduct pro-active outreach actions throughout Project permitting and construction, and public hearings will take place in accordance with NH SEC rules.

2.13 A plan showing the proposed activities to scale including:

2.13.1 The location(s) and boundaries of the activities;

2.13.2 The location(s), dimension(s), and type(s) of any existing and/or proposed structures; and

2.13.3 The location(s), name(s), identification number(s), and extent of all potentially affected surface water bodies, including wetlands

Wetland plan sheets submitted with NHDES Wetland Permit Application for this project depict the proposed impacts and Assessment Unit IDs of affected surface waters. The maps are provided electronically on the thumbdrive at the front of this application.

Appendix A. Modeling Sediment Dispersion From Cable Burial

Modeling Sediment Dispersion from Cable Burial for Seacoast Reliability Project, Little Bay, New Hampshire

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Project Number: 2014-270
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Executive Summary

Public Service of New Hampshire d/b/a Eversource Energy (PSNH) has proposed the construction of an electrical cable system to increase the reliability of the electrical transmission grid in southern New Hampshire. This cable, known as the Seacoast Reliability Project, would cross the Little Bay portion of the Great Bay Estuarine System. The crossing would entail burial of three separate but parallel cable bundles by jet plowing, which is a technique that liquefies the sediment with high pressure water jets and simultaneously allows the cable to be buried at a predetermined depth. The cable sections in the shallow areas near the western and eastern landfalls will be buried by diver. The environmental consultant for the Project, Normandeau Associates, Inc., contracted with RPS ASA to supply its modeling capabilities to simulate the jet plowing and diver burial processes along the cable route to determine both the likely suspended sediment concentrations generated in the water column above the cable route and the resulting re-deposition of the sediments in and along the route.

Two computer models were used in the analysis: BELLAMY, a hydrodynamic model used for predicting the currents in Little Bay, and SSFATE, a sediment dispersion model used for predicting the fate and transport of sediment resuspended by the jet plowing operation. BELLAMY, a finite element, two-dimensional, vertically averaged, time stepping circulation model developed at Dartmouth College and previously applied to the Great Bay Estuarine System (GBES) (McLaughlin et al. 2003; Swanson et al. 2014) was used in this analysis. The model can calculate the time varying surface elevation and currents under the influence of tides, winds and river flow on a model domain discretized by a large number of finite element triangles. Due to the fact that Great Bay is tidally dominated (currents up to 2 m/s [6.6 ft/s] and much of it consists of narrow channels in which the tidal currents mostly flow in flood and ebb directions, the effect of wind is expected to show only in areas with relatively larger surface areas such as Great Bay proper and not Little Bay where the cable burial will occur. The model includes simulation of wetting and drying of tidal flats. All simulation parameters were set to be consistent with previously published work. The reader is referred to Swanson et al., (2014), Bilgili et al. (2005) and McLaughlin et al. (2003) for more detailed information.

The SSFATE (Suspended Sediment FATE) model was utilized to predict the excess suspended sediment concentration and the dispersion of suspended sediment resulting from jetting and diver activities. Since ambient suspended sediment concentrations are variable and generally unpredictable, the model predicts excess concentration, which is defined as the concentration above ambient suspended sediment concentration generated by the jetting activities. In addition SSFATE calculates the resulting deposition thickness of resuspended sediments that have resettled back on the bottom. The sediment grain size information necessary to characterize the sediment was extracted from vibracore data logs taken in April 2014. Some of the cores exhibited high (70 to 90%) fractions of fines (clays and silts) while others exhibited equally high (70 to 90%) of sands. A single representative cable route among the three cable bundles crossing Little Bay was chosen for modeling since the cables will be installed in sequence and are proposed to be separated by only about 9.4 m (30 ft) and all were parallel except when they approached the landfalls.

The cables in the offshore areas are to be buried by jet plowing to minimum depths of 1.07 m (42 in) deep in the shallows on the western but offshore section of Little Bay and 2.7 m (8 ft) in the center and east sections. For ease of discussion, this report refers to the jet plow disturbance as a trench although while the jet plow will be occupying a three-dimensional space, the “trench” is very temporary as it will fill in immediately behind the jet plow. The total depth of the trench was 1.42 m (96 in) for the western section and 2.79 m (110 in) for the central and eastern sections. Based on Caldwell's specification the trench width was defined as 0.32 m (12.75 in) resulting in a vertical-walled trench cross sectional area of 0.46 m^2 (4.96 ft^2) in the shallow western portion and an area of 0.90 m^2 (9.69 ft^2) in the deeper central and eastern portions. The lengths of the trenches were defined by Caldwell to be 559 m (1,835 ft) for the shallow burial and 741 m (2,431 ft) for the deeper burial. The jet plow rate of advance was provided by the cable installer, Caldwell Marine International, LLC to be 100 m/hr (330 ft/hr). The model run was started on the west side of Little Bay at slack high water which is the beginning of the ebb tide. It was also conservatively assumed, based on past experience, that 25% of the material in the trench would be resuspended into the water column by the jetting activity.

The cables in the nearshore areas are to be buried by divers in trenches with a minimum depth of 1.07 m (42 in) deep in the shallows on both the western and eastern portions of Little Bay with lengths of 90 m (296 ft) in the western portion and 178 m (584 ft) in the eastern portion. The total depth of the trench was 1.22 m (48 in). Based on Caldwell's specification the trench width was defined as 1.22 m (48 in) resulting in a trench cross sectional area of 1.49 m^2 (16 ft^2). The diver rate of advance was much slower than the jet plowing at 2.3 m/hr (7.5 ft/hr) with an operational time restriction of 4 hr/dy. It was also conservatively assumed, based on past experience, that 50% of the material in the trench would be resuspended into the water column by the diver activity. The model run was started around two hours before high slack water and continued for four hours due to diver requirements of lower currents and deeper water. An option to use silt curtains for the diver burial operations in the western and eastern portions was also examined.

Jet Plowing

The size of the resulting excess suspended sediment (SS) concentration plume in the lower water column is defined as a series of areas enclosed by different concentration levels. The water column concentration contours shown, which are defined by a single concentration level, totally surround an enclosed area where concentrations are at or above the specified concentration, i.e., the area is cumulative. The entire area encompassed by the plume (as defined by the 10 mg/L excess SS concentration contour) averaged over time was 14.8 ha (36.58 ac) ranging from a low of 5.91 ha (14.61 ac) at 1 hr to a high of 22.36 ha (55.25 ac) at 10 hrs. These total enclosed areas dropped dramatically for the higher concentrations, averaging 1.94 ha (4.79 ac) at 100 mg/L, 0.28 ha (0.68 ac) at 1,000 mg/L and 0.02 ha (0.05 ac) at 5,000 mg/L. indicating that the extent of the plume is limited for higher concentrations. In the shallows, suspended sediments from the jet plow activity are likely to reach nearly to the water surface. In the channel, excess suspended sediments will be restricted to the lower half of the water column.

An important metric defining the plume is its duration for different concentrations, which could have biological significance if exposure (duration multiplied by concentration) is sufficiently elevated. The maximum plume size and duration at 10 mg/L excess SS concentration in the area that is totally enclosed by the contour is 90.20 ha (222.89 ac) but lasts for only 1 hr. This short duration continues for all the concentration contour thresholds through 1,000 mg/L. The enclosed areas quickly drop in time for a given concentrations so by 2 hrs the 10 mg/L area has dropped to 32.20 ha (79.57 ac) and the plume has completely dissipated within 6 hrs. The area coverages drop dramatically for the higher concentrations near the jet plow indicating that the duration and extent of the plume is relatively limited. Once the jet plow reaches the eastern terminus and shuts down no additional sediment will be suspended and the residual plume will quickly dissipate.

The bottom deposition was calculated based on all three cable routes being jet plowed and assuming that any sediment deposited on the bottom remained in place. The bottom deposition thickness is defined for the area exclusively between the range of thicknesses described, i.e., the area is not cumulative. As with the water column concentrations of suspended sediment the sizes of the deposition thickness patterns generally drop in size, but not always. At the range of 0.1 to 0.5 mm (0.004 to 0.02 in) thickness the area is 35.6 ha (87.9 ac) due to jet plowing the three cable routes. These areas drop overall for the high deposition thicknesses (e.g., 2.4 ha [5.9 ac] for the 5 to 10 mm (0.2 to 0.4 in) thickness range) near the jet plow indicating that the extent of the plume is relatively limited.

Diver Burial Assuming No Use of Silt Curtains

The size of the excess SS concentration plumes for the west and east diver burial sections were also examined. It was assumed that no silt curtains were used during this activity (if they had been modeled the amount of excess SS and would be reduced 10-fold outside the silt curtained area). Typically, at 10 mg/L excess SS concentration, the instantaneous total area enclosed by the contour is 8.4 ha (20.7 ac) for the west section and 1.9 ha (4.7 ac) for the east section. However, these total enclosed areas drop dramatically for the higher concentrations near the diver burial activities, i.e., the area at 1,000 mg/L is only about 0.2 ha (0.6 ac) for the west section and 0.0 ha (0.1 ac) for the east section, indicating that the extent of the plume is again relatively limited.

Assuming no silt curtains were used, the total area in the west section that is enclosed by the 10 mg/L excess SS concentration contour is 14.6 ha (36.1 ac) but lasts for only 1 hr. This short duration continues through all the concentration contour thresholds through 5,000 mg/L. The enclosed areas decrease in time for a given concentrations so by 6 hrs the 10 mg/L area has dropped to 8.6 ha (21.2 ac). The 10 mg/L area persists for two days because the initial buildup occurs near slack water with grain size distribution indicating mostly fines (silts and clays). The area coverages decrease for higher concentrations near the diver burial activities. At the east section the 10 mg/L excess SS concentration total area that is enclosed by the contour is 8.2 ha (20.2 ac) but lasts for only 1 hr. This short duration continues through all the concentration contour thresholds through 500 mg/L. The enclosed areas decrease in time for a given concentration so by 6 hrs the 10 mg/L area has dropped to 4.1 ha (10.2 ac). The 10 mg/L area persists for two days because the initial buildup occurs near slack water with grain size distribution indicating mostly fines (silts and clays). The area coverages decrease for higher concentrations near the diver burial activities.

The sizes of the deposition thickness patterns also dropped as the deposition increased. At the 0.1 to 0.5 mm (0.004 to 0.02 in) thickness range the area is 3.4 ha (8.5 ac) for the west and 4.4 ha (10.8 ac) for the east, both including the three cable routes combined. These areas drop dramatically for the higher deposition thicknesses (e.g., 0.5 ha [1.2 ac] for the 10 to 50 mm (0.4 to 2 in) thickness on the west section and 1.2 ha (2.9 ac) for the east section indicating that the extent of the plume is limited.

Diver Burial Assuming Use of Silt Curtains

The effects of using silt curtains were estimated by assuming that 90% of the suspended sediment resuspended from diver burial operations would be trapped by the curtains. That being the case, the results based on no silt curtain use can be reduced by a factor of 10 to estimate the concentrations outside the silt curtain. At 10 mg/L excess SS concentration the area enclosed by the contour was 1.2 ha (3.0 ac) for the west section and 0.4 ha (0.9 ac) for the east section.

In terms of exposure, for the west section at 10 mg/L excess SS concentration the area that is enclosed by the contour is 5.9 ha (14.7 ac) but lasts for only 1 hr. The areas decrease in time for a given concentrations so by 6 hrs the 10 mg/L area has dropped to 2.3 ha (5.7 ac). For the east section at 10 mg/L excess SS concentration the area that is enclosed by the contour is 2.1 ha (5.1 ac) but lasts for only 1 hr. The areas decrease in time for a given concentration so by 6 hrs the 10 mg/L area has dropped to 1.4 ha (3.6 ac). The area within the silt curtain area would, of course, see a significant increase in concentration until the material has settled out.

With the use of silt curtains the bottom deposition thickness outside the silt curtains can also be reduced by a factor of 10. At the 0.1 -> 0.5 mm (0.004 -> 0.02 in) thickness the area enclosed by the contour is 1.9 ha (4.6 ac) for the west and 1.1 ha (2.6 ac) for the east. Based on the trench geometry for diver burial 90% of the entire west resuspension volume or 181.0 m^3 (6,394 ft^3) spread over the area enclosed by the silt curtain results in an average deposition thickness of 94 mm (3.71 in) while 90% of the entire partial east resuspension volume or 224.5 m^3 (7,927 ft^3) spread over the enclosed area results in an average deposition thickness of 110 mm (4.32 in). Larger thicknesses would be found closest to the burial routes (including in the trenches) and smaller thicknesses found closer to the silt curtains distant from the routes.

Stability of Deposited Sediments

A measure of the stability of deposited sediments to the seabed is a function of the erosion velocity for each grain size in the sediment. Since the freshly deposited sediment is unconsolidated, the fine grains (clay and silt) and sand are eroded at a velocity of about 20 cm/s (0.4 kt). Maximum tidal currents exceed this minimum speed across most of Little Bay except in the shallows very near the shore. Thus sediment particles deposited along much of the route will likely be resuspended on subsequent tides and dispersed from the areas initially affected by deposition.

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1 Introduction

Public Service of New Hampshire d/b/a Eversource Energy (PSNH) has proposed the construction of an electrical cable system to increase the reliability of the electrical transmission grid in southern New Hampshire. This cable, known as the Seacoast Reliability Project, would cross the Little Bay portion of the Great Bay Estuarine System as shown in Figure 1-1. The crossing would entail burial of three separate but parallel cable bundles by jet plowing, which is a technique that liquefies the sediment with high pressure water jets and simultaneously allows the cable to be buried at a predetermined depth. The cable sections in the shallow areas near the western and eastern landfalls will be buried by diver. The environmental consultant for the Project, Normandeau Associates, Inc. (Normandeau), contracted with RPS ASA to supply its modeling capabilities to simulate the jet plowing process along the cable route to determine both the likely suspended sediment concentrations generated in the water column above the cable route and the resulting re-deposition of the sediments in and along the route.

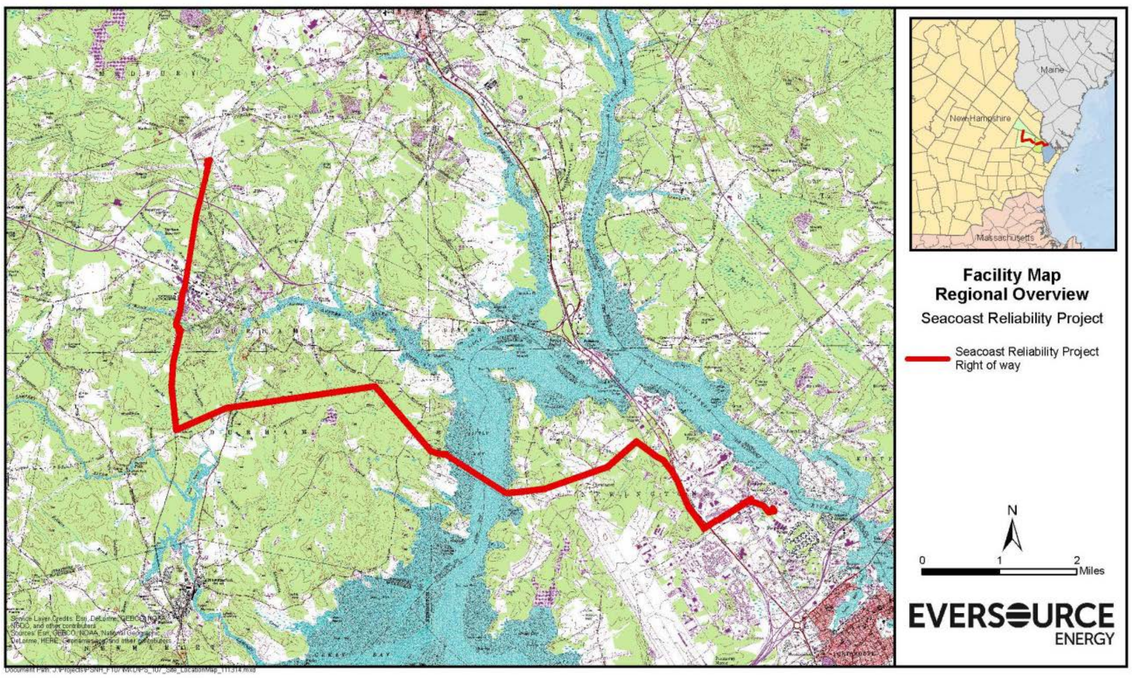

Figure 1-1. Location of the proposed cable route across Little Bay in the Great Bay Estuarine System (image from Normandeau Associates).

This report documents the hydrodynamic and sediment dispersion modeling activities performed to assess the effects from installation of the electrical cable using jet plowing and diver burial. Specifically, Section 1 provides an introduction to the effort by RPS ASA documented in the report, Section 2 presents the hydrodynamic modeling performed, and Section 3 presents the sediment dispersion modeling performed. Section 4 consists of conclusions drawn from the study and references are listed in Section 5.

2 BELLAMY Hydrodynamic Model

2.1 Model Description

A computer model system developed at Dartmouth College and previously applied by RPS ASA to the Great Bay Estuarine System (GBES) (McLaughlin et al. 2003) was used in this analysis and was based on the recent work of Swanson et al. (2014). The model system includes a finite element, two-dimensional, vertically averaged, time stepping circulation model. The circulation model, known as BELLAMY, can calculate the time varying surface elevation and currents under the influence of tides, winds and river flow on a model domain discretized by a large number of finite element triangles. Due to the fact that Great Bay is tidally dominated (currents up to 2 m/sec) and much of it consists of narrow channels in which the tidal currents mostly flow in flood and ebb directions, the effect of wind is expected to show only in areas with relatively larger wet surface areas such as Great Bay proper and not Little Bay where the cable burial will occur. The model includes simulation of wetting and drying of tidal flats.

All simulation parameters were set to be consistent with previously published work. The reader is referred to Swanson et al. (2014), Bilgili et al. (2005) and McLaughlin et al. (2003) for more detailed information. Sensitivity analyses previously reported are the basis for some of the values chosen. Some key assumptions and resulting parameter values are summarized as follows:

- The model domain consists of the entire GBES plus a stretch of the coastal Atlantic Ocean extending from Portland, ME, in the north to the tip of Cape Ann, MA, in the south to incorporate the effect of the Gulf of Maine coastal current. The Little Bay region is shown in Figure 2-1 between the Lower Piscataqua River-North to the east and Great Bay to the south.
- Tidal forcing used the constituent set of M2, N2, S2, O1, K1 and Z0 as described in previously published work (Bilgili et al. 2005).
- No wind forcing was applied to be consistent with previous studies, which showed the wind effect is short term and minimal, particularly since the modeling focused on steady state conditions.
- The model includes annually averaged freshwater discharges from the major rivers as constant values (Bilgili et al. 2005). The effect of time varying discharges is not investigated due to the fact that the total freshwater volume entering the estuary is less than 2% of the tidal prism (Reichard and Celikkol, 1978). The yearly averaged discharges from the WWTF outfalls are also incorporated as constants since these are considered as additional fresh water sources (Trowbridge, 2009).
- The internal hydrodynamic model time step was 99.36 seconds with model predicted velocities output on a 30 min interval. The model was run to capture the 15-day spring-neap cycle.

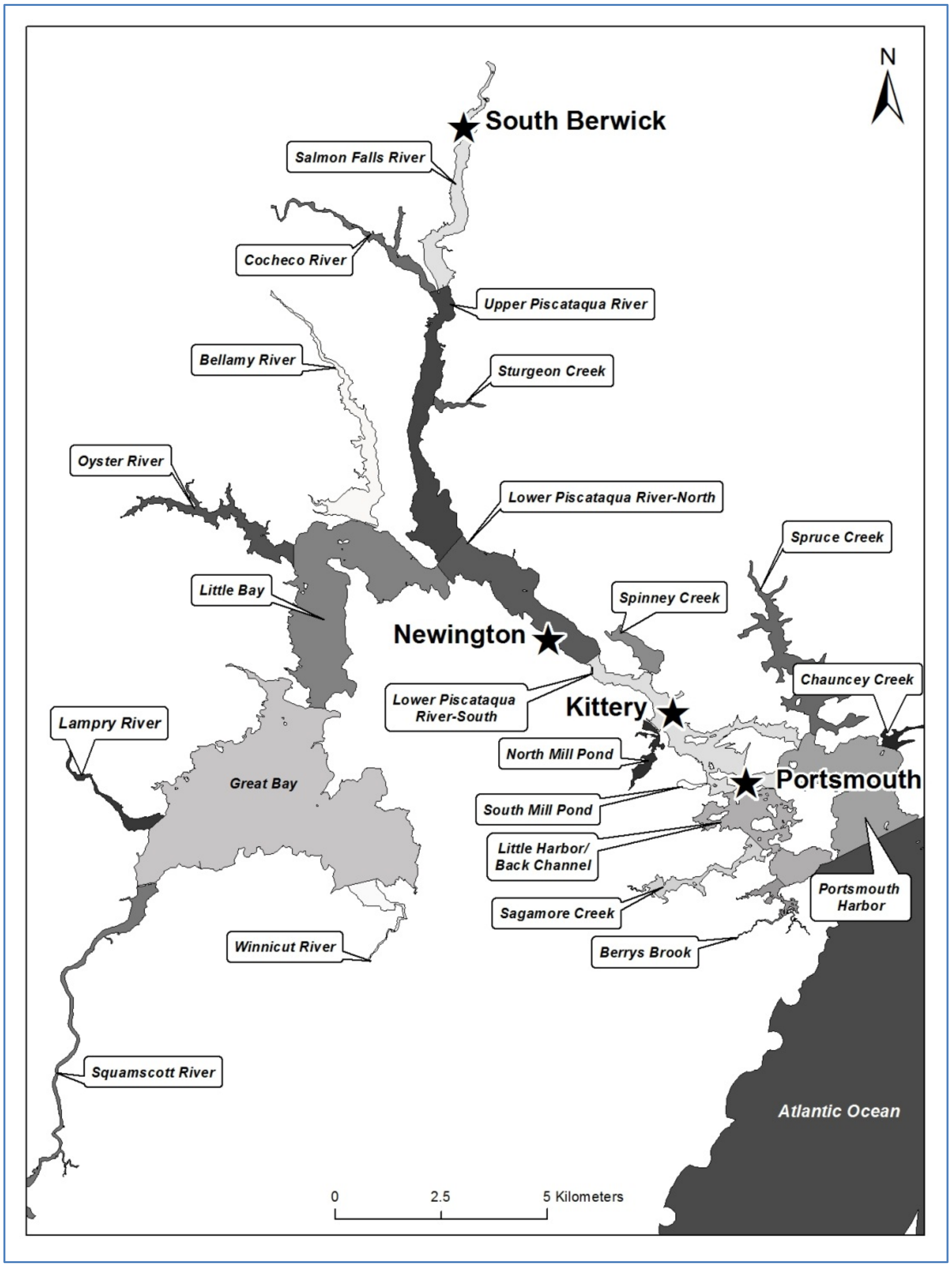

Figure 2-1. Great Bay Estuarine System regions used for previous modeling (Swanson et al., 2014). Little Bay is located in the central portion of the System.

BELLAMY has been tested and calibrated extensively in the Great Bay estuary over the past two decades (Ip et al. 1998; Erturk et al. 2002; McLaughlin et al. 2003; Bilgili et al. 2005). One quantitative statistical measure indicating how well the model reproduces observed currents is “skill”, with 0 indicating no match to data and 1 indicating perfect match with data. McLaughlin et al. (2003) report a mean skill of 0.918 while the Bilgili et al. (2005) work improves this to 0.942 for cross-section averaged current velocity comparisons. Point velocity comparisons also show good fit (McLaughlin et al. 2003; Bilgili et al. 2005), especially considering the inherent variability in this type of measurements.

2.2 Model Results

As noted above the current velocities to be used to disperse the excess suspended sediment were based on previous hydrodynamic modeling of the Great Bay System. Example current vectors for flood and ebb tides in lower Little Bay are shown in Figures 2-2 and 2-3. The vectors are scaled as displayed in the window in the upper left portion of the figures. The line shown across the Bay is a representative approximation of the route of the cables. The strength of the currents is similar in both flood and ebb directions at about 50 cm/s (1 kt) except at the shallow areas located on both sides of the Bay where the currents are reduced.

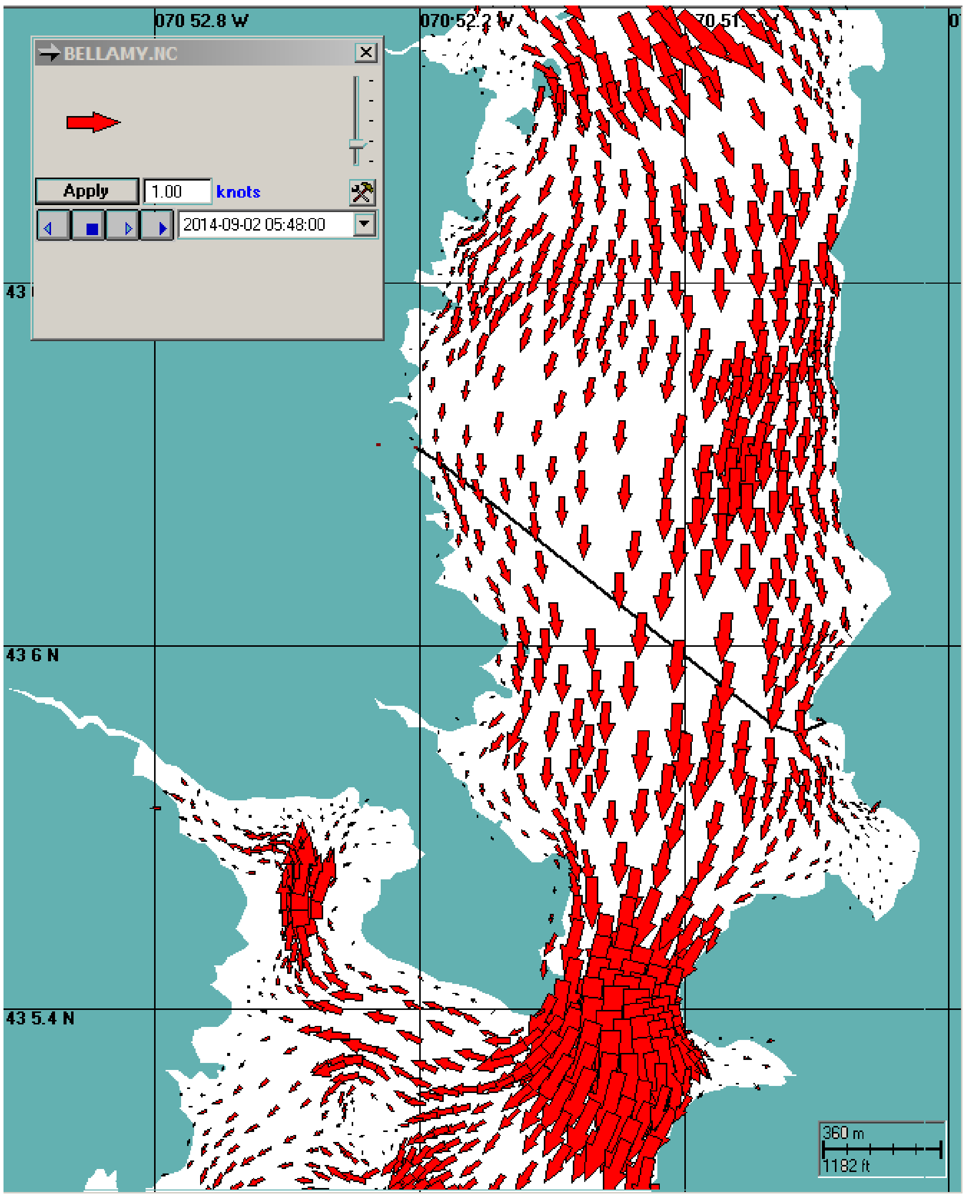

Figure 2-2. Example flood tide currents for lower Little Bay with the solid black line indicating the approximate cable route.

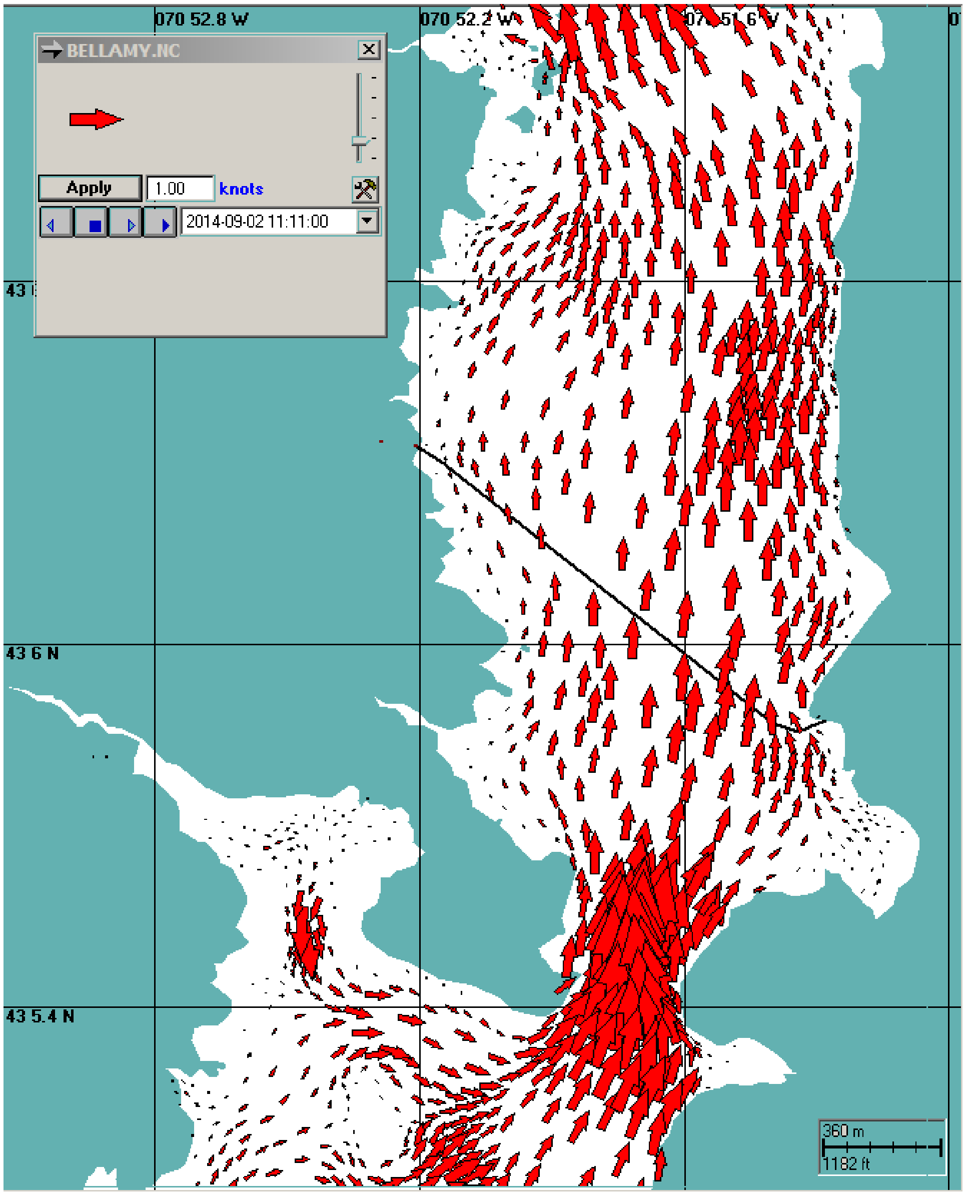

Figure 2-3. Example ebb tide currents for lower Little Bay with the solid black line indicating the approximate cable route.

3 SSFATE Sediment Dispersion Model

3.1 Model Description

The SSFATE (Suspended Sediment FATE) model was utilized to predict the excess suspended sediment concentration and the dispersion of suspended sediment resulting from jetting and diver activities. SSFATE addresses the short term movement of sediments where sediment is introduced into the water column and predicts the path and fate of the sediment particles using the local currents. Excess concentration is defined as the concentration generated by the jetting or diver activities above ambient suspended sediment concentration. In addition SSFATE calculates the resulting deposition thickness of resuspended sediments that have resettled back on the bottom.

SSFATE was jointly developed by ASA and the U.S. Army Corps of Engineers (USACE) Environmental Research and Development Center (ERDC) to simulate the sediment suspension and deposition from jetting operations. It has been documented in a series of USACE Dredging Operations and Environmental Research (DOER) Program technical notes (Johnson et al. 2000 and Swanson et al. 2000); at a previous World Dredging Conference (Anderson et al. 2001) and a series of Western Dredging Association Conferences (Swanson et al., 2004; Swanson and Isaji, 2006). A number of ASA technical reports have been prepared that demonstrate successful application to dredging. In addition SSFATE has been extended to include the simulation of dredged material disposal as well as cable and pipeline burial operations using water jet plows (Swanson et al., 2006; Mendelsohn et al., 2012), diver activities and mechanical plows.

The SSFATE modeling system computes suspended sediment distributions and deposition patterns resulting from various seabed activities. The suspended sediment concentrations are computed in three dimensions while the depositional patterns are computed in two dimensions. The model contains the following features:

- Ambient currents can be imported from a variety of numerical hydrodynamic models;
- The procedure which is a standard numerical approach that mimics the mixing of sediment within the water column due to turbulence;
- SSFATE simulates suspended sediment source strength and vertical distribution from mechanical (e.g., clamshell, long arm excavator) or hydraulic (e.g., cutterhead, hopper) dredges; and water jet plows, divers and mechanical plows;
- SSFATE assumes a continuous release of sediments over time, and calculates average excess sediment concentrations within each grid cell (minimum cell dimension of 10 to 25 m) at each time step;
- Multiple sediment types (different grain sizes) or fractions can be simulated simultaneously;
- SSFATE output consists of excess suspended sediment concentration contours in both horizontal and vertical planes, time series plots of concentrations, and the spatial distribution of sediment deposited on the sea floor.

In far field calculations the mean transport and turbulence associated with ambient currents dominate the distribution of the sediment particles. SSFATE, a particle-based model, predicts the transport and dispersion of the suspended material generated by seabed activities. Particle advection (i.e., transport) is based on the simple relationship that a particle moves linearly with a local velocity, obtained from the hydrodynamic model, for a specified model time step. Particle diffusion (i.e., dispersion) is assumed to follow a simple random walk process frequently used in simulating the dispersion of particles.

The particle model allows the user to predict the transport and dispersion of the different size classes of particles e.g., sands, silts, and clays. The particle-based approach is extremely robust and independent of the grid spacing. Thus, the method is not subject to artificial diffusion near sharp concentration gradients and is easily interfaced with all types of sediment sources including dredging, jet plowing, and backfilling operations.

In addition to transport and dispersion, sediment particles also settle at some rate through the water column to the bottom. Settling of mixtures of particles, some of which may be cohesive in nature, is a complex but predictable process with the different size classes interacting, i.e., the settling of one particle size is not independent of the other sizes. In addition, the clay-sized particles, typically cohesive, undergo enhanced settling due to flocculation. These processes have been implemented in SSFATE using empirically based formulations based on previous USACE studies (Teeter, 1998).

At the end of each time step, the concentration of each sediment class, as well as the total concentration, is computed on a concentration numerical grid. The size of all grid cells is the same, with the total number of cells increasing as the excess suspended sediment moves away from the source. The settling velocity of each particle size class is computed along with a deposition probability based on shear stress. Finally, the deposition of sediment from each size class from each bottom cell during the current time step is computed and the calculation cycle begins anew. Deposition is calculated as the mass of sediment particles that accumulate over a unit area.

Outputs from the model are sediment concentrations for each grid cell and deposition thickness for each grid cell that shares a boundary with the bottom of the river or bay. Concentrations and thicknesses are available for every time step during the period that the model is run.

3.2 Seabed Sediment Characterization

The sediment grain size information was extracted from vibracore data logs taken during a survey for the project in April 2014 by Normandeau (personal communication). The survey consisted of 12 sampling stations shown in Figure 3-1. The qualitative descriptions of each vibracore sediment sample were converted into fractions of sand, silt and clay based on a classification scheme presented by Flemming (2000). The classification scheme uses a ternary diagram where text descriptions of sediment texture (for example, “silty sand”), as summarized in Table 3-1, are mapped onto the diagram and assigned a sand-silt-clay ratio. If a vibracore contained only one sediment sample, the ratio obtained from the diagram defined the size fractions used in the SSFATE model simulations (Table 3-2). If more than one sediment sample was taken from a vibracore, a composite of the size fractions was calculated based on the relative quantities each sample contributed to the whole. Since the SSAFTE classification scheme divides silt into medium-fine and fine silt, the silt fraction obtained from the ternary diagram was equally divided.

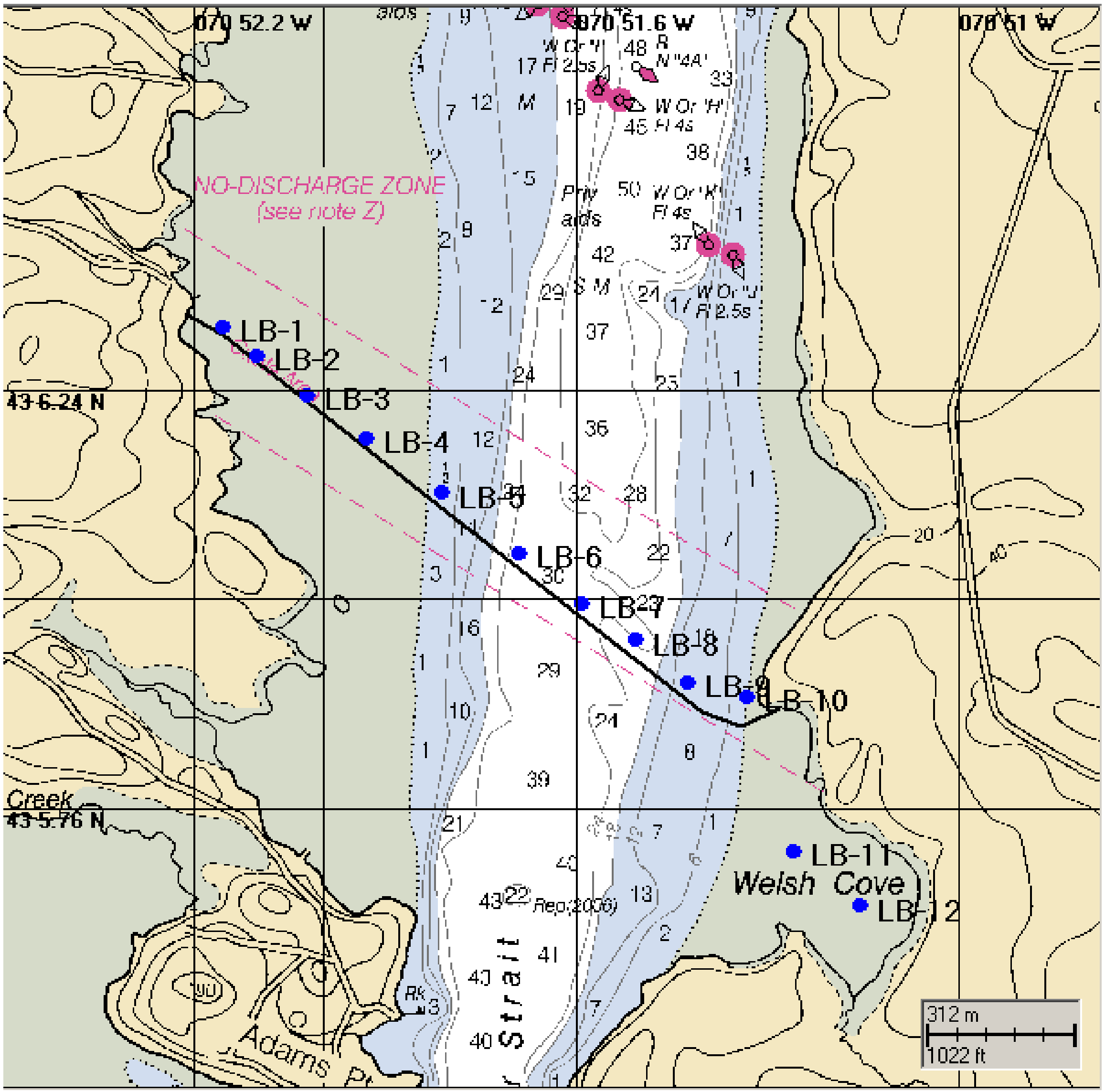

Figure 3-1. Location of vibracore borings across Little Bay along route of cable crossing (indicated by solid line).

Table 3-1 summarizes the vibracore data logs by location across the Bay from tidal flats at the western shore to Welsh Cove at the eastern shore, the Station number, penetration depth and sediment description. Table 3-2 and Figure 3-2 show the resulting sediment grain size distributions for each boring.

Table 3-1. Qualitative description of sediments along cable route from vibracore data logs from survey conducted in April 2014.

Zone	Station	Penetration Depth	Sediment Description
Tidal Flat (west)	LB-1-A	94”	Cohesive Clay with silt
	LB-2-B	104”	
	LB-3-B	104”	
	LB-4-A	120”	Cohesive Clay with silt and trace of fine sands
	LB-5-B	86”	
Channel	LB-6-A	44”	Cohesive Fine to medium sand with small amount of clay and silt
	LB-7-B	63”	0-19”: Cohesive Fine to medium sand with small amount of clay and silt
			19-63”: cohesive Clay with silt
	LB-8-B	29”	0-15”: cohesive Fine to medium sand with small amount of clay and silt
			15-22”: cohesive Fine sand and clay, shell fragments present
			22-29”: cohesive Clay
Slope	LB-9-A	97”	0-22”: cohesive Fine to medium sand with small amount of clay and silt
			22-97”: cohesive Clay with silt, minor shell fragments throughout
Tidal Flat (east)	LB-10-D	44”	Cohesive Fine to medium sand with small amounts of clay

Zone	Station	Penetration Depth	Sediment Description
Welsh Cove	LB-11-B	103”	Cohesive Clay and fine sand with silt
	LB-12-B	46”	0-18”: cohesive Clay and fine sand with silt
			Cohesive Fine to medium sand with little clay and silt; minor amount of wood debris and shell fragments

Table 3-2. Grain size distributions (in percent) for vibracore stations (composited over vertical).

CORE	Coarse Sand	Fine Sand	Med Fine Silt	Fine Silt	Clay
LB-1-A	0.00	0.00	10.00	10.00	80.00
LB-2-B	0.00	0.00	10.00	10.00	80.00
LB-3-B	0.00	0.00	10.00	10.00	80.00
LB-4-A	0.00	5.00	7.50	7.50	80.00
LB-5-B	0.00	5.00	7.50	7.50	80.00
LB-6-A	9.00	81.00	2.50	2.50	5.00
LB-7-B	1.78	16.03	10.52	10.52	61.15
LB-8-B	1.41	17.03	2.32	2.32	76.93
LB-9-A	2.06	18.56	10.21	10.21	58.96
LB-10-D	9.00	81.00	2.50	2.50	5.00
LB-11-B	0.00	20.00	2.50	2.50	75.00
LB-12-B	7.31	69.56	2.50	2.50	18.13

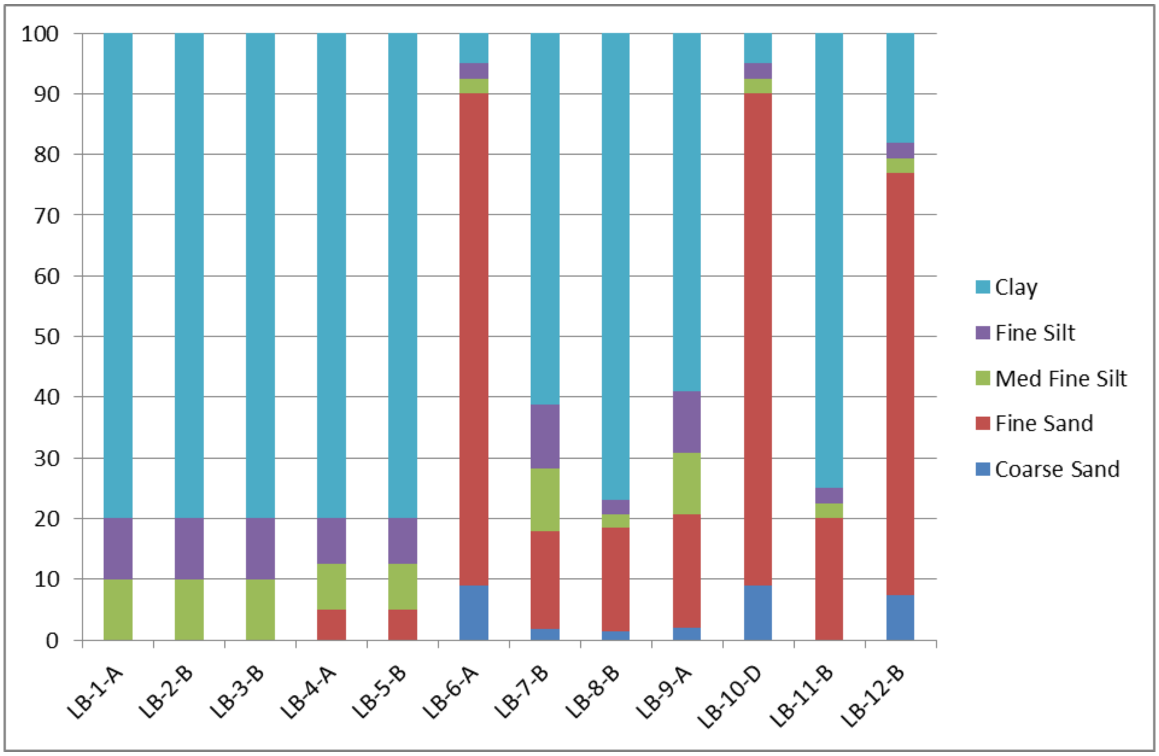

Figure 3-2. Histogram of grain size distributions (in percent) for vibracore stations in Little Bay.

The first five cores exhibit a large fraction (80%) of clay with smaller fractions of fine silt, medium fine silt and fine sand. In contrast cores LB-6-A and LB-10-D show 81% fine sand followed by LB-12-B with 70% fine sand, all within a range of 7 to 9% coarse sand. Cores LB-7-B, LB-8_B, LB-9-A and LB-11-B show clay fractions between 59 and 77% clay and between 16 and 20% fine sand. In general the cores with higher fines fractions will tend to generate larger suspended sediment plumes while those with higher sand fractions smaller plumes.

3.3 Model Input Parameters

The details of the planned route across Little Bay are shown in Figure 3-3 with the upper panel showing the western half of the route and the lower panel showing the eastern half. The three angled parallel lines represent the jet plow portion of the crossing for the three bundled cables with a separation of 9.4 m (30 ft). The western and eastern ends connecting the jet plowing portions to the land are represented by non-parallel routes ending at the shore which use diver burial.

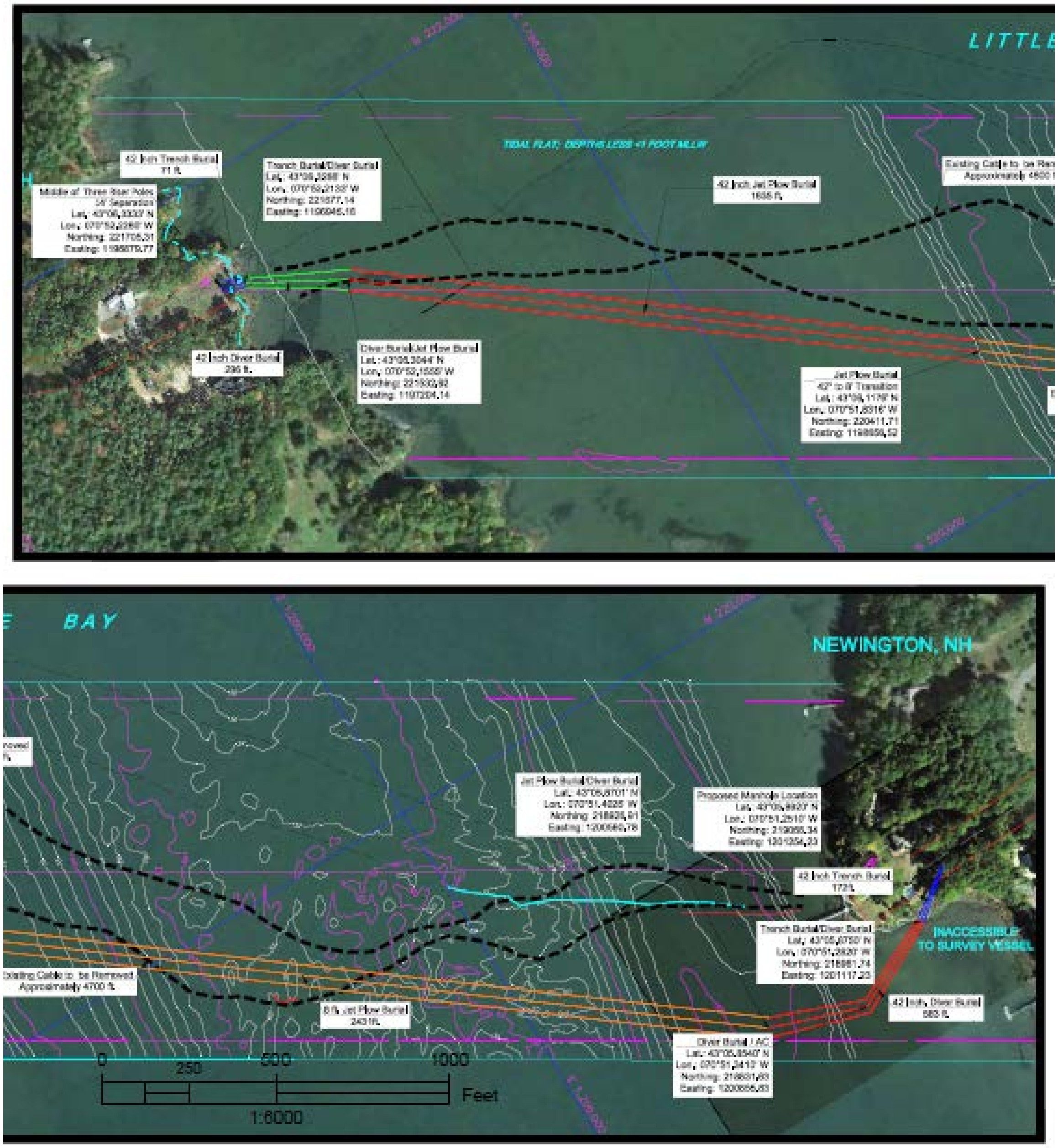

Figure 3-3. Details of proposed cable routes across Little Bay developed by Caldwell (Rev 6 Issue 01 – 20150424). Upper panel shows western half and lower panel shows eastern half.

3.3.1 Jet Plow Burial

The jet plow rate of advance was provided by the cable installer, Caldwell Marine International, LLC to be 100 m/hr (328 ft/hr). The central cable route among the three cable bundles crossing Little Bay was chosen for modeling since the cables are to be separated by only 9.4 m (30 ft).

The cables are to be buried by jet plowing to minimum depths of 1.07 m (42 in) deep in the shallows on the western but offshore section of Little Bay and 2.44 m (8 ft) in the center and east sections. For ease of discussion, this report refers to the jet plow disturbance as a trench although while the jet plow will be occupying a three-dimensional space, the "trench" is very temporary as it will fill in immediately behind the jet plow. The total depth of the trench included the minimum burial depth plus the cable diameter of 0.15 m (6 in) and an overage of 0.20 m (8 in) totaling 1.42 m (96 in) for the western section and 2.79 m (110 in) for the central and eastern sections. Based on Caldwell's specification the vertical-walled trench width was defined as 0.32 m (12.75 in) resulting in a trench cross sectional area of 0.46 m^2 (5.0 ft^2) in the shallow western portion and an area of 0.90 m^2 (9.7 ft^2) in the deeper central and eastern portions. The length of the each trench was defined by Caldwell to be 559 m (1,835 ft) for the shallow burial and 741 m (2,431 ft) for the deeper burial. The model run was started on the west side of Little Bay at slack high water which is the beginning of the ebb tide.

It was assumed that 25% of the material in the trench would be resuspended into the water column by the jetting activity. This is a conservative estimate consistent with previous studies that found a range of 10 to 35% (Foreman, 2002). Caldwell indicated that the jet plow technology they will be using generates significantly lower resuspension rates, closer to about 10%.

Table 3-3 summarizes the trench dimensions and SSFATE input parameters used in the jet plow simulation.

Table 3-3. Summary of trench dimensions and SSFATE input parameters for the jet plow portion of the cable burial simulation.

Parameter	Shallow Jet Plow Burial	Deep Jet Plow Burial
Cable burial depth	1.07 m 3.50 ft	2.44 m 8.00 ft
Cable diameter	0.15 m 0.5 ft	0.15 m 0.5 ft
Overage amount	0.2 m 0.67 ft	0.2 m 0.67 ft
Total trench depth	1.42 m 4.67 ft	2.79 m 9.17 ft
Trench width	0.32 m 12.75 in	0.32 m 12.75 in
Trench cross sectional area	0.46 m^2 4.96 ft^2	0.90 m^2 9.7 ft^2
Route distance	559 m 1835 ft	741 m 2431 ft
Advance Rate	100 m/hr 328 ft/hr	100 m/hr 328 ft/hr
Duration	5.6 hr	7.4 hr
Timing	Start at high slack	Continue after shallow portion
Resuspension Fraction	25% of trench volume	25% of trench volume

3.3.2 Diver Burial

The diver rate of advance was much slower than the jet plow at 2.3 m/hr (7.5 ft/hr). Again the central cable route among the three cable bundles crossing Little Bay was chosen for modeling since the cables are to be separated by a maximum of 9.4 m (30 ft) and decreased as they approached the landfalls.

The cables are to be buried by divers in trenches with a minimum depth of 1.07 m (42 in) deep in the shallows on both the western and eastern portions of Little Bay with lengths of 90 m (296 ft) in the western portion and 178 m (584 ft) in the eastern portion. The total depth of the trench included the minimum burial depth plus the cable diameter of 0.15 m (6 in) which equals 1.22 m (48 in). Based on Caldwell's specification the trench width was defined as 1.22 m (48 in) resulting in a trench cross sectional area of 1.49 m^2 (16.0 ft^2). The model run was started two hours before high slack water and continued for four hours due to diver requirements of working in lower currents and deeper water. It was also assumed, based on past experience, that 50% of the material in the trench would be resuspended into the water column by the diver activity. This rate is twice the rate for jet plowing because the technology used, high pressure water hoses, is expected to cause a higher resuspension rate. Modeling was done assuming that silt curtains would not be employed during the diver installation.

Table 3-4 summarizes the trench dimensions and SSFATE input parameters used in the diver portion of the simulation.

Table 3-4. Summary of trench dimensions and SSFATE input parameters for the diver portion of the single cable burial simulation.

Parameter	West Diver Burial	East Diver Burial
Cable burial depth	1.07 m 3.50 ft	1.07 m 3.50 ft
Cable diameter	0.15 m 0.5 ft	0.15 m 0.5 ft
Total trench depth	1.22 m 4.00 ft	1.22 m 4.00 ft
Trench width	1.22 m 4.00 ft	1.22 m 4.00 ft
Trench cross sectional area	1.49 m^2 16.0 ft^2	1.49 m^2 16.0 ft^2
Route distance	90 m 296 ft	178 m 583 ft
Advance Rate	2.29 m/hr 7.5 ft/hr	2.29 m/hr 7.5 ft/hr
Duration	4 hr/day for 9.9 days	4 hr/day for 19.4 days
Timing	Start at 2 hrs before high slack	Start at 2 hrs before high slack
Resuspension Fraction	50% of trench volume (no silt curtains used)	50% of trench volume (no silt curtains used)

3.4 Model Results

3.4.1 Jet Plow Results

3.4.1.1 Water Column Concentrations

The total duration of the cable burial by jet plowing is 13 hours based on an average advance rate of 100 m/hr (328 ft/hr) and a route distance of 1,300 m (4,266 ft) (see Table 3-3). To best display the resulting water column concentration a series of figures were generated for each hour of the crossing resulting in 13 “snapshots” of the submerged plume at that time. Figures 3-4 through 3-7 shows the plan view of the predicted instantaneous excess SS concentration in 1-hr increments after the start of jet plowing at high slack tide with four panels shown per page. The submerged SS concentration plume extends north of the cable route for hours 1 through 7 indicating an ebb condition and south of the route for hours 8 through 13 indicating a flood condition. The water column concentration contours shown, which are defined by a single concentration level, totally surround an enclosed area where concentrations are at or above the specified concentration, i.e., the area is cumulative. Thus the areas with higher concentrations must be smaller than areas with lower concentrations since those areas are enclosed within the lower concentration contour.

The contours show a decreasing concentration away from the immediate location of the jet plow on the cable route as material dilutes and settles out. The colored contours can be identified from the legend in the upper left corner of each panel showing concentrations from 10 mg/L and higher. A larger SS concentration legend is shown in the upper left panel of Figure 3-4.

A vertical section view defined along the cable route looking north is inserted at the bottom left of each hourly panel. The insert shows that the highest concentrations occur just above the jet plow near the bottom with reduced concentrations extending up into the water column above the plow. In the shallows, suspended sediments from the jet plow activity are likely to reach nearly to the water surface. In the channel, excess suspended sediments will be restricted to the lower half of the water column.

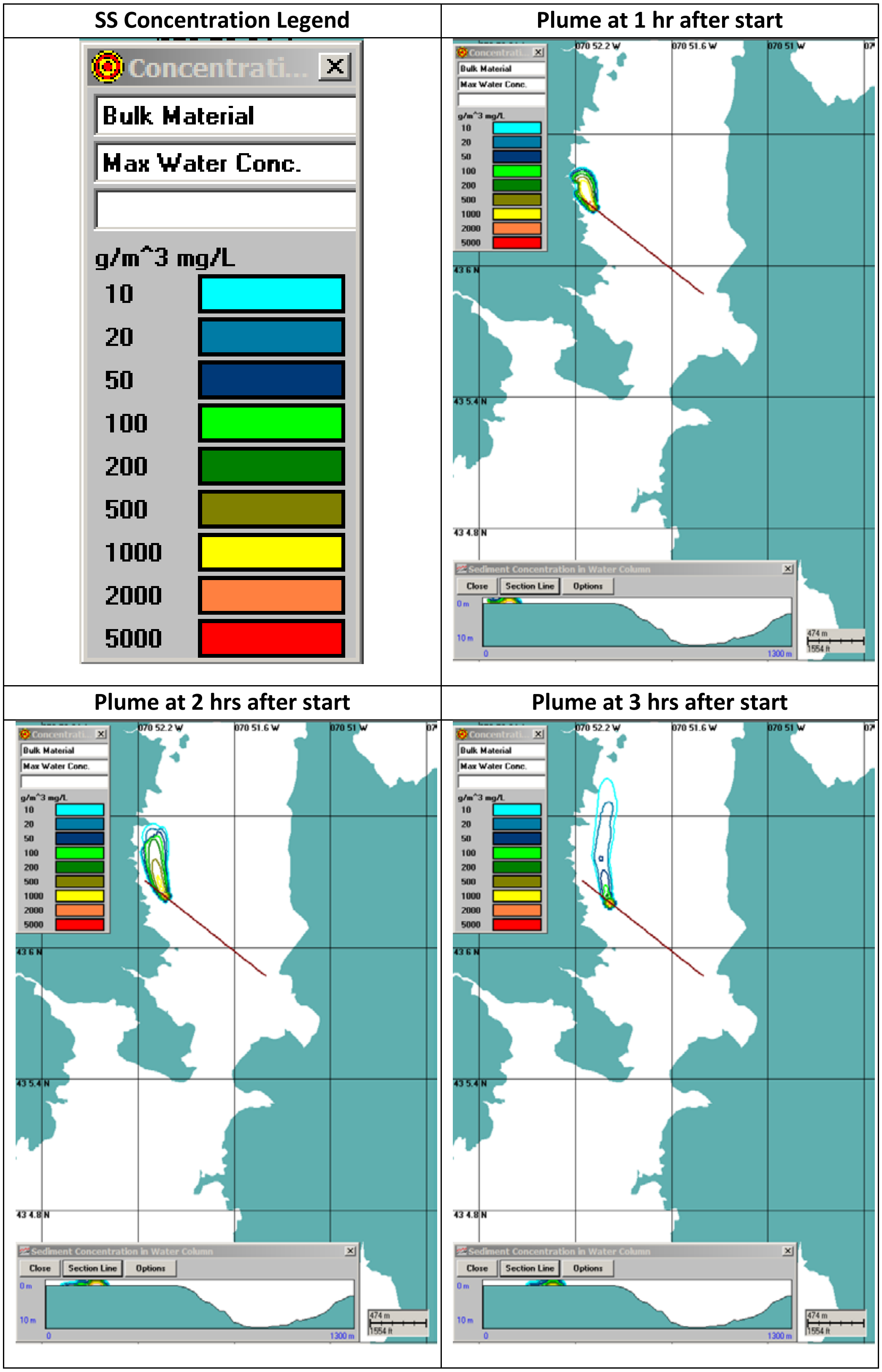

Figure 3-4. Plan view of instantaneous excess SS concentrations at 1 through 3 hrs after start of jet plowing. Vertical section view at lower left of each panel.

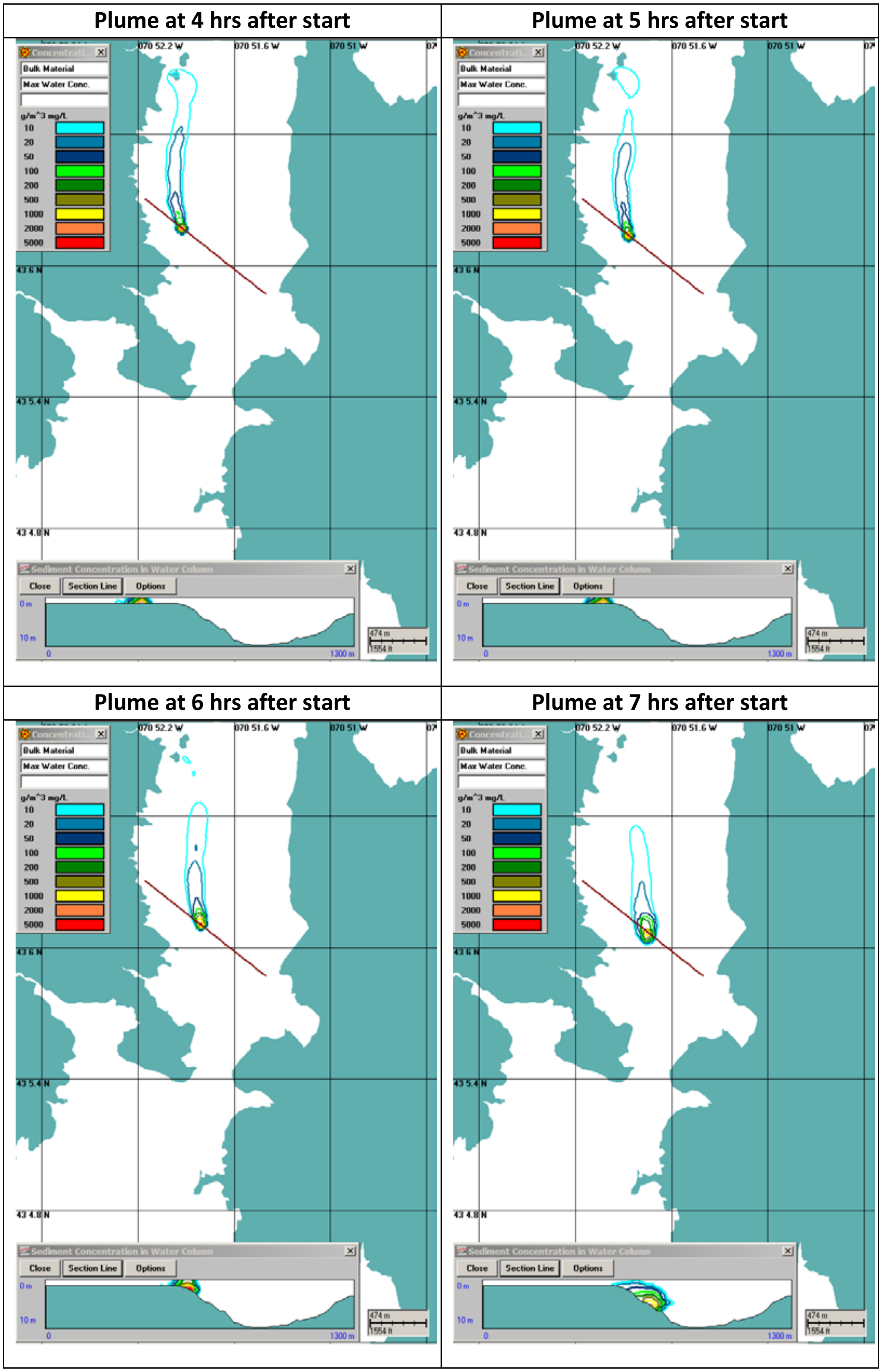

Figure 3-5. Plan view of instantaneous excess SS concentrations at 4 through 7 hrs after start of jet plowing. Vertical section view at lower left of each panel.

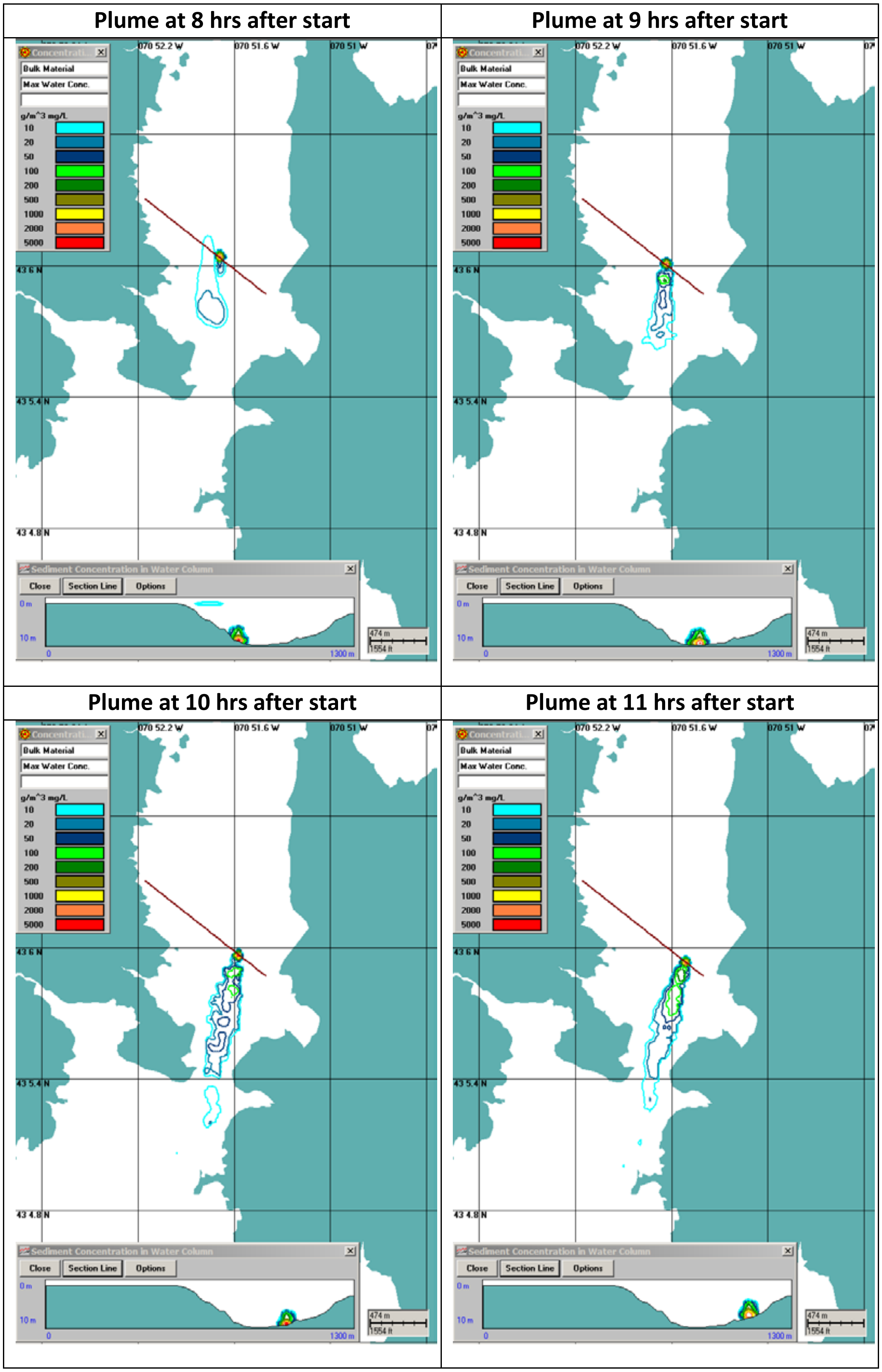

Figure 3-6. Plan view of instantaneous excess SS concentrations at 8 through 11 hrs after start of jet plowing. Vertical section view at lower left of each panel.

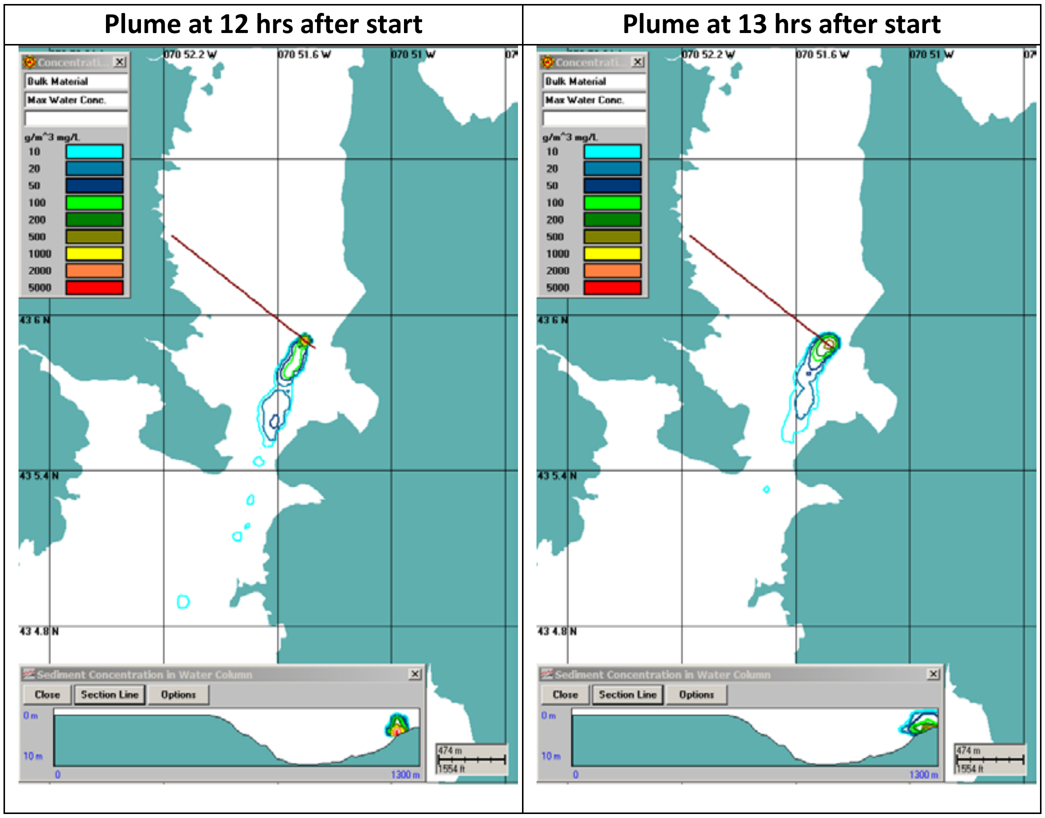

Figure 3-7. Plan view of instantaneous excess SS concentrations at 12 through 13 hrs after start of jet plowing. Vertical section view at lower left of each panel.

Since the currents are smaller right after slack water, the extent of the plume is smaller for hrs 1 and 2. The plume is at its greatest northern extent for hrs 4, 5, and 6. By hr 8 the tide has turned and the plume reaches its maximum southern extent by hrs 10, 11, and 12.

The instantaneous total enclosed area of the excess SS concentration plumes seen in Figures 3-4 through 3-7 is quantitatively summarized in Tables 3-5 (in area units of hectares) and 3-6 (in units of acres) for each 1-hr increment identified at the top of each figure panel. On average the entire area encompassed by the plume (as defined by the 10 mg/L excess SS concentration contour) was 14.8 ha (36.58 ac), ranging from a low of 5.91 ha (14.61 ac) at 1 hr to a high of 22.36 ha (55.25 ac) at 10 hrs. These total enclosed areas dropped dramatically for the higher concentrations, averaging 1.94 ha (4.79 ac) at 100 mg/L, 0.28 ha (0.68 ac) at 1,000 mg/L and 0.02 ha (0.05 ac) at 5,000 mg/L. indicating that the extent of the plume is limited for higher concentrations.

Table 3-5. Summary of the total area (hectares) enclosed by the excess SS threshold concentration contours shown in Figures 3-4 through 3-7 due to jet plowing. Hours start at high slack tide.

TSS (mg/L)	Area (ha) 1 hr Ebb	Area (ha) 2 hr Ebb	Area (ha) 3 hr Ebb	Area (ha) 4 hr Ebb	Area (ha) 5 hr Ebb	Area (ha) 6 hr Ebb	Area (ha) 7 hr Ebb
10	5.91	11.66	14.42	18.73	16.77	15.38	15.14
20	5.47	9.55	8.43	7.59	7.23	5.91	5.99
50	4.55	7.59	2.24	2.08	1.68	1.96	2.64
100	3.87	6.43	0.88	0.64	0.72	1.24	1.84
200	3.16	4.59	0.28	0.28	0.44	0.72	1.24
500	2.32	1.92	0.20	0.20	0.20	0.48	0.32
1000	1.44	0.44	0.20	0.20	0.20	0.28	0.08
2000	0.08	0.04	0.04	0.04	0.04	0.08	0.04
5000	0.00	0.00	0.04	0.00	0.00	0.04	0.00

TSS (mg/L)	Area (ha) 8 hr Flood	Area (ha) 9 hr Flood	Area (ha) 10 hr Flood	Area (ha) 11 hr Flood	Area (ha) 12 hr Flood	Area (ha) 13 hr Flood	Area (ha) Average
10	13.62	11.30	22.36	20.13	13.74	13.26	14.80
20	4.95	5.99	15.14	14.22	9.07	7.71	8.25
50	0.52	2.24	5.63	5.75	3.44	3.24	3.35
100	0.32	0.80	1.36	3.36	1.84	1.92	1.94
200	0.16	0.28	0.20	0.72	0.28	1.28	1.05
500	0.16	0.20	0.16	0.20	0.20	0.32	0.53
1000	0.16	0.16	0.16	0.08	0.20	0.00	0.28
2000	0.04	0.04	0.04	0.04	0.04	0.00	0.04
5000	0.04	0.04	0.04	0.00	0.04	0.00	0.02

Table 3-6. Summary of the total area (acres) enclosed by the excess SS threshold concentration contours shown in Figures 3-4 through 3-7 due to jet plowing.

TSS (mg/L)	Area (ac) 1 hr Ebb	Area (ac) 2 hr Ebb	Area (ac) 3 hr Ebb	Area (ac) 4 hr Ebb	Area (ac) 5 hr Ebb	Area (ac) 6 hr Ebb	Area (ac) 7 hr Ebb
10	14.61	28.81	35.63	46.28	41.44	38.00	37.41
20	13.52	23.59	20.82	18.75	17.86	14.61	14.80
50	11.25	18.75	5.53	5.13	4.14	4.84	6.51
100	9.57	15.89	2.17	1.58	1.78	3.06	4.54
200	7.80	11.35	0.69	0.69	1.09	1.78	3.06

TSS (mg/L)	Area (ac) 1 hr Ebb	Area (ac) 2 hr Ebb	Area (ac) 3 hr Ebb	Area (ac) 4 hr Ebb	Area (ac) 5 hr Ebb	Area (ac) 6 hr Ebb	Area (ac) 7 hr Ebb
500	5.72	4.74	0.49	0.49	0.49	1.18	0.79
1000	3.55	1.09	0.49	0.49	0.49	0.69	0.20
2000	0.20	0.10	0.10	0.10	0.10	0.20	0.10
5000	0.00	0.00	0.10	0.00	0.00	0.10	0.00

TSS (mg/L)	Area (ac) 8 hr Flood	Area (ac) 9 hr Flood	Area (ac) 10 hr Flood	Area (ac) 11 hr Flood	Area (ac) 12 hr Flood	Area (ac) 13 hr Flood	Area (ac) Average
10	33.66	27.92	55.25	49.74	33.95	32.77	36.58
20	12.24	14.80	37.41	35.14	22.40	19.05	20.38
50	1.28	5.53	13.91	14.21	8.49	7.99	8.27
100	0.79	1.97	3.36	8.29	4.54	4.74	4.79
200	0.39	0.69	0.49	1.78	0.69	3.16	2.59
500	0.39	0.49	0.39	0.49	0.49	0.79	1.31
1000	0.39	0.39	0.39	0.20	0.49	0.00	0.68
2000	0.10	0.10	0.10	0.10	0.10	0.00	0.11
5000	0.10	0.10	0.10	0.00	0.10	0.00	0.05

The simulation was continued for an additional six hours after jet plowing was completed (hour 13 after the start of installation) to ensure that all residual concentrations had dissipated. Figure 3-8 showing the plan view of the maximum time-integrated excess SS concentration contours includes that additional post operational period. The time-integrated maximum concentration is generated from the model results by determining the highest concentration in each SSFATE grid cell which overlays Little Bay during the entire simulation. This plot shows only the maximum excess SS concentration integrated over time and would not be actually seen in the Bay (the results shown in Figures 3-4 through 3-7 are representative of what would be seen instantaneously). The advance rate is sufficiently slow that one sees the ebb-directed plume heading north on the west side of the Bay at the beginning of the simulation, then the flood-directed plume heading south in the center of the Bay and finally another ebb-directed plume heading north on the east side of the Bay (after the jetting operation has ceased and the plume is dissipating). The contours again show decreasing concentration from either side of the cable route with higher concentrations adjacent to the jet plow route.

A vertical section view defined by the jet plow route is shown at the bottom left of the figure. The highest concentrations, between 2,000 and 5,000 mg/L occur just above the bottom at the jet plow with reduced concentrations extending up into the water column along the route.

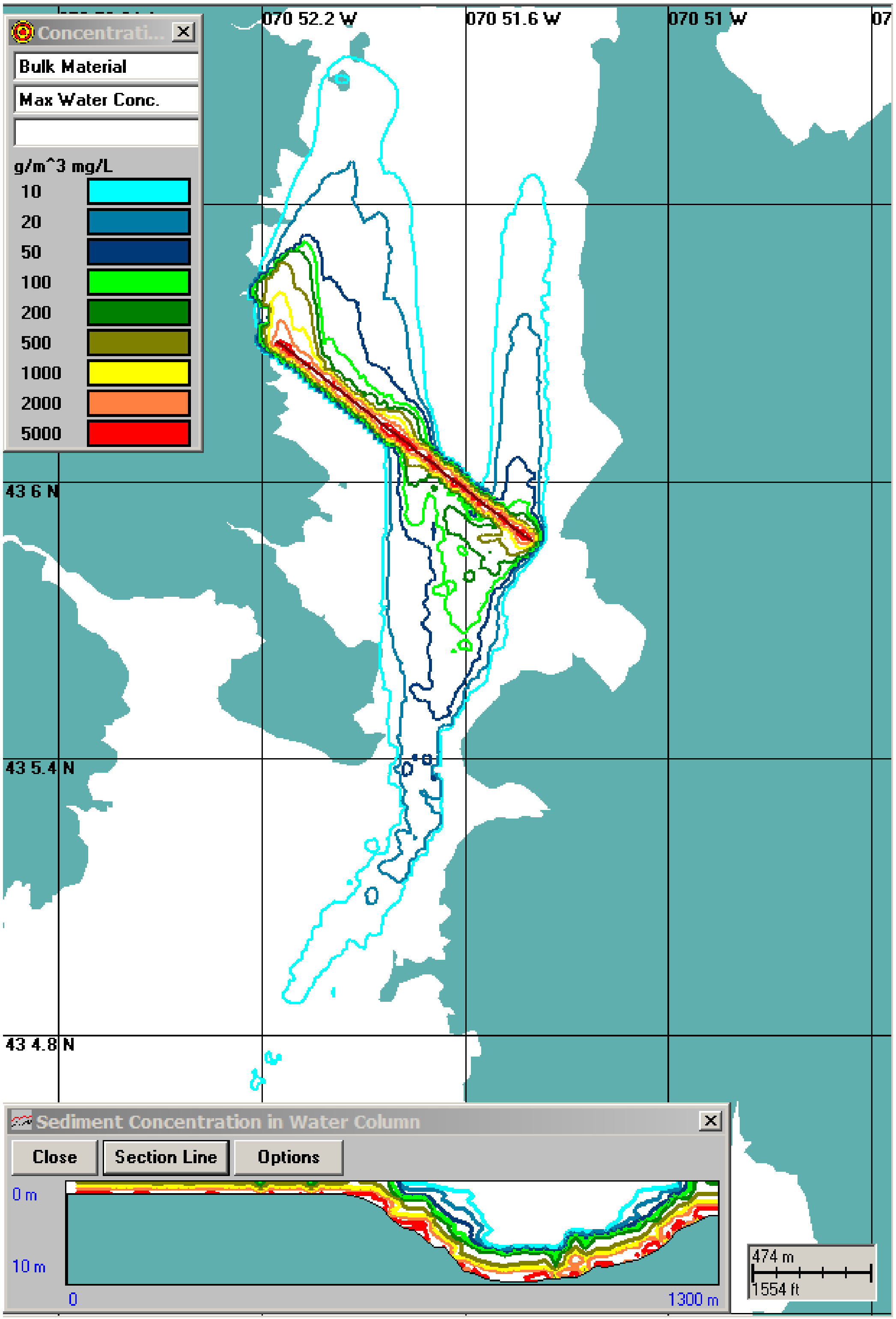

Figure 3-8. Plan view of maximum time integrated excess SS concentration contours over the entire jet plowing operation and the post operational period (while concentrations dissipate). Vertical section view at lower left.

Table 3-7 summarizes the total area enclosed by the maximum time-integrated excess SS concentration contours over the entire jet plowing operation and the post operational period (while concentrations dissipate) shown in Figure 3-8. This table shows that during the operation and post operational period an area of 165.1 ha (408.0 ac) sees a 10 mg/L concentration for a minimum of 5 minutes (the SSFATE model output timestep) but at different times during the simulation. The 5,000 mg/L time integrated enclosed area is 1.9 ha (4.6 ac) and is restricted to the area averaging about 14 m (46 ft) wide straddling the cable route and lasting only a short time.

Table 3-7. Summary of the total area (hectares and acres) enclosed by the maximum time-integrated excess SS concentration contours over the entire jet plowing operation and the post operational period (while concentrations dissipate) in Figure 3-8.

TSS (mg/L)	Area (ha)	Area (ac)
10	165.1	408.0
20	107.4	265.4
50	56.2	138.9
100	35.9	88.7
200	22.0	54.3
500	14.2	35.1
1000	9.3	23.1
2000	4.2	10.3
5000	1.9	4.6
10000	0.0	0.0

An important metric defining the plume is its duration for different concentrations, which could have biological significance if exposure (duration multiplied by concentration) is sufficiently elevated. Figure 3-9 and Table 3-8 summarize the area that experiences a specific exposure (duration at or above concentration) due to jet plow operations. Areas totaling 90.20 ha (222.89 ac), 32.2 ha (79.57 ac), 3.57 ha (8.82 ac) are exposed to a concentration of 10 mg/L or greater for 1 hr, 2 hrs and 4 hrs respectively while no areas are exposed to such a concentration for a duration of six hours; note that these areas are summations and not necessarily contiguous. The area coverages drop dramatically for the exposures of higher concentrations near the jet plow indicating that the duration and extent of the plume is relatively limited. Furthermore, once the jet plow stops operating, no additional sediments will be dispersed into the water column and concentrations above 10 mg/L dissipate within approximately 2 hrs (Figure 3-10).

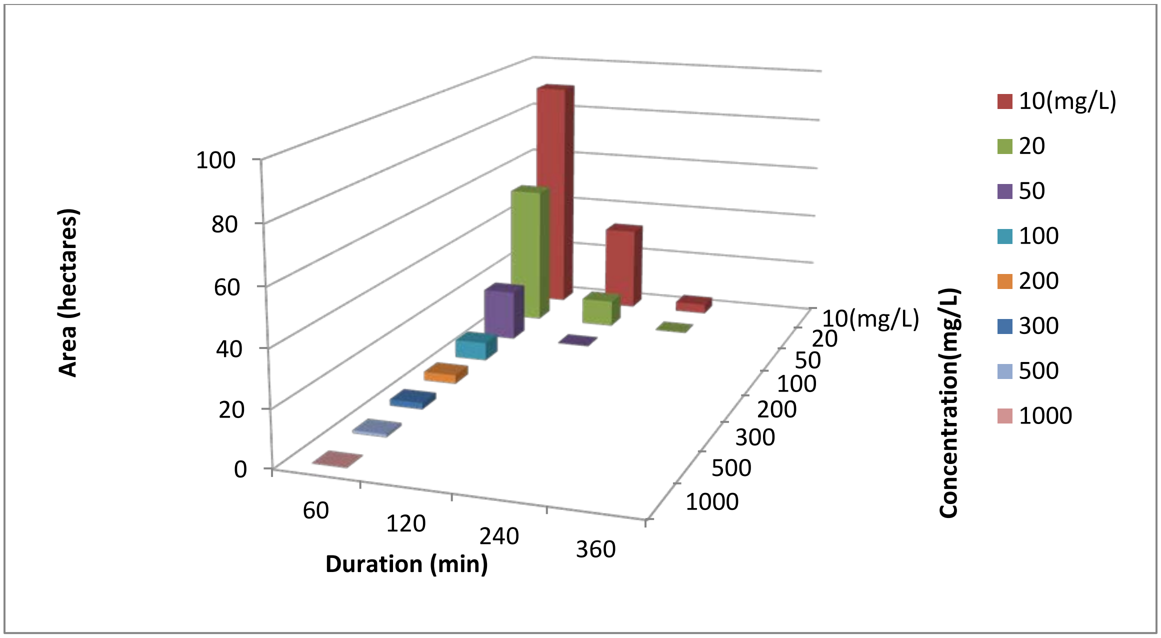

Figure 3-9. Duration (minutes) and total enclosed area (hectares) of maximum time integrated excess SS concentration contours over the entire jet plowing operation and the post operational period (while concentrations dissipate).

Table 3-8. Duration (minutes) and total enclosed area (hectares and acres) of maximum time integrated excess SS concentration contours over the entire jet plowing operation and the post operational period (while concentrations dissipate).

SS Concentration (mg/L)	Hectares				Acres			
	60 (min)	120 (min)	240 (min)	360 (min)	60 (min)	120 (min)	240 (min)	360 (min)
10	90.20	32.20	3.57		222.89	79.57	8.82	
20	52.60	10.00	0.12		129.98	24.71	0.30	
50	18.70	0.16			46.21	0.40		
100	6.72				16.61			
200	3.20				7.91			
300	2.24				5.54			
500	1.04				2.57			
1000	0.08				0.20			

Plume ½ hr after Jet Plow Stops	Plume 1 hr after Jet Plow Stops

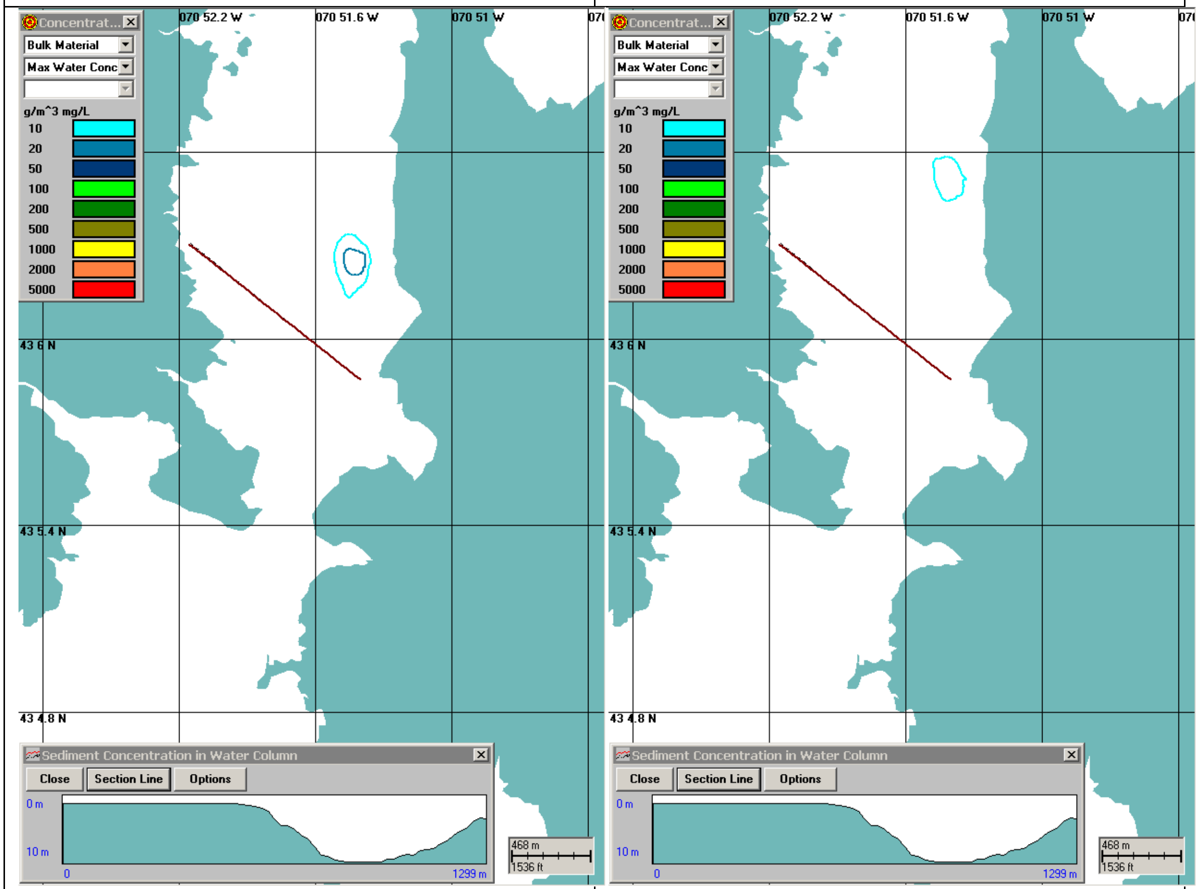

Figure 3-10. Plan view of instantaneous excess SS concentrations at 0.5 and 1 hour after cessation of jet plowing (13.5 and 14 hrs after start of jet plowing). Vertical section view at lower left of each panel.

3.4.1.2 Bottom Deposition

Figure 3-11 shows the plan view of the bottom deposition thickness distribution from 0.1 to 10 mm (0.004 to 0.4 in) due to jet plowing all three cable routes combined and assuming that any sediment deposited on the bottom remains in place. The color filled areas are defined by the legend for different deposition thickness ranges, e.g., 1 mm to 5 mm (0.04 to 0.2 in) denoted by yellow. In contrast to the water column concentration contours, which are defined by a single concentration value totally surrounding an enclosed area where concentrations are at or above the specified concentration (i.e., the area is cumulative), the bottom deposition thickness is defined for the area exclusively between the range of thicknesses described (i.e., the area is not cumulative). Thus the areas with larger thicknesses are not necessarily smaller than areas with smaller thicknesses. The shape of the distribution pattern is generally similar to the water column plume (ebb-then-flood) but reduced in extent. The higher deposition areas are at and adjacent to the cable route and occur when the sediment distribution is weighted toward the sand fractions. There are a few non-contiguous areas of 0.1 to 0.5 mm (0.004 to 0.02 in) deposition further south of the cable route that are due to the slight changes in current direction transporting water column plumes from slightly different locations on the route so that they happen to form a thin deposit at the same place.

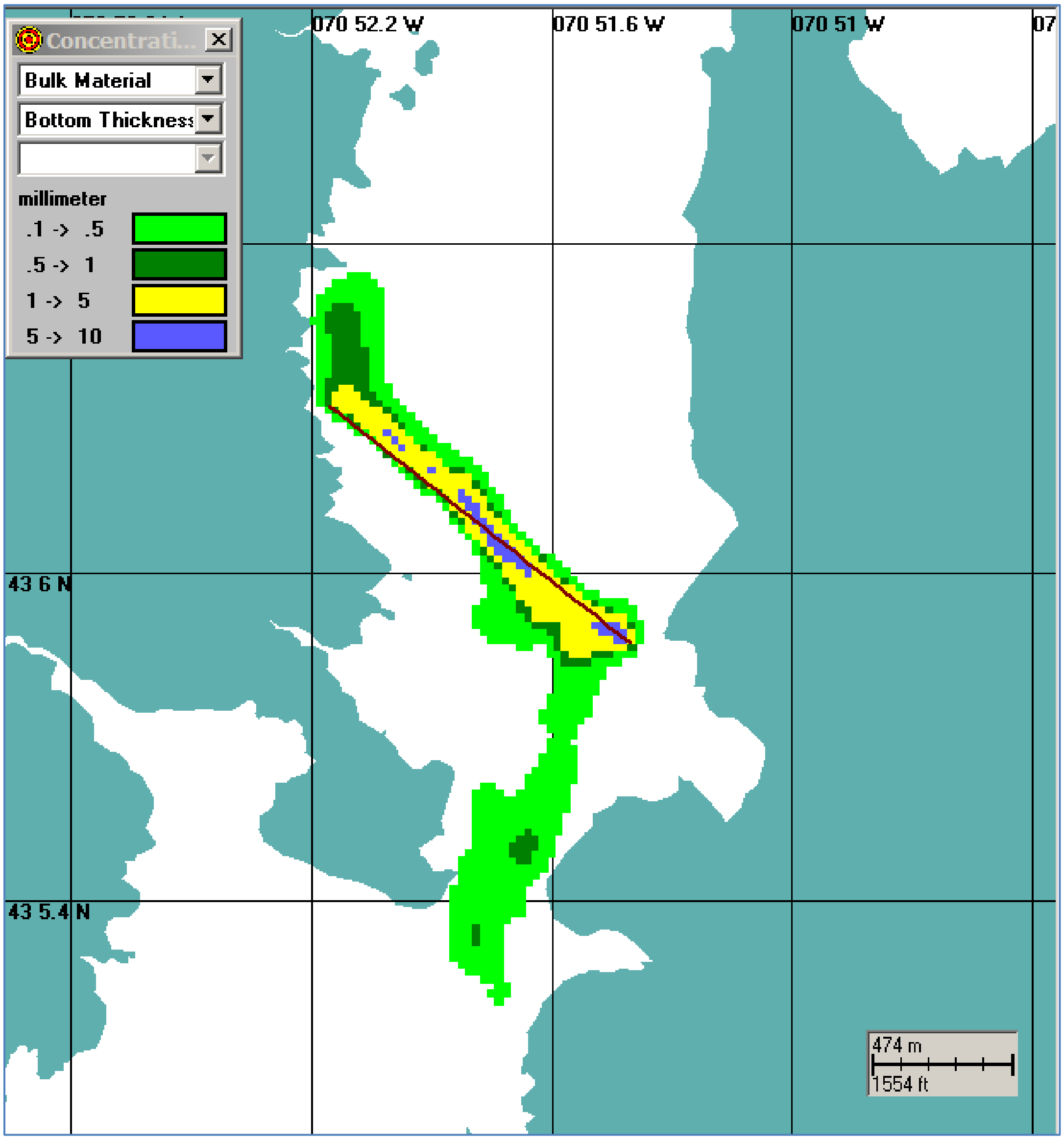

Figure 3-11. Plan view of integrated bottom thickness (mm) distribution due to jet plowing for the three cable trenches combined.

The areal sizes of the deposition thickness patterns seen in Figure 3-11 are summarized in Table 3-9 for each thickness increment range. At the range of 0.1 to 0.5 mm (0.004 to 0.02 in) thickness range the area is 35.6 ha (87.9 ac) due to jet plowing the three cable routes. These areas generally drop in size, but not always, for the higher deposition thicknesses. For example, the area of 12.4 ha [30.7 ac] for the 1 to 5 mm [0.04 to 0.2 in) thickness range is larger than the 0.5 to 1 mm (0.02 to 0.04 in) area of 8.1 ha (20.0 ac).

Table 3-9. Bottom thickness (millimeter and inch) areal distribution (hectare and acre) due to jet plowing for the three cable routes combined.

Thickness (mm)	Area (ha)	Thickness (in)	Area (ac)
0.1 to 0.5	35.6	0.004 to 0.02	87.9
0.5 to 1	8.1	0.020 to 0.04	20.0
1 to 5	12.4	0.04 to 0.2	30.7
5 to 10	2.4	0.2 to 0.4	5.9
Totals 0.1 to 10	58.5	0.004 to 0.4	144.5

3.4.2 Diver Burial Results

3.4.2.1 Water Column Concentrations

The total duration of the cable burial by divers is 4 hr/day for 9.9 days for the west area and 4 hr/day for 19.4 days for the east area for each of the three cable bundles to be buried. This is based on an estimated advance rate of 2.29 m/hr (7.5 ft/hr) for the 4 hrs around high slack water for a 90 m (296 ft) route distance for the west area and 178 m (583 ft) for the east area (see Table 3-4). To best display the resulting water column concentration a figure was generated for each area for 1 day at a representative location in the area. Figure 3-12 shows the plan view of the predicted instantaneous excess SS concentration contours for both the west and east area. The submerged SS concentration plumes extend both north and south of the cable route due to the timing of operations before and after slack water. Again, the water column concentration contours shown, which are defined by a single concentration level, totally surround an enclosed area where concentrations are at or above the specified concentration, i.e., the area is cumulative. Thus the areas with higher concentrations must be smaller than areas with lower concentrations since those areas are enclosed within the lower concentration contour.

The contours in Figure 3-12 show a decreasing concentration away from the location of the diver activities on the cable route as material dilutes and settles out. The colored contours can be identified from the legend in the upper right corner of the figure showing concentrations from 10 mg/L and higher. Modeling was done assuming that silt curtains would not be employed during the diver installation.

A vertical section view defined along the cable route looking north is inserted at the bottom left of the figure. The insert shows that the highest concentrations occur near the bottom with reduced concentrations extending up into the water column. In the western shallows, suspended sediments from the diver burial activity are likely to reach nearly to the water surface. In the somewhat deeper eastern area, excess suspended sediments will be restricted to the lower half of the water column.

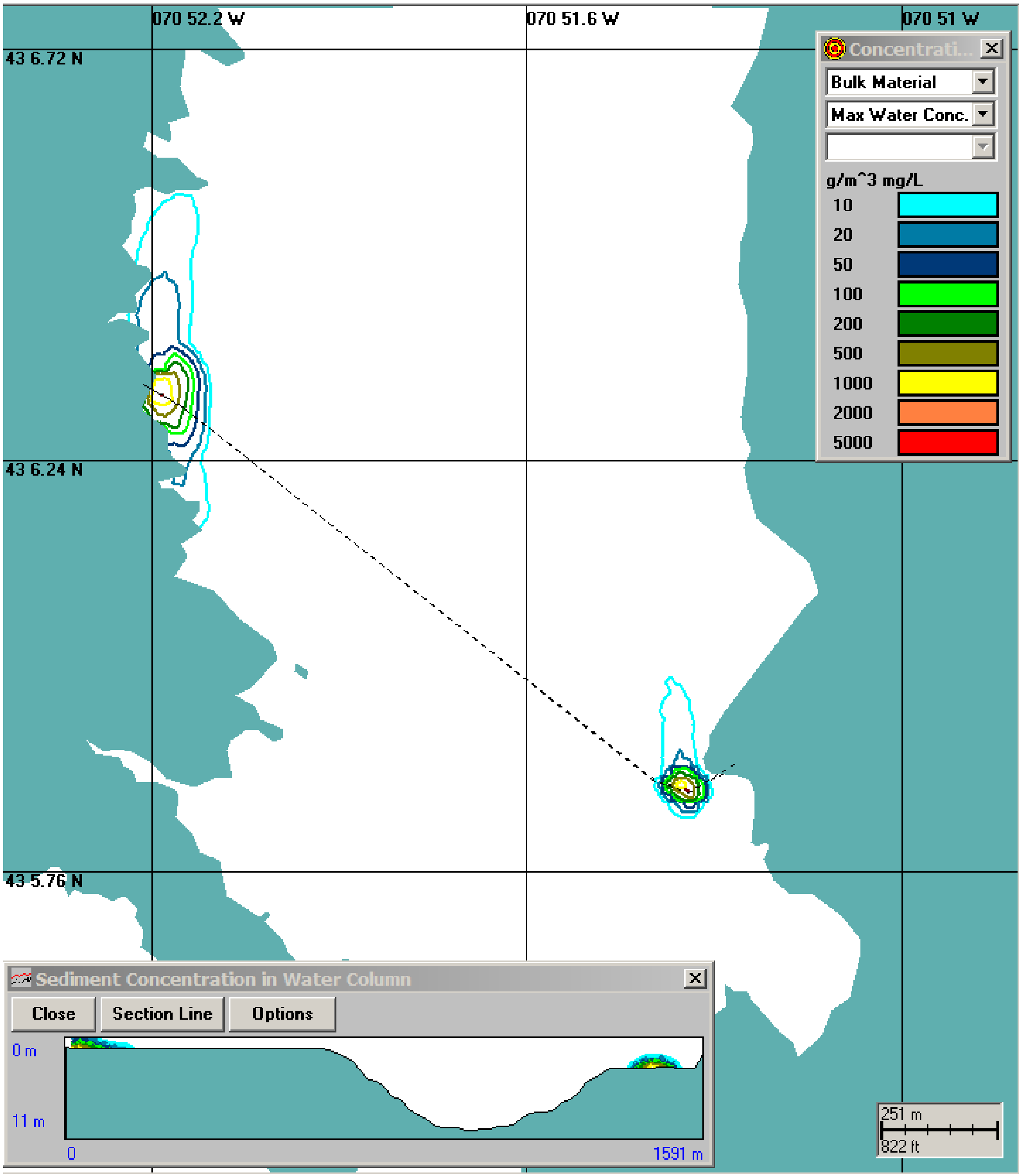

Figure 3-12. Plan view of instantaneous maximum excess SS concentration contours for 1 day approximately midway across the west and east diver burial sections. Vertical section view at lower left. Assumes silt curtains were not used.

The instantaneous total enclosed area of the excess SS concentration plumes for the west and east diver burial sections seen in Figure 3-12 is summarized in Table 3-10 for each increment identified in the color legend. At 10 mg/L excess SS concentration the total area enclosed by the contour is 8.4 ha (20.7 ac) for the west section and 1.9 ha (4.7 ac) for the east section. However, these total enclosed areas drop dramatically for the higher concentrations near the diver burial activities, i.e., the area at 1,000 mg/L is only about 0.2 ha (0.6 ac) for the west section and 0.0 ha

(0.1 ac) for the east section, indicating that the extent of the plume is again relatively limited for higher concentrations.

Table 3-10. Summary of the total area (hectares and acres) enclosed by the excess SS threshold concentration contours shown in Figure 3-11 due to diver burial. Assumes silt curtains were not used.

	West Section	West Section	East Section	East Section
TSS	Area	Area	Area	Area
(mg/L)	(ha)	(ac)	(ha)	(ac)
10	8.4	20.7	1.9	4.7
20	4.5	11.0	0.8	2.0
50	2.0	4.9	0.5	1.2
100	1.2	3.0	0.4	0.9
200	1.0	2.5	0.3	0.7
500	0.5	1.2	0.1	0.3
1000	0.2	0.6	0.0	0.1

Figure 3-13 shows the plan view of the maximum time-integrated excess SS concentration contours for both diver burial sections. As before, these concentrations are generated from the model results by determining the highest concentration in each SSFATE grid cell during the entire simulation, approximately 10 and 20 days for the west and east sections, respectively. This plot shows only the maximum excess SS concentration integrated over time and would not be actually seen in the Bay. The contours again show decreasing concentration from either side of the cable route with higher concentrations adjacent to the jet plow route. This model run assumed silt curtains were not used.

A vertical section view defined by the jet plow route is shown at the bottom left of the figure. The highest concentrations, above 5,000 mg/L on the west side, occur just above the bottom with dramatically reduced concentrations extending up into the water column along the route. The same is true for the east section but the highest concentrations there are between 500 and 1,000 mg/L.

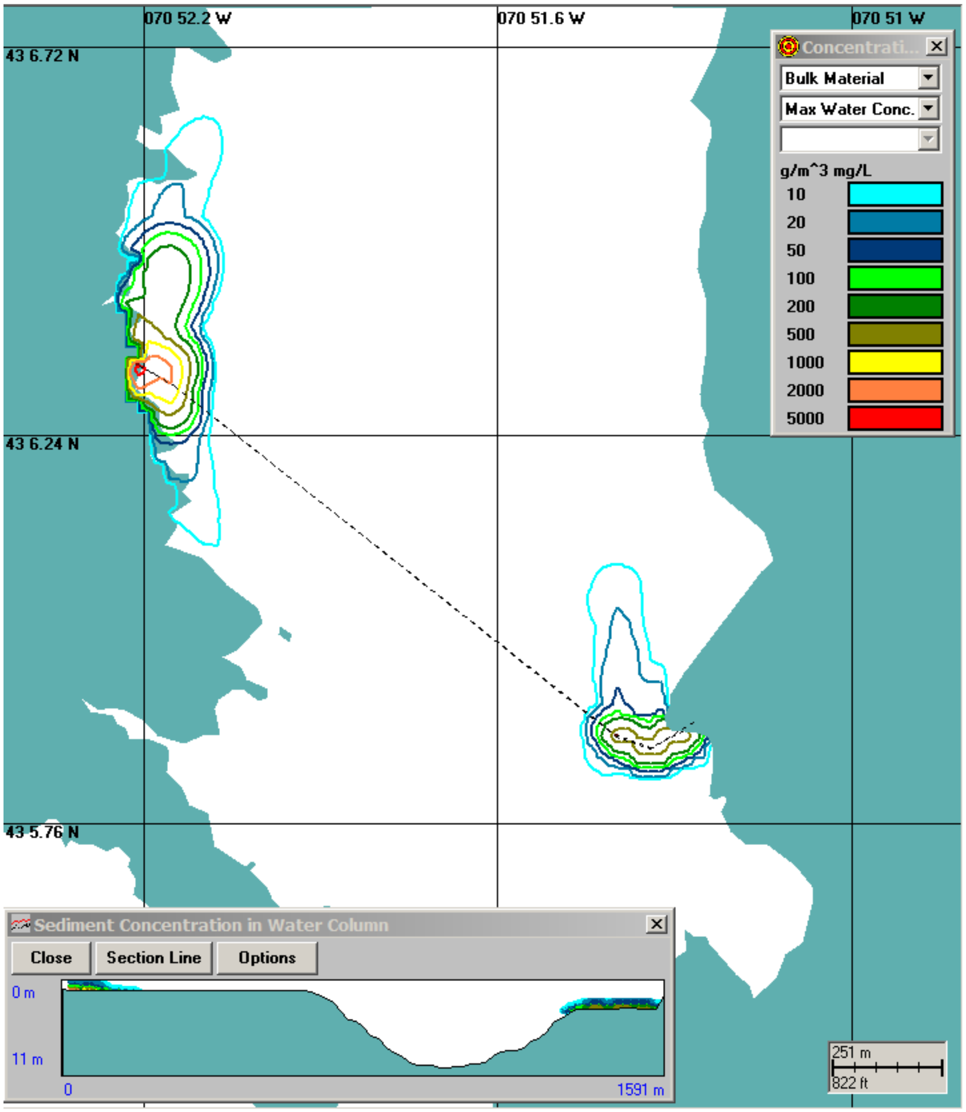

Figure 3-13. Plan view of maximum time integrated excess SS concentration contours over both diver burial operations. Vertical section view at lower left. Assumes silt curtains were not used.

Table 3-11 summarizes the total western and eastern areas enclosed by the maximum time-integrated excess SS concentrations over the diver burial operations shown in Figure 3-13. This table shows that during the diver burial activities on the west side, a total enclosed area of 14.5 ha (35.9 ac) sees a minimum 10 mg/L concentration for a minimum of 5 minutes (the SSFATE model output timestep) but at different times during the simulation. For the east side the 10 mg/L concentration contour encloses a total area of 8.2 ha (20.2) ac.

Table 3-11. Summary of the total area (hectares and acres) enclosed by the maximum time-integrated excess SS threshold concentration contours shown in Figure 3-13 due to diver burial for the west and east sections. Assumes silt curtains were not used.

TSS (mg/L)	West Area (ha)	West Area (ac)	East Area (ha)	East Area (ac)
10	14.5	35.9	8.2	20.2
20	9.7	24.0	5.1	12.5
50	7.2	17.7	2.9	7.1
100	5.9	14.6	2.1	5.1
200	4.5	11.1	1.6	3.9
500	2.0	4.9	0.5	1.2
1000	1.2	3.1		
2000	0.6	1.4		
5000	0.1	0.2		
10000				

An important metric defining the plume is its duration for different concentrations, which could have biological significance if exposure (duration multiplied by concentration) is sufficiently elevated. The total enclosed area and duration of the time-integrated maximum west section plume seen in Figure 3-13 is summarized in Figure 3-14 and Table 3-12 for each contour identified in the color legend. At 10 mg/L excess SS concentration the total area that is enclosed by the contour is 14.6 ha (36.1 ac) but lasts for only 1 hr. This short duration continues through all the concentration contour thresholds through 5,000 mg/L. The enclosed areas decrease in time for a given concentrations so by 6 hrs the 10 mg/L area has dropped to 8.6 ha (21.2 ac). The 10 mg/L area persists for two days because the initial buildup occurs near slack water with grain size distribution indicating mostly fines (silts and clays). The area coverages decrease for higher concentrations near the diver burial activities.

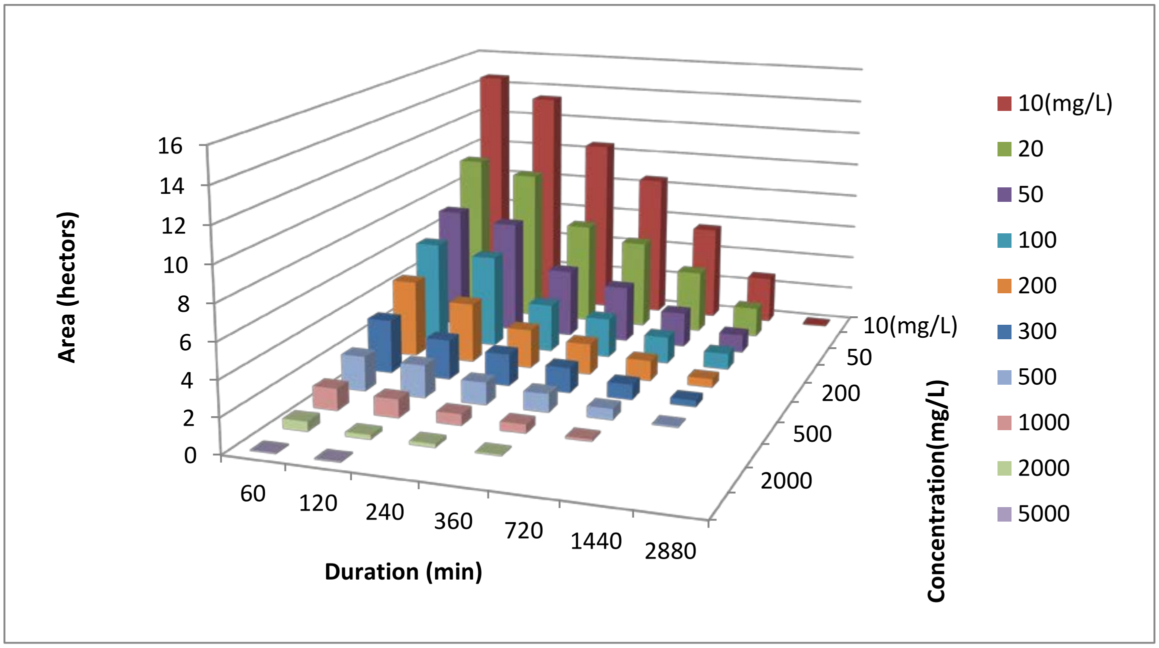

Figure 3-14. **Duration (minutes) and total enclosed area (hectares) of maximum time integrated excess SS concentration due to diver burial for west section with total duration of 9.9 4-hour days (2,368 min). Assumes silt curtains were not used.**

Table 3-12. Duration (minutes) and total enclosed area (hectares and acres) of maximum time integrated excess SS concentration due to diver burial for west section with total duration of 9.9 4-hour days (2,368 min). Assumes silt curtains were not used.

West	Area (ha)						
Max SS	Minutes						
(mg/L)	60	120	240	360	720	1440	2880
10	14.6	13.4	10.5	8.6	5.6	2.8	0.1
20	9.8	9.1	6.0	5.3	3.7	1.8	
50	7.2	6.7	4.0	3.3	2.1	1.1	
100	5.9	5.4	2.8	2.3	1.6	0.9	
200	4.5	3.5	2.3	1.8	1.2	0.5	
300	3.1	2.3	1.9	1.4	0.9	0.4	
500	2.0	1.9	1.3	1.1	0.6	0.1	
1000	1.3	1.1	0.6	0.5	0.1		
2000	0.6	0.3	0.2	0.1			
5000	0.1	0.1					

West	Area (ac)						
Max SS	Minutes						
(mg/L)	60	120	240	360	720	1440	2880
10	36.1	33.1	26.0	21.2	13.9	6.8	0.2
20	24.1	22.4	14.9	13.0	9.1	4.3	

West	Area (ac)						
Max SS	Minutes						
(mg/L)	60	120	240	360	720	1440	2880
50	17.8	16.5	9.9	8.2	5.1	2.6	
100	14.7	13.4	7.0	5.7	3.9	2.3	
200	11.1	8.6	5.6	4.5	2.9	1.2	
300	7.7	5.7	4.6	3.6	2.2	0.9	
500	4.9	4.6	3.2	2.6	1.5	0.2	
1000	3.1	2.6	1.6	1.2	0.3		
2000	1.4	0.6	0.5	0.2			
5000	0.2	0.2					

The total enclosed area and duration of the time-integrated maximum east section plume seen in Figure 3-13 is summarized in Figure 3-15 and Table 3-13 for each contour identified in the color legend. At 10 mg/L excess SS concentration the total area that is enclosed by the contour is 8.2 ha (20.2 ac) but lasts for only 1 hr. This short duration continues through all the concentration contour thresholds through 500 mg/L. The enclosed areas decrease in time for a given concentration so by 6 hrs the 10 mg/L area has dropped to 4.1 ha (10.2 ac). The 10 mg/L area persists for two days because the initial buildup occurs near slack water with grain size distribution indicating mostly fines (silts and clays). The area coverages decrease for higher concentrations near the diver burial activities. These results assumed silt curtains were not used.

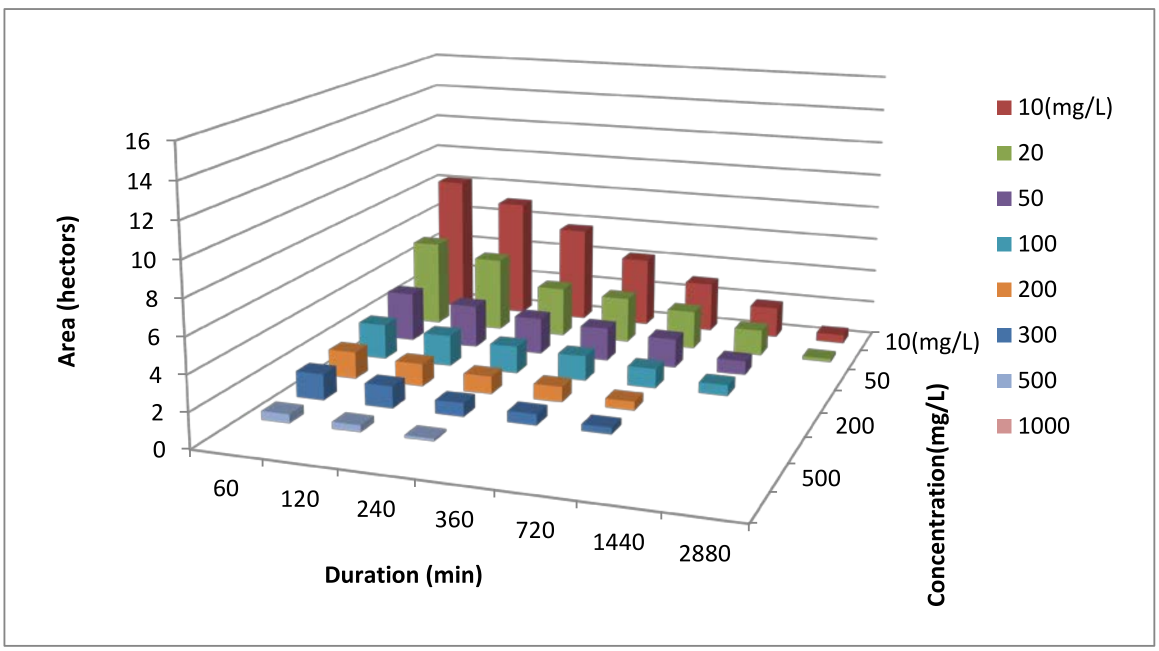

Figure 3-15. Duration (minutes) and total enclosed area (hectares) of maximum time integrated excess SS concentration due to diver burial for east section with total duration of 19.4 4-hour days (4,664 min). Assumes silt curtains were not used.

Table 3-13. Duration (minutes) and total enclosed area (hectares and acres) of maximum time integrated excess SS concentration due to diver burial for east section with total duration of 19.4 4-hour days (4,664 min). Assumes silt curtains were not used.

East	Area (ha)						
Max SS	Minutes						
(mg/L)	60	120	240	360	720	1440	2880
10	8.2	7.1	5.7	4.1	2.9	1.8	0.5
20	5.1	4.4	2.9	2.7	2.3	1.5	0.2
50	2.9	2.5	2.1	1.9	1.7	0.8	
100	2.1	1.8	1.6	1.4	1.1	0.6	
200	1.6	1.3	1.0	0.9	0.5		
300	1.5	1.3	0.8	0.6	0.4		
500	0.5	0.4	0.1				
1000							

East	Area (ac)						
Max SS	Minutes						
(mg/L)	60	120	240	360	720	1440	2880
10	20.2	17.4	14.0	10.2	7.3	4.5	1.2
20	12.5	10.8	7.2	6.6	5.6	3.7	0.5
50	7.1	6.2	5.3	4.8	4.2	2.0	
100	5.1	4.5	3.9	3.6	2.8	1.5	
200	3.9	3.2	2.5	2.2	1.2		
300	3.7	3.1	1.9	1.5	0.9		
500	1.2	0.9	0.3				
1000							

Use of Silt Curtains

The effects of using silt curtains can greatly reduce the size of the water column areas affected which has been described above. The US Army Corps of Engineers refers to reductions in loss rates up to 80 to 90% when silt curtains are correctly employed (Francingues and Palermo, 2005). A recent model application by the USACE (Lackey, et. al., 2012) assumed reductions of 90 to 100% in loss rates due to the use of silt curtains to be protective of coral reefs in Guam.

If a 90% reduction is assumed with the use of silt curtains then the excess suspended sediment concentration results presented above can be reduced by a factor of 10 for areas outside the silt curtains. This means that the legend appearing in Figures 3-12 through 3-15 showing concentration levels ranging from 10 to 5000 mg/L can be reduced to 1 to 500 mg/L to be representative of the results from using silt curtains. In addition, Tables 3-10 through 3-13 can also be reinterpreted for the use of silt curtains by reducing the listed concentrations by a factor of 10. The area inside the silt curtains adjacent to the cable routes will, of course, see a local increase in concentrations.

3.4.2.2 Bottom Deposition

Figure 3-16 shows the plan view of the bottom deposition thickness distribution from 0.1 mm to 50 mm (0.004 to 2 in) due to diver activity for both the west and eastern sections of all three cable routes combined and assumed that any sediment deposited on the bottom remained in place. The color filled areas are defined by the legend for different deposition thickness ranges, e.g., 1 mm to 5 mm (0.04 to 0.2 in) denoted by yellow. The bottom deposition thickness is defined for the area exclusively between the range of thicknesses described, i.e., the area is not cumulative. Thus the areas with larger thicknesses are not necessarily smaller than areas with smaller thicknesses. The distribution pattern is generally similar to the water column plume (ebb) but much reduced in extent. The higher deposition areas are adjacent to the cable route.

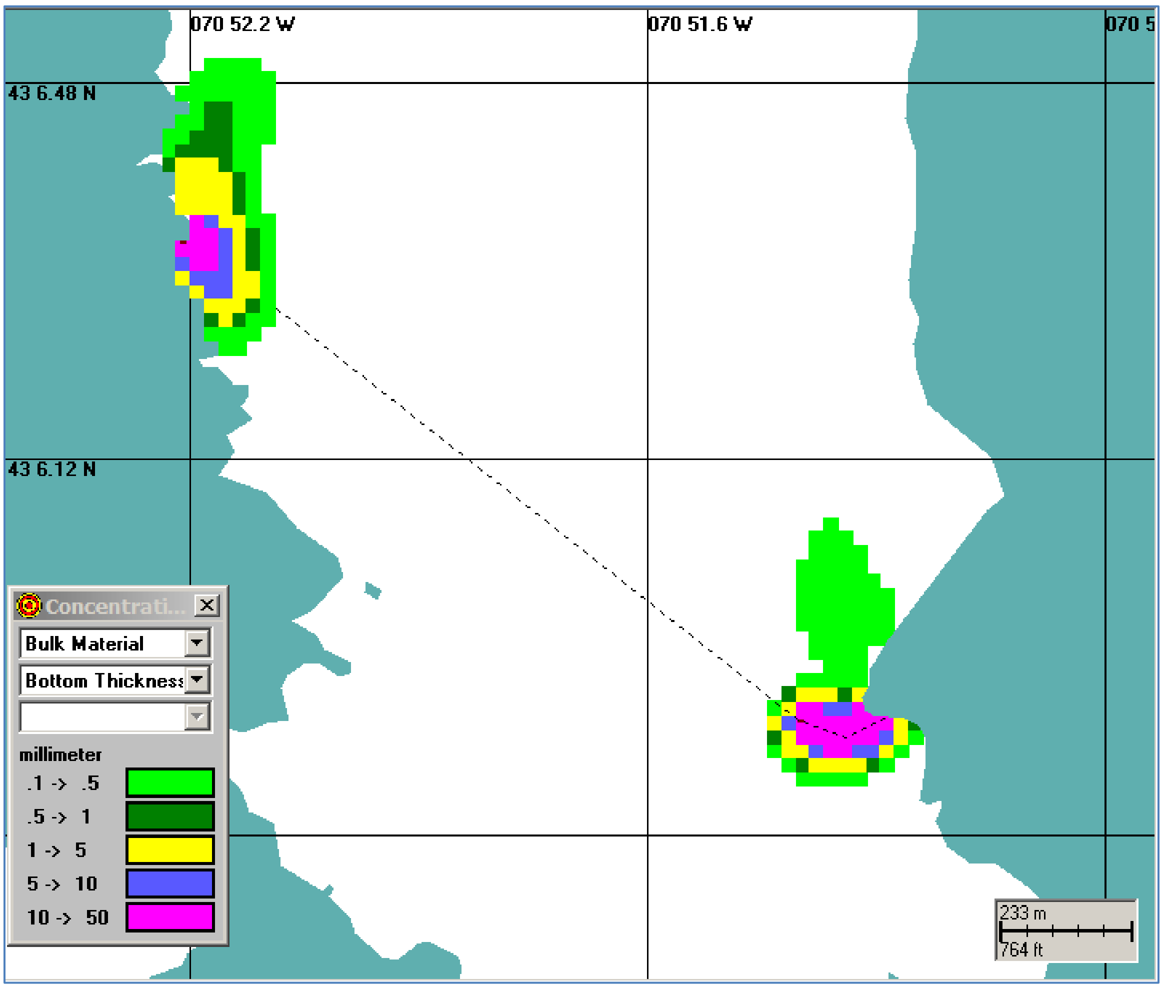

Figure 3-16. Plan view of time integrated bottom thickness (mm) distribution due to diver burial for west and east sections for three cable routes combined. Assumes that silt curtains were not used.

The areal sizes of the deposition thickness patterns seen in Figure 3-16 for both the west and east sections are summarized in Table 3-14 for each thickness increment range. At the 0.1 to 0.5 mm (0.004 to 0.02 in) thickness range the area is 3.4 ha (8.5 ac) for the west and 4.4 ha (10.8 ac) for the east, both including the three cable routes combined. These areas generally drop in size, for example, the west area of 1.9 ha [4.6 ac] and the east area of 1.1 ha [2.6 ac] for the 1 to 5 mm [0.04 to 0.2 in) thickness range is larger than the 0.5 to 1 mm (0.02 to 0.04 in) areas but not always, for the higher deposition thicknesses.

Table 3-14. Bottom thickness (millimeter and inch) areal distribution (hectare and acre) due to diver burial for west and east sections for the three cable routes combined. Assumes silt curtains were not used.

Thickness (mm)	West Area (ha)	East Area (ha)	Thickness (in)	West Area (ac)	East Area (ac)
0.1 to 0.5	3.4	4.4	0.004 to 0.02	8.5	10.8
0.5 to 1	1.4	0.4	0.02 to 0.04	3.4	0.9
1 to 5	1.9	1.1	0.04 to 0.2	4.6	2.6
5 to 10	0.6	0.5	0.2 to 0.4	1.5	1.2
10 to 50	0.5	1.2	0.4 to 2	1.2	2.9
Totals 0.1 to 50	7.8	7.6	0.004 to 2	19.2	18.4

Use of Silt Curtains

As with the 10-fold reduction in suspended sediment concentrations with the use of silt curtains, the results shown for bottom deposition can also be reduced by a factor of 10. This means that the legend appearing in Figure 3-16 showing bottom thickness levels ranging from 0.1 to 50 mm (0.004 to 2 in) can be reduced to 0.01 to 5 mm (0.0004 to 0.2 in) to be representative of the results from using silt curtains. In addition, Table 3-14 can also be reinterpreted for the use of silt curtains by reducing the listed thickness ranges by a factor of 10.

The area inside the silt curtains adjacent to the cable routes will, of course, see a significant local increase in bottom deposition thickness. Current velocities in the area where diver burial will be required on the western tidal flat and in the intertidal portion of the diver burial area on the eastern side are in the range for which silt curtains can be used effectively. In the more exposed portion of the diver burial area on the eastern end of the route, currents are likely to exceed those for which silt curtains can be used. The project proposes that silt curtains will be used to enclose the entire three western diver burial routes 90 m (296 ft) long with an area of 1,923 m^2 (20,695 ft^2) and also used along a portion (112 m [367 ft]) of the three eastern diver burial routes enclosing an area of 2,046 m^2 (22,021 ft^2). Approximately 66 m (216 ft) of each of the three cables on the eastern end of the route will not be enclosed during diver burial. Based on the trench geometry for diver burial summarized in Table 3-4 90% of the entire west resuspension volume or 181.0 m^3 (6,394 ft^3) spread over the enclosed area results in an average deposition thickness of 94 mm (3.71 in) while 90% of the entire partial east resuspension volume or 224.5 m^3 (7,927 ft^3) spread over the enclosed area results in an average deposition thickness of 110 mm (4.32 in). Larger thicknesses would be found closest to the burial routes (including the trenches) and smaller thicknesses found closer to the silt curtains distant from the routes.

3.5 Effects of Multiple Cable Laying Operations

Since there are three cable bundles to be laid in individual trenches the question arises as to what happens to the water column concentration and bottom deposition created by a single pass and whether it might affect the subsequent pass. The schedule to embed each cable by jet plowing is planned to occur on a 5 to 7 day interval. The water column concentration duration analysis shows that the excess concentration will drop to zero within approximately 6 hours. Thus there will be no cumulative increases in suspended sediment concentrations as a result of these installations.

A measure of the stability of deposited sediments to the seabed is a function of the erosion velocity for each grain size in the sediment. This relationship is shown via a Hjulstrom diagram as shown in Figure 3-17. Here the y-axis is the current velocity in Little Bay and the x-axis is sediment grain size. Since the freshly deposited sediment is unconsolidated, the fine grains (clay and silt) and sand would be eroded at a velocity of about 20 cm/s (0.4 kt). Examining the example figures of flood and ebb tide velocities in Figures 2-2 and 2-3, respectively, this minimum speed is exceeded across most of Little Bay except in the shallow tidal flat very near the shore where there could be some accumulation. Thus most of the fine sediment is likely to be resuspended on subsequent tides and dispersed from the areas initially affected by deposition unless flocculation of the clay particles occurs and they remain in place. The larger grain sizes will quickly drop back into the channel when first resuspended by the jetting process.

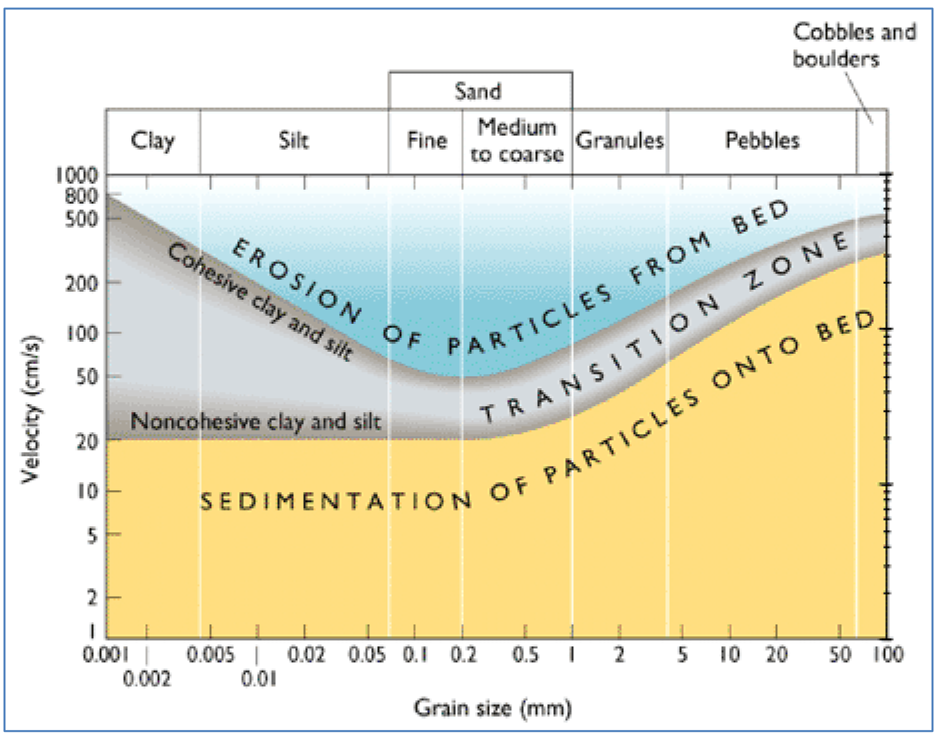

Figure 3-17. Hjulstrom diagram showing relationship between velocity and gran size (from http://eesc.columbia.edu/courses/ees/lithosphere/homework/hmwk1_s08.html).

4 Conclusions

Two computer models were used in the analysis: BELLAMY, a hydrodynamic model used for predicting the currents in Little Bay, and SSFATE, a sediment dispersion model used for predicting the fate and transport of sediment resuspended by the jet plowing and diver burial operations. BELLAMY is a finite element, two-dimensional, vertically averaged, time stepping circulation model developed at Dartmouth College and previously applied to the Great Bay Estuarine System. The SSFATE (Suspended Sediment FATE) model was utilized to predict the excess suspended sediment concentration and the dispersion of suspended sediment resulting from jetting activities. The model predicts excess concentration, which is defined as the concentration above ambient suspended sediment concentration generated by the seabed activities. The SSFATE model results are summarized below for the jetting and diver burial activities.

Jet Plowing

The size of the resulting excess suspended sediment (SS) concentration plume in the lower water column is defined as a series of areas enclosed by different concentration levels. The water column concentration contours shown, which are defined by a single concentration level, totally surround an enclosed area where concentrations are at or above the specified concentration, i.e., the area is cumulative. The entire area encompassed by the plume (as defined by the 10 mg/L excess SS concentration contour averaged over time was 14.8 ha (36.58 ac) ranging from a low of 5.91 ha (14.61 ac) at 1 hr to a high of 22.36 ha (55.25 ac) at 10 hrs. These total enclosed areas dropped dramatically for the higher concentrations, averaging 1.94 ha (4.79 ac) at 100 mg/L, 0.28 ha (0.68 ac) at 1,000 mg/L and 0.02 ha (0.05 ac) at 5,000 mg/L. indicating that the extent of the plume is limited for higher concentrations. In the shallows, suspended sediments from the jet plow activity are likely to reach nearly to the water surface. In the channel, excess suspended sediments will be restricted to the lower half of the water column.

An important metric defining the plume is its duration for different concentrations, which could have biological significance if exposure (duration multiplied by concentration) is sufficiently elevated. The maximum plume size and duration at 10 mg/L excess SS concentration in the area that is totally enclosed by the contour is 90.20 ha (222.89 ac) but lasts for only 1 hr. This short duration continues for all the concentration contour thresholds through 1,000 mg/L. The enclosed areas quickly drop in time for a given concentrations so by 2 hrs the 10 mg/L area has dropped to 32.20 ha (79.57 ac) and by 6 hrs the plume is completely gone. The area coverages drop dramatically for the higher concentrations near the jet plow indicating that the duration and extent of the plume is relatively limited.

The areal sizes of the deposition thickness patterns also generally drop in size, but not always. At the range of 0.1 to 0.5 mm (0.004 to 0.02 in) thickness the area is 35.6 ha (87.9 ac) due to jet plowing the three cable routes. These areas drop overall for the higher deposition thicknesses (e.g., 2.4 ha [5.9 ac] for the 5 to 10 mm (0.2 to 0.4 in) thickness range) near the jet plow indicating that the extent of the plume is relatively limited.

Diver Burial Assuming No Use of Silt Curtains

The total enclosed area of the excess SS concentration plumes for the west and east diver burial sections were also examined, specifically assuming that silt curtains were not used. Typically, at

10 mg/L excess SS concentration the instantaneous total area enclosed by the contour is 8.4 ha (20.7 ac) for the west section and 1.9 ha (4.7 ac) for the east section. However, these total enclosed areas drop dramatically for the higher concentrations near the diver burial activities, i.e., the area at 1,000 mg/L is only about 0.2 ha (0.6 ac) for the west section and 0.0 ha (0.1 ac) for the east section, indicating that the extent of the plume is again relatively limited.

Assuming no silt curtains were used, the total area in the west section that is enclosed by the 10 mg/L excess SS concentration contour is 14.6 ha (36.1 ac) but lasts for only 1 hr. This short duration continues through all the concentration contour thresholds through 5,000 mg/L. The enclosed areas decrease in time for a given concentrations so by 6 hrs the 10 mg/L area has dropped to 8.6 ha (21.2 ac). The 10 mg/L area persists for two days because the initial buildup occurs near slack water with grain size distribution indicating mostly fines (silts and clays). The area coverages decrease for higher concentrations near the diver burial activities. At the east section the 10 mg/L excess SS concentration total area that is enclosed by the contour is 8.2 ha (20.2 ac) but lasts for only 1 hr. This short duration continues through all the concentration contour thresholds through 500 mg/L. The enclosed areas decrease in time for a given concentration so by 6 hrs the 10 mg/L area has dropped to 4.1 ha (10.2 ac). The 10 mg/L area persists for two days because the initial buildup occurs near slack water with grain size distribution indicating mostly fines (silts and clays). The area coverages decrease for higher concentrations near the diver burial activities.

The sizes of the deposition thickness patterns also dropped as the deposition increased. At the 0.1 to 0.5 mm (0.004 to 0.02 in) thickness range the area is 3.4 ha (8.5 ac) for the west and 4.4 ha (10.8 ac) for the east, both including the three cable routes combined. These areas drop dramatically for the higher deposition thicknesses (e.g., 0.5 ha [1.2 ac] for the 10 to 50 mm (0.4 to 2 in) thickness on the west section and 1.2 ha (2.9 ac) for the east section indicating that the extent of the plume is limited.

Diver Burial Assuming Use of Silt Curtains

The effects of using of silt curtains were estimated by assuming that 90% of the suspended sediment resuspended from diver burial operations would be trapped by the curtains. That being the case, the results based on no silt curtain use can be reduced by a factor of 10 to estimate the concentrations outside the silt curtain. At 10 mg/L excess SS concentration the area enclosed by the contour was 1.2 ha (3.0 ac) for the west section and 0.4 ha (0.9 ac) for the east section.

In terms of exposure, for the west section at 10 mg/L excess SS concentration the area that is enclosed by the contour is 5.9 ha (14.7 ac) but lasts for only 1 hr. The areas decrease in time for a given concentrations so by 6 hrs the 10 mg/L area has dropped to 2.3 ha (5.7 ac). For the east section at 10 mg/L excess SS concentration the area that is enclosed by the contour is 2.1 ha (5.1 ac) but lasts for only 1 hr. The areas decrease in time for a given concentration so by 6 hrs the 10 mg/L area has dropped to 1.4 ha (3.6 ac). The area within the silt curtain area would, of course, see a significant increase in concentration until the material has settled out.

With the use of silt curtains the bottom deposition thickness outside the silt curtains can also be reduced by a factor of 10. At the 0.1 -> 0.5 mm (0.004 -> 0.02 in) thickness the area enclosed by the contour is 1.9 ha (4.6 ac) for the west and 1.1 ha (2.6 ac) for the east. Based on the trench geometry for diver burial 90% of the entire west resuspension volume or 181.0 m^3 (6,394 ft^3)

spread over the area enclosed by the silt curtain results in an average deposition thickness of 94 mm (3.71 in) while 90% of the entire partial east resuspension volume or 224.5 m^3 (7,927 ft^3) spread over the enclosed area results in an average deposition thickness of 110 mm (4.32 in). Larger thicknesses would be found closest to the burial routes (including in the trenches) and smaller thicknesses found closer to the silt curtains distant from the routes.

Stability of Deposited Sediments

A measure of the stability of deposited sediments to the seabed is a function of the erosion velocity for each grain size in the sediment. Since the freshly deposited sediment is unconsolidated, the fine grains (clay and silt) and sand are eroded at a velocity of about 20 cm/s (0.4 kt). This minimum speed is exceeded across most of Little Bay except in the shallow very near the shore. Thus sediment particles deposited along much of the route will likely be resuspended on subsequent tides and dispersed from the areas initially affected by deposition.

5 References

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Appendix B. Natural Resource Existing Conditions Report

Public Service of New Hampshire
Seacoast Reliability Project

Madbury, Durham, Newington & Portsmouth, NH

Natural Resource Existing Conditions Report

Prepared For:
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Executive Summary

Public Service Company of New Hampshire d/b/a Eversource Energy ("PSNH") is proposing to construct a new 115 kilovolt ("kV") transmission line between the existing Madbury and Portsmouth substations. The Seacoast Reliability Project ("SRP") would be located in the Towns of Madbury, Durham and Newington as well as the City of Portsmouth, in Strafford and Rockingham Counties, New Hampshire. The 12.9-mile long project would begin at the existing PSNH Madbury Substation in Madbury, traversing Durham, crossing Little Bay via an underwater cable into Newington, and then continuing east before ending in Portsmouth. The terrestrial portions of the project lie almost entirely within an existing electric utility corridor, and the submarine portions of the project are proposed within a mapped cable corridor across Little Bay. Natural resources, including wetlands, streams, vernal pools, estuarine resources, soils and wildlife, were identified in the approximately 152-acre Project Area. This report summarizes the methodology used in the surveys, and describes the existing natural resources along the proposed SRP corridor.

Streams, Rivers and Ponds

The majority of the streams identified in the Project Area are perennial or intermittent (81%), which is consistent with the flat topography and low elevation of the site. Eighteen perennial streams were mapped; the most notable being the Oyster River which is a designated river under the New Hampshire Rivers Management and Protection Program ("RMPP")(RSA 483). As a designated river, the Oyster River is subject to the protections afforded by the New Hampshire Shoreland Water Quality Protection Act ("SWQPA"). The SRP corridor crosses through a small portion of the Lamprey River Watershed which is also designated; however it does not cross the Lamprey River, or any of the tributaries cited in the watershed designation description (North Branch, North, Little, Pawtuckaway, or Piscassic Rivers). The only other water resource protected under the SWQPA is Little Bay, which the Project will cross via underwater cable.

Wetlands

Wetlands were delineated in 2013, 2014 and 2015 with a total of 114 wetlands identified within the SRP corridor. Approximately 77 percent (by area) of the delineated wetlands were palustrine (freshwater) systems, while the remaining 23 percent were estuarine. Due to the routine vegetation maintenance activities associated with the existing electric lines, the majority of the terrestrial wetlands were a combination of palustrine emergent and scrub-shrub systems (49%) or palustrine emergent (17%) wetlands. The remaining palustrine wetlands were different combinations of emergent, scrub-shrub, forested and unconsolidated bottom. A fringing salt marsh borders the west shore and portions of the east shore of Little Bay. Other estuarine wetlands include rocky shore, mudflat and subtidal unconsolidated sands and mud associated with Little Bay. Many of the wetlands were parts of larger wetland systems that included the SRP corridor, and many were disturbed to some extent due to development and other ongoing activities. In the freshwater wetlands, the most common principal functions and values identified across the study area include groundwater recharge/discharge, wildlife habitat, production export, sediment retention, and floodflow alteration. Five of the wetlands are sections of three prime wetlands mapped in the Town of Newington.

Vernal Pools

Some of the water resource surveys were conducted outside of the vernal pool identification window, which typically occurs in April and May along the coastal plain of New Hampshire. During the initial wetland and stream delineation in the summer and fall of 2013, two potential vernal pools ("PVPs") were identified. A follow-up survey was conducted in the spring of 2014 to identify any other active vernal pools and verify the previously identified PVPs. Another vernal pool review was conducted in the spring of 2015 and resulted in one area that contained a primary vernal pool indicator (wood frogs) utilizing a permanently inundated pond within a larger wetland complex. The pond did not meet the definition of a vernal pool. Based on the 2014 and 2015 spring surveys, no vernal pools occur within the Project Area.

Little Bay Bathymetry and Substrate

The SRP crosses Little Bay north of Adams Point and Furber Strait into Newington north of Welsh Cove within an area denoted as Cable Area on the National Oceanic and Atmospheric Administration ("NOAA") navigation chart 13285. A broad tidal flat with depths ranging from about +1 to -1 feet Mean Lower Low Water ("MLLW") extends from the western shoreline approximately 1800 feet. At this point water depths increase gradually (over a distance of about 800 feet) to ~30 feet below MLLW. Water depth remains deep for about 400 feet, gradually decreasing to about 17 feet below MLLW and then more abruptly to 0 feet MLLW. The tidal flat on the eastern shoreline into northern Welsh Cove is about 500 feet wide.

Sediment surveys by PSNH and by others were consistent in showing that the substrate on the western tidal flat was predominantly silt-clay and in the channel and eastern channel slope was predominantly sand. Values for samples within Little Bay (by others) indicated that total organic carbon ranged from 0.55 to 2.35 percent, averaging 1.4 percent, a relatively low value. Sediment toxicity testing by others revealed no significant mortality among test benthic organisms. Based on these data, USEPA (2007) characterized sediment quality in Little Bay as good. Trowbridge (2009) noted that although sediment contaminant levels in tributaries to the Great Bay/Little Bay system often exceeded NOAA screening levels, the concentrations within the bays themselves did not. It is unlikely that this has changed since the last assessment. Sediment contamination was not considered as a factor affecting the estuary in Piscataqua Region Estuary Program's 2013 State of the Estuary report.

Little Bay Water Quality

NOAA's National Estuarine Eutrophication Assessment program has designated all of Little Bay as part of the Seawater Zone of the Great Bay Estuary system, with salinities exceeding 25 parts per thousand (ppt). In Great Bay, estimates of water temperature from April 2009 through September 2014, ranged from -2 to 29.1°C (28.4 to 84.4°F), with July having the highest monthly mean temperature (24°C; 75.2°F). Dissolved oxygen ("DO") levels ranged from 3.7 to 17.4 mg/l during April 2009 through September 2014, with the lowest monthly mean DO in July (7.5 mg/l).

Several studies have found that total suspended solids off Adams Point located south of the project area were statistically higher during the period from 2001-2008 than during 1974-1981. This increase was linked to decreases in eelgrass, whose root and rhizome system stabilizes sediments and helps sequester nutrients in the substrate. Total suspended solids concentrations vary widely both seasonally and tidally.

Eelgrass and Macroalgae

Eelgrass is the most widespread aquatic vegetation in the Great Bay Estuary, of which Little Bay is part. Eelgrass provides significant habitat functions and values both biologically and physically. It is important for cover, nursery and breeding grounds for invertebrates and fish, sediment stability, and nutrient and carbon retention. Eelgrass distribution in Little Bay has varied tremendously over decades. In the Project Area, it has varied from thick beds in the 1980s to sparse or absent in more recent years. Project specific surveys did not observe any attached eelgrass within the survey areas.

Most macroalgae require hard substrate for attachment so their presence is restricted in Little Bay to nearshore areas where bedrock outcrops, cobble, or boulders are present. Substrate in the Cable Area is predominantly unconsolidated fine granular sediment however limited areas of rock outcrops occur along both shorelines where the macroalgae was observed.

Shellfish

The Great Bay estuary system supports populations of several shellfish species of interest to harvesters, including oysters (*Crassostrea virginica* and *Ostrea edulis*), softshell clams (*Mya arenaria*), blue mussels (*Mytilus edulis*), razor clams (*Ensis directus*), and sea scallops (*Placopecten magellanicus*). Recreational harvesting of oysters and softshell clams is allowed in specified areas in the estuary but the proposed SRP lies within a Cable Area mapped on NOAA chart 13285 and is permanently closed to harvest. Major natural oyster beds have not been documented in Little Bay in recent years; the closest beds to the Cable Area are at Adams Point (about 0.75 mile south of the Cable Area) and Nannie Island (off of Woodman Point; about 1.75 mile south of the Cable Area). Small populations of oysters are likely to be present on some rocky surfaces in Little Bay. New Hampshire Department of Environmental Services ("NHDES") is also encouraging oyster aquaculture in the estuary. Existing aquaculture operations include an aquaculture lease that falls partially within the Cable Area; NHDES may move this lease to the north to avoid the non-harvestable Cable Area. New Hampshire Department of Fish and Game ("NHFG") considers the western tidal flats of Little Bay to provide suitable habitat for softshell clams, razor clams, and the non-harvested *Macoma balthica*. Normandeau's field surveys on the western flats identified softshell clams at nine of fifteen stations and live razor clams were identified at two. Razor clam shells were noted in several locations. No live *Macoma* were observed although shells were present. These results confirm that these resources are present within the Cable Area.

Benthic Infauna

Benthic infauna are the macro- and micro-organisms that reside in the sediments of tidal and intertidal systems. In the Project Area, infaunal abundance was generally highest at the stations on the western tidal flat, most variable in the channel, and most consistent along the channel slope. The total number of unique taxa was most consistent on the tidal flat and most variable among the stations in the channel and along the channel slope.

Results of the project-specific survey compare well to data collected between 2000 and 2006 for the National Coastal Condition Assessment ("NCCA") program. Most taxa that were numerical dominants in the NCCA samples were also dominants in the Project Area. A study of infauna in the Great Bay estuary reported that species richness and dominant species (including *Streblospio*, *Heteromastus*, *Scoloplos*, *Pygospio*, *Aricidea*, and oligochaetes, many of the dominants in the Project Area) were similar over a twenty-year period (1972-1995) indicating that the benthic infaunal community in the estuary was been relatively stable in composition for those three decades. The National Estuary Program rated benthic conditions in Little Bay as good based on the fact that Shannon-Weiner diversity at all of the stations within the bay itself (excluding tributaries) exceeded 0.63, a condition that was also met in the project-specific data collected in 2014.

Epibenthos

Epibenthic organisms that live and feed on the substrate surface and are known to, or are likely to, occur in the Great Bay Estuary include American lobster (*Homarus americanus*), rock crabs (*Cancer irroratus*), green crabs (*Carcinus maenas*), mud crabs (Xanthidae) and horseshoe crabs (*Limulus polyphemus*) (Jones 2000). These species move around on and burrow into the substrate seeking food or refuge. Bioturbation caused by these activities can have a substantial effect on the infaunal biota and on eelgrass beds. Lobsters are present throughout the estuary and are fished both commercially and recreationally, although no landings or distribution data are available for the estuary. Lobsters move in and out of the estuary seasonally, with their greatest presence during late spring through fall.

Horseshoe crabs are ecologically important because their eggs, laid intertidally, provide a rich food source for migrating shorebirds in the spring. In addition, the crabs forage in muddy substrates for food and by doing so, bioengineer the substrate. Studies have not identified breeding habitat in the immediate vicinity of the Project. Juveniles are most apt to reside in the upper regions of Great Bay, with none being observed in Little Bay. Mudflats throughout the Great Bay Estuary are important feeding habitats for both adult and juvenile horseshoe crabs.

Rock crabs have been reported from the Great Bay system and may occur in deeper portions of the proposed cable crossing as this species prefers sandy substrate (Jeffries 1966). Rock crabs are fished commercially and recreationally to some degree. NHFG has found green crabs, an invasive species, to be the most abundant invertebrate species collected in New Hampshire's estuaries (NHFG 2014c). Green crabs have been shown to consume juvenile softshell clams, contributing to the failed recruitment to harvestable sizes and to uproot eelgrass plants, particularly in restoration areas. Abundances of rock and green crabs in Great Bay are not readily available; results of the NHFG surveys are reported as total Great Bay, Little Bay, Piscataqua River, Little Harbor and Hampton/Seabrook Estuary combined (NHFG 2014c). Jones (2000), however, noted that rock crabs are abundant in Great Bay and that green crabs are more common in Little Bay than in Great Bay.

Fish

A number of fish species are known to utilize the Great Bay Estuary during at least one life stage. The NHFG and National Marine Fisheries Service are tasked with management of ecologically and economically important fish species including, diadromous fish species, Essential Fish Habitat ("EFH") species, and rare, threatened, or endangered ("RTE") species. Diadromous fish species either spend their life in saltwater and spawn in freshwater (anadromous) or spend their life in freshwater and spawn in the ocean (catadromous), and are discussed below. EFH (SEC Appendix 38) and RTE (SEC Appendix 37, NHDES Wetlands Application Appendix C) fish species are also summarized, and described in more detail in separate reports.

Six species of diadromous fish utilize Great Bay Estuary for some portion of their life cycle: American eel, American shad, alewife, blueback herring, rainbow smelt, and sea lamprey. All species with the exception of American shad have been observed in the Mill Pond fish ladder on the Oyster River, and therefore have the potential to be within the corridor crossing the Oyster River. All species except blueback herring may transit through the Cable Area in Little Bay during migrations between the marine and freshwater environments.

Two federally listed fish species, short-nosed sturgeon (Endangered) and Atlantic sturgeon (Threatened), may use the Little Bay corridor as feeding habitat. Neither species is known to breed in New Hampshire, and short-nosed sturgeon is considered extirpated in New Hampshire, but adults from other populations in the Gulf of Maine could occasionally feed in Great Bay, including the Project Area. Three state-listed Special Concern fish species, American eel, swamp darter and banded sunfish, are known to occur upstream and downstream of several streams crossing the Project Area, including the Oyster River. These species are assumed to periodically use the Project Area.

The proposed Project Area in Little Bay was determined to provide EFH for at least one life stage of 10 species at some point during the year: Atlantic cod, Atlantic Halibut, Atlantic mackerel, bluefish, pollock, red hake, white hake, windowpane flounder, winter flounder, and yellowtail flounder.

Soils, Vegetation and Habitat Types

The Natural Resources Conservation Service ("NRCS") soil mapping indicates that soils within the Project Area are derived from till, or are of glaciomarine or outwash parent material. The soils observed during field surveys were primarily fine or very fine sandy loams or silt loams. Example series include the Hollis-Charlton very rocky fine sandy loams, Scantic silt loam, Buxton silt loam, Suffield silt loam, and Swanton fine sandy loam. In Little Bay, surveys showed that sediments on the western tidal flat were predominantly silt-clay and in the channel and eastern channel slope were predominantly sand.

The project corridor is located within the Coastal Plain ecological region of New Hampshire. The highest elevation is approximately 130 feet above sea level near the Madbury Substation. Based on the NHFG 2015 Wildlife Action Plan's ("WAP") cover type map and field observations, habitat cover types in the vicinity of the SRP consist mostly of Appalachian oak-pine forest, with smaller areas of wet meadow/shrub wetlands, grasslands, and temperate swamp. The Appalachian oak-pine forests are found across the subtle ridges and rises within the landscape, with the depressions and low areas consisting mostly of larger wetland complexes. One rare plant species in Durham, and four exemplary natural communities all associated with Little Bay have been identified within the Project Area.

Wildlife

Transmission corridors in general are known to provide suitable habitat for a variety of wildlife species, including mammals, birds, reptiles, amphibians, and invertebrates. Species with small home range requirements may use a portion of a corridor as their primary habitats. Animals with larger home ranges may use a corridor as a part of their overall home range, or as a travel/dispersal route. Transmission corridors may also provide intrinsic habitat value as a relatively undeveloped habitat area in locations were the surrounding land use consists of commercial, institutional, and/or residential development.

The undeveloped areas and low density residential areas surrounding the SRP are primarily forested while the vegetation maintenance practices conducted in the existing cleared corridor create grass and/or shrubby habitat types. Although narrow (approximately 60 feet wide), the existing cleared corridor provides some relatively valuable habitat resources for grassland/shrubland species, and may also provide a dispersal corridor for species that depend on grassy and/or shrubby habitats.

The SRP corridor crosses though some areas designated as Highest Priority Habitat by the New Hampshire WAP, primarily in Durham. Most of the remainder of the corridor is designated as Supporting Landscapes or has no designation at all.

In late fall, Great Bay typically hosts large numbers (>500) of migrating Canada geese and black ducks, as well as smaller numbers (<100) of other diving and dabbling ducks, shorebirds and seabirds. These birds use a variety of areas around the bay and are not likely resource constrained. Bald eagles and osprey also nest on lands bordering Great Bay. No known nests occur in the vicinity of the Project Area.

1.0 Introduction

Public Service Company of New Hampshire d/b/a Eversource Energy is proposing to construct a new 115 kV transmission line between their existing Madbury and Portsmouth substations to enhance the electric reliability in the seacoast region. The SRP would be located in the Towns of Madbury, Durham and Newington as well as the City of Portsmouth, in Strafford and Rockingham Counties, New Hampshire. Normandeau Associates ("Normandeau") was contracted by PSNH to delineate and evaluate natural resources including rivers, streams and ponds, wetlands, vernal pools, wildlife, fish, shellfish, benthic infauna, eelgrass, and water quality in Little Bay for the Project. This report summarizes the methodology used by Normandeau and describes the existing conditions along the proposed Seacoast Reliability Project corridor.

1.1 Project Description

The SRP is proposed to be approximately 12.9 miles long including a 0.9-mile crossing under Little Bay (Figure 1.1-1). The entire line will be constructed within existing electric corridors, with minor adjustments to right-of-way ("ROW") widths in several locations. The corridor ranges from 40-130 feet wide, but is predominantly 100 feet wide. For most of its length, a mowed clearing approximately 60 feet in width has been maintained by PSNH in support of the existing electric distribution line. The edges of the corridor are unmaintained and frequently support forest (approximately 20 feet on each side) which will need to be cleared for the SRP. The cable crossing proposed in Little Bay will directly affect a corridor approximately 90 feet wide within a charted Cable Area approximately 1,000 feet wide.

The majority of the SRP will be constructed aboveground on overhead structures between 65 and 115 feet in height. It will cross under Little Bay by being buried 3.5-8 feet in the substrate using jet plow and hand jet technology. For this crossing, the transmission line will be necessarily split into three cables to maintain the required transmissivity for the reliability project. East of Little Bay, the line will remain underground until it crosses Little Bay Road in Newington, after which it will emerge to cross overland until it terminates at Portsmouth substation. In most locations, the existing distribution line will be co-located on the new structures and the existing distribution structures will be removed. In several locations, the existing distribution line will be relocated outside of the SRP corridor and the new structures will carry the new transmission cables only. A short portion of an existing transmission line will need to be relocated to accommodate the new SRP alignment at Crossings at Fox Run Mall in Newington. Substation improvements in Madbury and Portsmouth will be confined to the existing substation footprints. No other substation modifications are proposed.

1.2 Site Description

The length and acreage of the SRP is in each of the four towns is shown in Table 1.2-1. The Project begins in Madbury at the existing PSNH Madbury Substation located off of Perkins Road. From the Madbury Substation, the corridor passes immediately into Durham and follows an existing PSNH distribution line that parallels a railway line

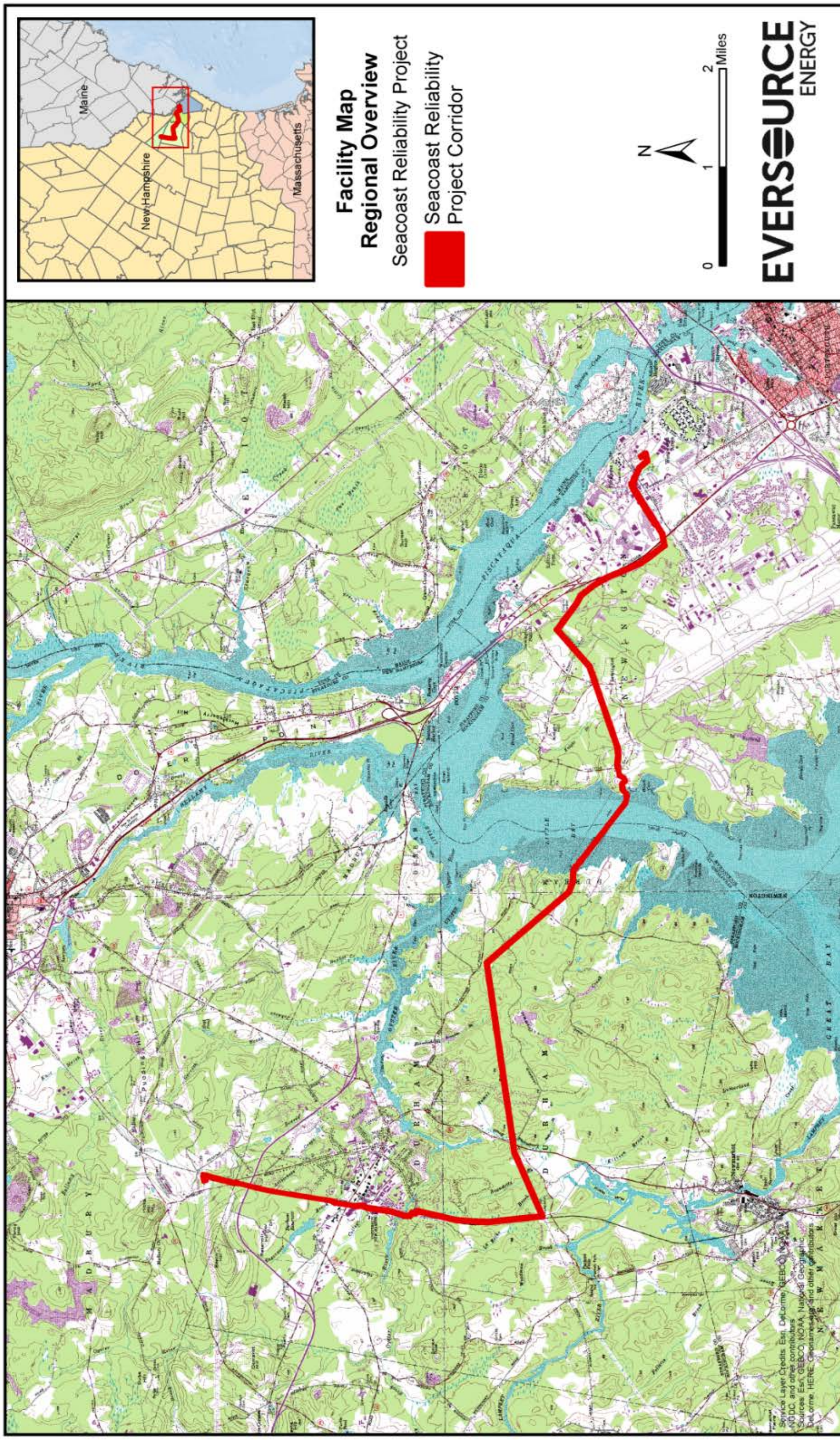

Figure 1.1-1. Site Location Map.

Table 1.2-1. Extent of the Seacoast Reliability Project's corridor within the four towns.

Town	Length (Miles)	Area (acres)
Madbury	0.4	5
Durham	7.8	87
Newington	4.4	56
Portsmouth	0.3	4
Total	12.9	152

southward towards the campus of the University of New Hampshire ("UNH"). The corridor passes to the west of the main campus and continues south over Mill Road where it crosses through undeveloped lands as it approaches Bennett Road. From just north of Bennett Road, the corridor bends sharply to the east and traverses rolling hills and a mix of undeveloped and residential areas where it crosses NH Route 108 and Durham Point Road before approaching the western shore of Little Bay.

The transmission line will transition from an overhead line to an underwater cable and cross Little Bay within an existing charted Cable Area. Remnants of a former electric cable crossing are still present in the form of cable houses on both shores, and four old de-energized cables still present within the Cable Area. On the east side of Little Bay, the line will transition from an underwater cable to an underground line where it will pass through a residential area buried in Gundalow Landing (road). Where the corridor crosses Little Bay Road, the line will transition once again to an overhead line and continue to the east before bending south parallel to the Spaulding Turnpike. After approximately one mile, the corridor crosses over the Spaulding Turnpike and passes through densely developed commercial and industrial areas associated with Gosling Road and Woodbury Avenue. Near the Newington Substation the line turns south until it terminates at the existing PSNH Portsmouth Substation.

The Project corridor crosses through a diverse assemblage of land uses and habitat types. These include relatively rural and undeveloped areas in Madbury and Durham, densely developed areas associated with the UNH campus and commercial lands to the east of the Spaulding Turnpike in Newington and Portsmouth, and several lower and moderate density residential areas to the east and west of Little Bay. The topography is generally flat to rolling which is typical in the coastal areas of eastern New Hampshire.

1.3 Agency Pre-Application Meetings

Three pre-application meetings have been held with New Hampshire and federal natural resource regulatory agencies. The first was at the NHDES in Concord, New Hampshire, on January 6, 2015. Agencies represented included NHDES staff from the Wetlands Bureau, Coastal Program, Alteration of Terrain, and Public Information; NHFG; New Hampshire Department of Resource and Economic Development's Natural Heritage Bureau ("NHB"); U.S. Army Corps of Engineers ("USACE"); U.S. Environmental Protection Agency ("USEPA"); U.S. Fish and Wildlife Service ("USFWS") and National Marine Fisheries Service. The agencies were given a presentation of the proposed Project and preliminary natural resource studies and findings, which were then followed by a discussion of the various regulatory concerns. Key decisions that resulted from the meeting and feedback immediately following the meeting were as follows:

- an Alteration of Terrain permit would likely not be required because most of the project will not trigger the need for the permit, and the Little Bay crossing is entirely within wetlands thus will be reviewed by the Wetlands Bureau; however follow-up conversations indicated that an Alteration of Terrain permit would indeed be required to address potential disturbances;
- water quality impacts in Little Bay will be reviewed by NHDES;
- compensatory wetland mitigation via in-lieu-fee payment to the Aquatic Resource Mitigation (ARM) fund appears appropriate; and
- the Corps expects the Project to qualify for a General Permit review, given that almost all impacts are temporary and permanent terrestrial impacts are less than <1,000 square feet.

Data and study requests included justification for the jetplow installation versus horizontal directional drilling, rationale for the need to cross the Oyster River during construction which was resolved by utilizing a new access route that avoids the need for the crossing, the addition of sea lamprey to diadromous fish list, and a final eelgrass survey the growing season before the Little Bay cable installation.

A meeting of the marine agencies was held on March 3, 2015, at Normandeau's Portsmouth office. Agencies present included NHDES Watershed Bureau, USACE, National Marine Fisheries Service, and USEPA. The focus was to discuss the Little Bay crossing in particular, including the construction process, and impacts on potential resources and water quality.

Another joint pre-application meeting was held January 12, 2016 with state and federal agencies. Attendees included NHDES Wetlands Bureau, Alteration of Terrain, and Water Quality staff, NHFG; NHB; USACE; USEPA; USFWS and National Marine Fisheries Service ("NMFS"). The purpose of this meeting was to present the final permitting design, describe the project community outreach efforts, and request any outstanding agency concerns. Topics of discussion included a description of alternatives, installation methods in Little Bay, impact details to terrestrial and marine areas and sedges, resource survey findings such as eel grass, mitigation and permitting, monitoring including salt marsh areas, water quality, and re-deposition of sediments. The development of Little Bay water quality monitoring program, post-construction bathymetric surveys, and *Carex cristatella* monitoring were also discussed.

In addition to these multi-agency meetings, the SRP has met or spoken with various agencies individually or in small focus groups to provide updates on the Project; discuss specific rare species, historic, and mitigation measures; and present Great Bay impacts.

Summaries of all meetings are provided in SEC application.

2.0 Methods

This section describes the methods used to investigate terrestrial and estuarine natural resources within the limits of the SRP.

2.1 Terrestrial Resources

Normandeau used qualified and experienced staff scientists to provide wetland delineations, wildlife habitat surveys, botanical surveys and marine surveys. Normandeau New Hampshire Certified Wetland Scientists ("NHCWS") and other field scientists investigated the study area in 2013, 2014 and 2015. All delineated resource boundaries, including wetlands, streams, and vernal pools were located with a Trimble® Global Positioning System ("GPS") that is capable of sub-meter accuracy. A project-specific data dictionary was used with each GPS unit to supplement the data recorded on field data sheets. The dictionary aided in maintaining consistency for data collection between field teams. The GPS files were post-processed and incorporated into a geodatabase using ESRI ArcMap 10.2. Selected field delineations were subjected to field Quality Assurance/Quality Control reviews by senior Normandeau biologists and other wetland staff throughout the field data collection effort.

Other resources, such as water quality, fish, epibenthos, general vegetation cover types, wildlife, rare species, soil map units and conservation lands, were investigated via a combination of mapped resources from GRANIT and the municipalities, as well as field observations.

Latin names for plants used in this document are from *Flora Novae Anglia* (Haines 2012), which includes the most current plant taxonomy.

Streams, Rivers and Ponds

All jurisdictional streams and waterbodies within the study area were delineated and located with GPS. A project-specific data form was utilized to standardize the collection of stream characteristics. The centerlines of streams less than six feet wide were delineated with orange flagging and approximate channel width noted. The tops of bank for streams greater than six feet wide were individually flagged. Drainage swales and ditches in uplands were not considered jurisdictional streams when it was apparent that water flow only occurred during precipitation events and the ditch or swale was not functioning as a wetland, or did not provide a connection between wetlands. The data forms included basic information such as flow regime, apparent flow (at the time of delineation), width, depth and relationship to other streams and wetlands. The following guidance was used in determining the watercourse type, which is based on Federal definitions (Federal Register, March 12, 2007) and is generally consistent with New Hampshire regulations:

- *Ephemeral stream*: Flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow.
- *Intermittent stream*: Flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow.
- *Perennial stream*: Flowing water year round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary

source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow.

The New Hampshire Shoreland Water Quality Protection Act (SWQPA; RSA 483-B) provides oversight of activities within designated buffers that range between 50 to 250 feet from an established reference line, either the ordinary high water mark for rivers or a defined surface elevation for lakes and ponds, or the highest observable tide line associated with waters subject to the ebb and flow of the tide (NHDES 2011a). Waterbodies include lakes and ponds greater than 10 acres in size, tidal waters, fourth order and greater streams and rivers and, "designated rivers" under the Rivers Management and Protection Act of 1988 (RSA 483).

The portions of the project corridor that are within 250 feet of the highest observable tide line for Little Bay are subject to the requirements of the SWQPA. The corridor also crosses the Oyster River, which is a Designated River and is therefore managed and protected for its outstanding natural and cultural resources in accordance with RSA 483, The Rivers Management & Protection Act. The portions of the corridor within 250 feet of the ordinary high water mark on the Oyster River will also be subject to the SWQPA. No other rivers or waterbodies within the project corridor qualify for review under the SWQPA.

Wetlands

The NHDES has jurisdiction of wetland resources under RSA 482-A and New Hampshire Code of Administrative Rules (Env-Wt.100-900). The USACE has jurisdiction over wetlands and waterways under Section 404 of the Clean Water Act. Field protocols were developed to ensure consistency during the delineation of wetlands and the documentation of wetland characteristics. Wetland boundaries were delineated by, or with oversight by, a NHCWS. Wetland delineations were completed in the field using the routine determination according to the criteria established by the USACE in the *1987 Corps of Engineers Wetlands Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)* (2012). The manual and regional supplement both utilize a three parameter approach to the field determination of wetland boundaries and requires the presence of hydric soils, hydrophytic vegetation and hydrology under normal circumstances.

Wetland boundaries were flagged with pink and black "Wetland Delineation" flagging and numbered with an identifier for the wetland and a flagging sequence. The wetland boundary flags were located with GPS and a project-specific data form was completed for each wetland. The data form included an evaluation of the functions and values of each wetland according to the USACE "Highway Methodology" (USACE 1995). Functions and values considered principal for the wetland, as well as those considered suitable were noted. Other field information gathered and recorded on the data forms included wetland associations with water bodies, streams, vernal pools and dominant cover type class based on the USFWS classification system (Cowardin, et al. 1979).

Under RSA 482-A:15 and the associated administrative rules (Env-Wt 700), individual municipalities may elect to designate wetlands as "prime-wetlands" if the municipality can demonstrate that high-quality wetlands are present. Newington and Portsmouth have designated Prime wetlands and Durham and Madbury have not. The Newington and Portsmouth prime wetland maps were reviewed and those that intersect with the SRP corridor are indicated on the project Environmental Maps.

Vernal Pools

The SRP corridor was surveyed for potential vernal pools during wetland delineations. Each potential vernal pool encountered was visually inspected for egg masses and/or larvae of amphibian vernal pool indicator species during the spring 2014 vernal pool species breeding season. A follow-up review of specific areas was also conducted in the spring of 2015. A dip net was also used to survey for amphibian larvae and invertebrates. Vernal pools were identified in accordance with the NHDES Wetland Rules (Env-Wt) 101.106 and Env-Wt 301.01, and procedures described in *Identification and Documentation of Vernal Pools in New Hampshire*, published by the New Hampshire Fish and Game Department (NHFG 2004).

A vernal pool is defined (Env-Wt 101.106(a-b)) as:

> *a surface water or wetland, including an area intentionally created for purposes of compensatory mitigation, which provides breeding habitat for amphibians and invertebrates that have adapted to the unique environments provided by such pools and which:*
>
> *(a) Is not the result of on-going anthropogenic activities that are not intended to provide compensatory mitigation, including but not limited to: (1) Gravel pit operations in a pit that has been mined at least every other year; and (2) Logging and agricultural operations conducted in accordance with all applicable New Hampshire statutes and rules; and*
>
> *(b) Typically has the following characteristics: (1) Cycles annually from flooded to dry conditions, although the hydroperiod, size, and shape of the pool might vary from year to year; (2) Forms in a shallow depression or basin; (3) Has no permanently flowing outlet; (4) Holds water for at least 2 continuous months following spring ice-out; (5) Lacks a viable fish population; and (6) Supports one or more primary vernal pool indicators, or 3 or more secondary vernal pool indicators.*

Primary and secondary vernal pool indicator species are described in Env-Wt 101.75 and Env-Wt 101.86, respectively. Under these rules, primary vernal pool indicators refer to:

> "*the presence or physical evidence of breeding by marbled salamander (Ambystoma opacum), wood frog (Rana sylvatica), spotted salamander (Ambystoma maculatum), Jefferson-blue spotted salamander complex (Ambystoma jeffersonianum/A. laterale complex), or fairy shrimp (Eubranchipus sp.)*". [Env-Wt 101.71]

Secondary vernal pool indicators are:

> "*physical evidence used by wildlife biologists or certified wetlands scientists who are familiar with vernal pool habitats as evidence of the presence of a vernal pool, if primary vernal pool indicators are absent and other vernal pool characteristics suggest vernal pool habitat. Secondary vernal pool indicators include, but are not limited to, caddisfly larvae and cases (Limnephilidae, Phyrganeidae, or Polycentropodidae), clam shrimp and their shells (Laevicaudata, Spinicaudata), fingernail clams and their shells (Sphaeriidae), aquatic beetle larvae (Dytiscidae, Gyrinidae, Haliplidae, and Hydrophilidae), dragonfly larvae and exuviae (Aeshnidae, Libellulidae), spire-shaped snails and their shells (Physidae, Lymnaeidae), flat-spire snails exuviae (Coenagrionidae, Lestidae), and true fly larvae and pupae (Culicidae, Chaoboridae, and Chironomidae).*" [Env-Wt 101.82]

2.2 Estuarine Resources

Normandeau investigated estuarine resources within the SRP corridor in 2013 and 2014. The investigations included a desktop review of historical and existing eelgrass (*Zostera marina),* macroalgae, shellfish areas, benthic infauna, fish, sediment characteristics and water quality. Field surveys were performed to confirm the current condition of eelgrass, shellfish and benthic infauna, and incidentally observed macroalgae and sediment characteristics.

Eelgrass

On October 14, 2013, Normandeau conducted a towed underwater video survey along transects within and south of the charted Cable Area where eelgrass had been reported in 2012. One transect extended across the bay to the western shoreline. No attached eelgrass was observed on any of the five transects. In addition, because water clarity was good, the field crew was able to observe that eelgrass was absent on the eastern side of the cable route. Other incidental observations by Normandeau biologists during shellfish surveys in September 2014 did not find eelgrass on the western tidal flats within the cable corridor. Surveys by the marine contractor in mid-July 2014 to inspect the condition of the existing cables also did not observe eelgrass in the corridor.

Shellfish

A conversation with Mr. Bruce Smith, NHFG on August 25, 2014, indicated that the department considers the Cable Area as suitable habitat for softshell clams (*Mya arenaria*), razor clams (*Ensis directus*), and the non-harvested *Macoma balthica*. In order to assess this resource, at the suggestion of Mr. Smith, Normandeau conducted an observational survey within the Cable Area on the western tidal flat on September 16, 2014. Scientists accessed the area by canoe and a molluscan expert observed the substrate through a view tube in water depths ranging from about 1 to 2 feet. Three transects equating to nearshore, mid-tidal flat, and off-shore tidal flat were pre-selected in the office to cross the 1000-foot charted Cable Area. On each transect, five stations were distributed equidistantly along transects that extended beyond the boundaries of the Cable Area identified on NOAA Chart 13285 such that three stations on each transect were within the Cable Area and two were beyond to serve as reference stations. Including reference stations beyond the potential impact area facilitates the evaluation of whether the shellfish within the Cable Area is unique or similar to nearby resources. In the field, each of the 15 sampling stations was located by GPS, and three circular fields of vision using an underwater viewtube (each approximately 1 foot in diameter (0.8 square feet) were examined. The number of distinct molluscan siphon holes, species of mollusk and associated macrofauna were recorded. The three species of interest have distinct siphons so it was possible to identify feeding individuals to species.

Benthic Infauna

A site-specific benthic survey was undertaken on September 9, 2014. Fifteen stations were sampled along three depths zones to represent the western shallow subtidal mud flat (approximately 0 to -1 foot MLLW), the channel (approximately -30 feet MLLW), and the eastern channel slope (approximately -20 feet MLLW). Stations were distributed equidistantly along transects that extended beyond the boundaries of the Cable Area identified on NOAA Chart 13285 such that three stations on each transect were within the Cable Area and two were beyond to serve as reference stations. Including reference stations beyond the potential impact area facilitates the evaluation of whether the benthos within the Cable Area is unique or similar to nearby resources and it also minimizes the concern that recovery could be masked by broadscale temporal changes in the benthos. Infaunal samples were collected using a 0.43 ft^2 (0.04 m^2) Ted Young grab, the same sampler used for the NCCA (USEPA 2007) program which evaluates long-term conditions in Great Bay as part of a national estuary assessment. Samples were processed in Normandeau's biological laboratory where all organisms were removed from the sediment and identified to the lowest practical taxonomic level, generally species, consistent with NCCA protocols.

3.0 Existing Conditions

3.1 Watersheds and Water Bodies

Watersheds

The entire project corridor is located in the Salmon Falls-Piscataqua River watershed (HUC8) of the larger Saco River basin (HUC6; Appendix A; Map 1) . Northernmost portions of the study area, in Madbury and Durham, are located in the Oyster River watershed (HUC10). The central portions of Durham and Newington are located in the Great Bay Drainage watershed. A small portion of the corridor in Durham is located in the Lamprey River (HUC10) watershed before the corridor bends east and crosses back into the Great Bay Drainage in Durham and Newington near Little Bay. The easternmost portions of the project corridor in Newington and Portsmouth are located in the Portmouth Harbor watershed.

Streams and Rivers

Streams were classified using the Cowardin classification system (Cowardin et al, 1979). A total of 32 streams were delineated within the project study area (Map 2; Appendix A). A summary table of the delineated streams is included in Appendix B.

The study area contained 18 perennial streams (Table 3.1-1). These include Beards Creek, College Brook, Oyster River and several unnamed tributaries to Oyster River, two reaches of LaRoche Brook, Beaudette Brook, and Longmarsh Brook (Map 2; Appendix A). Eight intermittent stream segments, including Hamel Brook and Reservoir Brook were also identified; with the remaining six stream segments classified as ephemeral.

In general, the streams identified within the project corridor were low gradient, slow flowing systems that are consistent with the flat topography of the coastal plain region of New Hampshire. Anthropogenic influences were observed near established development, including highways and larger-scale commercial developments; these influences included culverts, evidence of stormwater input, and ditching.

Table 3.1-1. Number and percent of stream segments by flow regime within the SRP study area.

Stream Flow Regime	#	%
Perennial	18	56%
Intermittent	8	25%
Ephemeral	6	19%
Total:	32	100%

The most significant drainage identified within the study area is the Oyster River. The Oyster River is a designated river, under the RMPP(RSA 483). According to the NHDES:

> *The Oyster River contains some of the highest quality natural habitat in New Hampshire. It is home to at least 12 rare, threatened or endangered wildlife species. One hundred-thirty-nine plant species have been identified along the river corridor, making it one of the most vegetation-diverse rivers in New Hampshire. Eighteen species of fish are known to live within the river, most notably the state endangered American brook lamprey and the state threatened bridle shiner. A large number of the fish are diadromous, capable of moving between fresh and salt waters. To facilitate this, a fish ladder has been installed at the Mill Pond Dam. The Oyster River is considered critical spawning ground for blueback herrings and sea lamprey, and is accessible via a fish ladder on the Mill Pond dam in Durham. However, blueback herring numbers have declined significantly in recent years, possibly due to decreased levels of dissolved oxygen.*(NHDES, 2011).

The Oyster River is also protected as a part of the New Hampshire Shoreland Water Quality Protection Act (SWQPA; RSA 483-B) because it is a designated river and also a fourth order or greater river. The SWQPA provides oversight of activities within designated buffers that range between 50 to 250 feet from the ordinary high water ("OHW") mark.

The project corridor crosses through a small portion of the Lamprey River watershed, including LaRoche Brook. Sections of the Lamprey River and five of its tributaries (the North Branch, North, Little, Pawtuckaway, and Piscassic Rivers) are also designated under the RMPP; however the Project does not cross any of these rivers or designated sections.

The project corridor also includes a recently implemented stream restoration project located in Newington along an abandoned railroad line north of Arboretum Drive. This area was constructed after the SRP's initial delineations in 2013, the area was re-delineated to reflect current conditions in the spring of 2015. It presently consists of a stone-armored channel, an outfall, and emergent seeding. Additional plantings may still be scheduled.

Ponds

No named freshwater ponds were identified within the study area. Several wetlands were noted to contain small areas of ponded water as indicated by the unconsolidated bottom ("UB") Cowardin classification, and others are prone to flooding as observed on aerial photography. Some of the ponds appear to be beaver influenced, associated with larger drainages and floodplains, or in a few cases associated with stormwater detention and treatment or are constructed landscaping features near residential areas. A small pond was mapped in Newington's Flynn Pit Town Forest, and is contained within a delineated wetland (NW4) immediately east of Little Bay Road.

Water Quality

Nearly the entire project corridor is located within one mile of an impaired freshwater waterbody, according to the NHDES OneStop GIS database and the 2010 Surface Water Impairments listing. The most common impairments are dissolved oxygen, total nitrogen, fecal coliform, *Escherichia coli*, enterococcus, and dissolved oxygen saturation. Other impairments include Chlorophyll-a, chloride, Benthic-Macroinvertebrate Bioassessments and aluminum. In

2012, the NHDES categorized all surface waters as Category 5 as a result of a statewide fish consumption advisory for mercury in freshwater fish (Edwardson 2012).

3.2 Wetlands

A total of 114 wetlands were delineated along the approximately 152-acre ROW (Map 2; Appendix A). A summary table of each wetland including cover type and functions and values is included in Appendix B.

The wetlands delineated within the SRP corridor were generally portions of larger wetlands that extended outside of the project corridor. These large, flat wetlands are common throughout the Coastal Plain region of New Hampshire. Land use and vegetation management within and around the project corridor governed wetland structure and species composition, and this is reflected in the cover type classifications documented in the field.

Wetland Cover Types

Table 3.2-1 lists the extent of the dominant vegetation cover types delineated within the study area. All but four of the wetlands fit the Palustrine system, symbolized by the letter "P" and defined as Freshwater Nontidal wetlands (Cowardin 1979). The wetlands associated with Little Bay are symbolized by the letter "E" and are characterized as Estuarine, Intertidal and Subtidal wetlands.

The majority of the freshwater wetlands delineated within the Project Area were mixed systems comprised of both emergent and scrub-shrub cover types (49%), followed by emergent (17%) and then various combinations of emergent, forested, scrub-shrub and unconsolidated bottom systems (Table 3.2-1). Forested wetland cover types were uncommon, due to the routine vegetation management within the existing electric line corridor, and were generally restricted to the wetland areas at the edges of the project corridor. Shallow ponded areas observed within the delineated wetlands were classified as UB. The UB areas were typically bordered by emergent or scrub-shrub cover types and included shallow ponds, beaver ponds, and other sparsely vegetated (generally less than 30 percent) areas with standing water of shallow but unknown depth. Many of the wetlands continued outside of the project corridor as either forested, scrub-shrub or emergent wetlands, however these areas were not reviewed in detail due to lack of permission to access.

The estuarine wetlands delineated within Little Bay include two different subsystems and multiple classes depending on the nature of the substrate material and vegetation. Beginning at the highest observable tide line ("HOTL") and continuing downslope to the lowest observable tide line ("LOTL") the wetlands are considered intertidal, and include emergent high-marsh and low-marsh areas dominated by saltmarsh grasses (*Spartina* sp.), rocky shore, and unconsolidated tidal flats. Below the LOTL the wetland is considered subtidal and is dominated by sands (unconsolidated bottom), and sparse macroalgae, depending on the nature of the substrate and any algal growth.

Photographs of common wetland cover types are included in Appendix C.

Table 3.2-1. Cover type of wetlands delineated within the study area of the SRP Project.

Wetland Cover Type	Area (acres)	%
Palustrine (Freshwater) Wetlands		
Emergent and Scrub-Shrub Wetlands	21.6	48.9%
Palustrine Emergent Wetlands	7.5	17.1%
Palustrine Emergent, Scrub-Shrub and Unconsolidated Bottom Wetlands	3.7	8.3%
Palustrine Scrub-Shrub Wetlands	3.5	8.0%
Palustrine Scrub-Shrub and Forested Wetlands	3.5	7.9%
Palustrine Emergent, Scrub-Shrub and Forested Wetlands	3.2	7.2%
Other combinations of Palustrine Classifications (Emergent, Scrub-Shrub, and Unconsolidated Bottom)	1.2	2.6%
Sub-total:	*44.1*	
Estuarine Wetlands		
Subtidal Estuarine Wetlands	6.0	46.2%
Intertidal Estuarine Wetlands (includes saltmarsh, rocky intertidal, and mudflats)	6.9	53.8%
Sub-total:	*12.9*	

Mixed Emergent and Shrub-Scrub Wetland (PEM1/PSS)

The majority of the wetlands identified within the project corridor contained both emergent and scrub-shrub components. These natural communities were often distributed according to the hydrologic regime; the wettest portion of the wetland was an emergent marsh often dominated by cattail (*Typha latifolia and T. angustifolia*), and the percentage of woody shrub and sapling species increased as the water regime trended drier. Wetland NW11 and DW18 are examples of these circumstances. A more detailed description of the emergent and scrub-shrub components are provided below.

Wetland DW41 is a large example of a wetland system that is primarily emergent and scrub-shrub, but that also contains small pockets with limited vegetation cover and ponded water (classified as Unconsolidated Bottom), especially near the railroad tracks.

Emergent (PEM1)

Emergent marsh and/or wet meadow wetlands were common throughout the project corridor. These wetlands were dominated by non-woody, herbaceous plant species and were primarily the result of on-going land use including utility maintenance mowing, clearing in wet areas associated with agriculture and residential areas. The hydrology in these emergent wetlands was mainly groundwater controlled and a reflection of a shallow water table and seasonal fluctuations of this water table. Other hydrological influences included floodflow where the wetlands were located adjacent to large water courses and groundwater seeps in the hillier portions of the project corridor. The species composition of the emergent marshes frequently included cattail, sedges such as fringed sedge (*Carex crinita*) and tussock sedge (*C. stricta*), ferns species such as sensitive and marsh ferns (*Onoclea sensibilis* and *Thelypteris palustris*), rushes such as soft rush (*Juncus effusus*), and goldenrods (*Solidago* sp.). Invasive species noted during the delineations included purple loosestrife (*Lythrum salicaria*) and reed canary grass (*Phalaris arundinacea*). Examples of emergent wetlands include wetlands MW02, DW02, and DW67.

Wetland NW28, NW30 and NW32 are examples of wet meadow wetlands that are associated with actively mowed hayfields; consequently the species composition of these resources were dominated by grasses, such as reed canary grass, sedges, rushes and bulrushes (e.g. *Scirpus cyperinus*).

Shrub-Scrub Wetland (PSS1)

As with the emergent wetlands, the scrub-shrub resources were governed primarily by land use. Scrub-shrub wetlands were found away from mowed hayfields and residential areas, and included shrub species as well as small, regenerating tree species that are routinely mowed during utility line maintenance. The hydrology of these wetlands was primarily controlled by a shallow water table; however some areas were also influenced by floodflows, particularly near larger water courses in the floodplains. Common shrub species noted in these wetlands include speckled alder (*Alnus incana*), meadowsweet (*Spiraea alba*), steeplebush (*S. tomentosa*), glossy buckthorn (*Frangula alnus*), highbush blueberry (*Vaccinium corymbosum*) and assorted willows (*Salix* sp.). Commonly observed tree species include birches (*Betula* sp.), red maple (*Acer rubrum*), and swamp white oak (*Quercus bicolor*). Several invasive species were also documented throughout the project corridor and include glossy buckthorn, autumn olive (*Elaeagnus umbellate*), oriental bittersweet (*Celastrus orbiculatus*), and multiflora rose (*Rosa multiflora*). All of these latter species are listed on the New Hampshire Prohibited Invasive Plant Species List[1].

Approximately nineteen were classified as predominantly scrub-shrub wetlands, although many included some lesser areas where emergent/herbaceous vegetation was dominant. Examples include NW15, which is primarily an alder swamp, and NW26 which is a disturbed area located between a road and hayfield.

Unconsolidated Bottom (UB), Forested (FO) and Other Wetland Classifications

Several wetlands delineated within the project corridor included either unconsolidated bottom or forested classifications. The unconsolidated bottom wetlands were primarily small ponds and the forested wetland components were a result of tree species bordering the project corridor. Approximately 50% of wetland NW34 was flooded at the time of delineation due to a beaver dam along Pickering Brook outside of the corridor. Nearby, wetland NW13 was also flooded due to beaver activity, and included fringing areas of emergent vegetation including cattails and rooted aquatic species; this wetland also hosted waterfowl.

Wetlands with forested components include DW22, DW36, DW38, DW74 and NW04. In most cases, the percentage of the wetland that was forested within the project corridor was low at approximately 20 percent, but continued as forested outside of the corridor where vegetation management was not performed. Common tree species include red maple and white pine

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[1] http://agriculture.nh.gov/publications-forms/documents/prohibited-invasive-species.pdf

(*Pinus strobus*), with fewer instances of swamp white oak and Atlantic white cedar (*Chamaecyparis thyoides*).

Estuarine Wetland (E1 or E2)

The entire corridor in Little Bay is classified as an estuarine wetland, with both intertidal and subtidal subsystems depending on the location relative to the LOTL. On the western shore, beginning at the HOTL, the wetlands included a fringing marsh of shallow peat over a cobble and rock substrate. The saltmarsh vegetation was dominated by salt cordgrass (*Spartina alterniflora)*, with smaller patches of salt hay (*S. patens)*, and sea-blite (*Sueda linearis)* along the upper limit of the marsh. The substrate was a mix of peat over mud and bedrock outcrops as the wetland descended to the LOTL. Rocky shore (bedrock colonized by fucoid algae (*Fucus vesiculosus* and *Ascophyllum nodosum*) followed a ledge/rock outcrop below the salt marsh. The western shore had extensive tidal flats for approximately 2,000 feet dominated by a mud mix of silt, fine sand, clay and organics. The subtidal channel was predominantly sands with silts at depth. On the eastern shore, the intertidal zone was primarily unvegetated muck tidal flat. This shore included a patchy band of salt cordgrass near the high tideline.

Wetland Functions and Values

Representative wetland functions and values were assessed for each wetland using the U.S. Army Corps of Engineers Highway Methodology (USACE 1999). This methodology evaluates thirteen functions and values potentially provided by individual wetlands. The assessment relies on professional judgment that is documented according to characteristics provided within the methodology for each function. The methodology indicates whether a wetland provides a specific function, and if that function is considered Principal. Principal functions are those that provide "an important physical component of a wetland ecosystem (function only) and/or are considered of special value to society, from a local, regional and/or national perspective". The functions and values for all wetlands are provided in the summary table in Appendix B. While multiple functions were provided to some degree by most wetlands, the principal functions were the distinguishing features among the wetland types. The most common principal functions include: Groundwater Recharge/Discharge, Wildlife Habitat, Production Export, Sediment/Toxicant/Pathogen Retention, Floodflow Alteration and Nutrient Retention. Fewer than ten wetlands were noted as having Fish/Shellfish Habitat, Sediment/Shore Stabilization, Visual Quality/Aesthetics, Education, Recreation, Rare/Threatened/Endangered Species or Uniqueness/Heritage principal function or values. The following descriptions address the principle functions in general terms.

Groundwater Recharge/Discharge (GW)

This function combines recharge and discharge into a single function, based on the concept that many wetlands provide both recharge and discharge depending on seasonality and the relative position of ground and surface waters. On the coastal plain of New Hampshire, the majority of the wetlands were interacting with groundwater, with discharge more prevalent in the hillier areas of the corridor and recharge where sandier substrates were noted. In reality, most of the wetlands were likely functioning as both recharge and discharge sites depending on the spatial location within the wetland and also depending on the season and location of the water table.

Ninety-eight percent (98%) of the delineated wetlands were characterized having the GW function as a principal function or as suitable for either recharge or discharge and this was by far the most common wetland function.

Nutrient Removal & Sediment/Toxicant Retention (NUT & STR)

These two functions are combined because they are provided by similar wetland conditions – those that have the exposure to a pollutant and/or nutrient source, and have the structure and vegetation to treat it. Sixty-eight percent (68%) of the wetlands in the project corridor were listed as suitable or principal for the STR function and 50% were listed for the NUT function. These functions are mostly associated with the ability for the large wetlands identified along the project corridor to trap and attenuate nutrients, sediments, fertilizers, and toxicants from the many roadways and turnpikes, residential areas, and dense commercial and educational development.

Wildlife Habitat Function (WH)

Wildlife habitat is a very broad term applicable to many wetland types, and for a variety of wildlife species. Fifty-eight percent (58%) of the wetlands delineated within the project corridor were observed or presumed to be suitable for the Wildlife Habitat function; with 31 listed as having Wildlife Habitat as a principal function. Common wildlife species observed within the wetlands included deer, beaver, water fowl, other bird species such as songbirds and species such as bittern; amphibians and reptiles along with invertebrates including dragonflies were also noted. The larger scrub-shrub wetlands provide breeding habitat for a number of passerine species: red-winged blackbird, swamp sparrow, yellowthroat and black and white warbler. The Little Bay wetlands provide habitat for multiple marine species.

Floodflow Alteration & Sediment/Shoreline Stabilization (FF & SSS)

Wetlands with dense vegetation that are in close proximity to larger brooks and rivers are typically valuable for detaining and storing surface water and reducing downstream flooding. Fifty-three percent (53%) of the wetlands delineated within the project corridor are suitable or principal for this function, most of which are associated with larger drainages. Examples include DW01 along Longmarsh Brook,DW58 which is associated with Roche Brook and DW74 located along College Brook. The Sediment/Shoreline Stabilization ("SSS") is related, and generally associated with wetlands that border larger streams, rivers and areas of open water. Twenty-seven percent (27%) of the wetlands were noted as either suitable or principal for this function.

Production Export (PE)

The ability for a wetland to produce food or useable products is considered when evaluating this function. Other functions are considered when rating this function: wildlife habitat and fish or shellfish habitat for the consideration of food; and sediment/shore stabilization for the consideration of export by stream. Thirty-eight percent (38%) of wetlands were suitable for production export within the study area, including 21 listed as principal. These were primarily attributed to dense patches for fruiting shrubs (primarily high-bush blueberry). The Little Bay wetland also contributes this function due to fish, shellfish and other benefits. Wetlands connected to streams are also important for production export.

Fish & Shellfish Production (FSH)

While not a common function, fish and shellfish production is an important function for several wetlands, including all of the estuarine wetlands and several rivers and streams known to support anadromous and/or rare species of fish. Several listed fish species are known to utilize the Oyster River, the Valentine Canal and the subtidal and intertidal portions of Little Bay. Diadromous fish (those that migrate between fresh and salt water in the course of their life cycles) also use these water bodies, and some rely on adjacent wetland vegetation for cover, food, spawning and nursery habitat. Additionally, the intertidal and subtidal area in Little Bay provide habitat for several commercially important shellfish species, including oysters, softshell clams and razorclams.

Wetland Values (REC, EDU, UH, VQ, & RTE)

In general, the majority of the identified wetlands within the study area were common for the region, slightly disturbed, not easily accessible, or the leased lands were generally posted against unauthorized access for hunting, hiking, and other forms of recreation. These factors contributed to the relatively low levels of function and values associated with visual quality and aesthetics, recreation, uniqueness and heritage and rare, threatened, and endangered species. Several wetlands within the corridor are located near the UNH campus; however, the extent of their use for educational purposes or research is low due to the ongoing routine maintenance, and access and safety considerations.

The exceptions are the Little Bay wetlands. Salt marsh and sparsely vegetated intertidal flats are considered Exemplary Natural Communities by the NHB.

Prime Wetlands

Newington and Portsmouth have designated specific wetlands as "prime" due in part to their large size, unspoiled character and ability to sustain populations of rare or threatened plant and animal species. Three of the Newington prime wetlands (designated as Prime Wetlands Q, K and F) intersect with the SRP study area in five different locations, and therefore correspond with five individually delineated wetlands (Map 2c). These locations include Wetland NW12 to the west of Nimble Hill Road (Prime Wetland Q, Knight's Brook); Wetlands NW34 and NW17 to the north of Fox Point Road (Prime Wetland K, Pickering Brook); and Wetlands NW1 and NW45 along the Spaulding Turnpike (Prime Wetland F)(West Environmental, 2005). Field surveys indicated that no sections of these wetlands within the project corridor contain rare species or communities.

3.3 Vernal Pools

Springtime surveys of all pools identified during resource mapping in the SRP corridor did not yield habitats that met the definition of a vernal pool (Env-Wt 101.106(a-b)) and also contained the requisite indicator species, and therefore no vernal pools are located within the project corridor. One pond in Newington associated with delineated wetland NW4 contained wood frogs in spring 2015, however observations in 2013, 2014 and 2015 suggest that the deeper portion of this pond is permanently flooded year-round. The permanent hydroperiod does not meet the definition of a vernal pool.

3.4 Estuarine Resources

3.4.1 Eelgrass

Eelgrass (*Zostera marina*) is the most widespread aquatic vegetation in the Great Bay Estuary. Eelgrass provides significant habitat values and functions both biologically and physically (Thayer et al. 1984; Jones 2000). In the Great Bay system, the plants create a three-dimensional structure on an otherwise flat substrate. This structure provides refuge, settlement surfaces, and feeding opportunities for numerous invertebrates and finfishes. Invertebrates, including lobsters, and finfishes, including winter flounder, have been documented as using eelgrass beds as breeding or nursery grounds. A vascular plant, eelgrass generally occurs subtidally in the Northeast. Eelgrass is a deciduous, perennial plant with an extensive root and rhizome system that remains year-round even when above-ground biomass has gone senescent and been shed. The underground structures help bind the sediments and retain nutrients and carbon. During the months when above-ground structures are abundant, these structures can attenuate current flow and wave action, enhancing sedimentation in the immediate vicinity. Plant growth is typically greatest from May through August (Nedeau 2004). Light penetration, or water clarity, is a critical factor in controlling the depth at which eelgrass can survive (Morrison et al. 2008) and can be affected by phytoplankton, suspended sediments, and colored dissolved organic matter. Based on the assumption that eelgrass needs 22% of surface incident light to survive (Koch 2001), Morrison et al. (2008) predicted that the survival depth of eelgrass in Little Bay would range from 1.068 to 1.679 meters (3.4 to 5.4 feet) below mean water level ("MWL") and average 1.404 meters (4.5 feet) below MWL.

Eelgrass distribution in Little Bay has varied tremendously over decades. In 1980, eelgrass beds were found throughout Little Bay, covering the entire length of the shallow subtidal zones along both sides of the upper bay from Adams Point to Fox Point (Jones 2000). It was completely absent from Little Bay in 1991 (Jones 2000). PREP (2013) reported that it was essentially absent from Little Bay from 2007 through 2010. More recently, eelgrass was recorded in Welsh Cove and along the eastern shoreline from the point north of Welsh Cove nearly to Fox Point in 2011 and 2012 (Figure 3.4-1). Short (2013) noted that the bed along the eastern shore first appeared as seedlings that developed into patches of reproductive plants in 2010 and expanded into beds in 2011 through vegetative growth and seed production. When Barker (2014) mapped the distribution of eelgrass in the Great Bay system from aerial photography in August 2013 with field verification in September and October, he found, however, that eelgrass was absent from both Welsh Cove and the eastern side of Little Bay (Figure 3.4-1; 2014 survey results not available through GRANIT as of 12/09/15). Eelgrass was also absent from Welsh Cove and the eastern side of Little Bay in 2014 (P. Colarusso, USEPA, pers. com. 03/03/15).

Normandeau did not observe any attached eelgrass during the five video transect surveys conducted in early fall 2013 (Figure 3.4-2). In addition, because water clarity was good, the field crew was able to observe that eelgrass was absent to the shoreline in Welsh Cove in the vicinity of the proposed SRP corridor. Other incidental observations by Normandeau biologists during shellfish surveys in September 2014 did not find eelgrass on the western tidal flats within the cable corridor.

It is not expected that there will be an established eelgrass bed in the Project Area when cable installation takes place in 2017. As seen by the recent disappearance of the bed in Little Bay, eelgrass bed development from seed dispersal may not be successful. Various factors, such as burrowing invertebrates (e.g., lobsters or green crabs) or storm waves can uproot seedlings. Eelgrass beds can expand through vegetative growth of the rhizomes, but this is a slow process. Marbà and Duarte (1998) reported that horizontal growth of *Z. marina* rhizomes was about 26 cm/year (10 inches/year). The nearest established eelgrass bed is located within Great Bay proper more than 3,000 feet (914 meters) away from the Project Area.

3.4.2 Macroalgae

Mathieson and Penniman (1991, as cited in Jones 2000) reported 132 species of macroalgae occurring in Little Bay. Most macroalgae require hard substrate for attachment so their presence is restricted in Little Bay to nearshore areas where bedrock outcrops, cobble, or boulders are present. As detailed below, substrate in the Cable Area is predominantly unconsolidated fine granular sediment however small areas of rock outcrops occur along both shorelines. Dominant macroalgae observed during field surveys were rockweeds, predominantly *Fucus vesiculosus* with lesser amounts of *Ascophyllum nodosum*. As Short (2013) has pointed out, distribution and biomass of nuisance algae including *Gracilaria* sp. (graceful red weed) and *Ulva* sp. (sea lettuce) have increased in the Great Bay system. *Ulva* was observed during field surveys of the cable corridor. These species are considered to be threats to eelgrass habitat because they cover the substrate, essentially smothering the eelgrass shoots (Short 2013). Based on maps presented in Nettleton et al. (2011) and PREP (2012), Great Bay itself is the area of greatest concern in terms of nuisance algae, although no widespread surveys are available. In addition to *Ulva* and *Gracilaria*, smaller algal species often settle on eelgrass fronds and this biofouling has been regarded as contributing to the decline of eelgrass in the Great Bay system.

3.4.3 Shellfish

The Great Bay estuary system supports populations of several shellfish species of interest to harvesters, including oysters (*Crassostrea virginica* and *Ostrea edulis*), softshell clams, blue mussels (*Mytilus edulis*), razor clams, and sea scallops (*Placopecten magellanicus*) (Jones 2000). Blue mussels are generally limited by salinity to the lower estuary (Dover Point to Portsmouth Harbor) and sea scallops occur in the lower Piscataqua and Portsmouth Harbor. Historical distribution of major oyster and softshell clam beds is shown in Figure 3.4-3. Capone, et al. (2008) reported finding, however, high densities of oysters (up to $150/m^3$) associated with the fucoid alga *Ascophyllum nodosum* in the rocky intertidal at both Nannie Island and Woodman Point in the Great Bay estuary. Presumably, other rocky intertidal areas in the estuary support oysters as well. It is likely that small beds of oysters occur subtidally as well. Recreational harvesting of both of these species is allowed in specified areas in the estuary (Figure 3.4-4). The area designated as Cable Area on NOAA Chart 13285 and estimated in Figure 3.4-4 is permanently closed to harvest.

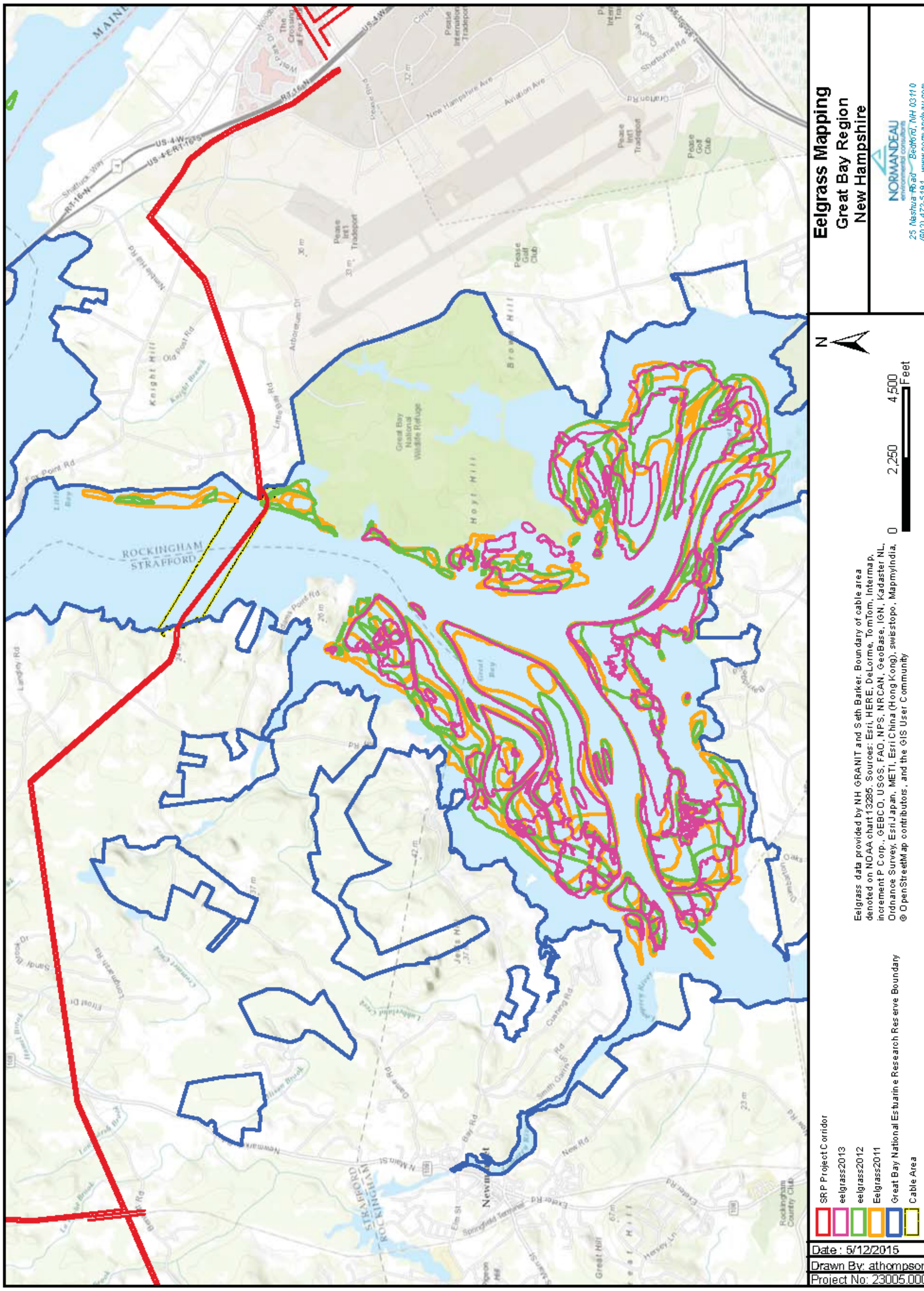


Figure 3.4-1. Historical Eelgrass Distribution.

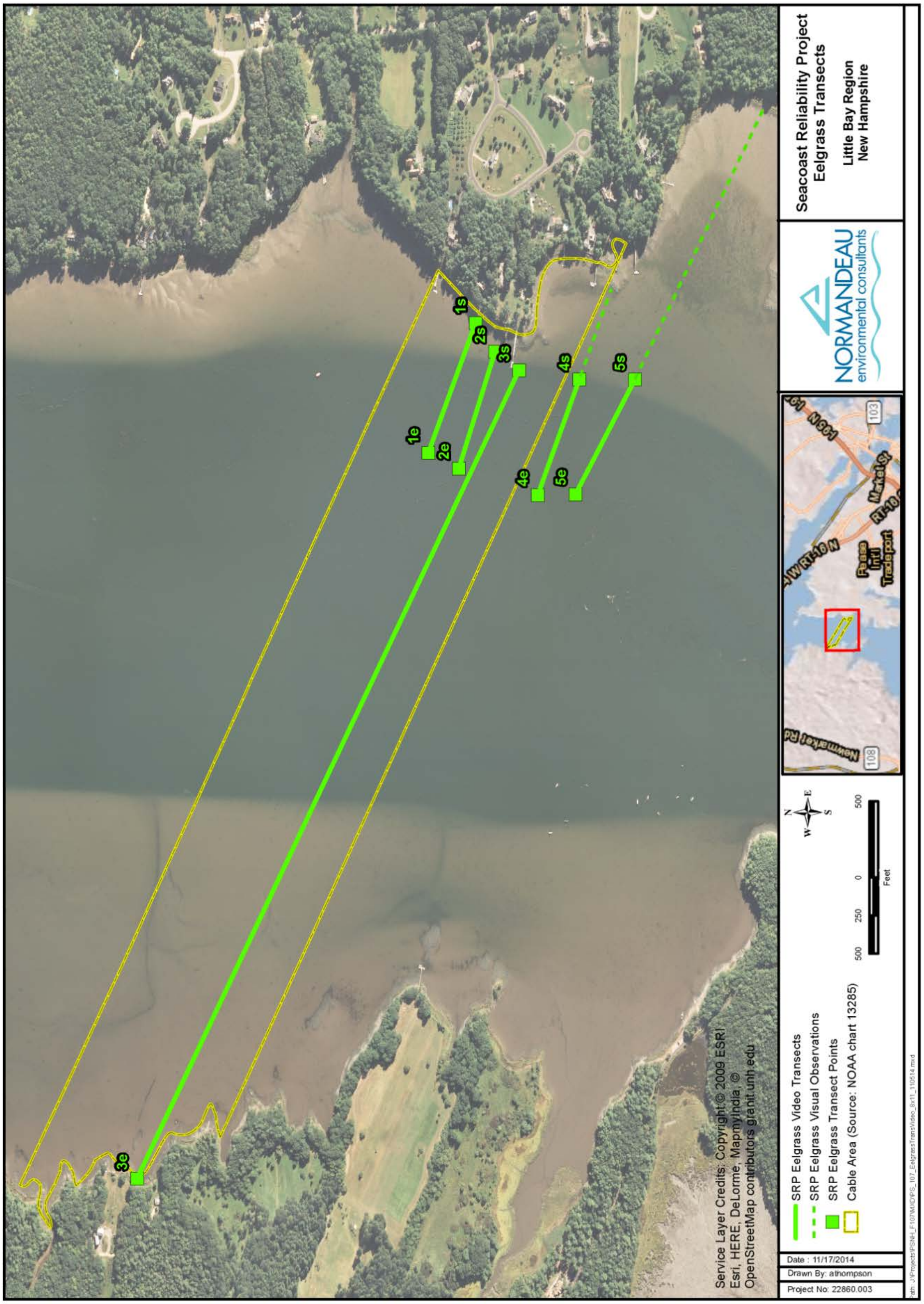


Figure 3.4-2. Normandeau Eelgrass Video Transects.

The status of oyster beds in the estuary has been of great concern to the Piscataqua Regional Estuary Project ("PREP") and other Great Bay environmental groups because this species is considered an indicator of environmental health. Oysters are long-lived, filter feeding organisms and therefore reflect cumulative exposure to environmental conditions. Major natural oyster beds have not been documented in Little Bay; the closest major beds to the Cable Area are at Adams Point (about 0.75 mile south of the Cable Area) and Nannie Island (off of Woodman Point; about 1.75 mile south of the Cable Area). Grizzle and Ward (2013) surveyed the known oyster beds in 2012 to estimate size and relative density. They determined that the bed at Adams Point in Furber Strait covered an area of 13.9 acres and classified it as a reef because more than 20 percent of the area contained shell cover and live oysters. The bed off Nannie Island was about 32.4 acres in 2012 and was also classified as a reef. The standing stock of oysters in the Great Bay estuary has been monitored since 1993 when there were more than 25 million oysters in the bays. PREP (2013) reported that in 2011, the standing stock was less than 10 percent of that total. Oyster populations at both Adams Point and Nannie Island experienced substantial declines. PREP (2013) attributed at least part of the decline observed starting in the mid-1990s to the oyster diseases MSX and Dermo and suggested that the large increase in Dermo in the last decade could be related to warming water temperatures. Konisky et al. (2014) indicated that siltation, resulting from increases in impervious surfaces within the watershed that have changed runoff patterns, may also be a factor in oyster decline (Great Bay Siltation Commission 2010).

There has been an active effort to restore oyster beds in Great and Little Bays and their tributaries with restoration sites located at the mouths of the Squamscott, Lamprey, and Oyster Rivers, in upper Great Bay, in the Bellamy River, and in the Piscataqua River (Konisky et al. 2014) (Figure 3.4-3). Restoration efforts include placement of clamshells on the substrate to serve as settlement sites to allow for natural settlement and rearing of oyster larvae for settlement in holding tanks prior to placement in the restoration sites. In 2014, oyster spat were reared at eight locations in upper Little Bay, including adjacent to the northern boundary of the charted Cable Area along the western shoreline; spat were retrieved from these sites in late September (McKeton et al. 2014). Monitoring has demonstrated that natural settlement at the restored oyster reefs is occurring and laboratory-reared spat are surviving in the field.

NHDES is also encouraging oyster aquaculture in the estuary. Grizzle and Ward (2012) evaluated the potential for shellfish aquaculture in the Great Bay system based on occurrence of red tide toxicity, water depth, harvest closures, eelgrass distribution, and mooring fields and concluded that conditions were most suitable in Little Bay (Figure 3.4-5), although there is no expectation that the entire suitable area would be utilized for aquaculture. Existing and recently proposed aquaculture operations as of December 2015 are shown on Figure 3.4-6. However, applications for new or expanded facilities are made frequently (C. Nash, NHDES Shellfish Coordinator; pers. comm. 07/17/15). The aquaculture lease that falls partially within the Cable Area may move to the north although bathymetric conditions could limit this.

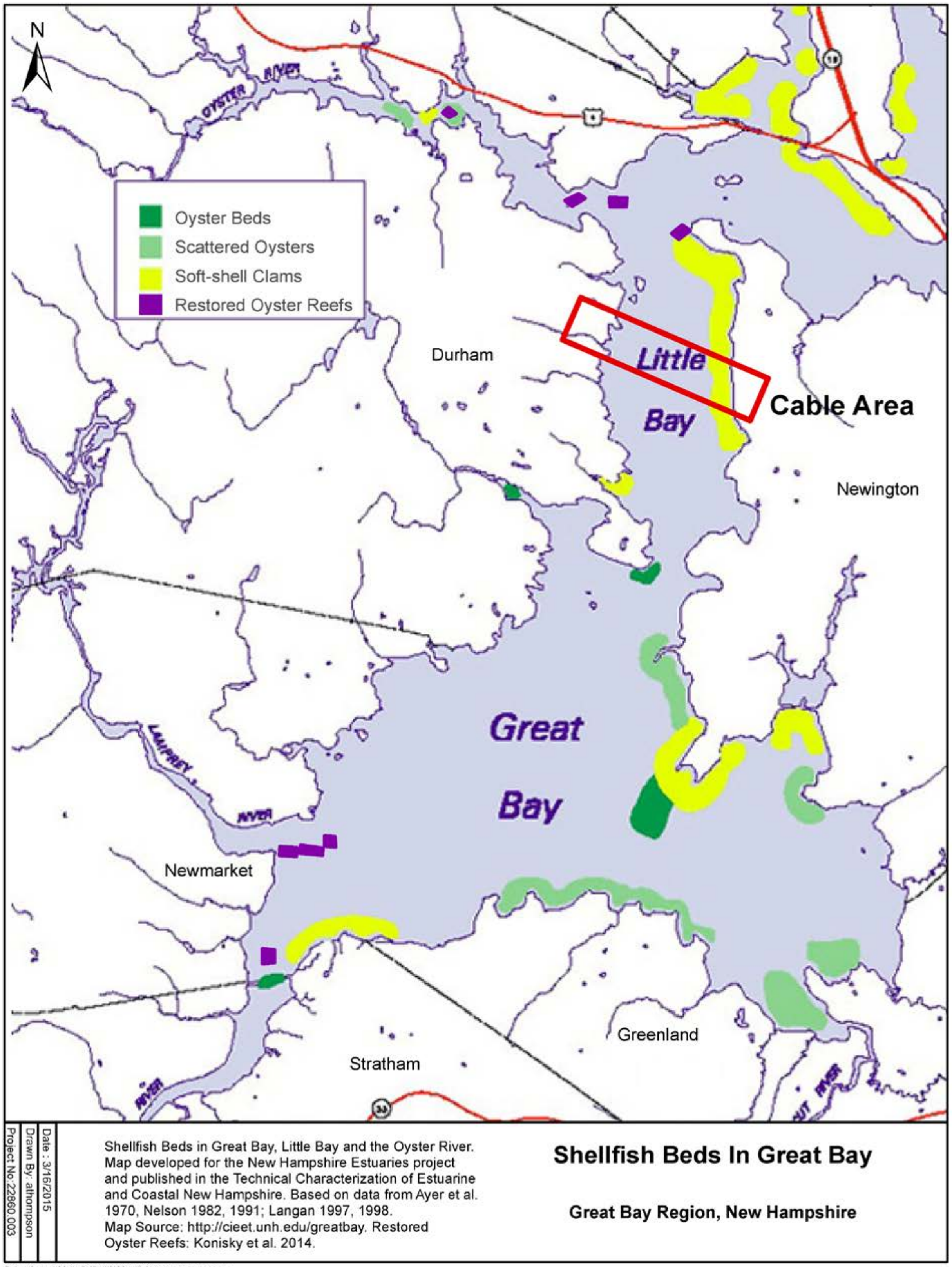


Figure 3.4-3. Historical Distribution of Shellfish.

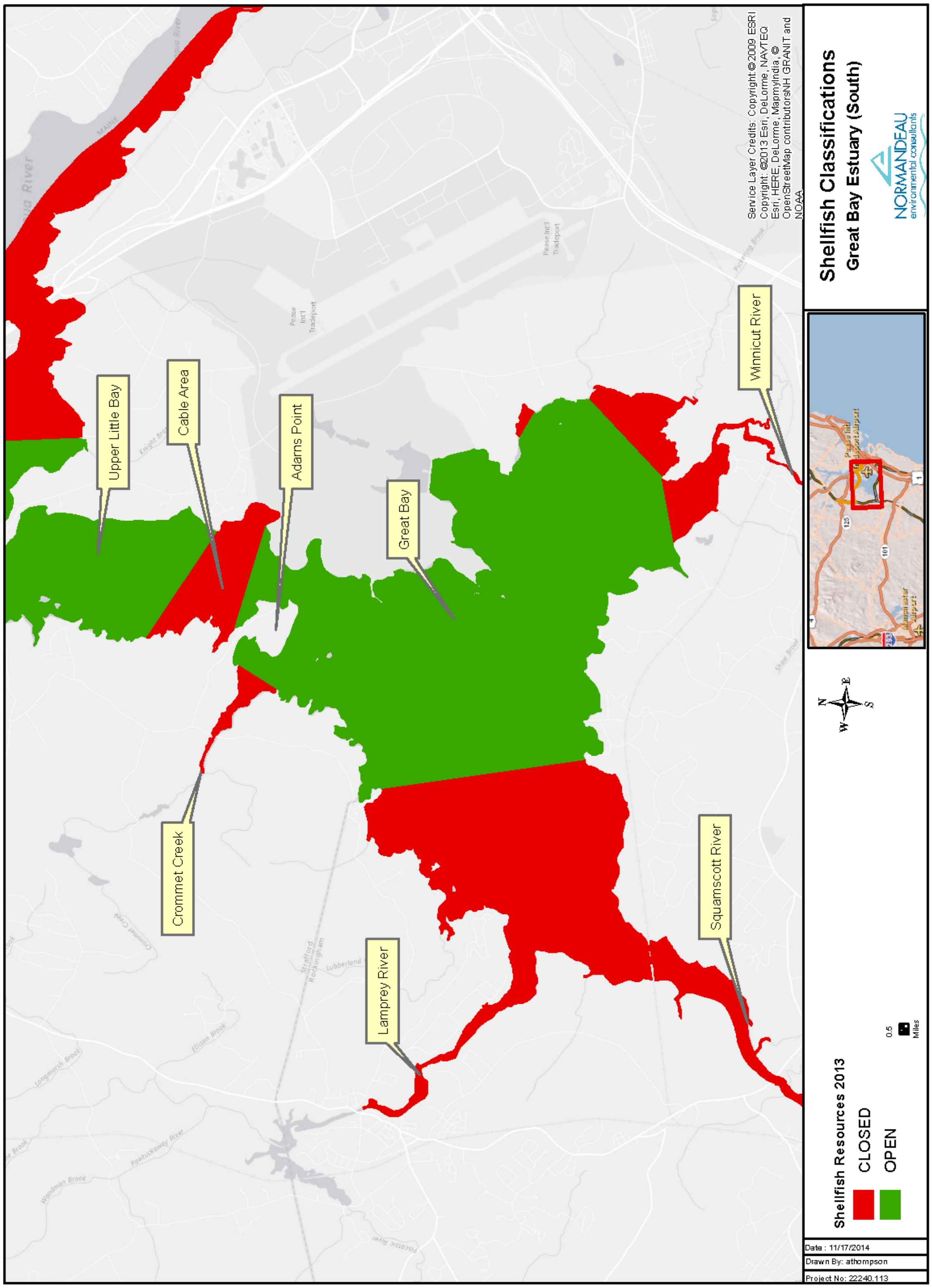


Figure 3.4-4. NHDES Classification of Great Bay Estuary Waters for Shellfish Harvesting.

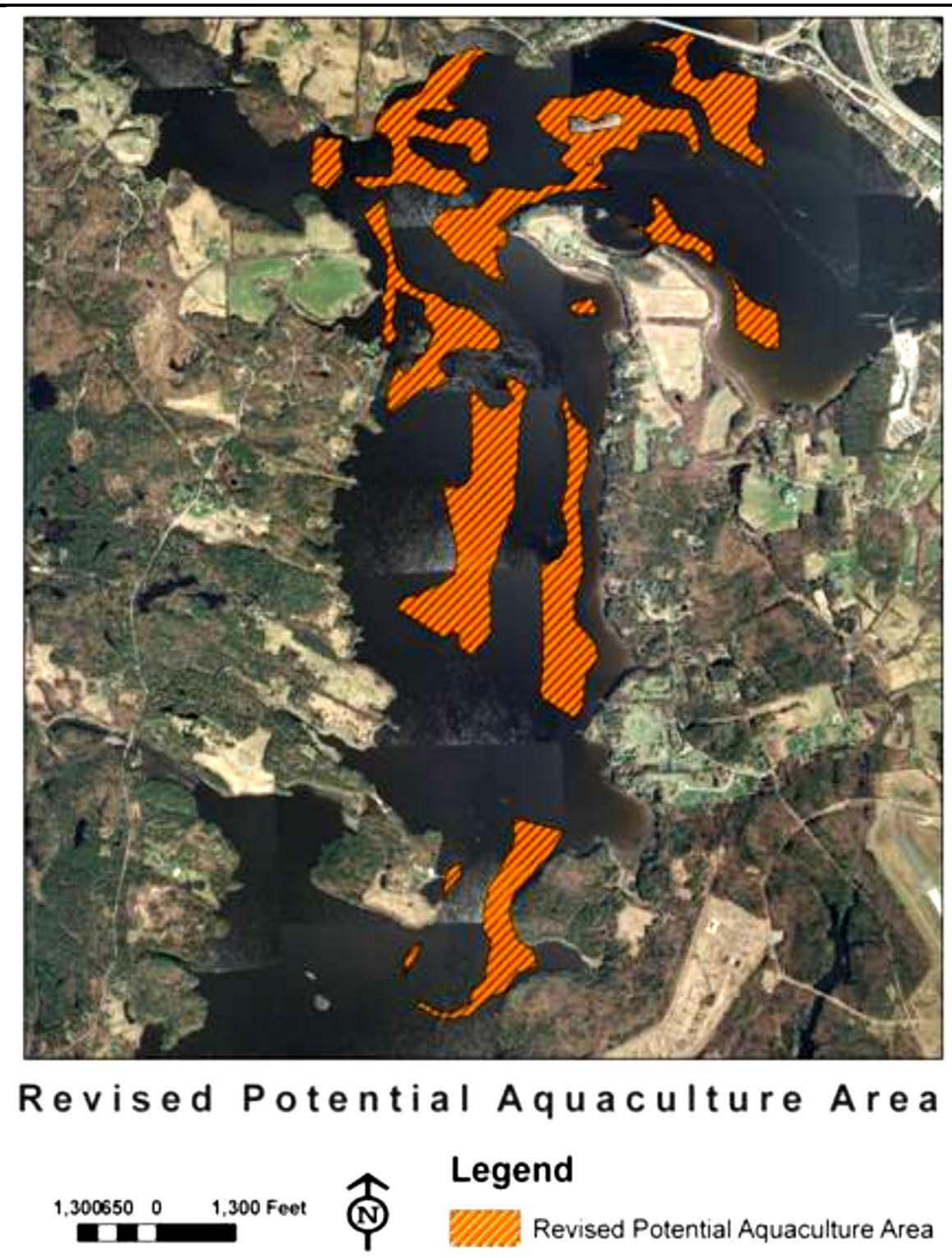


Figure 3.4-5. Areas Suitable for Aquaculture Identified by Grizzle and Ward (2012).

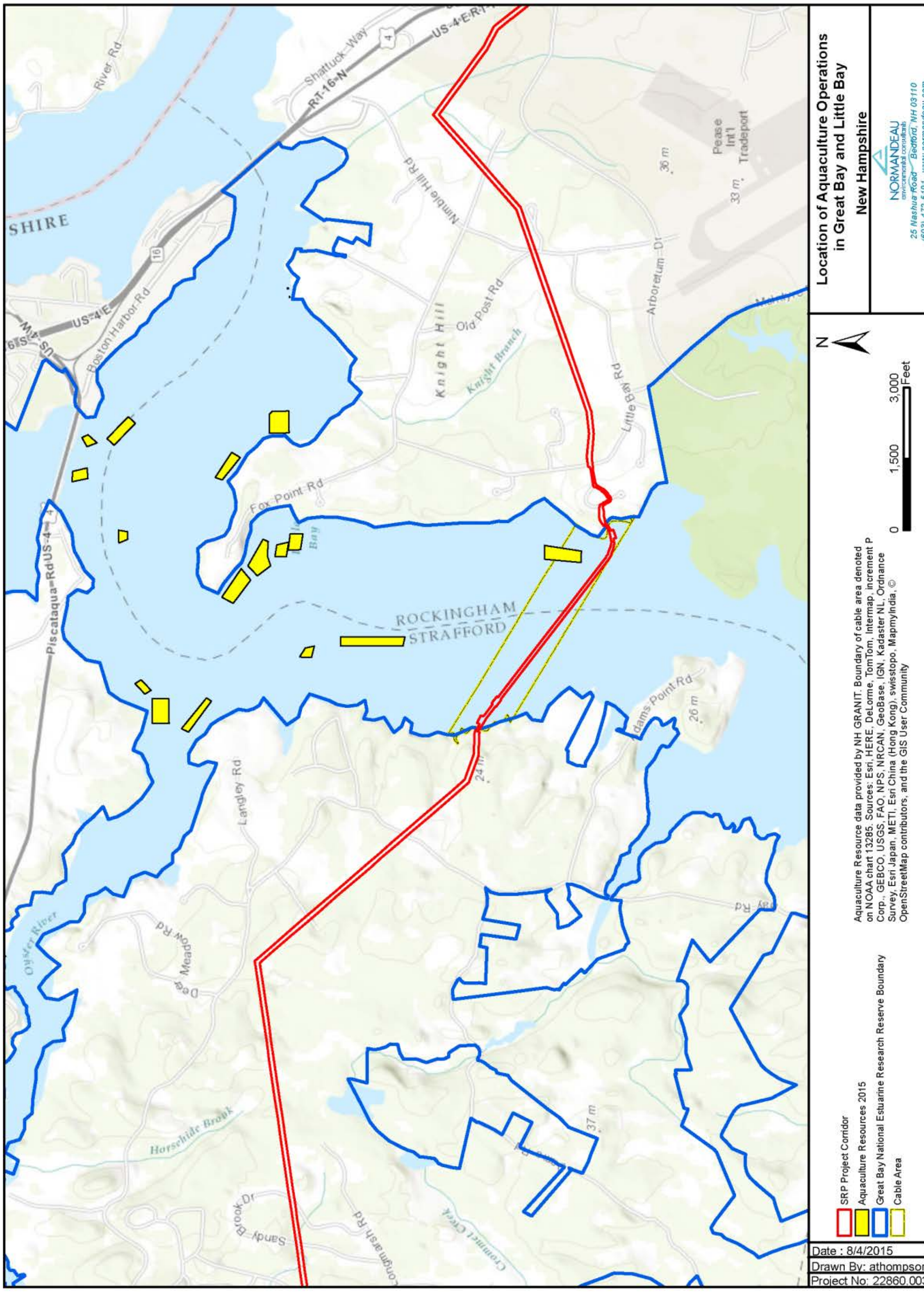


Figure 3.4-6. Location of Aquaculture Leases as provided by NHDES in 2015.

Historically, softshell clams were widespread in Great Bay and Little Bay (Figure 3.4-3). In New England, softshell clams are most abundant in the intertidal and shallow subtidal zone. Past records do not show softshell clam beds on the western side of Little Bay, although, it is possible that the historic records partially reflect accessibility. The substrate on the western tidal flat is very soft mud, unsuitable for access on foot. A conversation with Mr. Bruce Smith, NHFG, indicated that the department considers this area to provide suitable habitat for softshell clams, razor clams, and the non-harvested *Macoma balthica*.

Results of Normandeau's field surveys on the western flats are presented in Table 3.4-1 and Figure 3.4-7. Softshell clams (*Mya*) were observed at nine stations and live razor clams (*Ensis*) were identified at two. Razor clam shells were noted in several locations. No live *Macoma* were observed although shells were present. In addition to the bivalves observed, mud snails (*Ilyanassa trivitattus*) were numerous in many locations and were likely grazing on the benthic diatoms that were present. Hermit crabs were also common. Most sites had numerous invertebrate holes, most likely polychaetes (see Section 3.4.4 on benthic infauna). While this survey was not designed to quantify the bivalve population on the tidal flat, it clearly shows that these resources are present within the Cable Area.

3.4.4 Benthic Infauna

Benthic resources along the cable route will be affected by the installation process. In order to evaluate the ability of the infaunal resources to recover from this impact and to evaluate whether this impact would have consequences to other resources, such as species that rely on the benthos for feeding, it is important to characterize the benthos. USEPA's NCCA program includes sampling of benthic infauna in the Great Bay system (http://water.epa.gov/type/oceb/assessmonitor/ncca.cfm), but data available for Little Bay are limited (Figure 3.4-8) particularly in the immediate vicinity of the Project.

Benthic infaunal community structure is closely linked to substrate conditions and water depth. The Normandeau field crew characterized the sediment at the fifteen benthic infauna stations (Figure 3.4-9). Substrate texture differed among the three depth zones in the Project Area. All stations on the tidal flat consisted of a fine soft silt surface layer with some clay at the bottom of the grab. In the channel, sediments at the northern stations were fine sand with silt and shell hash and the three southern stations consisted of fine and medium sand. Along the channel slope, sediments were fine sand mixed with silt and shells or shell hash; the two northern stations also included some small gravel.

Infaunal abundance was generally highest at the stations on the western tidal flat, most variable in the channel, and most consistent along the channel slope (Table 3.4-2). The total number of unique taxa was most consistent on the tidal flat and most variable among the stations in the channel and along the channel slope (Table 3.4-2).

Table 3.4-1. Results of visual inspection of western tidal flat for shellfish and other benthic resources conducted on September 16, 2014 from mid-ebb to start of flood tide.

Station	Water Depth	Tide Stage	*Mya*	*Ensis*	Polychaetes	Mud snails	Hermit crabs	Substrate	Comments[b]	Between transects
1	24″	Ebb	1		holes	9	1	Diatom cover Soft silt (anoxic just below surface)		Areas with dense numbers of mud snails (*Ilyanassa*)
S2	n/a		2		holes		1	Diatom cover Soft silt (anoxic just below surface)	*Mya* shell Green crab depression	
S3	20″		4		holes		2	Diatom cover	Crab hole	
S4	18″		4		holes	2	3	Soft silt (anoxic just below surface)		
S5	16″		1		holes			Diatom cover	Crab burrow	
S6	24″		1		holes			Soft silt (anoxic just below surface)	*Macoma* shells	
S7	20″				holes			Diatom cover	Drift algae *Macoma* shells	Razor clam shells between stations
S8	20″					Too numerous to count	Present	Soft silt (anoxic just below surface)		
S9	20″	Low slack	2		holes	Present	2	Diatom cover	*Macoma* shells *Ascophyllum scarpoides*	
S10	20″			(1-shell)	holes	Too numerous to count		Soft silt (anoxic just below surface)	*Ulva*	
S11	18″				holes			Diatom cover	Unidentified bivalve holes (2) 3 small "grapes" (egg cases?) *Ulva*	
S12	18″			(2-shell)	holes	Present		Soft silt (anoxic just below surface)	Drift algae Razor clam shells	
S13	18″	Flood		4	holes		Present	Diatom cover		
S14	18″		1	3	holes		Present	Soft silt (anoxic just below surface)	Razor clam shells *Macoma* shells Drift algae (cover ~25%) *Ulva*	
S15	21″		2		holes		Present	Diatom cover	Drift algae Green crab burrow	
S16[c]	24″				holes			Soft silt (anoxic just below surface)	Snail trail Drift algae "grape"	Several horseshoe crabs

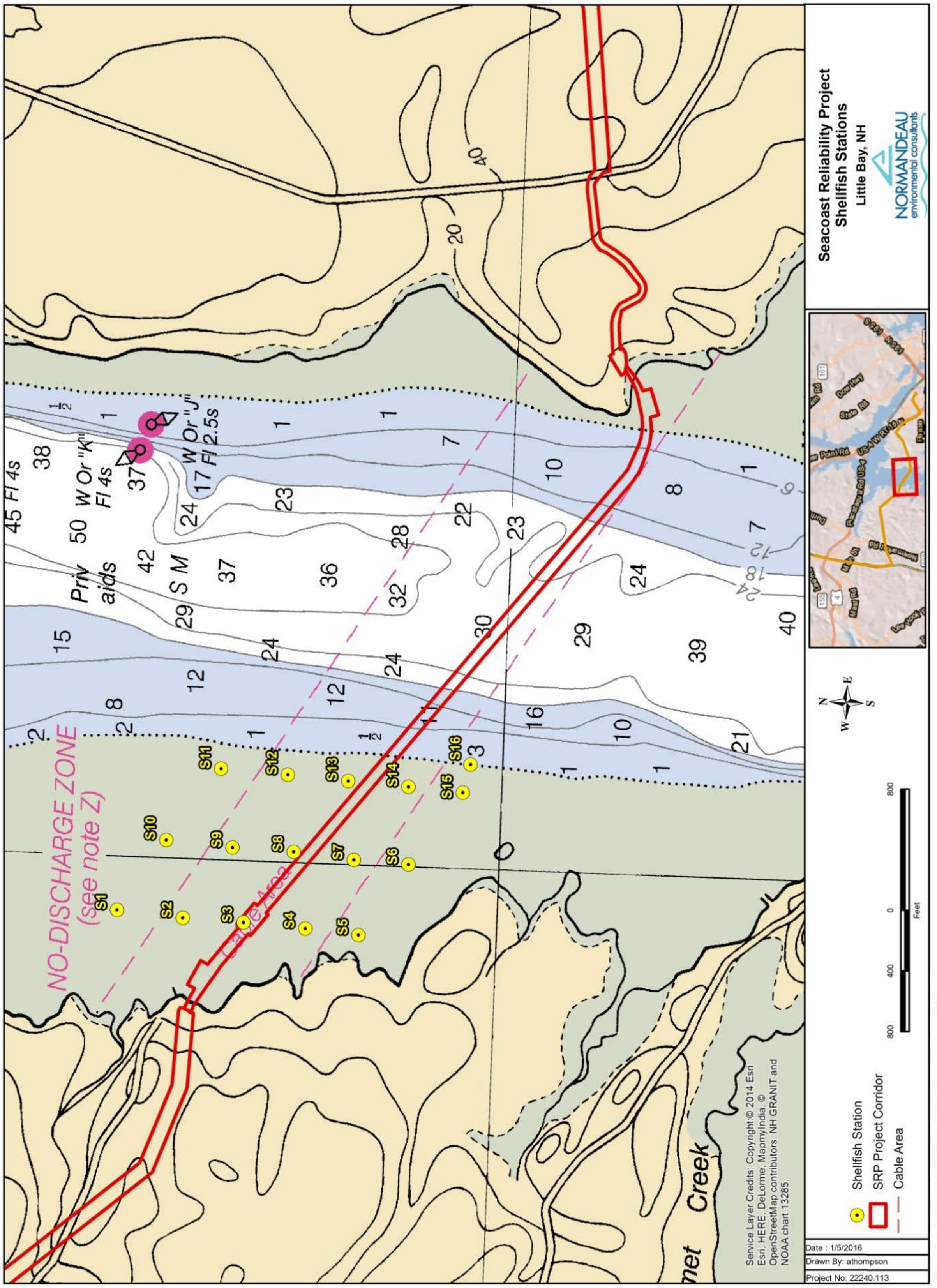
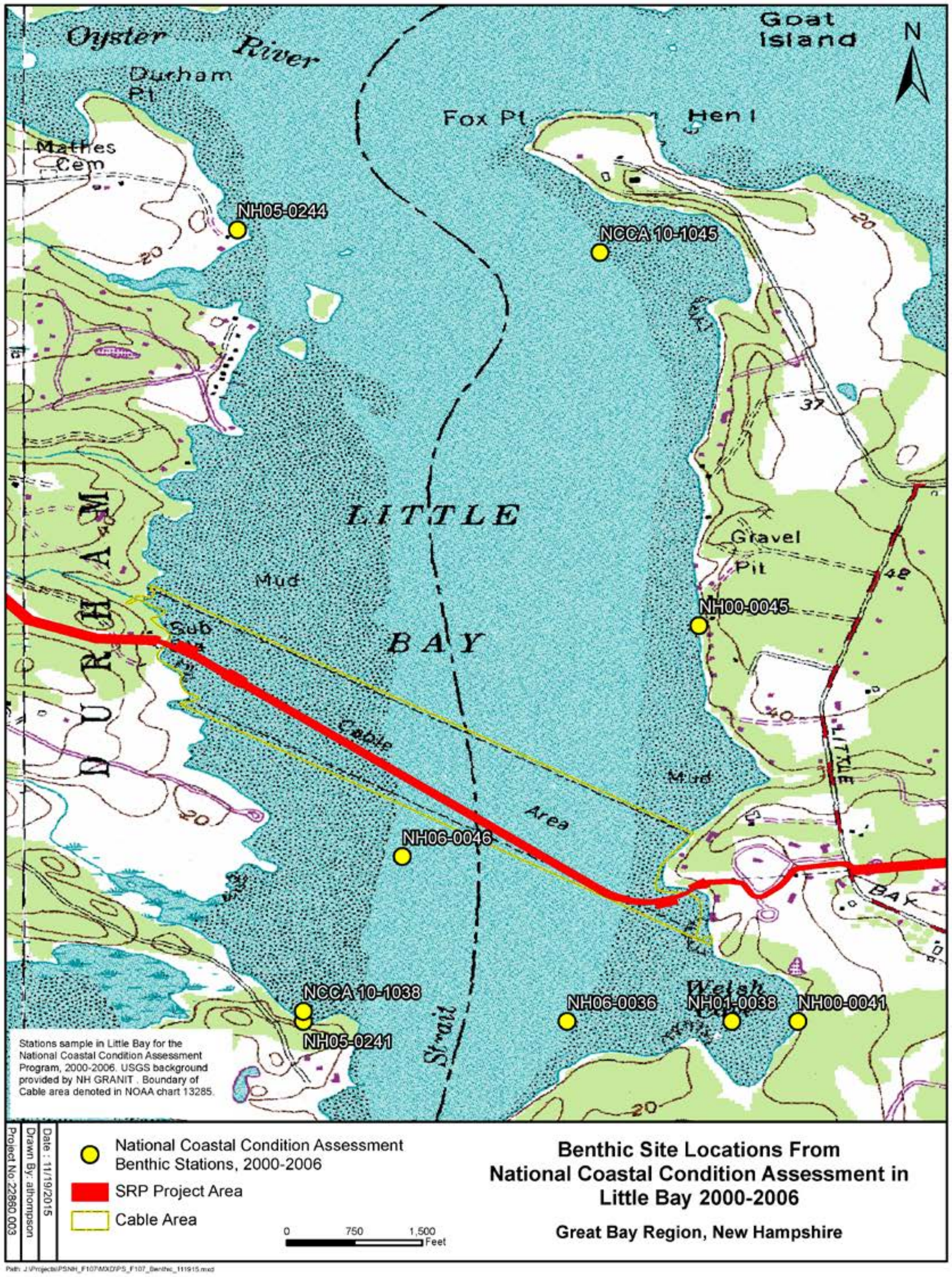


Figure 3.4-7. Normandeau Shellfish Survey Stations.



Source: http://www.epa.gov/emap/nca/html/data/index.html

Figure 3.4-8. National Coastal Condition Assessment Sampling Locations, 2000-2006.

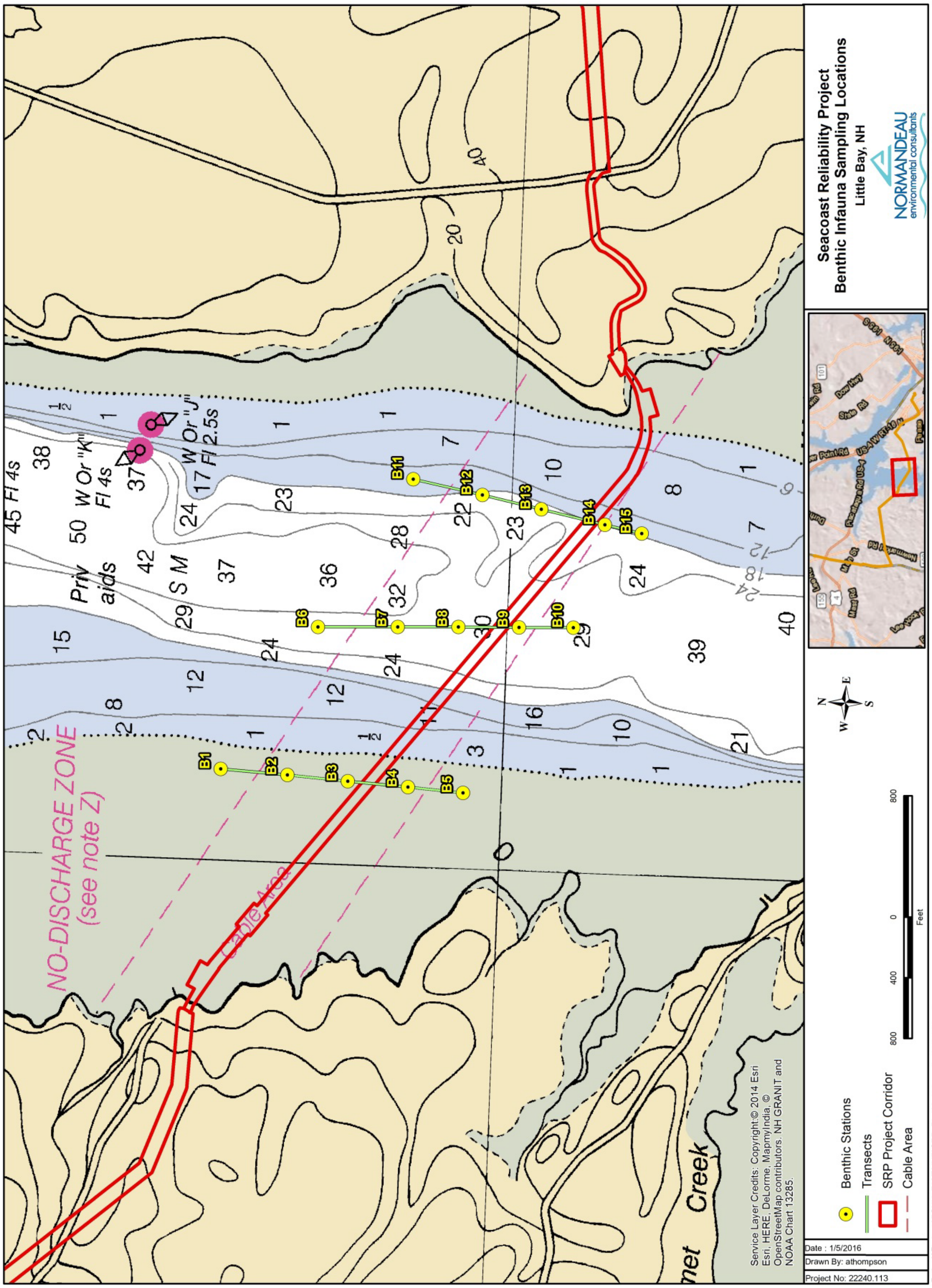


Figure 3.4-9. Normandeau Benthic Infauna Sampling Locations.

Table 3.4-2. Total abundance (no./0.04 m² grab), species richness (no./0.04 m² grab), diversity (H'), and evenness (J') of benthic infauna at stations along the cable route in Little Bay, August 2014.

Parameter	Range (mean) values		
	Tidal flat	Channel	Channel slope
Abundance (no./grab)	1,961 – 3,883 (2,733)	548 – 2,521 (1,470)	1,039 – 1,397 (1,204)
No. of unique taxa (no./grab)	26 - 31 (28.2)	22 - 35 (25.8)	22 - 33 (27.8)
Shannon-Weiner Diversity (H')	1.43 - 1.79 (1.564)	1.59 - 2.12 (1.812)	1.66 - 1.63 (1.796)
Pielou's Evenness (J')	0.44 – 0.56 (0.476)	0.47 – 0.69 (0.574)	050 – 0.60 (0.556)

Table 3.4-3. Mean abundance (no./0.04 m² grab) and rank of dominant taxa (≥ 1% of mean total abundance within area) along the cable route in Little Bay.

Taxon	Mean Abundance (Rank)		
	Tidal Flat	Channel	Channel Slope
Nematoda	246.4 (3)	78.8 (5)	74.2 (5)
Hypereteone heteropoda	68.4 (6)	*	*
Scoletoma tenuis	1457 (1)	*	
Aricidea (Acmira) catherinae	*	375.4 (2)	226.4 (3)
Polydora cornuta	83.4 (4)		*
Spio filicornis		*	11.6 (9)
Pygospio elegans	*	14 (9)	*
Streblospio benedicti	541.4 (2)	56 (7)	24.6 (7)
Scolelepis (Parascolelepis) texana	58.6 (8)	159 (3)	389.8 (1)
Cirratulidae	*	76.8 (6)	61.4 (6)
Tharyx acutus	60.8 (7)	417.8 (1)	249 (2)
Capitella capitata	*	40.2 (8)	11.8 (8)
Oligochaeta	*	106.4 (4)	105 (4)
Haminoea solitaria	80.8 (5)		

*present in area, but not among the dominant taxa

Within each of the three depth zones, eight or nine taxa individually made up more that 1% of the total abundance (Table 3.4-3). Combined, these taxa made up more than 90% of the total abundance in each zone. Although four taxa were among the dominants in each depth zone (nematodes, and three polychaetes: *Streblospio benedicti*, *Scolelepis texana*, and *Tharyx acutus*), the composition of the dominants was clearly different on the tidal flat than in the channel or the slope. These differences in species compositions likely reflected a combination of depth zone and substrate texture differences. Muddy sediments tend to support different benthic infaunal species than do sandier sediments. Two species, the lumbrinerid polychaete *Scoletoma tenuis* and the spionid polychaete *Streblospio benedicti*, accounted for more than 70% of the mean total abundance on the tidal flat. *Scoletoma i*s an actively burrowing species that reworks the sediment and is indicative of a moderately stable community. *Streblospio*, on the other hand, is often considered an opportunistic species that is capable of rapid population of disturbed sediments. Most of the other dominant polychaetes (*Polydora*, *Scolelepis*, and *Tharyx*) are also surface deposit feeders (Fauchald and Jumars 1979). Nematodes move about in the sediment and feed primarily on microorganisms and sediment particles. The gastropod snail *Haminoea solitaria* is among the dominants only on the tidal flat. This species lives and feeds on the sediment surface, consuming sediment particles and benthic diatoms (Chester 1993). The dominance by surface oriented infauna suggests that the sediments are frequently disturbed, perhaps by wave action during storms or icing in the cold months, although the species richness indicates good quality habitat.

Dominant taxa were virtually identical in the channel and on the channel slope although rank order differed. As on the tidal flat, polychaetes were the most important taxa numerically. The same three species (*Aricidea* (*Acmira*) *catherinae*, *Scolelepis* (*Parascolelepis*) *texana*, and *Tharyx acutus*) together contributed 65-70% of the total abundance at these depths indicating that sediment texture had a larger role in structuring the benthic community than depth. Each of these three species are considered to be surface deposit feeders but exhibit different levels of mobility, with *Aricidea* the most mobile and *Tharyx* sessile (Fauchald and Jumars 1979). A variety of behaviors provides some resiliency, but the predominance by surface-oriented species suggests some instability in the habitat, such as mobile sediments (to which *Scolelepis* is adapted; Fauchald and Jumars 1979).

Although polychaetes dominate both in terms of abundance and in terms of species richness, both arthropods and mollusks were well represented in each depth zone (Table 3.4-4).

Table 3.4-4. Number of unique species (no. across all samples) and mean total abundance (no./0.04 m^2 grab) of arthropods, mollusks, and polychaetes along the cable route in Little Bay

Taxonomic Group	Tidal Flat	Channel	Channel Slope
Arthropoda No. species	8	10	12
Mean abundance	41.2	82	21.2
Mollusca No. species	10	3	6
Mean abundance	97	11.6	5.6
Polychaeta No. species	15	23	21
Mean abundance	2307	1187.8	995.2

Species richness of arthropods was highest on the channel slope but abundances of these species were lowest in this area. Species richness and abundance of mollusks were highest on the tidal flat. Polychaete species richness was highest in the channel and lowest on the tidal flat but abundance was nearly double on the tidal flat compared to other areas. Results of the project-specific survey compare well to data collected between 2000 and 2006 for the NCCA program. Of the seven stations sampled during that time frame, total abundances (no./0.04 m^2 grab) ranged from 40 to 785 individuals and species richness (no. per grab) ranged from 5 to 22 unique taxa. Most taxa that were numerical dominants in the NCCA samples were also dominants in the Project Area. Jones (2000) reported that species richness and dominant species (including *Streblospio*, *Heteromastus*, *Scoloplos*, *Pygospio*, *Aricidea*, and oligochaetes, many of the dominants in the project area) in the Great Bay Estuary were similar over a twenty-year period (1972-1995) indicating that the benthic infaunal community in the estuary has been relatively stable in composition in the last three decades.

Recent alignment changes in the Little Bay crossing result in a short segment passing through the northern portion of Welsh Cove where no samples were collected during the benthic survey. However, several stations sampled during previous NCCA surveys were located in Welsh Cove (Figure 3.4-8). Total abundances and number of taxa of benthic infauna were lower in Welsh Cove than on the western tidal flat, but dominant taxa were similar which reinforces the concept that the estuary has supported a relatively stable macrofauna community for an extended period.

The National Estuary Program rated benthic conditions in Little Bay as good based on the fact that Shannon-Weiner diversity at all of the stations within the bay itself (excluding tributaries) exceeded 0.63 (USEPA 2007). The site-specific sampling confirmed this condition in the Project Area in 2014 (Table 3.4-2). Hale and Heltshe (2008), considered Shannon-Weiner diversity and predominance of capitellid polychaetes as two of the important factors indicating benthic habitat quality in the nearshore Gulf of Maine. The relatively low abundance of capitellids in the Project Area is an indication of good sediment quality (absence of organic pollution). Compared to Hale and Heltshe index values for diversity, the habitat value is most stressed on the western tidal flat and most consistently diverse on the channel slope.

Epibenthos

Epibenthic organisms that live and feed on the substrate surface known to, or are likely to, occur in the Great Bay Estuary include American lobster (*Homarus americanus*), rock crabs (*Cancer irroratus*), green crabs (*Carcinus maenas*), mud crabs (Xanthidae) and horseshoe crabs (*Limulus polyphemus*) (Jones 2000). These species move around on and burrow into the substrate seeking food or refuge. Bioturbation caused by these activities can have a substantial effect on the infaunal biota and on eelgrass beds. Lobsters are present throughout the bays and are fished both commercially and recreationally, although no landings or distribution data are available specifically for the estuary. Banner and Hayes (1996) reviewed environmental conditions (preferred substrate availability, salinity, temperature, and depth) in the estuary and concluded that the deeper portions of Little Bay provided good habitat for adult lobsters, but not juveniles. Watson et al. (1999) found that males were more common than females in the bay and that berried females tended to move into coastal waters to release larvae. Lobsters are generally active nocturnally, residing in burrows or crevices when they are not feeding. Although omnivorous, they feed primarily on large invertebrates (Jones 2000). Lobsters move in and out of the estuary seasonally in response to variations in salinity and temperature, with their greatest presence during late spring through fall (Watson et al. 1999; Jones 2000).

Rock crabs have been reported from the Great Bay system and may occur in deeper portions of the proposed cable crossing as this species prefers sandy substrate (Jeffries 1966). Rock crabs are fished commercially and recreationally to some degree. NHFG has found green crabs, an invasive species, to be the most abundant invertebrate species collected in New Hampshire's estuaries (NHFG 2014c). Green crabs have been shown to consume juvenile softshell clams, contributing to the failed recruitment to harvestable sizes and to uproot eelgrass plants, particularly in restoration areas. Abundances of rock and green crabs in Great Bay is not readily available; results of the NHFG surveys are reported as total catch from Great Bay, Little Bay, Piscataqua River, Little Harbor and Hampton/Seabrook Estuary combined (NHFG 2014c). Jones (2000) reported that green crabs were more abundant in the Piscataqua River and Little Bay than in Great Bay, however, and that both rock crabs and mud crabs are abundant in Great Bay.

Horseshoe crabs are ecologically important because their eggs, laid intertidally, provide a rich food source for migrating shorebirds. In addition, the crabs forage in muddy substrates for food and by doing so, bioengineer the substrate. Lee (2010) reported that mudflats in the Great Bay Estuary are important feeding habitats for both adult and juvenile horseshoe crabs. Horseshoe crabs are most noticeable in the estuary in the late spring and early summer when they undergo their spawning movements onto intertidal beaches (Mills 2010). According to Atlantic States Fisheries Management Commission (“ASFMC” 1998), preferred spawning habitat is sandy beaches in protected bays and coves, although spawning has been observed on substrates such as mud or peat. The tidal flats within the Project location could, therefore, provide spawning habitat. After investigating 15 locations in the estuary, ASFMC (undated) identified five (Wagon Hill Farm, Adams Point, Chapman’s landing, Sandy Point, and Emery Point) as potential horseshoe crab spawning and nursery habitat. Over five years (2001-2006), researchers observed nesting and eggs in all but 2001 at these locations. CPUE was highest at beaches farther up Great Bay than at Adams Point. According to Cheng (2014) juveniles are most apt to reside in the upper regions of Great Bay, with none being observed in Little Bay.

3.4.5 Bathymetry and Substrate

The SRP crosses Little Bay north of Adams Point and Furber Strait, a span of approximately 5,470 feet. A broad tidal flat with depths ranging from about +1 to -1 foot MLLW extends from the western shoreline approximately 1800 feet. Moving eastward, water depths increase gradually (over a distance of about 800 feet) to ~30 feet below MLLW. Water depth remains deep for about 400 feet, gradually decreasing to about 17 feet below MLLW and then more abruptly to 0 feet MLLW. The tidal flat on the eastern shoreline is about 100 feet wide. Bathymetric conditions in Little Bay are shown in Figure 3.4-10.

Information on sediment texture in the Project vicinity is available from three sources – a vibracore survey conducted along the proposed cable alignment in April 2014 with the purpose of obtaining sediments for testing their thermal conductance properties (Figure 3.4-11), a survey conducted by Professor Thomas Lippmann (University of New Hampshire, personal communication, 2014) on a transect south of the cable route (Figure 3.4-12), and a diver survey along the route to determine the locations of existing cables. As the cable will be routed only through the northernmost portion of Welsh Cove, samples collected in the cove during the vibracore and Lippmann surveys are not relevant to this characterization. Sediment characteristics observed during the vibracore survey are shown in Table 3.4-5 and from Dr. Lippmann’s survey are shown in Table 3.4-6. These two surveys were consistent in showing that sediments on the western tidal flat were predominantly silt-clay and in the channel and eastern channel slope were predominantly sand. Sediments were generally consistent within depth zones: the western tidal flat was predominantly silt with some clay and detritus; the channel (water depth about 30 feet below MLLW) was predominantly fine to medium sand with shell hash; the eastern channel slope (water depth about -20 feet below MLLW) was predominantly fine sand with silt and some shells. Neither survey collected samples in the northernmost section of Welsh Cove, however vibracore station LB-

11 and Lippmann stations 1-4 are likely to be fairly representative of conditions across the eastern tidal flat along the crossing. These results indicate that sediments farthest offshore are sandier and sediments closer to shore are siltier. During the in-water survey investigating old cables, Caldwell divers described the substrate at water depths of 10.6 to 32 feet as compact gravel, covered with 0-24 inches of fine sands and soft mud (Caldwell 2014). For depths <10 feet within the cable corridor, the substrate assumed to be fine sand and soft mud.

USEPA's NCCA has conducted surficial sediment quality sampling in Little Bay. The most recent publically available data were collected in 2000-2010. Stations sampled in Little Bay for this program are shown on Figure 3.4-8.

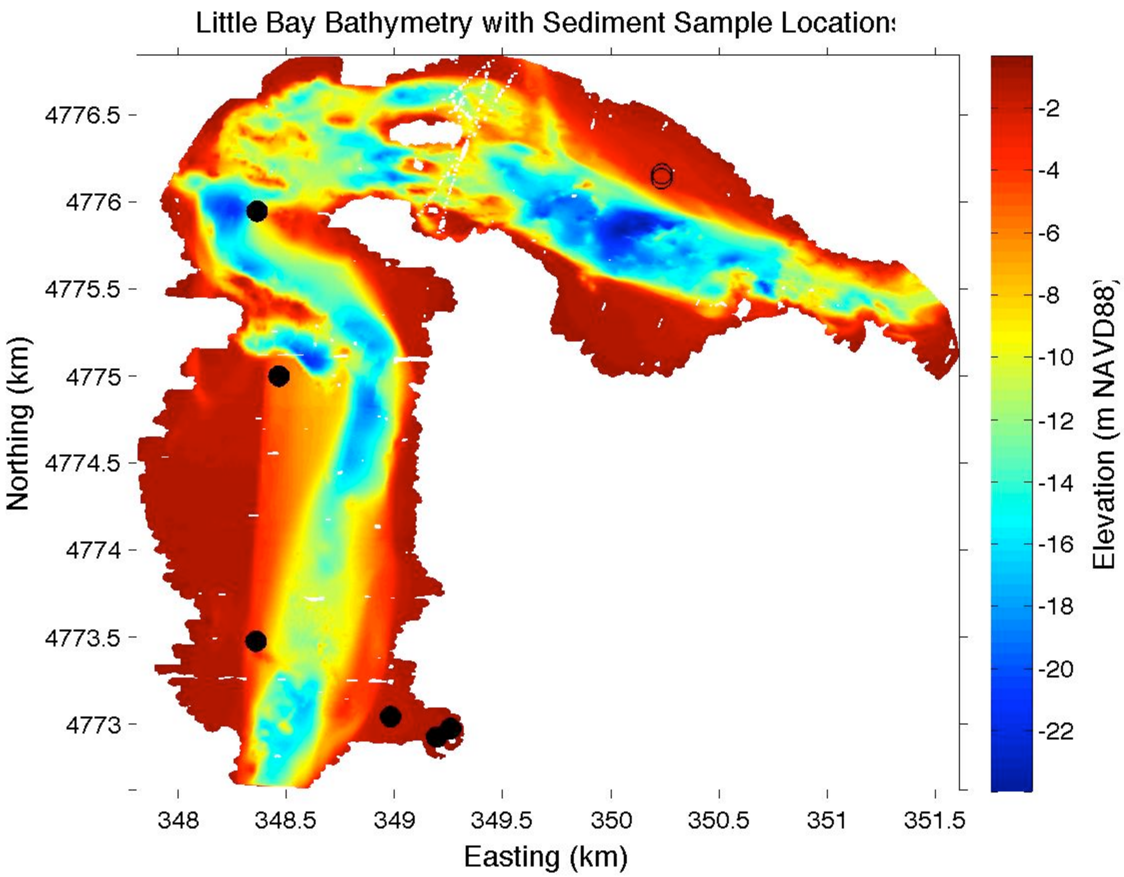


Figure 3.4-10. Bathymetric Map of Little Bay (Lippman 2013).

Values for total organic carbon ("TOC") at these stations ranged from 0.55 to 2.35 percent, averaging 1.4 percent, a relatively low value. Chemistry data are shown in Table 3.4-7. Sediment toxicity testing in 2000-2006 revealed no significant mortality among test benthic organisms. Based on the 2000-2006 data, USEPA (2007) characterized sediment quality in Little Bay as good. Trowbridge (2009) noted that although sediment contaminant levels in tributaries to the Great Bay/Little Bay system often exceeded NOAA screening levels, the concentrations within the bays themselves did not, which is consistent with low TOC values. It is unlikely that this has changed since the last assessment. Sediment contamination was not even considered as a factor affecting the estuary in the 2013 State of the Estuary report (PREP 2012, 2013). Data from 2010 (Table 3.4-7) suggest that sediment contaminant levels have shown little change since the previous assessment.

Table 3.4-5. Qualitative description of sediments along cable route from vibracore collections, April 2014.

Zone	Station	Penetration Depth	Sediment Description
Tidal Flat (west)	LB-1-A	94″	Cohesive Clay with silt
	LB-2-B	104″	
	LB-3-B	104″	
	LB-4-A	120″	Cohesive Clay with silt and trace of fine sands
	LB-5-B	86″	
Channel	LB-6-A	44″	Cohesive Fine to medium sand with small amount of clay and silt
	LB-7-B	63″	0-19″: Cohesive Fine to medium sand with small amount of clay and silt
			19-63″: cohesive Clay with silt
	LB-8-B	29″	0-15″: cohesive Fine to medium sand with small amount of clay and silt
			15-22″: cohesive Fine sand and clay, shell fragments present
			22-29″: cohesive Clay
Slope	LB-9-A	97″	0-22″: cohesive Fine to medium sand with small amount of clay and silt
			22-97″: cohesive Clay with silt, minor shell fragments throughout
Tidal Flat (east)	LB-10-D	44″	Cohesive Fine to medium sand with small amounts of clay
Welsh Cove	LB-11-B	103″	Cohesive Clay and fine sand with silt
	LB-12-B	46″	0-18″: cohesive Clay and fine sand with silt
			Cohesive Fine to medium sand with little clay and silt; minor amount of wood debris and shell fragments

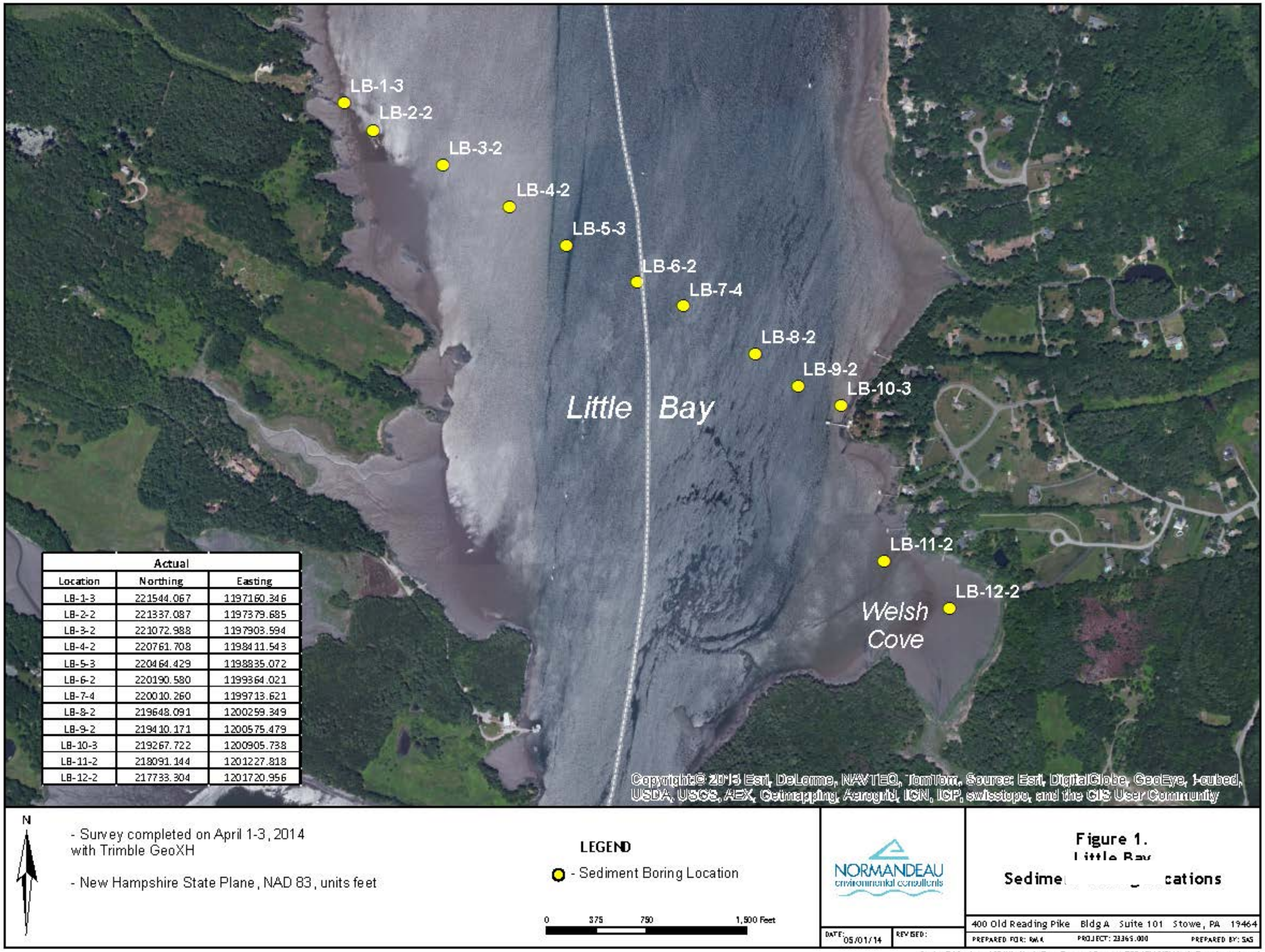


Figure 3.4-11. Normandeau Vibracore Sediment Boring Locations.

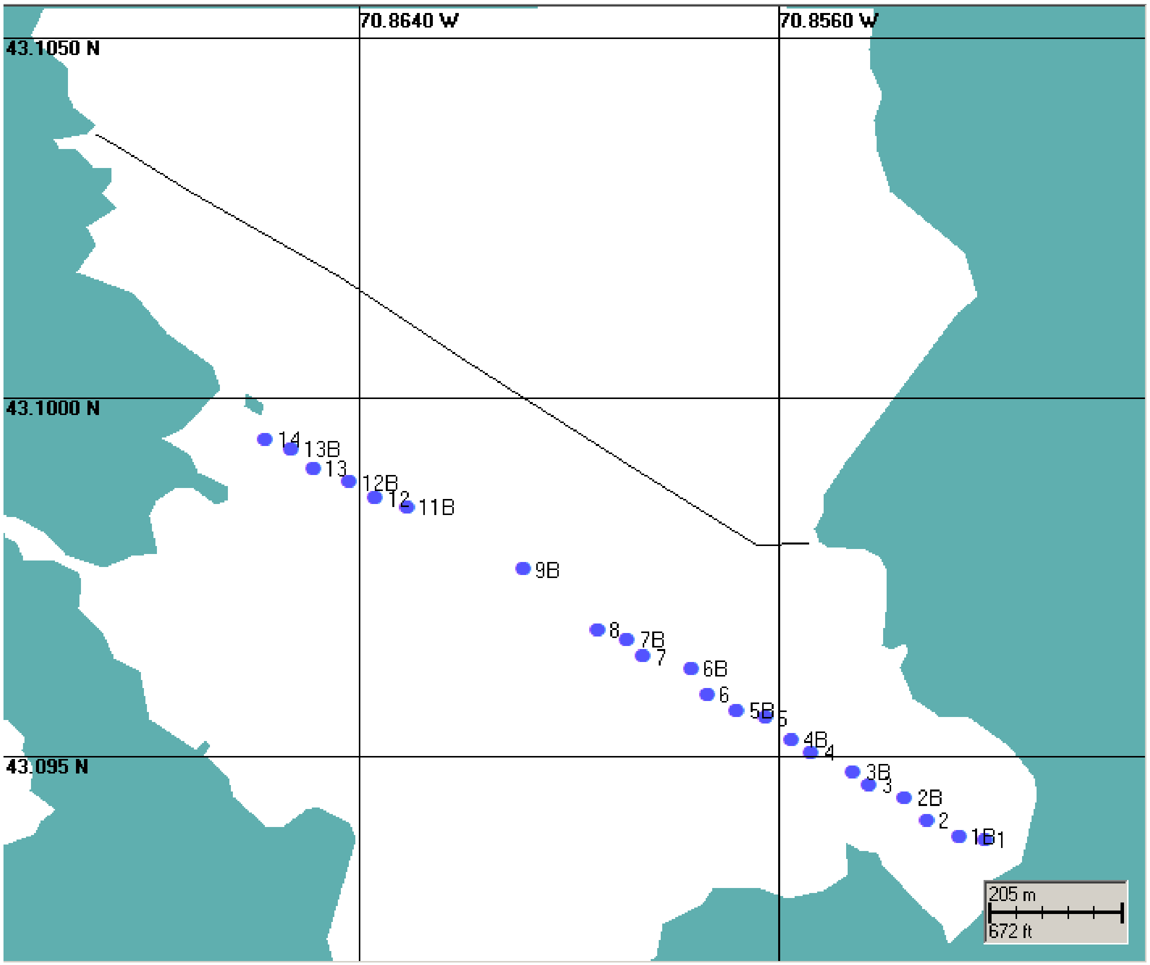


Figure 3.4-12. UNH Sediment Samples (Lippman, unpublished data, 2014).

Table 3.4-6. Grain size distributions (in percent) for Lippmann sampling stations. (refer to Figure 3.4-12 for sampling locations)

Station	14	13B	13	12B	12	11B	9B	8	7B	7	6B	6	5	4	3	2	1
Clay	10.71	9.20	6.97	4.41	7.03	1.34	2.78	0.00	0.00	0.00	1.18	2.14	3.08	6.58	4.22	5.53	5.31
F Silt	20.68	18.31	15.14	8.53	12.87	2.91	4.76	0.00	0.00	0.00	1.99	3.93	5.71	12.76	8.67	11.62	11.13
C Silt	40.42	32.02	35.52	19.38	23.84	6.02	5.74	0.00	2.13	0.00	3.71	6.95	9.85	28.02	24.75	40.89	36.62
F Sand	26.65	37.69	40.28	60.37	50.84	84.57	49.43	16.67	48.34	69.43	87.46	83.05	68.06	51.23	57.03	40.45	43.78
C Sand	1.54	2.79	2.10	7.31	5.41	5.17	37.29	83.33	49.53	30.57	5.66	3.92	13.30	1.41	5.34	1.52	3.15

Source: Lippmann 2014, pers. comm.

Table 3.4-7. Chemistry of surficial sediments at Stations in Little Bay sampled as part of the National Coastal Condition Assessment, 2000-2006.

Analyte (units)	NH00-045 2000	NH00-045 2000	NH01-0038 2001	NH06-0036 2006	NH06-0046 2006	NH10-1038 2010	NH10-1045 2010
Silver (ug/g)	0.4	0.1	0.5	0.736	0.743	1.6	1.1
Aluminum (ug/g)	54800	38100	59300	56100	48200	34310	18400
Arsenic (ug/g)	9	2	8	7.55	4.46	10.8	4.8
Cadmium (ug/g)	0.31	0.12	0.2	0.325	0.211	1.5	0.8
Chromium (ug/g)	73	21	81	65.3	33.6	95	34.6
Copper (ug/g)	14	4	16	11.9	5.75	16.8	5.6
Iron (ug/g)	24400	9780	24100	20800	13800	23410	10610
Mercury (ug/g)	0.14	0.04	0.14	0.149	0.056	0.2	0.06
Manganese (ug/g)	426	436	401	399	521	400.3	439.8
Nickel (ug/g)	15	6	17	14.6	9.16	18.9	8.1
Lead (ug/g)	38.8	22.2	36.5	36.1	24.4	43.4	24
Antimony (ug/g)	0.3	0.1	0.3	0.292	0.188	0.4	0.2
Selenium (ug/g)	0.28	0.06	0.23	0.371	0.29	0	0
Tin (ug/g)	5.8	2	5.9	5.85	2.91	9.4	4.1
Zinc (ug/g)	79	28	80	63.8	35.6	82.5	32.9
High Molecular Wgt PAHs (ng/g)	829	191.1	685	659.7	265.6	385.6	1029.7
Low Molecular Wgt PAHs (ng/g)	124.7	27.16	64.04	58.9	23.4	128.2	270
Total PAHs (ng/g)	994.7	229.26	786.04	801.2	323.1	585.2	1479.4
Total PCBs (ng/g)	3.999	0.841	7.52	0	0	0	0
Aldrin (ng/g)	<0.4	<0.27	<0.37	<1	<1	0	0
Alpha-Chlordane (ng/g)	<0.37	<0.25	0.045	<1	<1	0	0
Total DDTs (ng/g)	1.474	0.256	1.99	0	0	0	0
Dieldrin (ng/g)	<0.37	<0.25	<0.34	<1	<1	0	0
Endosulfan I (ng/g)	<0.62	<0.42	<0.58	<1	<1	0	0
Endosulfan II (ng/g)	0.12	<0.42	<0.58	<1	<1	0	0
Endosulfan (ng/g)	0.092	<0.12	0.068	<1	<1	0	0
Endrin (ng/g)	<0.37	<0.25	<0.34	<1	<1	0	0

Source: http://www.epa.gov/emap/nca/html/data/index.html

(continued)

Table 3.4-7. (Continued)

Analyte (units)	NH00-045 2000	NH00-045 2000	NH01-0038 2001	NH06-0036 2006	NH06-0046 2006	NH10-1038 2010	NH10-1045 2010
Heptachlor (ng/g)	<0.37	<0.25	<0.34	<1	<1	0	0
Heptachlor Epoxide (ng/g)	<0.37	<0.25	<0.34	<1	<1	0	0
Hexachlorobenzene (ng/g)	<0.18	<0.12	0.027	<1	<1	0	0
Lindane (ng/g)	0.041	<0.18	<0.25	<1	<1	0	0
Mirex (ng/g)	<0.18	<0.12	0.16	<1	<1	0	0
2,4'-DDD (ng/g)	0.32	0.099	0.24	<1	<1	0	0
2,4'-DDE (ng/g)	<0.62	<0.42	<0.58	<1	<1	0	0
2,4'-DDT (ng/g)	<0.62	<0.42	0.16	<1	<1	0	0
4,4'-DDD (ng/g)	0.4	0.064	0.56	<1	<1	0	0
4,4'-DDE (ng/g)	0.66	0.093	0.87	<1	<1	0	0
4,4'-DDT (ng/g)	0.094	<0.58	0.16	<1	<1	0	0
Trans-Nonachlor (ng/g)	0.034	<0.18	0.054	<1	<1	0	0
Toxaphene (ng/g)			<23	<10	<10		

Source: http://www.epa.gov/emap/nca/html/data/index.html

3.4.6 Water Quality

NOAA's National Estuarine Eutrophication Assessment program has designated all of Little Bay as part of the Seawater Zone of the Great Bay Estuary system (Figure 3.4-13). Salinity in this zone exceeds 25 parts per thousand ("ppt"). Data from the National Estuarine Research Reserve System ("NERRS") Great Bay sampling station (station ID: GRBGBWQ) were used as estimates of water temperature and dissolved oxygen at the Little Bay cable crossing location (Figure 3.4-13). From April 2009 through September 2014, water temperature in Great Bay ranged from -2 to 29.1°C (28.4 to 84.4°F), with July having the highest monthly mean temperature (24°C; 75.2°F; NERRS 2014; Figure 3.4-14). DO levels in Great Bay ranged from 3.7 to 17.4 mg/l during April 2009 through September

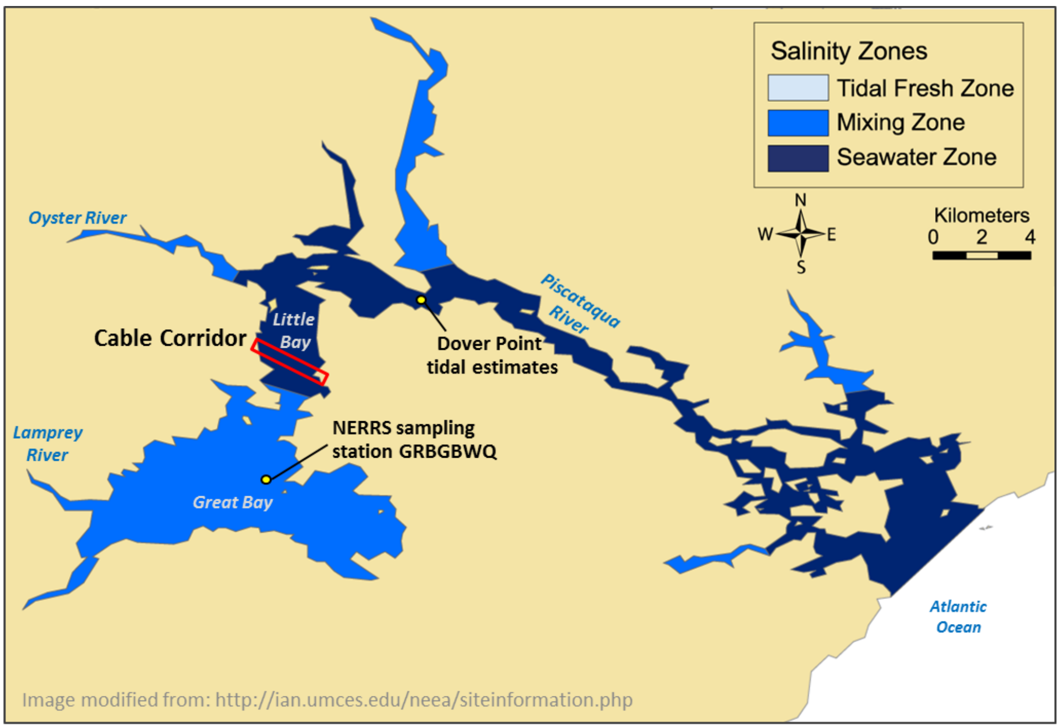


Figure 3.4-13. Salinity Zones of Great Bay (NERRS 2014).

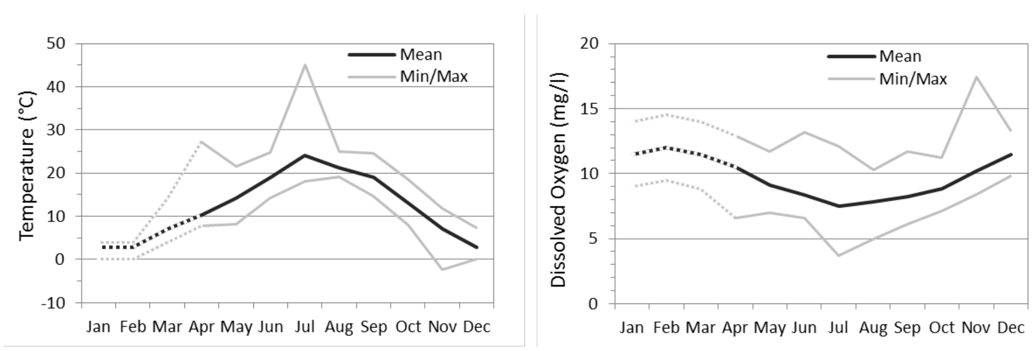
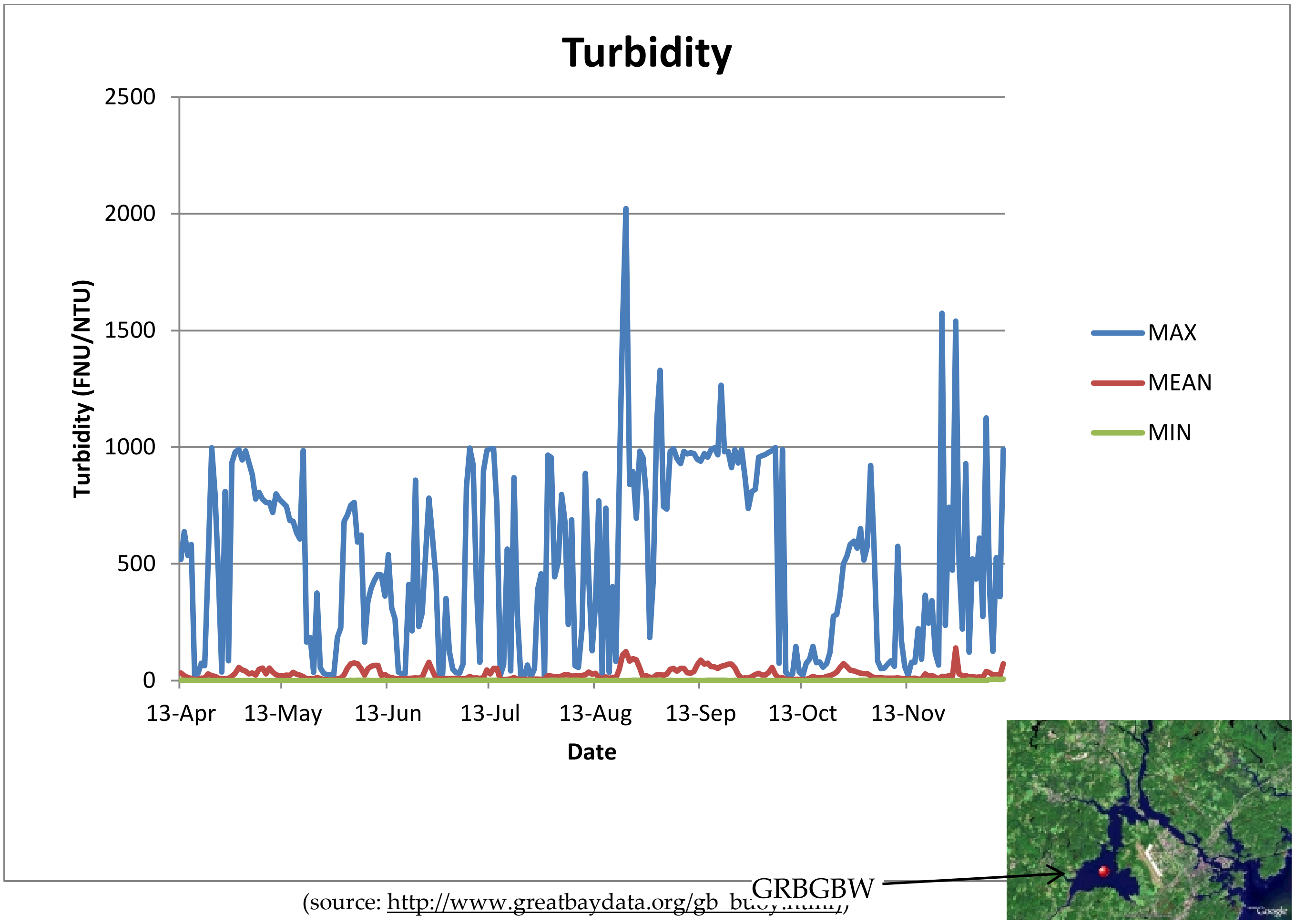


Figure 3.4-14. Monthly Temperature and Dissolved Oxygen in Great Bay (NERRS 2014).



(source: http://www.greatbaydata.org/gb_buoy.html)

Figure 3.4-15. Range of Turbidity at Station GRBGBW (NERRS 2014).

2014, with the lowest monthly mean DO in July (7.5 mg/l; NERRS 2014; Figure 3.4-14). For the months not sampled (January - March), the report estimated that temperature and dissolved oxygen levels ranged between the December and April estimates.

Trowbridge (2009) compiled total suspended solids ("TSS") data collected off Adams Point and found that mean concentrations at low tide were statistically higher during the period from 2001-2008 than during 1974-1981 (Table 3.4-8). Consistent with that finding, PREP (2013) reported that TSS concentrations more than doubled (122% increase) at Adams Point between 1976 (mean of 1974-1976) and 2011 (mean of 2009-2011; averaging 16.3 mg/L). PREP linked this increase to decreases in eelgrass, an aquatic plant whose root and rhizome system stabilize sediments and help sequester nutrients in the substrate. It is likely that TSS concentrations can vary widely both seasonally and tidally. Monthly TSS measurements in surface waters off Adams Point indicated that from 2002 through 2011 maximum values in the fall ranged from 18 to 105 mg/L (GBNERR undated). Although not directly relatable, turbidity levels are often used as a surrogate for TSS because turbidity can be measured in the field whereas TSS requires a laboratory test. Figure 3.4-15 shows continuously collected turbidity measurements over four years (2009-2013) at Station GRBGBWQ located in central Great Bay. While mean turbidity values are typically low, the range of values clearly show a high level of variability with maximum values frequently exceeding mean values by 100-

fold. As GRBGBWQ is located along the main northeast/southwest axis of Great Bay, it is likely representative of conditions northeast of Furber Strait and the general vicinity of the Cable Area, at least in terms of fluctuations of turbidity. Jones (2000) noted that wave action on tidal flats, rain events, and ice scour are important factors in resuspension of fine grained sediments. Jones (2000) also cited studies that showed large variation in TSS over tidal cycles and over seasons.

Table 3.4-8. Total suspended solids (TSS) data collected off Adams Point (Trowbridge 2009).

	Total Suspended Solids (mg/L)		
Statistic	**n**	**Mean**	**Standard Deviation**
1974-1981	65	8.825	10.822
1993-2000	94	10.185	5.687
2001-2008	73	19.705	13.799
T-test	Significant (p<0.05}		
Kruskall-Walls test	Significant (p<0.05}		
Percent Change	123.28%		

T-test, Kruskall-Wallis test, and percent change calculated using 1974-1981 and 2001-2008 data.

3.4.7 Fish

A number of fish species are known to utilize the Great Bay Estuary during at least one life stage. The NHFG and NMFS are tasked with management of ecologically and economically important fish species. Management goals include the restoration of populations that have been depleted from historic levels, maintenance of recently recovered populations, and protection of populations that may be at risk due to habitat loss or overexploitation. Although not mutually exclusive of each other, groups of fish considered for management include: diadromous fish species, EFH species, and RTE species. Diadromous fish species either spend their life in saltwater and spawn in freshwater (anadromous) or spend their life in freshwater and spawn in the ocean (catadromous), and are discussed below. EFH (SEC Appendix 38) and RTE (SEC Appendix 37, NHDES Wetlands Application Appendix C) fish species are also summarized, and described in more detail in separate reports

Diadromous Fish

The proposed Project Area, which includes both freshwater and estuarine habitats, potentially contains habitat for multiple Species of Special Concern (“SC”) as identified by the NHFG. SC species are also considered trust resources by NMFS. Species of Special Concern are classified as Category A or B. Species with Category A designation as are considered ‘Near-threatened’ presently, but may become ‘Threatened’ in the near future if conservation actions are not taken. Sub-category A1 describes species susceptible to further decline. Sub-category A2 identifies species that are considered recovered and were recently down-listed from the state Endangered and Threatened list. Category B Species of Special Concern are described as ‘Responsibility Species’, with a major portion of the total global population existing with New Hampshire.

The fish Species of Special Concern related to the proposed Project include diadromous (anadromous and catadromous) and freshwater species. Anadromous describes species that live as adults in the ocean and spawn in freshwater where the early life stages develop before migrating to the ocean. Catadromous fish live in freshwater, and migrate to the ocean to spawn. Freshwater species are strictly found in freshwater for all life stages.

American Eel *(Anguilla rostrata)*

American Eel is currently designated as a Species of Special Concern Category A1 (SC-A1) due to declines in most populations relative to historic levels, and limited access to historic spawning grounds (NHFG 2009).

The American Eel is a catadramous species found from Greenland to South America (Collette and Klein-MacPhee 2002). Spawning occurs in the winter and spring, and larval development occurs in the ocean. In the spring, juveniles ("elvers") migrate into estuaries as transparent "glass eels", where they develop into pigmented juveniles ("browns"). Elvers then continue upstream migration into freshwater to develop into adults and remain for up to 25 years as "yellow" eels before migrating back to sea to spawn as "silvers".

Ongoing surveys in the Oyster River (yellow eels) and Lamprey River (glass eels/elvers) indicate that the Great Bay Estuary and its tributaries should be considered currently viable American Eel habitat (NHFG 2013a, Enterline *et al*. 2012). From late-April through late-September 2012, a total of 4,092 glass eels and 121 browns were collected during a NHFG survey of the Lamprey River in Newmarket, New Hampshire (NHFG 2013a). Therefore, the proposed Project Area may contain both freshwater and marine habitat for American Eels. The corridor crosses the Oyster River (freshwater) in Durham, New Hampshire where American Eels were reported in 1985 and 1998 (NHB 2014). Additionally, American Eels were reported in 2003 in the Lamprey River (freshwater) in Durham, New Hampshire (NHB 2014). Although the SRP does not cross the Lamprey River, access to the Lamprey River from the Atlantic Ocean requires passage through the Little Bay cable corridor. The reported occurrence of American Eel in the Lamprey River indicates that Little Bay had provided temporary habitat for migrating glass eels and elvers during their transition into freshwater. Assuming survival to reproductive age within the Lamprey River, Little Bay would also provide temporary habitat for adults migrating back to the ocean for spawning.

In New England, juvenile American Eel migration into freshwater may occur from March through June (Greene *et al*. 2009). Glass eels progress into estuaries by drifting on flood tides and holding position near the bottom during ebb tides (McCleave and Wippelhauser 1987). Migrating elvers are mainly active at night, and may burrow into soft undisturbed bottom sediments or remain in deep waters during the day (Facey and Van den Avyle 1987). Spawning in the ocean occurs during the winter and the spring (McCleave and Kleckner 1985), indicating that Little Bay has the potential to be used by out-migrating adults in the fall and winter. Based on this, the habitat at the Little Bay project location may be considered American Eel habitat during the spring for juveniles and during fall and winter for adults. If present, juveniles would be most susceptible to jet plowing impacts during the day when they may be burrowed into soft substrate. The portion of the Oyster River within the SRP corridor may be considered year-round habitat for adult (yellow) American Eels.

American Shad *(Alosa sapidissima)*

American Shad is currently designated as SC-A1 due to declines in most populations relative to historic levels, and limited access to historic spawning grounds (NHFG 2009).

The geographic distribution of American Shad adults includes the coastal watersheds of New Hampshire. Although the historic spawning distribution within these New Hampshire coastal watersheds is not well documented, American Shad likely spawned in all rivers and tributaries throughout the Atlantic coast from Newfoundland to Florida prior to the construction of impassable dams (Colette and Klein-MacPhee 2002, NHFG 2005, Greene et al. 2009). Migrating adults may spend two to three days in estuarine waters before continuing to tidal or non-tidal freshwater rivers to spawn with an optimal water temperatures range of 57 to 77°F (Leggett 1976, Chittenden 1976, Greene et al. 2009). American Shad eggs and larvae remain at the spawning location or are transported downstream and may be found in areas with salinities < 15ppt and a minimum dissolved oxygen level of 5mg/l (Miller et al. 1982, Greene et al. 2009). For northern New England rivers, the spawning migration would occur from late-April through August, and juvenile out-migration to the ocean would occur during September and October. NHFG (2014a) determined that suitable spawning habitat for American Shad is accessible in both the Exeter and Lamprey Rivers. No American Shad passage through fish ladders was estimated for the Oyster, Lamprey, or Winnicut Rivers during April 15 through June 3, 2013 (NHFG 2014b). This suggests that the likelihood of American Shad using habitat within the proposed Little Bay cable corridor is low.

River Herrings *(Alewife (Alosa pseudoharengus) and Blueback Herring (Alosa aestivalis))*

Alewife (sea-run only) and Blueback Herring (together "River Herrings") are currently designated as SC-A1 due to declines in most populations relative to historic levels, and limited access to historic spawning grounds (NHFG 2009).

River Herrings are anadromous species with a current geographic range extending from North Carolina to Newfoundland. Spawning occurs in freshwater rivers, where the eggs, larvae, and early juveniles remain until the juveniles migrate downstream to estuaries and the ocean to develop into adults. Juvenile migration from freshwater nursery habitats to estuaries occurs from late summer to early fall for Alewife, and in the fall for Blueback Herring (NHFG 2005). Alewife spawning generally occurs in northern New England from early-April through mid-June, with Blueback Herring generally spawning 3 to 4 weeks later than Alewife in areas where the species overlap geographically (Greene *et al*. 2009).

Surveys by the NHFG in 2012 found 2,573 River Herring (55% Blueback Herring, 45% Alewife) in the Oyster River, and 86,862 (100% Alewife) in the Lamprey River (NHFG 2013b). From April 15 through June 3, 2013 the estimated total number of River Herring that passed through fish ladders was 79,408 for the Lamprey River, and 7,149 for the Oyster River (NHFG 2014). These recent spawning migrations occurred from mid-April through late-June in the Oyster River, and from mid-April through the end of May in the Lamprey River. This indicates that the portion of the Oyster River within the proposed project corridor may contain Alewife and Blueback Herring spawning habitat from April through June, and nursery (egg, larvae, juvenile) habitat from May through October. Note that no impacts to the Oyster River are expected because a new off-ROW access route will be utilized to access the area south of the river. Additionally, Alewife migration between the Atlantic Ocean and the Lamprey River would require passage through the Little Bay cable corridor in May and April for adults and in September and October for juveniles.

Rainbow Smelt *(Osmerus mordax, sea-run stock only)*

Rainbow Smelt is currently designated as SC-A1 because of restricted access to historical spawning areas due to undersized culverts and dams, and existing spawning habitat vulnerability to sedimentation and pollution (NHFG 2009).

Great Bay and its tributaries are important spawning and nursery habitats for coastal (anadromous) Rainbow Smelt populations. Following the breakup of winter ice in early spring, adult Rainbow Smelt migrate upstream from coastal areas into rivers to spawn at the head-of-tide. Smelt are transported downstream as larvae in the spring to brackish nursery areas, move into upper estuarine areas as juveniles by fall, and complete the migration to the ocean by the following spring (Collette and Klein-MacPhee 2002).

Adult Rainbow Smelt have been identified in recent NHFG surveys of the Oyster River (2008, 2010, 2011), and tributaries of Great Bay: the Lamprey (2008), Squamscott (2008-2011), and Winnicut Rivers (2008-2011; Enterline *et al*. 2012). The spawning run in the Squamscott and Oyster Rivers occurs from March through May. Rainbow Smelt egg deposition surveys were also conducted by NHFG from mid-March to mid-April, 1978 through 2007, in the Oyster, Lamprey, Squamscott and Winnicut Rivers (Enterline *et al*. 2012). These surveys indicate that the portion of the Oyster River within the proposed project corridor currently has the potential to provide spawning habitat for sea-run Rainbow Smelt adults, and nursery habitat for eggs and larvae. No impacts to the Oyster River are anticipated. Additionally, the area of the Little Bay cable crossing may provide nursery habitat for larvae and juveniles spawned in the tributaries of Great Bay, including the Lamprey, Winnicut, and Squamscott Rivers. Passage through the Little Bay cable corridor would also be required for adult Rainbow Smelt spawning in or for juveniles emigrating from any Great Bay tributaries.

Sea Lamprey *(Petromyzon marinus)*

Sea Lamprey is currently designated as a Species of Special Concern Category A1 (SC-A1) due to declines in most populations relative to historic levels, and limited access to historic spawning grounds (NHFG 2009).

Sea Lamprey are anadromous, and in the western Atlantic Ocean range from Greenland to the Gulf of Mexico (Collette and Klein-MacPhee 2002). In Gulf of Maine tributaries, adults migrate upstream from the ocean to spawn in freshwater rivers during May and June, and all adults die after spawning. Eggs and larvae remain in the natal stream until approximately October, when metamorphosis into juveniles is complete. Juvenile out-migration to the ocean begins following metamorphosis, and overwintering in estuaries may occur (Collette and Klein-MacPhee 2002).

From April 15 through June 3, 2013, an estimated 48 Sea Lamprey passed through the Oyster River fish ladder, and 114 passed through the Lamprey River fish ladder (NHFG 2014). These recent spawning migrations occurred in early-May in the Oyster River and from early-May through the early-June in the Lamprey River. This indicates that the portion of the Oyster River within the proposed project corridor may contain Sea Lamprey spawning habitat in May, and nursery (eggs and larvae) habitat from June through October. Additionally, Sea Lamprey spawning in the Lamprey River would require passage of migrating adults through the Little Bay cable corridor during May and June. The Little Bay cable corridor may also provide overwintering habitat for out-migrating juvenile Sea

Lamprey from both the Oyster and Lamprey Rivers. Note that no impacts to the Oyster or Lamprey Rivers are anticipated.

3.5 Conserved and Public Lands

The SRP is located in New Hampshire's coastal watersheds, which have experienced rapid development over the past few decades and as a result, are the focus of ongoing conservation efforts. The 2006 report titled *The Land Conservation Plan for New Hampshire's Coastal Watersheds* identified areas that are important for conserving native plants, animals and natural communities and water quality in the coastal watersheds (Zankel, M., et al. 2006). These focus areas, which are available as GIS layers, and GIS data for existing conserved and public lands (as of April 2013) were reviewed along the project corridor. A more detailed report including conservation lands associated with the SRP is included in the *Review of Land Use and Local and Regional Planning, The Seacoast Reliability Project* report (See SEC, Appendix 43).

The SRP corridor crosses through portions of fifteen conserved parcels. Approximately 58 acres (36%) of the corridor are located within these conserved areas. The majority of the areas identified as "core" conservation focus areas in the vicinity of the project corridor are currently protected via conservation easements or other protection strategies. These lands near the corridor are concentrated in two clusters in Durham: the first located in and around the UNH campus including portions of the UNH College Woods, Foss Farm, Horticulture Farm, and NHFG La Roche Brook parcel; and the second to the east of Sandy Brook Drive and northwest of Longmarsh Road (Map 3; Appendix A). This second cluster is associated with the Durham Point Sedge Meadow Preserve and Crommet Creek. The Durham Point Sedge Meadow Preserve is a 20-acre site located north of the SRP corridor owned by The Nature Conservancy ("TNC"), and provides habitat for the globally-rare banded bog skimmer dragonfly (*Williamsonia lintneri*), which is listed as Endangered (S1) in New Hampshire. The conservation lands around Crommet Creek include parcels owned by TNC, plus state and municipally owned lands.

The project corridor crosses several other conserved and public parcels including six other fee ownership parcels, one parcel that has been set aside as open space, off Sandy Brook Drive, and three parcels protected by conservation easements. The corridor also crosses through a parcel owned by the Town of Durham, adjacent to the existing Durham Substation off Mill Road.

In Newington, the project corridor crosses a small town-owned conserved parcel (Flynn Pit) immediately to the east of Little Bay Road and the lower hay fields of the historic Frink Farm. No other conserved lands are crossed by the Project between the Frink Farm and the Portsmouth Substation. No conserved lands lie within or near the project corridor in Madbury or Portsmouth.

Little Bay is part of the Great Bay NERRS. The Great Bay estuary is New Hampshire's largest estuarine system that includes a diversity of land and water area, including upland forest, salt marsh, mudflats, tidal creeks, rocky intertidal, eelgrass beds, channel bottom/subtidal and upland field habitats (NERRS, 2014). The reserve encompasses 10,235 acres, including approximately 7,300 acres of open water and wetlands. The Great Bay's cultural heritage is equally diverse, ranging from paleo-Indian villages from 6,000 years ago to colonial transportation and industrial use (NERRS 2014).

3.6 Soils

The soils within the project corridor were mapped by the NRCS and these data were reviewed using GIS software. The NRCS soil surveys are made for planning purposes at a scale of 1:20,000. Due to mapping scale, inclusions of less than 3 acres may not be identified without detailed field surveys. The Project field delineations of wetlands, streams and vernal pools, completed by Normandeau provide more detail on hydric soil inclusions overlooked by the NRCS soil survey.

NRCS soil data and Normandeau's wetland delineations highlight the variation in soils within the project corridor. These differences are a result of variations in parent materials, landscape position, elevation, slope, aspect and vegetation. Deeper soils with larger areas of poorly drained (hydric) soils are found in depressions on the landscape while the low hills and higher elevations have shallower soils. The majority of the soils mapped within the corridor are derived from till, or are of glaciomarine or outwash parent material. The following is an overview of the soils within the project corridor by town. Soil maps are provided in the *Phase I-A Preliminary Archeological Survey* report and addenda (See SEC, Appendix 9).

Town of Madbury

Only a small portion of the Project is located within the Town of Madbury. Three soils are mapped within Madbury, and include Buxton silt loam, Scantic silt loam, and Paxton fine sandy loam. Buxton soils are moderately well drained, while Scantic soils are poorly drained, hydric soils and Paxton fine sandy loams are well drained and partially hydric.

Town of Durham

The soils mapped within the project corridor in Durham are primarily fine or very fine sandy loams or silt loams. Examples include the Hollis-Charlton very rocky fine sandy loams, Scantic silt loam, Buxton silt loam, Suffield silt loam, and Swanton fine sandy loam. The majorities of the soils in the corridor within Durham are well drained or poorly drained, which is consistent with the number and extent of wetlands delineated within the town.

Town of Newington

Similar to the soils mapped within Durham, the soils mapped within the project corridor in the Town of Newington are predominantly fine or very fine sandy loam or silt loams. Examples include Pennichuck Channery very fine sandy loam, Boxford silt loam, Scitico silt loam, and Hoosic gravelly fine sandy loam. Urban land and complexes that include urban land are also present in modest quantities. The majority of the soils in Newington are mapped as partially hydric or of unknown hydric nature.

City of Portsmouth

Only a very small portion of the Project is located within the City of Portsmouth. This area is predominantly mapped as a mix of the urban land-Canton complex and the Chatfield-Hollis-Canton complex. The latter is well drained and slopes range from three to 15 percent.

3.7 Vegetation Communities and Habitat Types

The SRP is located within the Coastal Plain ecological region of New Hampshire. The highest elevation along the project corridor is approximately 130 feet above sea level near the Madbury Substation. Based on the NHFG 2015 WAP cover type map and field observations, the undeveloped habitat cover types through which the Project passes consist mostly of Appalachian oak-pine forest, with smaller areas of wet meadow/shrub wetlands, grasslands, and temperate swamp (Map 4; Appendix A). The Appalachian oak-pine forests are found across the subtle ridges and rises within the landscape, with the depressions and low areas consisting mostly of larger wetland complexes.

The Appalachian oak and pine forests are common throughout southern New Hampshire on dry to dry-mesic glacial till soils and on sand plain features. Good examples of mesic Appalachian oak – hickory forests are known near Little Bay and have a mix of canopy species including white, black, scarlet and red oaks, shagbark hickory, white ash, white pine, and other species common in more northern portions of New Hampshire such as birches, maples and beech (Sperduto and Kimball, 2011). Understory species include Canada mayflower, poison ivy, wild sarsaparilla, and other low herbs and forbs.

The residential and open areas are planted with common landscaping species and lawn grasses and escaped ornamental species are common in close proximity to residential areas. Escaped invasive species were noted in many of the identified wetlands throughout the project corridor.

In natural habitats, the vegetation communities within the existing electric corridor frequently differed substantially from adjacent communities due to the routine vegetation management typical of utility corridors. Under the existing electric lines, the vegetation was shrub and grasses as a result of periodic mowing in contrast with the adjacent forested communities. Common upland forest species found along the edge of the corridor included white pine (*Pinus strobus*), red and white oak (*Quercus rubra* and *Q. alba*), quaking aspen (*Populus tremuloides*) and gray birch (*Betula populifolia*). The size of trees varied from mature to early successional depending on the adjacent land use. Common shrub species within upland areas included glossy and common buckthorn (*Rhamnus frangula* and *R. cathartica*), multi-flora rose (*Rosa multiflora*), sumacs (*Rhus* spp.), barberries (*Berberis* spp.), honeysuckles (*Lonicera* spp.) and dogwoods (*Cornus* spp.). Many of these species are non-native invasives in New Hampshire. Clovers (*Trifolium* sp.), hayscented fern (*Dennstaedtia punctilobula*), sweet fern (*Comptonia peregrina*), goldenrods (*Solidago* spp.), common juniper (*Juniperus communis*), raspberries and blackberries (*Rubus* spp.), little bluestem (*Schizachyrium scoparium*), and plantain species (*Plantago* sp.) were frequently noted upland herbaceous plants in the maintained portion of the corridor.

Wetlands identified within the project corridor were generally dominated by both scrub-shrub and emergent (herbaceous) plant species (Section 3.2). Common woody species include red maple, glossy buckthorn, silky dogwood (*Cornus amomum*), speckled alder

(*Alnus incana*) and several meadowsweet (*Spiraea* sp.) species. Herbaceous species included sedges (*Carex* sp.), cattails (*Typha* sp.), several hydrophytic fern species including sensitive (*Onoclea sensibilis*), cinnamon and interrupted varieties (*Osmunda cinnamomea* and *O. claytoniana*), rushes (*Scirpus* sp.), and other species such as tearthumb (*Polygonum* sp.), asters (*Symphyotrichum* sp.), and purple loosestrife (*Lythrum salicaria*), which is an invasive species. Trees were observed within the wetland along the edges of the corridor, including red maple (*Acer rubrum*), swamp white oak (*Quercus bicolor*), and cedar (*Thuja* sp.).

One State-listed plant species, *Carex cristatella,* and four Exemplary Natural Communities or Natural Community Systems were documented within the project corridor: *High salt marsh (shallow peat variant)*, *Salt marsh system*, *Sparsely vegetated intertidal system* and *Subtidal system.*. No federally listed rare plant species were observed within the SRP corridor. See the *Rare, Threatened, and Endangered Species and Exemplary Natural Community Report* for more information.

3.8 Wildlife Habitat and Wildlife

Transmission corridors in general are known to provide suitable habitat for a variety of wildlife species, including mammals, birds, reptiles, amphibians, and invertebrates. Species with small home range requirements may use a portion a corridor as their primary habitats. Animals with larger home ranges may use a corridor as a part of their overall home range, or as a travel/dispersal corridor. Transmission corridors may also provide intrinsic habitat value as a relatively undeveloped habitat area in locations were the surrounding land use consists of commercial, institutional, and/or residential development.

An evaluation of the wildlife habitat for the project corridor was conducted using aerial photography and other GIS data combined with site visits in specific locations. The lands surrounding the SRP have a low to moderate amount of development, including some protected conservation lands, substantial areas of low density residential development, and some areas of higher intensity development associated with Durham and Newington/Portsmouth. The undeveloped areas and low density residential areas are primarily forested while the vegetation maintenance practices conducted in the existing cleared corridor create grass and/or shrubby habitat types. Shrublands and grasslands are a required resource for many types of wildlife and are also relatively rare in New Hampshire's predominantly forested landscape. Although narrow (approximately 60 feet wide), the existing cleared corridor provides some relatively valuable habitat resources for grassland/shrubland species, and may also provide a dispersal corridor for species that depend on grassy and/or shrubby habitats.

The SRP corridor crosses though some areas designated as Highest Priority Habitat by the WAP (Map 5). The remainder of the corridor passes primarily though areas that are designated as Supporting Landscapes or that have no designation at all. The relative proportion of these habitat types in the corridor reflects their wider distribution in the surrounding landscape.

In late fall, Great Bay typically hosts large numbers (>500) of migrating Canada geese and black ducks, as well as smaller numbers (<100) of other diving and dabbling ducks, shorebirds and seabirds. These birds use a variety of areas around the bay and are not likely resource constrained.

Portions of the SRP corridor are in the vicinity of state-listed rare wildlife species, including New England cottontail, northern long-eared bat, northern black racer, Blandings turtle, spotted turtle, and ringed boghaunter, among others. While a number of these species may use the corridor for portions of their life cycle, the New England cottontail is dependent on early successional habitat such as shrub and grasslands and is declining throughout its range as these habitats mature or are developed. PSNH is actively working with NHFG to manage electric corridors to benefit New England cottontail. The SRP corridor passes through UNH's Foss Farm and NHFG's LaRoche Brook parcel, both of which are being actively managed for this species. The SRP corridor clearing will supplement that habitat and provide a connective route for the rabbit to disperse to other suitable habitats. See the *Rare, Threatened, and Endangered Species and Exemplary Natural Community Report* for more information.

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Appendices

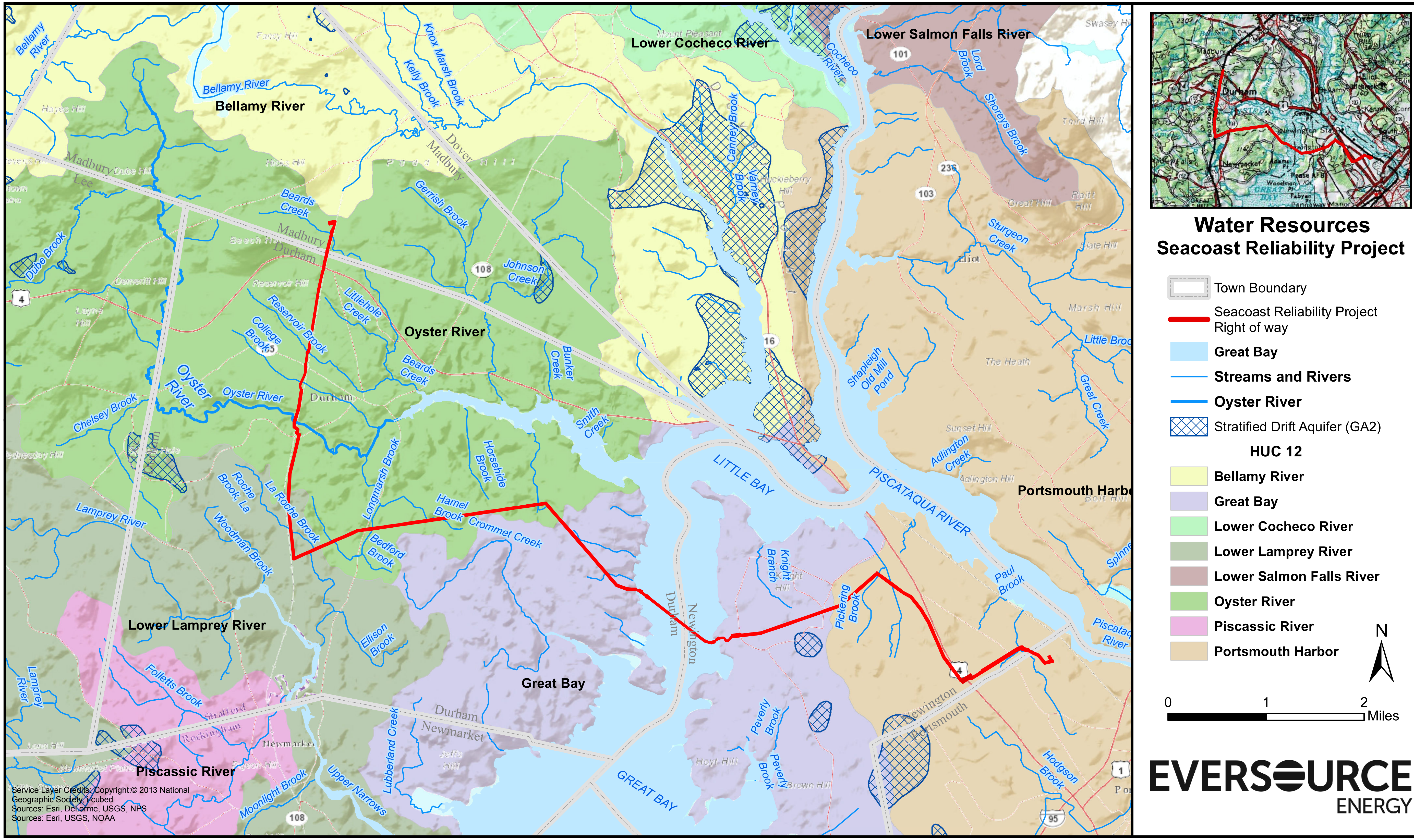
Appendix A. Maps

Map 1: Water Resources

Map 2: Wetland and Stream Map

Map 3: Conservation Land

Map 4: NH Wildlife Action Plan (WAP) Communities



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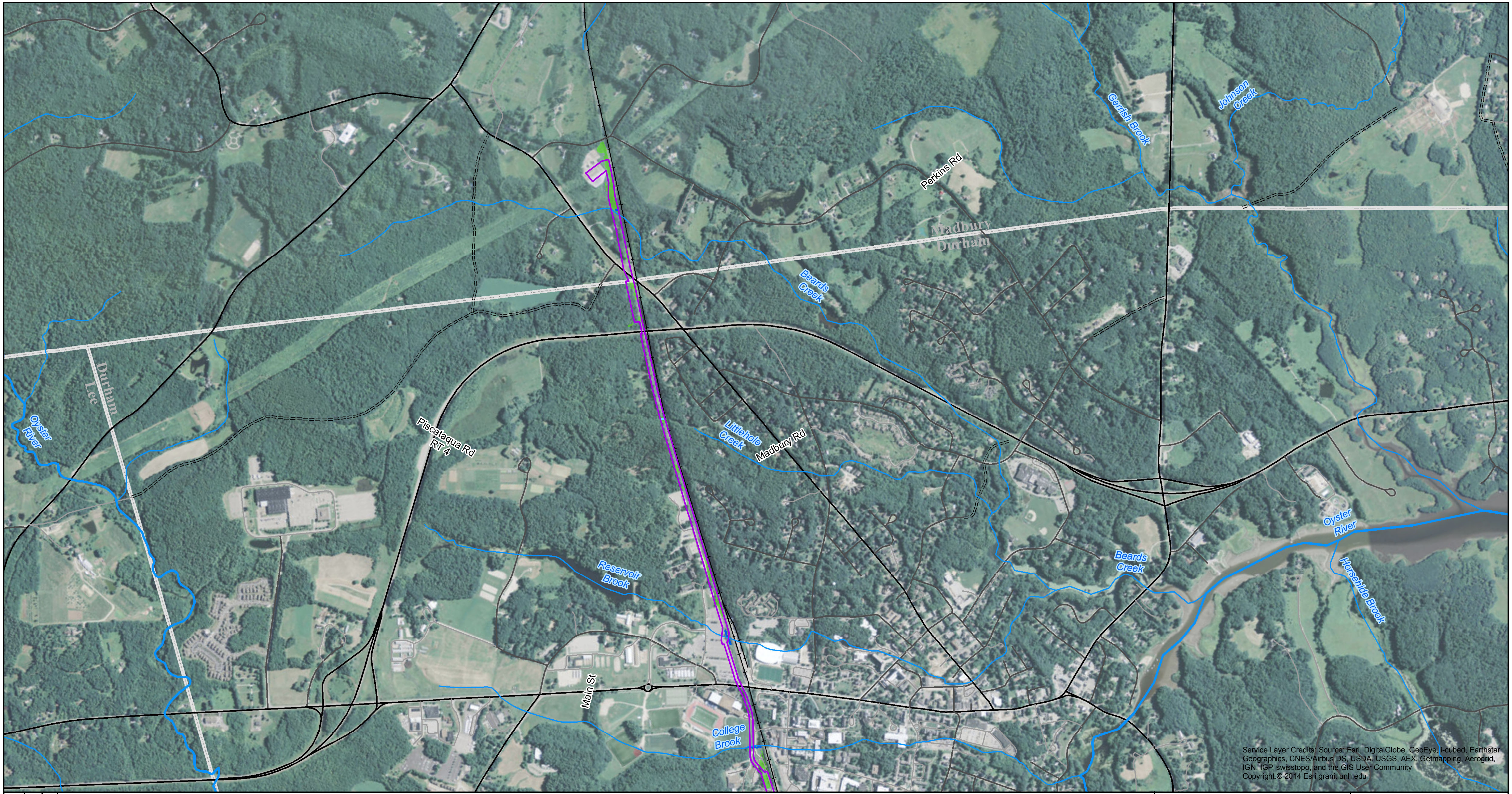


Project No: 22240.113

Drawn By: wmccloy

Date : 12/22/2015

SRP Project Area/ROW

Town Boundary

Roads

- Local
- Not Maintained
- Private
- State

Wetlands

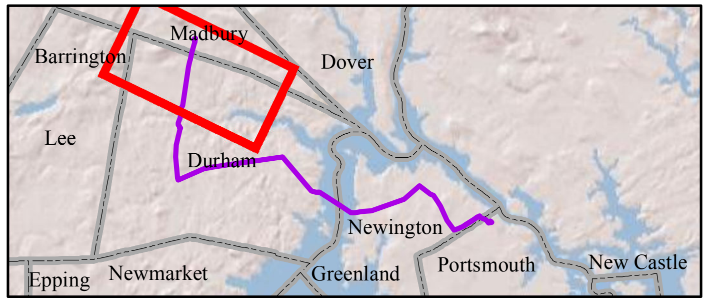
- Not Prime
- Prime
- River Stream
- Ephemeral Stream
- Intermittent Stream
- Perennial Stream

NHD Flowline

- Streams and Rivers
- Oyster River

N E S W

0 0.25 0.5 Miles



EVERSOURCE ENERGY

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Seacoast Reliability Project

Wetlands And Streams

Page 1 of 4

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Project No: 22240.113
Drawn By: wmccloy
Date : 12/22/2015

SRP Project Area/ROW
Town Boundary

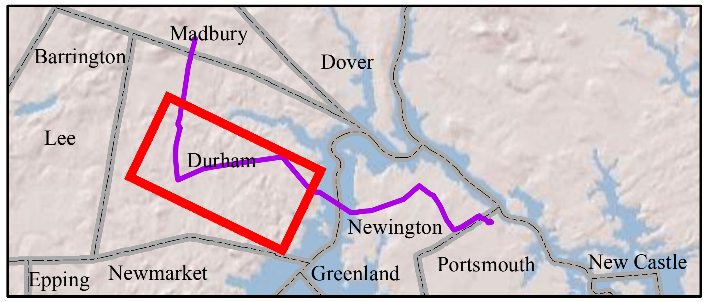
Roads
- Local
- Not Maintained
- Private
- State

Wetlands
- Not Prime
- Prime
- River Stream
- Ephemeral Stream
- Intermittent Stream
- Perennial Stream

NHD Flowline
- Streams and Rivers
- Oyster River

N E S W

0 0.25 0.5 Miles



EVERSOURCE ENERGY

NORMANDEAU ASSOCIATES Environmental Consultants

Seacoast Reliability Project

Wetlands And Streams

Page 2 of 4

Path: J:\Projects\PSNH_F107\MXD\PS_107_Wetlands_Map_040815.mxd

Date : 12/22/2015
Drawn By: wmccloy
Project No.: 22240.113

SRP Project Area/ROW
Town Boundary

Roads

- Local
- Not Maintained
- Private
- State

Wetlands

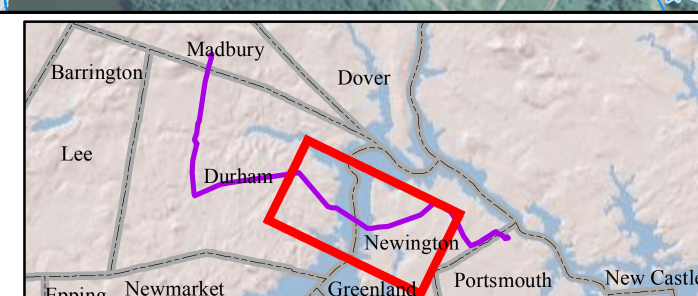
- Not Prime
- Prime
- River Stream
- Ephemeral Stream
- Intermittent Stream
- Perennial Stream

NHD Flowline

- Streams and Rivers
- Oyster River

N E S W

0 0.25 0.5 Miles



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NORMANDEAU ASSOCIATES Environmental Consultants

Seacoast Reliability Project

Wetlands And Streams

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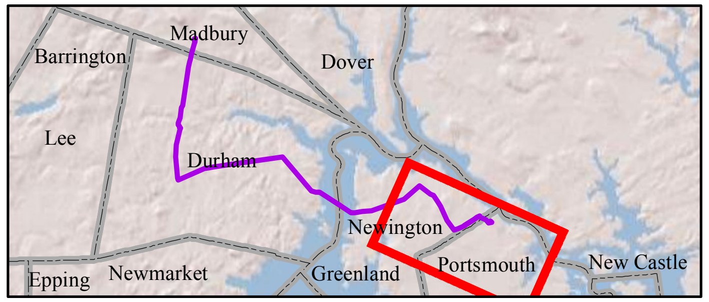

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Seacoast Reliability Project

Wetlands And Streams

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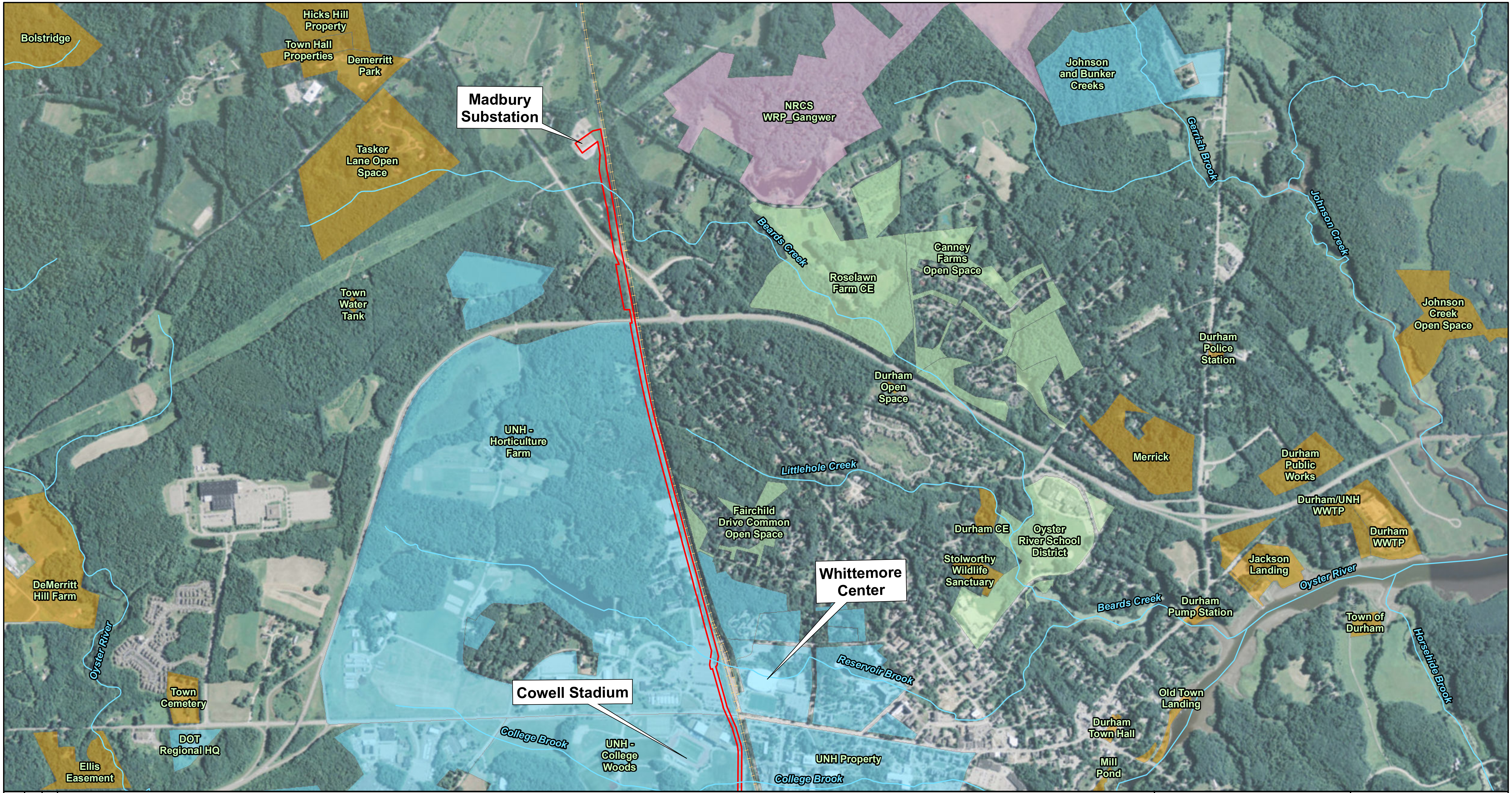

Project No: 22240.113

Drawn By: wmccloy

Date: 12/22/2015

Conservation Lands

- Municial/County
- Federal
- State
- Private
- Streams and Rivers
- Railroads

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
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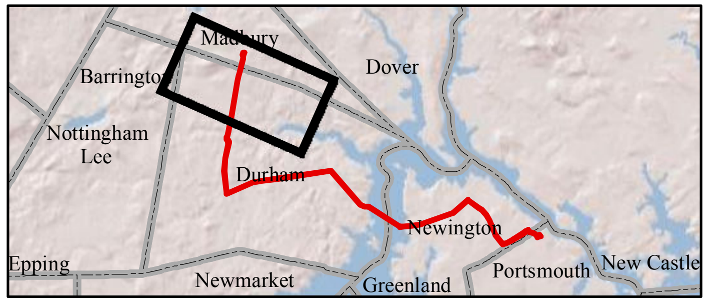
N E S W

0 600 1,200 Feet



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Seacoast Reliability Project

Conservation Mapping

Page 1 of 4

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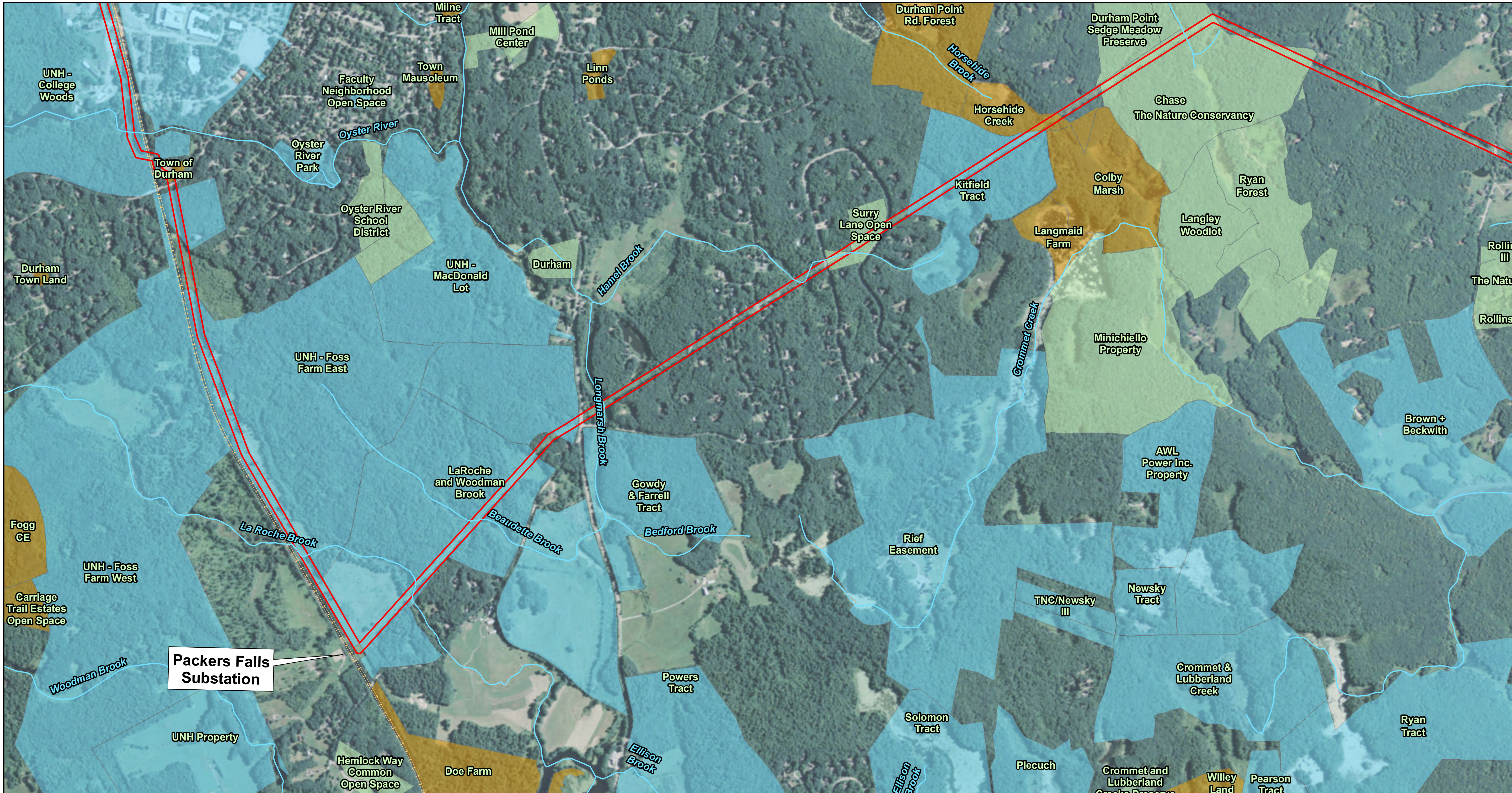

Project No: 22240.113

Drawn By: wmccloy

Date : 12/22/2015

Conservation Lands

- Municial/County
- State
- Private
- Streams and Rivers
- Railroads

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
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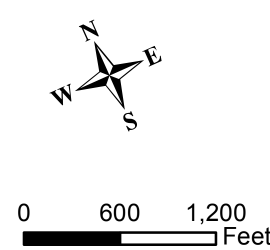

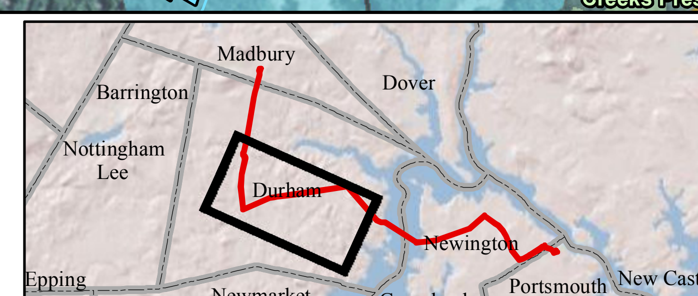

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Seacoast Reliability Project

Conservation Mapping

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Path: J:\Projects\PSNH_F107\MXD\PS_107_Conservation_022515 mxd

Project No: 22240.113

Drawn By: wmccloy

Date: 12/22/2015

Conservation Lands

- Municial/County
- Federal
- State
- Other Public/Quasi-Public Entity
- Private
- Streams and Rivers

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
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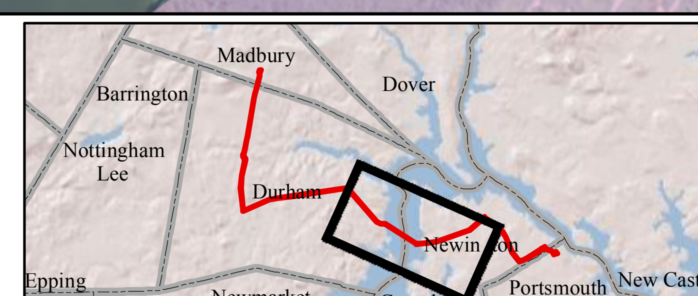
0 600 1,200 Feet



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Seacoast Reliability Project

Conservation Mapping

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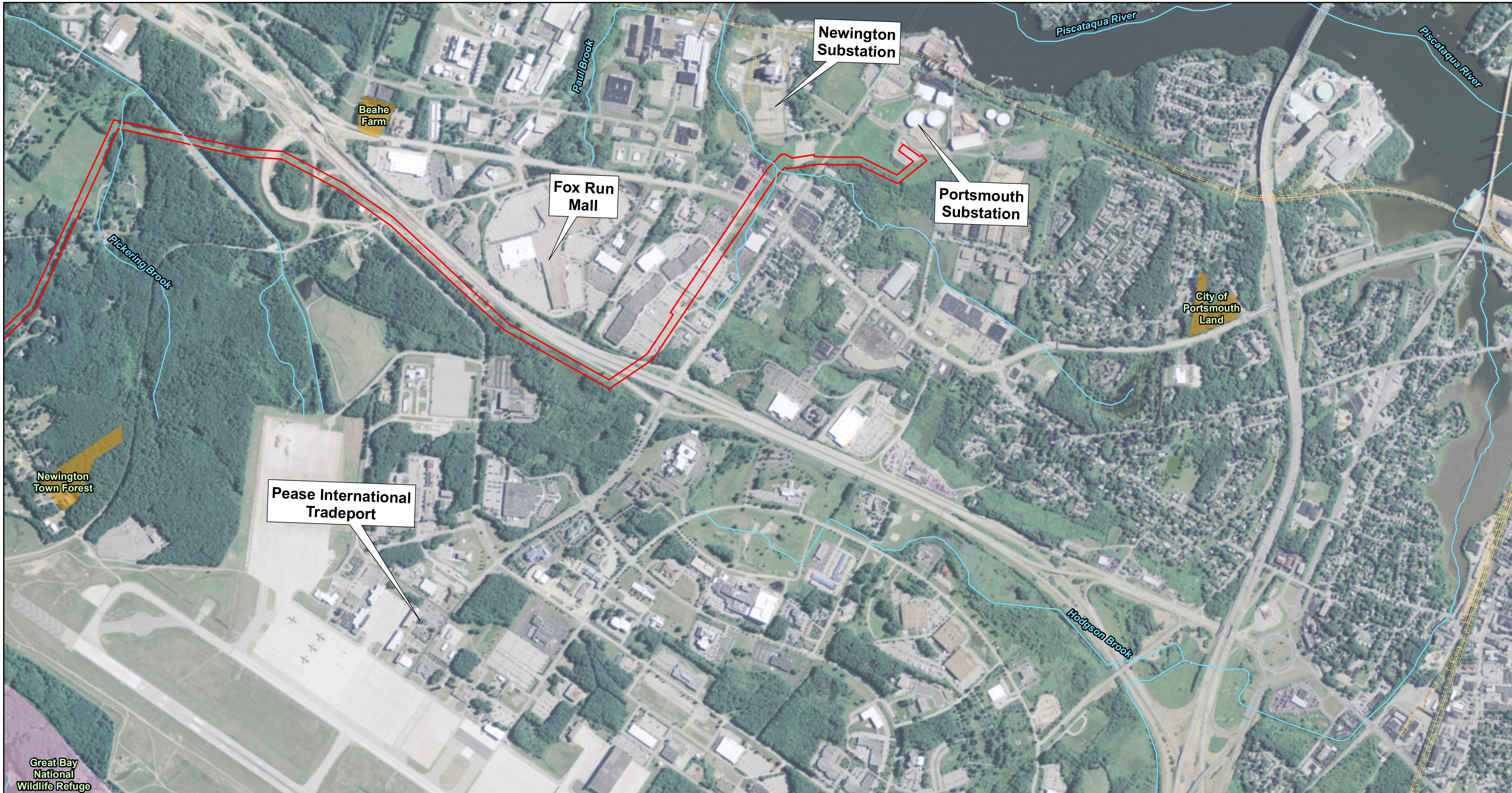

Date : 12/22/2015
Drawn By: wmccloy
Project No: 22240.113

Conservation Lands
- Municial/County
- Federal
- Streams and Rivers
- Railroads

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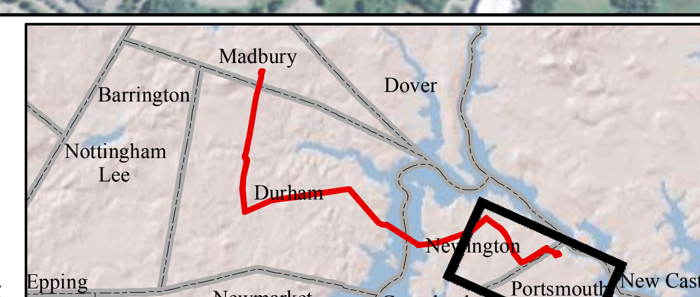
N E S W

0 600 1,200 Feet



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Seacoast Reliability Project

Conservation Mapping

Page 4 of 4

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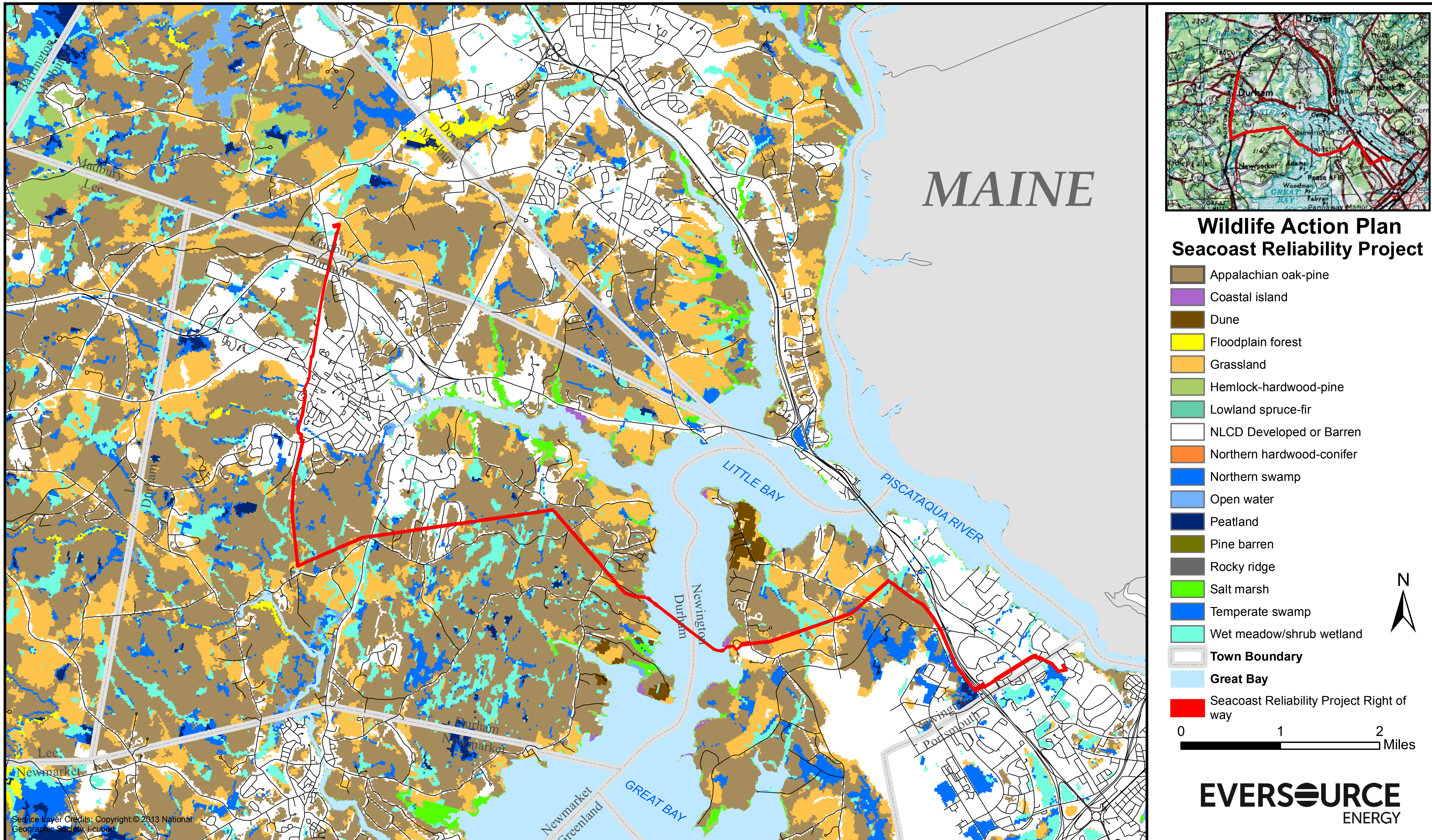

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Appendix B. Summary Tables

Wetland ID	Cowardin Class	Area (SF)	Town	Functions and Values^												
				GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
DNW2 (Subtidal)	E1UB	259,459	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DNW2 (Salt Marsh)	E2EM	9,047	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DNW2 (Rocky Shore)	E2RS	15,636	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DNW2 (Intertidal Flats)	E2US	278,668	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DW1	PEM1/PSS1	18,663	Durham	S	S	S	S	S	S	S	S	-	S	-	S	-
DW2	PEM1E	51,456	Durham	P	-	-	-	-	S	-	P	-	-	-	S	-
DW4	PEM1J	6,829	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW5	PSS1	18,121	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW6	PEM1E/PSS1E	35,338	Durham	S	S	-	S	-	P	S	P	-	-	-	S	-
DW7	PSS1	4,726	Durham	S	S	-	S	S	-	-	-	-	-	-	-	-
DW9	PSS1/PEM1	5,839	Durham	S	S	-	S	S	-	-	-	-	-	-	-	-
DW10	PSS1E/PEM1J	17,144	Durham	S	-	-	-	-	P	-	S	-	-	-	-	-
DW11	PEM1/PSS1	7,353	Durham	S	-	-	S	S	-	-	-	-	-	-	-	-
DW12	PSS1E/PEM1E	11,821	Durham	S	-	-	S	-	-	-	P	-	-	-	S	-
DW13	PSS1/PEM1	48,977	Durham	S	-	-	S	S	-	-	-	-	-	-	-	-
DW14	PEM1J/PSS1E	21,504	Durham	P	S	-	S	-	S	-	P	S	-	-	P	-
DW16	PEM1E	763	Durham	S	S	-	-	-	-	-	S	-	-	-	-	-
DW17	PSS1/PEM1	11,886	Durham	S	P	-	P	P	S	P	P	-	-	-	-	-
DW18	PSS1E/PEM1E	54,161	Durham	P	S	-	-	-	S	-	P	-	S	-	S	-
DW20	PEM1J	3,144	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW21	PSS/PEM	24,887	Durham	S	-	-	S	S	S	-	S	-	-	-	-	-
DW22	PSS1E/PFO14E	40,728	Durham	P	S	-	-	-	S	-	P	-	-	-	-	S
DW24	PSS1E/PEM1E	35,043	Durham	S	-	-	-	-	P	-	P	-	P	S	S	-
DW25	PEM/PSS	10,231	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW26	PEM1J	245	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW27	PSS1E/PEM1F	2,294	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW28	PEM1J	839	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW29	PEM/PSS	9,272	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW30	PSS1E/PEM1J	14,577	Durham	S	S	-	S	-	P	S	P	-	S	-	-	-
DW31	PEM	46,279	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW33	PEM/PSS	39,676	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW36	PSS1/PFO1	10,787	Durham	P	P	-	-	-	-	-	-	-	-	-	-	-
DW37	PEM/PSS	3,294	Durham	S	S	-	S	S	-	S	S	-	-	-	-	-
DW38	PSS1/PFO1	32,062	Durham	P	S	-	-	-	S	-	-	-	-	-	-	-
DW40	PSS1/PEM1	6,354	Durham	P	-	-	-	-	P	-	S	-	-	-	P	-

Wetland ID	Cowardin Class	Area (SF)	Town	Functions and Values^												
				GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
DW41	PEM/PSS/PUB	96,107	Durham	S	S	-	S	S	-	S	S	-	-	-	-	S
DW42	PSS1/PFO1	4,930	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW43	PSS/PFO	4,476	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW44	PEM1	7,145	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW45	PSS	7,812	Durham	S	-	-	-	-	-	-	S	-	-	-	-	-
DW47	PEM/PSS	23,061	Durham	S	S	-	S	S	-	S	S	-	-	-	-	-
DW48	PSS/PEM	14,505	Durham	P	P	-	-	-	S	P	S	-	-	-	-	-
DW49	PEM/PSS	3,533	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW50	PEM1	2,753	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW52	PSS1/PFO1/PEM1	18,865	Durham	P	-	-	-	-	S	-	-	-	-	-	-	-
DW54	PSS1	12,577	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW55	PSS	687	Durham	S	-	-	S	-	-	-	S	-	-	-	-	-
DW56	PEM1/PSS1	41,860	Durham	P	-	-	-	-	S	-	S	-	-	-	-	-
DW58	PSS1/PEM4	70,192	Durham	P	P	-	-	-	P	P	P	-	-	-	-	-
DW59	PEM/PUB	3,150	Durham	S	S	S	S	S	-	S	-	-	-	-	-	-
DW63	PSS/PEM	6,200	Durham	S	S	-	S	S	-	S	S	-	-	-	-	-
DW65	PEM	8,221	Durham	P	-	-	S	S	-	-	-	-	-	-	-	-
DW67	PEM	15,266	Durham	P	S	-	S	S	-	-	S	-	-	-	-	-
DW69	PEM	7,574	Durham	P	S	-	P	S	-	-	S	-	-	-	-	-
DW71	PEM	163	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW72	PSS1	2,527	Durham	-	-	-	S	S	-	-	-	-	-	-	-	-
DW73	PSS1/PEM1	1,098	Durham	S	S	S	S	S	-	S	-	-	S	-	-	-
DW74	PFO1/SS1	2,795	Durham	S	P	-	S	S	-	S	-	-	-	-	-	-
DW76	PSS1	12,237	Durham	S	-	-	-	-	-	-	-	-	-	-	S	-
DW77	PSS1	9,755	Durham	P	-	-	P	-	-	-	-	-	-	-	-	-
DW78	PSS1	139	Durham	P	-	-	P	P	-	-	-	-	-	-	-	-
DW79	PSS1	2,189	Durham	S	-	-	S	S	-	-	-	-	-	-	-	-
DW80	PSS1	5,966	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW91	PSS1	4,177	Durham	S	S	-	-	-	-	S	S	-	-	-	-	-
DW93	PSS1	4,637	Durham	P	-	-	-	-	P	-	-	-	-	-	-	-
DW94	PSS1	12,802	Durham	S	-	-	S	-	S	-	-	-	-	-	-	-
DW100	PEM1E	6,571	Durham	S	S	-	P	-	-	-	-	-	-	-	-	-
DW101	PEM1/SS1E	3,219	Durham	S	-	-	S	-	-	-	S	-	-	-	-	-
DW102	PSS1E	5,043	Durham	-	-	-	S	-	-	-	-	-	-	-	-	-
DW103	PSS1/EM1B	12,099	Durham	P	-	-	S	S	S	-	S	-	-	-	-	-

Wetland ID	Cowardin Class	Area (SF)	Town	Functions and Values^												
				GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
DW104	PSS1/EM1E	874	Durham	P	-	-	S	S	-	-	-	-	-	-	-	-
DW105	PFO1E	1,227	Durham	S	-	-	S	S	S	-	S	-	S	-	-	-
MW1	PSS1	8,078	Madbury	P	-	-	-	-	P	-	-	-	-	-	-	-
MW2	PEM1/PSS1	74,736	Madbury	P	P	P	-	-	P	P	P	-	P	-	P	-
NW1*	PEM1/SS1	75,679	Newington	S	P	-	P	P	P	-	-	-	-	-	S	-
NW3	PEM1/SS1	80,336	Newington	S	P	-	S	S	-	S	-	-	-	-	-	-
NW4	PSS1E/PUB3/PFO14E	48,442	Newington	S	S	-	P	S	S	-	P	-	-	-	S	-
NW6	PSS1C	13,332	Newington	S	P	-	S	-	P	S	P	-	-	-	-	-
NW9	PEM1	44,940	Newington	P	-	-	S	-	-	-	-	-	-	-	S	-
NW10	PSS1E/PEM1E/PFO1B	31,671	Newington	P	-	-	-	-	-	-	P	S	-	-	-	-
NW11	PSS1/PEM1	38,909	Newington	P	P	-	P	P	P	-	S	-	-	-	S	-
NW12*	PSS1E/PEM1E	30,058	Newington	S	S	-	S	-	P	S	P	-	-	-	-	-
NW13	PEM1/PUB	16,815	Newington	S	S	-	S	S	S	S	P	-	-	-	S	-
NW16	PEM1F/PSS1E	47,505	Newington	P	S	-	S	-	S	-	P	-	S	-	S	-
NW17*	PSS1	12,715	Newington	P	-	-	S	S	S	-	-	-	-	-	-	-
NW18	PEM1J/PSS1J	7,003	Newington	S	-	-	P	-	-	-	S	-	-	-	-	-
NW19	PEM1	578	Newington	S	-	-	-	-	S	-	-	-	-	-	-	-
NW20	PEM1J	1,929	Newington	P	-	-	S	-	-	-	S	-	-	-	-	-
NW21	PEM1	6,666	Newington	S	-	-	-	-	-	-	-	-	-	-	-	-
NW22	PFO1E/PSS1E	10,953	Newington	P	-	-	-	-	-	-	S	-	-	-	-	-
NW24	PEM1F/PSS1E/PFO1E	18,186	Newington	S	-	-	S	-	P	-	P	-	-	-	-	-
NW26	PSS1E	15,500	Newington	P	-	-	S	-	-	-	S	-	-	-	-	-
NW28	PEM1J	39,285	Newington	P	-	-	S	-	-	-	-	-	-	-	-	-
NW30	PEM1J	13,978	Newington	S	-	-	-	-	-	-	-	-	-	-	-	-
NW32	PEM1J	11,001	Newington	S	-	-	-	-	-	-	-	-	-	-	-	-
NW34*	PSS1E/PUBb	23,065	Newington	P	S	S	S	-	S	S	P	-	-	-	-	-
NW35	PEM1/SS1/FO1B	8,824	Newington	P	S	-	P	P	-	-	P	-	-	-	-	-
NW37	PEM1/SS1E	33,462	Newington	P	P	S	P	P	P	P	P	-	-	-	-	-
NW39	PEM1/SS1E	2,472	Newington	P	P	-	P	P	P	P	P	-	-	-	-	-
NW41	PEM1E	4,114	Newington	P	P	-	P	P	P	S	S	-	-	-	-	-
NW42	PEM1/UB1E	7,736	Newington	P	P	-	P	P	S	S	P	-	-	-	-	-
NW43	PEM1B	9,495	Newington	P	S	-	P	P	-	S	S	-	-	-	-	-
NW44	PEM1E	4,194	Newington	P	S	-	P	P	S	S	P	-	-	-	-	-
NW45*	PEM1/SS1B	27,199	Newington	P	P	-	P	P	-	-	P	-	-	-	-	-
NW100	PEM1E	6,727	Newington	S	S	-	P	-	-	-	S	-	-	-	-	-

Wetland ID	Cowardin Class	Area (SF)	Town	Functions and Values^												
				GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
NW102	PEM/PFO/PSS	33,836	Newington	S	-	-	S	S	-	-	-	-	-	-	-	-
NW104	PEM	716	Newington	S	S	-	S	S	-	-	-	-	-	-	-	-
NW105	PEM	3,070	Newington	S	-	-	S	S	-	-	-	-	-	-	-	-
NW106	PEM/PSS	6,017	Newington	S	S	-	S	S	-	-	-	-	-	-	-	-
PW1	PEM/PSS	2,440	Portsmouth	S	-	-	S	S	-	-	-	-	-	-	-	-
PW2	PEM1/SS1/FO1B	51,333	Portsmouth	P	S	-	S	S	-	-	P	-	-	-	-	-
PW3	PEM1B	2,132	Portsmouth	P	S	-	S	S	-	-	P	-	-	-	-	-
PW4	PEM1E	535	Portsmouth	P	S	-	P	P	-	-	S	-	-	-	-	-
PW5	PEM1/SS1E	2,760	Portsmouth	S	-	-	S	S	-	-	-	-	-	-	-	-

^ GW= Groundwater Recharge/Discharge; FF= Floodflow Alteration; FSH= Fish/Shellfish Habitat; STR= Sediment/Toxicant Retention; NUT= Nutrient Removal; PE= Production Export; SSS= Sediment/Shoreline Stabilization; WH= Wildlife Habitat; REC= Recreation; EDU= Education/Scientific Value; UH= Uniqueness/Heritage; VQ= Visual Quality/Aesthetics; RTE= Endangered Species

* Prime Wetland

PSNH Seacoast Reliability Project (SRP)
Stream Summary Table

Stream ID	Town	Flow Regime	Cowardin Class	Average Width (ft)	Length (ft)	Area (SF)
DS3	Durham	Perennial	R2UB2	5	278	2,016
DS8	Durham	Ephemeral	n/a	1	238	238
DS15	Durham	Intermittent	R4SB4	2	103	154
DS15A	Durham	Intermittent	R4SB4	3	294	881
DS19	Durham	Intermittent	R4SB4	2	344	688
DS32	Durham	Intermittent	R4SB4	3	139	416
DS34	Durham	Ephemeral	n/a	2	48	72
DS35	Durham	Perennial	R2UB4	4	144	575
DS39	Durham	Perennial	R2UB2	3	120	361
DS46	Durham	Perennial	R2UB2/4	5	222	1,110
DS51	Durham	Perennial	R2UB2	2	49	98
DS53	Durham	Perennial	R2UB2	45	428	6,887
DS57	Durham	Perennial	R2UB2	6	226	1,877
DS60	Durham	Perennial	R2UB3	7	189	1,323
DS61	Durham	Perennial	R2UB3	2	236	473
DS61A	Durham	Perennial	R2UB3	2	13	27
DS61B	Durham	Perennial	R2UB3	2	56	112
DS74	Durham	Perennial	R2UB2	5	220	1,100
DS75	Durham	Perennial	R2UB1/2	6	215	1,288
DS92	Durham	Intermittent	R4SB4	3	56	140
DS100	Durham	Ephemeral	n/a	1	65	65
MS1	Madbury	Perennial	R3UB2	4	56	225
NS5	Newington	Ephemeral	n/a	1	391	391
NS8	Newington	Intermittent	R4SB4	5	153	763
NS14	Newington	Ephemeral	n/a	3	115	288
NS36	Newington	Ephemeral	n/a	1	62	62
NS38	Newington	Perennial	R3UB3/4	2	506	1,011
NS40	Newington	Perennial	R3UB2	3	94	283
NS50	Newington	Intermittent	R4SB2	10	35	346
NS51	Newington	Perennial	R3RB2	6	119	712
NS101	Newington	Intermittent	R4SB4	1	61	61
NH107	Newington	Perennial	R2UB2	3	149	447

Appendix C. Wetland Photographs

Wetland NW11: Emergent and Scrub-Shrub Wetland

Wetland DW18: Emergent and Scrub-Shrub Wetland

Wetland DW41: Emergent and Scrub-Shrub Wetland

Wetland MW2: Emergent Wetland

Wetland DW41: Emergent Wetland with Cattail, Sedges and Ferns

Wetland DW67: Emergent Wetland with Cattail and Grasses

Wetland NW28: Emergent Wet Meadow Wetland

Wetland NW30: Wet Meadow with Sedges and Other Hydrophytic Herbs

Wetland NW15: Scrub-Shrub Wetland

Wetland NW26: Wetland that is Primarily Scrub-Shrub

Wetland NW34: Flooded Wetland with Unconsolidated Bottom and Emergent Cover

Wetland DW22: Wetland with Area of Predominantly Forested Cover

Wetland NW4: Wetland with Forested Areas along Edge of ROW

Wetland DNW2: Estuarine Wetland along Little Bay

Wetland DNW4: Estuarine Wetland along Little Bay with Saltmarsh Fringe
in foreground and Rocky Intertidal in background

Appendix C. Natural Resource Impact Assessment Report

Public Service of New Hampshire
Seacoast Reliability Project

Madbury, Durham, Newington & Portsmouth, NH

Natural Resource Impact Assessment

Prepared For:
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d/b/a Eversource Energy
780 North Commercial Street
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1.0 Project Description

Public Service Company of New Hampshire d/b/a Eversource Energy ("PSNH") is proposing to construct a new 115 kilovolt ("kV") transmission line between their existing Madbury and Portsmouth substations to enhance the electric reliability in the seacoast region. The Seacoast Reliability Project ("SRP") is proposed to be located in the Towns of Madbury, Durham and Newington as well as the City of Portsmouth, in Strafford and Rockingham Counties, New Hampshire. The SRP transmission line will be approximately 12.9 miles long, including a 0.9 mile crossing under Little Bay (Figure 1-1). It will be primarily located in an existing electric corridor, 12.0 miles of which will be a new transmission route, 0.9 miles will be in an existing transmission corridor. The corridor ranges from 50-300 feet wide, but is predominantly 100 feet wide. For most of the length of the corridor, a mowed area approximately 60 feet in width has been maintained by PSNH in support of the existing electric distribution line. The edges of the corridor are unmaintained and frequently support forest which will need to be cleared for the SRP. The cable crossing proposed in Little Bay will affect a corridor approximately 100 feet wide within a charted Cable Area approximately 1,000 feet wide.

2.0 Proposed Work

PSNH has designed the SRP to avoid environmental impacts where possible. Extensive environmental surveys were conducted by an experienced team of consultants and in consultation with the regulatory agencies. Detailed descriptions of the various natural resources in Little Bay are included in the Natural Resource Existing Conditions Report (see Appendix), Rare, Threatened and Endangered Species and Exemplary Natural Communities Report (see Appendix) the Essential Fish Habitat Report (see Appendix), and the Modeling Sediment Dispersion from Cable Burial report (see Appendix) . The results of these studies were incorporated into the siting, design and construction aspects of the Project, resulting in a final design that avoids and minimizes environmental impacts to the greatest extent possible, while still achieving the goals of the Project. The resulting unavoidable impacts to natural resources are presented below.

The majority of the SRP will be constructed aboveground on overhead structures between about 65 and 120 feet in height. It will cross under Little Bay by being buried about 3.5-8 feet in the substrate using a combination of jet plow and hand-jet technology. For this crossing, the transmission line will be necessarily split into three cables to maintain the required transmissivity for the Reliability Project (Figure 2-1). East of Little Bay, the line will remain underground until it crosses Little Bay Road in Newington, after which it will emerge to cross overland until it terminates at Portsmouth substation. In most locations, the existing distribution line will be co-located on the new structures and the existing distribution structures will be removed. In several locations, the existing distribution line will be relocated outside of the project corridor and the new structures will carry the new transmission cables only. A short portion of an existing transmission line will be relocated to accommodate the new SRP alignment at The Crossings at Fox Run Mall in Newington.

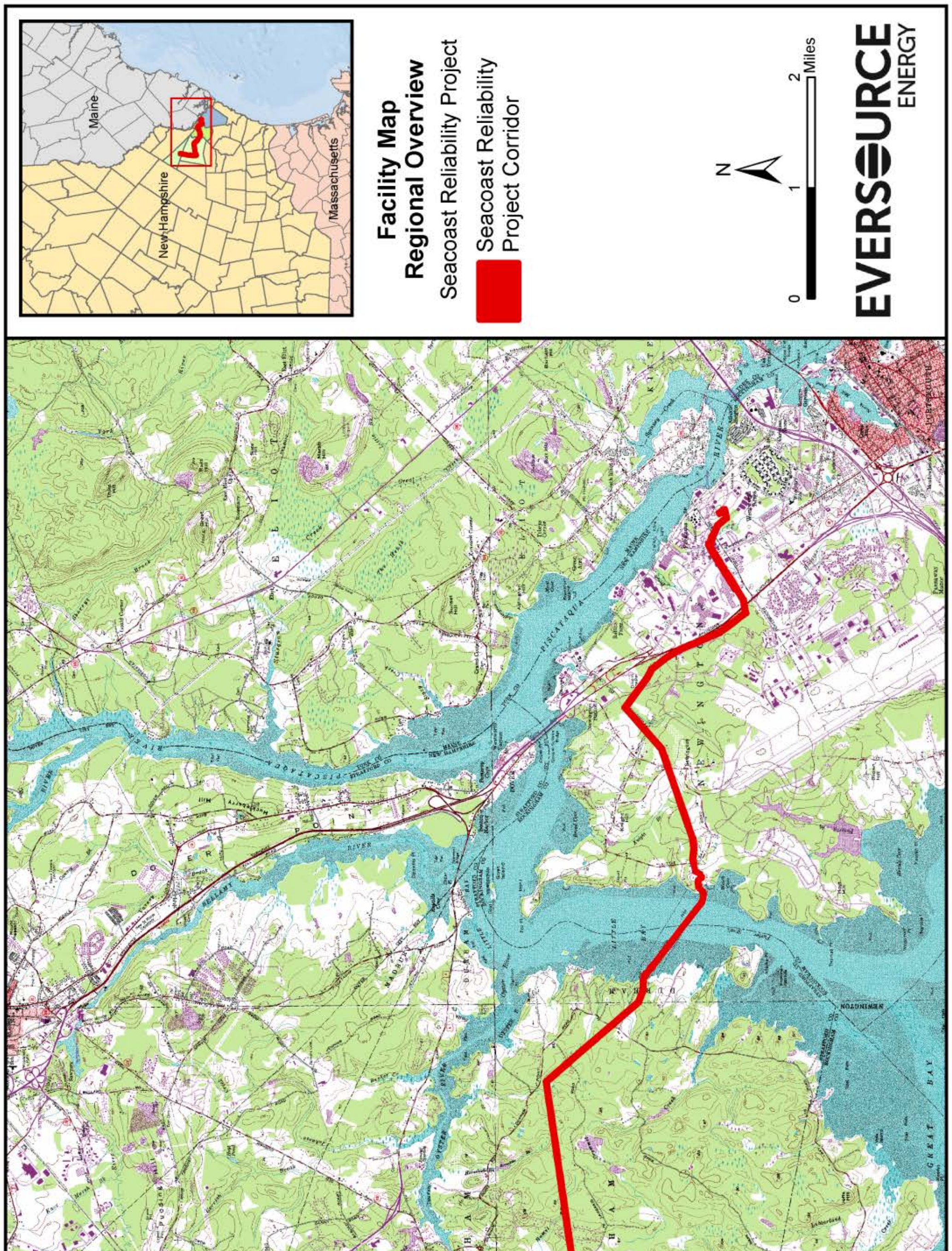

Figure 1-1. Seacoast Reliability Project location map.

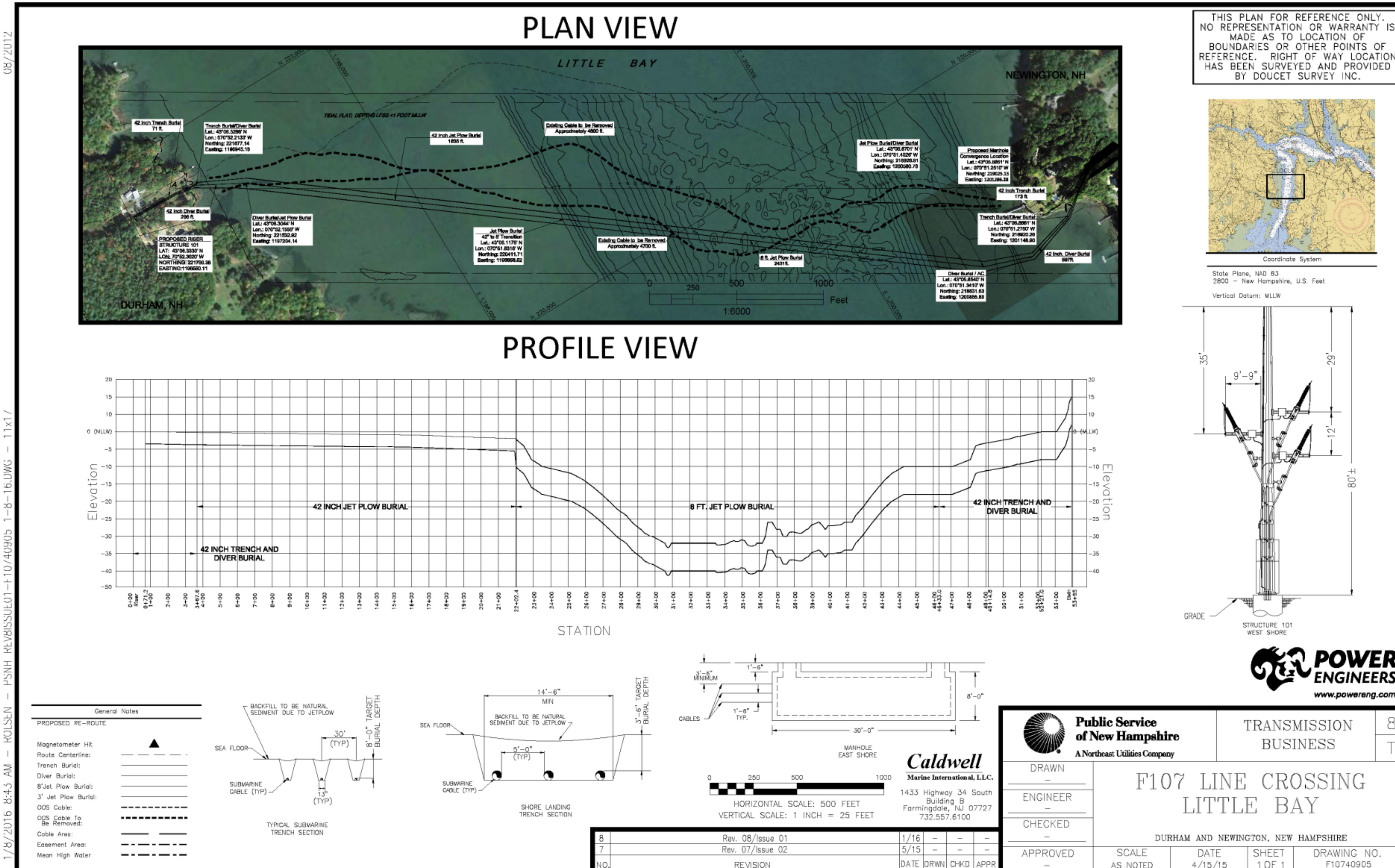

Figure 2-1. Little Bay cable crossing detail for the Seacoast Reliability Project

Substation improvements in Madbury and Portsmouth will be confined to the existing substation footprints. No other substation modifications are proposed.

The Project will result in minor permanent impacts and wetland conversion, plus temporary impacts during construction to both terrestrial and freshwater resources, as well as Little Bay. The following sections discuss the physical and biological components of those impacts in two sections: terrestrial and water resources (including estuarine wetlands), and estuarine resources, primarily effects to tidal waters in Little Bay. See the Natural Resource Existing Conditions Report in Appendices for a detailed description of each component.

3.0 Water Resource Effects

The impacts to freshwater and estuarine water resources, including wetlands and streams, are predominantly temporary (Table 3.0-1). Direct fill impacts have been avoided where possible, resulting in 792 square feet (0.02 acres) of permanent fill in freshwater wetlands; and 5,336 square feet (0.12 acres) of permanent fill in estuarine areas associated with Little Bay. Total proposed permanent impacts are 6,128 square feet (“SF”), or 0.14 acres. Permanent impacts to terrestrial areas are associated with new transmission line structures, their associated foundations,and relocated distribution structures. Permanent impacts to Little Bay are associated with concrete “mattresses” which are required by National Electrical Safety Code (“NESC”) Code (NESC Section 352D) to be laid over the submarine cables where the minimum burial depths (42 inches to the top of the cable) cannot be reached due to bedrock or other material. The articulated concrete mattresses provide protection to the cables from accidental and environmental contact/disturbances. The extent of the need for concrete mattresses will not be identified until the project is installed, but has been conservatively estimated for the permit application review. Permanent wetlands to streams and rivers have been avoided.

Temporary impacts to freshwater wetlands primarily result from timber matting to access structure sites, to clear trees and to establish work pads around proposed structures (304,053 square feet, 6.98 acres). Temporary estuarine wetland impacts result from open cut-and-cover in the salt marsh (1,222 square feet; 0.03 acres), and sediment disturbance during cable burial via jet plow and hand-jetting across the tidal flat and subtidal waters (271,984 square feet; 6.24 acres). Temporary impacts to streams are minimal and limited to 211 SF (104 linear feet) of temporary culverts where streams pass through proposed work pad areas and in one location where the underground line will be installed under College Brook in Durham via an open trench.

Indirect, or secondary, impacts are related to vegetation conversion (permanent tree removal) of forested or forest canopy covered wetlands and upland clearing within stream buffers. Clearing is proposed within 317,800 SF (7.30 acres) of forested or forest canopy covered wetlands and within 87,225 SF (2.00 acres) of upland areas within 100 feet of perennial streams, 50 feet of intermittent streams and 25 feet of ephemeral streams.

Table 3.0-1. Summary of Total Proposed Direct Permanent and Temporary Wetland Impacts by Town.

Town	Permanent (SF)	Temporary (SF)	Total (SF)
Madbury	199	29,261	29,460
Durham	3,764	325,627	329,391
Newington	2,165	221,520	223,685
Portsmouth	0	851	851
Total (Sq. Ft.):	6,128	577,259	583,387
Total (Acres):	0.14	13.25	13.39

As required by State and Federal regulations, the SRP design has avoided and minimized impacts to water resources wherever it was feasible and reasonable to do so. The following sections describe the avoidance and minimization measures, and the type and extent of the remaining unavoidable impacts.

3.1 Impact Avoidance

Permanent and temporary impacts to water resources were avoided where possible throughout the design and engineering phases of project development. Multiple rounds of preliminary design reviews were conducted between project engineering and environmental specialists. New structures were located outside of wetlands, unless technical constraints pertaining to project corridor limitations, structure height and maximum spans dictated that a structure be placed in a wetland resource. With the final design, 27 new structures, of the 180 proposed new or relocated transmission and distribution structures will be located within or partially within wetland areas and will result in permanent impacts.

Access routes and temporary work pads for construction were similarly reviewed and wetland crossings were avoided where possible. The required tree clearing along the edges of the existing corridor limited the amount of wetland avoidance; however other methods such as clearing during winter/frozen-ground conditions and hand cutting, may be employed to minimize temporary impacts associated with these activities (see below).

3.2 Impact Minimization

Engineering constraints limited the ability to avoid placing 27 new structures within or partially within wetland areas, thus wetlands have been avoided by approximately 85 percent of the 180 proposed new structures. Additionally, it should be noted that approximately 51 existing distribution structures will be removed from wetland areas by utilizing double circuit designs where necessary. The existing distribution line will be co-located on the same new structures below the new transmission lines. This will result in the net decrease of 24 structures within wetland areas.

Several steps are planned to minimize the extent of temporary impacts on protected areas, including wetlands. For the terrestrial portions of the Project, temporary impacts will be associated with construction access, access for corridor tree removal, access for the removal of existing structures, and construction work pads around new structures. Timber mats (approximately 16 feet long by 4 feet wide) will be utilized where necessary depending on the ground conditions during construction activities. Work will be performed where possible during frozen conditions and using low-ground pressure vehicles as practicable. To the extent feasible, access paths already present in the corridor will be utilized to avoid creating new routes and minimize wetland crossings. Additionally, timber mats will be placed on shrubs to reduce mat timbers sinking into wetland soils. Previous similar projects have found that the shrubs survive the short-term matting. Streams will be spanned with timber mats from bank to bank, with no permanent impacts anticipated.

Potential impacts to water quality related to the construction of the SRP were also considered during project planning and design. Erosion control measures including adherence to New Hampshire Department of Environmental Services ("NHDES") *Best Management Practices Manual for Utility Maintenance in and Adjacent to Wetlands and Waterbodies in New Hampshire* and applicable in ternal Best Management Practices ("BMP") associated with erosion control and clearing during transmission line construction will be strictly enforced. The NHDES manual includes 14 different BMPs that are detailed in Appendix A of thatdocument. BMP #1 through #13 are applicable to the access roads and work pad areas associated with the SRP, and will be utilized where needed.

In addition, the project alignment and all proposed work areas were reviewed to identify potentially high-risk sites for erosion and other soil disturbances associated with construction activities where enhanced BMPs may be needed in addition to those referenced in the applicable BMPs. These areas included steep upland slopes (generally >10 percent) that are located in close proximity to wetland and riparian resources where access roads or work pads are proposed. Minimal grading and gravel may be required in these locations to safely accommodate the required construction equipment. In addition to the standard BMPs, water bars will be installed on access roads that are located on steep (>10% slope) slopes and greater than 100 feet in length, with level spreaders located at the downslope end to disperse flow.

The identified high-risk sites are listed below, and identified on the Project's Environmental Mapping:

1. Proposed Structure #6 (Madbury): Steep slopes associated with Madbury Road up-gradient of Wetland MW1
2. Proposed Structures #13/14 (Durham): Steep slope north of Wetland DW91 and Stream DS92
3. Proposed Structures #28-#30 (Durham): Steep slopes to the north and south of the Oyster River (DS53) including small tributary streams (DS51, DS61, DS61A and DS61B) and multiple wetland areas (DW49, DW55, DW59, DW63)
4. Proposed Structure #47 (Durham): access road on steep slopes up-gradient of Wetland DW56
5. Proposed Structure #58 (Durham): access road and work pad on steep slopes up-gradient of Wetland DW31
6. Proposed Structures #66-#67 (Durham): access roads on steep slopes located immediately to the east and west of Wetland DW9

7. Proposed Structures #80-#81 (Durham): access road traverses steep side-slope up-gradient of Wetland DW42
8. Proposed Structures #82-#83 (Durham): steep access road immediately east of Structure #82 and up-gradient of Wetland DW38

Normandeau environmental monitors and PSNH construction monitors will be on site during construction to insure that the construction contractors follow the approved access plans and construction BMPs.

3.3 Impact Analysis

Unavoidable direct and secondary impacts to water resources and associated upland buffer areas were reviewed throughout the Project area. Direct impacts include permanent and temporary disturbances, as discussed above. Secondary impacts were also reviewed, including wetland conversion and upland clearing within perennial and intermittent stream buffers. Wetland conversion will occur where forested wetland areas within the SRP corridor are cleared to allow for the safe construction and operation of the proposed transmission line. Temporary direct impacts from timber matting to allow for mechanized clearing and construction of the transmission line may be necessary in these areas. These areas will not be stumped or grubbed and soil disturbance will be minimal. The forested wetlands will naturally convert to emergent or scrub-shrub resources following the clearing activities. Upland stream buffer tree removal within 100 feet of perennial streams, 50 feet of intermittent streams, and 25 feet of ephemeral streams was also quantified.

3.3.1 Direct Wetland Impacts

The SRP will impact greater than 20,000 square feet of tidal and non-tidal wetland and intersects with potential habitat for wetland-dependent threatened and endangered species. It is therefore classified as a Major project in accordance with Env-Wt 303.02(c) and Env-Wt 303.02(h).

Direct permanent wetland impacts associated with the SRP total 6,128 SF (0.14 acres). The breakdown of impacts by town and Cowardin cover class associated with the SRP is summarized in Table 3.3-1. A detailed table of individual wetland resources, cover classification, functions and values, and impacts is included in Appendix A of this report.

3.3.2 Direct Stream Impacts

Direct permanent impacts to streams have been avoided, with all structures located in upland or wetland areas. Direct temporary impacts to streams total 211 square feet (104 linear feet) (see Table 3.3-2). The majority of streams will be crossed using temporary mat bridges, with matting placed parallel to, but outside of each bank, and other matting placed perpendicular to these and over the stream. Three streams are located within work pad areas, and may need temporary culverts during construction activities. Temporary culverts will be sized based on appropriate guidelines to accommodate flows. These areas will be inspected and maintained throughout construction by an environmental monitor and the temporary culverts will be removed when no longer needed.

Table 3.3-1. Proposed Direct Permanent and Temporary Wetland Impacts by Cover Class and Town.

	# Wetlands	Permanent Impact (SF)	Temporary Impact (SF)	Total (SF)
Madbury				
PEM/PSS	1	199	28,940	29,139
PSS	1	0	321	321
Sub-Total:	***2***	***199***	***29,261***	***29,460***
Durham				
E1UB (Subtidal)	1	0	49,832	49,832
E2US (Mud Flat)	1	3,550	114,166	117,716
E2EM (Salt Marsh)	1	0	624	624
E2RS (Rocky Shore)	1	0	279	279
PEM (Emergent/Marsh)	5	71	31,185	31,256
PEM/PSS	23	60	72,663	72,723
PEM/PSS/PFO	1	0	807	807
PEM/PSS/PUB	1	20	18,285	18,305
PEM (Wet Meadow)	8	20	5,779	5,799
PFO	3	23	4,517	4,540
PSS	11	20	18,120	18,140
PSS/PFO	4	0	9,370	9,370
Sub-Total:	***60***	***3,764***	***325,627***	***329,391***
Newington				
E1UB (Subtidal)	1	0	77,565	77,565
E2US (Mud Flat)	1	1,484	29,925	31,409
E2EM (Salt Marsh)	1	0	598	598
E2RS (Rocky Shore)	1	302	217	519
PEM (Emergent/Marsh)	2	134	16,500	16,634
PEM/PSS	8	173	54,020	54,193
PEM/PSS/PFO	3	0	3,722	3,722
PEM/PUB	2	0	976	976
PEM (Wet Meadow)	5	41	13,829	13,870
PSS	3	20	8,854	8,874
PSS/PFO	2	0	4,131	4,131
PSS/PUB	1	11	10,063	10,074
PUB	1	0	1,120	1,120
Sub-Total:	***31***	***2,165***	***221,520***	***223,685***
Portsmouth				
PEM/PSS/PFO	1	0	648	648
PEM (Wet Meadow)	1	0	203	203
Sub-Total:	***2***	***0***	***851***	***851***
Total:	**SF**	**6,128**	**577,259**	**583,387**
	Acres	**0.14**	**13.25**	**13.39**

Additionally, one perennial stream in Durham, College Brook (DS74), is proposed to be crossed with an open trench associated with underground line construction. A short section of this stream will be temporarily relocated using coffer dams to divert water around the impact area during construction. The underground electrical conduit will be installed and the impacted portion of the channel will be reconstructed with native material and stream flow will be restored to its original channel. The area will be stabilized as needed to support the disturbed banks.

3.3.3 Secondary Wetland and Stream Impacts

Secondary impacts include wetland conversion from a forested canopy to scrub-shrub and emergent due to tree removal within wetlands and upland stream buffer tree removal within 100 feet of perennial streams, 50 feet of intermittent streams and 25 feet of ephemeral streams.

The majority of the existing legal corridor is 100 feet wide; however the width of currently cleared and regularly maintained area is on average 60 feet, although it varies from nearly the entire 100 feet width to as narrow as 30 feet. To safely accommodate the proposed transmission line while meeting the applicable clearances for 115kV and the co-located distribution lines, the entire corridor will need to be cleared of capable tree species to its full width. Capable species are those woody (tree) species that have the potential of growing to a height (typically 30 feet) that could pose a risk to the structures and conductor if they were to fall. Lower growing shrubs and herbaceous vegetation will not be cleared as they will not grow up to a height that could endanger the line. Minimum clearances from all vegetation must be maintained, and routine maintenance clearing according to PSNH's vegetation clearing procedures and practices is an important component of the SRP operation[1].

Wetland areas within the surveyed treeline boundary were quantified within each town (Table 3.3-3). Cleared wetlands will not be stumped or grubbed and PSNH will consult with individual landowners on the disposal of cut trees. The remaining logs and brush will be removed from wetlands and either sold or chipped for erosion control.

Stream buffers function to protect the riparian areas of streams from sedimentation by trapping runoff, erosion by binding the soils near and along stream banks, and providing shade to keep water cool and for cover, plus other habitat benefits for wildlife and aquatic organisms. Tree removal within wetland areas near streams is included in the forested wetland conversion calculation. Proposed tree clearing of upland areas within 100 feet of perennial streams, 50 feet of intermittent streams and 25 feet of ephemeral streams was quantified based on agency recommendations (Table 3.3-4). Cleared areas within these buffers will not be stumped or grubbed and ground disturbances will be limited to those associated with the logging equipment. Additionally, low-growing native shrubs and other species common within riparian buffers will not be removed. Over time, other shrub and low-growing woody species will colonize the cleared areas helping to enhance and restore stream functions.

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[1] Northeast Utilities, 2013. *Vegetation Clearing Procedures and Practices for Transmission Line Sections*. OTRM 230. Rev. 2 8/19/2013.

Table 3.3-2. Proposed Temporary Stream Impacts by Town and Flow Regime with Proposed Crossing Type.

Stream ID	Stream Type	Name	Temp. Impact (SF)	Temp. Impact (LF)	Crossing Type
Durham					
DS8	Ephemeral		0	0	Mat Bridge
DS32	Intermittent		0	0	Mat Bridge
DS34	Ephemeral		0	0	Mat Bridge
DS35	Perennial	Beaudette Brook	0	0	Mat Bridge
DS39	Perennial		0	0	Mat Bridge
DS46	Perennial	LaRoche Brook	0	0	Mat Bridge
DS51	Perennial		20	10	Temp. Culvert
DS60	Perennial	LaRoche Brook	0	0	Mat Bridge
D061	Perennial		0	0	Mat Bridge
DS74	Perennial	College Brook	146	49	Diversion, Trench & Mat Bridge
DS92	Intermittent		0	0	Mat Bridge
		Subtotal:	*166*	*59*	
Newington					
NS8	Intermittent		0	0	Mat Bridge
NS14	Ephemeral		0	0	Mat Bridge
NS36	Ephemeral		45	45	Temp. Culvert
NS50	Intermittent		0	0	Mat Bridge
NS107	Perennial		0	0	Mat Bridge
		Subtotal:	*45*	*45*	
		Total:	**211**	**104**	

Table 3.3-3. Forested Wetland Conversion by Town.

	Wetland Conversion (SF)	Wetland Conversion (acres)
Madbury	2,072	0.05
Durham	217,334	4.99
Newington	87,089	2.00
Portsmouth	11,305	0.26
Total (SF):	**317,800**	**7.30**

Table 3.3-4. Upland Stream Buffer Tree Removal by Town.

	Perennial Stream Buffer (SF)	Intermittent Stream Buffer (SF)	Ephemeral Stream Buffer (SF)	Total (SF)
Madbury	7,383	0	0	7,383
Durham	53,348	11,453	4,221	69,022
Newington	5,010	4,691	1,119	10,820
Portsmouth	0	0	0	0
Total (SF):	**65,741**	**16,144**	**5,340**	**87,225**
Total (Acres):	**1.51**	**0.37**	**0.12**	**2.00**

3.3.4 Vernal Pool Impacts

No vernal pools were identified within the SRP corridor and no impacts are anticipated.

3.3.5 Effects on Wetland Functions and Values

Permanent impacts to wetlands and streams were avoided and minimized wherever possible. The remaining unavoidable permanent impacts to terrestrial (palustrine) wetlands are relatively minor in extent (792 SF) and distributed across 27 structures in 24 wetlands. Table 3.3-5 summarizes the total proposed permanent impact to each principapal wetland function or value in each town. These data do not include functions or values that a wetland is classified as suitable for, as the wetland was not observed performing this function or value within or immediately adjacent to the ROW area. Additionally, because wetlands can have multiple principal functions or values, proposed permanent impacts to a given function or value will exceed the total permanent impact to each given wetland. Wetlands The functions most commonly associated with the permanently impacted wetlands include groundwater discharge, floodflow alteration, production export, sediment/toxicant retention and wildlife habitat. The small footprint of the new transmission line structures is not expected to affect the existing wetland functions or values. The impacted wetland areas are primarily located within an existing electric corridor and are already subject to periodic maintenance including clearing and other repair work. Temporary impacts are anticipated to have minimal adverse effects on the functions and values associated with the impacted wetland systems. Applicable construction BMPs, on-site monitoring, and restoration of temporarily impacted areas according to standards and based on agency recommendations will be employed (Section 4.0). More details on the expected impacts to the estuarine resources associated with Little Bay are included below (Section 5).

Table 3.3-5. Permanent Impacts to Principal Functions and Values for Wetlands in each Town.

Town	Groundwater Discharge	Floodflow Alteration	Fish/Shellfish	Sediment/Toxicant Retention	Nutrient Removal	Production Export	Shoreline/Sediment Stabil.	Wildlife Habitat	Recreation	Education/Scientific	Uniqueness/Heritage	Visual Quality/Heritage	RTE Habitat
Madbury	199	199	199	0	0	199	199	199	0	199	0	199	0
Durham	94	3,550	3,550	3,570	0	3,553	0	3,600	3,550	3,550	3,550	3,570	0
Newington	298	1,979	1,786	1,940	154	1,959	0	1,817	1,786	1,786	1,786	1,786	0
Portsmouth	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (SF):	**591**	**5,728**	**5,535**	**5,510**	**154**	**5,711**	**199**	**5,616**	**5,336**	**5,535**	**5,336**	**5,555**	**0**

*RTE: Rare, Threatened and Endangered

3.3.6 Temporary Impacts Restoration Plan

Wetland and upland areas temporarily disturbed for access road and structure replacement activities will be restored. The likely wetland restoration areas will be associated with the location of timber mats shown for the structures and access roads in wetlands on the construction plans. Once timber mats and other temporary wetland protections have been removed, any displaced or compacted topsoil will be smoothed or graded to match previous or adjacent soil elevations. Acquired upland and wetland topsoil or reused topsoil will be evaluated for project use in any areas requiring fill, and will be spread and moderately compacted to match adjacent grades. Areas with disturbed soils will be stabilized with upland or wetland seed mix of native and naturalized species along with annual ryegrass (for erosion control while the other seed germinates). Alternative seed mixes or stabilization methods may be negotiated with individual landowners for upland areas by the contractor, as long as these alternatives are equally protective of jurisdictional wetlands and waterbodies and do not introduce noxious or invasive species.

Areas of the fringing salt marsh that will be temporarily impacted by the underwater cable installation will be restored immediately following completion of the cable laying. Prior to construction, all salt marsh peat will be salvaged within the impact area and stockpiled for replacement during restoration. The stockpiled peat blocks will be protected and maintained for the duration of the installation period. Upon completion of construction, the underlying gravel substrates will be restored to match surrounding elevations. The peat blocks will be replaced and anchored with rebar stakes driven into the gravel and/or adjacent peat. Any open interstices between the peat blocks will be filled with a mixed sand to cover exposed roots and maintain grades. The seaward face of the restored peat will be protected from ice and wave action with a coir log.

All construction and restoration will be done under the supervision of the Engineer and an environmental monitor to ensure minimization of impacts to native vegetation and wildlife, and that all disturbed areas are stabilized.

The environmental monitor will assure compliance with permit conditions during and after the construction activities, including one year of post-construction corridor monitoring after one full growing season, and preparation of the appropriate compliance reports for submittal to NHDES. The monitoring will include a site inspection, vegetation cover estimates in restored wetlands and uplands by species in random plots, photographs, and wildlife observations. Areas with less than 80% cover at the end of the growing season will require additional seed or other appropriate enhancements. Any areas with erosion will be repaired immediately. Non-biodegradable erosion control materials will be removed as soon as they are no longer necessary. Other potential maintenance issues, such as erosion gullies or vandalism, will be documented and reported immediately to PSNH for repair.

Restored areas will be monitored for invasive species. Potential invasive species on this site include purple loosestrife, glossy and smooth buckthorn, bittersweet, multiflora rose and autumn olive among others. Invasive plants will be pulled and removed from restoration areas and disposed of in a manner and location to preclude their survival or spread. PSNH has a maintenance mowing protocol that encourages native shrubs while removing capable trees and non-native species. A monitoring report will be submitted to NHDES by November 1 of the year following construction impacts.

4.0 Compensatory Wetland Mitigation

Compensatory mitigation is proposed for unavoidable impacts to permanent wetland fill, and conversion of forested wetlands as a result of tree clearing. The first steps in mitigating wetland impacts are to avoid and minimize impacts. This has been a key component of the design for SRP project. The Project design team has worked with engineers and scientists to make design changes in order to avoid and minimize wetland impacts wherever possible (Sections 3.1 and 3.2)

Permanent direct wetland impacts are below the NHDES threshold for mitigation (10,000 SF of permanent wetland impact). . Secondary impacts due to tree removal are in accordance with applicable U.S. Army Corps of Engineers ("USACE") regulations and guidance, howver, mitigation is proposed for direct and secondary Project impacts to wetlands and impacts to stream buffers.

SRP wetland resource impacts are currently calculated as 5,336 square feet of permanent estuarine impact, 792 square feet of permanent terrestrial wetland impact, 317,800 square feet of forested wetland conversion and 87,225 square feet of upland stream buffer clearing. Direct temporary impacts to streams total 211 square feet (104 linear feet). No vernal pool impacts occur. Mitigation ratios were applied to these anticipated impacts in accordance with the *New England Army Corps of Engineers Mitigation Guidance* document and in coordination with the USACE, and NHDES. A qualitative assessment of 13 wetland functions and values using the USACEHighway Methodology found that, while multiple functions were provided to some degree by most wetlands, the principal functions were the distinguishing features among the wetland types. The most common principal functions include: Groundwater Recharge/Discharge, Wildlife Habitat, Production Export, Sediment/Toxicant/Pathogen Retention, Floodflow Alteration and Nutrient Retention.

Because of the linear nature of the Project and its wetland resource impacts, high value within-project mitigation would be difficult. The Project includes four towns, multiple watersheds and a variety of freshwater and estuarine resources. During agency pre-application meetings, NHDES and USACE agreed that in-lieu fee payment into the State's Aquatic Resource Mitigation fund was potentially appropriate compensatory mitigation for a linear project such as the SRP. Mitigation ratios were applied to these anticipated impacts in accordance with the *New England Army Corps of Engineers Mitigation Guidance* document and in coordination with the USACE, and NHDES. Calculations for payment into the In-Lieu Fee program based on the types and extent of impacts by town are shown in Table 4.0-1. The dollar value shown in Table 4.0-1 may change during the review process with NHDES and USACE should design modifications result in changes in wetland impacts.

The Town of Durham provided a potential wetland restoration and upland buffer protection project, summarized below. The restoration concepthas merit for compensation for different aspects of wetland resource impacts by the SRP if the regulatory agencies concur.

Durham

The Town of Durham has proposed an environmental mitigation project to reduce the amount of erosion from the Wagon Hill Farm shoreline bordering the Great Bay Estuary and the Oyster River. Wagon Hill Farm is Town-owned conservation land consisting of 139 acres with 1100 feet of tidal frontage on the Little Bay, Oyster River and Smith Creek, and 8.5 acres of tidal and freshwater wetlands. The project proposes to stabilize the existing eroded portions of the shoreline, which is partially the result of uncontrolled foot traffic along the shoreline. The erosion has been exacerbated by natural conditions including wind, wave, ice action, and shading from mature trees on the bank. This erosion is continuing to degrade shoreline and salt marsh habitats and has negative impacts on wildlife, shellfish, and fish habitats. The erosion stabilization would include both stabilizing and restoring the shoreline, as well as further measures to halt foot traffic in the sensitive areas by re-designing nearby walking paths to discourage off-path travel, fences and viewing platforms on the adjacent upland. A second habitat protection effort is a footbridge proposed to be constructed over Davis Creek and adjacent wetlands to control off-path travel by people and pets.

The stabilization projects will help to protect the water quality and aquatic habitats of the local streams, adjoining bordering wetlands, and the Great Bay estuary including the adjacent Salt Marsh and Sparsely Vegetated Intertidal systems, both of which are Exemplary Natural Communities documented by NHNHB. Preliminary estimates suggest that approximately 700-900 square feet of salt marsh, plus approximately 1,100 linear feet of adjacent shoreline could be restored. Impacts to freshwater wetlands along Davis Creek are estimated as 500 square feet. The Town of Durham has recently partnered with UNH ecologists and DES coastal staff to develop strategies for restoring salt marsh and developing long-term stabilization along the shoreline.. This partnership will bring current and potentially innovative techniques to addressing erosion, controlling freshwater runoff, and protecting from human-caused destabilization.

The Wagon Hill Farm shoreline stabilization project provides the opportunity to mitigate for unavoidable permanent impacts caused by SRP structures in freshwater wetlands (approximately 700 square feet in Durham), potentially 2,500 square feet of impact from concrete mattresses on tidal flats, and clearing of freshwater wetlands and streams as a result of tree removal within the SRP project corridor. It also provides the opportunity to restore sections of deteriorated or fully eroded salt marsh, and would further reduce sediment loading into critical estuarine habitats. The project has been estimated to cost $370,000, including $340,000 for shoreline restoration, $10,000 for a bridge over Davis Creek, and $20,000 to stabilize and restore Davis Creek Point. The Town of Durham is anticipating that PSNH's contribution of approximately $170,000 would complete the project, in addition to $115,000 from the Lois Brown Trust and approximately $84,000 to be raised by the town. The Durham Selectmen and Budget Committee have approved this project as part of the 2016 annual budget, pending regulatory permit approval for the PSNH contribution. Additional detail on the project is provided in Appendix B of this report within a memorandum regarding *Environmental Mitigation Project along the Wagon Hill Farm Shoreline* prepared by the Town of Durham Department of Public Works.

PSNH will continue to work with applicable parties to develop a mitigation package that will be acceptable to NHDES and USACE.

Table 4.0-1. New Hampshire Aquatic Resource Mitigation (ARM) Fund Payment Calculation for Permanent and Secondary Wetland Impacts

Town	A: Secondary Impact: Forested Wetland Conversion (SF)	A1: Conversion Mitigation Area (15% of total area A)(SF)	B: Secondary Impact: Stream Buffer Clearing (SF)	B1: Conversion Mitigation Area (15% of total area B)(SF)	C: Permanent Impacts (SF)	Total Impacts for Mitigation by Town (SF) (Sum A1+B1+C)	ARM Payment (from NH DES ARM Fund Calculator by Town)[2] (USD)
Madbury	2,072	311	7,383	1107	199	1,617	$6,488.92
Durham (Freshwater)	217,334	32,600	69,022	10,353	214	43,167	$183,385.10
Durham (Tidal)	-	-	-	-	3,550	3,550	$30,162.72
Newington (Freshwater)	87,089	13,063	10,820	1,623	379	15,065	$66,079.42
Newington (Tidal)	-	-	-	-	1,786	1,786	$15,667.82
Portsmouth	11,305	1,696	0	0	0	1,696	$8,187.14
Total:	317,800	47,670	87,225	13,084	6,128	66,882	$309,971.11

[2] http://des.nh.gov/organization/divisions/water/wetlands/wmp/

5.0 Impacts in Little Bay

The three transmission cables will be installed across Little Bay within an area mapped as "Cable Area" on NOAA Chart 13825. The primary installation will involve sinking each cable to the desired burial depth using a jet plow (Figure 2-1). This process essentially softens sediments, lays the cable which sinks through the softened sediments, and buries the cable in one step. The jet plow functions by injecting pressurized water into the sediment to fluidize it, allowing the cable to settle below the bay floor to the required depth (3.5-foot burial on the tidal flats; 8-foot burial in the channel). The support barge and jet plow will not be able to reach the shoreline on either side, however. In these nearshore areas, the cable will be laid on the substrate surface and divers will use hand jets to lower the cable to the desired 3.5-foot burial depth (a total distance of approximately 880 feet [268 meters] per cable). Silt curtains will be placed surrounding the intertidal areas to be hand jetted or trenched to contain suspended sediments.

Within the jet plowing zone, each cable will disturb a rectangular area about 1-foot wide (the width of the plow blade) and about 4,266 feet (1,300 meters) long for a total direct surface disturbance of 4,266 SF (0.1 acre) per crossing or a total of 12,798 SF (0.3 acres) for all three cables. The jet plow installation will begin on the western tidal flat approximately 300 feet (95 meters) seaward of the shoreline and continue until approximately 580 feet (178 meters) west of the eastern landfall. For the majority of the length, the cables will be laid 30-feet apart on center, although as they near the shorelines they funnel together to rejoin. The wide separation is necessary to protect the cables because the physical constraints of the crossing will require a multipoint anchoring system on the installation barge.

Both the jet plowing and diver hand jetting will require the support of a barge. On the shallow tidal flats, the barge will be grounded for a period of time for each installation phase.

Additional underwater construction activity will include removal of sections of existing cables and other minor debris that could present obstacles to the jet plow. Four PSNH transmission cables from an earlier crossing currently lie on or within 24 inches of the sediment surface within the Cable Area. The cables are between 60 and 110 years old, and are largely intact on the seafloor. PSNH attempted to remove the cables in the mid-1990's (NHDES Wetlands Board Permit 95-02299; USACEPermit 1996-00160), but the effort was halted after the cables fractured during the removal attempt. An inspection by divers in 2014 indicated that the cables were sufficiently intact to be successfully "grappled" to the surface. Most of one cable and approximately half of a second cable lie within the proposed jet plow route. The planned approach is to sever the old cables and cap the ends at the minimum length necessary to clear the jet plow route. The severed cable sections will be lifted to a barge for on-land disposal (See proposed Marine Work Plan in Appendix).

The jet plow process is expected to extend over a period of three to four weeks, including all equipment mobilization. Each cable will require about five to seven days in total, including equipment mobilization and cable preparation. The jet plow installation will generally take one day per cable. Divers using hand held jets will complete the cable burial from the end of the jet plow to each landfall. This process will take up to 90 days. Cable laying is planned for the fall (after Labor Day) and will be completed before air temperatures routinely fall below 32˚F, a point at which the cables would not be flexible enough to handle off the spool.

Potential temporary impacts along the Little Bay crossing include:

- Direct disturbance of the sediment surface from cable installation along each cable trench (quantifiable) and from anchoring of the installation vessel (not quantifiable)
- Deposition of sediments suspended during the jet plowing and dispersed beyond the footprint of each trench (quantifiable)
- Increase in suspended sediments above ambient conditions during jet plowing
- Entrainment of planktonic organisms in the jet plow water intake

Potential long-term impacts as a result of the operating cables include:

- Exposure of organisms to electromagnetic fields emitted from the three cables
- Exposure of organisms to heat emanating from the cables

5.1 Water Quality Effects

RPS ASA used the SSFATE model to predict the excess suspended sediment concentration and dispersion of suspended sediments from jet plowing and hand jetting (see Appendices). Since ambient suspended sediment concentrations are variable and unpredictable based on available information, the model predicts excess concentration, defined as the concentration above ambient suspended sediment concentration that results from the jetting activities. SSFATE also calculates the resulting deposition thickness of suspended sediments that have resettled back on the bottom. Ambient current speeds, tidal stage, trench depth and rate of advance of the jet plow are important factors in predicting settlement, resuspension and dispersion. The jet plow model was run assuming spring tide conditions. Spring tides usually result in a larger areal coverage (larger transport from the currents) but with lower concentrations and deposition thickness (since sediment would be spread over a larger area) than neap tides. The three-to-four week duration of the installation process will encompass at least one spring and one neap tidal period. The hand jetting model assumed that no silt curtains would be used to isolate the work area in order to evaluate the worst case for this activity.

5.1.1 Water Quality Effects from Jet Plowing

Jet plowing will always be initiated on the western tidal flat and, because of the shallow depths encountered on the flat, it will have to start at high tide. Burial depth determines the amount of sediment that could potentially be fluidized and released into the water column. The Project has determined that each cable must be buried to 3.5 feet below the sediment surface on the western and eastern tidal flats and 8 feet below the sediment surface under the channel. According to the marine contractor, Caldwell Marine Inc., the jet plow is likely to advance at a rate of 100 m/hr (330 ft/hr). At this rate, each installation will take approximately 13 hours. The likelihood of starting the jet plowing substantially later than high slack tide on a given day or of moving more slowly than the modeled advance rate is very low. The jet plow will be launched (i.e., placed on the substrate) the day before the scheduled crossing so that it will be ready to activate immediately as soon as water depths are sufficient for operation of the barge. Should the plow encounter an obstruction, the blade will be raised incrementally until it clears the obstruction. The ability to adjust the vertical position of the blade ensures that forward progress will continue.

Figures 5.1-1 through 5.1-4 show the plan view of the predicted excess suspended sediments ("SS") concentration at one-hour intervals starting one hour after jet plowing has been initiated for one cable. The colored contours can be identified from the legend showing concentrations from 10 mg/L on up. Figures 5.1-1 and 5.1-2 depict an ebbing or low tide and the plume is directed northward. By eight hours after the start (Figure 5.1-3), the tide has begun the flood stage and the plume has headed south towards Furber Strait. When the jet plow has reached the eastern end, the tide is still flooding (Figure 5.1-4). The contours show the highest concentrations centered directly over and adjacent to the immediate location of the jet plow on the cable route. Once the jet plow shuts down, no additional sediment will be dispersed into the water column and the plume will quickly dissipate. This is depicted in the two bottom panels in Figure 5.1-4 (13.5 and 14 hours after start).

A vertical section view of the cable path is inserted at the bottom of the figure. The insert shows that the highest concentrations occur just above the jet plow near the bottom with reduced concentrations extending up into the water column above the plow. In the shallow portions of the route, the plume reaches the surface but in the deeper portions the plume is generally restricted to the lower half of the water column.

At any given point in time during the crossing, the size of the entire plume (defined as greater than or equal to 10 mg/L excess suspended sediments) would encompass an area of about 14 acres (4 hours after start) to 55 acres (9 hours after start), averaging 37 acres. The area encompassed by the portion of the plume where excess suspended sediment concentrations are predicted to be equal to or greater than 100 mg/L is estimated to range from 0.8 (8 hours after start) to 15.9 (2 hours after start) acres instantaneously averaging 5 acres. 100 mg/L is the highest "natural" concentration measured by GBNERR off Adams Point in the fall during monthly surface water collections between 2002 and 2011. Concentrations of 1000 mg/L or higher would encompass a maximum of 3.5 acres and would typically be much smaller in extent (averaging <1 acre).

Figure 5.1-5 shows the plan view of the maximum time-integrated (i.e., maximum extent of plume at any given time over the entire installation period for one cable) excess SS concentration for the entire 13-hour jet plowing operation plus continuation for six additional hours in order to track the residual plume. This plot shows only the maximum excess SS concentration integrated over time and would not actually be seen in the Bay. However, it is useful for understanding the maximum potential extent of the plume for identifying natural resources exposure. The biological significance of that exposure depends on both excess suspended sediment concentration and the duration; these are summarized in Figure 5.1-6 and Table 5.1-1 for each plume concentration identified in Figure 5.1-5. At 10 mg/L excess SS concentration, the area that is enclosed by the contour is 90.2 hectares (222.9 acres) but lasts for only 1 hour. This short duration continues through all the concentration thresholds through 1000 mg/L. The areas quickly drop in time for a given concentrations so by 2 hours the 10 mg/L area has dropped to 32.2 hectares (79.6 acres). The plume will have completely disappeared within six hours. The area coverages drop dramatically for the higher concentrations near the jet plow indicating that the duration and extent of the plume are relatively limited.

5.1.2 Water Quality Effects from Hand Jetting

Cable installation in nearshore areas with insufficient water depth to support the jet plow and installation barge will involve a two-step process. Each cable will be laid directly on the substrate surface and then divers will use hand-operated jets to fluidize the sediments under the cables, allowing them to sink to the required burial depth (3.5 feet). Caldwell estimates that each this process will temporarily open a 4-foot wide trench for burial of each cable. This work will take place during a four-hour window around high slack tide. With an advancement rate of approximately 30 feet per day (7.5 ft/hr), it is estimated that installation for all three cables will take approximately 30 days on the west side and 60 days on the east side. Silt curtains will be placed around the entire work area on the west and a portion of the work area on the east (370 feet) to contain the suspended sediments. A 230-foot long section of the area to be hand jetted on the east side is located offshore of the intertidal and is likely to be exposed to currents in excess of 0.5 knot, the limiting speed for silt curtains.

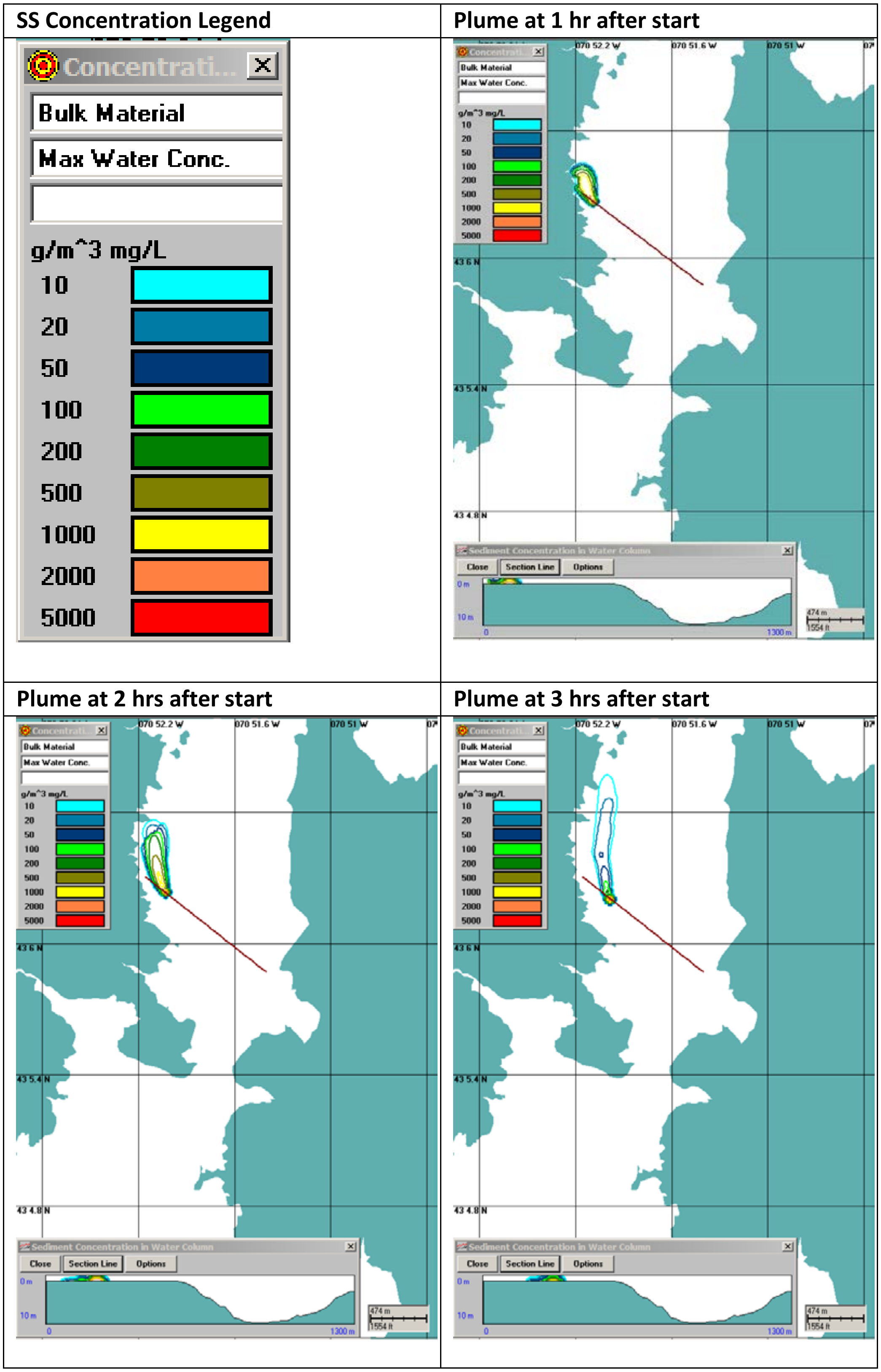

Figure 5.1-1. Plan view of instantaneous excess SS concentrations at 1 through 3 hours after start of jet plowing initiated at high slack. Vertical section view at lower left.

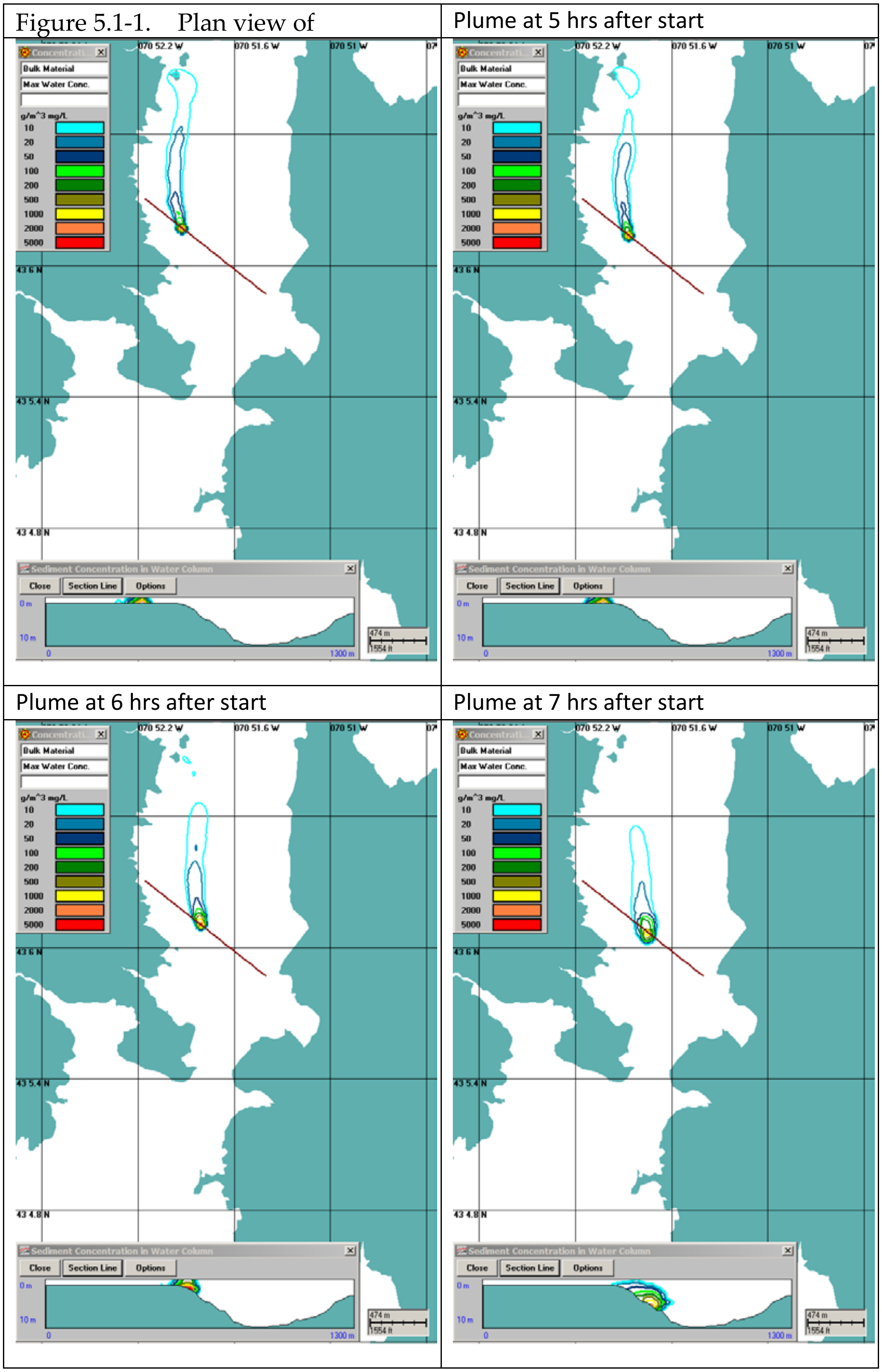

Figure 5.1-2. Plan view of instantaneous excess SS concentrations At 4 through 7 hours after start of jet plowing initiated at high slack. Vertical section view at lower left.

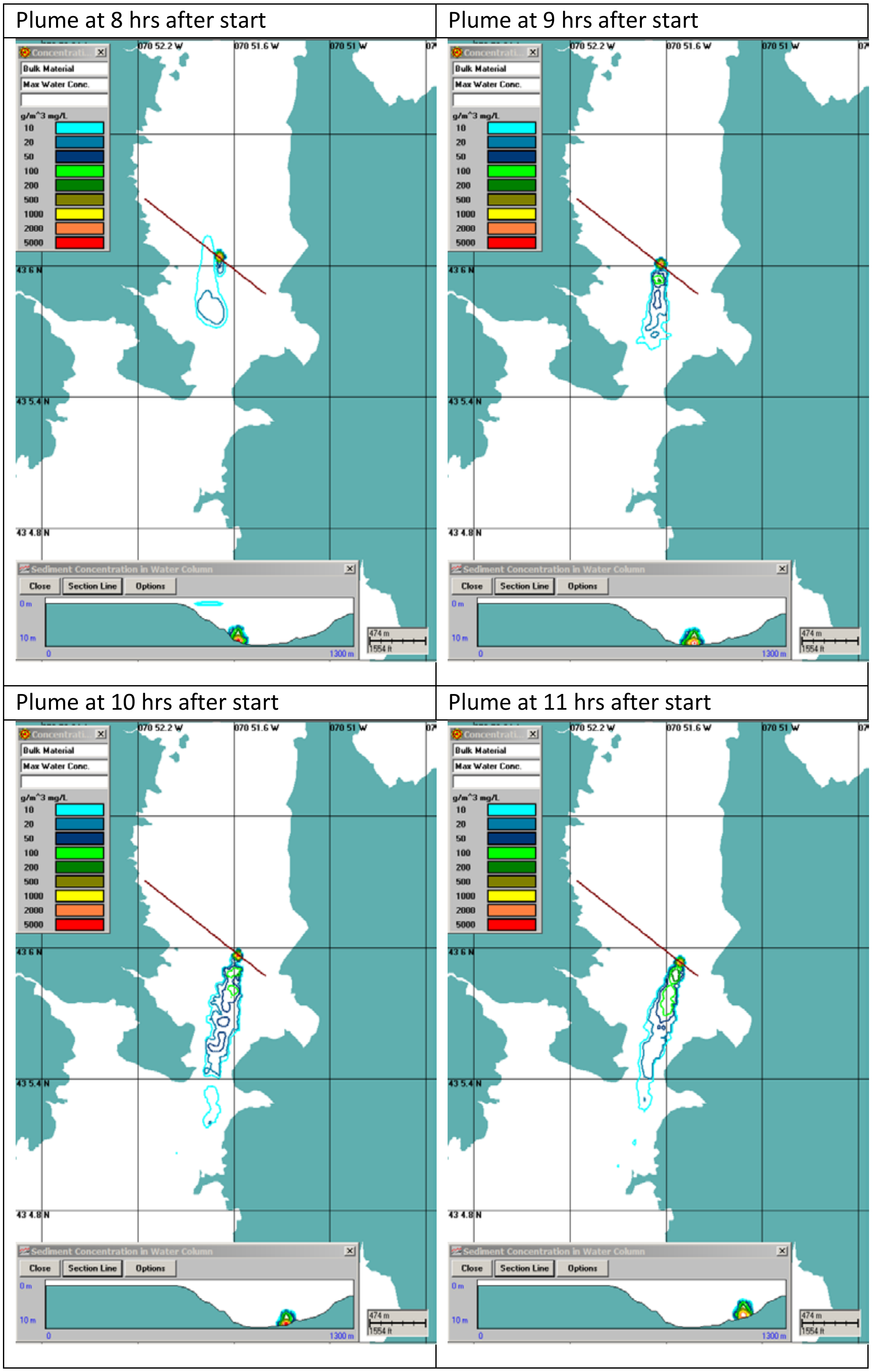

Figure 5.1-3. Plan view of instantaneous excess SS concentrations At 8 through 11 hours after start of jet plowing initiated at high slack. Vertical section view at lower left.

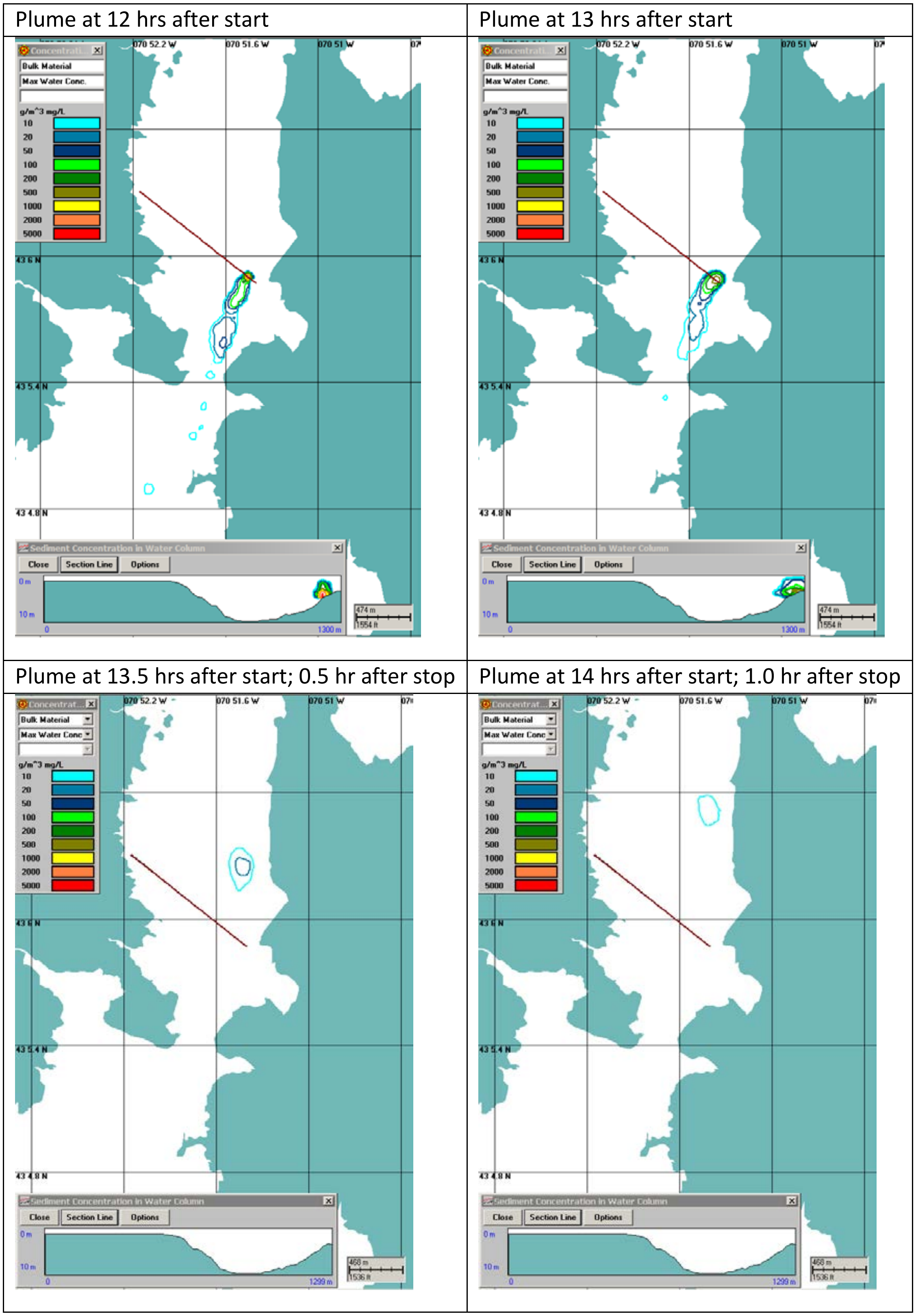

Figure 5.1-4. Plan view of instantaneous excess SS concentrations at 12 through 14 hours after start of jet plowing initiated at high slack and ending at hour 13. Vertical section view at lower left.

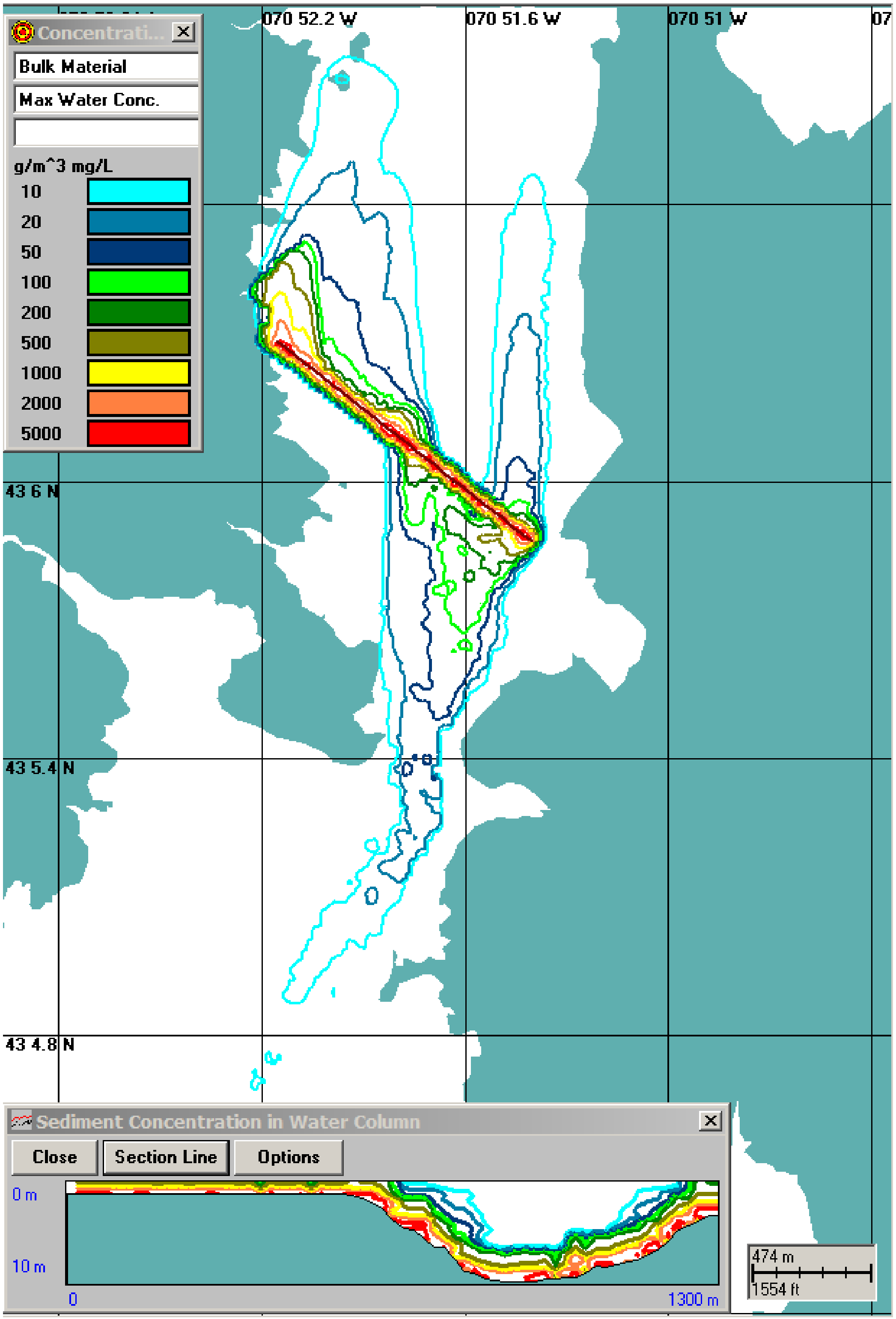

Figure 5.1-5. Plan view of maximum time integrated excess SS concentration over the entire jet plowing operation during one passage of a jet plow on a spring tide. Vertical section view at lower left.

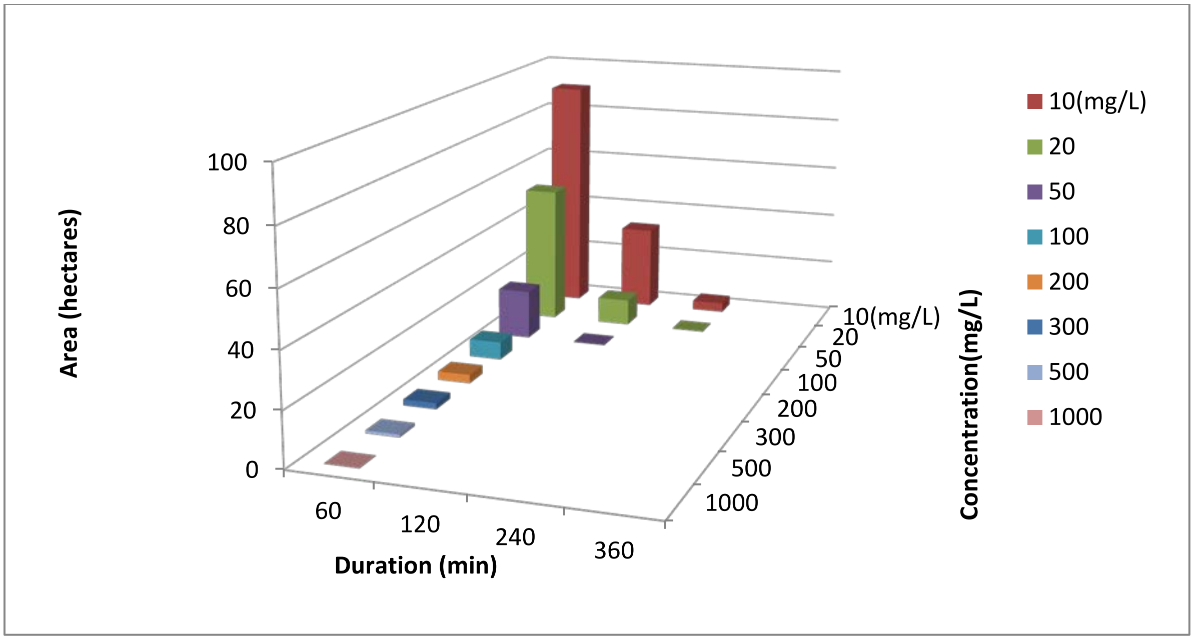

Figure 5.1-6. Duration (minutes) and area (hectares) of maximum time integrated excess SS concentration during one complete passage of a jet plow on a spring tide.

Table 5.1-1. Duration (Minutes) and Area (Hectares and Acres) of Maximum Time Integrated Excess SS Concentration During One Passage of a Jet Plow on a Spring Tide.

SS Concentration	Hectares				Acres			
	60	120	200	360	60	120	200	360
(mg/L)	(min)	(min)	(min)	(min)	(min)	(min)	(min)	(min)
10	90.20	32.20	4.76		222.89	79.57	11.76	
20	52.60	10.00			129.98	24.71		
50	18.70	0.16			46.21	0.40		
100	6.72				16.61			
200	3.20				7.91			
300	2.24				5.54			
500	1.04				2.57			
1000	0.08				0.20			

Water quality modeling of the hand jetting operation was conducted assuming that no silt curtains would be used and that work would only take place during the period from two hours before until two hours after high slack tide. Figure 5.1-7 shows those results, but is actually directly applicable only to the outer portion of the east side. At any given time, the plume (defined as the suspended sediment concentration of 10 mg/L above ambient) from the hand jetting in the section not protected by silt curtains is, likely to extend approximately 850 feet (260 meters) north of the work area and occupy an area of less than 5 acres. Highest

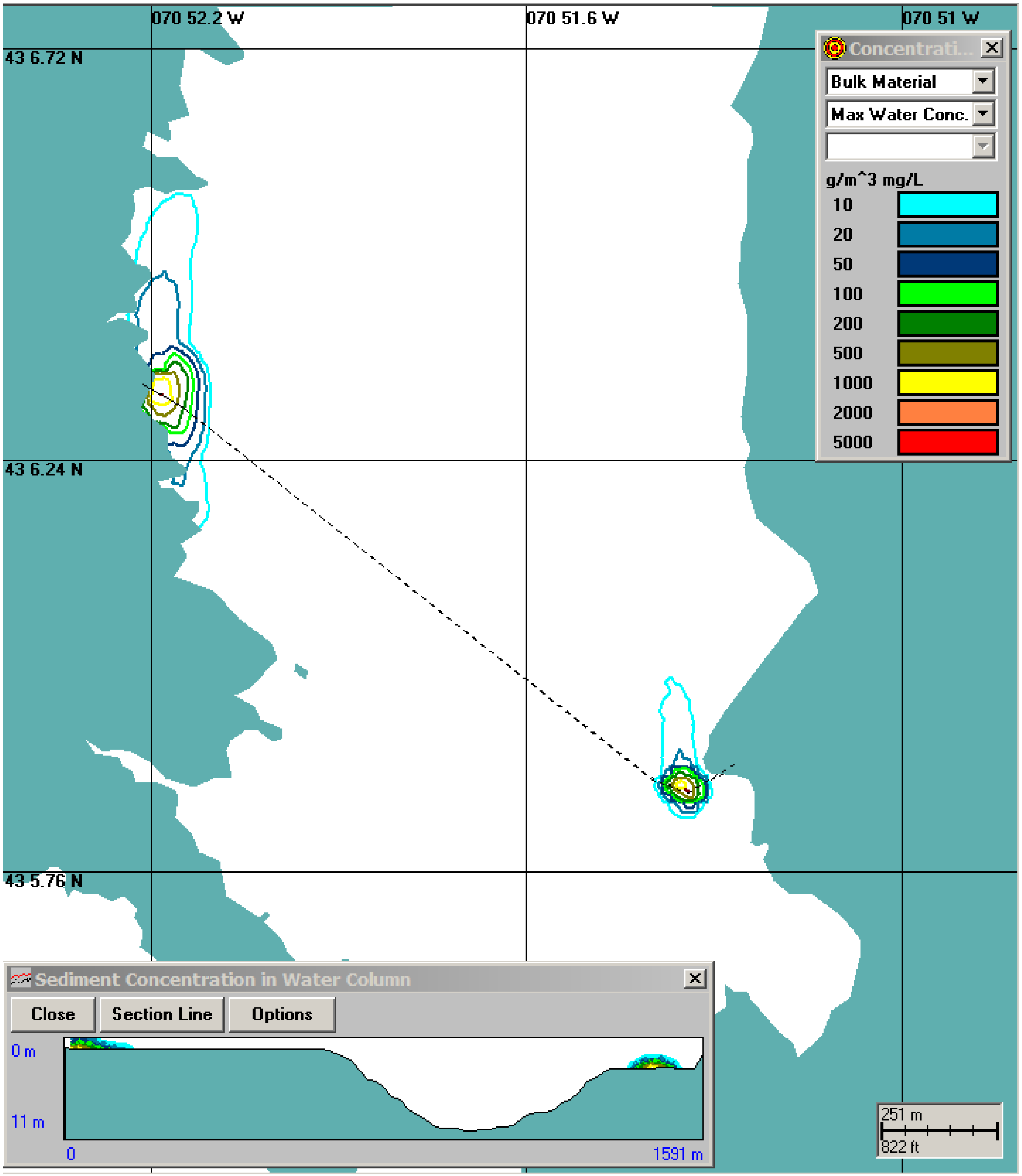

Figure 5.1-7. Plan view of instantaneous maximum excess suspended sediment concentrations for one day approximately midway across the west and east diver burial sections assuming silt curtains were not used. Vertical section view at lower left.

concentrations would be centered over the immediate vicinity of the activity. The plume would remain in the lower half of the water column. RPS ASA (2015) predicted that a residual plume of 10 mg/L excess suspended sediments would remain for about two days after hand jetting is completed because the initial buildup occurs near slack water and the sediments are mostly silts and clays. Water depths along a portion of the outermost section where silt curtain use is unfeasible are sufficient to allow divers to also work around low slack tide as well. When this occurs, the plume would flow primarily to the south. The horizontal and vertical distribution of suspended sediments would have a similar pattern to that described for the northerly flowing plume.

Use of silt curtains around the remaining areas where hand jetting will take place will greatly reduce the potential for a sediment plume outside the work area. The USACE has published suspended sediment retention rates of 80-100% (Francingues and Palermo 2005; Lackey, et al. 2012) for correctly deployed silt curtains. Thus, plumes escaping the silt curtains can be of low concentration with the 10 mg/L contour extending approximately 1100 feet (244 meters) beyond the work area on the west and 200 feet (152 meters) beyond the work area on the east.

5.2 Impacts to Bathymetry and Sediments

In addition to the temporary changes in bathymetry caused by cable installation (through jet plowing, hand jetting, or excavating), substrate conditions in the Project Area will be affected by redeposition of suspended sediments (jet plowing and hand jetting) and potentially by placement of artificial material on top of the cables to ensure the required level of protective cover. These impacts are discussed in this section.

5.2.1 Impacts to Bathymetry and Sediments from Jet Plowing

During the mobilization process for each cable, the installation barge will be maneuvered onto the tidal flat during high tide to allow deployment of the jet plow to the west. It is likely that the barge will become grounded on the substrate as the tide recedes and will compress the unconsolidated sediments beneath. Grounding will affect an area equivalent to three times the dimensions of the barge, a total of approximately 29,160 SF (0.67 acre).

SSFATE modeling conducted by RPS ASA also examined the redeposition of sediments suspended by the jet plow. Figure 5.2-1 shows the plan view of the cumulative bottom deposition thickness distribution from 0.1 milimeter to 50 milimeters (0.004-2.0 inches; see color legend) due to jet plowing the three cables. The distribution pattern is generally similar to the water column plume (ebb-flood-ebb) but much reduced in extent. The higher deposition areas are at and adjacent to the cable routes. There are a few non-contiguous areas of 0.1 – 0.5 milimeter (0.004-0.02 inch) further south of the cable route that are due to the slight changes in current direction transporting water column plumes from slightly different locations on the route so they happen to form a thin deposit at the same place.

The sizes of the deposition thickness patterns seen in Figure 5.2-1 are summarized in Table 5.2-1. The model predicts that an area totaling 144.5 acres would experience redeposition of sediments suspended by the jet plow as a result of installation of three cables. Of this total, 87.9 acres would receive deposition in the range of 0.1 -> 0.5 milimeter (0.004->0.02 inch) thick. These areas drop dramatically for the higher deposition thicknesses (e.g., 2.4 hectares [5.9 acres]

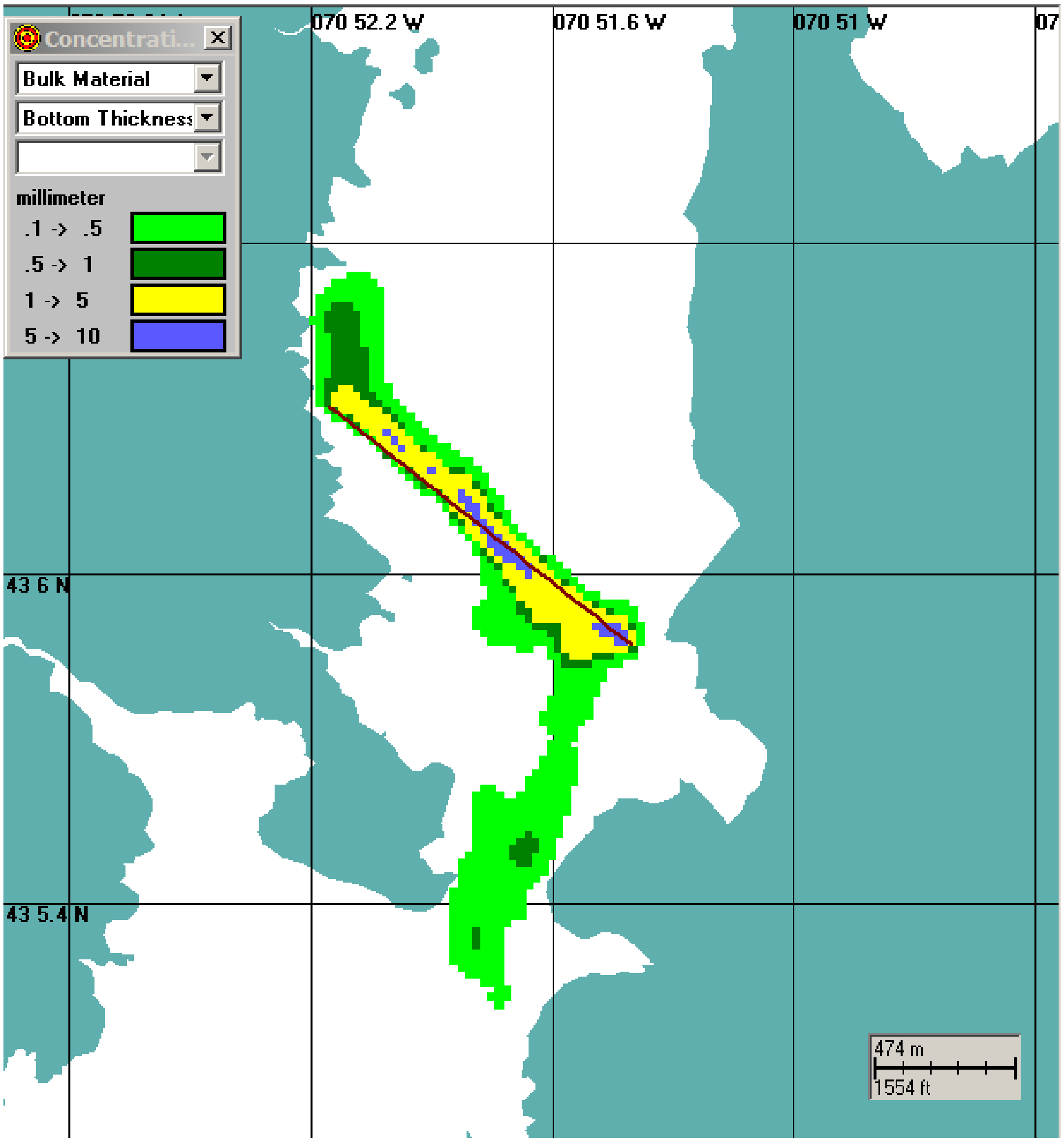

Figure 5.2-1. Plan view of cumulative bottom thickness (milimeters) distribution due to jet plowing for the three cable trenches.

Table 5.2-1. Bottom Thickness (Milimeters) Area Distribution (Hectare and Acre) Due to Jet Plow Installation of Three Cables.

Thickness (mm)	Area (ha)	Thickness (in)	Area (ac)
0.1 -> 0.5	35.6	0.004 -> 0.02	87.9
0.5 -> 1	8.1	0.02 -> 0.04	20.0
1 -> 5	12.4	0.04 -> 0.2	30.7
5 -> 10	2.4	0.2 -> 0.4	5.9

for the 5 -> 10 milimeter [0.2->0.4 inch] thickness range) near the jet plow indicating that the extent of the plume is relatively limited. This deposition may be temporary. RPS ASA (2015) concluded that newly deposited silt/clay and sand grains could be resuspended on subsequent flood and ebb tide within the channel because tidal velocities are sufficient to do so. Tidal currents are lower on the tidal flats, however, so the likelihood of resuspension due to currents is reduced; however Jones (2000) noted that rain events and ice scour are also important factors in resuspension of fine grained sediments on tidal flats in the Great Bay system. All of these factors are likely to contribute to post-installation reworking of the sediments on the tidal flat.

Existing data show that contaminant levels in sediments that will be disturbed by cable installation are low (EPA 2007). Therefore, there is little risk that use of the jet plow will result in dispersal of contaminants to other parts of the estuary.

5.2.2 Impacts to Bathymetry and Sediments from Hand Jetting

Divers performing the hand jetting will operate from a support vessel, either the installation barge or a smaller vessel. Where silt curtains are used, the vessel will be maneuvered inside the silt curtains and then remain stationary. At low tide, it will become grounded and the sediments compressed beneath. On both the west and the east sides, the maximum area affected this way would be the dimensions of the installation barge, 9,720 SF (0.22 acre).

All hand jetting on the western end of the Little Bay crossing will be conducted within silt curtains so an estimated 90% of the sediments suspended during this activity will be redeposited within the work area. The fine grained sediments in this area will likely be more or less uniformly redeposited within the work area forming a layer that averages 94 milimeters (3.7 inch) thick, although deposition will be thickest directly over (and filling) the trench and taper towards the silt curtains. Some evidence of the trenches created by the divers will remain until the uncompacted sediments are reworked and redistributed by currents. The same thing will occur in the eastern intertidal area where use of silt curtains is feasible. The temporary deposition layer in the eastern intertidal is expected to average about 110 milimeters (4.3 inch) thick, with the thickest deposition directly over (and filling) the trench and thinnest near the silt curtains.

Because it will not be feasible to use silt curtains in the offshore portion of the area requiring hand jetting on the eastern end of the route, suspended sediments will be dispersed and redeposited beyond the work area. Areas in the immediate vicinity of, but beyond, the trenches could experience deposition of up to 50 milimeters (2 inches). Beyond that, the depositional layer is likely to be less than 10 milimeters (0.4 inch) thick. Tidal action will rework and redistribute the uncompacted sediments and will tend to fill in the trenches. It is unlikely that the support vessel in this area will become grounded.

5.2.3 Impacts to Bathymetry and Sediments from Placement of Protective Mats

Portions of both shorelines have rock or ledge and the thickness of unconsolidated sediments above large rocks or bedrock has not been determined. Hand probing detected some areas where burial to only 12 inches (30 centimeters) may be achievable. As a result, it is not known whether the marine cable installer will be able to bury the cables to the required 3.5 feet (106 centimeters) burial depth in all locations. If this burial depth cannot be achieved, protective matting must be placed over the cables. The matting will consist of articulated concrete mattresses measuring 8 feet by 20 feet (2.4 m x 6.1 m) and 9 inches (0.2 meter) thick. Caldwell estimated that up to 24 mattresses (3,550 SF; 0.08 acre) might be required at the western shoreline and a total of 12 mattresses (1,920 SF; 0.04 acre) might be required at the eastern shoreline.

Placement of articulated concrete mattresses will permanently change the substrate from unconsolidated to artificial hard ("rock") substrate. It is likely that macroalgae such as *Fucus vesiculosus* or *Ascophyllum nodosum* and invertebrates such as oysters and barnacles that are common on the nearby rocky shore will ultimately colonize the mattresses.

5.3 Impacts to Eelgrass

The shallow flats along the eastern side of Little Bay have supported eelgrass in some years, most recently in 2011 and 2012 when it occurred in the southern portion of the Cable Area. Surveys conducted in 2013 and observations in 2014 indicate there is no established eelgrass bed in this area at the present time. Repopulation of the area would likely be governed by dispersal of seeds from other eelgrass beds rather than through vegetative growth, as was hypothesized by Short (2013) for the new bed observed in 2011. Therefore, the likelihood of the Project directly affecting eelgrass is very low. Results of water quality modeling discussed in Sections 5.1 and 5.2 indicate that the likelihood of indirect impacts to eelgrass is also very low as neither the plume nor the areas of deposition are predicted to intersect with established eelgrass beds. The cable installation will be performed in the fall, at the time when eelgrass is senescing for the year, further limiting any potential impacts.

Because of the importance of eelgrass to the Great Bay estuary system however, PSNH is committed to conducting an eelgrass survey in the summer of 2017 prior to installation of cables through Little Bay. If the Project area (particularly Welsh Cove) has been re-colonized by eelgrass, potential impacts are still likely to be minor. The portion of the cable route that crosses Welsh Cove will be disturbed during diver installation of the three cables. Any eelgrass within the three four-foot wide trenches or in the area where the diver support barge is grounded would be uprooted and killed. Eelgrass adjacent to the trenches within the area bounded by silt curtains (0.5 acre) would be subject to sedimentation, but may survive because once the silt curtains are removed as it is likely that some of the recently deposited sediments will be redistributed as a result of current and scour processes reworking the sediments. It is expected that the habitat conditions would be as suitable for eelgrass in the following year as they were prior to installation.

5.4 Impacts to Macroalgae

Distribution of macroalgae within Little Bay is not well known but is likely concentrated on rocky areas. An estimated 496 SF of rocky shore within the work area will be temporarily disturbed, and macroalgae on the rocks will be eliminated. Once construction is complete, it is likely that the same species of macroalgae currently present on the rocks will recolonize during the next reproductive season. The temporary sediment plumes and minor redeposition are not expected to adversely affect other macroalgae beds.

Up to 302 square feet (0.01 acres) of rocky shore may be permanently impacted if concrete mattresses are required to protect the cable; however if placement of concrete mattresses over unconsolidated intertidal substrate is required in order to provide sufficient protective cover for the cables, this material is likely to be colonized by macroalgae such as the commonly occurring

Fucus vesiculosus or *Ascophyllum nodosum*, thereby increasing suitable habitat for intertidal macroalgae by an area of up to approximately 5,760 SF (0.13 acre).

5.5 Impacts to Shellfish

Molluscan shellfish are sessile organisms that reside in or on the substrate. Normandeau surveys found that the soft substrate conditions along the proposed cable route provide suitable habitat for several species of infaunal shellfish, including softshell clams, razor clams, and the noncommercial *Macoma*. Highest abundances of these species are most likely to occur on the shallow subtidal flats although they may also be present in the channel. Individuals that are in the areas where the barge becomes grounded will be crushed. Those in the direct path of the jet plow will be displaced and potentially injured or killed. Shellfish adjacent to the trenched areas may be buried. Maurer et al. (1986) reported that deep and rapidly burrowing species were able to tolerate burial by as much as 10-50 centimeter (3.9 – 5.9 inches), with larger individuals being more resistant than smaller individuals. Thus, it is likely that adult softshell clams and razor clams covered by sediments deposited after passage of the jet plow would survive, although juveniles (e.g., less than at least half the deposition depth) would not. Individuals located between two cables may be subjected to deposition a second time. If concrete mattressing is required on either side of the route, any shellfish residing in the sediment will be covered and the substrate will no longer be suitable for infaunal shellfish. However, the mattresses could provide new substrate for oysters, particularly if the new substrate is colonized by macroalgae; Capone et al. (2008) reported the intertidal occurrence of oysters in association with macroalgae in the Great Bay estuary.

There are no major natural or restored oyster beds identified in the immediate vicinity of the Cable Area although it is likely that oysters are present in relatively small numbers wherever there is suitable habitat (hard substrate). The closest major bed is located offshore of the southeastern point of Adams Point and a planned restoration area adjacent to this bed is expected to be in place by the time cable installation occurs. Water quality modeling indicates that by the time the turbidity plume reaches this area excess suspended sediment concentrations will likely be ≤10 mg/L and that the plume will be likely to intersect only a small portion of the bed for two hours or less (Figure 5.5-1), an exposure level that Wilbur and Clarke (2001) indicated would be too low to elicit any response from the oysters. Deposition closest to the oyster bed will be ≤0.5 milimeter (≤0.02 inch). Thus, there will be no sedimentation impacts to natural oyster beds from the jet plow operation. The sediment plume and subsequent redeposition of sediments suspended by hand jetting outside of silt curtains are not expected to reach the vicinity of the Adams Point oyster bed.

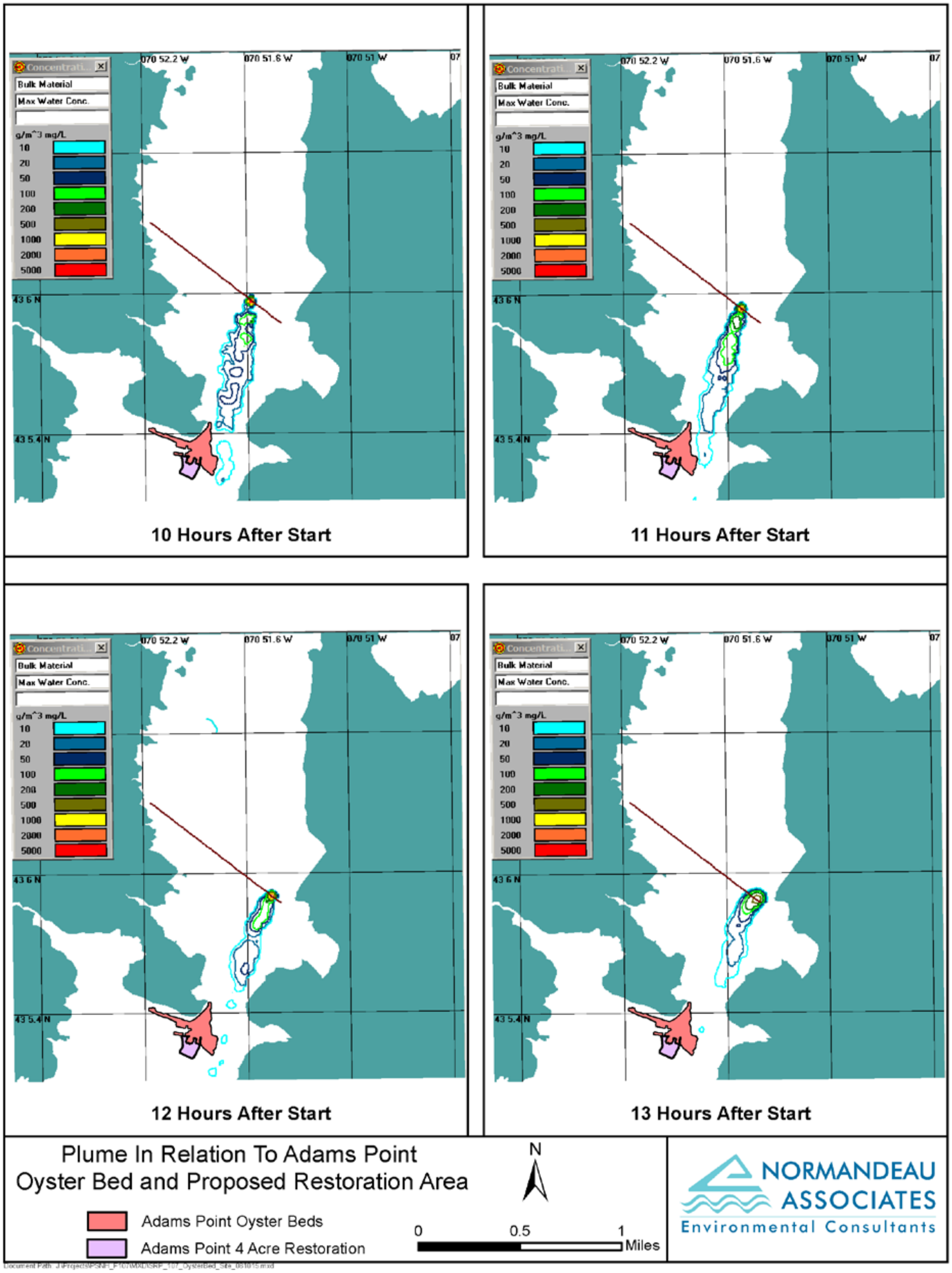

Figure 5.5-1. Potential exposure of Adams Point oyster bed and restoration area to sediment plume generated by jet plow installation of cable.

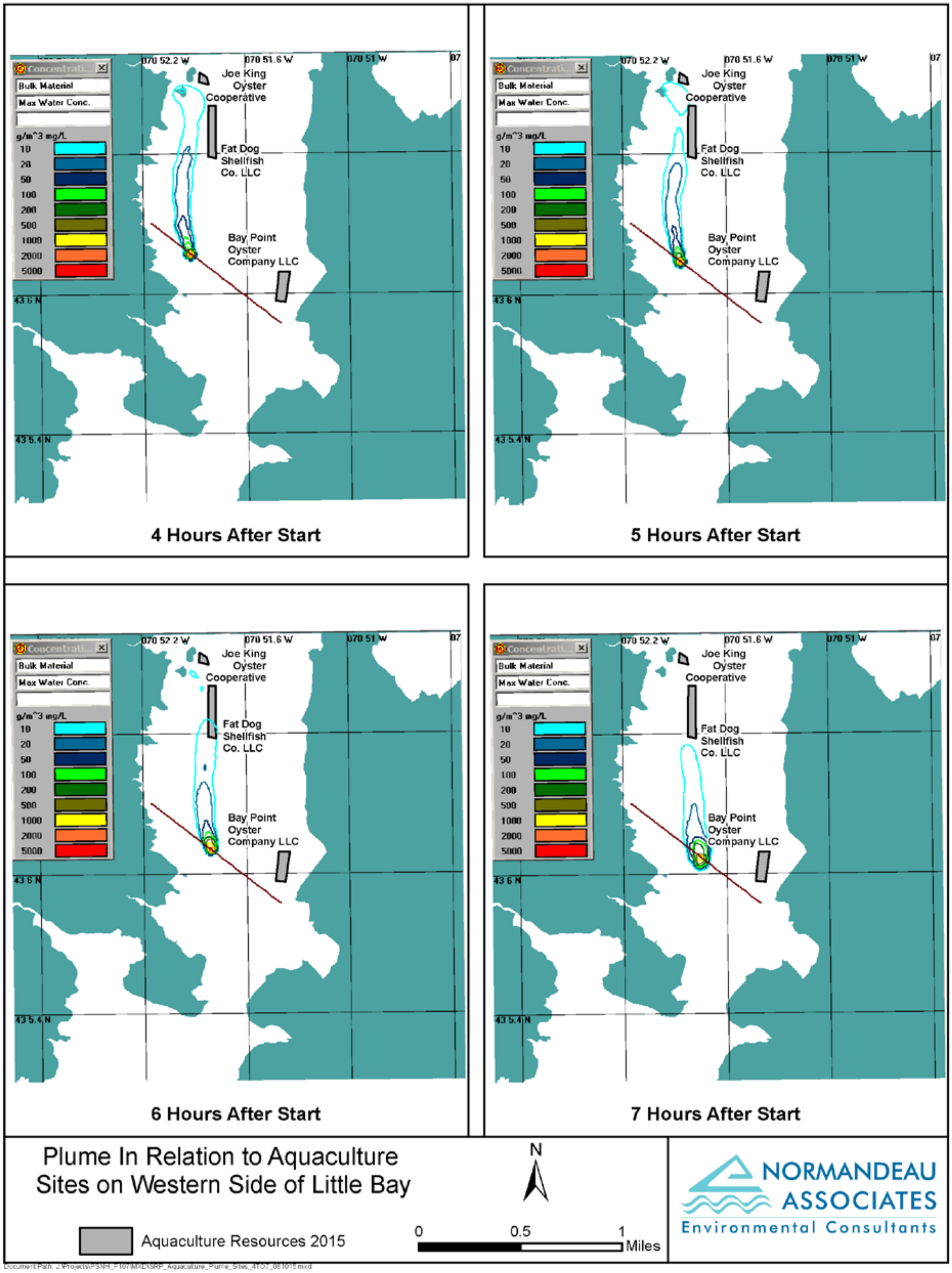

Figure 5.5-2. Potential exposure of shellfish aquaculture areas on west side of Little Bay to sediment plume generated by jet plow installation of cable.

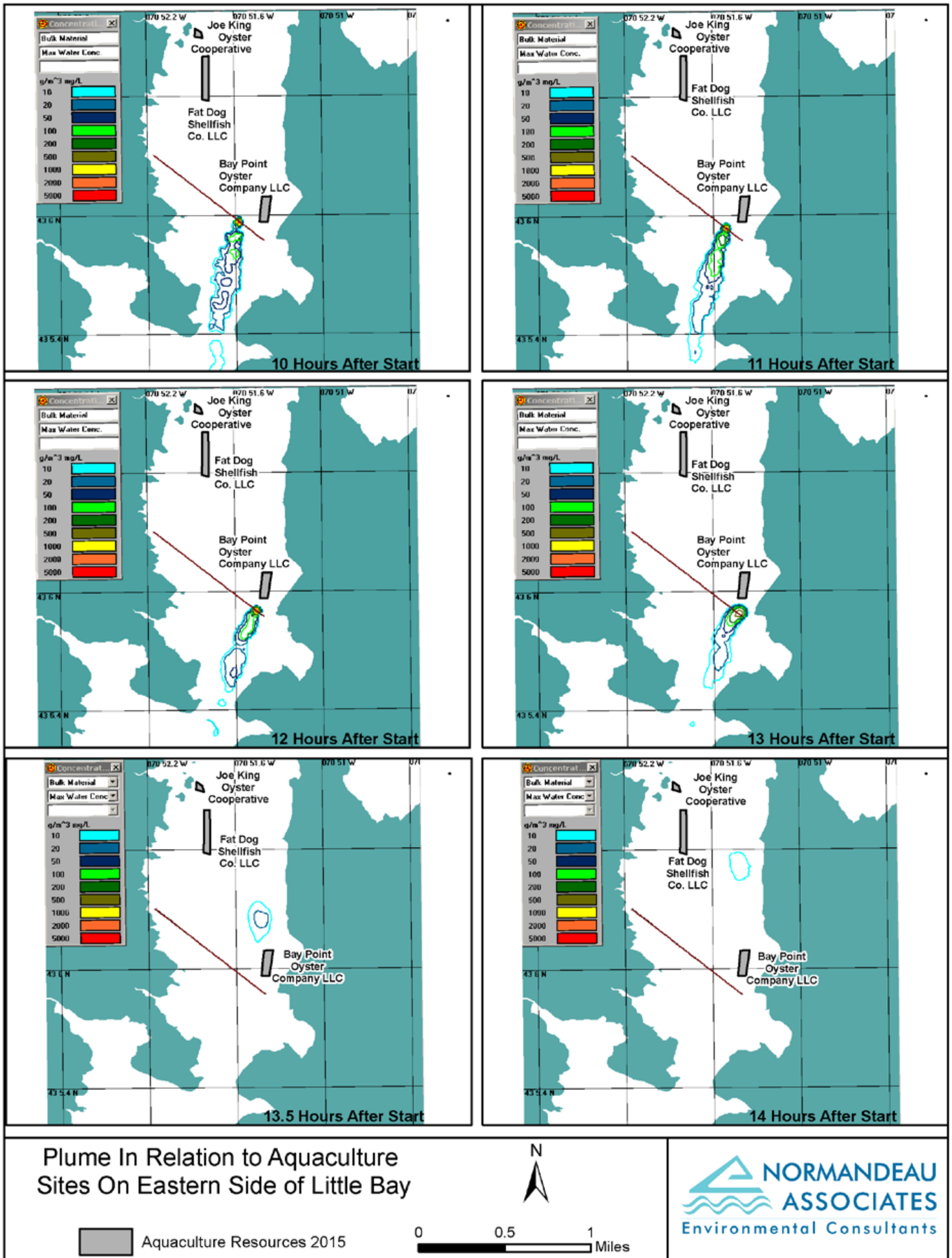

Figure 5.5-3. Potential exposure of shellfish aquaculture areas on east side of Little Bay to sediment plume generated by jet plow installation of cable.

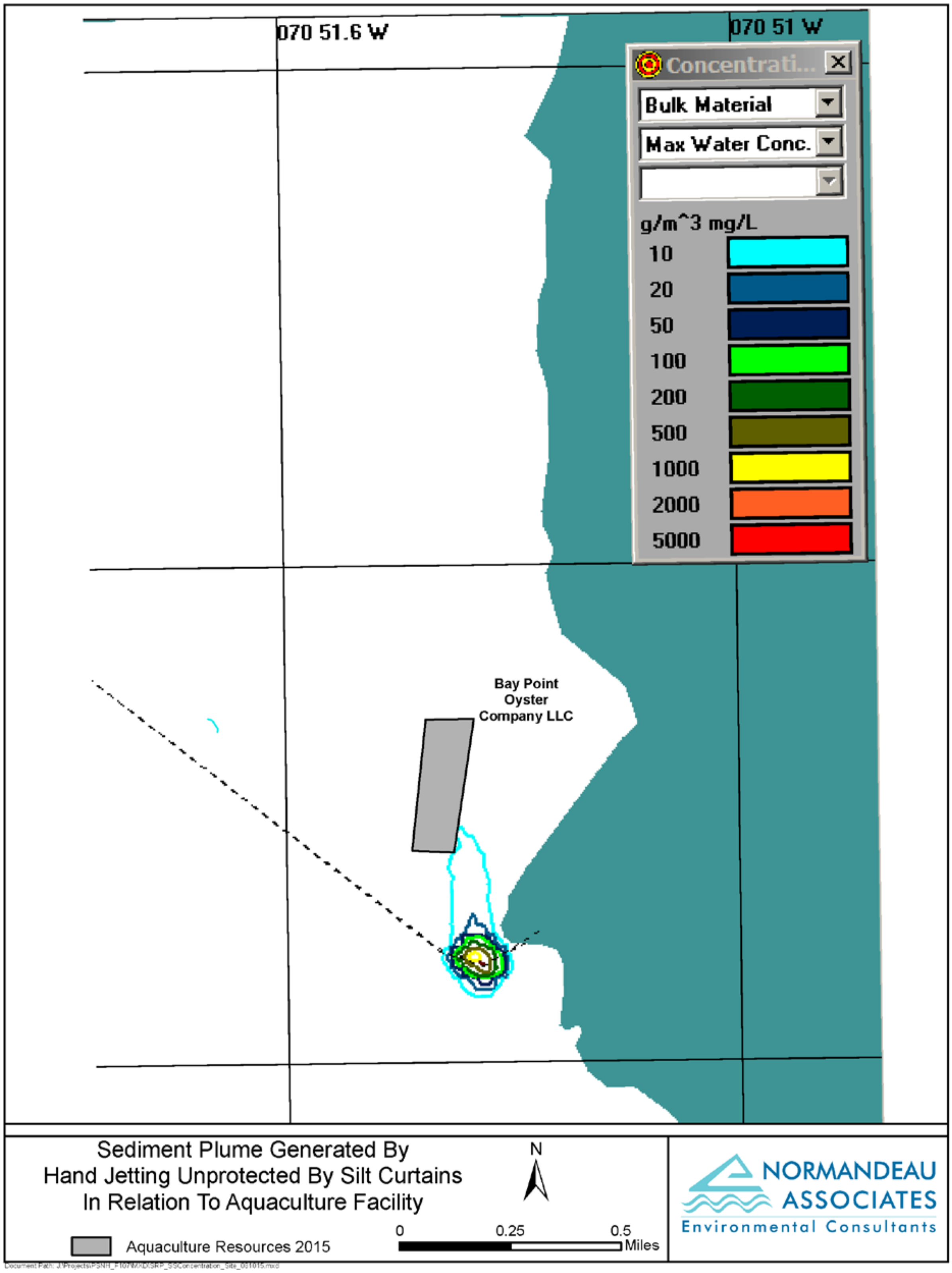

Figure 5.5-4. Potential exposure of shellfish aquaculture areas on east side of Little Bay to sediment plume generated by burial of cable by hand jetting in area where use of silt curtains is infeasible.

Larval forms of both American oysters and softshell clams may be in the water column during the cable installation. The jet plow will cycle approximately 1,000 m^3/hr (264,172 gallons/hour) during this process from a depth of about 4-5 feet below the water surface, for an approximate total of $4.2x10^4$ m^3 ($1.11x10^7$ gallons). As there will be no filtration on the intake, planktonic organisms will be entrained in the system and will be unlikely to survive. Trowbridge (2007) determined that the volume of water contained in upper Little Bay, where the crossing is located, is $1.58x10^7$ m^3 ($4.16x10^9$ gallons) at low tide and $2.51x10^7$ m^3 ($6.62x10^9$ gallons) at high tide. Water withdrawn from the bay for the jet plow will therefore consume 0.17 to 0.27 percent of the volume of upper Little Bay and the associated plankton. There are no data on shellfish larval densities available to calculate absolute losses, but these percentages represent a very minor proportion of the Little Bay capacity so should be considered insignificant.

There are several aquaculture operations (Joe King Oyster Cooperative, Fat Dog Shellfish Co., and Bay Point Oyster Co.) within the predicted range of the plume generated by the jet plow. As shown in Figure 5.5-2, the plume is predicted to flow north on the western side of the bay and reach the vicinity of Joe King Oyster Cooperative and Fat Dog Shellfish Co. for a period of several hours. It is expected that the highest excess suspended sediment concentrations that will near, and potentially intersect with, these operations will be limited to 10-20 mg/L. Wilbur and Clarke (2001) reported that the eastern oyster exhibited no discernible response to a three-week exposure to TSS concentrations as high as 710 mg/L but a two-day exposure to concentrations $\geq$1000 mg/L resulted in reduced pumping activity. Based on this research, it is likely that the farmed oysters will exhibit no response to the turbidity plume. If they do continue pumping, subsequent exposure to less turbid seawater will allow them to cleanse any excess sediments from their tissues. It is also possible that sediments will be deposited on the shells and cages. The low levels of sediment contaminants means that there is negligible risk of contaminating the meat of the farmed shellfish. Because of the low suspended sediment concentrations reaching these two shellfish farms, sedimentation is expected to be negligible, less than 0.1 milimeter (0.004 inch).

While the Bay Point Oyster Company LLC is located immediately north of the proposed cable route off Gundalow Landing, exposure to a suspended sediment plume caused by jet plowing is expected to be very limited. As Figure 5.5-3 shows, as the jet plow approaches this operation the tide will be flooding causing the plume to flow towards the south. Once the jet plow stops, about 13 hours after starting and at about high slack tide, no additional sediment will be dispersed into the water column. Thus when the tide starts ebbing, the plume will dissipate quickly. It is expected that concentrations in the residual plume will be on the order of $\leq$ 20 mg/L when it passes over this facility and the duration of exposure will be well under an hour. Bay Point Oyster Co. is located north of the area where cable burial must be done by divers using hand-held jets and the currents are too swift to allow use of silt curtains. When this work is conducted during the period from about two hours before until two hours after high slack, a sediment plume will flow towards the aquaculture site (Figure 5.5-4). However, any sediment plume associated with the hand jetting that reaches this facility will be of very low suspended sediment concentration (10 mg/L). A portion of the hand jetting is likely to take place during the four-hour period around low slack tide. As noted in Section 5.1.2, the resulting suspended sediment plume will flow primarily to the south away from the Bay Point Oyster farm. Sedimentation on this bottom-oriented oyster farm is expected to be negligible. For both jet plowing and hand jetting, plume concentrations in the vicinity of the oyster farm would be within the range of natural conditions.

There is some level of infestation of oysters in Great Bay by the polychaete *Polydora* a genus that was found in the site-specific surveys for the Project. The concern was raised that disturbing the sediments to bury the cables could increase the risk of infestation to farmed oysters. *Polydora* densities ranged from 0 to 7 per 0.04 m^2 on the eastern channel slope and from 39 to 98 per 0.04 m^2 on the western tidal flat. Given that these organisms are much larger than sediment particles, although less dense, it is likely that individuals suspended in the water column would be redeposited well within the area demarcated by the 0.1 milimeter thickness contour shown on Figure 5.2-1. Impacts to farmed oysters through increased exposure to *Polydora* would therefore be negligible.

The buried cables have the potential to emit electromagnetic fields into the sediments surrounding the cables (Eversource 2015). Cable design, including sheathing, will prevent emission of electric fields from the buried cable but cannot prevent emission of magnetic fields. Infaunal shellfish could potentially be exposed to the magnetic fields. Immediately above the cable, Eversource (2015) predicted a maximum magnetic field strength of 100 milliGauss (mG) that would decay laterally to 20 mG within 60 feet either side of the center cable. The magnetic field will also decay vertically above the cable. Several researchers (Malagoli et al. 2003, 2004 and Ottaviani et al. 2002) have examined the physiological effects of exposure of the Mediterranean mussel *Mytilus galloprovincialis* to magnetic fields from a 50 Hz source. In each case, the minimum magnetic field strength required to evoke a change (e.g., change in shape of immunocyts or increase in concentration of heat shock proteins) was 30 to 40 times higher than the predicted magnetic field strength at the cables in Little Bay. It is unlikely, therefore, that the magnetic fields emitted by the SRP cables will have a discernable effect on area shellfish or on the oysters stock at the Bay Point Oyster Co.

The buried cables could also emit heat. Power Engineers (2015) predicted that each cable will elevate the temperature of the sediment two feet (0.6 meter) above the cable (or 1.5 feet [0.5 meter] below the substrate surface in the tidal flats) to 30˚C. Adult softshell clams may burrow that deep into the substrate so could be exposed to elevated temperatures, although smaller clams will reside closer to the substrate surface and, therefore, not be exposed to as great an increase in temperature. Kennedy and Mihursky (1971) found that softshell clams (*Mya arenaria*) acclimated at 20-25˚C (likely temperature of the substrate in the summer in Little Bay) experienced a 50 percent mortality rate when exposed to temperatures of 31-32˚C. *Macoma balthica*, another common estuarine bivalve, exhibited similar temperature tolerance (Kennedy and Mihursky 1971). The area where increased sediment temperatures will occur is limited to a narrow band above each cable, so any deleterious effects to shellfish will be limited. Increased temperature associated with the cables in the deep burial (8 feet) section will not reach the biotic zone of the substrate.

5.6 Impacts to Benthic Infauna

Benthic infauna along each cable route will be displaced into the water column and adjacent substrate by the jet plow and the diver jetting. Displaced individuals may or may not survive. Predators such as lobsters and demersal-feeding fish are often attracted to areas of disturbance, so the likelihood of being consumed will be increased for displaced infauna. Individuals buried by redeposition may or may not survive depending on their mobility. The most abundant species on the western tidal flat is the polychaete *Scoletoma tenuis*, an active burrower that reworks the sediments. Individuals from this species may survive burial. The second most abundant species in this area (*Streblospio benedicti*) is a small-bodied sessile surface deposit feeder. While it is unlikely to survive burial, it is considered to be an opportunist with high reproductive rates that can quickly colonize disturbed sediments. This species will be able to recolonize the cable route from adjacent habitats. The most abundant species in the channel, *Tharyx acutus*, *Aricidea (Acmira) catherinae*, and *Scolelepis (Parascolelepis) texana*, are all sessile surface deposit feeders so may not survive burial. Again, however, these species are present outside the Cable Area so they are likely to be available to recolonize the disturbed areas. Small areas in the upper intertidal may require placement of articulated concrete mattresses to provide sufficient protection for the cables. This will result in the conversion of unconsolidated substrate to hard substrate. It is likely that this material will be ultimately colonized with the same organisms that occupy the nearby rocky intertidal.

Recovery of the benthic infauna will be dependent on recruitment from nearby populations. As noted, the numerically-dominant species are present beyond the area to be disturbed and will provide a source of individuals for recruitment. Some mobile species may start moving into the disturbed sediments soon after installation is complete simply by crawling or burrowing. It is likely that most repopulation will not occur until the next major reproductive period when infauna produce planktonic larvae however. This will probably take place the following spring and summer.

As described in Section 5.5 (Impacts to Shellfish), the buried cables have the potential to emit low level magnetic fields into the sediments to which benthic infauna could potentially be exposed. Little is known about how benthic invertebrates respond to EMF (Normandeau et al. 2011), and while exposure would be higher on the tidal flats where cable burial is shallower than in the channel, the fact that the predicted field from the SRP cables is too low to evoke physiological changes in mussels suggests it is unlikely that other benthic organisms would be affected either. It is unlikely that the magnetic fields emitted by the SRP cables will have a discernable effect on area benthic infauna.

As described in Section 5.5, the buried cables could also emit heat. The potential effects on benthic infauna are unknown. Because most infauna occur in the uppermost 6 inches (0.2 meter) and will be separated from the cables by at least 3 feet (1 meter), effects are likely to be very limited.

5.7 Impacts to Epibenthos

American lobsters and horseshoe crabs are both large benthic organisms likely to occur along the submarine cable route although population estimates for these species are not available for Little Bay. American lobsters often burrow in the substrate during the daytime, feeding actively at night. The soft sediments along the cable route would be suitable for burrowing. Lobsters that have burrowed along the cable route would be displaced and potentially injured or killed by the force of the jet plow. Lobsters adjacent to the jet plowroute would be subject to burial although it is likely that they would be able to uncover themselves even in the area of thickest deposition as the newly deposited sediments would be loose and unconsolidated and lobsters are capable of rapid excavation. Lobsters close to the jet plow paths would likely be attracted to the disturbed sediments to scavenge for exposed prey items so may receive some feeding benefits.

Horseshoe crabs likely feed on the tidal flats along the Little Bay shorelines. This species bulldozes through the sediments in search of benthic infaunal prey items. Those located along the jet plow path would be displaced and potentially injured or killed by the force of the plow. Those adjacent to the plowed area would be subject to burial. Horseshoe crabs are adapted to turbulent conditions because they must cross the nearshore wave zone to reach the intertidal zone for spawning. When flipped over, adults are able to right themselves using their elongated telson. Thus, those adult individuals that are simply displaced by the jet plow or buried under a relatively thin layer sediment are unlikely to experience more than a fleeting impact from cable installation. The proposed time frame for cable installation avoids the critical spring spawning period for horseshoe crabs so there will be no effect on the vulnerable early lifestages.

Population estimates for lobsters and horseshoe crabs in the Great Bay estuary are not available. There is no reason to believe that the Cable Area represents unique habitat for either species within the estuary. Thus, the proportion of suitable habitat within the Great Bay system affected by the cable installation is small and it is reasonable to assume that the number of American lobsters or horseshoe crabs potentially affected is also small.

Jury et al. (1994) reported that American lobster larvae have been documented in Great Bay in fall months when cable installation will occur making them susceptible to entrainment by the jet plow water intake. As described for shellfish, the volume of water that will be withdrawn to support the jet plow represents about 0.17 to 0.27 percent of the volume of upper Little Bay so entrainment impacts to American lobster would be insignificant.

It is unlikely that horseshoe crab larvae will be present in the water column during cable installation. Horseshoe crabs spawn in the spring and Rudloe (1979, 1980) and Botton et al. (2010) reported that the duration of the planktonic stage is approximately one week. Thus there will be no entrainment impacts to this species.

Spiny lobsters (*Panulirus*) have been found to be able to detect magnetic fields from DC sources, but not from AC sources (Normandeau et al. 2011). It is not expected, therefore, that EMF emitted from the SRP cables will affect American lobsters in the Project Area.

5.8 Impacts to Fish

Impacts to fishes will be temporary and include alteration of benthic habitat, increased levels of suspended sediments, and mortality of early life stages entrained in the jet plow's water system. Available habitat for demersal species will be temporarily disturbed and altered, slightly reducing the area available for use. Disturbance of sediment during jet plowing will, however, expose some benthic infauna which may attract demersal feeders. While this could expose them to increased suspended sediments, reduced effort to capture prey could be beneficial energetically.

Highest concentrations of suspended sediments will be close to the seafloor adjacent to the cable route being plowed. This could be a deterrent for some fishes and cause them simply to avoid the densest part of the plume. Wilbur and Clarke (2001) reported that salmonids exposed to suspended sediment concentrations of 1000 mg/L or higher for up to one full day generally respond with behavioral changes (e.g., altered swimming behavior with either attraction or repulsion to the plume) or experience sublethal effects (e.g., reduced feeding). Given that the duration of the highest densities in the plume is limited to about an hour per cable, it is not expected that fish would be impacted by exposure.

According to Jury et al. (1994), eggs or larvae of a number of fishes, included Atlantic cod, Atlantic mackerel, white hake, windowpane flounder, and yellowtail flounder may be present in the water column during the fall when cable installation will occur. These early lifestages would be vulnerable to entrainment by the withdrawal of water for the jet plow. As indicated in the discussion on shellfish, the amount of water expected to be withdrawn represents approximately 0.17 to 0.27 percent of the total volume in upper Little Bay so the impact to early fish lifestages is expected to be insignificant.

The buried cables have the potential to emit magnetic fields into the sediments and overlying water column and demersal and pelagic fishes could potentially be exposed to these fields, particularly in the shallow portions of the crossing where cables will be buried with only 3.5 feet of cover. Normandeau et al. (2011) found, however, that the magnetic fields emitted from low voltage AC cables are unlikely to be detectable by most fishes.

5.8.1 Impacts to Essential Fish Habitat

The proposed crossing provides EFH for juvenile, adult, or spawning life stages of ten species at some point during the year. Of these, Atlantic halibut, red hake, white hake, windowpane flounder, winter flounder, and yellowtail flounder are demersal (bottom-dwelling) species. Pollock is a semi-demersal species; Atlantic mackerel and bluefish are pelagic (mid-column dwelling) species. One or more lifestages of six of these species is expected to be in Little Bay in September-October during the cable installation work window. EFH for demersal species will be temporarily reduced in areal extent during the installation of the cables due to suspended solids and bottom disturbance for several hours for any given location. It is expected that along the jet plow routes, plowing and cable burialwill occur nearly simultaneously. EFH for pelagic species will be temporarily degraded by increased suspended sediments for a short period in a narrow band perpendicular to the cable route during installation of each cable. No permanent impacts to EFH are anticipated.

5.8.2 Impacts to Diadromous Fish

Diadromous species are those that use both freshwater and saltwater for some portion of their life cycle. Diadromous fish require unobstructed passage through any streams within the proposed project corridor that meet the habitat requirements for migration, spawning, or development. Additionally, any migrations to and from tributaries of Great Bay (e.g. Lamprey River) would require passage through the Little Bay cable corridor. The Little Bay cable crossing area may also provide nursery or staging habitat for diadromous species. Any impacts to diadromous species habitat within the corridor or Little Bay related to construction activities could be minimized by restricting underwater construction activities or adhering to customary time-of-year restrictions to address the time period when the least number of species are likely to occur (Table 5.9-1).

Adult American eel ("yellow") and juvenile alewife, blueback herring, American shad, and rainbow smelt may all encounter the cable installation process during their seaward migration in the fall. Eels burrow into the substrate during the day so those in the pathway of the cable installation will be disturbed by the advancing jet plow. Each species has the potential to encounter the turbidity plume generated by the jet plow. Although none of these species was specifically examined by either Newcombe and Jensen (1996) or Wilbur and Clarke (2001), it is likely that results of those studies can be applied in general. Specifically, lethal or sublethal effects are likely to require exposures to SS concentrations for a minimum of several hours. Because these fishes would not be constrained to remain in the jet plow plume if conditions were "distasteful," the most likely response to exposure to the plume would be to actively swim away from it or to meander in the general area. Within a short distance or a short period of time, the fish would find more favorable water quality conditions and be able to continue their outmigration.

Table 5.9-1. Summary of Potential Seasonal Occurrence of Diadromous Species Within the Proposed Project Corridor and Little Bay Cable Corridor.

Species	Designation*	Life Stage	Spring	Summer	Fall	Winter
American Eel	SC-A1	Juveniles (Elvers)	X			
		Adults (Yellow)	X	X	X	X
		Adults (Silver)	X			X
Alewife (Oyster River)	SC-A1	Eggs/Larvae/Juveniles	X	X	X	
		Adults	X			
Alewife (Little Bay)	SC-A1	Juveniles		X	X	
		Adults	X			
Blueback Herring (Oyster River)	SC-A1	Eggs/Larvae/Juveniles	X	X	X	
		Adults	X			
American Shad	SC-A1	Juveniles			X	
		Adults	X	X		
Rainbow Smelt (Oyster River)	SC-A1	Eggs/Larvae	X			
		Adults	X			
Rainbow Smelt (Little Bay)	SC-A1	Juveniles		X	X	X
		Adults	X			
Sea Lamprey (Oyster River)	SC-A1	Eggs/Larvae		X	X	
		Adults	X			
Sea Lamprey (Little Bay)	SC-A1	Juveniles	X			X
		Adults	X			

* New Hampshire Fish and Game Department - Nongame and Endangered Species Program (NHFG 2009).

6. 0 Impacts on Rare Species

One state-listed plant species, the state-Endangered crested sedge (*Carex cristatella*), was observed within the Project Area. Four exemplary natural communities or natural community systems were confirmed within the Project Area in Little Bay: *High salt marsh, Salt marsh system, Sparsely vegetated intertidal system* and *Subtidal system*.

The ringed boghaunter, a state Endangered dragonfly, occurs in a sedge meadow near the Project Area. Some marginally suitable larval habitat for this species was identified during a field survey, but no exuvia were observed.

Two federally listed fish species, shortnosed sturgeon (Endangered) and Atlantic sturgeon (Threatened), may use the Project Area in Little Bay as feeding habitat. Neither species is known to breed in New Hampshire, but adults could occasionally feed in Great Bay, including the Project Area. Short-nosed sturgeon is considered extirpated in New Hampshire. Three state-listed Special Concern fish species, American eel, swamp darter and banded sunfish, are known to occur upstream and downstream of several streams crossing the SRP corridor, including the Oyster River. These species are assumed to periodically use the Project Area.

Three state-listed reptiles, northern black racer (Threatened), Blandings turtle (Endangered), and spotted turtle (Threatened), and two state listed bird species, bald eagles (Threatened), and osprey (Special Concern) are likely to occur in the Project Area based on their relatively large home ranges and use of varied habitats. Two listed mammals, northern long-eared bat (federally Threatened; state Threatened) and New England cottontail (state Endangered species) have habitat potential within the Project Area.

In general, impacts to protected species will be avoided and minimized through species-specific management practices and standard BMPs during construction. Species specific management practices will include include pre-construction surveys to ensure the absence of nesting bald eagles and osprey (if either species is breeding within or near the Project Area, time-of-year restrictions may apply); cable installation in the fall to minimize impacts to marine species; repeated surveys during land-based construction to clear the active work area of turtles and snakes; handcutting in the vicinity of the ringed boghaunter habitat; and minimization of clearing preferred shrubby areas in high priority New England cottontail habitat.

The northern long-eared bat (NLEB; *Myotis septrionalis*) is state and federally threatened. Therefore, a formal consultation with the USFWS is required as part of the permitting process (NLEB Biological Assessment, see Appendices). The USFWS rules and guidance on this species are still evolving. The interim 4(d) rule published as part of the NLEB's April 2, 2015 listing allows tree clearing for expansions of transmission corridors up to 100 feet from the edge of an existing cleared Project Area, which applies to the SRP, but the final rule may contain different or additional requirements. PSNH is committed to meeting the USFWS rules when finalized.

Unavoidable temporary impacts to the fringing salt marsh will be restored following burial of the cable. Restoration techniques will include salvaging the intact peat prior to trenching for replacement after the cables are buried.

The intertidal flats and subtidal bottom will be allowed to restore and recolonize naturally after completion of the cable installation. The jetplow process will disturb sediments while laying the cable, but the water pressure of the jets and the speed of the plow will be controlled to maximize the return of sediments to the trench and minimize sediments going into suspension in the water column. The currents within the channel and wave and ice action on the tidal flats are expected to restore existing bottom contours in the vicinity of the trenches, followed by recolonization of benthic infauna and shellfish after completion of construction.

Monitoring of all impacted rare, threatened and endangered ("RTE") habitats will occur both during and after construction to assess the success of the habitat restoration.

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Appendix A. Wetland Resource Summary Table

PSNH Seacoast Reliability Project (SRP)
Wetland Summary Table

Wetland ID	Permanent Impact (SF)	Temporary Impacts (SF)	Cowardin Class	Delineated Area (SF)	Town	Functions and Values^												
						GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
DNW2 (Subtidal)	0	127,397	E1UB	259,459	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DNW2 (Salt Marsh)	0	1,222	E2EM	9,047	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DNW2 (Rocky Shore)	302	496	E2RS	15,636	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DNW2 (Intertidal Flats)	5,034	144,091	E2US	278,668	Durham/Newington	S	P	P	P	S	P	S	P	P	P	P	P	S
DW1	0	0	PEM1/PSS1	18,663	Durham	S	S	S	S	S	S	S	S	-	S	-	S	-
DW2	30	9,303	PEM1E	51,456	Durham	P	-	-	-	-	S	-	P	-	-	-	S	-
DW4	0	1,325	PEM1J	6,829	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW5	0	230	PSS1	18,121	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW6	0	3,857	PEM1E/PSS1E	35,338	Durham	S	S	-	S	-	P	S	P	-	-	-	S	-
DW7	0	667	PSS1	4,726	Durham	S	S	-	S	S	-	-	-	-	-	-	-	-
DW9	0	1,005	PSS1/PEM1	5,839	Durham	S	S	-	S	S	-	-	-	-	-	-	-	-
DW10	0	376	PSS1E/PEM1J	17,144	Durham	S	-	-	-	-	P	-	S	-	-	-	-	-
DW11	0	0	PEM1/PSS1	7,353	Durham	S	-	-	S	S	-	-	-	-	-	-	-	-
DW12	0	822	PSS1E/PEM1E	11,821	Durham	S	-	-	S	-	-	-	P	-	-	-	S	-
DW13	0	1,942	PSS1/PEM1	48,977	Durham	S	-	-	S	S	-	-	-	-	-	-	-	-
DW14	20	3,246	PEM1J/PSS1E	21,504	Durham	P	S	-	S	-	S	-	P	S	-	-	P	-
DW16	0	64	PEM1E	763	Durham	S	S	-	-	-	-	-	S	-	-	-	-	-
DW17	0	42	PSS1/PEM1	11,886	Durham	S	P	-	P	P	S	P	P	-	-	-	-	-
DW18	0	2,619	PSS1E/PEM1E	54,161	Durham	P	S	-	-	-	S	-	P	-	S	-	S	-
DW20	0	169	PEM1J	3,144	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW21	0	3,241	PSS/PEM	24,887	Durham	S	-	-	S	S	S	-	S	-	-	-	-	-
DW22	0	3,011	PSS1E/PFO14E	40,728	Durham	P	S	-	-	-	S	-	P	-	-	-	-	S
DW24	0	7,267	PSS1E/PEM1E	35,043	Durham	S	-	-	-	-	P	-	P	-	P	S	S	-
DW25	0	1,399	PEM/PSS	10,231	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW26	0	245	PEM1J	245	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW27	0	53	PSS1E/PEM1F	2,294	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW28	0	643	PEM1J	839	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW29	20	3,551	PEM/PSS	9,272	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW30	0	857	PSS1E/PEM1J	14,577	Durham	S	S	-	S	-	P	S	P	-	S	-	-	-
DW31	20	8,940	PEM	46,279	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW33	0	5,436	PEM/PSS	39,676	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW36	0	1,104	PSS1/PFO1	10,787	Durham	P	P	-	-	-	-	-	-	-	-	-	-	-
DW37	0	1,420	PEM/PSS	3,294	Durham	S	S	-	S	S	-	S	S	-	-	-	-	-
DW38	0	4,089	PSS1/PFO1	32,062	Durham	P	S	-	-	-	S	-	-	-	-	-	-	-
DW40	0	630	PSS1/PEM1	6,354	Durham	P	-	-	-	-	P	-	S	-	-	-	P	-
DW41	20	18,285	PEM/PSS/PUB	96,107	Durham	S	S	-	S	S	-	S	S	-	-	-	-	S
DW42	0	0	PSS1/PFO1	4,930	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW43	0	0	PSS/PFO	4,476	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-
DW44	0	1,437	PEM1	7,145	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW45	0	2,889	PSS	7,812	Durham	S	-	-	-	-	-	-	S	-	-	-	-	-
DW47	0	4,563	PEM/PSS	23,061	Durham	S	S	-	S	S	-	S	S	-	-	-	-	-
DW48	0	1,176	PSS/PEM	14,505	Durham	P	P	-	-	-	S	P	S	-	-	-	-	-
DW49	0	3,172	PEM/PSS	3,533	Durham	S	S	-	S	S	-	-	S	-	-	-	-	-

Wetland ID	Permanent Impact (SF)	Temporary Impacts (SF)	Cowardin Class	Delineated Area (SF)	Town	Functions and Values^												
						GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
DW50	0	1	PEM1	2,753	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW52	0	807	PSS1/PFO1/PEM1	18,865	Durham	P	-	-	-	-	S	-	-	-	-	-	-	-
DW54	0	2,739	PSS1	12,577	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW55	0	0	PSS	687	Durham	S	-	-	S	-	-	-	S	-	-	-	-	-
DW56	20	13,910	PEM1/PSS1	41,860	Durham	P	-	-	-	-	S	-	S	-	-	-	-	-
DW58	0	8,060	PSS1/PEM4	70,192	Durham	P	P	-	-	-	P	P	P	-	-	-	-	-
DW59	0	0	PEM/PUB	3,150	Durham	S	S	S	S	S	-	S	-	-	-	-	-	-
DW63	0	0	PSS/PEM	6,200	Durham	S	S	-	S	S	-	S	S	-	-	-	-	-
DW65	7	3,917	PEM	8,221	Durham	P	-	-	S	S	-	-	-	-	-	-	-	-
DW67	14	8,972	PEM	15,266	Durham	P	S	-	S	S	-	-	S	-	-	-	-	-
DW69	0	53	PEM	7,574	Durham	P	S	-	P	S	-	-	S	-	-	-	-	-
DW71	0	0	PEM	163	Durham	P	-	-	-	-	-	-	-	-	-	-	-	-
DW72	0	0	PSS1	2,527	Durham	-	-	-	S	S	-	-	-	-	-	-	-	-
DW73	0	0	PSS1/PEM1	1,098	Durham	S	S	S	S	S	-	S	-	-	S	-	-	-
DW74	0	1,166	PFO1/SS1	2,795	Durham	S	P	-	S	S	-	S	-	-	-	-	-	-
DW76	20	4,321	PSS1	12,237	Durham	S	-	-	-	-	-	-	-	-	-	-	S	-
DW77	0	1,711	PSS1	9,755	Durham	P	-	-	P	-	-	-	-	-	-	-	-	-
DW78	0	0	PSS1	139	Durham	P	-	-	P	P	-	-	-	-	-	-	-	-
DW79	0	842	PSS1	2,189	Durham	S	-	-	S	S	-	-	-	-	-	-	-	-
DW80	0	935	PSS1	5,966	Durham	S	-	-	-	-	-	-	-	-	-	-	-	-
DW91	0	1,240	PSS1	4,177	Durham	S	S	-	-	-	-	S	S	-	-	-	-	-
DW93	3	1,949	PSS1	4,637	Durham	P	-	-	-	-	P	-	-	-	-	-	-	-
DW94	20	4,961	PSS1	12,802	Durham	S	-	-	S	-	S	-	-	-	-	-	-	-
DW100	20	1,895	PEM1E	6,571	Durham	S	S	-	P	-	-	-	-	-	-	-	-	-
DW101	0	4,019	PEM1/SS1E	3,219	Durham	S	-	-	S	-	-	-	S	-	-	-	-	-
DW102	0	0	PSS1E	5,043	Durham	-	-	-	S	-	-	-	-	-	-	-	-	-
DW103	0	0	PSS1/EM1B	12,099	Durham	P	-	-	S	S	S	-	S	-	-	-	-	-
DW104	0	0	PSS1/EM1E	874	Durham	P	-	-	S	S	-	-	-	-	-	-	-	-
DW105	0	153	PFO1E	1,227	Durham	S	-	-	S	S	S	-	S	-	S	-	-	-
MW1	0	321	PSS1	8,078	Madbury	P	-	-	-	-	P	-	-	-	-	-	-	-
MW2	199	28,940	PEM1/PSS1	74,736	Madbury	P	P	P	-	-	P	P	P	-	P	-	P	-
NW1*	20	6,583	PEM1/SS1	75,679	Newington	S	P	-	P	P	P	-	-	-	-	-	S	-
NW3	20	6,141	PEM1/SS1	80,336	Newington	S	P	-	S	S	-	S	-	-	-	-	-	-
NW4	0	3,987	PSS1E/PUB3/PFO14E	48,442	Newington	S	S	-	P	S	S	-	P	-	-	-	S	-
NW6	20	2,817	PSS1C	13,332	Newington	S	P	-	S	-	P	S	P	-	-	-	-	-
NW9	133	12,399	PEM1	44,940	Newington	P	-	-	S	-	-	-	-	-	-	-	S	-
NW10	0	3,499	PSS1E/PEM1E/PFO1B	31,671	Newington	P	-	-	-	-	-	-	P	S	-	-	-	-
NW11	133	13,147	PSS1/PEM1	38,909	Newington	P	P	-	P	P	P	-	S	-	-	-	S	-
NW12*	0	3,332	PSS1E/PEM1E	30,058	Newington	S	S	-	S	-	P	S	P	-	-	-	-	-
NW13	0	211	PEM1/PUB	16,815	Newington	S	S	-	S	S	S	S	P	-	-	-	S	-
NW16	0	8,145	PEM1F/PSS1E	47,505	Newington	P	S	-	S	-	S	-	P	-	S	-	S	-
NW17*	0	4,507	PSS1	12,715	Newington	P	-	-	S	S	S	-	-	-	-	-	-	-
NW18	0	2,016	PEM1J/PSS1J	7,003	Newington	S	-	-	P	-	-	-	S	-	-	-	-	-

Wetland ID	Permanent Impact (SF)	Temporary Impacts (SF)	Cowardin Class	Delineated Area (SF)	Town	Functions and Values^												
						GW	FF	FSH	STR	NUT	PE	SSS	WH	REC	EDU	UH	VQ	RTE
NW19	1	387	PEM1	578	Newington	S	-	-	-	-	S	-	-	-	-	-	-	-
NW20	0	0	PEM1J	1,929	Newington	P	-	-	S	-	-	-	S	-	-	-	-	-
NW21	0	295	PEM1	6,666	Newington	S	-	-	-	-	-	-	-	-	-	-	-	-
NW22	0	1,264	PFO1E/PSS1E	10,953	Newington	P	-	-	-	-	-	-	S	-	-	-	-	-
NW24	0	0	PEM1F/PSS1E/PFO1E	18,186	Newington	S	-	-	S	-	P	-	P	-	-	-	-	-
NW26	0	1,530	PSS1E	15,500	Newington	P	-	-	S	-	-	-	S	-	-	-	-	-
NW28	20	6,421	PEM1J	39,285	Newington	P	-	-	S	-	-	-	-	-	-	-	-	-
NW30	0	1,981	PEM1J	13,978	Newington	S	-	-	-	-	-	-	-	-	-	-	-	-
NW32	20	4,745	PEM1J	11,001	Newington	S	-	-	-	-	-	-	-	-	-	-	-	-
NW34*	11	10,063	PSS1E/PUBb	23,065	Newington	P	S	S	S	-	S	S	P	-	-	-	-	-
NW35	0	223	PEM1/SS1/FO1B	8,824	Newington	P	S	-	P	P	-	-	P	-	-	-	-	-
NW37	0	544	PEM1/SS1E	33,462	Newington	P	P	S	P	P	P	P	P	-	-	-	-	-
NW39	0	0	PEM1/SS1E	2,472	Newington	P	P	-	P	P	P	P	P	-	-	-	-	-
NW41	0	0	PEM1E	4,114	Newington	P	P	-	P	P	P	S	S	-	-	-	-	-
NW42	0	765	PEM1/UB1E	7,736	Newington	P	P	-	P	P	S	S	P	-	-	-	-	-
NW43	1	4,101	PEM1B	9,495	Newington	P	S	-	P	P	-	S	S	-	-	-	-	-
NW44	0	0	PEM1E	4,194	Newington	P	S	-	P	P	S	S	P	-	-	-	-	-
NW45*	0	14,112	PEM1/SS1B	27,199	Newington	P	P	-	P	P	-	-	P	-	-	-	-	-
NW100	0	0	PEM1E	6,727	Newington	S	S	-	P	-	-	-	S	-	-	-	-	-
NW102	0	0	PEM/PFO/PSS	33,836	Newington	S	-	-	S	S	-	-	-	-	-	-	-	-
NW104	0	0	PEM	716	Newington	S	S	-	S	S	-	-	-	-	-	-	-	-
NW105	0	0	PEM	3,070	Newington	S	-	-	S	S	-	-	-	-	-	-	-	-
NW106	0	0	PEM/PSS	6,017	Newington	S	S	-	S	S	-	-	-	-	-	-	-	-
PW1	0	0	PEM/PSS	2,440	Portsmouth	S	-	-	S	S	-	-	-	-	-	-	-	-
PW2	0	648	PEM1/SS1/FO1B	51,333	Portsmouth	P	S	-	S	S	-	-	P	-	-	-	-	-
PW3	0	0	PEM1B	2,132	Portsmouth	P	S	-	S	S	-	-	P	-	-	-	-	-
PW4	0	0	PEM1E	535	Portsmouth	P	S	-	P	P	-	-	S	-	-	-	-	-
PW5	0	203	PEM1/SS1E	2,760	Portsmouth	S	-	-	S	S	-	-	-	-	-	-	-	-

^ GW= Groundwater Recharge/Discharge; FF= Floodflow Alteration; FSH= Fish/Shellfish Habitat; STR= Sediment/Toxicant Retention; NUT= Nutrient Removal; PE= Production Export; SSS= Sediment/Shoreline Stabilization; WH= Wildlife Habitat; REC= Recreation; EDU= Education/Scientific Value; UH= Uniqueness/Heritage; VQ= Visual Quality/Aesthetics; RTE= Endangered Species
* Prime Wetland

Appendix B. Memorandum: Environmental Mitigation Project along the Wagon Hill Farm Shoreline, Town of Durham, NH.

Department of Public Works

Town of Durham
100 Stone Quarry Drive
Durham, N.H. 03824
603-868-5578
Fax 603-868-8063

MEMORANDUM

TO: Sarah Allen, Normandeau Associates Inc.

FROM: Michael Lynch, Public Works Director

DATE: September 3, 2015

RE: Environmental Mitigation Project along the Wagon Hill Farm Shoreline

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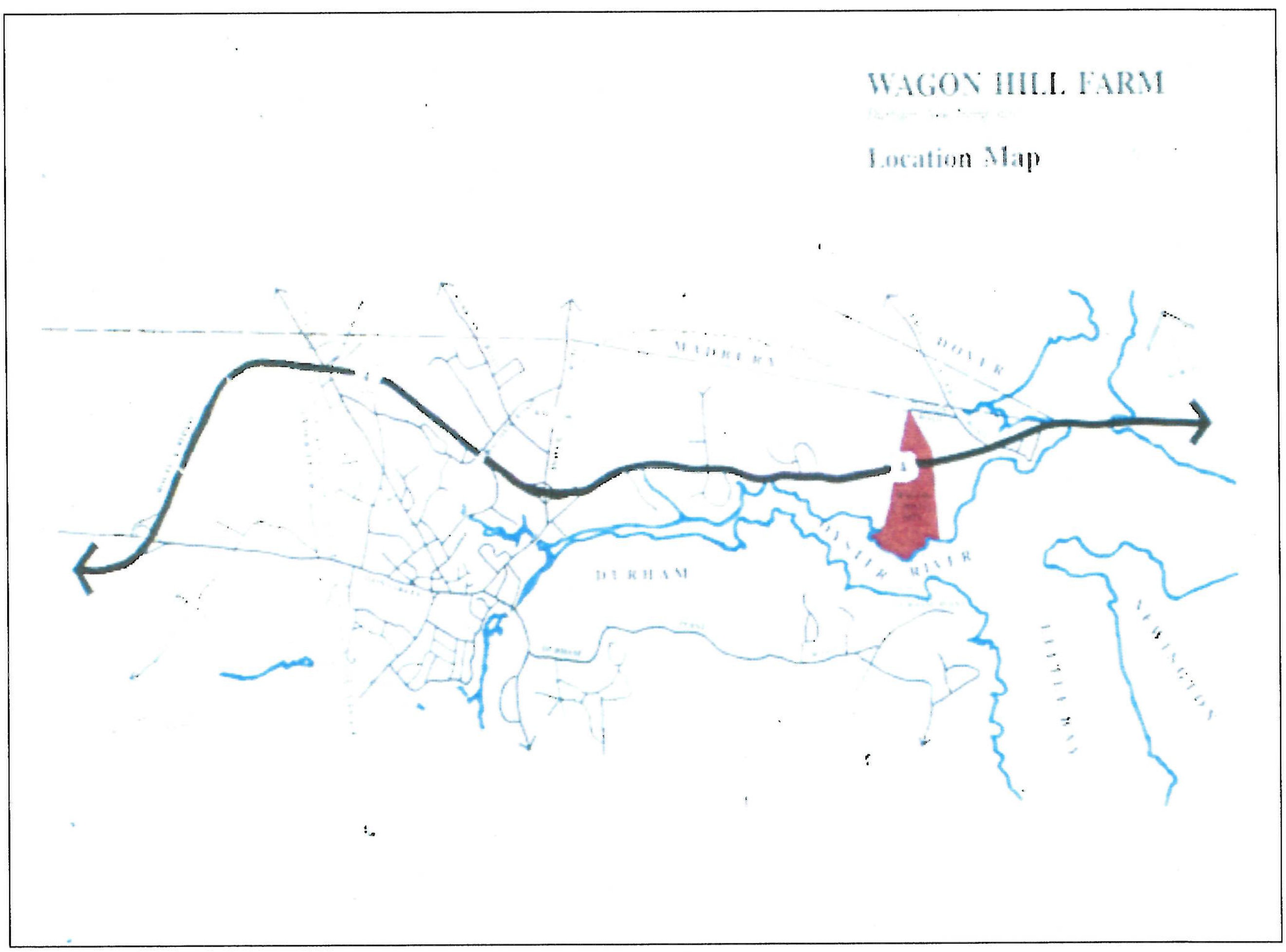
The Town of Durham in cooperation with Eversource (previously Public Service of New Hampshire) is partnering to propose an Environmental Mitigation Project which will eliminate a significant amount of erosion from the Wagon Hill Farm shoreline along the Great Bay Estuary and the Oyster River.

BACKGROUND

The Wagon Hill Farm consists of 139 acres. It consists of a 99 acre parcel on the south side of Route 4 and a 40 acre parcel on the north side of Route 4. It has approximately 1100 feet of frontage on Little Bay.

The farm was purchase by the Town of Durham in 1989. The land was purchased by the Town ***"to preserve its scenic vistas, provide for future municipal purposes, preserve open space, provide a healthful and attractive outdoor environment for work and recreation, and to conserve land, water, forest and wildlife resources."***

In 1995 the Strafford Regional Planning Commission and the Town of Durham received a grant from the New Hampshire Office of State Planning, New Hampshire Coastal Program to hire a consultant to prepare a master and a management plan for the process. The Strafford Regional Planning Commission issued a Request for Proposals for the work. It received four proposals from consulting firms. After reviewing three of the firms who submitted proposals it selected one of the firms, The Cavendish Partnership Inc., to perform the work. The following documents, the planning process and planning and management recommendations for the Wagon Hill Farm.



Existing Site Conditions

The 139 acre site is located three miles from downtown Durham on Route 4. The site is bisected east to west by Route 4 with 99 acres to the south and 40 acres to the north. The farm has not been used agriculturally for several years and indigenous plants have begun to reclaim the pastures north of Route 4 to some degree around the perimeter of the southern parcel. Gently rolling fields are the dominant feature of the parcel south of Route 4. (See location map)

The openness of the meadows affords distant views to Little Bay to the south and Oyster River to the southwest. The high knolls create an opportunity for significant views across the 99 acre parcel. The views from the shores of the Oyster River are exceptionally good. The views of Route 4 may be considered undesirable due to the heavy volume of automobile and truck traffic. The "wagon" is the focal point on the property for motorists traveling on Route 4.

There are a number of important historic sites and structures on the property. The most prominent historic feature of this site is the Bickford-Chesley farmhouse and its surrounding foundations. The Davis graveyard and the area where the garrison house once stood are also important features. On the northern parcel are the remains of a school house close to Route 4. The history of the site could be interpreted to provide a strong focus for future improvements.

The existing trails system traverses the southern portion of the site with trails in both meadows and wooded areas. Overall the trails are in excellent condition however, some degradation has occurred due to excessive use in sensitive areas by pedestrians and equestrians. Improved surfaces and the introduction of some structures in sensitive areas could prevent future degradation in wet and shoreline areas. If the number of visitors continues to increase, the trails will have to be surfaced with a material that will help define and maintain the walking surfaces while at the same time providing a surface suitable for physically and visually impaired visitors.

Elevation and Surface Hydrology

The site has two distinct high points. The northern high point is at the most northerly portion of the 40 acre parcel along Watson Road. Water drains from this area and collects in the wetland adjacent to Route 4. The other high point is on the 99 acre parcel and is where the wagon is located. Water drains from this ridge north to the wetlands along Route 4 and south to Davis Creek. Water that collects in the wetland along Route 4 eventually exits under the Wagon Hill driveway westerly to Smith Creek and into the Oyster River.

Slope Analysis

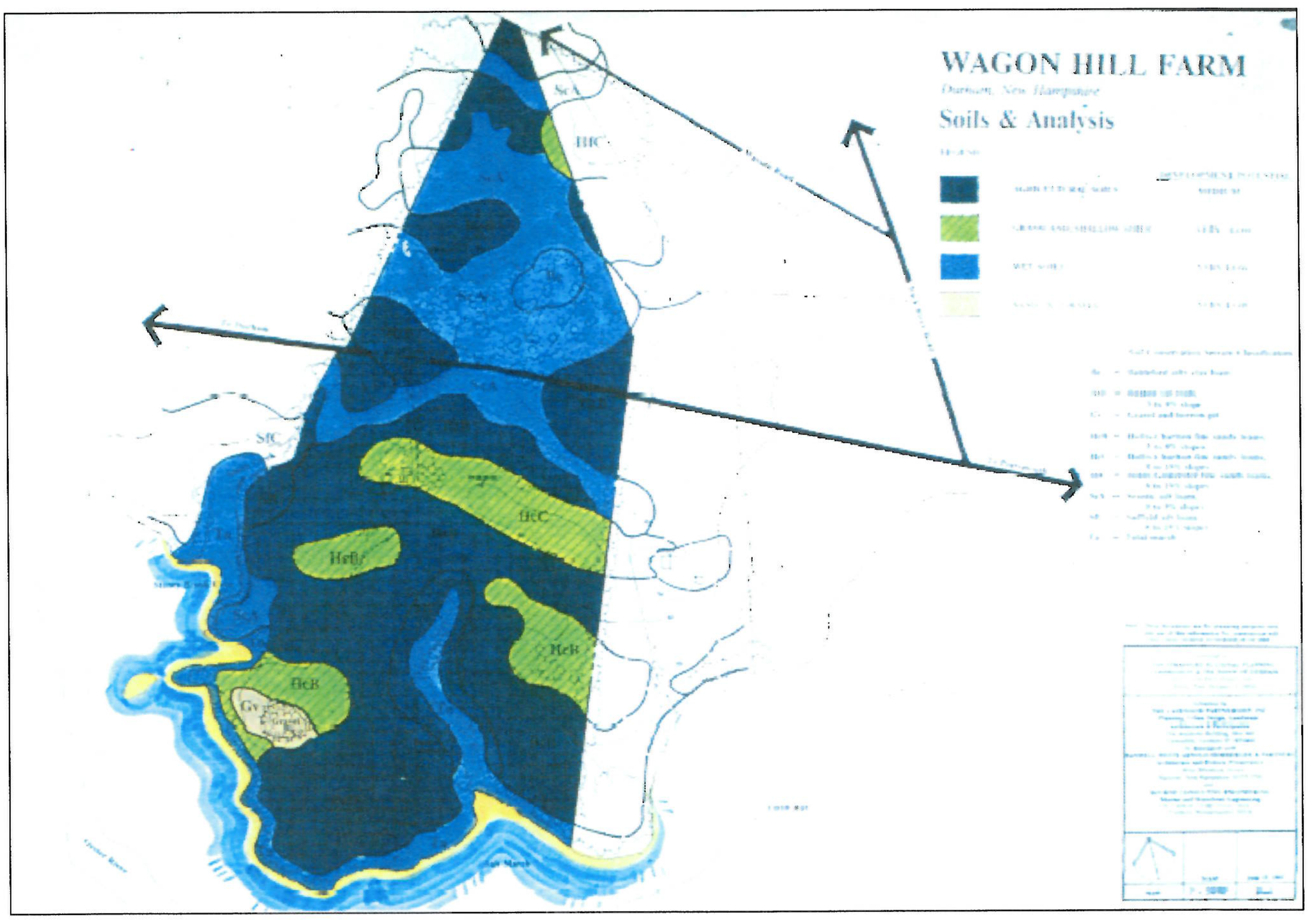
The slope analysis data was derived from United States Geological Survey mapping and site observations. The slopes are generally gradual to moderate on the 40 acre parcel with no areas above 10% gradient. The steepest slopes, in excess of 10% are on the 99 acre parcel around the farmhouse; along the southerly and westerly shorelines; in the gravel pit; adjacent to the knoll with the wagon; and along Davis Creek. The remainder of the 99 acre parcel has gradients within the 2 to 10% range. (See Slope Analysis Map)

Soils Analysis

Soil information was derived from the Soil Survey of Strafford County, New Hampshire prepared by the United States Department of Agriculture- Soil Conservation Service and the Soils Potential Report, prepared by the Strafford County Conservation District. The following soil types have been identified on the Wagon Hill Farm site. (See Soils Analysis Map)

Be	Biddeford Silty Clay on a small portion of the 40 acre parcel
BzB	Buxton Silt Loam- 3 to 8% gradients on the 99 and 40 acre parcels
GV	Gravel Pit located on in the southwest portion of the 99 acre parcel
HcB	Hollis-Charlton- fine sandy loams on top of the knoll on the 99 acre parcel
HcH	Hollis-Charlton- on 8 to 15% gradients on the 99 acre parcel
HfC	Hollis-Gloucester- fine sandy loams, on 8 to 15% gradients on the northeast portion of the 40 acre parcel
ScA	Scantic silt loams on 0 to 3% slopes on the majority of the 40 acre parcel and in the low lands adjacent to Route 4 on the 99 acre parcel
Ta	Tidal Marsh- along the shores of the Oyster River

The Soils Potential Report identified 48 acres on the 99 acre parcel (BzB and SfC) as having medium potential for recreational development. The remaining 92 acres were poorly drained with low to no potential for recreational development.



Vegetation

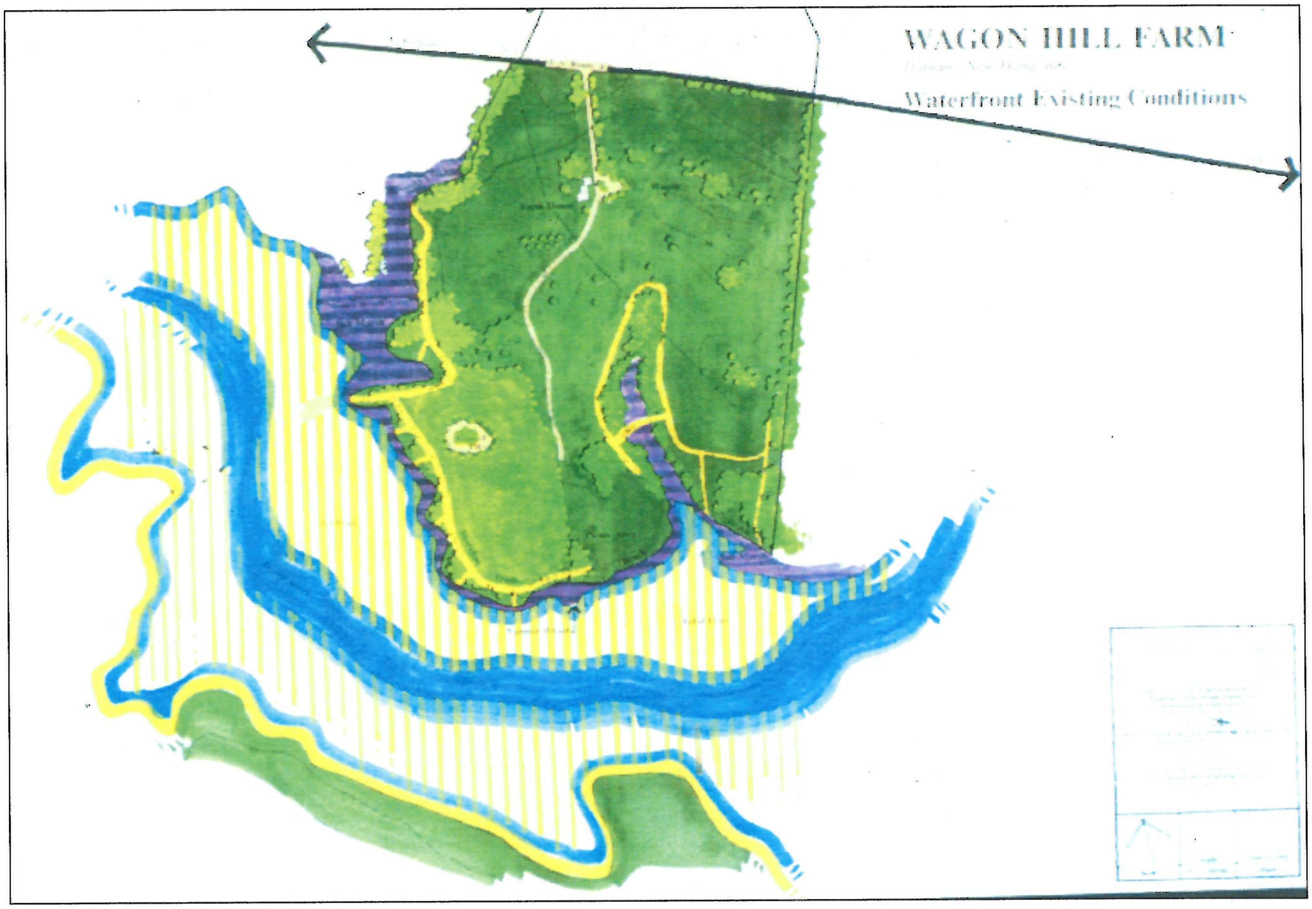
This information was derived from a report entitled, Summary of Existing Potential Bio-diversity of Wagon Hill Farm, Durham, New Hampshire, by Auchly, Jones, Kimmel, Midura, 1990. The report identified forty four different plants. The types of vegetation are indicative of the micro climatic and soil conditions of the site. The white pine stand is significant in that historically the British Navy harvested white pines for ships masts from this region. The diverse plant material also provides food for a variety of wildlife that lives on or in close proximity to the site. The site may be suitable for an arboretum or coastal botanical garden.

Wildlife and Domesticated Animals

This information was also derived from the Summary of Existing and Potential Bio-diversity of Wagon Hill Farm, Durham, New Hampshire report that identified birds, mammals, and coastal flora and fauna. There were fourteen bird species identified on the site and in addition another 28 species were identified as having the potential to utilize the site. Eleven mammals and two sea creatures were also identified. The site is used extensively by visitors walking and running dogs. Dogs (domesticated or otherwise) are natural predators for a variety of animal species and they are naturally perceived as a threat by mammals and birds, even if they don't physically harm them. Dogs may threaten other species by leaving a scent, making noise or by disturbing habitat areas. Dogs running loose can trample plants and unattended leave scat throughout the site. It is recommended that the management plan should provide an opportunity for dog owners to continue to bring their dogs to the farm if specific areas are designated for walking dogs with leashes and for allowing dogs to run free. In addition, existing leash laws should be strictly enforced and owners should be responsible for removing scat from the farm. Preservation and enhancement of the wildlife should be encouraged to create a balance in natural, economic and social use of the site.

Shoreline Conditions

The existing shoreline conditions are a result of soil and ice and tidal forces and human intervention. Segments of the shoreline indicate over use by visitors which has created erosion. These unnatural conditions (pathways) are exacerbated by natural conditions including wind, tidal and ice forces. This erosion, unchecked, has and will continue to result in degradation of the shoreline and salt marshes, negative impacts on wildlife, shell fish and fish habitats. It is recommended that a shoreline stabilization program be implemented as soon as possible. The measures taken should as minimally as possible, emulating the natural conditions of the shoreline. Rip-rapping should only be used where absolutely necessary and whenever possible plant materials or erosion control fabrics should be used. The farm site is susceptible to flooding during the 100-year flood stage and flooding should not impact most recreational uses. (See Waterfront Existing Conditions Map)



Water-based Recreation

The farm is primarily used for land-based recreation. The potential for boating is limited due to tidal conditions, water depths and shoreline that are naturally limited for launching boats. The installation of piers and boar landings may be difficult to permit and implement due to the currents, ice and tidal conditions. Swimming is now taking place on the 99 acre parcel on a limited basis. The site is not ideal for swimming due to tidal conditions and the water currents and it is not recommended that this activity be encouraged to expand for both safety and environmental reasons. Environmentally the salt marshes are particularly sensitive to pedestrian activity which may result from the unplanned expansion of existing swimming areas. Limited access from the water by canoes and kayaks is now taking place and has minimal impact on the farm as long as the access points are defined and controlled. (See Waterfront Existing Conditions Map)

SHORELINE RESTORATION RECOMMENDATIONS

1. The shoreline is in a state of deterioration and it is not anticipated that it will stabilize itself naturally. Shoreline stabilization along the water's edge should take two forms: a hardened edge installation of a rip rap slope. This would be appropriate in limited areas above the salt marsh fringe to prevent continued erosion. Rip rap would include filter

fabric insulation- $410 per linear foot, $451,000. (This project recommends rip rap in limited areas.)

A softer form of shoreline stabilization would require the installation of vegetated fiber roll along the toe of the slope backfilled with soil suitable for the salt marsh plantings. The system would include palette mats that are pre-vegetated to begin the initial re-vegetation of shoreline areas. This method is most desirable where the salt marsh has eroded and replacement is required to prevent further degradation of the salt marsh. Vegetated shoreline stabilization- $205 per linear foot= $225,500. (This project recommends substantial salt marsh plantings.)

2. Protecting the pristine marsh system involves two steps:
First areas of limited degradation should be re-vegetated using a pre-seeded mesh to reestablish plants quickly. The area around the point needs to be rip rapped to protect the area from further erosion.

Secondly, the area known as "The Point" where Davis Creek meets the Oyster River will require some type of structure and/or protection to prevent any further erosion. The area is a part of the pristine marsh system identified by the Durham Coastal Method Inventory & Evaluation Project (DCMT & EP). The structure will be a valuable spot to observe wildlife in the river and marsh. Some of the shoreline degradation is caused by ice and tides, however, most of the impact in this area is from human intervention. Estimate is $20,000

3. There is a desire to short cut the present trail system at Davis Creek bringing people through sensitive wetland habitats. Building a bridge structure will help prevent erosion from occurring at the crossing and will create a wildlife and habitat observation point along the trail. The construction of the bridge should begin by flagging the wetlands in the area and then creating a structure that effectively keeps people above the grasses.

A footbridge at Davis Creek would help protect the wetlands that are now being jeopardized by people crossing the creek. The cost could be minimized by donations- $50 per square foot or approximately $10,000.

4. Trail system improvements include the spreading mulch to help keep people on the trail and to prevent root compaction through wooded areas. The new surface will help prevent people from tripping over tree roots or into holes as well. Areas such as the steep bank down to the beach in the southeast shoreline should either be closed off to prevent further erosion or re-vegetated with plant mats to help protect the bank from further degradation. Simplifying the trails through the area south of the orchard will help keep environmental impact to a minimum. If a phasing program is needed to defer the costs, the areas closet to the river and through any wet areas should be the first to receive the bark mulch. No cost- in house project.

Project Details

Location: Route 4
Tax Map: Map 12, Lot 8-2
Acreage: Entire Property 139 acres
Road Frontage: 1,341' +/- of frontage on Piscataqua Road (US Route 4)
River Frontage: 1,100' +/- of tidal frontage on the Oyster River and Smith Creek
Zoning: Residence Coastal, with a minimum lot size of 150,000 square feet and road frontage requirement of 300 feet.

Wagon Hill Farm consists of high quality working farmland, healthy forest, and significant coastal and estuarine resources along the Oyster River in Durham, NH. The tract has important ecological resources including significant undeveloped coastal shoreline, tidal and estuarine riparian conservation values, and water quality protection attributes.

With 1100 feet of tidal frontage on Little Bay, Oyster River and Smith Creek, and 8.5 acres of tidal and freshwater wetlands, this project will permanently protect important on and off-site aquatic resources. The project will help protect the water quality and aquatic habitats of the Great Bay estuary including the adjacent NHB-documented "sparsely vegetated intertidal system", an exemplary natural community. Wagon Hill Farm has critical pollutant (e.g. nitrogen) attenuation characteristics (NH DES). Historically abundant oyster populations occurred in the Oyster River and Great Bay which The Nature Conservancy and others are working to restore to mitigate water quality impairments of Great Bay. This project will remove the threat of sediment loading from incompatible uses on the property that could smother oyster reefs. The Oyster River and Smith Creek are part of the Piscataqua River Network, classified as having "high relative resilience" according to a recent scientific analysis of predicted resilience to the impacts of climate change (TNC 2013). This project will incorporate significant riparian buffers to protect the estuarine and coastal resources of Smith Creek and the Oyster River.

Maintain Prominent Scenic Vista:

This project provides a very prominent viewshed for commuters along the heavily traveled corridor of Route 4 and boat traffic along the Oyster River. In fact, this parcel is the most visible and recognized parcel due to the prominent fields and the wagon on the hill.

The Durham Master Plan (2000) identifies this viewshed as one part of "the entrance to Durham as you pass Wagon Hill Farm, Emery Farm, Johnson Creek, Old Piscataqua River, and Bunker Creek" . . . protection of these viewsheds should be and will continue to be a high priority for Durham.

Draft Project Budget

Expenses

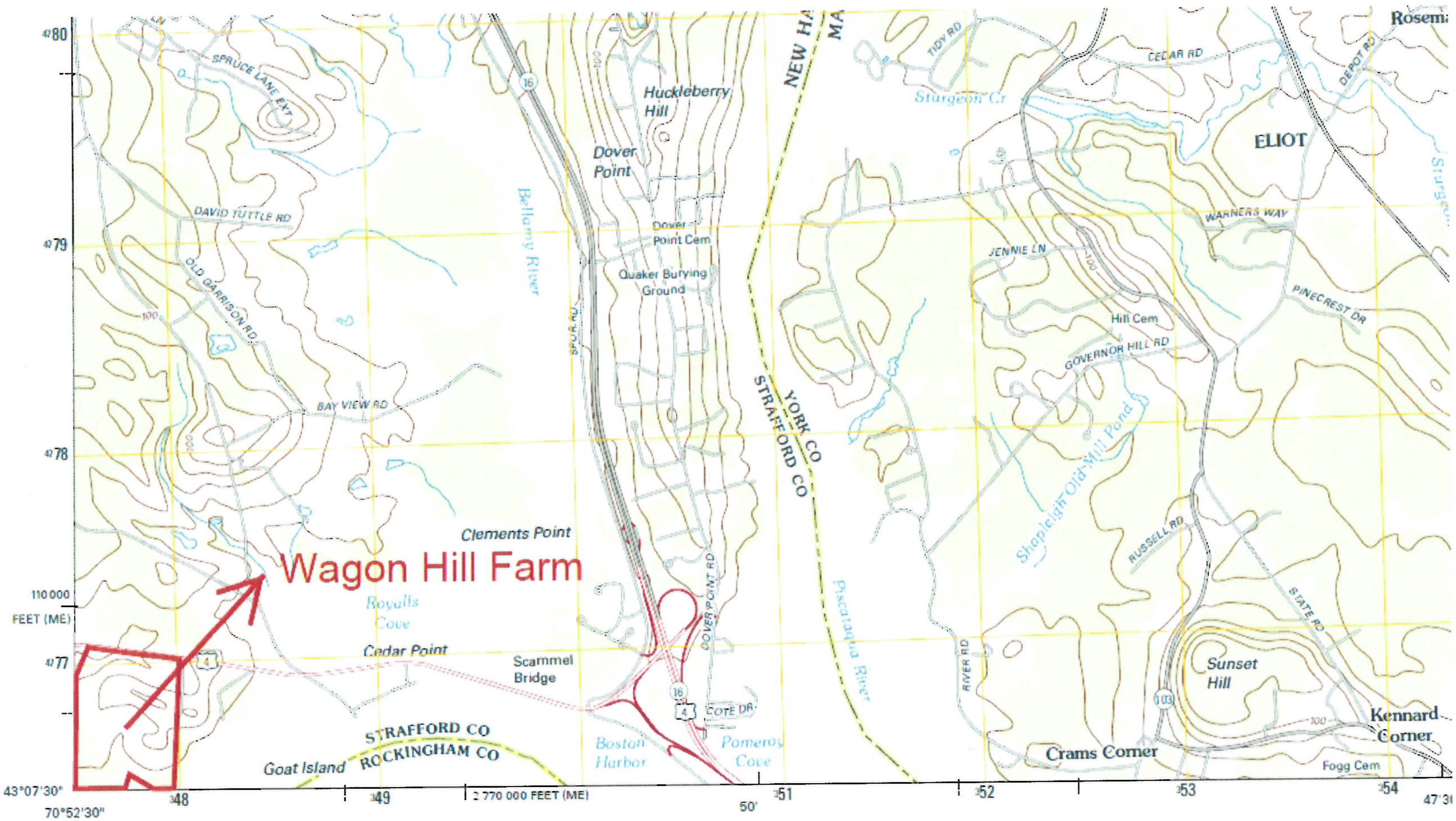
Shoreline Restoration	$338,250	(mix of hardened edge and soft re-vegetated stabilization.)
Bridge (Davis Creek)	$10,000	
Davis Creek Point	$20,000	
TOTAL EXPENSES	**$368,250**	

Revenues

Eversource Mitigation Project	$170,000
Lois Brown Trust	$115,000
Town of Durham	$83,250
TOTAL INCOME	**$368,250**

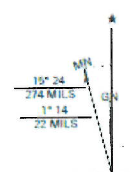
Attachments:

USGS Map
Current Erosion Photos (9/3/15)



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 19T
10 000-foot ticks: Maine Coordinate System of 1983 (west zone), New Hampshire Coordinate System of 1983

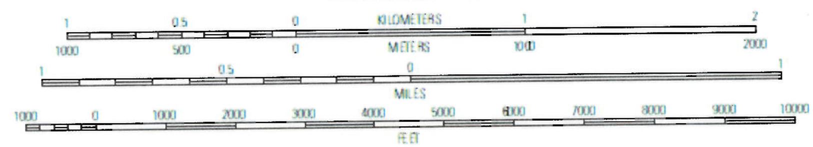
Imagery.........NAIP, July 2009 - July 2011
Roads.........©2006-2011 TomTom
Names.........GNIS, 2011
Hydrography.........National Hydrography Dataset, 2009
Contours.........National Elevation Dataset, 2005
Boundaries.........Census, IBWC, IBC, USGS, 1972 - 2010



UTM GRID AND 2012 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
CH
Grid Zone Designation
19T

SCALE 1:24 000



CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.2

EROSION PHOTOS 9/3/15

Appendix D. Little Bay Environmental Monitoring Plan

Seacoast Reliability Project
Little Bay Environmental Monitoring Plan

The 401 Water Quality Certification application prepared for the Seacoast Reliability Project acknowledges that exceedances of allowable turbidity increases are anticipated to occur during construction. In anticipation of water quality monitoring being required as a condition of the Water Quality Certification, PSNH proposes the following environmental monitoring plan.

Environmental monitoring associated with the installation (burial via jet plow) of three electric transmission cables across Little Bay for the Seacoast Reliability Project (SRP) includes three components: water quality monitoring during construction, recovery of benthic habitat conditions (i.e., bathymetry) along the installations, and recovery of benthic infaunal community after construction. The general approaches to these surveys are described in this document.

1.0 Water Quality Monitoring During Construction

As has been described in the SRP Natural Resource Impact Assessment Report, the installation of cables will cause suspension of sediments into the water column resulting in the creation of a tidally-driven plume. The Water Quality Certification Application has demonstrated that the suspended sediment plume projected to occur generated during cable installation will not have deleterious effects on sensitive resources in Little Bay. There is no simple correlation between suspended sediments and turbidity, the parameter NHDES uses to determine impairment, however. PSNH therefore proposes to conduct a field survey measuring turbidity during cable installation in order to verify that the turbidity criterion of < 10 NTUs above background has been met at the edge of the mixing zone. As shown by the water quality model, a plume of excess suspended sediments will cross the bay in conjunction with the jet plow. The width and length of the plume will vary with the tidal stage. During ebbing and flooding tides, the plume will be narrow and elongated; during slack tides, the plume will be shorter and wider. At no time is the plume predicted to encompass more than a fraction of the width of the bay.

Suspended sediments cannot be measured directly *in situ* so turbidity is proposed as a surrogate and is the parameter that NHDES uses as a criterion for water quality. According to Env-Wq 1700.11, turbidity in Class B waters such as Little Bay shall not exceed naturally occurring levels by more than 10 NTUs, specifically stating "For purposes of state enforcement actions, if a discharge causes or contributes to an increase in turbidity of 10 NTUs or more above the turbidity of the receiving water upstream of the discharge or otherwise outside of the visible discharge, a violation of the turbidity standard shall be deemed to have occurred." As the installation operation via jet plow will take place over a discrete period of time (about 13 hours for each cable) and the activity will constantly progress across the bay (rather than remaining in one location), PSNH believes that demonstrating that the plume is ephemeral will show that the project meets the water quality criterion.

1.1 General Water Quality Monitoring Procedures

As allowed under New Hampshire Surface Water Quality Regulation Env-Wq 1707, PSNH proposes to implement a mixing zone during construction, when exceedances of turbidity increases over 10 NTUs above background levels are anticipated to occur. The proposed mixing zone complies with all Minimum Criteria established in Env-Wq 1707.02. Monitoring will take place at the edge of the proposed mixing zone, defined as 1,000 ft down current of the planned cable route for each cable. A reference station will be located 1,000 ft up current of the planned cable route for each cable. During high slack and ebbing tides, the southern station will be considered the reference station and the northern station will be considered the mixing zone or impact station. During low slack and flooding tides, the location of the reference and mixing zone stations will reverse.

There will be a series of five stations north and south of the cable route. Each station down current and up current of the jet plow will be occupied hourly during the installation. At each station, turbidity will be measured using a turbidity probe at the near-surface (within 1 foot of the surface), mid-depth, and near-bottom (within 1 foot of the substrate). In addition, a continuously recording turbidity probe will be deployed adjacent to the southern boundary of the Bay Point Oysters Co. lease.

Monitoring will be initiated one hour prior to the startup of the jet plow and continue for two hours after jet plowing has been completed. Data collected prior to jet plow startup is considered to be reference data regardless of the location of the station.

Other information to be recorded will include date, time, water depth, tide stage, weather conditions, and other relevant observations.

Determination of Compliance with Turbidity Criterion

Logistics of jet plowing make it very difficult to stop and re-start operations once a plow has been initiated without causing a greater disturbance. Because PSNH plans to install three cables in close proximity to one another, results of water quality monitoring during the first installation can be used to make adjustments to the later installations.

Monitoring data will be evaluated as follows:

- The three water column measurements collected at each impact and each reference station will be averaged for each hour
- Average values at an impact station will be compared to the range of reference station averages for that hour
- If average turbidity at any impact station exceeds the highest reference station value by ≤ 10 NTUs at a given time, the difference between values will be considered to be insignificant

- If average turbidity at any impact station exceeds the highest reference station value by more than 10 NTUs for that particular hour, but does not exceed the highest reference station value the following hour, then the exceedance is considered to be insignificant
- If average turbidity at any impact station exceeds the highest reference station value by more than 10 NTUs for two consecutive hours, then further evaluation will be required (see below).

Data will be provided to regulatory agencies within 48 hours of completion of the jet plow crossing to enable further evaluations if required. Further evaluations could include comparison of the impact station results to the long term database maintained for the CICEET buoy in the middle of Great Bay. If the absolute value of the impact data falls within the range of observations for the fall months, then it could be considered to be consistent with natural variability. If it is determined that the impact station results are outside the range of natural variability, then the marine contractor will be required to modify their operation of the jet plow for the subsequent installation(s). The most likely factors that could be changed are the advancement rate across the bay and the pressure directed through the water chambers on the plow blade.

2.0 Bathymetric Monitoring

Substrate condition, including microtopography and grain size distribution, is one of the dominant factors affecting benthic habitat. The installation of the three cables will temporarily affect bathymetry along an approximately 100-ft wide swath crossing Little Bay, potentially resulting in areas of excess deposition adjacent to the cables and areas of depression over the cables. The changes in microtopography could influence the composition and distribution of benthic infauna and the use of the substrate by epibenthic species (e.g., lobsters, crabs, and horseshoe crabs). Grain size distribution will be characterized during benthic infauna sampling (see below).

Based on discussions with PSNH's consulting marine contractor, Caldwell Marine, it is not expected that there will be a substantial (i.e., more than a few inches) depression over each cable. Predictions for redeposition of sediments mobilized during cable installation indicated that the bulk of the sediments will settle back into the plow scar and the likelihood of creating mounds of sediments adjacent to the cables is low. It is expected that normal currents and storm action will redistribute any displaced sediments resulting in natural restoration of bathymetry to the relatively smooth condition that existed prior to the cable installation.

PSNH proposes to conduct a detailed bathymetric survey immediately following cable installation. If results indicate bathymetric changes in excess of six inches above or below the surrounding topography, a second survey will be conducted in the spring to incorporate the effects of natural processes, such as winter storms or ice activity. This timing is reasonable because peak benthic infaunal recruitment will occur during the spring and summer months. The survey area will extend at least 100 ft north and south of the 100-ft wide cable route for a minimum total width of 300 ft. The survey will cover the entire jet plow installation route. The data will be examined for evidence of a depression directly over any of the cables or mounding adjacent to the cables. If such changes are noted and the benthic infaunal survey to be conducted in the late summer/early fall (see Section 3) indicates that benthic infaunal recruitment has been very limited then a follow-up survey will be conducted a year later. If after two years, bathymetric changes have persisted and infaunal recruitment has continued to be insufficient, PSNH will discuss with the agencies what mitigation would be required. If adequate infaunal recruitment has occurred in the first year, no follow up bathymetric survey and no mitigation would be required.

3.0 Benthic Infaunal Community Monitoring

Installation of the three cables across Little Bay will unavoidably disturb the estuarine substrate in approximately 6.3 acres through a combination of displacement into the water column, compression by the jet plow skids, and redeposition of suspended sediments back on to the bay floor. As described in the Impact Report, the benthic infaunal community in this footprint will be impacted. It is expected that the substrate will be restored to its approximate pre-construction condition, including grain size distribution and bathymetry, by natural processes. Because the in-water cable installation is planned to take place during the fall, recruitment of infaunal organisms into the disturbed area is likely to be limited until the following spring through summer when benthic reproduction is typically at its peak. PSNH proposes to document the recovery of the infaunal community to demonstrate that there is no long term degradation of this resource in the project footprint and that the benthic community within the area of disturbance is functioning the same as that outside the disturbance.

3.1 General Benthic Monitoring Approach

Baseline sampling was conducted in early fall 2014 along three transects running perpendicular to the charted Cable Area in different depth strata (Figure 1). This design was selected to enable a characterization of the benthic infaunal community in the project area. It will also provide an indication of spatial variability, although a single year does not capture the full range of natural temporal variability that occurs in a system like Little Bay and does not account for events such as storms that affect large areas. In general, the baseline collections showed that within a depth stratum, the transects represented a single, fairly consistent community across the proposed construction zone indicating that a similar gradient-type design for post-installation monitoring should be effective in documenting recovery. For that reason, PSNH proposes a similar study design for the post-construction monitoring, locating stations along the transects so that they fall both within and well outside the predicted area of disturbance.

Post-construction benthic monitoring will include analysis of grain size, total organic carbon (TOC), and benthic infauna collected from five stations along each of the three transects occupied during the baseline survey. On each transect, one of the stations will be located within the 100-ft wide area of disturbance and the remaining stations will be located outside the disturbed area, two stations to the north and two to the south. This design will allow the evaluation of whether there is a gradient of community parameters with distance from the impact area. The eastern portion of the cable route has been shifted slightly south since the baseline sampling took place, so it will be necessary to relocate some of the benthic stations. Sampling will take place in September to capture the majority of the annual peak benthic reproductive period and to allow comparisons to the baseline survey as appropriate (e.g., magnitude of spatial variability within a depth zone).

3.2 Determination of Recovery of Benthic Resource Function

Evaluation of recovery of benthic infaunal resources will be based on a series of parameters and measures, including: percent fines (silt + clay), percent sand, total abundance, species diversity and evenness, relative abundance of opportunistic species, specific dominant species, and feeding guilds.

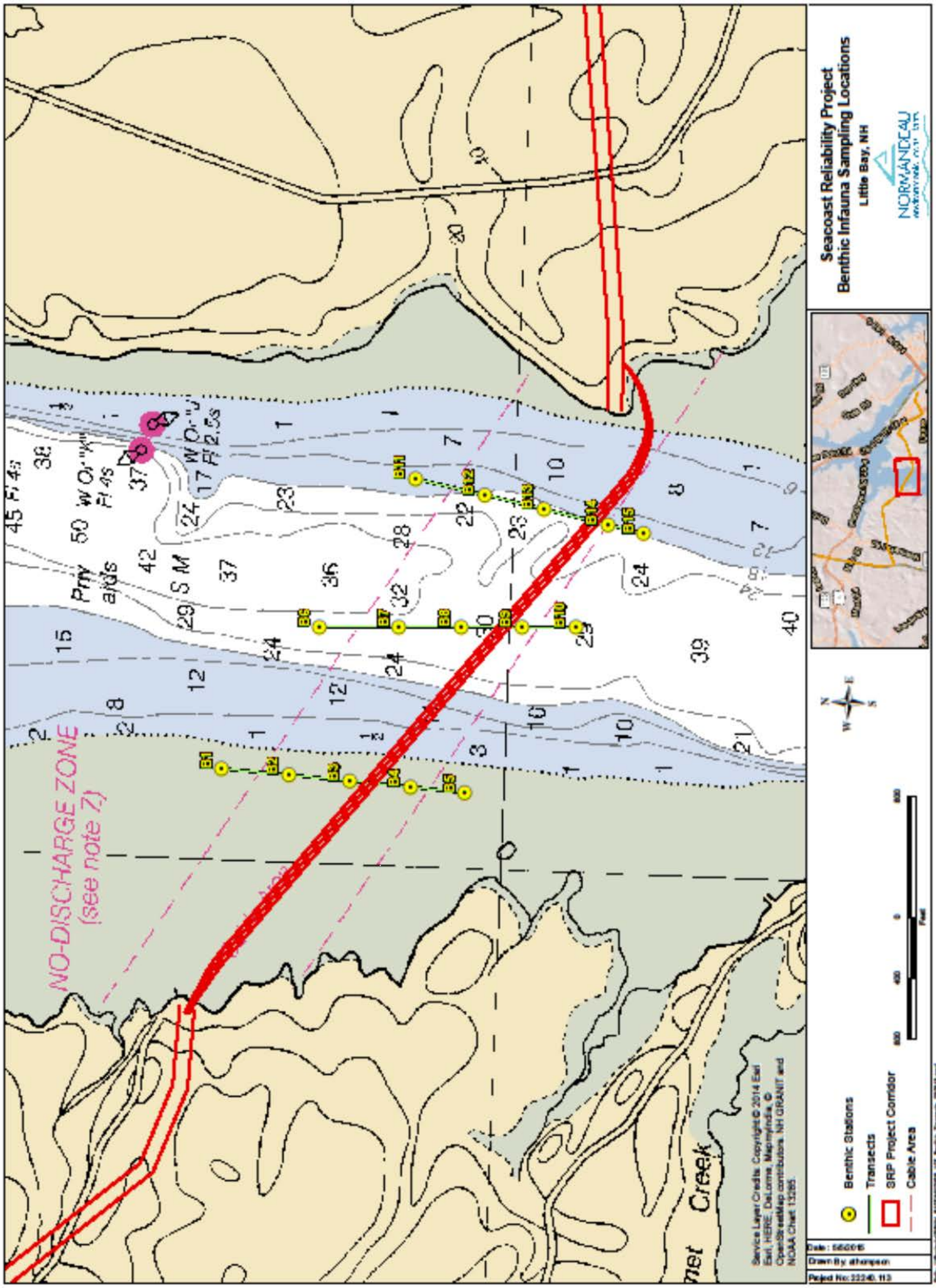


Figure 2. Location of benthic infaunal baseline collections.

Comparisons will be made across the stations along a specific transect. Suggested criteria for evaluating recovery of the benthic infaunal community, as have been used in other monitoring programs (e.g. MWRA's harbor and outfall monitoring program and the HubLine and Northeast Gateway Lateral gas pipeline monitoring programs), are presented in Table 1.

Table 1. Criteria for Measuring Successful Restoration of Benthic Habitat

Parameter	Criterion (Comparison of Impact Station to range in Non-impact Stations within same depth zone)
Percent Fines	Within 10%
Percent Sand	Within 10%
Total Infauna Abundance	Within 20% (higher or lower)
Species Diversity (Shannon Weiner H′)	No more than 10% lower than range
Evenness (Pielou's J′)	No more than 10% lower than range
Relative Abundance of Opportunistic Species (e.g., *Polydora cornuta*, *Streblospio benedicti*, and *Capitella capitata*)	On tidal flat, no more than 3-fold difference between impact station and non-impact stations (comparable to range in baseline) In channel – no more than 4-fold difference (range in baseline was 0-186 per grab) unless explainable by differences in grain size and TOC On slope – no more than 4-fold difference (comparable to range in baseline)
Similarity of Dominant Species	Three numerical dominants in impact station are among the dominants (i.e., those taxa that combined make up $\geq$75% of total abundance) in at least one of the non-impact stations and their relative abundances are within 10%
Similarity of Community Structure	Based on Bray-Curtis similarity, impact station clusters at a similarity value of 60% or higher to at least one other non-impact station
Feeding Guilds	Distribution of species within feeding guilds similar among stations along the transect; no shift from predominantly subsurface deposit feeding to surface deposit feeding community

Sediment grain size is one of the primary factors affecting infaunal community structure. A 10 percent difference in either percent fines or percent sand could potentially result in an altered community and should be considered as an alert. However, it should not stand alone as an indication of project-related change in the benthos. If the criteria based directly on infauna parameters show no or limited differences between the impact station and non-impact stations, then the change in sediment grain size distribution would be considered to be inconsequential.

If the preponderance (i.e., four or more) of the seven biological criteria show similarity between impact stations and non-impact stations along a depth transect, then it will be concluded that benthic infaunal community recovery has occurred. If the preponderance of the criteria shows differences between impact stations and non-impact stations along a depth transect, then greater weight will be given to species diversity, similarity of community structure, and feeding guilds because these criteria each integrate multiple aspects of community structure. The number of opportunistic organisms (e.g., *Polydora, Streblospio* or *Capitella* were examples observed in the 2014 infauna sampling) can vary widely temporally as many have multiple reproductive cycles per year. Therefore, if "relative abundance of opportunists" is one of the criteria suggesting a lack of recovery, the other criteria will be recalculated without these species to get a sense of the magnitude of their influence. If this re-analysis causes other criteria to be met, then PSNH will conclude that recovery has occurred.

Should the results of the survey conducted in the year following installation indicate that any of the impact stations has not recovered biologically, then the survey will be repeated a second year for the affected transect(s). Lack of recovery after two years would suggest a more long-term change in infaunal community structure and the need for mitigation, to be discussed with the regulatory agencies.