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Appendix D

Jet Plow Trial Run Plan

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Seacoast Reliability Project
Jet plow Trial Plan
Draft

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1.0 Introduction

Eversource's Seacoast Reliability Project (SRP) will involve burying three cables in the sediments crossing Little Bay north of Adams Point within a corridor previously identified as "Cable Area" on navigation charts. The cables will be installed along most of the route across Little Bay using a jet plow (also called a jet sled). While this technology has been used extensively worldwide, it has not been used in New Hampshire. Impacts associated with the jet plow installation were described in several project documents (Normandeau 2016; RPS 2016, 2017). The primary effect from jet plowing will be release of sediments into the water column creating a turbidity plume that will move with the tides and with the progress of installation along the route.

Cable installers typically incorporate a trial run of the jet plow into their project plans. Every project area presents different conditions in terms of water depth, sediment characteristics, and tidal conditions that can affect the efficiency of the jet plow. Conducting a trail run gives the installer a better understanding of how the jet plow will behave under site specific conditions than can be obtained otherwise. Through the trial run, the installer can evaluate the effects of different advance rates and changing water pressure through the jets prior to cable placement.

NH DES's Permit Condition 60b stipulates that Eversource provide a plan for the jet plow trial at least 90 days prior to the actual trial, further stipulating that water quality be monitored during the trial run and that cable installation by jet plow cannot proceed until NHDES has reviewed and accepted the results of that monitoring. Condition 60b specifically states:

Condition 60b: Jet Plow Trial Run

If the SEC determines that jet plowing should be allowed for submarine cable installation in Little Bay (instead of other alternatives such as horizontal directional drilling), and that a jet plow trial run (without cable) should be conducted prior to installation of the submarine cable (as recommended by NH DES in a letter dated February 28, 2018 to the SEC if jet plowing is the selected alternative), the Applicant shall, unless otherwise authorized by NH DES, comply with the following:

- *At least 90 days prior to the trial, the Applicant shall submit a Jet Plow Trial Plan (JPTP) to NHDES for approval and then implement the approved plan. The JPTP shall describe in detail how and when the trial and monitoring will be conducted and results reported.*
- *At least 14 days prior to the scheduled start of submarine cable installation in Little Bay the Applicant shall submit a jet plow trial run summary report to the SEC and NH DES that addresses the following:*
  - *how well the model predicts the sediment plume ;*
  - *how well the water quality monitoring plan works (including communication between the monitors and jet plow operators) and what if, any, modifications to the plan are necessary;*
  - *water quality monitoring results within the mixing zone and at the boundary;*
  - *how measures taken to reduce sediment suspension due to jet plowing (including, but not limited to jet plow speed and pressure reductions) impact water quality;*
  - *if results suggest that cable installation by jet plowing is likely to meet NH surface water quality standards; and*
  - *if any additional sediment suspension reduction measures are needed to help ensure surface water quality standards will be met.*
  - *Installation of submarine cable in Little Bay shall not proceed until authorized by NH DES and the SEC.*

This document provides the jet plow trail run protocol developed by Kokosing Industrial Inc., the construction contractor for the SRP (Appendix A) and a summary of the water quality monitoring approach (see the Water Quality Monitoring Plan for full details).

2.0 Water Quality Monitoring During Jet Plow Trial

Eversource will implement the water quality monitoring program described in Normandeau (2019). The location of the jet plow trial run is shown on Figure 1. This location slightly south of the planned cable route was selected to avoid areas where remnant cables occur and to enable testing of the jet plow in both shallow and deeper conditions. The start point of the 1,000 foot long trial area is farther east from the western shoreline than the start point for an actual installation. In order to ensure that plume conditions during the trial run are similar to those during an installation, therefore, the trial run will start 2-3 hours after high slack tide, or the length of time that it would take the jet plow to reach this point during an installation.

3.0 Field Decision

3.1 Communication During Operations

Coordination among sampling teams and the Independent Environmental Monitor (IEM) are critical to ensure that appropriate decisions necessary to protect water quality in Little Bay can be made in a timely manner. Communication protocols will be discussed during the training session conducted in advance of the jet plow trial run.

Field crews will report routine turbidity readings to the onshore field coordinator periodically through the day. If a turbidity exceedance occurs, the IEM will be notified immediately and will confirm with each field crew what the next course of action will be.

3.2 Determination of Compliance with Turbidity Criterion

The field team performing the water quality monitoring will be in contact with the IEM on the jet plow vessel to coordinate an immediate response, if turbidity results indicate the need. It is important to understand, however, that one purpose of the trial run is to experiment with adjustments to the operation of the jet plow. It will be critical, therefore, for the plow operators to maintain a detailed log of these adjustments so that water quality results can be interpreted appropriately.

Turbidity monitoring data will be compared to the baseline database described in the Water Quality Monitoring Plan (Normandeau 2017).

Water quality monitoring will focus on the six stations (near-field stations 11, 12, 16, and 17; boundary stations 23 and 24) and the reference stations (41, 42, and 43) in the vicinity of the predicted plume. Fixed instruments will be deployed at stations 31, 32, and 33 prior to the trial run. Coordinates for these stations are shown in Table 1. Anticipated time when plume would be in the vicinity of each of these stations is shown in Table 2. Further details of the monitoring are included in Normandeau (2017).

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Figure 1. Location of the jet plow trial run.

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Table 1. Coordinates for SRP Water Quality Monitoring Stations.

Station	Latitude	Longitude
Near-Field Stations		
11	43.10481	-70.8658
12	43.10289	-70.8624
16	43.10138	-70.8659
17	43.09959	-70.8628
Boundary Stations		
23	43.10959	-70.865
24	43.10758	-70.8615
Fixed Instrument Stations		
31	43.10949	-70.8636
32	43.10529	-70.8577
33	43.09365	-70.8613
Reference Stations		
41	43.1164	-70.8605
42	43.11501	-70.8551
43	43.08367	-70.868

Table 2. Anticipated timing of water sampling based on predicted presence of plume in general vicinity of boundary and near-shore stations.

Boundary sampling station	Depth condition	Period when plume could be in vicinity (hrs after start of jet plow passage)		Maximum planned no. of hours to collect water	Maximum total water samples (assumes 3 depths)[b]
		Fast passage	Slow passage		
North of crossing[a]					
21	Tidal flat (W)	0-1	0-1	2	6
22	Tidal flat (W)	1-3	1-4	4	12
23	Tidal flat (W)	1-3	1-4	4	12
24	Channel	3-4	5-7	5	15
25	Channel	5-7	n/a	3	9
26	Tidal flat (E)	7-8	n/a	2	6
South of crossing[a]					
27	Channel	n/a	6-9	4	12
28	Channel	n/a	9-12	4	12
29	Channel	n/a	10-13	4	12

[a] stations numbered from west to east
[b] water samples for lab analyses only collected at depths where turbidity exceeds 10 NTUs above background

(continued)

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Table 2. (Continued)

Near-field sampling station	Depth condition	Period when plume could be in vicinity (hrs after start of jet plow passage		Maximum planned no. of hours to collect water	Maximum total water samples (assumes 3 depths)[b]
		Fast passage	Slow passage		
North of crossing[a]					
10	Tidal flat (W)	1-2	1-4	4	24
11	Tidal flat (W)	1-2	1-4	4	24
12	Channel	3-4	5-7	5	30
13	Channel	5-6	8-9	5	30
14	Tidal flat (E)	7-8	12-13	2	12
South of crossing[a]					
15	Tidal flat (W)	1-2	1-4	4	24
16	Tidal flat (W)	1-2	1-4	4	24
17	Channel	3-4	5-7	5	30
18	Channel	5-6	8-9	5	30
19	Tidal flat (E)	7-8	12-13	2	12

[a] stations numbered from west to east
[b] water samples collected each time station is occupied

4.0 Data Reporting and Actions

Parameters collected instantaneously (turbidity, DO and salinity) will be summarized immediately for a preliminary assessment of the effects of jet plow operation. Water samples will be sent to the analytical laboratory immediately and the fastest turn-around time will be requested. Rapid turn-around times for most parameters will be 24 hours from receipt at the laboratory although nitrogen analyses may require up to two days. Once laboratory results are validated, the data will be tabulated. Patterns will be summarized briefly and a written report (with a complete data package) will be submitted the NHDES no later than one week after the jet plow trial.

Several key questions will be addressed in the report, including:

- do the TSS results corroborate the sediment plume predictions made by the model in terms of location, duration, and concentration;
- does the water chemistry within the mixing zone indicate that acute toxicity standards will be met; and
- do the turbidity results indicate that water quality at the mixing zone boundary will meet the state's turbidity standard?

The report will also provide an account of the actions taken during the trial run, including:

- a copy of the operator's log, linking the time line to the water quality monitoring;
- a summary of actions taken in response to turbidity data reports;
- an analysis of whether these actions produced a noticeable change in water quality;
- an evaluation of whether the water quality monitoring plan (Normandeau 2019) was effective in terms of:

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  - communications between the monitors and the IEM and between the IEM and the operators (including input from the IEM)
  - ability to sample efficiently and completely; and,
- an assessment of whether the sediment suspension reduction measures proposed in Normandeau (2017) were effective and sufficient to ensure the project would meet surface water quality standards during jet plow installation. If these measures do not appear effective, the report will provide recommendations for additional measures that could be implemented.

5.0 Literature Cited

Normandeau. 2016. Natural Resource Impact Assessment. Appendix 34 in Application of Public Service Company of New Hampshire d/b/a Eversource Energy for Certificate of Site and Facility for the Construction of a New 115 kV Electrical Transmission Line from Madbury Substation to Portsmouth Substation. Application to the New Hampshire Site Evaluation Committee, SEC Docket No.2015-04. April 12, 2016.

Normandeau. 2019. Seacoast Reliability Project Water Quality Monitoring Plan.

RPS. 2016. Modeling Sediment Dispersion from Cable Burial for Seacoast Reliability Project, Little Bay, New Hampshire. Appendix 35 in Application of Public Service Company of New Hampshire d/b/a Eversource Energy for Certificate of Site and Facility for the Construction of a New 115 kV Electrical Transmission Line from Madbury Substation to Portsmouth Substation. Application to the New Hampshire Site Evaluation Committee, SEC Docket No.2015-04. April 12, 2016.

RPS. 2017. Revised Modeling Sediment Dispersion from Cable Burial for Seacoast Reliability Project, Upper Little Bay, New Hampshire. Document 1 in Supplemental Information, Application to the New Hampshire Site Evaluation Committee, SEC Docket No.2015-04. June 30, 2017.

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Appendix A

Jet Sled Instream Water Quality Test Procedure

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Jet Sled Instream Water Quality Test Procedure

Abstract

Kokosing Industrial – Durocher Marine Division utilizes a jet sled to expedite the burial installation of high voltage submarine power cables. The jet sled accomplishes burial by guiding the power cable through a burial stinger into a trench created by fluidizing sediment using water jets. Depending on the characteristics of the sediment, a portion of the fluidized sediment can become suspended in the water column, causing increased turbidity and total suspended solid levels. This testing procedure outlines the installation practices associated with using a jet sled. These procedures will be used to perform a trial jet sled run to sample instream conditions representative of normal operating conditions.

Document No. LSCA-EE-KIDMD045

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Document type:	Contractor Name	
Test Report	Kokosing Industrial Inc. Durocher Marine Division	
Project:	Contractor's Document Number:	Issue
Little Bay Cable Installation	LSCA-EE-KIDMD045	D1
Document title:	Page:	Category:
Jet Sled Instream Water Quality Test Procedure	1 of 7	EXTERNAL

D2	04/24/19	Normandeau Review	TJP	04/25/19	TJP	TJP
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Issue	Date	Document Status	Prepared	Checked	Approved	Released

Contractor:	Contract Information:
LS Cable America	Job No. : 25090
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A common method of submarine cable installation is through the use of a jet sled. A jet sled is deployed and pulled by an installation vessel along a cable route. As the sled is being pulled, submarine power cable is allowed to exit off the vessel stern chute, through the water column and into the jet sled bellmouth. The power cable then passes through a stinger that places the cable at a pre-determined burial depth. In order to reduce the pulling tensions on the sled, water jets are used to fluidize the sediment in front of the burial stinger. By fluidizing the sediment, there is potential to cause a change in water quality adjacent to the work site. The extent of the sediment plume caused by the jetting operations is entirely site specific, dependent on soil grain size and flow conditions. The procedures laid out herein are the normal operating parameters for a jet sled during an installation event. These procedures should be followed as closely as possible during a trial run to replicate conditions analogous to the cable installation event.

2 EQUIPMENT

2.1 JET SLED

Kokosing Industrial – Durocher Marine Division (KIDM) utilizes an ETA, Ltd. designed jet sled that allows burial up to two meters as shown in Figure 2. This sled is designed with a maximum pulling tension of 40,000 lbf. The speed at which burial occurs is dependent on keeping the pull force below the 40,000 lbf limit. Typical installation speeds range from 300-600 feet/hour based on soil condition, with a maximum allowable soil pressure of 20 kPa. Installations in jettable material occur at an average speed of 3-5 ft./min after taking anchor moves into consideration. The rate of jetting advance is optimized based on the water jet flow, pressure, and nozzle configuration. Using pre-construction site soil survey information, the jet sled nozzle size and pumps are chosen.

2.2 JET PUMPS

KIDMD uses a pair of high head, high flow jet pumps to meet the requirements for flow and nozzle pressure. These pump have been used successfully on multiple jobs and meets the flow and pressure requirements for projects requiring less than 500 feet of hose to reach the jet sled. Flow and pressure are directly proportional to hose length due to friction loss. A cut sheet of a typical pump curve can be found in Figure 1. This pump curve is compared with the system curve to determine the system operating point.

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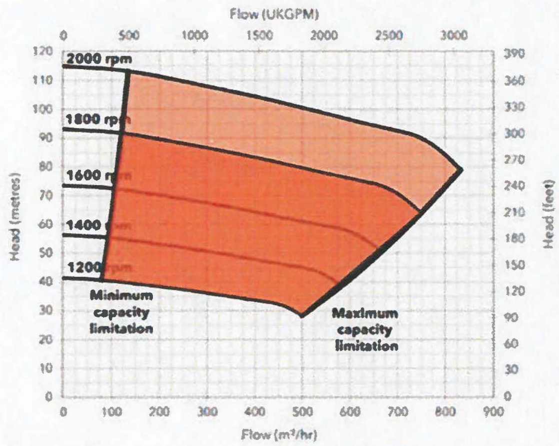

FIGURE 1: TYPICAL HIGH HEAD, HIGH FLOW JET PUMP CURVE

3 OPERATION

Upon deployment of the jet sled from the cable installation vessel, the power cable will be pulled through the bellmouth and out the back of the raised stinger to the manhole location on the shore. After the power cable is secured in the pullbox/manhole, burial operations are ready to begin. The pumps on the installation vessel are started and brought up to operating speed to supply the jet sled with water. The installation vessel begins moving ahead using anchors and the burial stinger is slowly rotated down until the desired burial depth is achieved. The installation will continue moving ahead on the route until the anchor or anchors used for advancing the vessel need to be repositioned. As the vessel anchors are repositioned the jet pumps used to supply the sled will be reduced to idle speed. The pumps are run at idle speed to prevent the intrusion of sediment into the system and block the jetting nozzles.

The speed at which burial occurs is limited by the maximum pulling tension on the sled. During installation the jet pump/s RPM's are adjusted to allow for the fastest rate of burial without compromising the structural integrity of the sled. Maximum advancement rates are limited due operator reaction time when subsea obstructions are encountered.

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3.1 TELEMETRY

To determine if the jet sled is operating properly during installation events, telemetry is installed on the jet sled and flow system. This data is recorded and displayed in real-time from KIDM's proprietary cable lay software system. Information recorded by this system includes sled pitch and roll, depth of burial, sled position, water depth, jet hose pressure at sled, jet hose pressure at surface, system flow rate, and sled tow tension.

3.2 ANCHORING

The project intends to use four (4), 8,000 lb anchors to maneuver the barge along the cable route. As the barge advances, the anchors will need to be moved approximately three times to reach the opposite shore landing site. The approximate time to reposition anchors can take up to one hour. It should be noted that in shallow water areas the repositioning of anchors can cause sediment to be introduced into the water column from the anchor handling tug's propellers. This operation would generate sediment in the water column similar to lobster boats or perhaps oil spill support vessels.

4 TRIAL RUN PROCEDURE

The intent of the trial run will be to operate the jet sled under conditions as close as possible to the actual cable installation procedure. The trial run is to be performed over 1,000 feet in a simulated cable burial. The trial route will encompass both the shallow burial and the deeper burial portions of the route so that it characterizes the different water depths, sediments and burial depths expected along the route. The trial run will be performed using a cable installation vessel and equipment representative of an actual cable installation, including the use of all telemetry to compare jet sled data to water quality data collected by others. Total time to perform the trial run after all anchors are positioned and the vessel begins advancing the sled should take approximately 200 minutes at an average rate of 5.0 ft./min. An anchor move during the trial run should not be necessary unless the trial route goes around a curve, but an anchor move can be simulated for the study. The trial run is scheduled to start jetting operations at a slack high tide. Total time for setup and execution of the trial run after vessel mobilization should take two days.

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5 JET SLED DRAWING

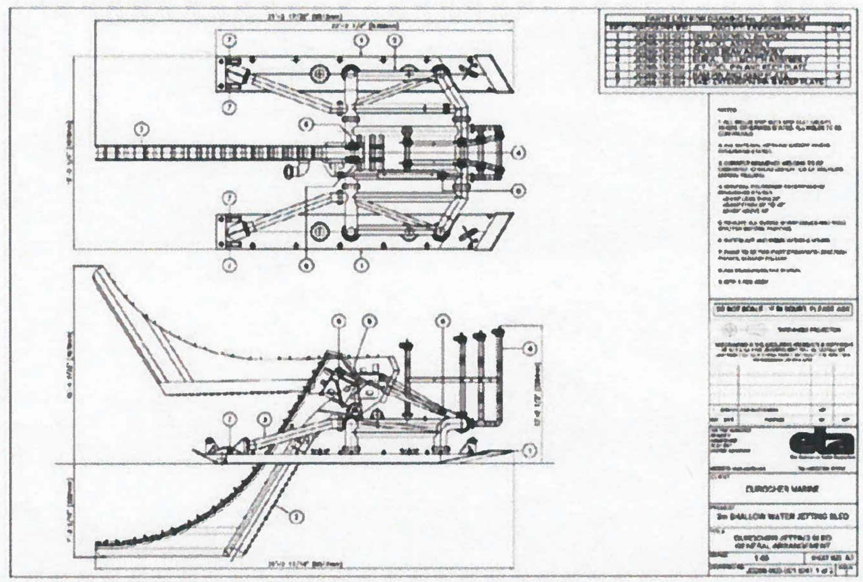

FIGURE 2: JET SLED AUTOCAD DRAWING

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6 CONCLUSION

This procedural report outlines the basic use of a jet sled during submarine power cable installation. The submarine cable installation operator will attempt to install the submarine power cable at a respectable pace that does not risk damage to the power cable. The use of a trial run will determine the actual turbidity and suspended solids generated from the jet sled based on the site specific conditions. By comparing the instream water quality information with the jet sled telemetry, an optimized jetting procedure may be developed to reduce the impact jet sled installation has on the environment.