Seacoast Reliability Project Post-Construction Bathymetry Report

Eversource Energy

Prepared For

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1 Introduction

Eversource Energy (Eversource) constructed a 12.9-mile, 115 kV transmission project to improve the electrical reliability in the Seacoast region of New Hampshire. The Seacoast Reliability Project (SRP) involved burying three cables approximately 1 mile across Little Bay north of Adams Point within a corridor previously identified as "Cable Area" on navigation charts. The cables were installed using a jet plow along most of the route across Little Bay. Hand jetting was used to install cables close to shore where water depths were too shallow for use of the jet plow. The project was approved by the NH Site Evaluation Committee on January 29, 2019 and by the US Army Corps of Engineers on July 3, 2019.

Impacts anticipated for the jet plow installation were described in several project documents associated with Eversource's permit application review with the SEC (Normandeau 2016a, 2016b and 2017; RPS 2016, 2017). The primary effect from jet plowing is the release of sediments into the water column creating a turbidity plume that moves with the tides and with the progress of installation along the route. A detailed water quality monitoring plan (Normandeau 2019) was implemented to document the spatial extent and quality of the suspended sediments during installation, as they varied with tidal stage and with the progress of installation along the route. Results indicated that the plume generally behaved as predicted in that it was very localized and ephemeral; however, concentrations of suspended sediments were typically well below predicted levels (Normandeau 2020).

NHDES issued its final recommendations for approval on October 29, 2018, in which requirements related to benthic habitat monitoring are addressed in DES Condition 42:

> *At least sixty {60) days prior to the start of construction in Little Bay, the Applicant shall obtain NHDES and NHFGD approval of a Benthic Habitat Monitoring Plan {BHMP). The purpose of the plan is to determine if substrate conditions (topography and grain size distribution) in the Little Bay estuary in the vicinity of the proposed underground cables were significantly altered during construction. The plan shall include, but not be limited to, details regarding the method, accuracy and extent of the bathymetric survey, when the study will be conducted, the locations and methods for sampling and analyzing grain size distribution, how the data will be assessed, how data will be reported and provisions for inputting the data electronically into the NHDES Environmental Monitoring Database. The Applicant shall then implement the approved plan.*

A jet plow trial was conducted on September 9, 2019. The submarine three cables were installed via jet plow between October 15 and November 7, 2019 (Figure 1). The northernmost cable was installed first, over a period of 4 days, October 15–18, 2019. The installation of the middle cable began 9 days later on October 25 and occurred over a period of 2 days. The installation of the southernmost cable began 8 days later on November 6 and occurred over a period of 2 days. For the cable sections either too close to shore or with ledge too shallow to achieve the prescribed 3.5-ft burial depth, the cables were buried by divers operating water-propelled hand jets. This work was conducted periodically over 28 days between November 11 and December 18, 2020. In areas where burial depth could not be achieved due to bedrock, concrete mattresses were used to protect the cables. The concrete mattresses were considered permanent impacts and affected approximately 0.2 acres of intertidal habitat.

This document addresses the monitoring and assessment of change in bathymetry following the cable installation. Changes in sediment grain size, another component of Condition 42, will be assessed during the benthic infaunal community monitoring in summer 2020.

2 Potential Effects to Bathymetry

The cable installation had two potential types of direct impacts on bathymetry: loss of sediment along the three cable routes resulting in depressions, and deposition of sediments on adjacent substrate, resulting in accretion. Industry experience has found that most sediments fluidized by the jet plow remain in the narrow trench. Based on the grain size distribution observed along the project route, RPS (2016, 2017) predicted that suspended sediments that dispersed away from the jet plow would redeposit close to the route. These predictions are shown in Figure 1, representing the slowest advance rate (100 m/hour; RPS 2016) and the fastest advance rate (183 m/hour; RPS 2017). The extent of deposition resulting from hand jetting where no turbidity barrier was feasible on the east side is also shown in Figure 1 (RPS 2017).

Substrate condition, including microtopography and grain size distribution, are among the dominant factors defining benthic habitat. The changes in microtopography from the cable installation 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).

Eversource conducted high-resolution bathymetric surveys before cable work began and after it was completed to characterize the effects of cable installation on microtopography. Grain size distribution will be characterized during benthic infauna sampling in summer 2020.

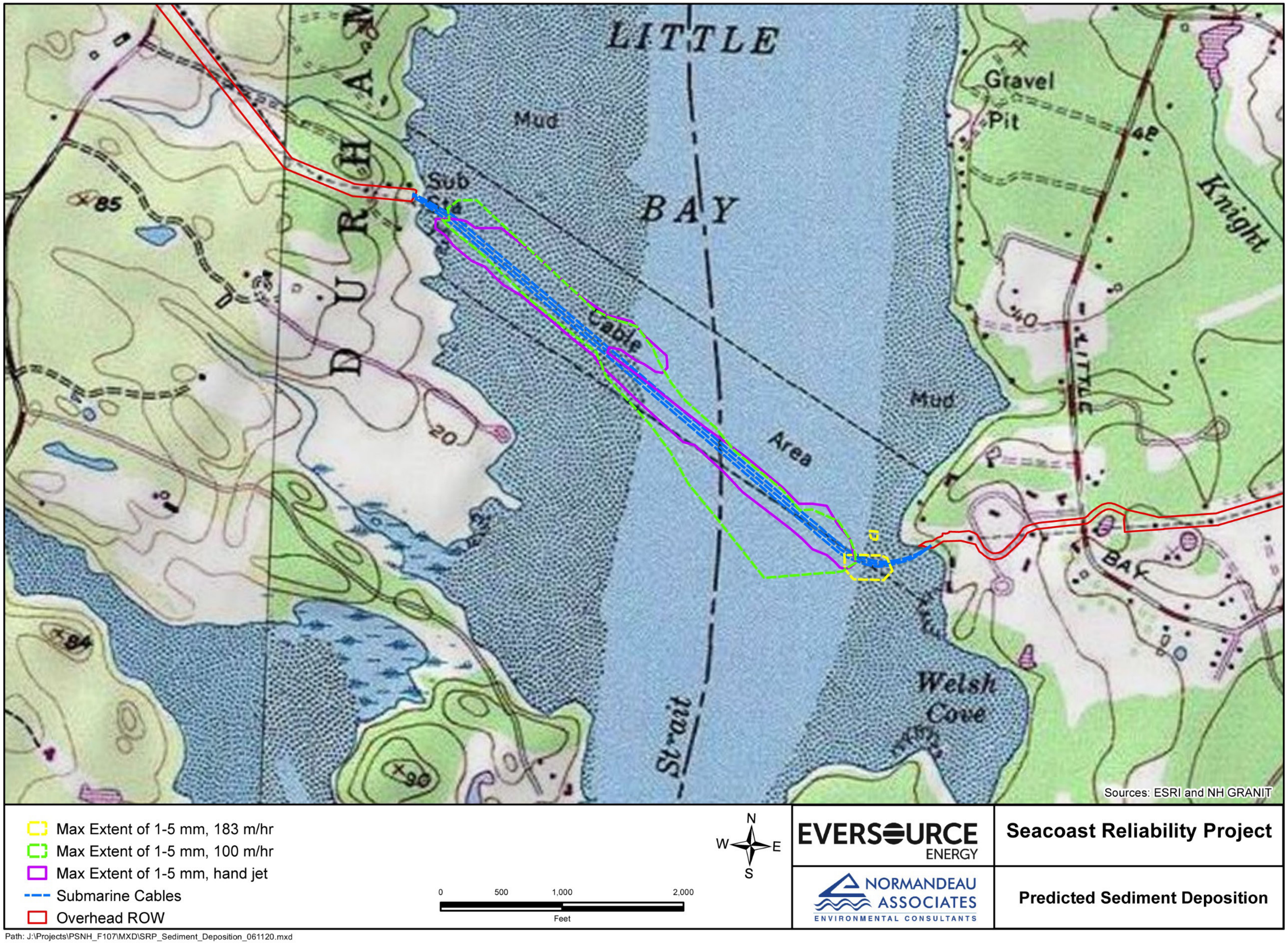

Figure 1. Area predicted to experience redeposition of sediments suspended during jet plowing or hand jetting.

3 Methods

Ocean Survey Inc. (OSI) conducted an initial pre-construction bathymetric survey in late summer of 2019, followed by a post-construction bathymetric survey in March 2020 to document changes to the bottom. Because the installation was not completed until early January 2020, scheduling of the bathymetric survey was complicated by the need for spring tides and lack of ice. In addition, survey could not be conducted without a clear weather window of 4–5 days. Such conditions did not occur until March 2020. The post-construction data were compared to the pre-construction data to determine the extent and type of impacts from construction relative to naturally occurring changes due to currents and weather.

3.1 Survey Area

The bathymetric survey encompassed an approximately 94-acre area around the cable route (Figure 2). The survey was centered along the three cables (approximately 30 m [100 ft] in width) and extended 100 m (320 ft) both north and south for a total survey width of approximately 230 m (740 ft). This width was selected to allow us to assess the conditions in the immediate vicinity of the new cables where construction-related impacts were expected, and substrates further from the work area where little disturbance was expected.

The bathymetric surveys used a combination of boat-based multibeam sonar, and drone-mounted LiDAR with the goal of providing complete coverage within the submarine cable corridor. The aerial LIDAR covered the intertidal mudflats and shoreline, and the multibeam echosounder data covered the deeper portions of the crossing, with a degree of overlap between the two methods to allow “stitching” the results into a seamless bathymetric map.

The bathymetry surveys were conducted during spring high tides to take advantage of the extreme high water for boat-based work, and extreme low water for the LiDAR work, which was flown in the “dry.” The pre-construction multibeam survey was conducted between August 26 and September 1, 2019, and the LiDAR was flown on August 31 and September 1, 2019. The post-construction multibeam survey was conducted between March 8–12, 2020, and the LiDAR was flown on March 11 and 12, 2020.

All survey work was completed under the supervision of an ACSM/NSPS Certified Hydrographer.

3.1.1 Multibeam Echosounder Surveys

The multibeam surveys were conducted by an OSI field team experienced in shallow water multibeam operations. The vessel was a 24-ft survey launch operated in accordance with USCG regulations.

OSI used the following equipment and instrumentation:

- HYPACK trackline control and hydrographic data logging system
- Applanix POS MV inertial navigation system
- Reson SeaBat multibeam echosounder
- Sea-Bird SBE19 CTD profiler or AML Base X sound speed profiler
- Sea-Bird SBE37 or AML Micro X sound speed sensor

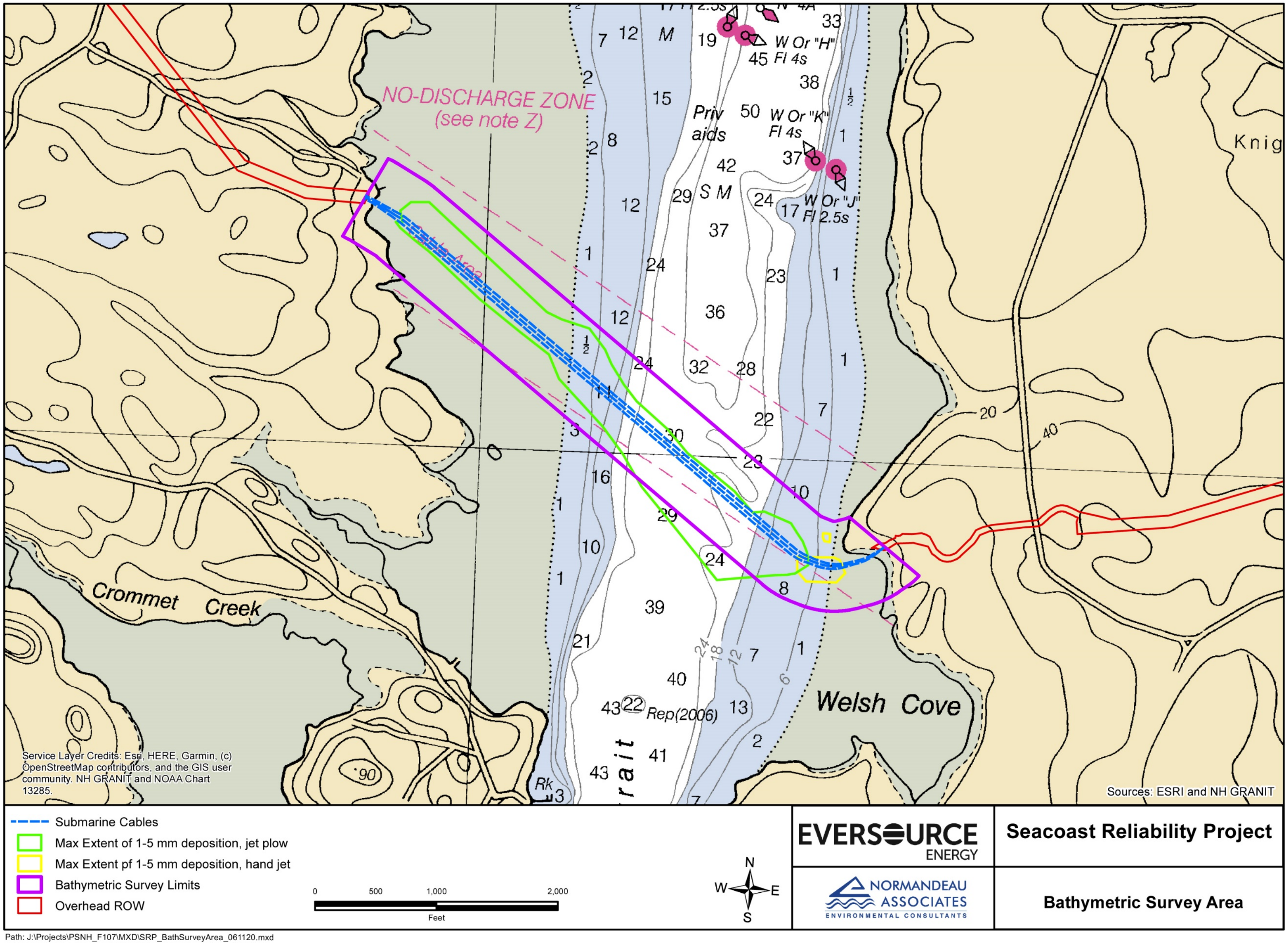

Figure 2. Approximate extent of bathymetric survey coverage.

Survey vessel navigation, trackline control, and position fixing for the sounding survey was accomplished using the POS MV system interfaced with the HYPACK hydrographic software package. Precision water depth measurements were obtained by employing a Reson Seabat multibeam echosounder. During survey operations, digital depths output from the device were merged with navigation and motion sensor/heading data via the navigation program, which subsequently computed the precise position of each sounding.

The sound speed profile data was incorporated into the hydrographic data processing procedure to correct for depth errors introduced by variations in the sound speed profile. Depth sounding accuracy was verified by means of a bar check of the multibeam system nadir beam.

3.1.2 Aerial LIDAR Surveys

The Aerial LiDAR survey were conducted by American Rail Engineers AirShark (ARE), who are FAA certified UAS pilots. ARE used the following equipment and instrumentation:

- DJI M600 Aircraft equipped with RTK GPS
- On site Radio and Cell Phone communications with Airport and Crew
- Phoenix Aerial UAS LiDAR System
    - Riegel miniVUX LiDAR system
    - Novatel OEM / Lite SPAN IMU
    - Basler RGB Camera
- CHC NAV X900R GNSS Static Base Station for PPK Processing

3.1.3 Survey Units and Accuracy

All survey units were in feet and referenced horizontally to the New Hampshire State Plane Coordinate System, NAD83. The vertical datum for the survey was NAVD88. Real-time positioning of the survey vessel was accomplished using a POS MV inertial navigation system receiving RTK correctors from a local GPS base station. An inertially aided-post-processed kinematic (IAPPK) solution was compared to the real-time solution and applied to the sounding data during post-processing.

The primary vertical benchmark for this survey was “TIDAL 1 1975”—a local National Geodetic Survey (NGS) disk. To facilitate daily XYZ performance checks, OSI installed a temporary XYZ control at Adams Point which was compared to local NGS control.

3.1.4 Data Analysis and Products

Throughout the pre-construction and post-construction surveys, raw data files and records were reviewed while still on site to ensure data quality and data density. The final processing of the data was conducted by OSI in the office.

For the purposes of contour generation, multibeam and LIDAR XYZ data were binned based on a 1-ft by 1-ft grid. The reported elevation from each grid cell was an average of all points within the cell and positioned at the center of the cell. Each cell was colorized according to its average elevation and used to create pre-construction and post-construction bathymetric maps.

A difference map was generated by comparing the average elevations of the 1-ft square cells of the pre-construction survey and the post-construction survey. The difference map was colorized by depth difference and presented at the same scale as the source maps. A "zero"-band (i.e., no difference) was based on total propagated uncertainty and statistical confidence and is approximately 0.25 ft around 0 (depicted in gray on the maps). The difference results were tabulated as both acreage and percentage based on 0.33-ft increments, as proposed in the monitoring plan.

As an additional ground check, multibeam performance (repeatability) tests were conducted for each survey as recommended by the US Army Corps of Engineers (2013) (Table 1).

Table 1. Multibeam Performance Test Results for Pre-Construction and Post-Construction Surveys

Performance Test Date	Mean Difference (Reference Surface – Check Line)	Maximum Outlier (Between Reference and Check Line)	Depth Standard Deviation (1-σ)	Depth Accuracy at 95% Confidence Level
09-02-2019	0.02 ft	0.38 ft	0.06 ft	0.12 ft
03-09-2020	-0.01 ft	0.37 ft	0.05 ft	0.10 ft

4 Results

The pre-construction and post-construction maps are provided in Appendix A (Figure A–1 and Figure A–2). Figure A–3 is the difference map which depicts elevation changes between pre-construction and post-construction.

The pre-construction map shows the general setting of the cable crossing area (Figure A–1). The western tidal flat is very flat, with a slope of less than 0.2% (2 ft change over 1600 ft). At the western edge of the channel, grades drop from approximately 5 ft to 30 ft at an average slope of 5%. The channel bottom ranged between 25 and 40 ft deep, and shows the extreme variability associated with "sand waves," most of which were 3–4 ft in height. The largest one, south of the cable corridor, is approximately 12 ft high. The eastern edge of the channel rises steadily to 15 ft (slope 7%), flattens out on a shelf for approximately 350 ft (slope 1%) after which the eastern tidal flat rises again and then extends to shore (1% slope).

The post-construction map shows little change in overall setting relative to slope and elevations (Figure A–2). There is evidence of disturbance from both the cable installation and the support vessels. The three cable trenches are clearly visible, as is the 1200-ft jet plow trial path located south of the cables on the western tidal flat and channel slope. Paths from the twin propellers of several of the installer's support vessels are evident on the western tidal flat, as are occasional single propeller paths. Presumably, these tracks were made from the vessels needing to come in at low water on some occasions as the boats were there on almost a daily basis, and that level of use is not visible. On the eastern shore, the cable route remains clearly visible, but there are few propeller tracks. The cable route is also visible in the channel; less so in the vicinity of the sand waves and pronounced on the channel slopes. The concrete mattresses on the eastern and western shorelines are visible as raised surfaces.

The difference map depicts the post-construction changes in substrate surface elevation, either gains or losses as indicated by color (Figure A–3). The gray color represents areas with no discernable change (less than 0.25 ft [7.5 cm]) difference between pre-construction and post-construction). The cooler tones (blue, green, magenta) indicate a decrease of more than 0.25 ft in surface post construction, the warmer tones (yellow, orange, red) indicate an increase of more than 0.25 ft in post-construction surface elevation. Depressional areas are visible over the paths of the cable tracks and the jet plow trial route, with most areas showing between 0.25 and 1 ft of sediment loss. Some locations exceed 1 ft, and a few small areas exceed 2 ft.

Areas of increases related to construction include the concrete mattresses at the shorelines where the hard surfaces of the mattresses are clearly visible. Areas of increase are also visible adjacent to the cable trenches. This is most pronounced on the western shore in the vicinity of the hand jetting. Narrow, discrete ridges are also visible paralleling the paths of the three cables on the western tidal flat. In the channel, the sand waves are the dominant features, generally in the same location but the tops show changes in location and elevation. The cable paths are intermittently visible as minor (approximately 0.5 ft) depressions within small sections of the sand waves. It is clear from Appendix Figure A–3 that most bathymetric changes west and east of the channel are near the cable route and are therefore assumed to have been caused during cable installation. Within the channel, it appears that the sand waves are dynamic and are the dominant feature affecting change; the presence of construction-related change is less clear cut

Areas of change were calculated in three sections to allow better discrimination between the project-related and natural (sand waves) changes: western side, channel, and eastern side. The western side included the slope of the channel to the 25-ft contour (Table 2). The channel included the sand waves, between the 25-ft contour lines on the west and east slopes. The eastern side extended from the 25-ft contour to the shoreline. Table 1 presents the areas of elevational differences in 0.33-ft increments in each section. Because most of the construction-related disturbance was closely associated with the cable route, the same data were also assessed for a narrower survey corridor approximately 300 ft wide.

The percent of area with change varies by section (Table 3). In the construction-dominated sections (west and east sides), approximately 97% of the entire survey area, and 94% of the narrower survey corridor showed little change (less than 0.33 ft). In the sand waves, the percentage of area with little change decreased to 79% of the entire survey area, and 77% of the narrower survey corridor. The great majority of changes were less than 1.00 ft in elevation.

Table 2. Areas (square ft) of Elevational Difference Ranges for Each Section of the Submarine Cable Crossing for the Full Survey Corridor and the Narrow Corridor.

Depth Difference category (ft)	West side (<25' contour) (square ft)	Sand waves (>25' contour) (square ft)	East side (<25' contour) (square ft)
Full Corridor (230 m [700 ft] wide)			
>2.00	44	940	22
+1.01–2.00	103	14,794	75
+0.68–1.00	1,026	24,492	1,820
+0.34–0.67	39,748	80,997	6,098
+0.33–(-0.33)	2,082,733	905,442	797,301
(-0.34)–(-0.67)	27,794	75,542	6,783
(-0.68)–(-1.00)	4,042	23,987	2,850
(-1.01)–(-2.00)	651	13,576	1,505
>(-2.00)	43	1,150	11
Total	**2,156,184**	**1,140,920**	**816,465**
Narrow Corridor (94 m [300 ft] wide)			
>2.00	5	170	1
+1.01–2.00	70	6,734	17
+0.68–1.00	984	12,672	1,701
+0.34–0.67	29,703	41,291	5,538
+0.33–(-0.33)	919,429	403,043	338,638
(-0.34)–(-0.67)	24,700	38,620	6,254
(-0.68)–(-1.00)	3,859	13,077	2,787
(-1.01)–(-2.00)	616	7,457	1,472
>(-2.00)	44	612	10
Total	**979,410**	**523,676**	**356,418**

Table 3. Areas (square ft) and Percent of Elevational Difference Ranges for the Construction-Dominated (East and West Sides) and Sand Wave-Dominated Sections of the Submarine Cable Crossing for the Full Corridor and the Narrow Corridor

Depth Difference category (ft)	Construction-dominated Sections (<25' Contour)		Sand wave-dominated Section (>25' contour)	
	Area (square ft)	% of total corridor area	Area (square ft)	% of total corridor area
Full Corridor (230 m [700 ft] wide)				
>2.00	88	0%	940	0%
+1.01–2.00	253	0%	14,794	1%
+0.68–1.00	4,666	0%	24,492	2%
+0.34–0.67	51,944	1%	80,997	7%
+0.33–(-0.33)	3,677,335	97%	905,442	79%
(-0.34)–(-0.67)	41,360	1%	75,542	7%
(-0.68)–(-1.00)	9,742	0%	23,987	2%
(-1.01)–(-2.00)	3,661	0%	13,576	1%
>(-2.00)	65	0%	1,150	0%
Total	**3,789,114**	**100%**	**1,140,920**	**100%**
Narrow Corridor (94 m [300 ft] wide)				
>2.00	6	0.00%	170	0.03%
+1.01–2.00	87	0.01%	6,734	1.29%
+0.68–1.00	2,685	0.20%	12,672	2.42%
+0.34–0.67	35,241	2.64%	41,291	7.88%
+0.33–(-0.33)	1,258,067	94.18%	403,043	76.96%
(-0.34)–(-0.67)	30,954	2.32%	38,620	7.37%
(-0.68)–(-1.00)	6,646	0.50%	13,077	2.50%
(-1.01)–(-2.00)	2,088	0.16%	7,457	1.42%
>(-2.00)	54	0.00%	612	0.12%
Total	**1,335,828**	**100.00%**	**523,676**	**100.00%**

Because the difference map (Figure A–3) indicates multiple areas of construction-related bathymetric changes in the immediate vicinity of the submarine cables, a second targeted post-construction survey is proposed. This second survey will focus on the narrow corridor (94 m [300 ft] wide). As described in the habitat monitoring plan (Normandeau 2019), if bathymetric changes indicate a second post-construction survey is necessary, it will be conducted in the following summer to incorporate the effects of natural processes. This survey, planned for the August–September 2020 timeframe, will follow shortly after the benthic infaunal sampling, which will measure sediment grain size and benthic community, both of which are also key indicators of habitat recovery, and is proposed in early August 2020.

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Appendix A. Pre-construction, Post-construction, and Difference Bathymetric Maps

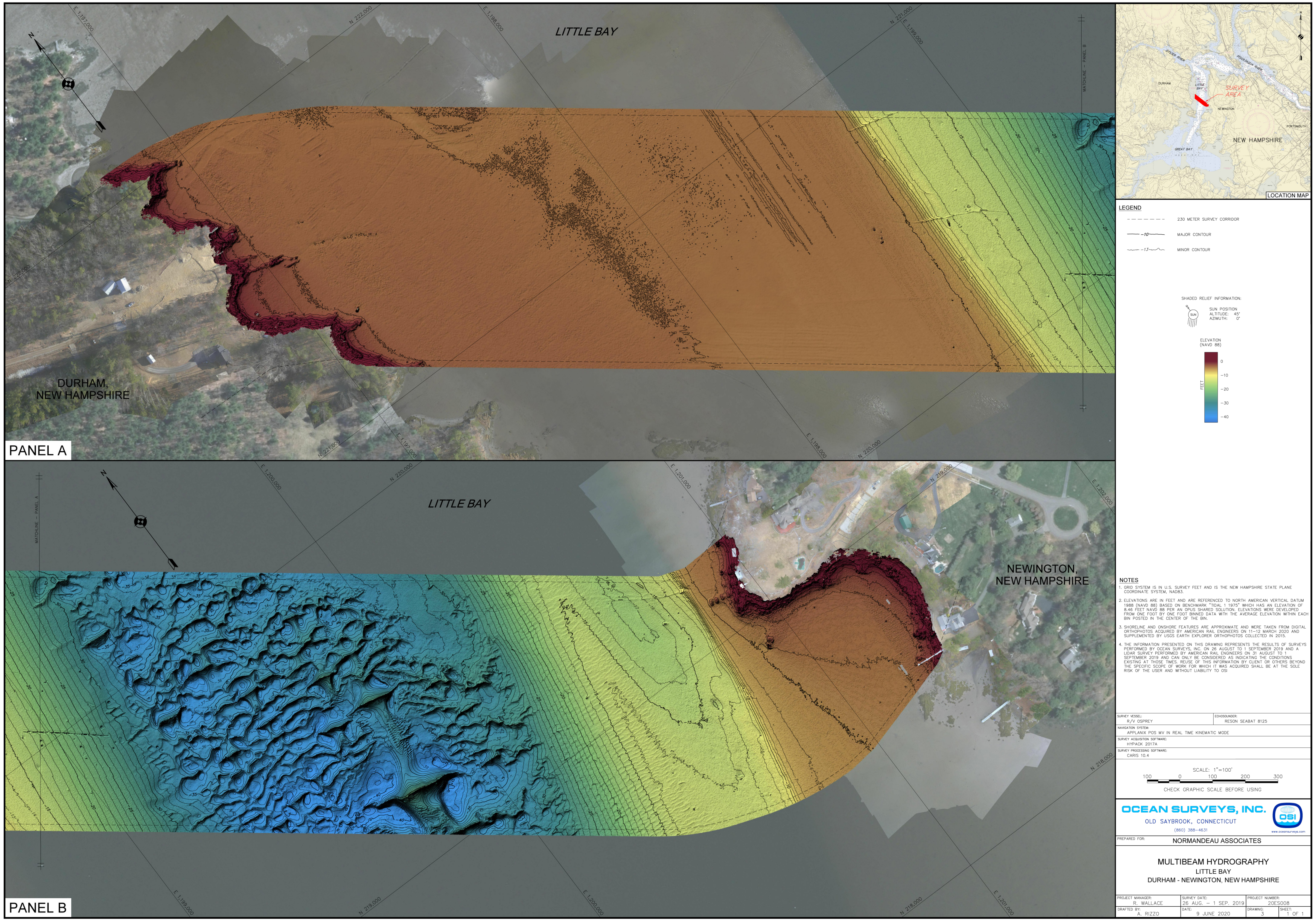

Figure A–1. SRP Pre-construction bathymetric map.

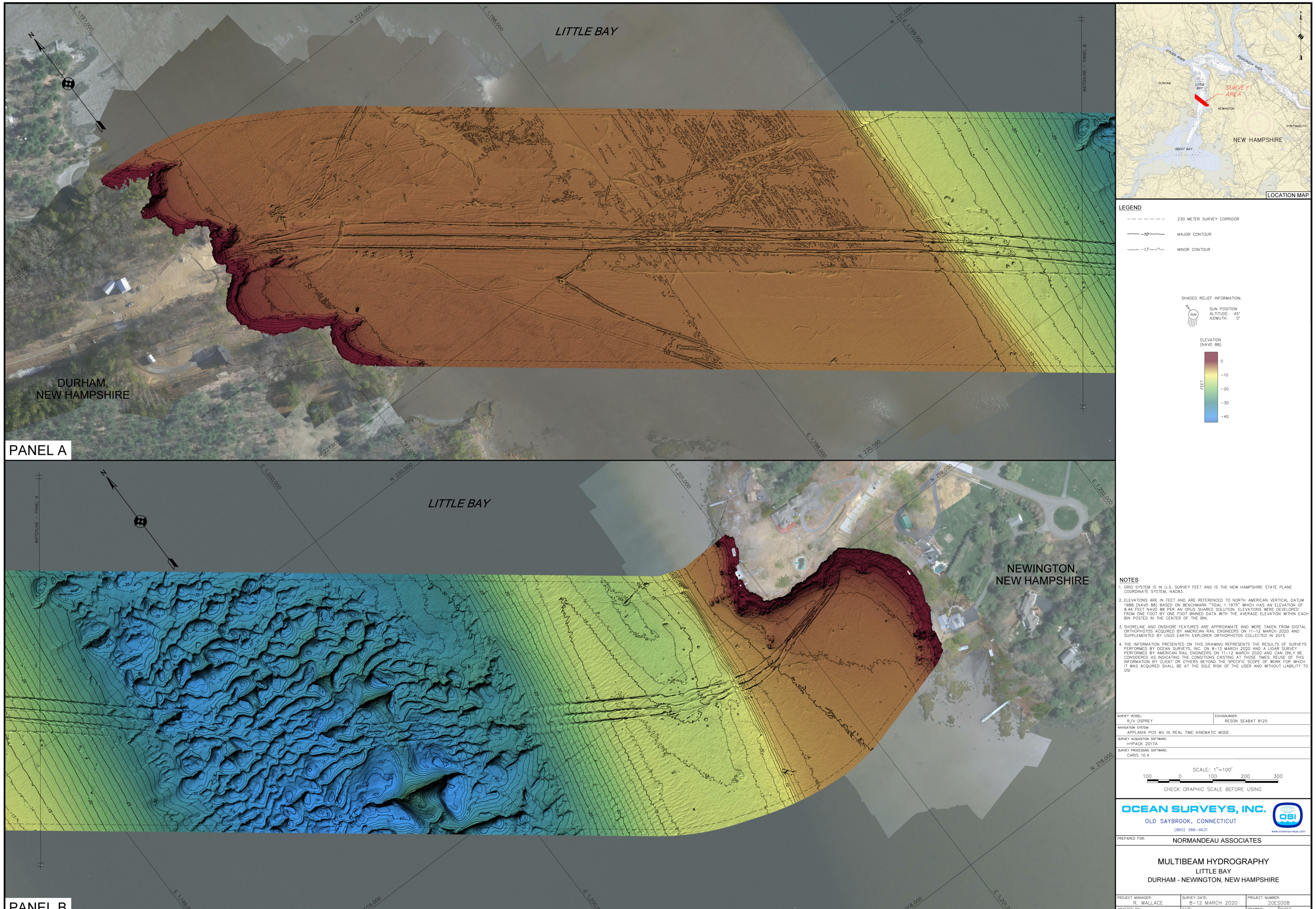

Figure A–2. SRP Post-construction bathymetric map.

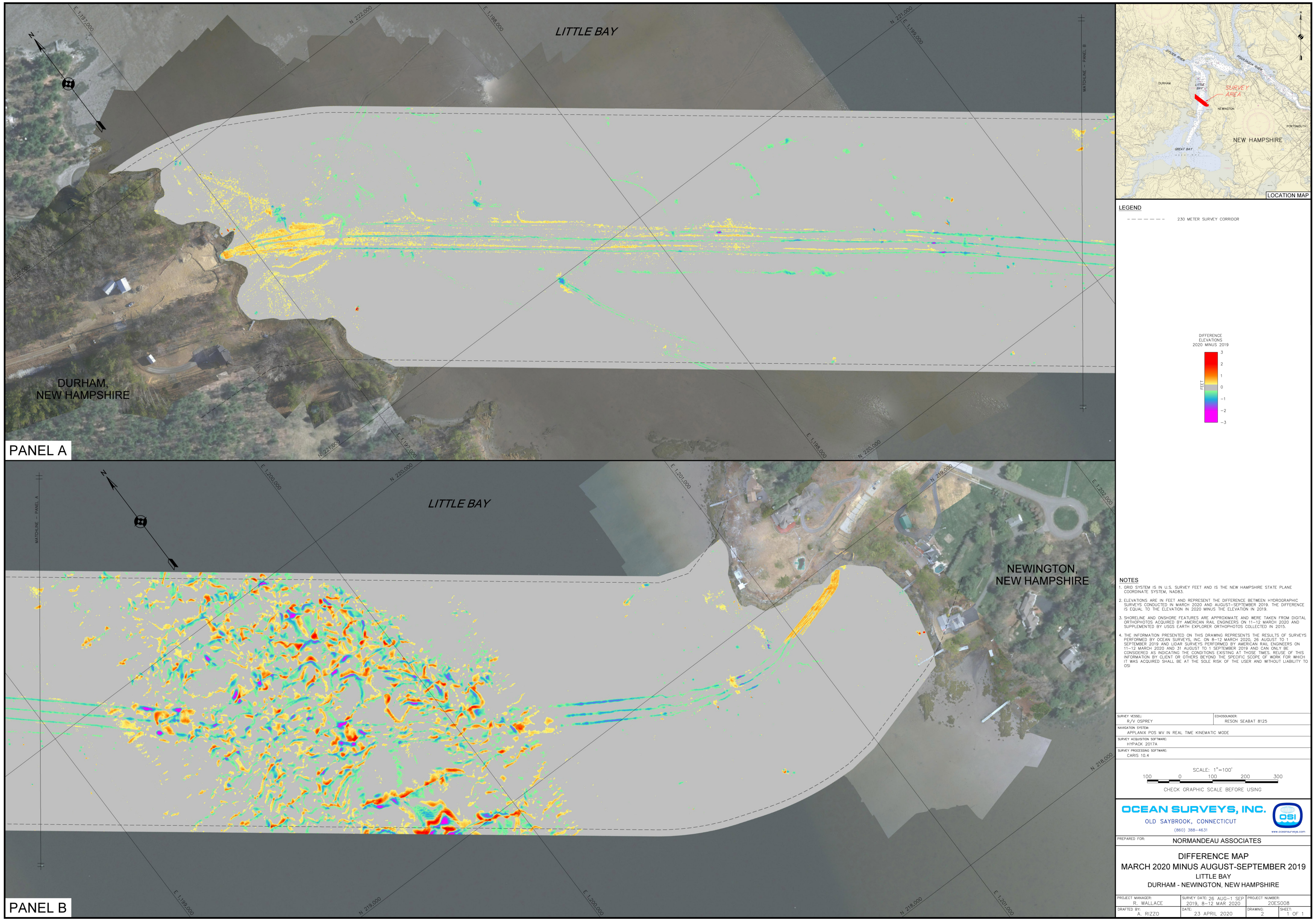

Figure A–3. SRP bathymetric difference map.