Seacoast Reliability Project
Shellfish Tissue Monitoring Report

Eversource Energy

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Acronyms and Abbreviations

ANOVA	Analysis of Variance
BSAL	Boundary Station Action Limit
FDA	U.S. Food and Drug Administration
MDL	Method Detection Limit
MLLW	Mean Lower Low Water
NHDES	New Hampshire Department of Environmental Services
NHFG	New Hampshire Fish and Game
NSSP	National Shellfish Sanitation Program
NTU	Nephelometric Turbidity unit
PAH	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated Biphenyls
Project	Seacoast Reliability Project
RIM	US Army Corps of Engineers Dredging Regional Implementation Method
RL	Reporting limit
SRP	Seacoast Reliability Project
TSS	Total suspended solids

Executive Summary

Eversource's Seacoast Reliability Project (referred to as SRP or "the Project") buried three cables in the sediments crossing Little Bay north of Adams Point within a corridor identified as "Cable Area" on navigation charts. The planned installation methods, primarily jet plow and diver burial (hand jet), were anticipated to release sediments into the water column creating a turbidity plume that would move with the tides and with the progress of installation along the route. Analysis of the sediments along the route indicated that, while various organic and inorganic contaminants were present, they were typically within the ranges observed elsewhere in Little Bay. Except for arsenic, all contaminants were below the concentrations likely to cause ecological impairment, and arsenic values were at the low end of potential impairment concentrations.

Based on Project-specific hydrologic modeling and the sediment contaminant analysis, Eversource concluded that the plume had the potential to cross portions of some aquaculture sites at very low concentrations of suspended sediments for short periods of time (minutes to a few hours). Given that recreational and commercial shellfishing is allowed in Little Bay, New Hampshire Department of Environmental Services (NHDES) wanted field confirmation that exposure to the suspended sediment plume did not result in bioaccumulation of contaminants in organisms that would be consumed by people. NHDES thus required Eversource to conduct a monitoring program during cable installation that measured shellfish tissue concentrations of the contaminants of concern by the National Shellfish Sanitation Program (NSSP) and those that are monitored periodically by the Gulfwatch program.

A Shellfish Tissue Monitoring Plan (Normandeau 2019) was approved by NHDES as part of Condition 46. Local blue mussels (*Mytilus edulis*) and locally cultured American oysters (*Crassostrea virginica*) were deployed in August 2019 before the jet plow trial and cable installation beginning in September. Four sites were selected jointly with NHDES, resulting in two impact stations within the predicted footprint of the plume and two control stations nearby but outside the footprint of the plume. Subsets of the shellfish were collected for testing before the jet plow trial in September, following completion of the jet plow cable installation in November, and following completion of cable burial via hand jetting in December.

Chemical analyses of blue mussel and oyster tissue were conducted for 106 compounds of concern as requested by NHDES in the approved shellfish monitoring plan. The results indicate that construction activities had little effect on body burdens of contaminants. Both shellfish species were tested for 11 compounds (or groups of compounds, i.e., total PCBs) defined as deleterious under FDA guidelines for human consumption. While several of these compounds were present in some tissue samples, concentrations were always at least three orders of magnitude below the relevant FDA-defined Action Level. Therefore, it can be concluded that installation of the SRP cables did not compromise the safety of these shellfish for human consumption.

Blue mussel and oyster tissues were also tested for a large suite of compounds considered to be contaminants, but which did not have regulatory action levels. Most metals tested were present in both mussel and oyster tissue at control and impact stations during all sampling events. Aluminum, copper, and lead concentrations were significantly higher in mussels at one impact

station after the post-hand jetting event. However, neither aluminum, copper, nor lead levels observed in oyster tissue were elevated in either post construction collection compared to preconstruction concentrations. Thus, it can be concluded that cable installation had limited, if any, effect on bioaccumulation of metals by shellfish. Furthermore, as Eversource has previously discussed with NHDES, the monitoring protocol lacked sufficient control to scientifically determine causation between cable burial activities and observed compound concentrations in blue mussel and oyster tissues due to other potential exposure pathways in Little Bay.

Organic compounds exhibited very limited presence in shellfish tissues in any sampling event.

These data show that installation of the SRP cables did not cause bioaccumulation of any of the 11 toxic substances tracked by FDA that rendered them unsuitable for human consumption. For the other 96 compounds tested, none were accumulated in shellfish tissue in sufficient quantities to affect the ecological function of the estuary.

1 Introduction

Eversource's Seacoast Reliability Project (SRP) buried three cables in the sediments crossing Little Bay north of Adams Point within a corridor identified as "Cable Area" on navigation charts. Jet plow operations occurred in four events starting with the jet plow trial on September 9; Cable 1 burial October 16–19; Cable 2 burial October 26–27; and Cable 3 burial November 6–7. Hand jetting was conducted between November 11 and December 18, 2019.

The installation methods, primarily jet plow and hand burial, were anticipated to release sediments into the water column creating a turbidity plume that would move with the tides and with the progress of installation along the route. Analysis of the sediments along the route indicated that, while various organic and inorganic contaminants were present, they were typically within the ranges observed elsewhere in Little Bay (Normandeau 2016, 2017). Except for arsenic, all contaminants in sediments were below the concentrations likely to cause ecological impairment.

Eversource's consultant RPS Group prepared a model predicting the extent of the resulting turbidity plume based on construction conditions described by representatives of a firm highly experienced with operating a jet plow. Models were run for two operating scenarios that differed primarily on the rate at which the jet plow advanced across Little Bay (RPS 2016, 2017). The two models estimated that each cable installation via jet plow could take between 7 and 13 hours; this was then combined with tidal conditions to show the likely range of resulting suspended sediment plume. The maximum extent of the plume models for the two rates were used to define the limits of the potential impact for the Project (Figure 1). Based on these modeling results and the sediment contaminant analysis, Eversource concluded that the plume had the potential to cross portions of some aquaculture sites at very low concentrations of suspended sediments (~20 mg/L, roughly equivalent to 10 Nephelometric Turbidity Units [NTUs]) for short periods of time (minutes to a few hours). Results of research investigating the response of oysters to suspended sediments indicated that a short duration and low concentrations as expected for the SRP would be unlikely to elicit lethal or sublethal (e.g., reduced filtering) effects (Wilber and Clarke 2001). In addition, Eversource assessed the potential dissolution of metals (specifically copper and arsenic) from the suspended sediments and concluded that the likelihood of exposure to toxic levels of dissolved constituents was very low.

Given that recreational and commercial shellfishing is allowed in Little Bay, NHDES wanted field confirmation that exposure to the suspended sediment plume did not result in bioaccumulation of contaminants in organisms consumed by people. NHDES is required by the FDA under the NSSP (USFDA 2015) to regularly demonstrate that commercially sold shellfish meet consumption standards. Based on the perceived potential for suspended sediments associated with cable installation to affect shellfish quality, NHDES included a permit condition requiring Eversource to conduct a monitoring program during cable installation that measured the tissue concentrations of the contaminants of concern by the NSSP and those that are monitored periodically by the Gulfwatch program (Condition 46 of the NHDES's final recommendation; see Appendix A).

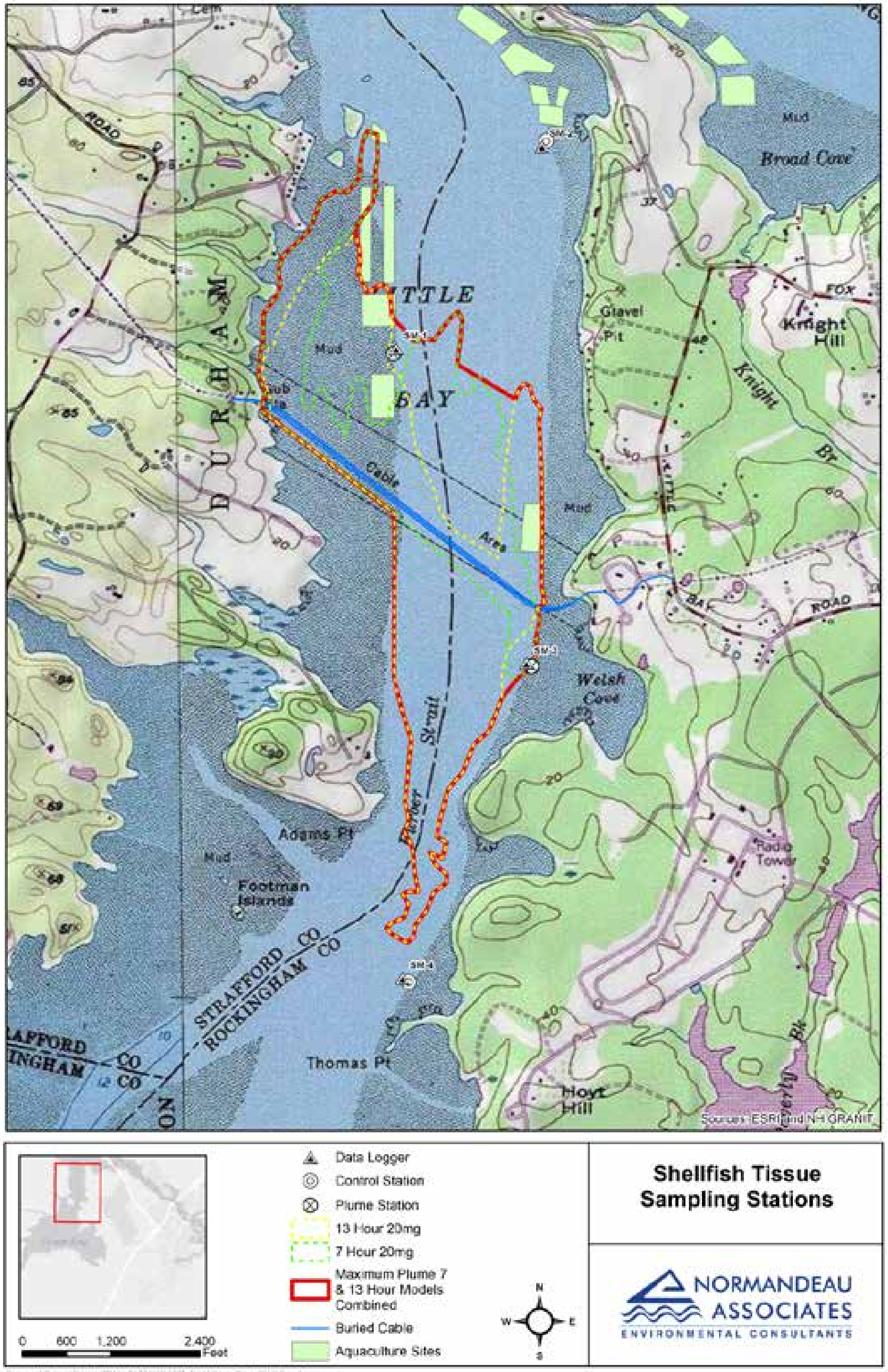

Figure 1. SRP Shellfish Monitoring Overview.

Briefly, Condition 46 includes two components:

- Notification of NHDES with the planned schedule of sediment-disturbing activities (including jet plowing and hand jetting) at least two weeks before the start of jet plowing so NHDES can assess possible changes in fecal coliform concentrations that could trigger temporary harvest closures
- Development and implementation (after NHDES approval) of a shellfish bioaccumulation study during the cable installation process

A Shellfish Tissue Monitoring Plan (Normandeau 2019) was approved by NHDES for this work. Normandeau Associates, Inc. (Normandeau), collected local blue mussels (*Mytilus edulis*) and purchased locally cultured American oysters (*Crassostrea virginica*) for deployment in August 2019 before the jet plow trial and cable installation beginning in September. Four sites were selected jointly with NHDES to provide two impact stations within the predicted footprint of the plume and two control stations nearby but outside of the footprint of the plume. Subsets of the shellfish were collected for testing before the jet plow trial in September, following completion of the jet plow cable installation in November, and following completion of cable burial via hand jetting in December. This document presents the methods and results of the shellfish tissue monitoring study.

2 Methods

Eversource acquired the appropriate New Hampshire Fish and Game (NHFG) permits for collection of indigenous mussels and deployment of test organisms in cages in Little Bay and Great Bay before initiating this monitoring program.

2.1 Species Tested

Blue mussels and American oysters were the species used for the bioaccumulation study. Blue mussels were obtained from an intertidal bed in lower Little Bay from under the General Sullivan Bridge on Dover Point (approximately 43°07.09’N, 70°49.39’W), which is the location where this species is obtained for the Gulfwatch program. Eversource conducted reconnaissance surveys at this site to evaluate the status of the mussel bed under the north end of the new bridge on January 14 and May 21, 2019. Counts of individuals at least 2 inches in shell length in random quadrats on May 21 estimated that the number of mussels (roughly 134,000 individuals greater than 2 inches) available at the site was more than sufficient for the SRP study without depleting the resource.

Approximately 2,800 blue mussels were collected by hand on August 5, 2019, taking care to minimize byssal thread injury to the animal. The mussels were predominantly 2.5–3 inches long. A subset of 160 mussels was sent to the laboratory for establishing baseline tissue quality. The remainder were placed in mesh bags and deployed at the Project stations that afternoon.

A total of 2,100 American oysters were purchased from commercial farmers in Little Bay located north of the Project. Per recommendations from NHDES and NHFG, the oysters measured approximately 2.5–4 inches in shell length. A primary purpose for using locally farmed market-size oysters was to ensure that organisms targeted for human consumption were tested. Because of differences in physiology between the two species (e.g., blue mussels are likely to feed more actively in cooler water temperatures than oysters) the concern was that Gulfwatch data on blue mussels may not be indicative of oysters.

Sufficient numbers of each species were deployed to allow for a 25% mortality factor to ensure that the requisite volume of tissue was available for all laboratory testing.

2.2 Deployment

Eversource placed shellfish cages containing the test organisms in four locations within Great Bay and upper Little Bay. Two locations were within areas predicted to be affected by the plume and two stations were located outside of areas predicted to be affected by the plume (Figure 1). Two stations, one plume-affected and one non-plume-affected (SM1 and SM2, respectively), were located north of the Project area and two were placed south of the Project area (SM3 and SM4).

The cages were placed in depths less than 7 ft Mean Lower Low Water (MLLW) to reflect the typical shallow depths in which oysters and mussels typically occur, but in sufficient water to ensure that the organisms are always submerged and to protect the co-located water quality data loggers. In addition, the plume-affected stations were located within the vicinity of commercial aquaculture facilities.

Coordinates for the monitoring stations are provided in Table 1. Plume-affected stations were Station SM1 (north of the cable route on the eastern edge of the western tidal flat) and Station SM3 (just south of the southernmost cable on the eastern side of Little Bay). Non-plume-affected stations are Station SM2 (to the northeast near Fox Point) and Station SM4 (in Great Bay, just north of Thomas Point). Field reconnaissance was conducted on June 7, 2019, with Chris Nash (NHDES) to confirm the suitability of the station locations.

The shellfish were deployed in two cages at each station. The blue mussels were placed in an “oyster condo,” wire mesh cages with four tiers holding a total of ten 20 × 38-inch polyethylene, 0.5-inch mesh bags with approximately 70 mussels in each bag (total 700 mussels per station). The oysters were placed loose in “triple stack cages,” a three-tier wire mesh cage where approximately 525 oysters were distributed. Both cages were on 6-inch legs to hold them off the bottom, but some settling into the soft sediment occurred. The shellfish on the bottom tier were harvested in the first event to minimize the effects of settling into the sediment.

Table 1. Location of Shellfish Monitoring Stations

Station	Purpose	Local Name	Latitude	Longitude
SM1	North plume-affected	Western Tidal Flat	43.1072	70.8635
SM2	North non-affected	Fox Point	43.1143	70.8546
SM3	South plume-affected	Welch Cove	43.0955	70.8566
SM4	South non-affected	Thomas Point	43.0834	70.8619

2.3 Sampling

Shellfish were placed at the monitoring stations about one month before the planned start of sediment-disturbing activities to allow organisms to acclimate to the new conditions. The mussels were set out August 5 and the oysters on August 6, 2019. Shellfish were subsequently collected for laboratory analysis three times related to construction events:

- September 23, six days before the jet plow trial run, 28 days after oyster deployment
- November 8, one day after the completion of the jet plow installation of the third cable, 94 days after oyster deployment, during which 9 days of construction occurred (1-day jet plow trial and 8 days of burial via jet plow)
- December 23, five days after final installation by hand jetting, 139 days after oyster deployment, during which 37 days of on-construction occurred (1 day jet plow, 8 days of cable burial via jet plow, and 28 days of cable burial via hand jetting)

Only mussels collected from the vicinity of the General Sullivan Bridge were analyzed for baseline contaminant concentrations because the oysters were from the immediate vicinity of the Project and represented baseline conditions. On the day of collection, the field crew carefully raised each cage to harvest the animals. For mussels, two bags were randomly divided into four replicates of 35 live mussels each, which were placed in a plastic bag provided by Enthalpy and stored in a cooler with ice or cool packs. If necessary additional mussels were taken from “spare” bags to achieve the necessary 35 mussels for each replicate. Similarly, 35 oysters were randomly collected from the open trays for each of four replicates. Mortality was recorded as both percent survival (none, 1–10%, 11–25%, 26–50%, 51–75%, 76–100%) and number of dead per bag or tray. Cage fouling was defined as the percent of biomatter (live and dead algae and eelgrass, silt) covering the cage, according to these classes: no fouling, 1–10%, 11–25%, 26–50%, 51–75%, 76–100%.

A chain-of-custody form was completed to transfer the shellfish to Enthalpy Laboratory for processing. The transfer occurred within 6 hours of collection for most events; the baseline mussels were held overnight on ice and delivered to Enthalpy the following morning. Samples were logged into the laboratory’s tracking system.

2.4 Water Quality Data

During the initial deployment of shellfish, a continuous data logger was installed at each station. The logger recorded water temperature, salinity, and turbidity at 15-minute intervals. The meters were In Situ AquaTroll 600, programmed to capture data every 15 minutes. Loggers were secured to moorings made up of ½-inch nylon line secured to a 100- to 150-pound pyramid anchor. A sub-surface, 11-inch diameter hard plastic trawl float was secured just above the logger to keep tension on the mooring to maintain the sensors at approximately 1.5 to 2.5 feet off the bottom. A small surface buoy was used for retrieval of the loggers.

Data loggers were deployed at Stations SM1 through SM4 with the shellfish tissue sampling cages beginning on August 6, 2019 (Figure 1). Data loggers were installed at three additional fixed stations 31, 33, and 34 on September 4, 2019, as part of the water quality monitoring program for cable installation. The seven dataloggers were downloaded and re-calibrated every

7–10 days until approximately December 12, and then had a final download and were retrieved from the site on December 26, 2019. Details of the installation, downloads and calibration of the data loggers were provided in the Project's Comprehensive Water Quality Monitoring Report (Normandeau 2020).

Water quality was monitored by hand at 23 additional stations during the construction activities (Normandeau 2020). Up to three depths were measured hourly to define and measure the suspended sediment plume from the cable installation using both handheld meters and water samples. Parameters measured via handheld YSI ProDSS meters included water temperature, salinity, turbidity, dissolved oxygen, and pH. Water samples were also collected by submerged centrifugal pumps for analysis of total suspended solids (TSS), the parameter used in the plume modeling), nitrogen species (nitrate, nitrite, ammonia, total Kjeldahl nitrogen), dissolved and total copper and arsenic. Fecal coliform samples were also collected in near-surface waters.

Per NHDES guidance, boundary station action levels (BSAL) were calculated for establishing the exceedance values for turbidity for each day of cable installation (Normandeau 2020). The BSAL were based on the background data collected in each of the tidal flats and channel regardless of collection depth. Real-time turbidity readings were compared to the reference database to determine whether adaptive management protocols needed to be implemented. NHDES required daily reporting, summaries of results for each jet plow event, and the Comprehensive Water Quality Monitoring Report to track the effects of construction.

3 Laboratory Procedures

Enthalpy Laboratories was required to adhere to standard good laboratory practices for sample tracking, clean room techniques, and QA/QC protocols. The analytical methods and method detection limits (MDL) matched those specified by NSSP and Gulfwatch.

The laboratory opened the individual mussels or oysters forming each replicate and allowed water to drain before shucking. Each of the four composite replicates consisted of shucked meat from 35 individuals. The tissue was homogenized and distributed into sample containers. Each 35-organism composite sample was treated as an individual replicate by the laboratory; therefore, each of the four sampling events (baseline, preconstruction, post jet plow and post hand jet) had four replicates at each station for each of the two shellfish species.

Shellfish composite samples were prepared for chemical analyses by homogenization using stainless steel equipment rinsed with methanol and deionized water before use. For each replicate, sample homogenates were split into appropriate containers for metals and organic analyses. Each composite was clearly identified with the unique sample identifier and maintained frozen until analyzed. Any portion of the composites not required for analysis was re-frozen and archived at the laboratory if results indicate the need to reanalyze any samples.

Each tissue replicate was tested for the parameters shown on Table 2. All results are presented as wet weight concentrations.

4 Data Analysis

Results for parameters for which two or more replicates exceeded the laboratory reporting limit (RL) were graphed to show the mean and standard deviation for each station on each sampling event. When any replicate was below the laboratory reporting limit, half of the RL was used in calculating means and standard deviations. Graphs of these metrics were used as a preliminary tool to evaluate whether there were temporal or spatial patterns evident but further analysis was necessary to confirm significance. Cornell Statistical Consulting Unit (2008) states that non-overlapping confidence intervals indicate statistically significant differences but overlapping confidence intervals cannot be interpreted to mean that differences are not significantly different. Because of the relatively small number of replicates for this project, the standard deviation shown on these plots is essentially identical to the 95% confidence interval. When post-exposure tissue concentrations at either of the impact stations appeared to be higher than at control stations (i.e., no or only small overlap between standard deviations), the results at the impact station were examined statistically using a one-way Analysis of Variance (ANOVA). Prior to running the ANOVAs, data were tested for normality both as actual concentrations and as log-transformed concentrations. Results of Shapiro-Wilk statistics indicated that transformation generally did not improve normal distribution; therefore, ANOVAs were run on raw data. Differences were considered statistically significant at $p \leq 0.05$. Box plots of the data from each event were generated showing mean, median, 25% and 75% quartiles, and the maximum and minimum values. Generally, an event was significantly different than other events if the 25% quartile concentration of one event did not overlap with the 75% quartile of another event. These observations were confirmed using Tukey’s Test, a single-step multiple comparison procedure that determines which means are significantly different from others.

When at least one of the post construction activity events was significantly higher than the preconstruction event at an impact station, an ANOVA was also run on the companion control station (i.e., north control SM2 was the companion station to north impact SM1; south control SM4 was the companion to south impact SM3) to help evaluate whether the concentrations at the impact station were likely to be attributable to the cable installation.

While individual polycyclic aromatic hydrocarbons (PAH) or polychlorinated biphenyls (PCB) compounds have differing environmental effects, regulatory decisions are often made on total concentrations of PAHs or PCBs. As concentrations of many of the individual compounds were below laboratory reporting limits (RL), a value of half the RL was assigned to those compounds to provide a conservative total for each suite of compounds.

Data from baseline collections for mussels were compared to Gulfwatch data from 1997 to 2000, the most recent years for which data are publicly available. As Gulfwatch data are reported based on dry weight, SRP data had to be converted from wet weight (as reported by Enthalpy) to dry weight based on the percent moisture for each sample by dividing the wet weight analytical result by the percent solid (i.e., 100 minus % moisture) and multiplying by 100.All analytical results will be digitally provided to the NHDES Shellfish Program in Microsoft Excel files in a format consistent with NHDES Environmental Monitoring Database protocols, procedures, and reporting formats.

5 Results

5.1 Collection

Of the 2,800 blue mussels collected by hand on August 5, 2019, approximately 10% were measured before deployment. The minimum length was 2.4 inches with a maximum of 3.3 inches. Of the 2,100 American oysters purchased and deployed on August 6, 2019, approximately 10% were measured and had a minimum length of 2.4 inches and a maximum length 4.1 inches.

Mortality was estimated at each collection period. Oysters had very limited mortality; none was found during the jet plow trial and post jet plow collections; 2–4 animals were dead at each station in the post hand jet collection. Mussels showed higher mortality, as might be expected given the deeper water and change in habitat conditions from their original location. Of the 140 collected at each event, 7–12 were dead in the jet plow trial collection, 19–41 were dead in the post jet plow collection, and 28–50 were dead in the post hand jet collection. No consistent pattern between impact and control stations was visible with mortality spread irregularly across the four stations. The highest mortality of 50 occurred at impact station SM1 during the post hand jet collection followed by a mortality of 41 at control station SM2 during the post jet plow station.

Cage fouling by live and dead algae and eelgrass and silt increased as the season progressed, which aligns with observations of more floating debris in the bay over time. During the pre-construction collection, fouling was recorded as less than 10% on both mussel and oyster cages. Cage fouling increased to 11–25% at all stations by the post jet plow collection (except the mussel cage at SM4 remained ≤10%), and to 25–50% by the post hand jet collection period (except the mussel cage at SM1, which recorded >75% fouling). The heavy debris load at SM1 was frequently observed during the data logger downloads at this station (Section 5.3) and may have contributed to the higher mussel mortality observed at this site.

5.2 Shellfish Tissue Results

Eversource conducted the shellfish bioaccumulation monitoring to evaluate whether installation of cables in the sediments of Little Bay had exposed oysters and blue mussels to water-borne contaminants at an exposure level (duration and concentration) that allowed accumulation in tissues. The laboratory report providing a complete listing of results and Quality Control is presented in Appendix C.

As proposed in the Shellfish Tissue Monitoring Plan (Normandeau 2019), Eversource reviewed the tissue data to answer these questions:

- Are there exceedances of tissue criteria (Table 3) present that can be attributed to the activity?
- If no criteria exist or there are widespread criteria exceedances, how do the tissue levels compare between the preconstruction levels and the postconstruction levels at a given station?

5.2.1 Are There Exceedances of Tissue Criteria Present That Can Be Attributed to the Project Activity?

Eleven pesticides, total PCBs, and methyl mercury have federally mandated Action Levels related to human consumption of fish or shellfish (Table 3). Two of the pesticides (TDE and 2,4-D) were excluded from the analysis based on NHDES concurrence that their short duration in the environment indicated that the possibility of bioaccumulation would be negligible (Appendix B). Prior to construction, sediments along the Project route were tested for several of these constituents (aldrin/dieldrin, chlordane, DDT/DDE, mercury [precursor to methylmercury], heptachlor epoxide, and total PCBs) (Normandeau 2016). None of the pesticides tested were detectable at levels about three orders of magnitude or more below the federal human consumption Action Levels. The Action Level for methyl mercury is 24 times the highest level of mercury found in sediments anywhere along the route, and most sediment levels were lower than that. Total PCBs (calculated using the US Army Corps of Engineers Dredging Regional Implementation Model (RIM) protocol of using half of the MDL for nondetectable compounds) in the sediments were about two orders of magnitude below the Action Level, and most individual PCBs were not detectable. The results of the sediment testing suggest that the potential for bioaccumulation of some compounds is possible; however, the anticipated short duration of exposure suggests bioaccumulation to Action Levels is unlikely.

Wet-weight tissue concentrations from pre-exposure, post jet plow, and post hand jet shellfish were compared to the Action Levels in Table 3. As proposed in the monitoring plan, if the post construction concentrations at the impact stations (SM1 and SM3) were below these thresholds, then no further analysis would be required. If tissue concentrations were above the Action Level for any constituent at either impact station, comparisons would be made to the pre-exposure concentrations at these sites to evaluate whether a trend is evident during the construction process, suggesting that cable installation could have affected body burdens.

Blue Mussels

Table 4 presents the mean and standard deviations of analytical data for mussel tissue samples collected during baseline, preconstruction, post jet plow, and post hand jet events. Many parameters were below the RLs. Means and standard deviations were calculated using ½ of the RL in these cases. A listing of the number of replicates that were below the RL is presented in Appendix Table D–1. Results for analytes with FDA Action Levels are presented herein.

Aldrin. Aldrin was not detected in any blue mussel samples at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm).

Dieldrin. Dieldrin was not detected in any blue mussel samples at a reporting limit of 0.2 ng/g wet weight (0.0002 ppm).

Chlordane. Blue mussel tissues were analyzed for both alpha and gamma chlordane and results were reported at a reporting level of 0.5 ng/g wet weight (0.0005 ppm). Neither compound was detected in any replicate.

Chlordecone (Kepone). Kepone was not detected in any mussel samples at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm).

DDT. Blue mussel tissues were analyzed for both 2,4’-DDT and 4,4-DDT at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm) for each compound. Neither compound was present at or above the reporting limit in any replicate tissue sample.

DDE. Blue mussel tissues were analyzed for both 2,4’-DDE and 4,4’-DDE at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm). 2,4’-DDE was not detected in any replicate mussel sample. 4,4’-DDE was present in all replicates including the baseline and preconstruction samples. As evident in Table 4 and Appendix Figure D–1, tissue burdens did not increase during the construction process at any station compared to the preconstruction levels. All body burdens were well below the Action Level of 4,4’-DDE; the highest average tissue concentrations was 1.72 ng/g wet weight (0.00172 ppm) or about 1/290 of the Action Level (Figure 2).

Methyl Mercury. Mussel tissue was analyzed for total mercury; therefore, reported results are conservatively high for methyl mercury. Low levels of total mercury were present in all replicates tested but all concentrations were less than 4% of the Action Level (Table 4; Figure 3). Lowest concentrations occurred in the baseline mussel samples (organisms tested after collection but before deployment in the Project area) and averaged 0.019 µg/g. Mussels deployed at all of the test stations for 28 days (pre-construction) exhibited a slight increase in mercury concentration above the background level, except at impact Station SM3 (Appendix Figure D–2). Tissue concentrations were higher following jet plowing at both control and impact stations. Station SM1 showed still higher concentrations following hand jetting while the mercury concentrations at the remaining stations declined. The fact that tissue concentrations of mercury increased between the baseline levels observed at the point of collection at the General Sullivan Bridge and the preconstruction collections in Upper Little Bay suggests there are higher concentrations of biologically available mercury in Upper Little Bay and that the slight increase in tissue concentrations reflect duration of exposure at both control and impact stations.

Heptachlor/Heptachlor Epoxide. Blue mussel tissues were analyzed for both heptachlor and heptachlor epoxide. No concentrations of either compound were observed in any sample collected prior to or following installation of the cables across Little Bay.

Mirex. Mirex was not detected in baseline samples of blue mussels. Preconstruction samples collected at control station SM2 (Fox Point) exhibited Mirex in two replicates at 1.41 and 12.4 ng/g (wet weight) but the remaining replicates were below the reporting limit of 0.5 ng/g. Mirex was not at detectable levels in any replicates following jet plowing at SM2. One replicate from impact station SM1 was measured at 0.601 ng/g wet weight; no other replicates at any station had detectable levels of Mirex. The highest tissue concentration observed (12.4 ng/g wet weight) was 12% of the Action Level and this occurred in one preconstruction sample. Only one of the 16 replicates analyzed from impact stations after the two major installation methods were complete exhibited traces of Mirex and was less than 1% of the Action Level. It appears that cable installation did not cause bioaccumulation of this compound.

PCBs. While one to several individual PCB compounds were found in most replicates, concentrations of individual PCBs never exceeded 1.85 ng/g, more than three orders of magnitude below the Action Level of 2,000 ng/g (2.0 ppm; Figure 3 through Figure 7). Only five PCB compounds ever exceeded the reporting limits (varied among samples, but approximately 0.5 ng/g wet weight): 2,2’,3,4,4’,5’ hexachlorobiphenyl (PCB 138; Appendix Figure D–3);

2,2’,3,4’,5,5’,6 heptachlorobiphenyl (PCB 187; Appendix Figure D–4); 2,2’,4,4’,5,5’ hexachlorobiphenyl (PCB 153; Appendix Figure D–5); 2,3’,4,4’,5 pentachlorobiphenyl (PCB 118; Appendix Figure D–6); and, unspecified pentachlorobiphenyl (PCB 90/101; Appendix Figure D–7). Each compound was present in most or all replicates from all baseline, preconstruction, post jet plow and post hand jet collections.

Even assuming all other PCB compounds occurred in samples at half of the reporting limits, total PCBs would never have exceeded 12 ng/g wet weight, or less than 1% of the Action Level.

Oysters

Table 5 presents the mean and standard deviations of analytical data for oyster tissue samples collected during preconstruction, post jet plow, and post hand jet events. Number of replicates for which concentrations were below the laboratory RLs are listed in Appendix Table D–2. Analytes with FDA Action Levels are presented herein.

Aldrin. Aldrin was not detected in any oyster tissue samples at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm).

Dieldrin. Dieldrin was not detected in any oyster samples at a reporting limit of 0.2 ng/g wet weight (0.0002 ppm).

Chlordane. Both alpha and gamma chlordane were analyzed in oyster tissues at a reporting level of 0.5 ng/g wet weight (0.0005 ppm). Gamma chlordane was never measured above this reporting limit; although, Enthalpy reported several instances at levels slightly below the reporting limit. Alpha chlordane was reported in preconstruction samples at SM1 (one replicate was slightly above the reporting limit), SM2 and SM4; post jet plow samples at the same stations; and post hand jet samples at SM1. Gamma chlordane was reported in preconstruction samples from SM4; post jet plow samples from SM2 and SM3; and post hand jet samples from SM1 and SM3. With one exception (post jet plow SM2 replicate D), only one of the two compounds was present in any replicate. In all cases, however, the individual concentrations were at least two orders of magnitude lower than the Action Level, and the sum of alpha and gamma chlordane concentrations for the post jet plow sample from SM2 (replicate D) was less than 0.4 ng/g wet weight.

There was no indication that chlordane was bioaccumulated by exposure of oysters to sediments suspended by cable installation.

Chlordecone (Kepone). Kepone was not detected in any oyster samples at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm).

DDT. Oyster tissues were analyzed for both 2,4’-DDT and 4,4-DDT at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm) for each compound. Neither compound was present at or above the reporting limit in any replicate tissue sample.

DDE. Oyster tissues were analyzed for both 2,4’-DDE and 4,4’-DDE at a reporting limit of 0.5 ng/g wet weight (0.0005 ppm). No station means or individual replicates exceeded 0.8% of the DDE Action Level (Figure 9).

2,4’-DDE was not detected in any replicate oyster sample. 4,4’-DDE was present in all replicates including the preconstruction samples (Table 5; Appendix Figure D–8). Concentrations at control station SM2 (Fox Point) remained fairly consistent among sampling events but the other three stations exhibited some differences over the exposure period. At impact station SM1, highest values occurred following the jet plow activity, but concentrations dropped back down by completion of the hand jetting. At both impact station SM3 and control station SM4, highest values occurred following hand jetting. As the impact and control stations south of the Project area exhibited similar patterns, these changes may not be attributable to the Project activities.

Methyl Mercury. Oyster tissue was analyzed for total mercury; therefore, reported results are conservatively high for methyl mercury. Low levels of total mercury were present in all replicates tested but all concentrations were less than 3% of the Action Level (Table 5; Figure 10). Lowest concentrations occurred in the preconstruction samples at control stations SM2 and SM4 and impact station SM3 and in the post jet plow samples at impact station SM1. While there were small changes at all stations during cable installation, there were no strong indications suggesting different patterns at the control and impact stations (Appendix Figure D–9).

Heptachlor/Heptachlor Epoxide. Oyster tissues were analyzed for both heptachlor and heptachlor epoxide. No concentrations of either compound were observed in any sample collected prior to or following installation of the cables across Little Bay.

Mirex. Mirex was not detected in any oyster tissue samples at a reporting limit of 0.5 ng/g wet weight, a value that is 0.5% of the Action Level.

PCBs. With only a few exceptions, five of the 31 PCB compounds analyzed occurred above the reporting limits in every replicate oyster tissue sample: (2,2’,3,4,4’,5-hexachlorobiphenyl or PCB 138 [Appendix Figure D–10]; 2,2’,3,4’,5,5’,6-heptachlorobiphenyl or PCB 187 [Appendix Figure D–11]; 2,2’,4,4’,5,5’-hexachlorobiphenyl or PCB 153 [Appendix Figure D–12]; 2,3’,4,4’,5-pentachlorobiphenyl or PCB 118 [Appendix Figure D–13]; and pentachlorobiphenyl or PCB 90/101 [Appendix Figure D–14]). The highest concentration for an individual PCB was 4.39 ng/g wet weight (preconstruction at SM4).

Total PCB body burdens were estimated if all other PCB compounds occurred in samples at half of the reporting limits. Based on this approach, total PCBs would never have exceeded 17 ng/g wet weight, or less than 1% of the Action Level. Comparison of the five PCB compounds that did occur above the RL to the Action Level are shown in Figure 11 through Figure 15.

5.2.2 Parameters Without Regulatory Thresholds for Human Consumption

For parameters with no regulatory tissue thresholds, are there differences in body burdens after cable installation compared to preconstruction levels?

Regulatory thresholds for human consumption have not been established for most of the compounds being tested for bioaccumulation in fish or shellfish. For these compounds, the initial analysis focused on whether there were changes in body burdens at a specific station over time and if there was consistency among the replicates. For each parameter for which there were one or more replicates above the reporting limit (RL), data was presented graphically showing mean and standard deviation over time. Where appropriate, results were tested statistically using a one-way ANOVA (before-after design). Reference stations were treated in a similar fashion to the impact stations. The ANOVA was used only on those parameters for which two or more replicates were above the RL.

Blue Mussels

Metals

Table 6 presents the mean and standard deviations of analytical data for parameters without federal Action Levels for mussel tissue samples collected during baseline, preconstruction, post jet plow, and post hand jet events. Measurable concentrations of aluminum, cadmium, chromium, copper, iron, lead, mercury, nickel, and zinc were found in mussel tissue in each of the four sampling events. In all cases, except for chromium at SM2 and SM3, mean concentrations in the baseline samples were lower than other collections. Results of ANOVAs run on selected parameters are presented on Table 7.

Aluminum. At both impact stations (SM1 and SM3), body burdens of aluminum appeared to decrease between preconstruction and post jet plow samples (Figure 16; Table 8). At SM1 aluminum levels following hand jetting were higher than preconstruction levels, whereas at SM3 levels were similar to post jet plow. ANOVA at SM1 indicated that tissue concentration of aluminum following hand jetting was similar to preconstruction tissue, which was similar to post jet plow concentrations, although post hand jet concentrations were significantly higher than post jet plow concentrations (Table 7; Appendix Figure E–1). This result suggests that the apparent difference between post construction samples could simply be related to the relatively high variability in the preconstruction collections. At the northern control station SM2, there were no significant differences in body burdens of aluminum among collection events. Similarly, there were no significant differences between sampling periods at impact station SM3 whereas an ANOVA on the southern control station SM4 found that tissue concentrations were significantly higher in the post jet plow samples than preconstruction or post hand jet samples.

Cadmium. For each of the three collections after the baseline measurements, three of the four stations had similar cadmium concentrations in mussel tissue (Figure 17). During the preconstruction samples, cadmium was similar at SM1, SM2, and SM4 and found at higher concentrations than at SM3. In samples collected after completion of the jet plowing, cadmium was similar at SM1, SM3, and SM4 and were lower than concentrations at SM2. In post hand jet samples, cadmium levels were similar at SM2, SM3 and SM4 and lower than at SM1. Post hand jet concentrations at SM1 were similar to post jet plow concentrations at SM2.

Chromium. Mussel tissue concentrations of chromium appeared to remain at consistent levels at impact stations SM1 and SM3 through the cable installation process (Figure 18) and that was supported by the results of one-way ANOVAs (Table 7; Appendix Figure E–2). Control stations SM2 and SM4 each exhibited increased body burdens after one of the construction activities, but there was high variability among replicates.

Copper. Concentrations of copper in mussel tissues appeared stable over time at the two southern stations (S3 and S4) and concentrations at the two stations were similar (Figure 19). Concentrations were most variable at SM1 where they declined between preconstruction and post jet plow collections and then rose again. ANOVA comparing tissue concentrations over the sampling periods at SM1 found that while the post hand jet concentrations were significantly higher than the post jet plow concentrations, the preconstruction concentrations were similar to both suggesting the lack of a Project-related effect (Table 9; Appendix Figure E–3). While the northern control station SM2 exhibited a similar pattern to SM1, ANOVA results indicated there were no significant differences in tissue concentrations among sampling periods at this station. Neither of the southern stations SM3 and SM4 exhibited significant differences across sampling events either.

Iron. Iron concentrations were highest following hand jetting at SM1 whereas concentrations at SM2 declined over construction (Figure 20). South of the route, concentrations at SM3 were lower following each of the two construction phases than before construction. SM4 exhibited an increase in concentrations following jet plowing and then concentrations dropped following hand jetting.

Lead. Lead concentrations at northern stations SM1 and SM2 followed similar patterns (Figure 21) Although variability among replicates was higher at SM2 than at SM1. At SM1, lead tissue concentrations were significantly higher following hand jetting than both the preconstruction and post jet plowing levels, which were similar in mean concentration (Table 9; Appendix Figure E–4). Lead concentrations at SM2 were not significantly different over time. Concentrations at SM3 and SM4 exhibited little change over time. There were no significant differences in lead concentrations among sampling events at SM3.

Mercury. Mercury concentrations were lowest in preconstruction samples at all stations. All stations exhibited higher levels in the two subsequent sampling events suggesting this change reflected a broader effect in Upper Little Bay than the localized cable installation.

Nickel. At SM1, nickel concentrations dropped between the preconstruction and the post jet plow collections and returned to the preconstruction levels in the post hand jet samples (Figure 22). Stations SM3 and SM4 following a similar pattern. Concentrations in tissue from SM2 showed little variation over time.

Silver. Silver was not detected in any sample.

Zinc. Preconstruction tissue concentrations of zinc were higher at all stations than in the baseline samples (Figure 23). At SM1, concentrations were lowest following jet plowing and highest levels were in the post hand jet samples. In contrast, at the other three stations concentrations were highest in the post jet plow samples and were lower in the post hand jet samples.

PAHs

No PAHs were detected in any mussel samples.

Pesticides

Trans-Nonachlor was the only pesticide detected in mussel tissues. It occurred only in preconstruction samples at SM2.

Oysters

Table 8 presents the mean and standard deviations of analytical data for parameters without federal Action Levels for oyster tissue samples collected during baseline, preconstruction, post jet plow and post hand jet events.

Metals

All metals tested were found in oyster tissues during each of the three sampling events for this species. Highest concentrations of aluminum, chromium, iron, lead, and nickel occurred in the preconstruction collections.

Aluminum. Preconstruction concentrations of aluminum were higher than subsequent samples at all stations (Figure 24). ANOVA on aluminum concentrations in oyster tissues supported that observation with pre-construction concentrations significantly higher than either post jet plow or post hand jet collections at impact stations SM1 and SM3 (Table 9; Appendix Figure E–5). At control stations SM2 and SM4, preconstruction concentrations were similar to post jet plow levels and post jet plow levels were similar to post hand jet levels which were significantly lower than preconstruction levels. There is no indication, therefore, that cable installation affected the tissue concentrations of these metals.

Cadmium. Preconstruction tissue concentrations of cadmium were similar at all four stations (Figure 25). Although mean cadmium concentrations were higher in post jet plow and post hand jet samples than preconstruction samples at SM1, concentrations were higher at control station SM2 in all events. Concentration patterns over time were similar at stations SM3 and SM4. The results indicate there was no apparent influence of cable installation on oyster tissue concentrations of cadmium.

Chromium. Tissue concentrations of chromium decreased over time at all stations (Figure 26).

Copper. Mean tissue concentrations of copper were generally highest in the post jet plow samples at all stations (Figure 27). Variability among replicates at impact station SM1, however, was high and post jet plow and post hand jet concentrations were lower than those observed at control station SM2. Mean concentrations in tissue from southern impact station SM3 exceeded those from control station SM4 in post jet plow samples, however, ANOVAs for each station indicated there were no significant differences in tissue concentrations of copper over time (Table 9; Appendix Figure E–6).

Iron. Oyster tissue concentrations of iron decreased over time at all stations (Figure 28).

Lead. Lead concentrations in oyster tissue exhibited little variability within and between stations in each collection (Figure 29). Concentrations were highest in the preconstruction samples from all stations.

Mercury. Although tissue concentrations of mercury were higher at station SM1 than at SM2 in the preconstruction samples, the reverse was true in post jet plow and post hand jet collections (Appendix Figure D–9). Concentrations in all events at SM3 were similar to those at SM4. Thus, there is no indication that installation of the cables resulted in bioaccumulation of mercury.

Nickel. Oyster tissue concentrations of nickel in the preconstruction samples were as high as or higher than in the other collections at all stations (Figure 30).

Silver. Silver concentrations in oyster tissues were generally lower in preconstruction samples than either post jet plow or post hand jet samples at all stations (Figure 31). Except for Station SM1, mean concentrations were highest in the post jet plow samples. In the two sampling events following construction activities, concentrations were higher at control station SM2 than impact station SM1. This same relationship was apparent when impact station SM3 was compared to control station SM4.

Zinc. Zinc concentrations were lowest in preconstruction samples (Figure 32). In the two post construction collections, concentrations at control station SM2 were higher than those at impact station SM1. While the mean concentration at SM3 in the post jet plow samples was slightly higher than the mean at the control station SM4, the reverse was true in the post hand jet samples.

PAHs

There were no PAHs detected in any oyster tissue samples.

Pesticides

As noted in Section 5.1.2, 4,4'-DDE was present in oyster tissue during all collections at all stations (Appendix Figure D–8). At northern impact station SM1 tissue concentrations collected following completion of jet plowing were significantly higher than either the post hand jet or the preconstruction samples (Table 9; Appendix Figure E–7). While ANOVA found that differences among sampling events were significant at northern control station SM2 those differences weren't clear cut; post hand jet concentrations were similar to the preconstruction levels and significantly higher than post hand jet levels but preconstruction and post hand jet levels were similar. At both southern stations SM3 and SM4, concentrations in samples collected following hand jetting were significantly higher than in either the preconstruction or post jet plow samples. Because concentrations of 4,4'-DDE were well below FDA Action Levels for human consumption, these differences have little ecological or human health effects.

Trans-Nonachlor was the only other pesticide detected in oyster tissues. It was not detected at SM1. It was present in low concentration following jet plowing at SM2. It was present at the same mean concentration during each collection event at SM3. It was also present at SM4 during the preconstruction and post jet plow events, again at the same concentration.

PCBs

Five PCB compounds occurred in most oyster tissue samples collected through the monitoring effort. While these concentrations were well below FDA Action Levels for human consumption, mean concentrations of 2,2',3,4',5,5',6 heptachlorobiphenyl (PCB 187), 2,2',3,,4',5' hexachlorobiphenyl (PCB 138) and 2,2',4,4',5,5' hexachlorobiphenyl (PCB 153) appeared to change over time. Results of ANOVAs conducted to evaluate these changes are presented in Table 9. In only one case were the concentrations significantly different among sampling events. Concentrations of 2,2',3,4,4',5' hexachlorobiphenyl were significantly higher in the preconstruction samples from SM2 than in either post construction activity event (Appendix

Figure E–8 through Figure E–10). Concentrations of the other compounds at the stations analyzed were not significantly different over time.

5.2.3 Comparison of Baseline Mussel Results to Gulfwatch

Four replicate mussel samples were submitted for laboratory analysis right after collection from Dover Point to provide an indication whether contaminant levels at the harvest site in 2019 were similar to those observed in the Gulfwatch program that also harvested from that bed. Table 10 provides results for the contaminants that were found in the baseline samples along with the annual results from Gulfwatch collections from 1997-2000 (the most recent years available; https://gulfofmaine.org/public/gulfwatch-contaminants-monitoring/). Of these two pesticides, one PAH, five PCBs and nine metals found in the baseline samples, all but one (2,2',3,4',5,5',6 heptachlorobiphenyl, PCB 187) were also reported in Gulfwatch samples.

Results between the studies are remarkably similar. Mean dry weight tissue concentrations are always within the same order of magnitude and generally very close in absolute value, with the SRP samples often being slightly lower than the Gulfwatch samples. The one exception was C-naphthalene. One SRP replicate contained a fairly high concentration of this compound while it was not detected in the other three replicates. Due to that one sample, the resulting mean was one to two orders of magnitude higher than any Gulfwatch data.

5.3 Water Quality Results

5.3.1 Turbidity

Near-bottom turbidity was measured every 15 minutes for the entire work period at the four shellfish stations (and three other data loggers). Graphs depicting results for all stations over the cable burial periods are provided in Appendix F. Note the NTU scale limit of 100 on the Y-axis. At various points in the survey, several stations recorded turbidity well above that number. Because we rarely recorded handheld turbidity above 50 NTU, the high readings are likely interference from debris in the bay such as senescing eelgrass and macroalgae wrapping around the sondes, which was noted multiple times during meter calibrations. Debris could contribute to the erratic readings by entering the sensor measurement space and causing optical interferences, and by weighing it down closer to the sediment surface during peak tidal flows. Debris was most frequently found during calibration on the shallow water sondes, SM1, SM2 and SM4, of which the latter two served as Project controls. The meter interference became more pronounced as the season advanced, which aligns with incidental observations of more senescing plant material in the estuary. Further evidence that the periodic high readings are not solely related to the Project is visible in the long-term graphs of the fixed station data, which show periods of elevated turbidity readings when no cable burial activities were occurring (see end of Appendix F).

Collectively, the 23 water quality monitoring stations were sampled nearly 3,500 times over 36 days of cable installation, resulting in over 17,500 meter measurements and 25,000 laboratory samples.

For the great majority of the installation, no exceedances of the established BSAL were observed at the edge of the state-permitted mixing zone. During the installation of Cables 1 and 2, a few minor turbidity exceedances were observed, but they all dropped back down below the BSAL on the next sample period, indicating a short-term, therefore ecologically insignificant, effect. The highest exceedance was on the tidal flats at Station 21 during Cable 2. That station remained approximately 5–10 NTU above the BSAL for an hour before dropping close to background. These values are within the natural variability observed in the bay and would not represent an ecological impact. For example, during a December 15 storm, background turbidity increased to over 16 NTU (over 10 NTU higher than average) for three days, indicating that the bay is periodically subjected to turbidity levels within the range measured during the cable installation.

5.3.2 Temperature, Salinity, Oxygen, and pH

Most results for both the continuous data loggers and the handheld meters for dissolved oxygen, temperature, salinity, and pH showed seasonal and storm event responses, but no changes that could be attributed to the jet plow activity.

5.3.3 Other Parameters

Of the 3,285 TSS samples collected overall, over 91% had values below 20 mg/L. Of the remaining 298 samples, only six exceeded 50 mg/L, and these were inside the mixing zone boundary.

Over 21,700 laboratory analyses were run measuring nitrogen species, total and dissolved arsenic and copper, and fecal coliforms. Most results for each parameter tested showed that changes to water quality caused by cable installation were minor, ephemeral, and localized. Fecal coliform values were clearly associated with weather events rather than Project activity.

6 Conclusions

Chemical analyses of blue mussel and oyster tissue were conducted for 106 compounds of concern as requested by NHDES in the approved shellfish monitoring plan. Samples of both organisms were placed in impact stations close to the SRP cable installation and at control stations located outside of the influence of sediment plumes generated by construction. The results indicate that construction activities had little effect on contaminant body burdens. Both species were tested for 11 compounds defined as deleterious under FDA guidelines for human consumption. FDA established Action Levels for each of these compounds that represented concentrations above which human consumption could be unsafe. While several of these compounds were present in some tissue samples, concentrations were always at least three orders of magnitude below the relevant Action Level. Therefore, it can be concluded that installation of the SRP cables did not compromise the safety of these shellfish for human consumption with respect to these analytes.

Blue mussel and oyster tissues were also tested for a large suite of compounds considered to be contaminants, but which did not have regulatory action levels. Most metals tested were present in both mussel and oyster tissue at control and impact stations during all sampling events. Aluminum, copper, and lead concentrations in mussels were significantly higher following hand jetting than preconstruction levels or post jet plow levels at northern impact station SM1, a pattern that was not observed at the other three stations. This suggests a possible link to project activities on the western tidal flat. However, neither aluminum, copper, nor lead levels observed in oyster tissue were elevated in either post construction collection compared to preconstruction concentrations. Thus, it can be concluded that cable installation had limited, if any, effect on bioaccumulation of metals by shellfish.

Organic compounds exhibited very limited presence in shellfish tissues in any sampling event. None of the 41 PAH compounds analyzed were detected in either mussel or oyster samples. Only five of the 31 PCBs analyzed were detected and their individual concentrations (as well as the total PCB concentrations) were well below the FDA Action Levels in both species. Two pesticides were found. 4,4’-DDE, part of the DDE complex regulated by FDA for human consumption, did occur in both species. In mussels, 4,4’-DDE concentrations showed no changes over time at any station. In oysters, northern impact station SM1 did exhibit a significant increase following jet plowing, but concentrations decreased to levels similar to preconstruction concentrations following hand jetting. While the northern control station exhibited a different pattern, the fact that concentrations at SM1 decreased during hand jetting suggests that bioaccumulation of 4,4’-DDE was minimal. Coupled with the fact that concentrations were orders of magnitude below Action Levels, it can be concluded that any uptake of 4,4’-DDE during cable installation posed minimal ecological risk. The only other pesticide present in shellfish tissue was trans-Nonachlor. It was present in preconstruction samples at both control and impact stations and only intermittently at other times in both species.

These data show that installation of the SRP cables did not cause bioaccumulation of any of the 11 toxic substances tracked by FDA that rendered them unsuitable for human consumption. For the other 96 compounds tested, none were accumulated in shellfish tissue in sufficient quantities to affect the ecological function of the estuary.

Table 2. Parameters to be Tested in Mussel and Oyster Tissue

Parameter	NSSP	Gulfwatch	Analytical Method (USEPA 2016)	MDL[a]
Physical				
Lipids (% wet weight)		x	EPA Method 9071B	
Percent Solids		x		
Metals (µg/ wet g [mg/L])				
Aluminum		x	EPA Method 6020A	10.0
Cadmium		x	EPA Method 6020A	0.2
Chromium		x	EPA Method 6020A	0.1
Copper		x	EPA Method 6020A	5.0
Iron		x	EPA Method 6020A	50.0
Lead		x	EPA Method 6020A	0.1
Mercury		x	EPA Method 245.7	0.01
Nickel		x	EPA Method 6020A	0.5
Silver		x	EPA Method 6020A	0.3
Zinc		x	EPA Method 6020A	50.0
PAHs (ng/wet g [µg/L])				
Acenaphthene		x	EPA Method 8270D SIM	2.0
Acenaphthylene		x	EPA Method 8270D SIM	2.0
Anthracene		x	EPA Method 8270D SIM	2.0
Benzo(A)anthracene		x	EPA Method 8270D SIM	2.0
Benzo(A)pyrene		x	EPA Method 8270D SIM	2.0
Benzo(B)fluoranthene		x	EPA Method 8270D SIM	2.0
Benzo(E)pyrene		x	EPA Method 8270D SIM	2.0
Benzo(GHI)perylene		x	EPA Method 8270D SIM	2.0
Benzo(K)fluoranthene		x	EPA Method 8270D SIM	2.0
Biphenyl		x	EPA Method 8270D SIM	2.0
Chrysene		x	EPA Method 8270D SIM	2.0
Dibenzo(AH)anthracene		x	EPA Method 8270D SIM	2.0
Dibenzothiophene		x	EPA Method 8270D SIM	2.0
Fluoranthene		x	EPA Method 8270D SIM	2.0
Fluorene		x	EPA Method 8270D SIM	2.0
Indeno(123CD)pyrene		x	EPA Method 8270D SIM	2.0
Naphthalene		x	EPA Method 8270D SIM	2.0
Perylene		x	EPA Method 8270D SIM	2.0
Phenanthrene		x	EPA Method 8270D SIM	2.0
Pyrene		x	EPA Method 8270D SIM	2.0
Cl-Chrysene		x	EPA Method 8270D SIM	2.0
Cl-Dibenzothiophene		x	EPA Method 8270D SIM	2.0
Cl-Fluoranthene		x	EPA Method 8270D SIM	2.0
Cl-Fluorene		x	EPA Method 8270D SIM	2.0

(continued)

Table 2. (continued)

Parameter	NSSP	Gulfwatch	Analytical Method (USEPA 2016)	MDL[a]
Cl-Naphthalene		x	EPA Method 8270D SIM	2.0
Cl-Phenanthrene		x	EPA Method 8270D SIM	2.0
C2-Chrysene		x	EPA Method 8270D SIM	2.0
C2-Dibenzothiophene		x	EPA Method 8270D SIM	2.0
C2-Fluoranthene		x	EPA Method 8270D SIM	2.0
C2-Fluorene		x	EPA Method 8270D SIM	2.0
C2-Naphthalene		x	EPA Method 8270D SIM	2.0
C2-Phenanthrene		x	EPA Method 8270D SIM	2.0
C3-Naphthalene		x	EPA Method 8270D SIM	2.0
C3-Chrysene		x	EPA Method 8270D SIM	2.0
C3-Phenanthrene		x	EPA Method 8270D SIM	2.0
C3-Dibenzothiophene		x	EPA Method 8270D SIM	2.0
C3-Fluorene		x	EPA Method 8270D SIM	2.0
C4-Chrysene		x	EPA Method 8270D SIM	2.0
C4-Fluorene		x	EPA Method 8270D SIM	2.0
C4-Naphthalene		x	EPA Method 8270D SIM	2.0
C4-Phenanthrene		x	EPA Method 8270D SIM	2.0
Total PAHS		x	EPA Method 8270D SIM	2.0
Pesticides (ng/wet g [µg/L])				
A_BHC (Alpha Lindane)		x	EPA Method 8270D	2.0
A-Endosulfan		x	EPA Method 8270D	0.5
Aldrin	x	x	EPA Method 8270D	0.5
B-Endosulfan		x	EPA Method 8270D	0.5
Chlordane	x		EPA Method 8270D	0.5
Chlordecone (Kepone)	x		EPA Method 8270D	0.5
CIS-Chlordane		x	EPA Method 8270D	0.5
Dieldrin	x	x	EPA Method 8270D	0.5
Endrin		x	EPA Method 8270D	0.5
G-Chlordane		x	EPA Method 8270D	0.5
Heptachlor	x	x	EPA Method 8270D	0.5
Heptachlor Epoxide	x	x	EPA Method 8270D	0.5
Hexachlorobenzene		x	EPA Method 8270D	0.5
Lindane (G-HCH)		x	EPA Method 8270D	0.5
Methoxychlor		x	EPA Method 8270D	0.5
Mirex	x	x	EPA Method 8270D	0.5
O,P'-DDD		x	EPA Method 8270D	0.5
O,P'-DDE		x	EPA Method 8270D	0.5
O,P'-DDT		x	EPA Method 8270D	0.5
P,P'-DDD		x	EPA Method 8270D	0.5

(continued)

Table 2. (continued)

Parameter	NSSP	Gulfwatch	Analytical Method (USEPA 2016)	MDL[a]
P,P'-DDE		x	EPA Method 8270D	0.5
P,P'-DDT		x	EPA Method 8270D	0.5
DDE	x		EPA Method 8270D	0.5
Total DDT	x	x	EPA Method 8270D	0.5
Trans-Nonachlor		x	EPA Method 8270D	0.5
TDE	x		EPA Method 8081B	2.0
PCBs (ng/wet g [µg/L])				
101 - Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
90 - Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
105 - 2,3,3’,4,4’ Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
118 - 2,3’,4,4’,5 Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
126 - 3,3’,4,4’,5 Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
128 - 2,2’,3,3’,4,4’ Hexachlorobiphenyl		x	EPA Method 8082 SIM	2.0
138 – 2,2’,3,4,4’,5’ Hexachlorobiphenyl		x	EPA Method 8082 SIM	2.0
153 – 2,2’,4,4’,5,5’ Hexachlorobiphenyl		x	EPA Method 8082 SIM	2.0
132 – 2,2’,3,3’,4,6’ Hexachlorobiphenyl		x	EPA Method 8082 SIM	2.0
169 – 3,3’,4,4’,5,5’ Hexachlorobiphenyl		x	EPA Method 8082 SIM	2.0
170 – Heptachlorobiphenyl		x	EPA Method 8082 SIM	2.0
190 – Heptachlorobiphenyl		x	EPA Method 8082 SIM	2.0
18 – 2,2’,3 Trichlorobiphenyl		x	EPA Method 8082 SIM	2.0
15 – 4,4’ Dichlorobiphenyl		x	EPA Method 8082 SIM	2.0
180 – 2,2’,3’4,4’,5,5’ Heptachlorobiphenyl		x	EPA Method 8082 SIM	2.0
187 – 2,2’,3,4’,5,5’,6 Heptachlorobiphenyl		x	EPA Method 8082 SIM	2.0
195 – 2,2’,3,3’,4,4’,5,6 Octachlorbiphenyl		x	EPA Method 8082 SIM	2.0
208 -2,2’,3,3’,4,5,5’,6,6’ Nonachlorobiphenyl		x	EPA Method 8082 SIM	2.0
206 – 2,2’,3,3’,4,5,5’,6,6’ Nonachlorobiphenyl		x	EPA Method 8082 SIM	2.0
209 – 2,2,3,3’,4,4’,5,5’,6,6’ Decachlorobiphenyl		x	EPA Method 8082 SIM	2.0
28 - 2,3,4’ Trichlorobiphenyl		x	EPA Method 8082 SIM	2.0
29 - 2,4,5 Trichlorobiphenyl		x	EPA Method 8082 SIM	2.0
44 – 2,2’,3,5 Tetrachlorobiphenyl		x	EPA Method 8082 SIM	2.0
50 – 2,2’,3,5 Tetrachlorobiphenyl		x	EPA Method 8082 SIM	2.0
52 – 2,2’,5,5’ Tetrachlorobiphenyl		x	EPA Method 8082 SIM	2.0
66 – 2,3’,4,4’ Tetrachlorobiphenyl		x	EPA Method 8082 SIM	2.0
95 – 2,2’,3,5’,6 Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
77 – 3,3’,4,4’ Tetrachlorobiphenyl		x	EPA Method 8082 SIM	2.0
8 – 2,4’ Dichlorobiphenyl		x	EPA Method 8082 SIM	2.0

(continued)

Table 2. (continued)

Parameter	NSSP	Gulfwatch	Analytical Method (USEPA 2016)	MDL[a]
5 – 2,3 Dichlorobiphenyl		x	EPA Method 8082 SIM	2.0
87 – 2,2',3,4,5 Pentachlorobiphenyl		x	EPA Method 8082 SIM	2.0
Sum PCBs	x	x	EPA Method 8082 SIM	2.0

[a]EPA defines Method detection limit (MDL) "as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte" (epa.gov/cwa-methods/method-detection-limit-frequent-questions). The reporting limit is the smallest concentration that can be reported and still maintain project QC criteria. Values reported that are greater than the MDL but less than the RL are flagged to indicate they are estimated values with a higher degree of uncertainty to them.

Table 3. Action Levels, Tolerances and Guidance Levels for Poisonous or Deleterious Substances in Seafood

Class of Substance	Substance Level	Food Commodity	Reference
Deleterious Substance			
Aldrin	0.3 ppm	All Fish	CPG sec 575.100b
Dieldrin	0.3 ppm	All Fish	CPG sec 575.100b
Chlordane	0.3 ppm	All Fish	CPG sec 575.100b
Chlordecone (Kepone)	0.3 ppm	All Fish	CPG sec 575.100b
DDT, DDE, TDE*	5.0 ppm	All Fish	CPG sec 575.100b
Methyl mercury**	1.0 ppm	All Fish	CPG sec 540.600
Heptachlor	0.3 ppm	All Fish	CPG sec 575.100
Heptachlor epoxide	0.3 ppm	All Fish	CPG sec 575.100
Mirex	0.1 ppm	All Fish	CPG sec 575.100
PCBs	2.0 ppm	All Fish	21 CFR 109.30
2,4-D*	1.0 ppm	Shellfish	40 CFR 180.142

Source: National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish: 2015 Revision (USFDA 2015)

*not analyzed per concurrence with NHDES

**to be tested as organic mercury

Table 4. Mean and Standard Deviation of Replicate Mussel Samples for Parameters with Federal Action Level Criteria

PARAMETER		Baseline		SM1						SM2						SM3						SM4					
				Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
		Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Metals	Mercury, total	0.02	0	0.02	0	0.03	0.01	0.04	0	0.02	0	0.03	0	0.03	0	0.02	0	0.03	0.01	0.03	0.01	0.02	0.01	0.03	0.01	0.03	0
Pesticides	2,4'-DDD	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,4'-DDE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,4'-DDT	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	4,4'-DDD	0.36	0.22	0.48	0.46	ND		ND		0.86	0.71	ND		ND		ND		ND		ND		ND		ND		ND	
	4,4'-DDE	1.07	0.04	1.35	0.06	0.91	0.2	0.82	0.39	1.72	0.4	0.68	0.1	1.23	0.2	1.21	0.22	0.68	0.12	1.18	0.2	1.09	0.22	1.1	0.35	1.06	0.17
	4,4'-DDT	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Aldrin	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Chlordane-alpha	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Chlordane-gamma	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Dieldrin	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Heptachlor	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Heptachlor Epoxide	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Kepone	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Mirex	ND		ND		ND		0.34	0.18	3.58	5.91	ND		ND		ND		ND		ND		ND		ND		ND	
PCBs	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,4',5,6-Octachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,4'-Hexachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,6'-Hexachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,4',5,5',6-Heptachlorobiphenyl	0.42	0.35	0.59	0.25	0.75	0.1	0.37	0.23	0.45	0.24	0.53	0.19	0.54	0.36	0.45	0.4	0.42	0.19	0.55	0.23	ND		0.34	0.17	0.57	0.05
	2,2',3,4,4',5'-Hexachlorobiphenyl	1.08	0.23	1.32	0.23	0.98	0.05	0.87	0.12	1.23	0.18	0.81	0.39	1.19	0.24	1.17	0.17	1.04	0.18	1.02	0.1	1.13	0.26	0.84	0.11	0.91	0.11
	2,2',3,4,4',5,5'-Heptachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,4,5'-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	

PARAMETER	Baseline		SM1						SM2						SM3						SM4					
			Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
2,2',3,5',6-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',3,5'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',4,4',5,5'-Hexachlorobiphenyl	1.35	0.22	1.41	0.21	1.25	0.09	1.01	0.19	1.44	0.29	1.25	0.21	1.4	0.12	1.42	0.19	1.2	0.21	1.17	0.05	1.36	0.44	0.76	0.35	1.11	0.17
2,2',4,5'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',4,6-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',5,5'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',5-Trichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,3',4,4',5-Pentachlorobiphenyl	0.6	0.24	0.62	0.29	0.45	0.23	0.41	0.18	0.81	0.17	0.55	0.21	0.69	0.14	0.81	0.09	0.51	0.18	0.82	0.19	0.65	0.31	0.41	0.18	0.7	0.11
2,3',4,4'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,3,3',4,4'-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,3-Dichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,4'-Dichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,4,4'-Trichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,4,5-Trichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3,3',4,4',5,5'-Hexachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3,3',4,4',5-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3,3',4,4'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
4,4'-Dichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Heptachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Pentachlorobiphenyl	0.66	0.32	0.94	0.18	ND		0.56	0.21	0.75	0.38	0.35	0.2	0.72	0.15	0.42	0.35	ND		0.34	0.18	0.71	0.39	ND		0.41	0.19
All	0.35	0.27	0.37	0.32	0.33	0.24	0.32	0.19	0.36	0.31	0.32	0.23	0.36	0.29	0.35	0.29	0.32	0.23	0.34	0.24	0.34	0.29	0.29	0.16	0.33	0.22

Table 5. Mean and Standard Deviation of Replicate Oyster Samples for Parameters with Federal Action Level Criteria

		SM1						SM2						SM3						SM4					
		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
	PARAMETER	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Metals	Mercury, total	0.02	0	0.02	0.01	0.03	0	0.02	0.01	0.03	0	0.03	0	0.02	0	0.03	0	0.02	0	0.02	0.01	0.03	0	0.02	0.01
Pesticides	2,4'-DDD	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,4'-DDE	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,4'-DDT	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	4,4'-DDD	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	4,4'-DDE	1.79	0.42	3.45	0.77	2.13	0.37	2.39	0.3	1.86	0.42	2.57	0.18	2.34	0.61	1.82	0.27	3.4	0.48	2.35	0.63	2.53	0.3	3.37	0.26
	4,4'-DDT	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Aldrin	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Chlordane-alpha	0.32	0.14	0.24	0.02	0.25		0.31	0.11	0.22	0.04	ND		ND		0.23	0.03	ND		0.23	0.03	ND		ND	
	Chlordane-gamma	ND		ND		0.24	0.01	ND		0.22	0.03	ND		ND		0.24	0.02	0.24	0.02	0.23	0.03	ND		ND	
	Dieldrin	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Heptachlor	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Heptachlor Epoxide	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Kepone	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Mirex	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
PCBs	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,4',5,6-Octachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,4'-Hexachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,3',4,6'-Hexachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2,2',3,4',5,5',6-Heptachlorobiphenyl	0.73	0.33	1	0.21	0.82	0.22	1.07	0.27	0.98	0.33	0.78	0.37	1.04	0.2	0.89	0.3	1.4	0.64	1.38	0.22	1.32	0.34	1.31	0.1
	2,2',3,4,4',5'-Hexachlorobiphenyl	1.23	0.13	1.54	0.3	1.15	0.24	1.99	0.25	1.34	0.34	1.21	0.27	1.38	0.26	1.37	0.26	1.4	0.83	1.79	0.56	2.11	0.46	2.13	0.28
	2,2',3,4,4',5,5'-Heptachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	

	SM1						SM2						SM3						SM4					
	Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
PARAMETER	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
2,2',3,4,5'-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',3,5',6-Pentachlorobiphenyl	ND		ND		ND		0.53	0.55	0.25		0.25		0.25		0.25		0.25		0.25		0.25		0.25	
2,2',3,5'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',4,4',5,5'-Hexachlorobiphenyl	1.28	0.72	2.12	0.49	1.75	0.35	2.56	1.15	1.79	0.49	1.73	0.34	1.94	0.47	2.02	0.37	1.84	1.12	3.09	1.06	3	0.7	2.89	0.27
2,2',4,5'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',4,6-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',5,5'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,2',5-Trichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,3',4,4',5-Pentachlorobiphenyl	0.91	0.11	1.16	0.18	1.1	0.15	1.53	0.59	1.22	0.57	1.05	0.19	1.08	0.25	1.27	0.18	1.16	0.66	1.66	0.5	1.94	0.45	1.98	0.27
2,3',4,4'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,3,3',4,4'-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,3-Dichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,4'-Dichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,4,4'-Trichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2,4,5-Trichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3,3',4,4',5,5'-Hexachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3,3',4,4',5-Pentachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3,3',4,4'-Tetrachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
4,4'-Dichlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Heptachlorobiphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Pentachlorobiphenyl	0.92	0.47	1.35	0.28	1.1	0.31	1.63	0.35	0.95	0.59	1.18	0.28	1.19	0.21	1.25	0.26	1.22	0.67	1.93	0.39	1.92	0.42	1.89	0.14
All	0.38	0.33	0.45	0.48	0.41	0.38	0.51	0.64	0.42	0.43	0.41	0.39	0.43	0.44	0.44	0.45	0.44	0.53	0.54	0.72	0.55	0.73	0.55	0.71

Table 6. Mean and Standard Deviation of Replicate Mussel Samples for Parameters without Federal Action Level Criteria

				SM1						SM2						SM3						SM4					
		Baseline		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
	PARAMETER	Mean[a]	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Metals	Aluminum, total	17.88	1.15	34.55	12.02	21.83	4.96	47.3	5.5	29.7	0.78	24.6	4.84	22.23	4.61	38.53	11.39	20.78	5.76	27.2	16.23	22.35	2.51	34.83	8.93	19.05	1.65
	Cadmium, total	0.19	0.02	0.31	0.04	0.29	0.04	0.38	0.05	0.3	0.02	0.36	0.05	0.32	0.03	0.25	0.04	0.28	0.06	0.29	0.04	0.29	0.03	0.3	0.03	0.28	0.01
	Chromium, total	0.28	0.02	0.36	0.05	0.38	0.12	0.45	0.03	0.34	0.08	0.68	0.35	0.26	0.04	0.34	0.02	0.28	0.05	0.28	0.12	0.3	0.01	0.36	0.07	0.52	0.57
	Copper, total	1.06	0.04	1.39	0.24	1.06	0.12	1.59	0.19	1.49	0.21	1.22	0.15	1.37	0.14	1.24	0.14	1.17	0.23	1.38	0.27	1.29	0.25	1.33	0.17	1.36	0.26
	Iron, total	49.43	1.84	83.3	19.01	60.43	10.33	114.25	11.15	73.53	4.24	69.8	14.59	61.45	10.83	102.3	51.21	58.73	13.44	73.5	39.59	61.3	4.86	84.73	17.66	61.13	14.08
	Lead, total	0.19	0.01	0.29	0.04	0.23	0.03	0.39	0.05	0.33	0.05	0.3	0.08	0.31	0.14	0.26	0.03	0.26	0.05	0.25	0.12	0.24	0.03	0.31	0.05	0.22	0.02
	Nickel, total	0.25	0.11	0.37	0.04	0.24	0.11	0.41	0.03	0.24	0.11	ND		0.32	0.2	0.34	0.14	0.24	0.1	0.37	0.12	0.39	0.12	0.3	0.05	0.36	0.13
	Silver, total	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Zinc, total	12.7	0.48	17.15	2.03	14.45	1.97	19.63	0.96	18.23	1.99	19.95	4.74	17.93	1.52	15.35	2.49	19.13	1.07	17.48	3.11	16.13	0.92	17.85	1.84	16.45	1.8
PAHs	1-Methylnaphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2-Methylnaphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Acenaphthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Acenaphthylene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Anthracene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(a)anthracene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(a)pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(b)fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(e)pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(g,h,i)perylene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(k)fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Biphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Dibenzothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1Phenathrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Dibenzothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	

				SM1						SM2						SM3						SM4					
		Baseline		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
	PARAMETER	Mean[a]	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	C2-Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Phenathrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Phenanthrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C4-Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C4-Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C4-Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Dibenzo(a,h)anthracene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Dibenzothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Indeno(1,2,3-cd)pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Perylene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Phenanthrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	All	9.99	0.04	10	0.05	9.99	0.04	10.03	0.03	9.99	0.04	11.22	5.85	10	0.04	10	0.04	10.01	0.04	10.04	0.02	9.99	0.02	9.99	0.04	10.04	0.02
Pesticides	BHC-alpha	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	BHC-gamma	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Endosulfan-I	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Endosulfan-II	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Endrin	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Hexachlorobenzene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Methoxychlor	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Oxychlordane	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	cis-Nonachlor	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	trans-Nonachlor	ND		ND		ND		ND		0.24	0.03	ND		ND		ND		ND		ND		ND		ND		ND	

[a]means and standard deviations were calculated using ½ RL for any replicates with concentrations below the RL (i.e., nondetects)

Table 7. Results of One-Way ANOVAs Evaluating Tissue Concentrations of Contaminants in Blue Mussels Over Time

Parameter	Station	Test Statistics			Multiple comparisons**
		Degrees of Freedom	F test	Probability	
Aluminum	SM1	2	9.77	0.0055*	PHJ Pre PJP***
	SM2	2	3.87	0.0613	Pre = PJP = PHJ
	SM3	2	2.27	0.1587	Pre = PHJ = PJP
	SM4	2	29.35	0.0064*	PJP>Pre = PHJ
Chromium	SM1	2	1.74	0.2301	PHJ = PJP = Pre
	SM3	2	0.64	0.5492	Pre = PJP = PHP
Copper	SM1	2	7.91	0.0104*	PHJ Pre PJP
	SM2	2	2.49	0.1382	Pre = PHJ = PJP
	SM3	2	1.01	0.4007	PHJ = Pre = PJP
	SM4	2	0.11	0.8977	PHJ = PJP = Pre
Lead	SM1	2	14.24	0.0016*	PHJ>Pre = PJP
	SM2	2	0.11	0.8977	Pre = PHJ = PJP
	SM3	2	0.01	0.9942	PJP = Pre = PHJ

*P<0.05 denotes significant difference

**based on Tukey's Test

*** Pre = preconstruction; PJP = post jet plow; PHJ = post hand jet; events listed in descending order of means

Table 8. Mean and Standard Deviation of Replicate Oyster Samples for Parameters without Federal Action Level Criteria

		SM1						SM2						SM3						SM4					
		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
PARAMETER		Mean[a]	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Metals	Aluminum, total	52.73	14.32	13.74	4.87	11.91	2.49	39.1	22.65	17.28	2.62	11.71	2.72	51.05	8.94	16.65	3.14	7.94	4.05	41.85	12.58	25.43	1.83	9.84	5.65
	Cadmium, total	0.29	0.04	0.32	0.1	0.37	0.03	0.28	0.13	0.47	0.05	0.41	0.03	0.27	0.04	0.36	0.03	0.27	0.08	0.28	0.08	0.37	0.07	0.3	0.1
	Chromium, total	0.27	0.06	0.12	0.05	0.09	0.05	0.21	0.11	0.13	0.01	0.1	0.03	0.27	0.05	0.18	0.11	0.08	0.03	0.23	0.09	0.15	0.03	0.08	0.04
	Copper, total	16.35	3.31	19.55	5.14	21	1.42	12.48	6.08	26.28	4.11	26.08	3.44	18.33	3.65	24.05	3.15	16.53	5.9	14.66	3.87	21.25	2.97	18.83	6.8
	Iron, total	103.93	26.71	45.5	14.27	37.43	4.52	80.8	44.63	54.88	5.02	41.8	6.91	101.75	18.61	50.85	5.88	30.38	11.92	85.63	26	58.83	11.75	33.28	11.86
	Lead, total	0.18	0.04	0.1	0.04	0.1	0.01	0.16	0.1	0.17	0.02	0.12	0.02	0.21	0.05	0.15	0.02	0.08	0.05	0.16	0.05	0.16	0.04	0.09	0.05
	Nickel, total	0.41	0.05	0.4	0.04	0.34	0.01	0.48	0.18	0.43	0.09	0.41	0.06	0.57	0.39	0.26	0.13	0.28	0.11	0.39	0.05	0.41	0.06	0.29	0.1
	Silver, total	0.49	0.12	0.6	0.18	0.68	0.05	0.4	0.21	0.98	0.16	0.89	0.1	0.59	0.13	0.85	0.13	0.54	0.2	0.49	0.14	0.84	0.18	0.66	0.25
	Zinc, total	562.25	130.46	640.25	144.9	696	47	409.75	197.66	933.75	145.53	925.25	82.35	618.75	103.18	871	73.38	628	183.52	480.75	152.96	790.75	174.06	637.5	238.33
PAHs	1-Methylnaphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	2-Methylnaphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Acenaphthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Acenaphthylene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Anthracene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(a)anthracene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(a)pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(b)fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(e)pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(g,h,i)perylene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Benzo(k)fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Biphenyl	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Dibenzothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1-Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C1Phenathrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Dibenzothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C2-Phenathrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	

		SM1						SM2						SM3						SM4					
		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet		Preconstruction		Post jet plow		Post hand jet	
	PARAMETER	Mean[a]	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
	C3-Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C3-Phenanthrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C4-Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C4-Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	C4-Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Chrysene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Dibenzo(a,h)anthracene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Dibenzothiophene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Fluoranthene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Fluorene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Indeno(1,2,3-cd)pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Naphthalene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Perylene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Phenanthrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Pyrene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	TOTAL PAH	10.01	0.02	10	0.04	11.19	5.9	10	0.05	11.19	5.87	11.21	5.87	9.99	0.04	12.38	8.11	9.99	0.04	10	0.04	14.75	10.98	9.99	0.04
Pesticides	BHC-alpha	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	BHC-gamma	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Endosulfan-I	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Endosulfan-II	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Endrin	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Hexachlorobenzene	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Methoxychlor	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	Oxychlordane	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	cis-Nonachlor	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
	trans-Nonachlor	ND		ND		ND		ND		0.23	0.03	ND		0.24	0.03	0.24	0.03	0.24	0.01	0.25	0.01	ND		0.24	0.02

[a]means and standard deviations were calculated using ½ RL for any replicates with concentrations below the RL (i.e., nondetects)

Table 9. Results of One-Way ANOVAs Evaluating Tissue Concentrations of Contaminants in Oysters Over Time

Parameter	Station	Test Statistics			Multiple comparisons**
		Degrees of Freedom	F test	Probability	
Aluminum	SM1	2	27.13	0.0002*	Pre>PJP = PHJ***
	SM2	2	4.77	0.0387*	Pre PJP PHJ
	SM3	2	58.67	<0.0001*	Pre>PJP=PHJ
	SM4	2	15.89	0.0011*	Pre>PHP=PHJ
Copper	SM1	2	1.72	0.2324	PJP = PHJ = Pre
	SM2	2	11.43	0.0034*	PHJ = PJP > Pre
	SM3	2	3.19	0.0896	PJP = Pre = PHJ
	SM4	2	1.90	0.2046	PJP = PHJ = Pre
4,4’-DDE	SM1	2	10.21	0.0048*	PJP>PHJ =Pre
	SM2	2	5.51	0.0274*	PHJ Pre PJP
	SM3	2	11.40	0.0034*	PHJ>Pre = PJP
	SM4	2	6.36	0.0190*	PHJ>PJP = Pre
2,2’,3,4’,5,5’,6 Heptachlorobiphenyl	SM3	2	1.52	0.2701	PHJ =Pre = PJP
2,2’,3,4,4’,5’ Hexachlorobiphenyl	SM1	2	3.07	0.0963	PJP = Pre = PHJ
	SM2	2	8.24	0.0093*	Pre>PJP = PHJ
2,2’,4,4’,5,5’ Hexachlorobiphenyl	SM1	2	2.41	0.1452	PJP = PHJ = Pre
	SM2	2	1.53	0.2676	Pre = PJP = PHJ

**P<0.05 denotes significant difference

**based on Tukey’s Test

*** Pre = preconstruction; PJP = post jet plow; PHJ = post hand jet; events listed in descending order of means

Table 10. Comparison of Concentration of Contaminants in Baseline Mussel Tissue Collected from Dover Point NH, August 2019 to Gulfwatch Results

Parameter[a]	Concentration (dry weight basis)								
	SRP Baseline Samples					GulfWatch			
	Rep A	Rep B	Rep C	Rep D	Mean (SD)	1997 (Dover Pt.)	1998 (Fox Pt.)	1999 (Dover Pt.)	2000 (Dover Pt.)
Pesticides (ng/g)									
4,4'-DDD	<0.5	<0.5	4.566	<0.5	1.33 (2.16)	3.85	1.52	1*	5.1
4,4'-DDE	7.35	6.97	6.711	6.75	6.95 (0.293)	8.53	0.6*	1.05*	6.78
PAHs (ng/g)									
C4-Naphthalene	<20.0	<20.1	513.68	<19.9	135.92 (240.30)	4.1*	3.5*	2.6*	12.75
PCBs (ng/g)									
Pentachlorobiphenyl (90/101)	<0.500	<0.200	4.769	<0.500	1.38 (2.26)	6.18	4.3	7.53	3.78
2,2',3,4,4',5'-Hexachlorobiphenyl (138)	<0.500	8.13	6.513	<0.5	3.79 (4.135)	2.34	8.19	13.25	10.4
2,2',4,4',5,5'-Hexachlorobiphenyl (153)	<0.500	10.58	8.158	<0.5	4.81 (5.357)	8.04	10.18	17	12.93
2,3',4,4',5-Pentachlorobiphenyl (118)	<0.500	5.03	4.197	<0.5	2.43 (2.543)	1.15	4.5	8.2	6.7
2,2',3,4',5,5',6 Heptachlorobiphenyl (187)	<0.5	<0.5	6.20	<0.5	1.74 (2.973)	ND	ND	ND	ND
Metals (µg/g)									
Aluminum	121.85	111.61	126.31	103.75	115.88 (10.165)	225	285	203	233
Cadmium	1.39	1.29	1.184	1.125	1.25 (0.118)	2	2.3	2.8	1.8
Chromium	1.98	1.61	1.842	1.875	1.83 (0.16)	3	2.6	3	2.5
Copper	7.28	6.90	6.842	6.375	6.58 (0.371)	8	7.3	6.1	6.7
Iron	341.05	322.58	323.02	294.375	320.26 (19.283)	515	430	385	326
Lead	1.32	1.16	1.18	1.125	1.20 (0.086)	3	2.8	3.0	1.7
Mercury	0.151	0.122	0.085	0.131	0.13 (0.03)	1	0.7	1	0.7
Nickel	<0.3	2.06	2.368	<0.3	1.18 (0.111)	3	1.53	1.7	1.38
Zinc	87.41	83.9	81.58	76.25	82.28 (4.683)	130	128	130	109

[a]contaminants that were present in any replicate baseline sample

*assigned value of half the detection limit for replicates that were below the detection limit

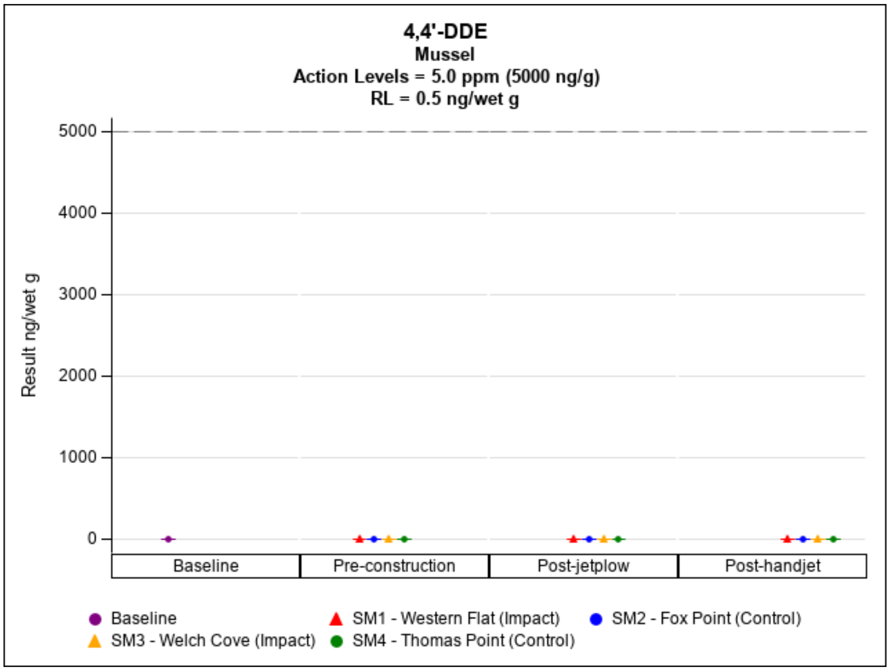

Figure 2. **Tissue concentrations of 4,4' DDE in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

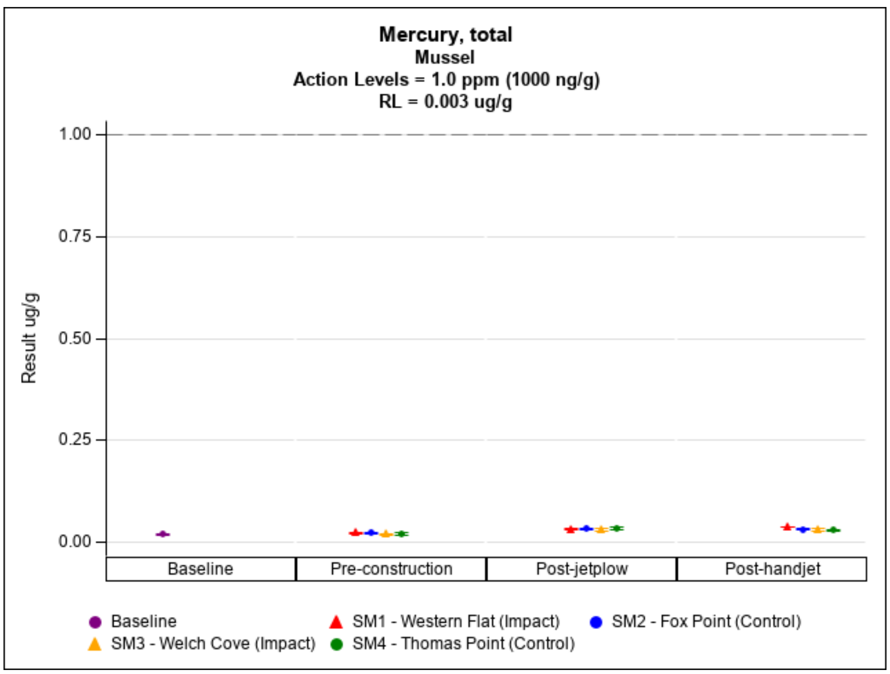

Figure 3. **Tissue concentrations of mercury in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

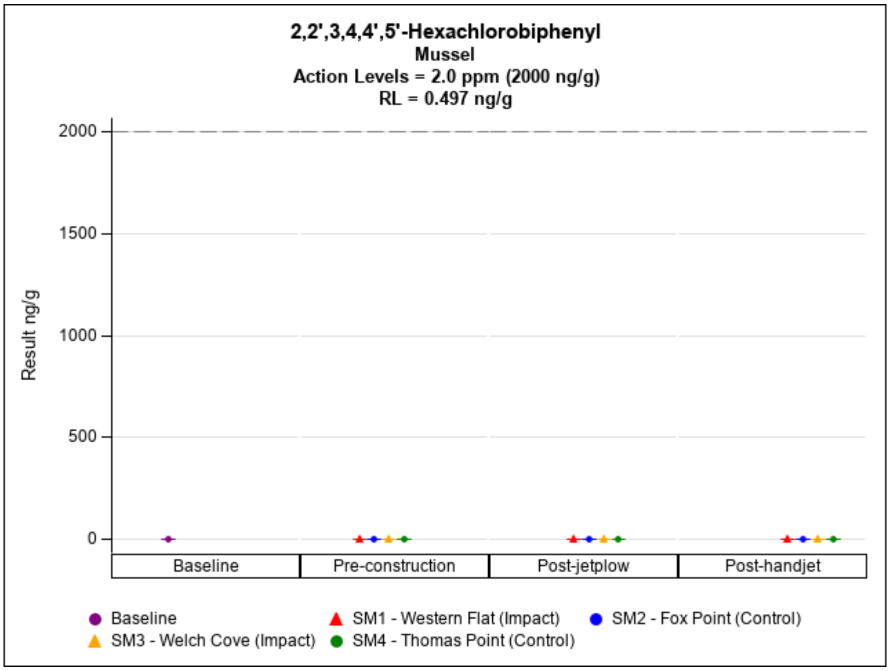

Figure 4. **Tissue concentrations of PCB 138 (2,2’,3,4,4’,5 hexachlorobipheny) in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

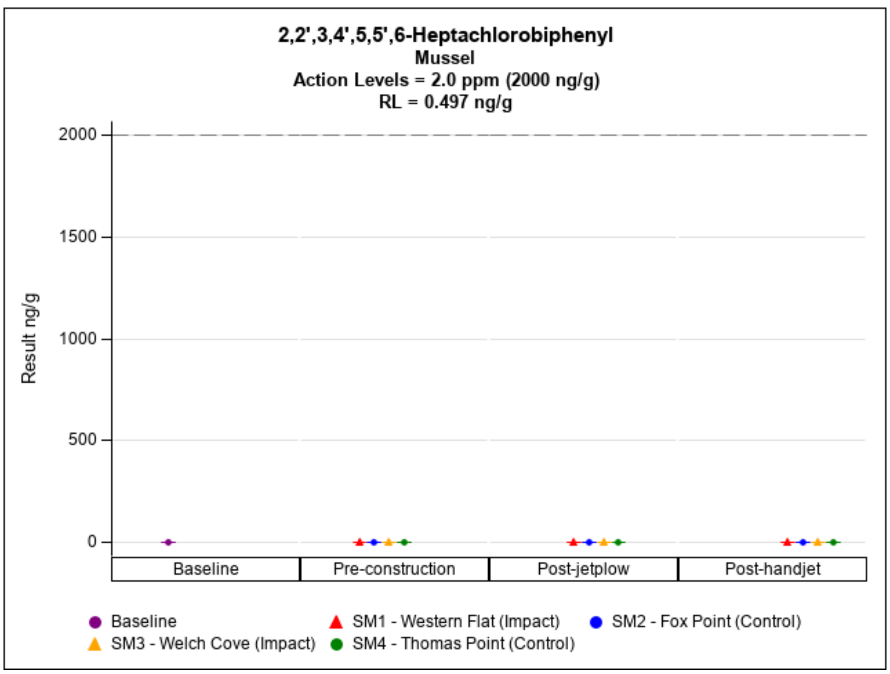

Figure 5. **Tissue concentrations of PCB 187 (2,2,3,4’,5,5’,6 heptachlorobiphenyl) in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

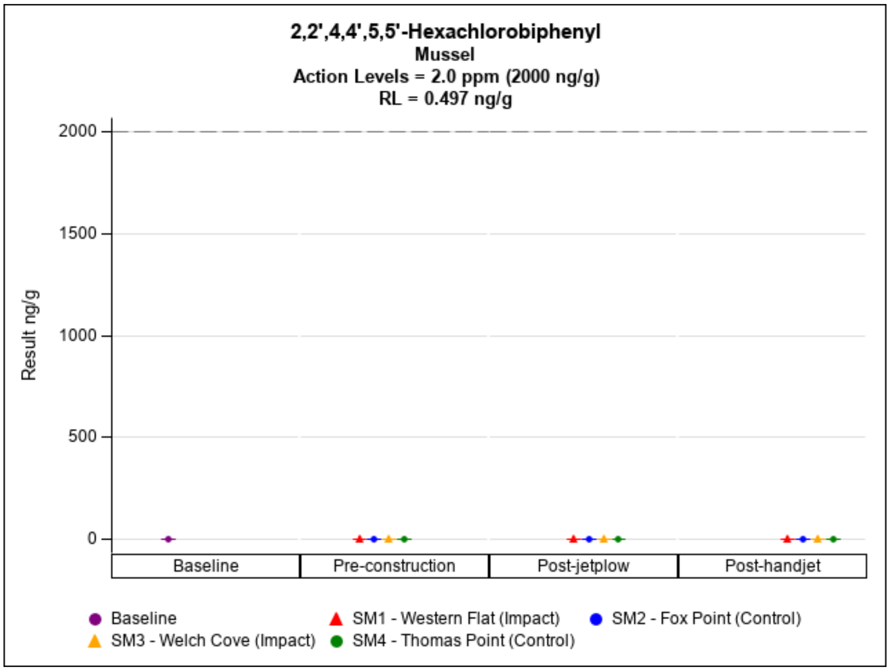

Figure 6. **Tissue concentrations of PCB 153 (2,2',4,4',5,5' hexachlorobiphenyl) in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

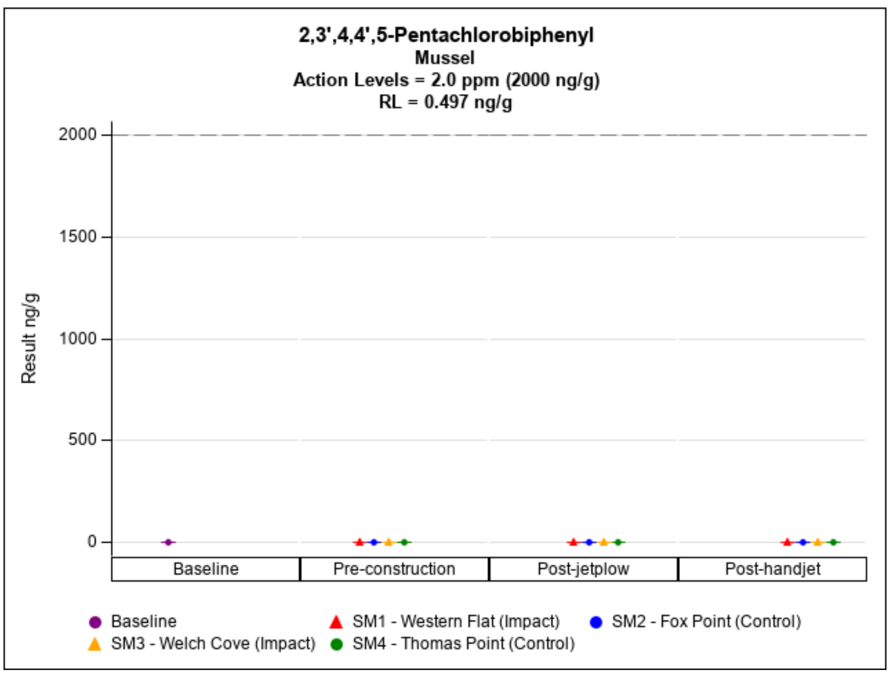

Figure 7. **Tissue concentrations of PCB 118 (2,3',4,4',5 pentachlorobiphenyl) in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

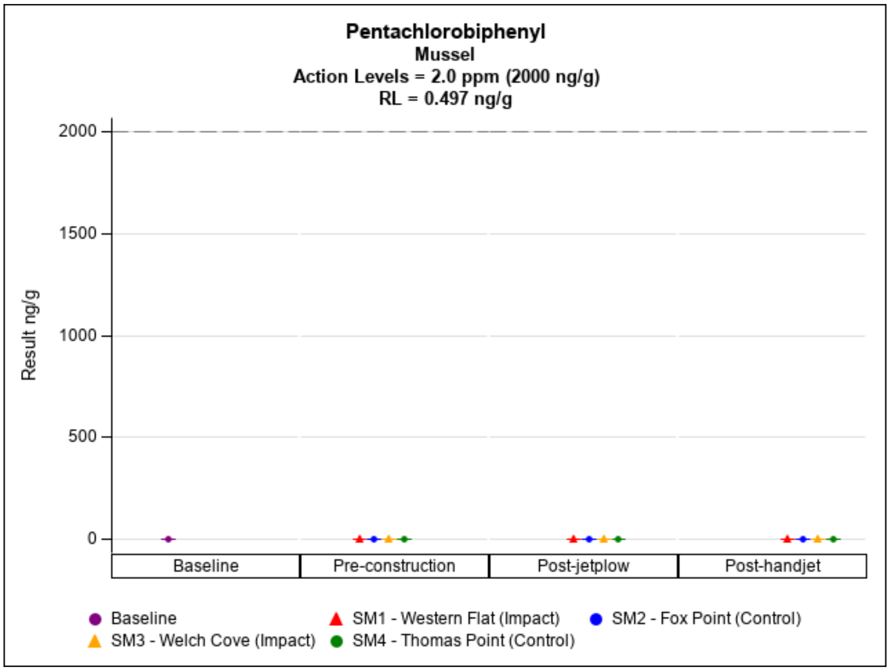

Figure 8. **Tissue concentrations of PCB 90/101 (pentachlorobiphenyl) in mussels compared to FDA Action Level in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

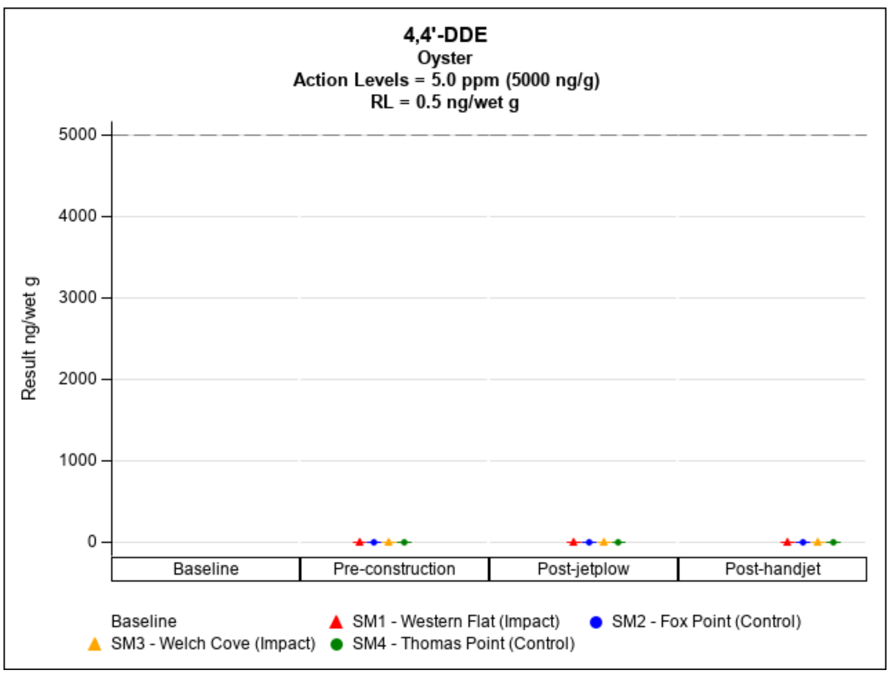

Figure 9. **Tissue concentrations of 4,4' DDE in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

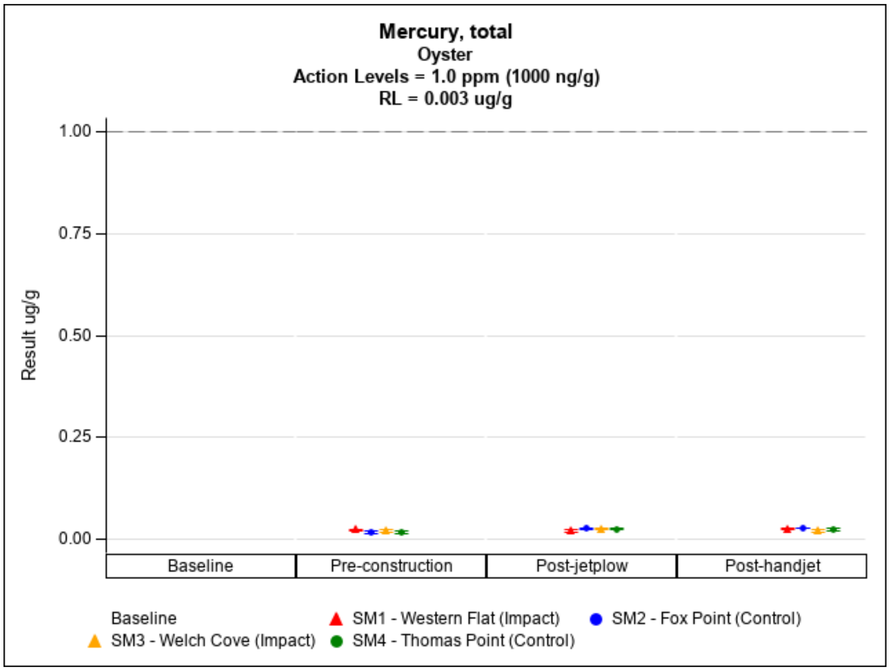

Figure 10. Tissue concentrations of mercury in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

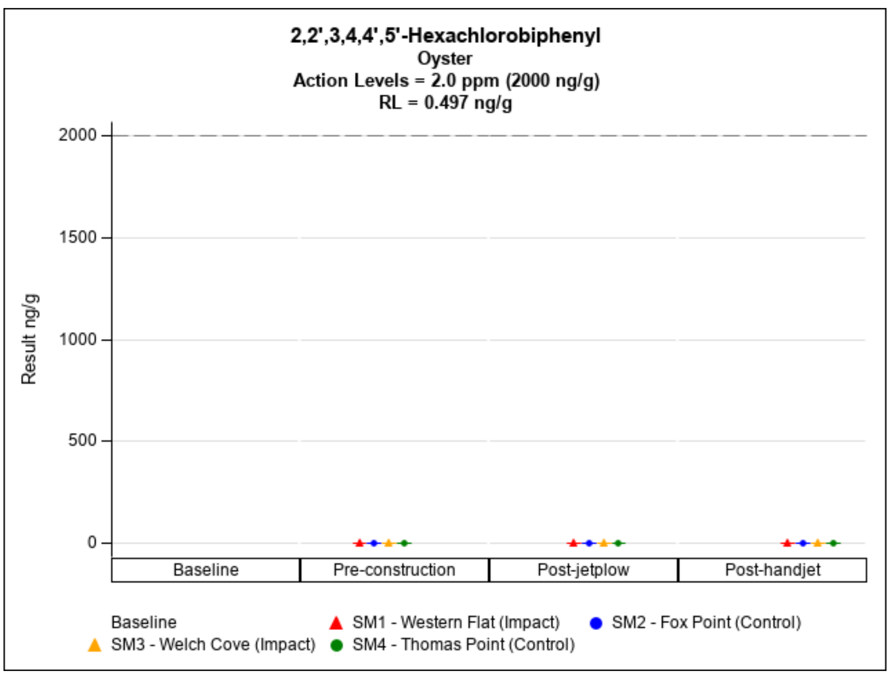

Figure 11. Tissue concentrations of PCB 138 (2,2',3,4,4',5 hexachlorobiphenyl) in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

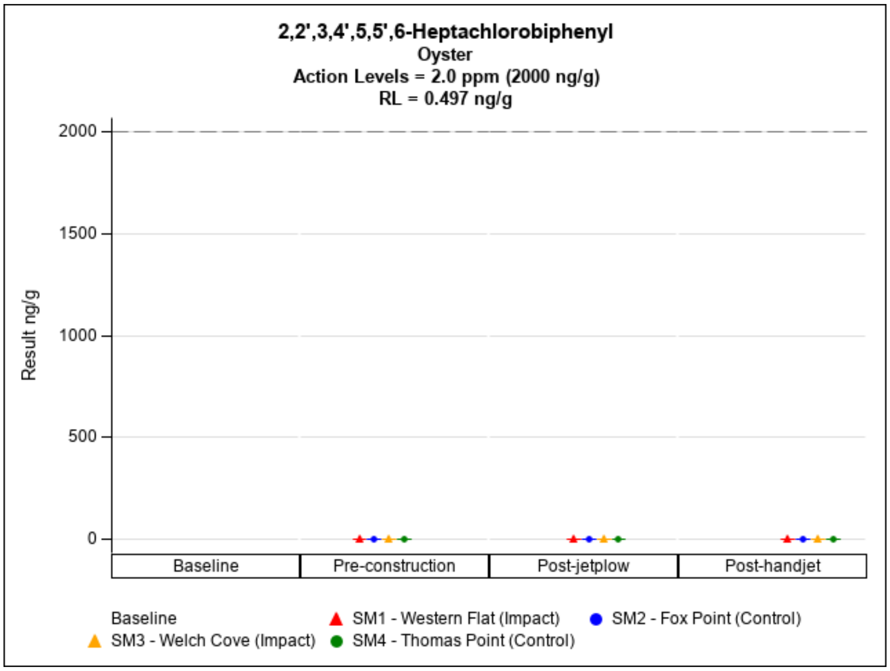

Figure 12. **Tissue concentrations of PCB 187 (2,2,3,4',5,5',6 heptachlorobiphenyl) in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

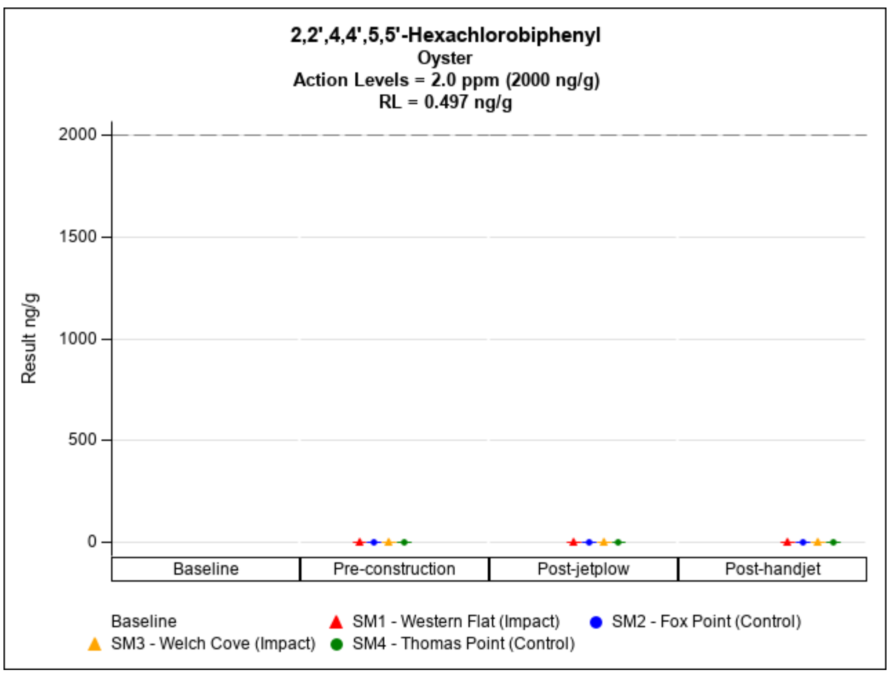

Figure 13. **Tissue concentrations of PCB 153 (2,2',4,4',5,5' hexachlorobiphenyl) in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

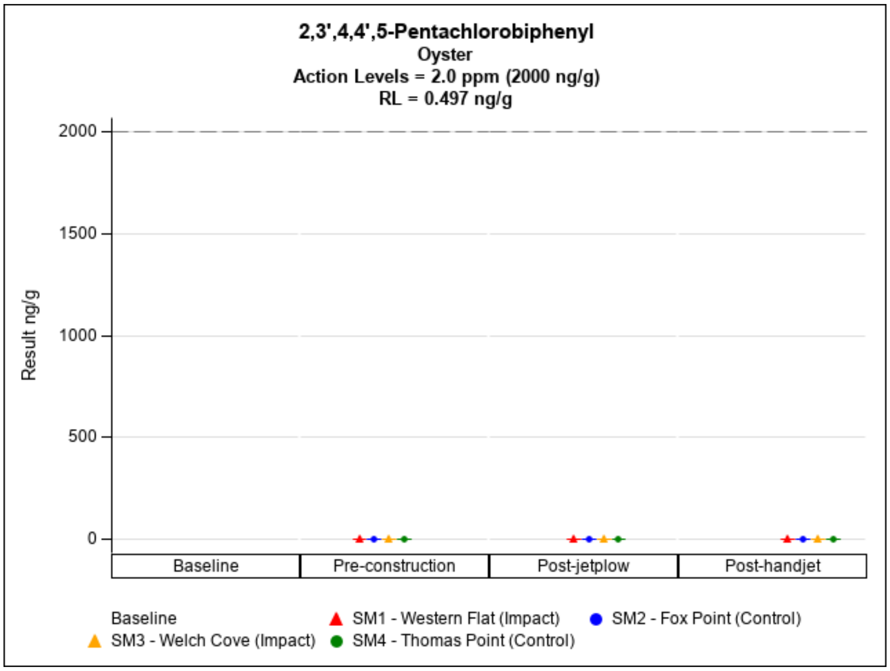

Figure 14. **Tissue concentrations of PCB 118 (2,3',4,4',5 pentachlorobiphenyl) in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

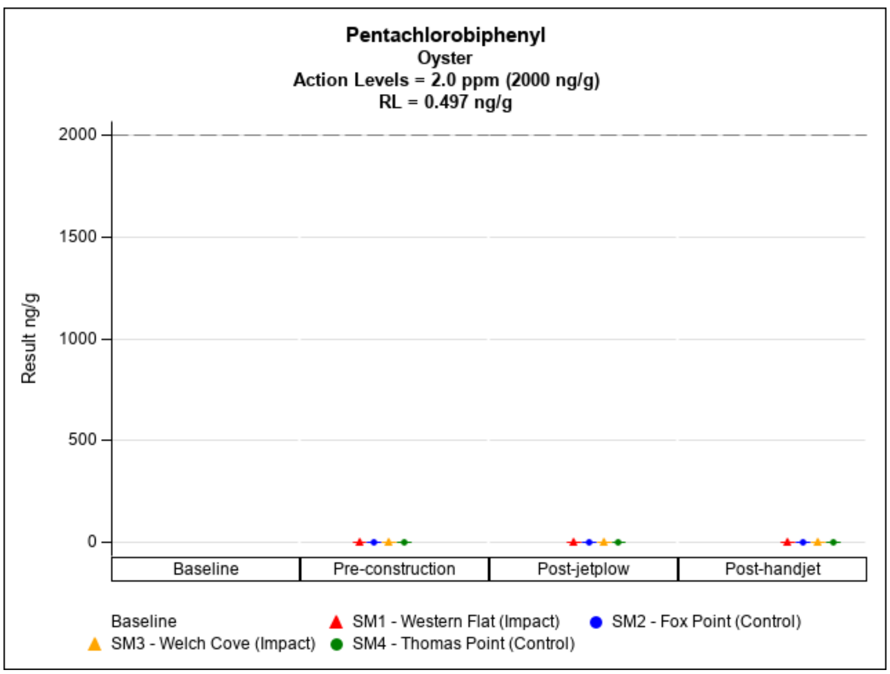

Figure 15. **Tissue concentrations of PCB 90/101 (pentachlorobiphenyl) in oysters compared to FDA Action Level in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

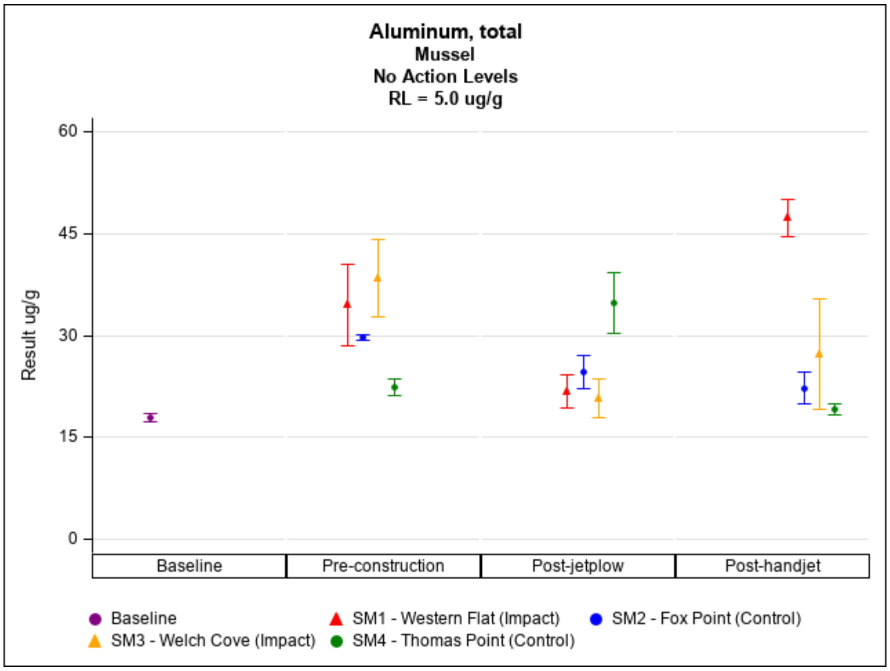

Figure 16. Tissue concentrations (mean and standard deviations) of aluminum in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

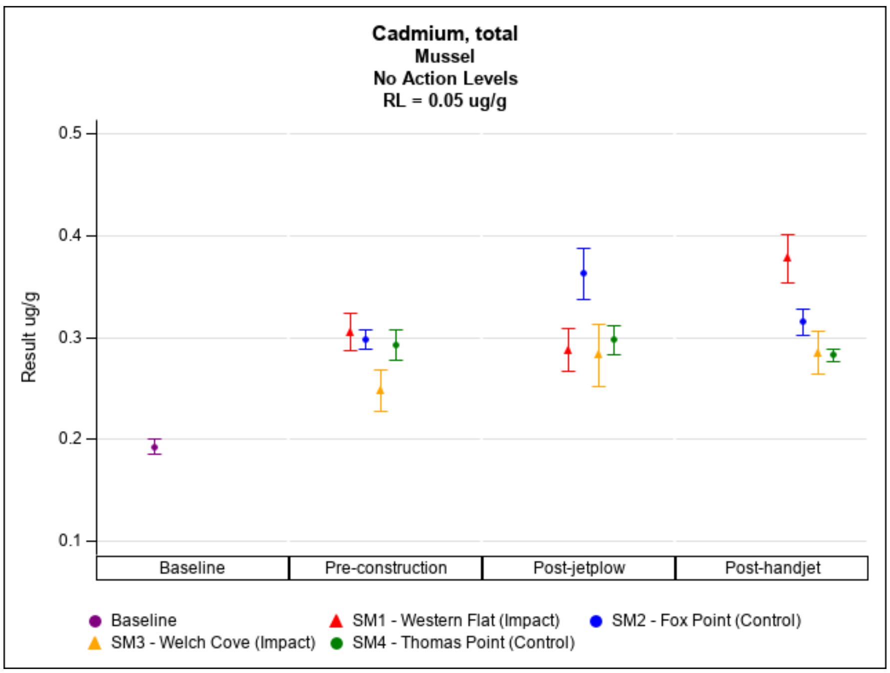

Figure 17. Tissue concentrations (mean and standard deviations) of cadmium in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

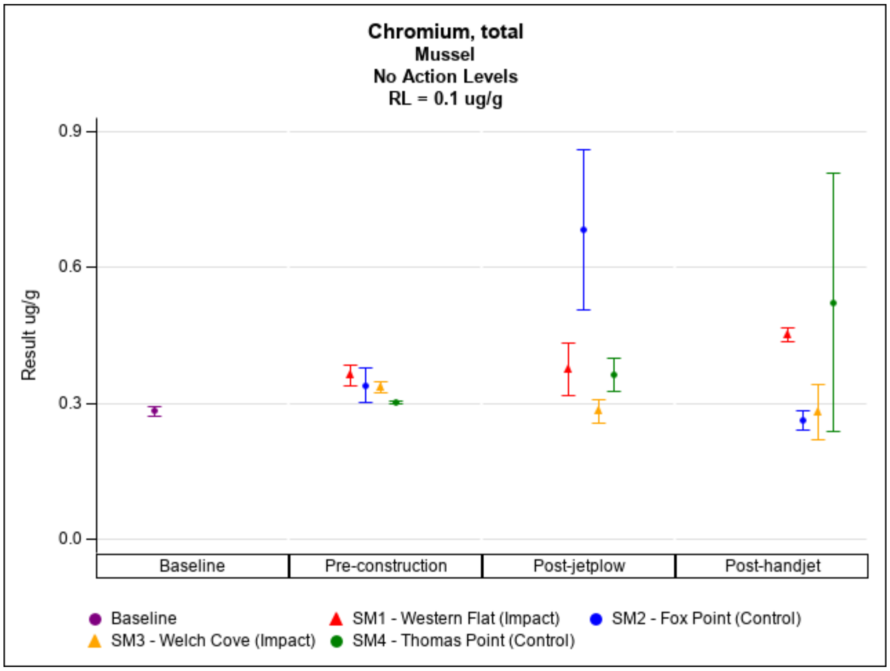

Figure 18. Tissue concentrations (mean and standard deviations) of chromium in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

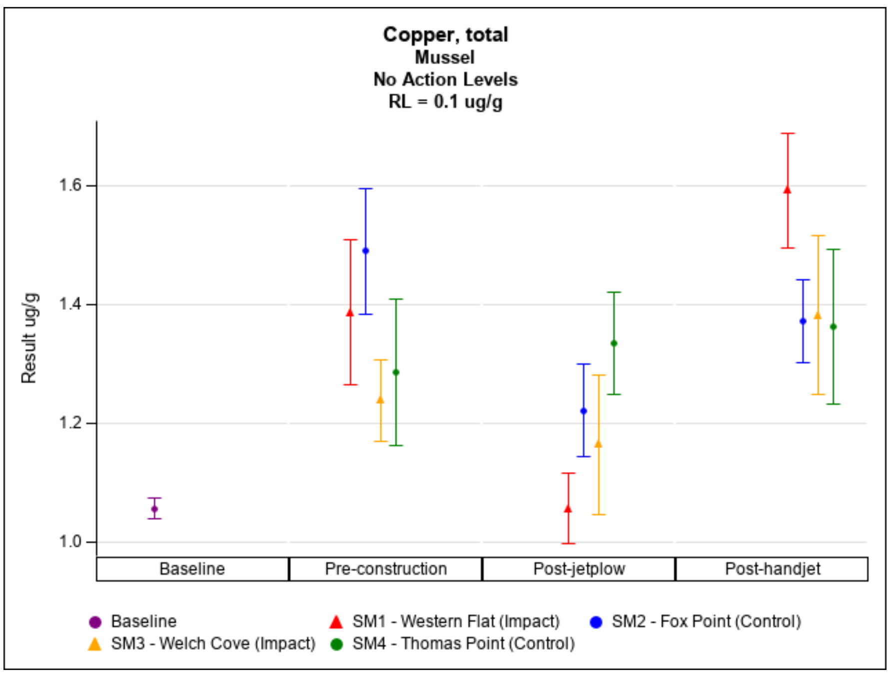

Figure 19. Tissue concentrations (mean and standard deviations) of copper in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

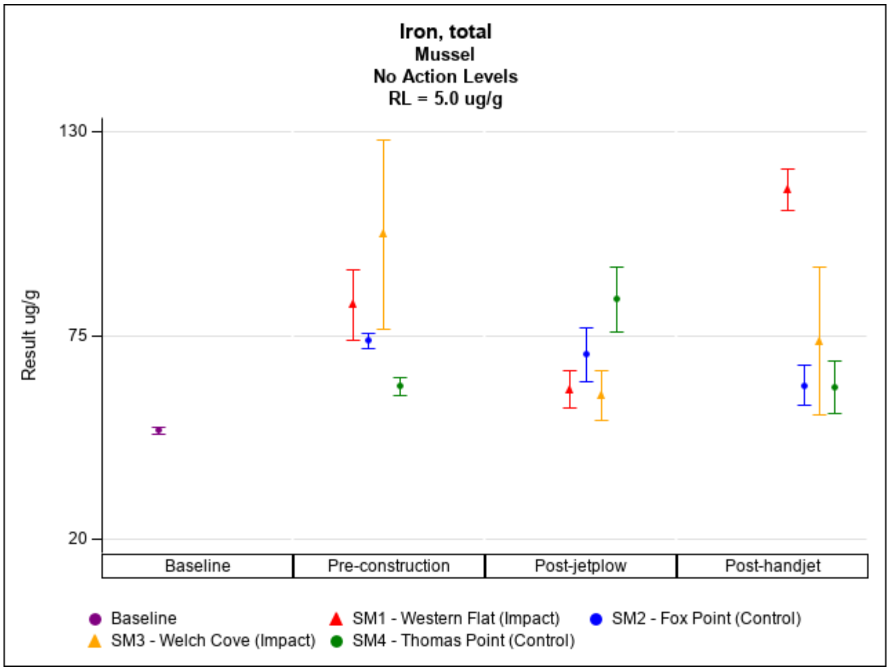

Figure 20. **Tissue concentrations (mean and standard deviations) of iron in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

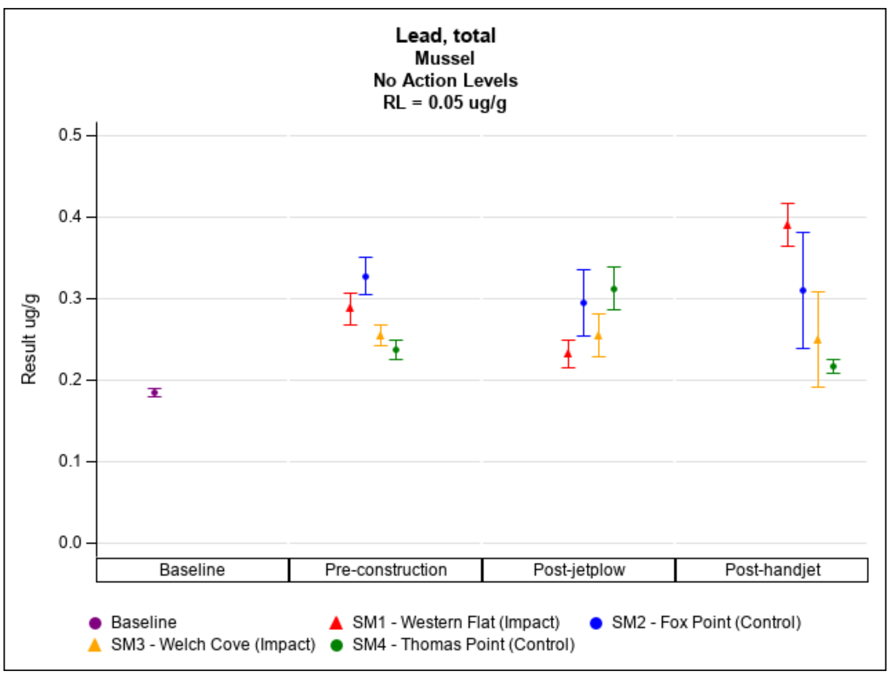

Figure 21. **Tissue concentrations (mean and standard deviations) of lead in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

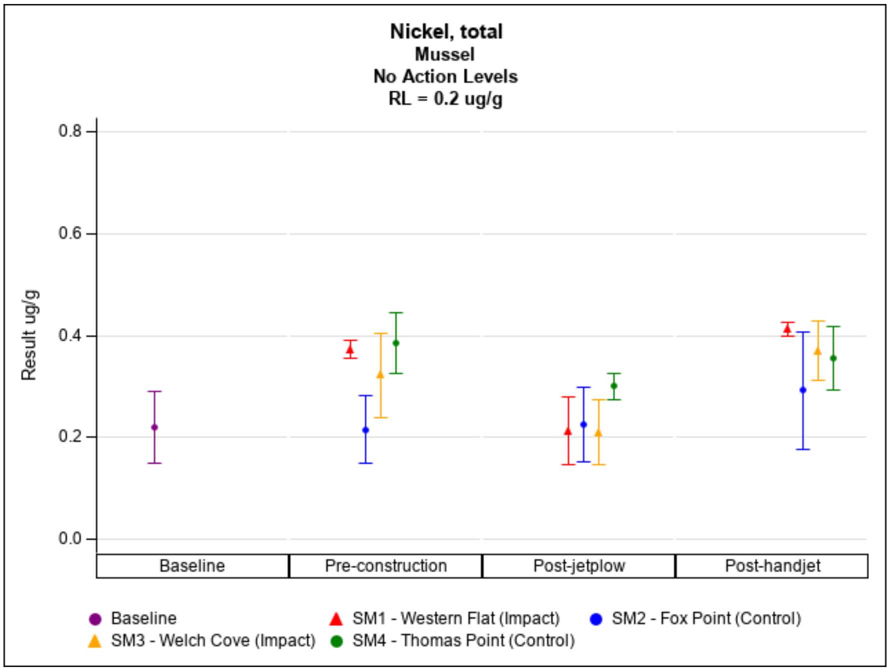

Figure 22. Tissue concentrations (mean and standard deviations) of nickel in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations

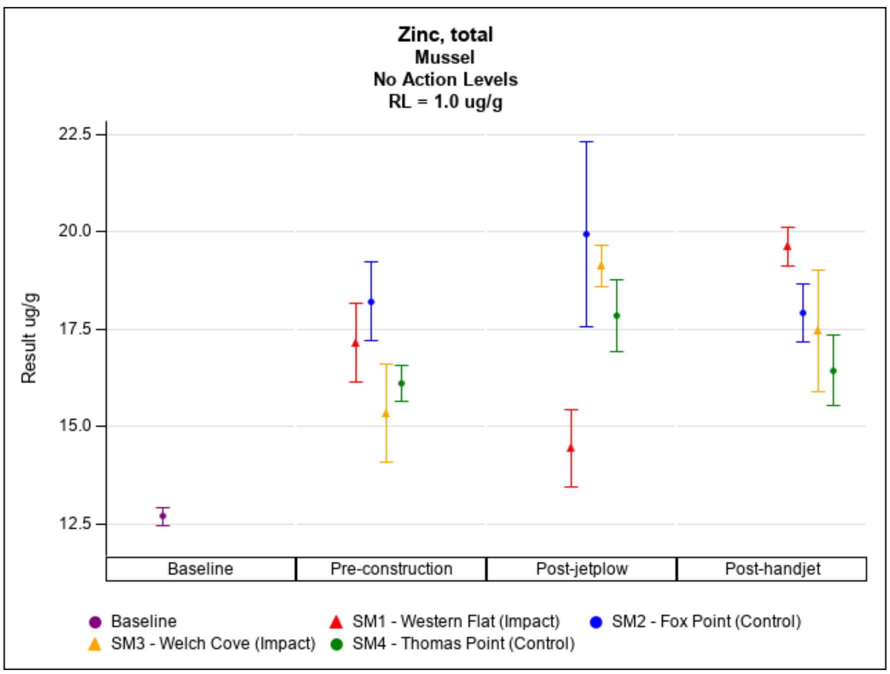

Figure 23. Tissue concentrations (mean and standard deviations) of zinc in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations

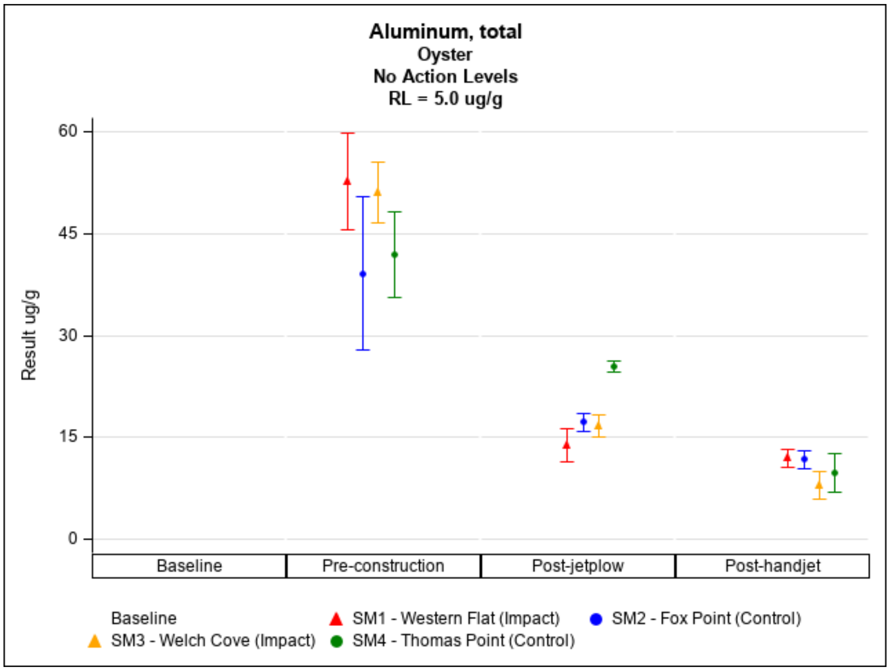

Figure 24. Tissue concentrations (mean and standard deviations) of aluminum in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

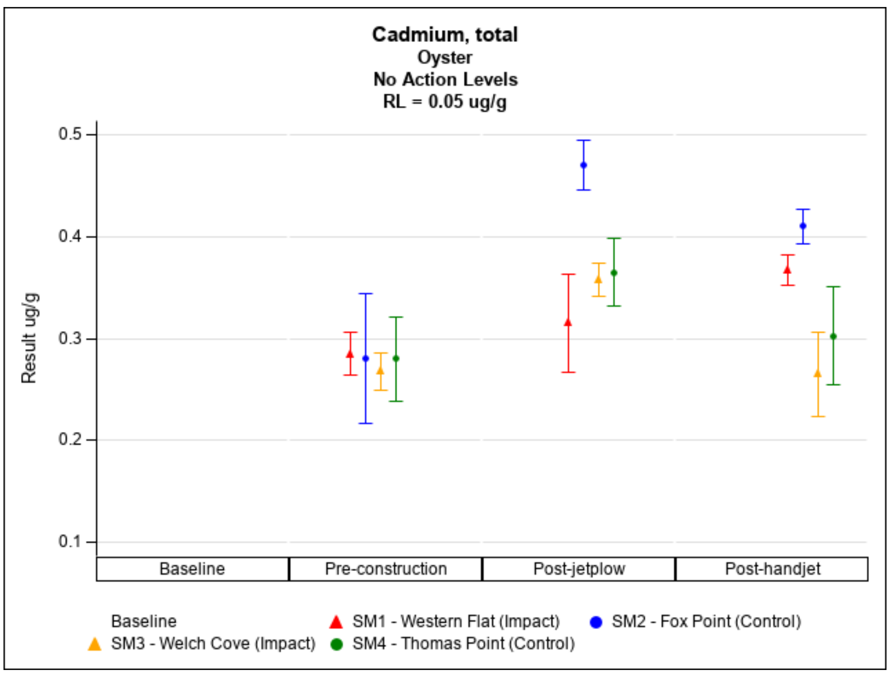

Figure 25. Tissue concentrations (mean and standard deviations) of cadmium in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

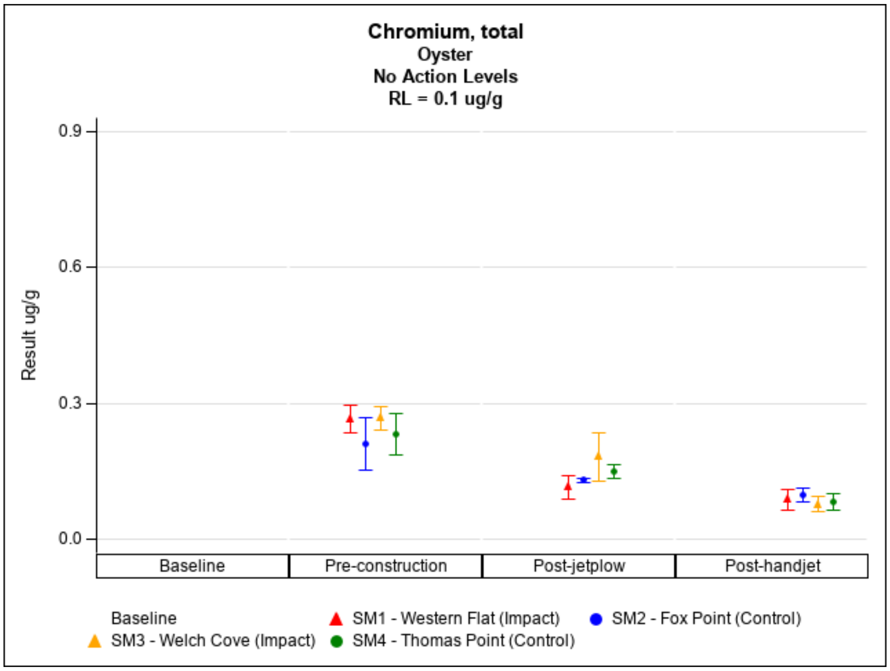

Figure 26. Tissue concentrations (mean and standard deviations) of chromium in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

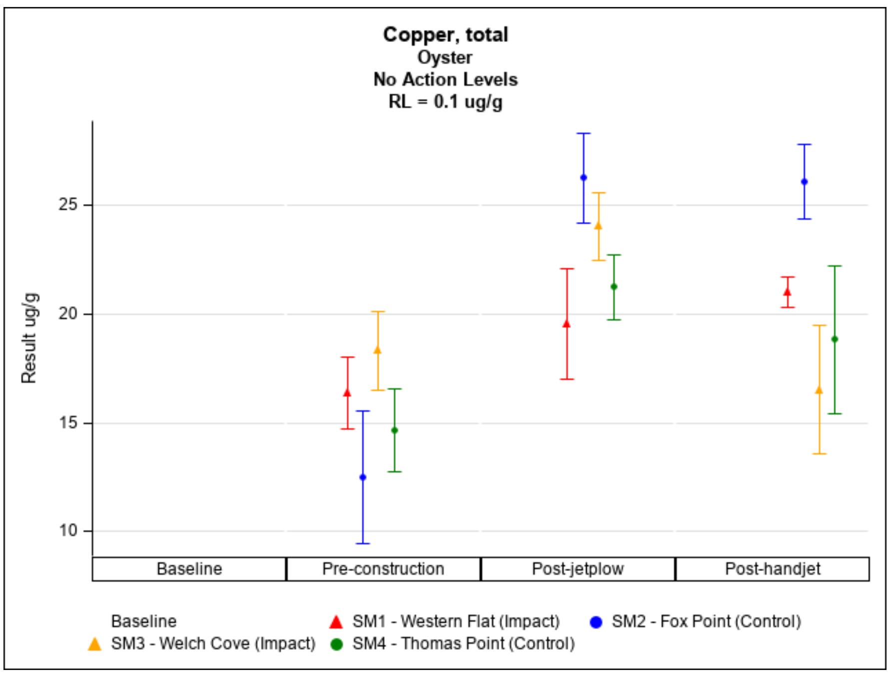

Figure 27. Tissue concentrations (mean and standard deviations) of copper in oysters in, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

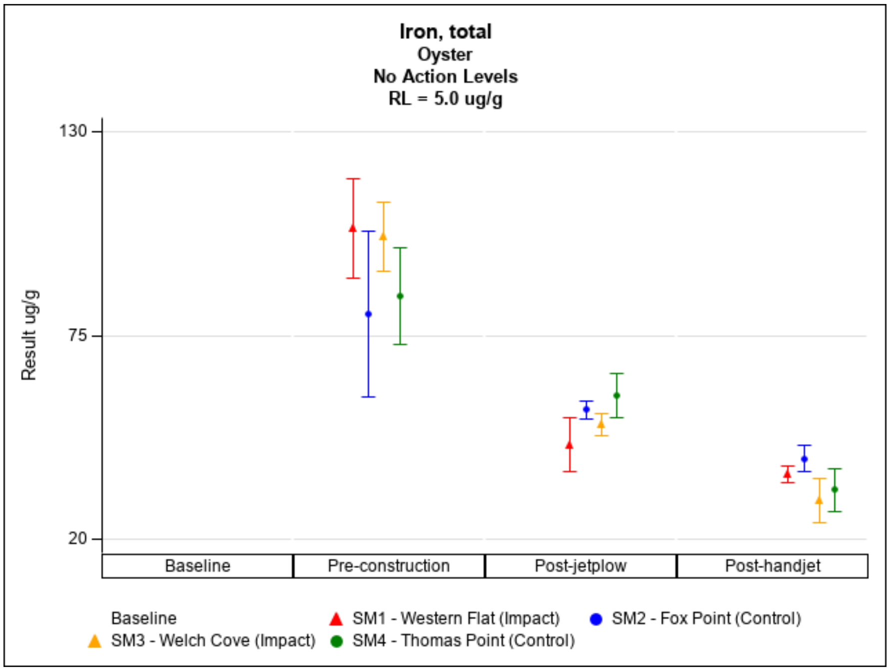

Figure 28. **Tissue concentrations (mean and standard deviations) of iron in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

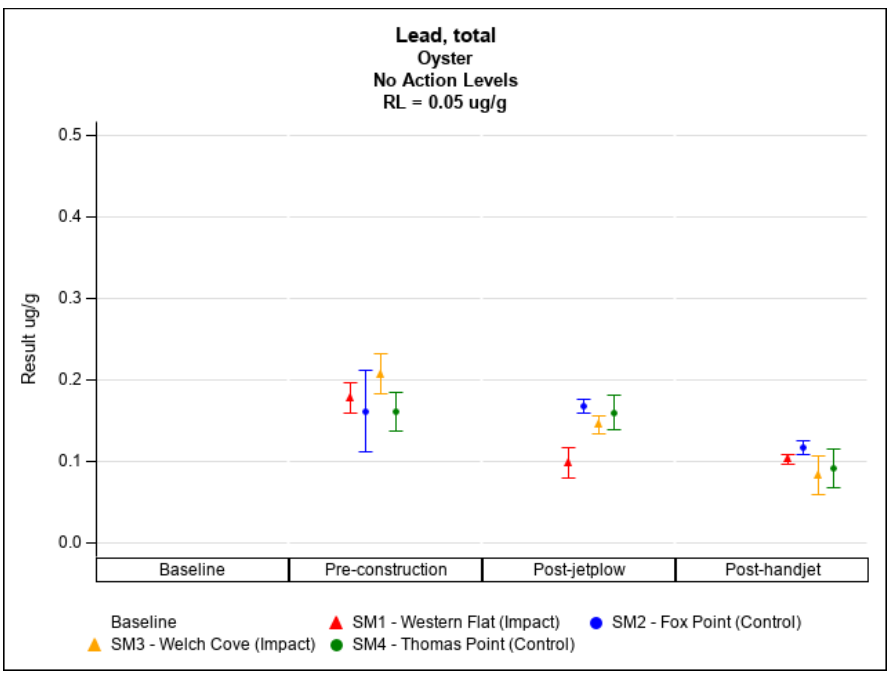

Figure 29. **Tissue concentrations (mean and standard deviations) of lead in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

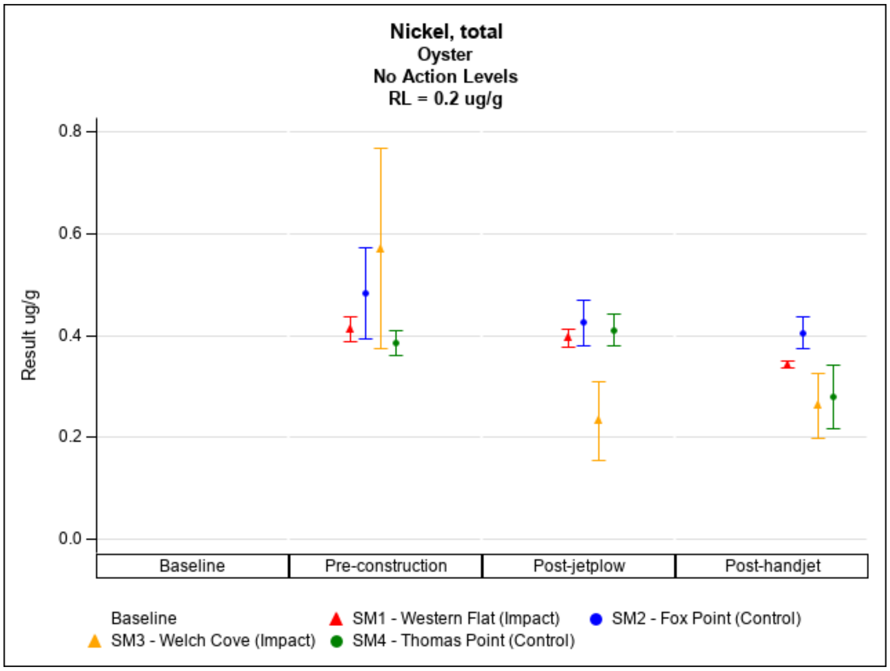

Figure 30. Tissue concentrations (mean and standard deviations) of nickel in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations

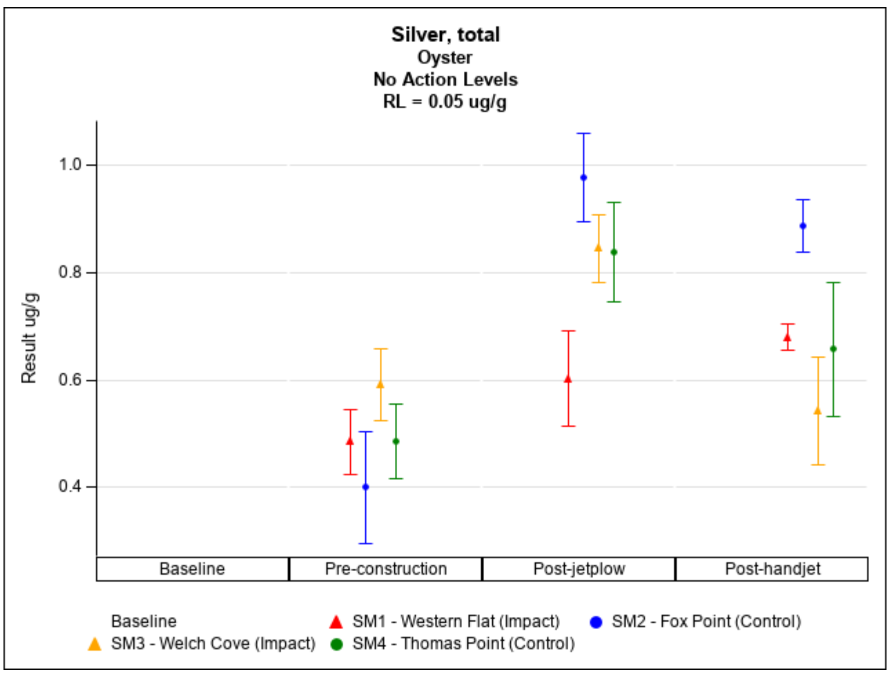

Figure 31. Tissue concentrations (mean and standard deviations) of silver in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

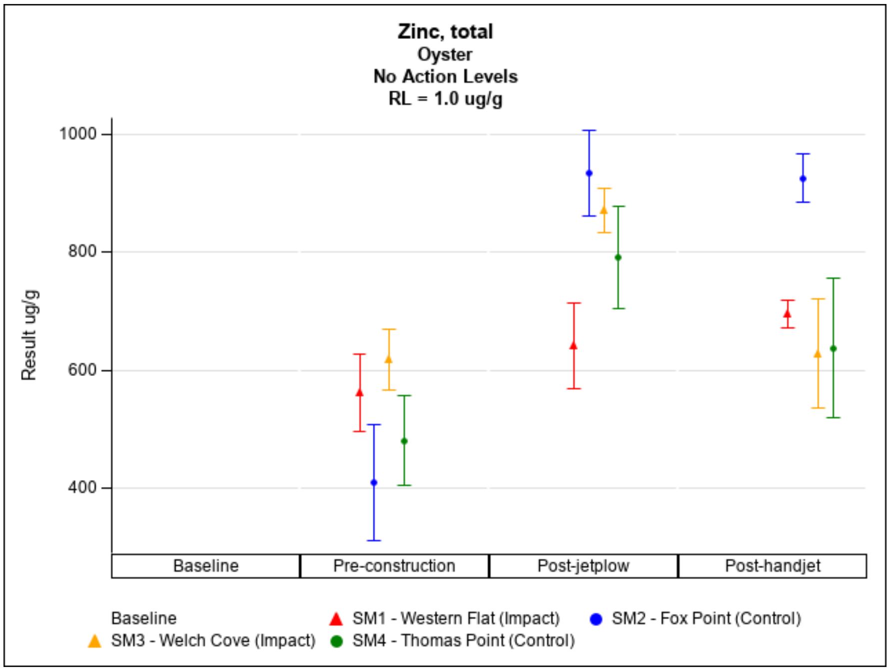

Figure 32. Tissue concentrations (mean and standard deviations) of zinc in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations

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Appendix A. NHDES Shellfish Tissue Monitoring Condition

Condition 46:
NHDES Shellfish Program Monitoring and Reporting Requirements:

Two-week Prior Notification:

At least two-weeks prior to the start of jet plowing activities, the Applicant shall notify the NHDES Shellfish Program of the dates and times of all activities that will resuspend sediments and introduce turbidity to the water column of Little Bay, so that NHDES may assess possible changes in water column fecal coliform concentrations that may warrant temporary closure of shellfish harvest areas

Plan to Assess Shellfish Tissue Before and After Little Bay Cable Crossing:

At least six months prior to the start of jet plowing activities (or other time frame acceptable to NHDES) the Applicant shall submit a plan to the NHDES Shellfish Program for approval for assessing molluscan shellfish tissue concentrations of selected chemical contaminants before and after the Project. The Applicant shall then implement the approved plan. Unless otherwise authorized by NHDES, the plan shall include provisions for the following:

Species to be tested: Blue mussels and American oysters shall be the primary species to be tested. To the extent practical, native species shall be used at all sites. If transplanted species must be used, NHDES Shellfish Program and the NH Fish and Game Department will need to approve the source of the shellfish, and the contractor will need to include provisions for additional shellfish tissue testing to document contaminant levels in the shellfish prior to transplant.

Location of testing sites: A total of at least four sites shall be monitored, with two sites inside the area affected by the plume, and two sites outside of the area affected by the plume.

Sites Affected by the Plume: At least two sites in areas that the Applicant believes will be affected by the sediment plume created by jet plowing will be identified. One of these sites shall be on the upstream side of the Project, and the other shall be on the downstream side of the Project. At least one of these two sites shall be in the vicinity of subtidal commercial oyster aquaculture farms in Little Bay. Water temperature and salinity shall be monitored with continuous data loggers (15-minute interval) at all sites.

Sites Not Affected by the Plume: At least two sites in areas that the Applicant believes will not be affected by the sediment plume created by jet plowing will be identified. One of these sites shall be on the upstream side of the Project, and the other shall be on the downstream side of the Project. To the extent practical, these sites shall be located at or near sites used for the NH Gulfwatch program so that data generated from this monitoring program can be compared to historical data.

Water temperature and salinity shall be documented with continuous data loggers (15-minute interval) at all sites. QA procedures to quantify data logger performance, accuracy, and precision shall be included in the plan and reported.

Timing of Sample Collection: All sites shall be sampled 1-2 two weeks before dredging or jet plowing begins and within one week of the completion of all dredging or jet plowing activities. A final round of sampling shall be completed within one week of the completion of all dredging activities.

All collected samples shall be immediately transported to the analytical laboratory(ies). The Applicant and/or its contractor shall assure the analytical laboratory completes testing as soon as possible and report the results as soon as they are completed.

Constituents for Tissue Analysis

Parameters specified in the National Shellfish Sanitation Program shall be tested:

Deleterious Substances: Aldrin/Dieldrin, Chlordane, Chlordecone, DDT, DDE, TDE, Diquat, Glyphosate, Carbaryl, Endothall and its Monomethyl Ester, Methyl Mercury, Heptachlor I Heptachlor Epoxide, Mirex, Polychlorinated Biphenyls (PCBs), 2,4-D

Chemotherapeutics: Chloramphenicol, Clenbuterol, Diethylstilbestrol (DES), Demetridazole, Ipronidazole and other nitroimidazoles, Furazolidone and other nitrofurans, Fluoroquinolones, Glycopeptides

Additional Parameters that are part of the NH Gulfwatch Program (note that some of the parameters below are also in the NSSP list):

Metals: Aluminum, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Silver, Zinc

Physical: Lipid Content, Percent Solids

PAHs: Acenaphthene, Acenaphthylene, Anthracene, Benzo(A)anthracene, Benzo(A)pyrene, Benzo(B)fluoranthene, Benzo(E)pyrene, Benzo(GHl)perylene, Benzo(K)fluoranthene, Biphenyl, Chrysene, Dibenzo(AH)anthracene, Dibenzothiophene, Fluoranthene, Fluorene, lndeno(123CD)pyrene, Naphthalene, Perylene, Phenanthrene, Pyrene, Cl-Chrysene, Cl-Dibenzothiophene, Cl-Fluoranthene, Cl-Fluorene, Cl-Naphthalene, Cl-Phenanthrene, C2-Chrysene, C2-Dibenzothiophene, C2-Fluoranthene, C2-Fluorene, C2- Naphthalene, C2-Phenanthrene, C3-Naphthalene, C3-Chrysene, C3-Phenanthrene, C3-Dibenzothiophene, C3-Fluorene, C4-Chrysene, C4-Fluorene, C4-Naphthalene, C4-Phenanthrene, Total PAHs

Pesticides: A_BHC (Alpha Lindane), A-Endosulfan, Aldrin, B-Endosulfan, CIS-Chlordane, Dieldrin, Endrin, G-Chlordane, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Lindane (G-HCH), Methoxychlor, Mirex, O,P'-DDD, O,P'-DDE, O,P'-DDT, P,P'-DDD, P,P'-DDE, P,P'-DDT, Total DDT, Transnonachlor, Permethrin, Cypermethrin, Deltamethrin

Polychlorinated Biphenyls (PCBs): 101; 90; 105; 118; 126; 128; 138; 153; 132; 169; 170; 190; 18; 15; 180; 187; 195; 208; 206; 209; 28; 29; 44; 50; 52; 66; 95; 77; 8; 5; 87; Sum PCBs

Field and Laboratory Methods and Protocols: Field and laboratory methods and protocols shall be consistent with methods and protocols specified in the National Shellfish Sanitation Program, Guide for the Control of Molluscan Shellfish (2015 Revision) and in documentation describing the NH Gulfwatch Program, including number of organisms in each sample, and number of duplicates as specified in the Gulfwatch program documentation.

Data Management and Communication of Results: All data will be digitally provided to the NHDES Shellfish Program in Microsoft Excel files and in a format consistent with NHDES Environmental Monitoring Database protocols, procedures, and reporting formats.

Compliance with all laws: The Applicant and/or its contractor shall be responsible for complying with all applicable local, state, and federal laws to execute this monitoring program, including but not limited to a NH Fish and Game Department permit to collect and test shellfish.

Appendix B. Emails

From: Nash, Chris
To: Ann Pembroke; Sarah Allen; Nelson, Kurt I
Subject: FW: chemotheraputics
Date: Friday, May 3, 2019 8:34:29 AM

Ann, Sarah, Kurt, please see below. Chris

From: Fitzpatrick, Amy [mailto:Amy.Fitzpatrick@fda.hhs.gov]
Sent: Friday, May 3, 2019 8:28 AM
To: Nash, Chris
Subject: RE: chemotheraputics

Hi Chris,

Sorry for the late response. We do not have any NSSP methods for chemotherapeutics nor have our LEOs evaluated any laboratories on performance of chemotherapeutics analyses in support of the NSSP. As such, we recommend that the best available science be used when selecting a method.

Eurofins and Silliker are two (2) laboratories that our LEOs have had some experience with in the past who performed chemotherapeutics testing. So, they may want to look into those two (2) laboratories.

I hope my reply is not too late....again, my apologies.

Regards,
Amy

From: Nash, Chris <Chris.Nash@des.nh.gov>
Sent: Wednesday, May 1, 2019 7:57 AM
To: Fitzpatrick, Amy <Amy.Fitzpatrick@fda.hhs.gov>
Subject: chemotheraputics

Hi Amy, I have a meeting with Eversource and Normandeau tomorrow about the shellfish monitoring plan. Have you received any feedback from your colleagues about labs that can analyze mussel and oyster tissue for chemotherapeutics? Thanks! Chris

Chris Nash, Shellfish Program Manager
Watershed Management Bureau
Water Division, NH Department of Environmental Services
222 International Drive, Suite 175
Portsmouth, NH 03801
Phone: (603) 559-1509
Email: Chris.Nash@des.nh.gov

From: Sarah Allen
To: Chris Nash (Chris.Nash@des.nh.gov); david.price@des.nh.gov; Comstock, Gregg (Gregg.Comstock@des.nh.gov)
Cc: kurt.nelson@eversource.com; apembroke@normandeau.com; dena.champy@eversource.com
Subject: SRP Revised Shellfish Tissue Monitoring Plan
Date: Friday, August 16, 2019 4:54:00 PM
Attachments: Final SRP Shellfish Monitoring Plan 081619.pdf
SRP DES Shellfish letter 081619.pdf
Final SRP Shellfish Monitoring Plan 081619.docx

Chris,

Please find attached a new version of the above-referenced plan in both word and pdf. It includes changes requested by you at our last meeting, and some changes recommended by the project team based on discussions with the analytical labs and the risk assessor advising the team, Dr. Bjorn Bjorkman. A letter explaining these changes is also attached. We look forward to discussing with you in the near future.

Sarah

Sarah Allen
Senior Principal Scientist
Normandeau Associates, Inc.
25 Nashua Road, Bedford, NH 03110
603-637-1158 (direct) 603-714-3085 (cell)
sallen@normandeau.com

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

August 16, 2019

Chris Nash
DES Shellfish Coordinator
Pease District Office
222 International Drive, Suite 175
Portsmouth, NH 03801

Re: Seacoast Reliability Project, Revised Final Shellfish Tissue Sampling Plan

Dear Chris:

On behalf of Eversource Energy, please find attached the revised shellfish tissue sampling plan for the Seacoast Reliability Project (SRP). The revisions address the changes we discussed in our meeting on May 2, 2019, as well as input from the analytical laboratory and from GEI's risk assessor, Bjorn Bjorkman, who provided review and expert testimony on sediments and shellfish at the SEC hearings for the SRP.

Normandeau has worked extensively with multiple analytical laboratories, including several suggestions from you and others, as we attempted to provide the analyses requested by you in NHDES' Final Revised Decision Condition #46. Enthalpy in collaboration with Eurofin is the only lab which placed a bid, and only for a portion of the analytes. As discussed below, chemotherapeutics and some of the herbicides are not typically tested in shellfish tissue.In fact, the laboratories have confirmed that there is no established, peer-reviewed method for analysis of the chemotherapeutics in tissue (Eurofin would have to develop the method). Based on Dr. Borkman's review of laboratory protocols and environmental fate of these parameters, he has recommended for that they not be included in the SRP shellfish analysis. We respectfully request that requirements for these analyses be removed from the plan.

The following is excerpted from Dr. Bjorkman's assessment of the issue:

"A review of the extensive proposed list of deleterious substances to be monitored includes several items that are unrealistic or impractical to evaluate in oyster or mussel tissue. Including these in the monitoring program would entail significant practical difficulties to measure compounds that have no basis for being available or capable of accumulating in oyster tissue due to environmental uptake. We propose that these be eliminated from the monitoring requirements. The basis for the request are presented below.

Chemotherapeutics. The listed chemotherapeutics consist of antibiotics and growth enhancers listed in 40CFR132, for which no residue is allowed in food products. The substances were previously directly applied or added to feed for meat producing animals (beef cattle and poultry in particular) in order to boost growth. Concerns about residues reaching consumers have caused all these to be banned for use in food animals in the U.S. and in any meat imported to the U.S. There are no methods readily available to evaluate residues in tissue. Analysis of these chemotherapeutics is done only in specialized laboratories, and are not conducted in environmental settings. Residues are only a concern following direct application to food animals (especially beef and poultry) and are not an environmental media concern. [Therefore], chemotherapeutics can be eliminated from the monitoring requirements.

Corporate Office: Normandeau Associates, Inc. • 25 Nashua Road • Bedford, NH 03110 • (603) 472-5191
www.normandeau.com

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

NHDES
August 16, 2019
Page 2

The monitoring program includes a number of "deleterious substances" with the listing ultimately derived from the NSSP. The list encompasses pesticides (several organochlorine pesticides also on the Gulfwatch list, the carbamate pesticide Carbaryl, and several pyrethroid pesticides), herbicides (2,4-D, Endothall, glyphosate and diquat), PCBs and methylmercury. As noted in the conditions for the monitoring program, the organochlorine pesticides on this list are also on the Gulfwatch list. These and the PCBs are routinely considered in environmental monitoring programs and present no technical difficulties. However, the remainder present either technical problems due to lack of recognized analytical methodologies in tissue; or have environmental fate properties that would make their environmental uptake and bioaccumulation in oyster tissue unrealistic. Including these in the monitoring program would add little value and would present significant practical and analytical problems.

- Because mercury is already included in the monitoring requirements, adding **methylmercury** would be redundant. Mercury residues of any form would be adequately described by the standard mercury analysis.

- The herbicides on the list can be eliminated. As a group, herbicides are characterized by relatively high solubility, by low persistence and by low bioaccumulation potential in animal tissues. Herbicides, as a group, would not be expected to be present in sediment or be taken up by oysters from dispersed sediment. There are no generally accepted laboratory methods for analysis in tissue of **glyphosate, endothall (and derivatives)** and **diquat**. Analysis of these would require proprietary or specialized methods generally unavailable in the environmental laboratory industry. Because these have very short persistence in the environment there is no reason to include in monitoring. The case of **2,4-D** is a little different. 2-4-D and related derivatives are chlorinated and have a relatively higher persistence than the other herbicides and there is also a standard method available. The standard method for 2,4-D and other chlorinated herbicides is EPA 8150. However, it remains unlikely that 2,4-D or any other chlorinated herbicide would persist in or be bioaccumulated from sediment.

- For the carbamate pesticide **Carbaryl**, there is currently not a generally accepted environmental method for tissue analysis. This pesticide belongs to a class of short-lived (days to weeks) pesticides with low bioaccumulation potential. Carbaryl is uses as molluscicide and may enter water ways where it can be highly acutely toxic. But as it does not persist for any length of time and is not bioaccumulated it is not a long-term concern, and would not be expected in the sediment. [Therefore], this pesticide can be eliminated from further consideration.

- The pyrethroid pesticides **permethrin, cypermethrin** and **deltamethrin** are currently in widespread use as household and commercial insecticides. These pesticides do partition to sediment, could bioaccumulate, and are of moderate to high aquatic toxicity. However, they have much lower persistence in the environment (several days in water, several weeks in sediment) than their organochlorine predecessors do, reducing the environmental concern. However, as a group they are considered of emerging environmental concern. We recommend that these pesticides be eliminated as they are not expected to be present in sediment due to their low environmental persistence.

Including these substances in monitoring imposes onerous and impractical requirements for monitoring due to absence of readily available methodology. While the remainder of the proposed monitoring list is feasible, including the majority of the chemicals on the Gulfwatch list, the substances discussed in practice are infeasible; and due to their properties and uses, monitoring of them would add little value."

The above recommendations have been incorporated into the attached revised plan. Given the short timeline until the September 9 jet plow trial, it may make the most sense to meet with you in person to further discuss this revised plan. Please let me know your thoughts and if you have availability to meet in the near future. If you have any questions regarding this letter, please contact Ann Pembroke (apembroke@normandeau.com, 603-637-1169) or me (sallen@normandeau.com, 603-637-1158).

Sincerely,
Normandeau Associates, Inc.

Sarah Allen

Sarah Allen
Project Manager

Cc:
Gregg Comstock (NHDES)
David Price (NHDES)
Kurt Nelson (Eversource)
Dena Champy (Eversource)

From: Nash, Chris
To: Sarah Allen; Price, David; Comstock, Gregg; Diers, Ted
Cc: kurt.nelson@eversource.com; Ann Pembroke; dena.champy@eversource.com
Subject: RE: SRP Revised Shellfish Tissue Monitoring Plan
Date: Friday, September 6, 2019 11:09:21 AM
Attachments: Final SRP Shellfish Monitoring Plan 081619.pdf

Sarah:

The document listed below (and attached), submitted by Public Service Company of New Hampshire (d/b/a Eversource Energy) pursuant to NHDES Wetlands Condition 46 In the NH Site Evaluation Committee *Order and Certificate of Site and Facility with Conditions* issued on January 31, 2019, is acceptable to the New Hampshire Department of Environmental Services (NHDES) Watershed Management Bureau (WMB).

Final SRP Shellfish Monitoring Plan 081619

Chris Nash, Shellfish Program Manager
NHDES Watershed Management Bureau

From: Sarah Allen [mailto:sallen@normandeau.com]
Sent: Friday, August 16, 2019 4:54 PM
To: Nash, Chris; Price, David; Comstock, Gregg
Cc: kurt.nelson@eversource.com; Ann Pembroke; dena.champy@eversource.com
Subject: SRP Revised Shellfish Tissue Monitoring Plan

EXTERNAL: Do not open attachments or click on links unless you recognize and trust the sender.

Chris,
Please find attached a new version of the above-referenced plan in both word and pdf. It includes changes requested by you at our last meeting, and some changes recommended by the project team based on discussions with the analytical labs and the risk assessor advising the team, Dr. Bjorn Bjorkman. A letter explaining these changes is also attached. We look forward to discussing with you in the near future.
Sarah

Sarah Allen
Senior Principal Scientist
Normandeau Associates, Inc.
25 Nashua Road, Bedford, NH 03110
603-637-1158 (direct) 603-714-3085 (cell)
sallen@normandeau.com

Appendix C. Enthalpy Data File

Appendix D. Analyte Detailed Figures

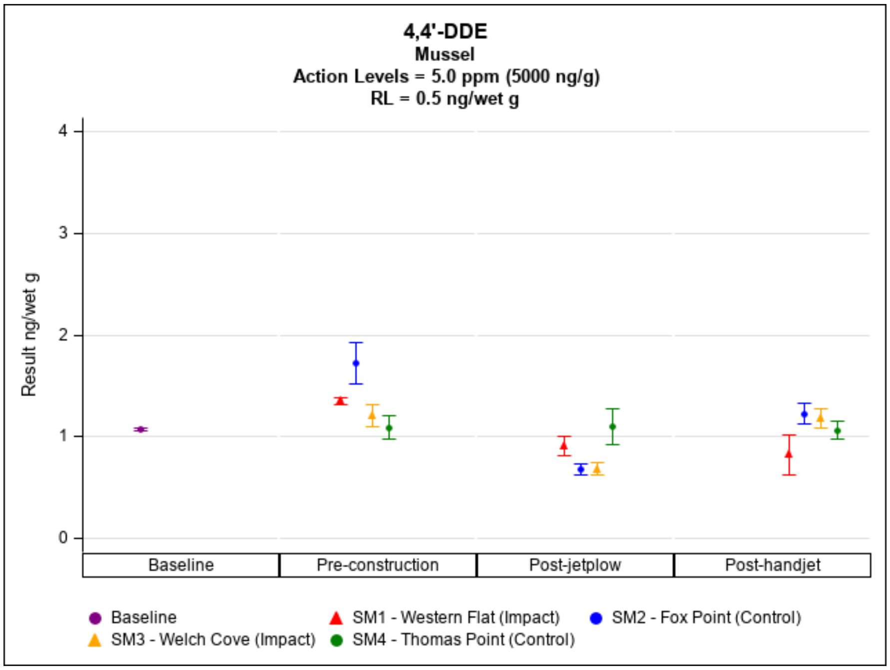


Figure D–1. **Tissue concentrations (mean and standard deviations) of 4,4'-DDE in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

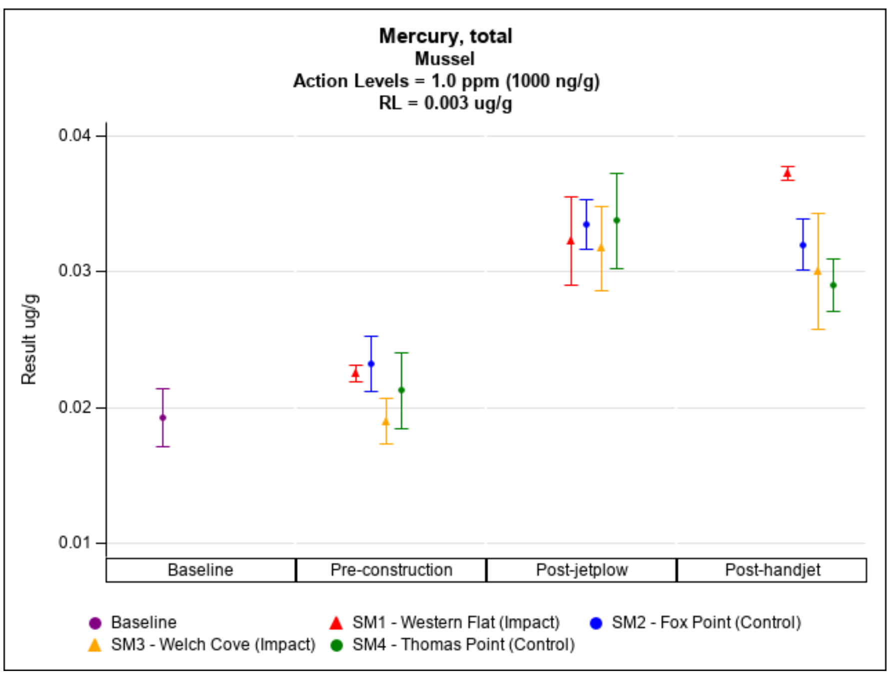


Figure D–2. **Tissue concentrations (mean and standard deviations) of mercury in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.**

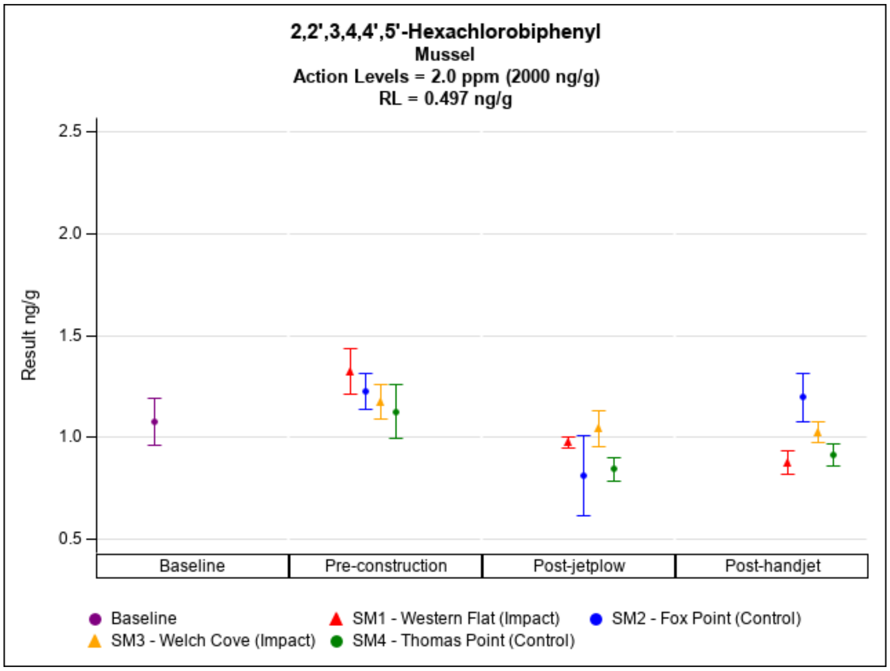


Figure D–3. Tissue concentrations (mean and standard deviations) of 2,2’,3,4.4’,5 Hexachlorobiphenyl (PCB 138) in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

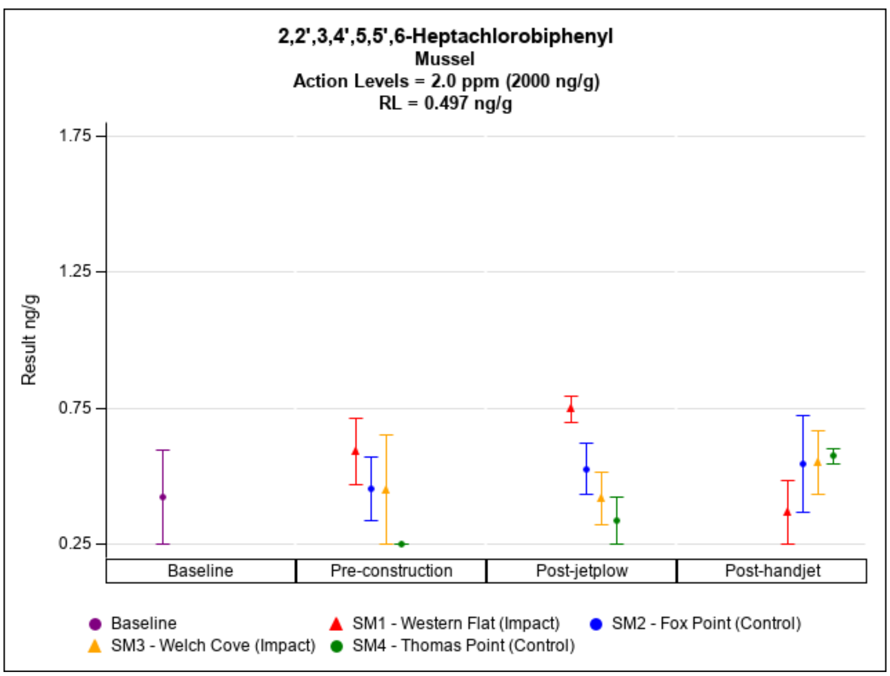


Figure D–4. Tissue concentrations (mean and standard deviations) of 2,2,3,4’,5,5’,6 heptachlorobiphenyl (PCB 187) in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

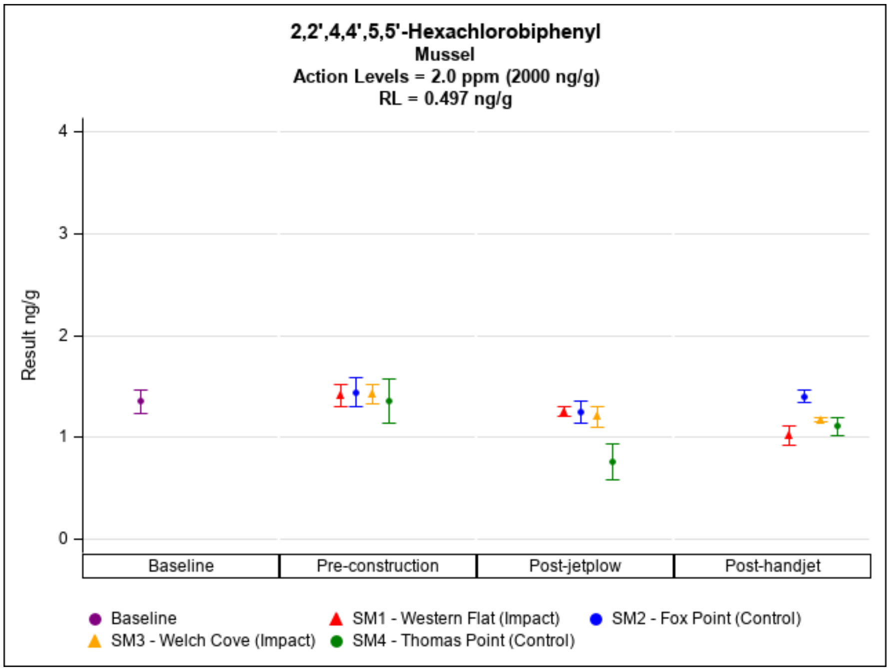


Figure D–5. Tissue concentrations (mean and standard deviations) of 2,2’,4,4’,5,5’ hexachlorobiphenyl (PCB 153) in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

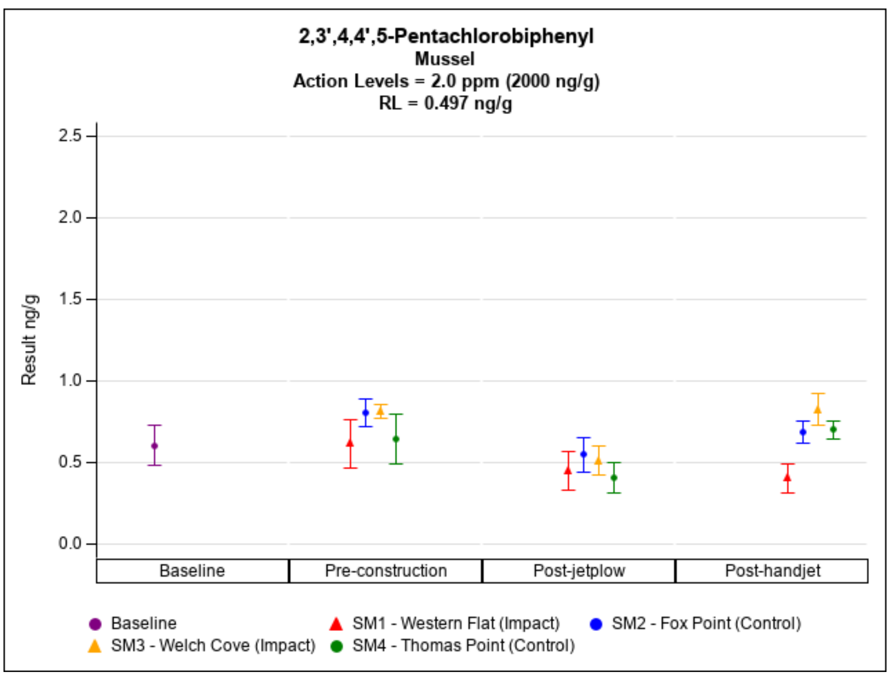


Figure D–6. Tissue concentrations (mean and standard deviations) of 2,3’,4,4’,5 pentachlorobiphenyl (PCB 118) in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

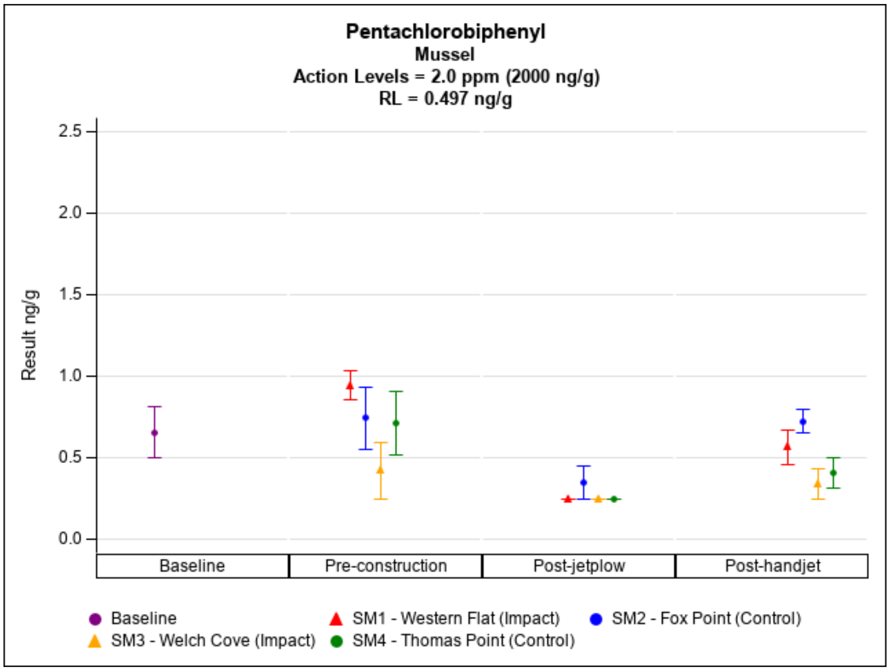


Figure D–7. Tissue concentrations (mean and standard deviations) of pentachlorobiphenyl (PCB 90/101) in mussels in baseline, preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

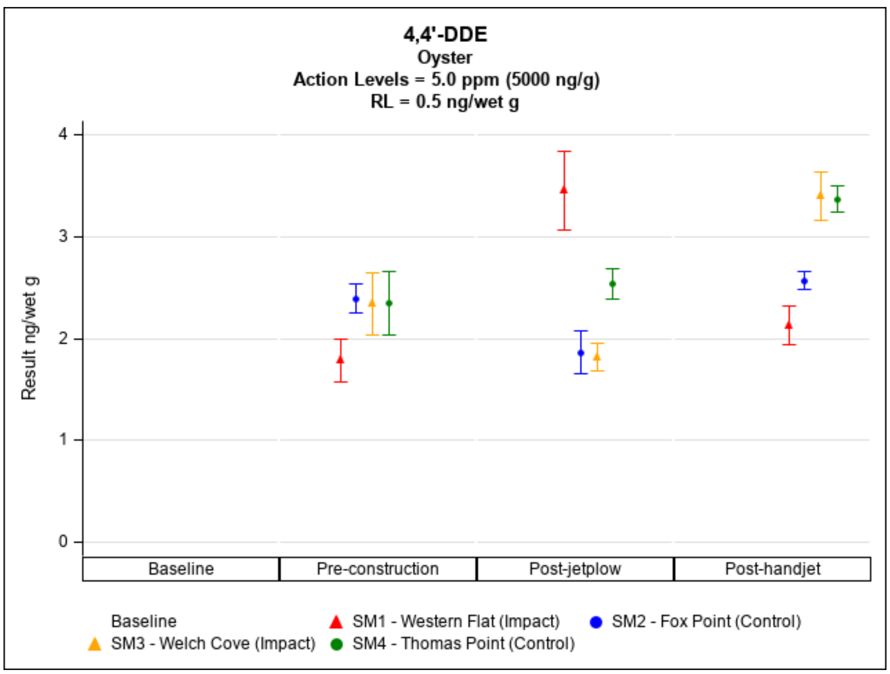


Figure D–8. Tissue concentrations (mean and standard deviations) of 4,4'-DDE in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

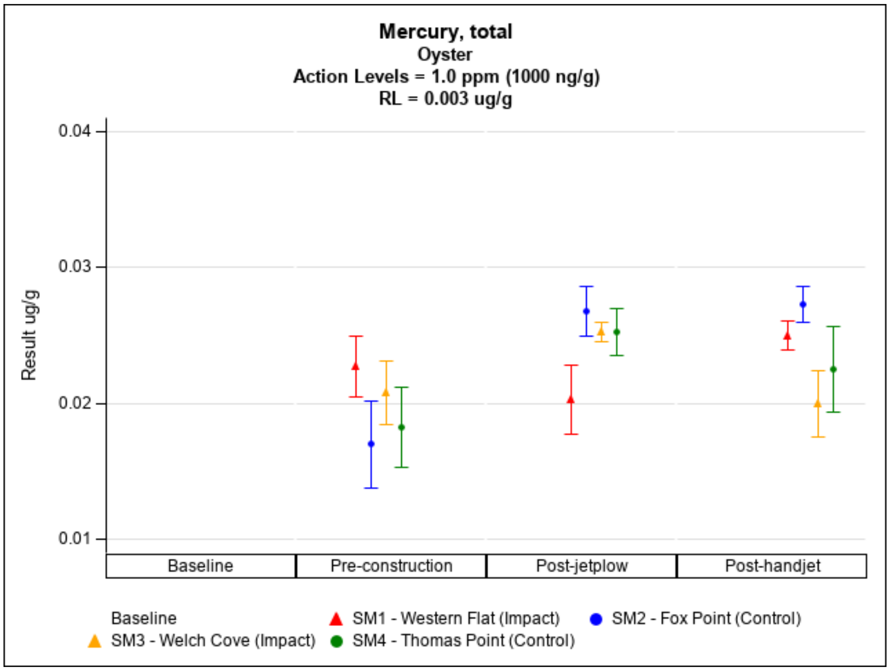


Figure D–9. Tissue concentrations (mean and standard deviations) of mercury in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

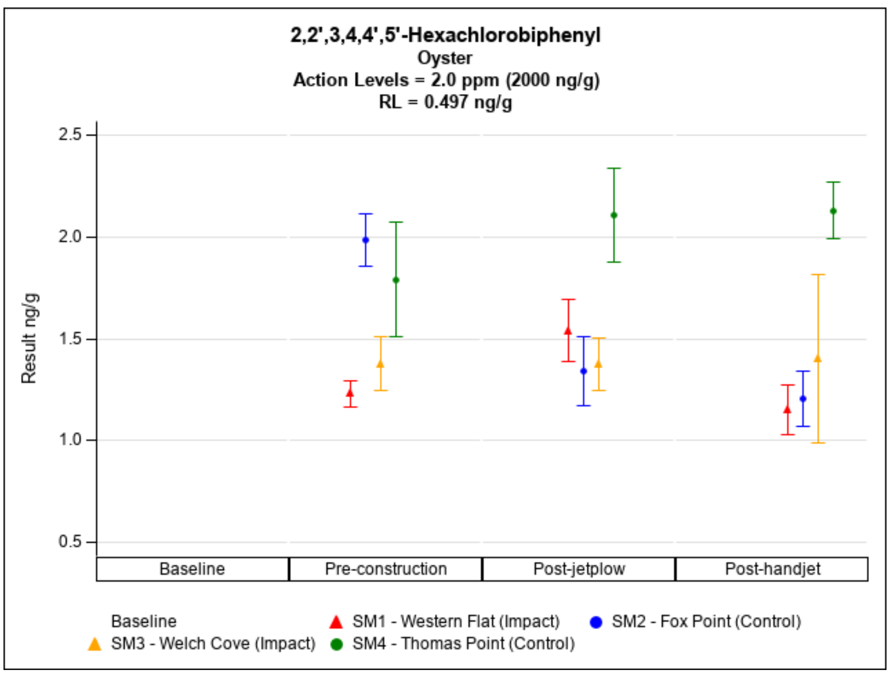


Figure D–10. Tissue concentrations (mean and standard deviations) of 2,2',3,4.4',5 Hexachlorobiphenyl (PCB 138) in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

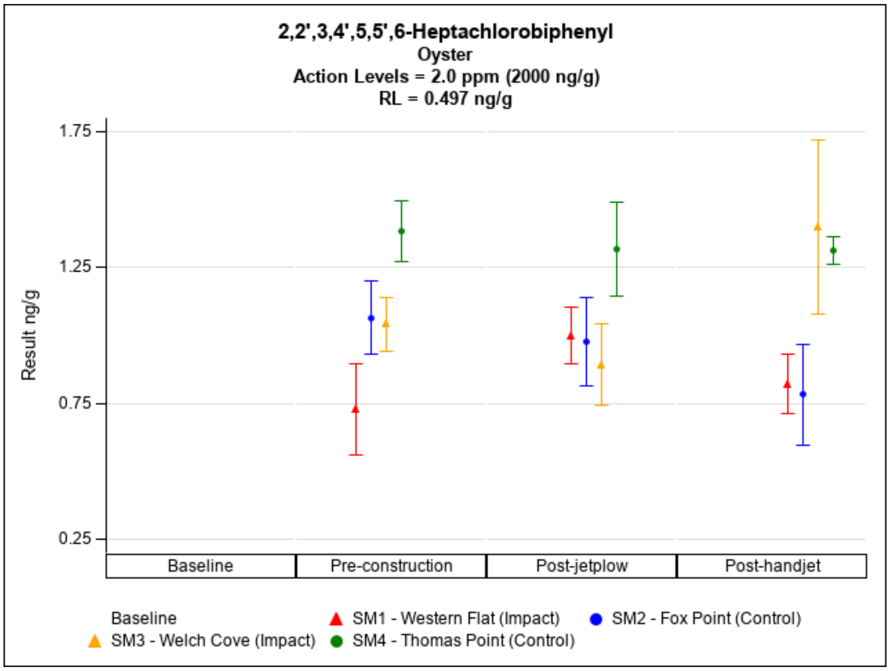


Figure D–11. Tissue concentrations (mean and standard deviations) of 2,2,3,4',5,5',6 heptachlorobiphenyl (PCB 187) in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

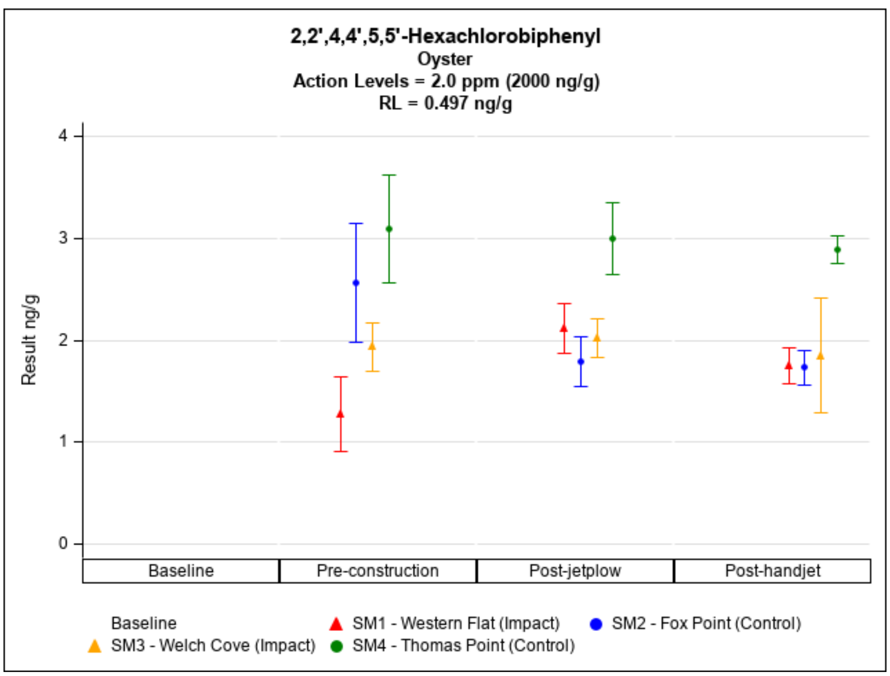


Figure D–12. Tissue concentrations (mean and standard deviations) of 2,3',4,4',5 pentachlorobiphenyl (PCB 153) in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

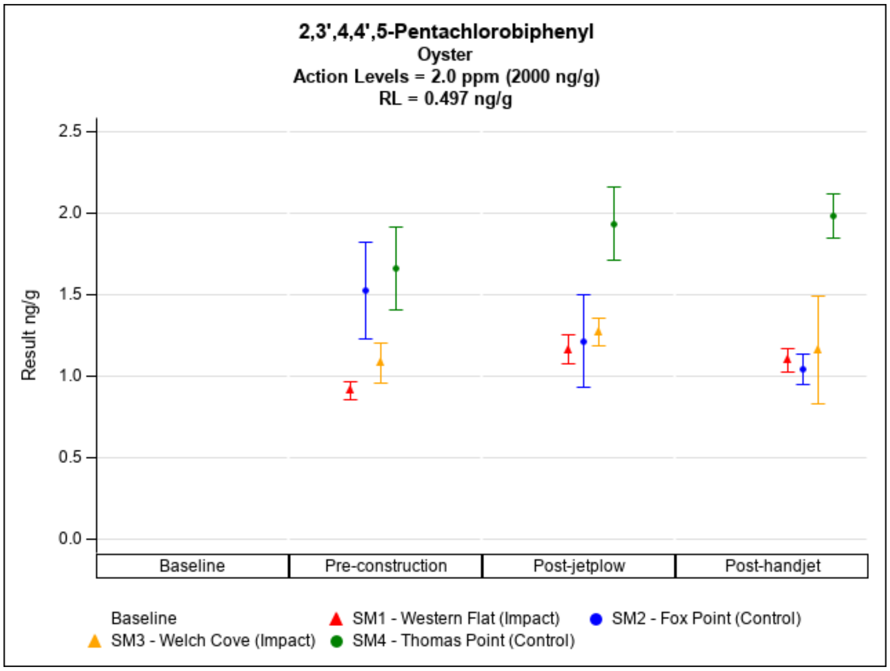


Figure D–13. Tissue concentrations (mean and standard deviations) of 2,3’,4,4’,5 pentachlorobiphenyl (PCB 118) in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

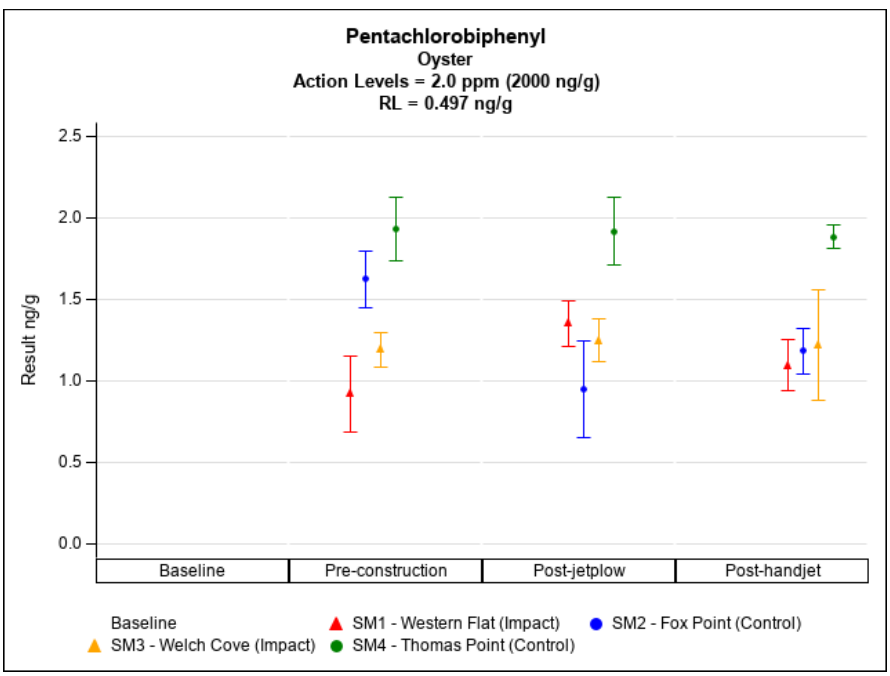


Figure D–14. Tissue concentrations (mean and standard deviations) of pentachlorobiphenyl (PCB 90/101) in oysters in preconstruction, post jet plow and post hand jet collections at SRP shellfish monitoring stations.

Table D–1. Number of Replicates with Concentrations below the Laboratory Reporting Limits for Parameters with Federal Action Levels

PARAMETER		Mussel													Oyster											
		SM0	SM1			SM2			SM3			SM4			SM1			SM2			SM3			SM4		
		Baseline	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet
Pesticides	2,4'-DDD																									
	2,4'-DDE	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,4'-DDT	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	4,4'-DDD	3	3	4	4	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	4,4'-DDE				1																					
	4,4'-DDT	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Aldrin	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Chlordane-alpha	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	4	4	1	4	3	4	4
	Chlordane-gamma	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	2	4	4	3	3	2	4	4
	Dieldrin	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Heptachlor	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Heptachlor Epoxide	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Kepone	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Mirex	4	4	4	3	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
PCBs	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,3',4,4',5,6-Octachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,3',4,4'-Hexachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,3',4,6'-Hexachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,4',5,5',6-Heptachlorobiphenyl	3	1		3	2	1	2	3	2	1	4	3		1					1						
	2,2',3,4,4',5'-Hexachlorobiphenyl						1																1			
	2,2',3,4,4',5,5'-Heptachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,4,5'-Pentachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',3,5',6-Pentachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4
	2,2',3,5'-Tetrachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',4,4',5,5'-Hexachlorobiphenyl												1		1								1			
	2,2',4,5'-Tetrachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2,2',4,6-Tetrachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

PARAMETER	Mussel													Oyster											
	SM0	SM1			SM2			SM3			SM4			SM1			SM2			SM3			SM4		
	Baseline	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet
2,2',5,5'-Tetrachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,2',5-Trichlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,3',4,4',5-Pentachlorobiphenyl	1	1	2	2		1			1		1	2										1			
2,3',4,4'-Tetrachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,3,3',4,4'-Pentachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,3-Dichlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,4'-Dichlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,4,4'-Trichlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2,4,5-Trichlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3,3',4,4',5,5'-Hexachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3,3',4,4',5-Pentachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3,3',4,4'-Tetrachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
4,4'-Dichlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Heptachlorobiphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Pentachlorobiphenyl	1		4	1	1	3		3	4	3	1	4	2	1				1				1			

Table D–2. Number of Replicates with Concentrations below the Laboratory Reporting Limits for Parameters with no Federal Action Levels

		Mussel													Oyster											
		SM0	SM1			SM2			SM3			SM4			SM1			SM2			SM3			SM4		
PARAMETER		Baseline	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet
Metals	Aluminum, total																									
	Chromium, total															1	2	1		1			2			2
	Lead, total																	1					1			1
	Nickel, total	2		2		2	2	2	1	2												2	1			1
	Silver, total	4	4	4	4	4	4	4	4	4	4	4	4	4												
PAHs	1-Methylnaphthalene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	2-Methylnaphthalene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Acenaphthene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Acenaphthylene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Anthracene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Benzo(a)anthracene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Benzo(a)pyrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Benzo(b)fluoranthene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Benzo(e)pyrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Benzo(g,h,i)perylene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Benzo(k)fluoranthene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Biphenyl	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C1-Chrysene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C1-Dibenzothiophene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C1-Fluoranthene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C1-Naphthalene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C1Phenathrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C2-Dibenzothiophene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C2-Fluoranthene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C2-Fluorene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C2-Phenathrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C3-Chrysene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C3-Fluorene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C3-Naphthalene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C3-Phenanthrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C4-Chrysene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C4-Fluorene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	C4-Naphthalene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Chrysene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Dibenzo(a,h)anthracene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Dibenzothiophene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Fluoranthene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Fluorene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Indeno(1,2,3-cd)pyrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Naphthalene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Perylene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

		Mussel													Oyster											
		SM0	SM1			SM2			SM3			SM4			SM1			SM2			SM3			SM4		
PARAMETER		Baseline	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet	Preconstruction	Post jet plow	Post hand jet
	Phenanthrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Pyrene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Pesticides	BHC-alpha	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	BHC-gamma	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Endosulfan-I	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Endosulfan-II	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Endrin	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Hexachlorobenzene	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Methoxychlor	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Oxychlordane	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	cis-Nonachlor	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	trans-Nonachlor	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	2	4	3	2	3	3	4	3

Appendix E. ANOVA Box Plots

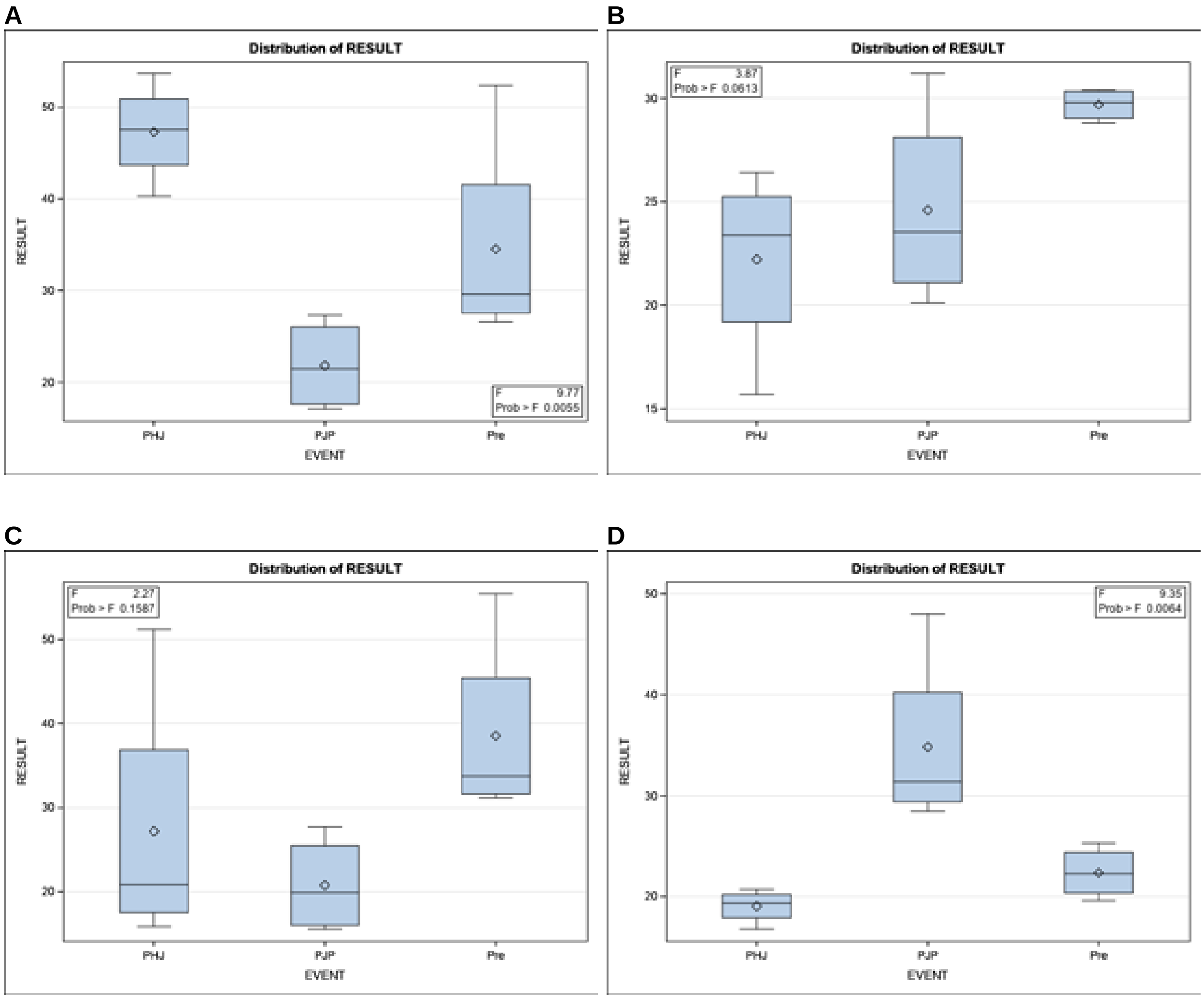


Figure E–1. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of aluminum in mussels at stations SM1 (a), SM2 (b), SM3 (c), and SM4 (d).

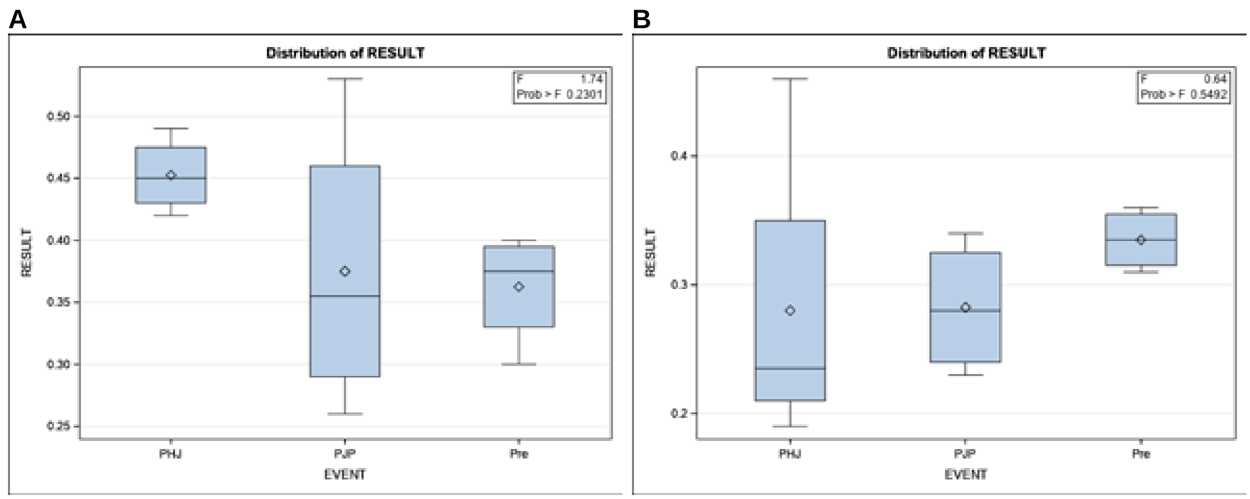


Figure E–2. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of chromium in mussels at stations SM1 (a) and SM3 (b).

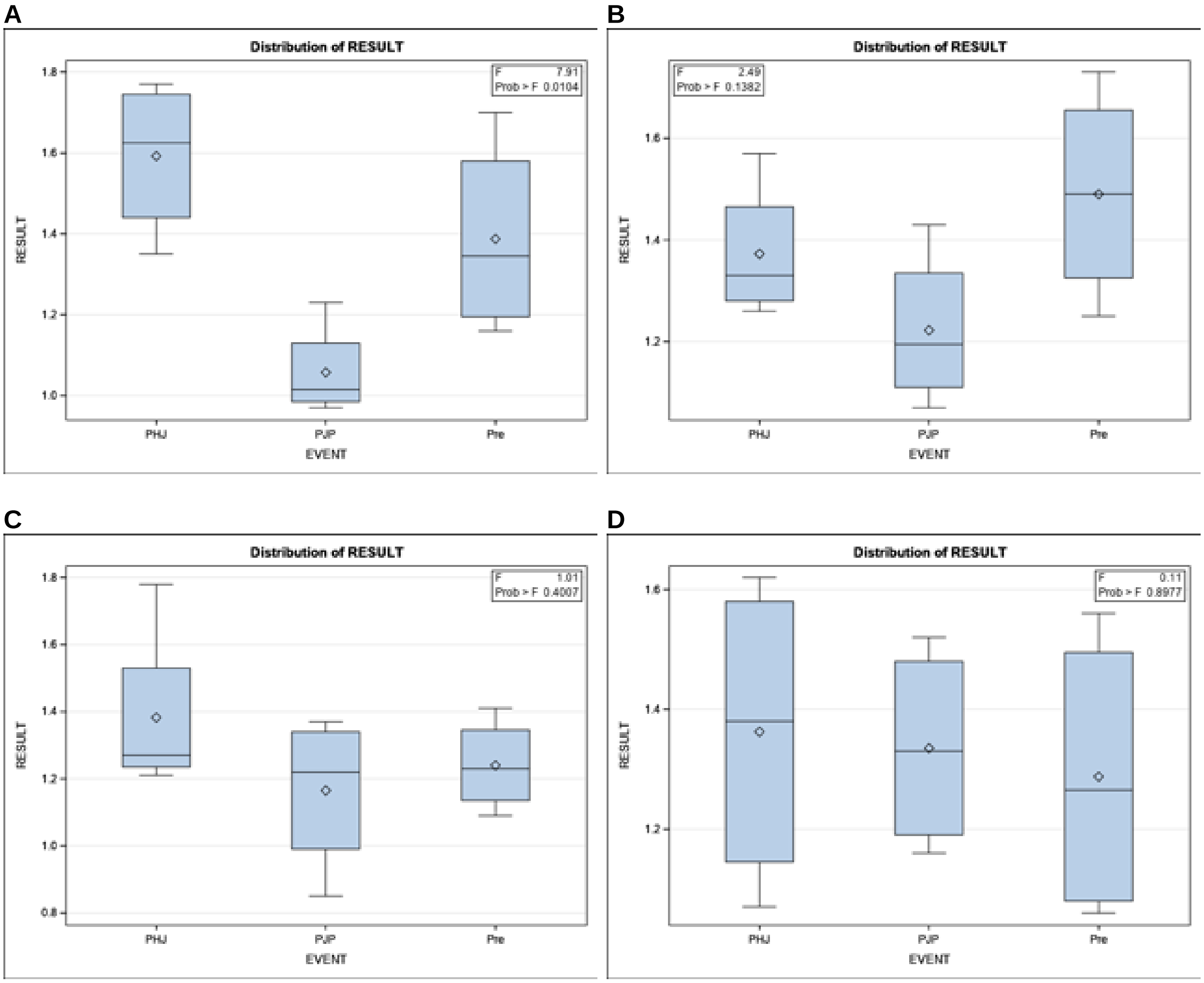


Figure E–3. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of copper in mussels at stations SM1 (a), SM2 (b), SM3 (c) and SM4 (d).

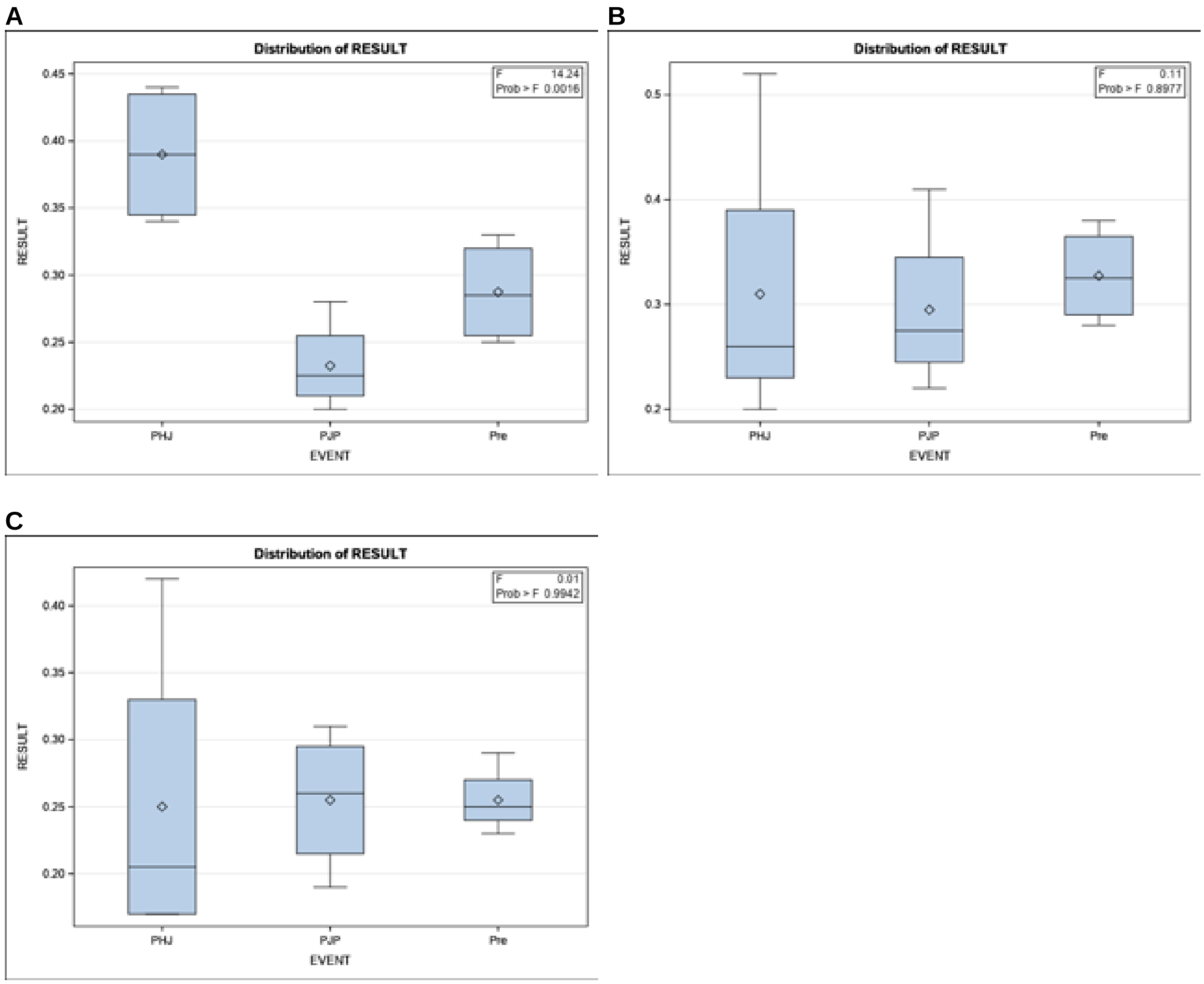


Figure E–4. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of lead in mussels at stations SM1 (a), SM2 (b) and SM3 (c).

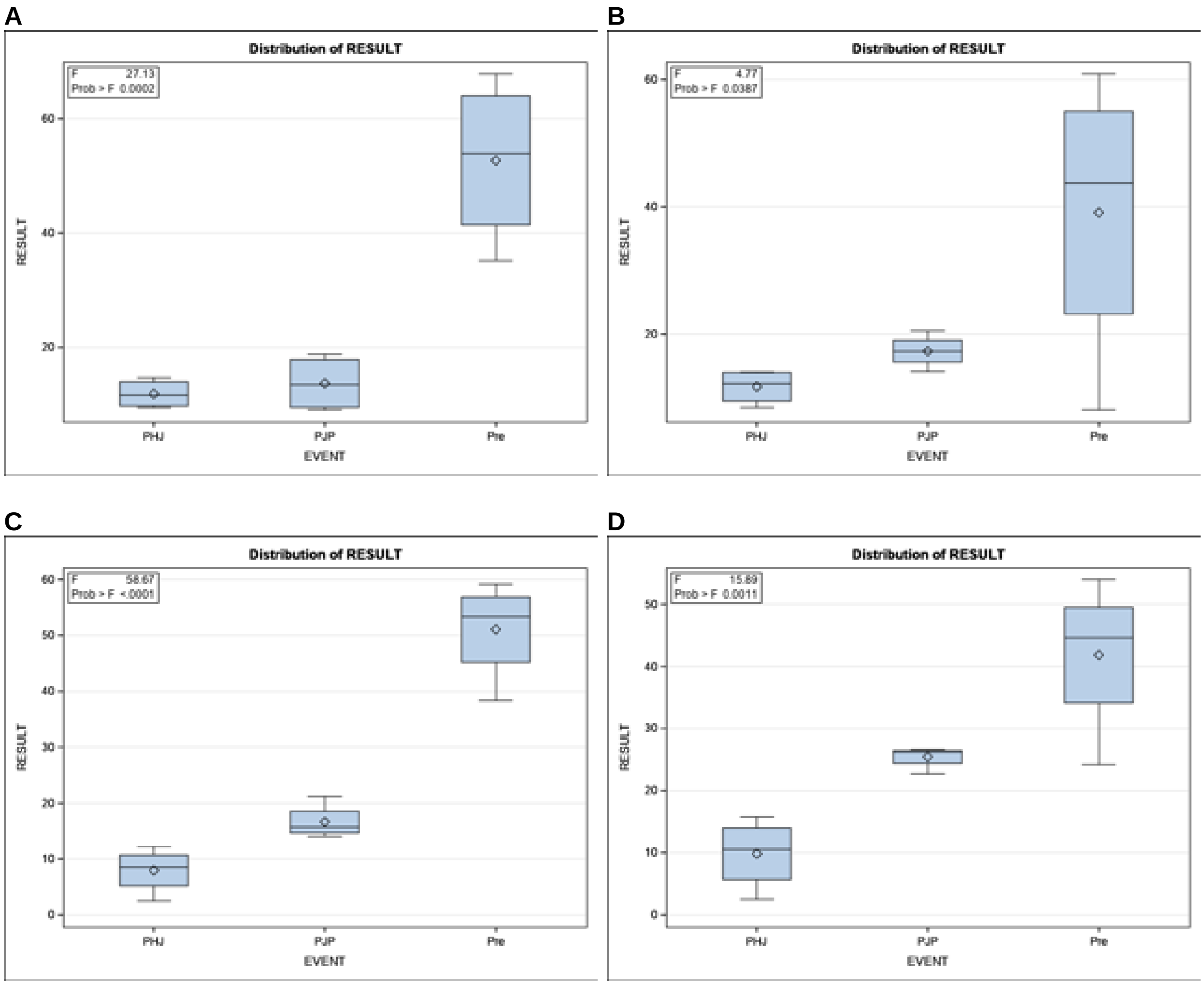


Figure E–5. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of aluminum in oysters at stations SM1 (a), SM2 (b), SM3 (c) and SM4 (d).

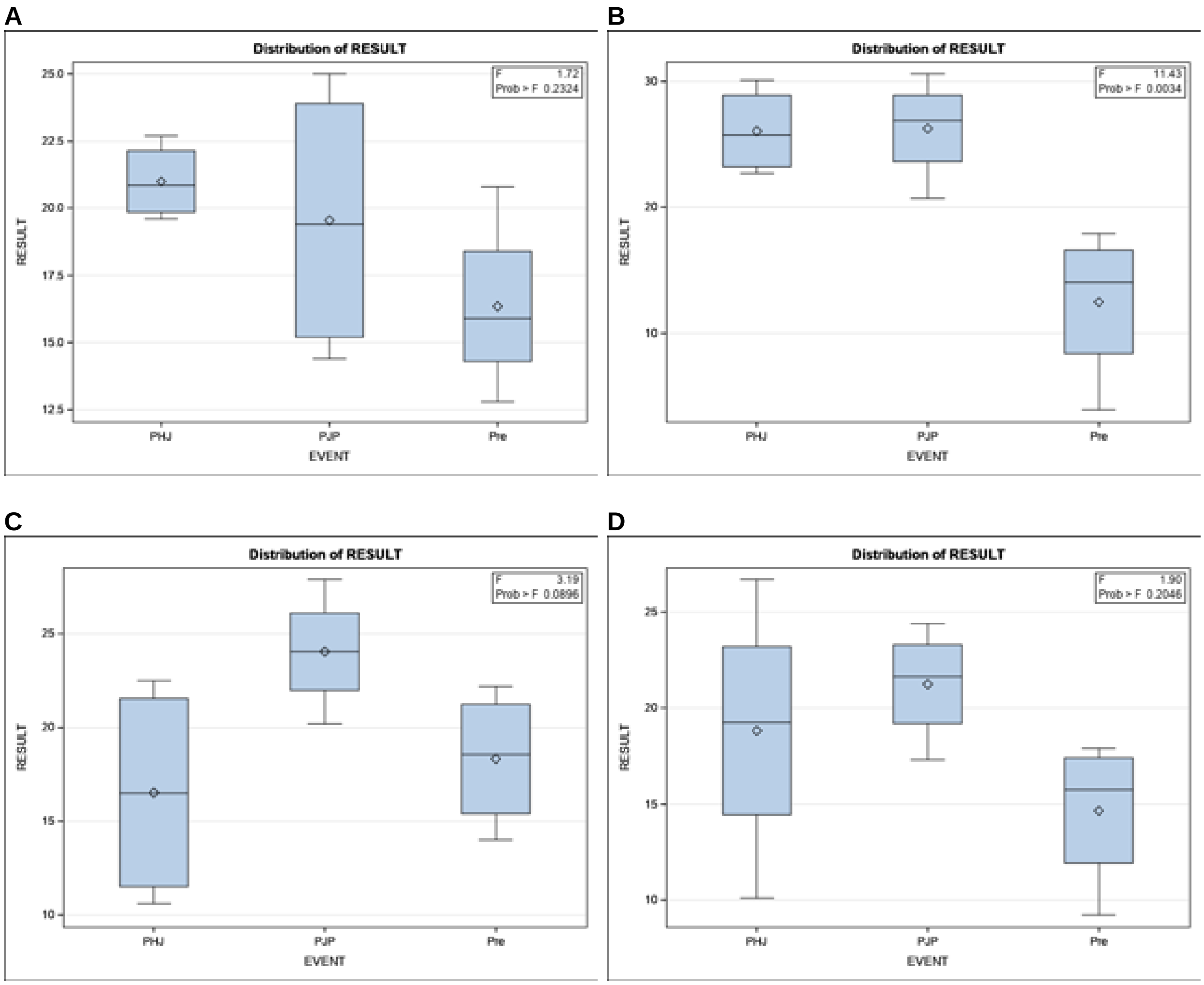


Figure E–6. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of copper in oysters at stations SM1 (a), SM2 (b), SM3 (c) and SM4 (d).

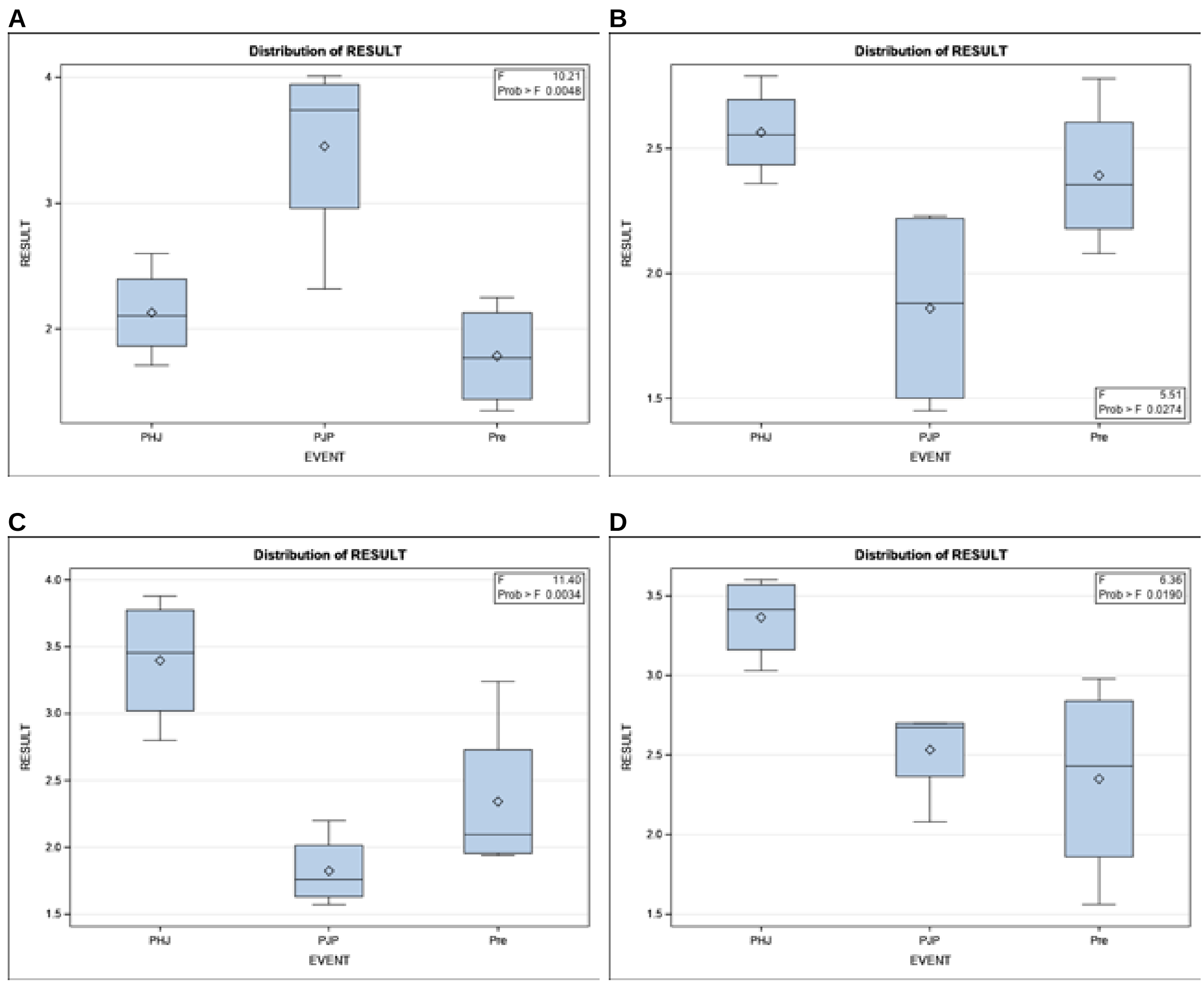


Figure E–7. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of 4,4’-DDE in oysters at stations SM1 (a), SM2 (b), SM3 (c), and SM4 (d).

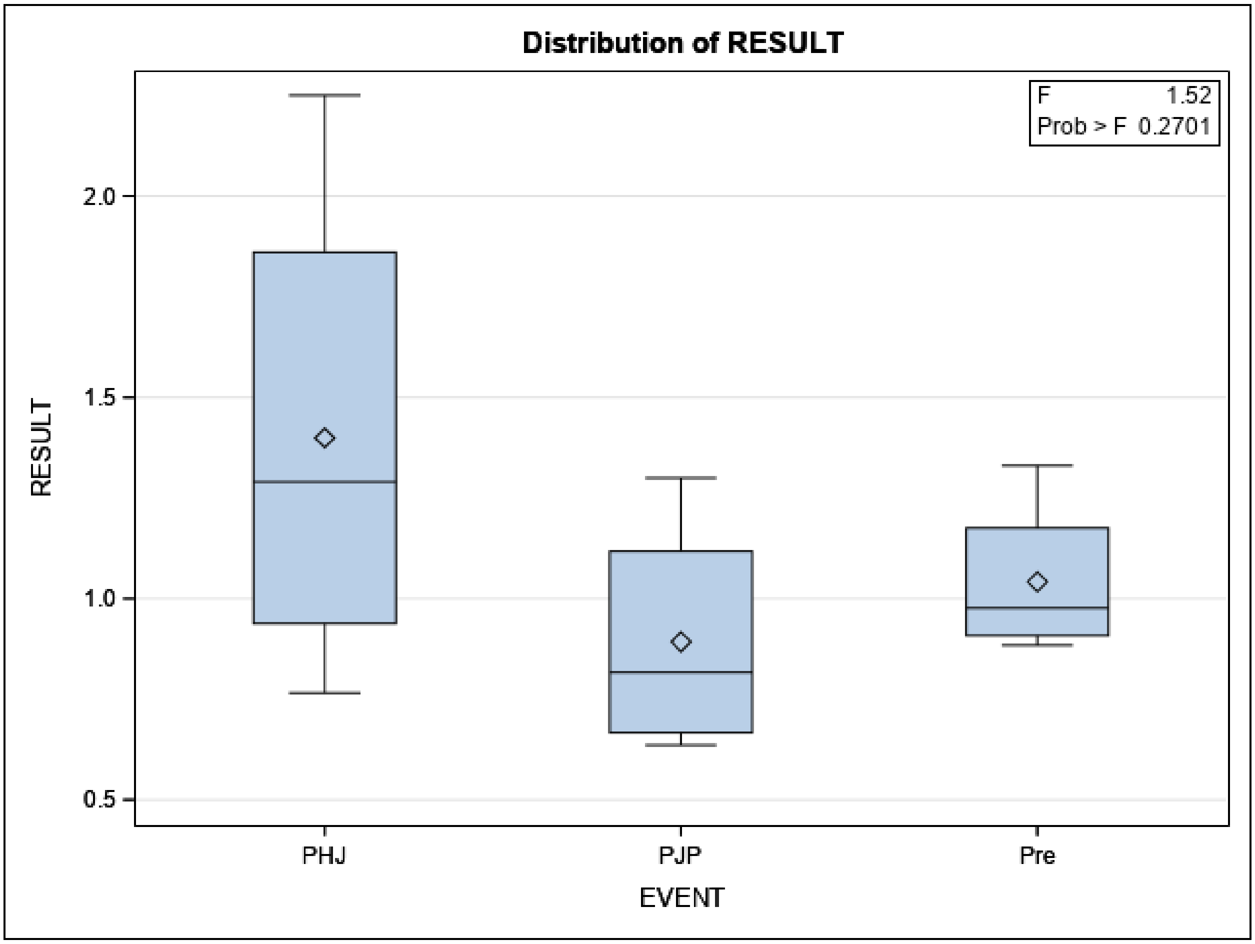


Figure E–8. **Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of 2,2’,3,4’,5,5’,6 heptachlorobiphenyl (PCB 187) in oysters at station SM3.**

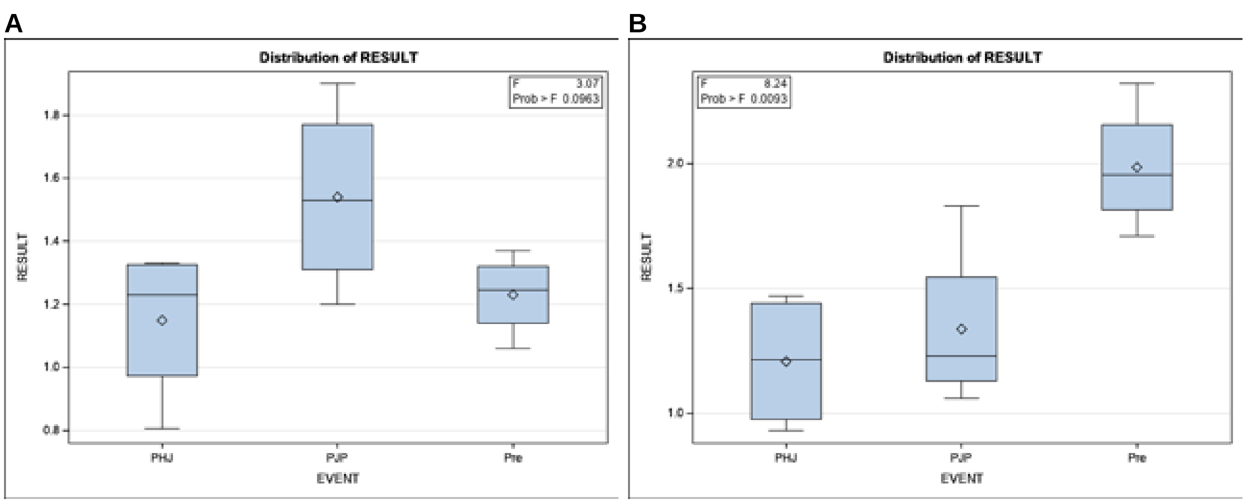


Figure E–9. **Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of 2,2’,3,4,4’,5’ hexachlorobiphenyl (PCB 138) in oysters at stations SM1 (a) and SM2 (b).**

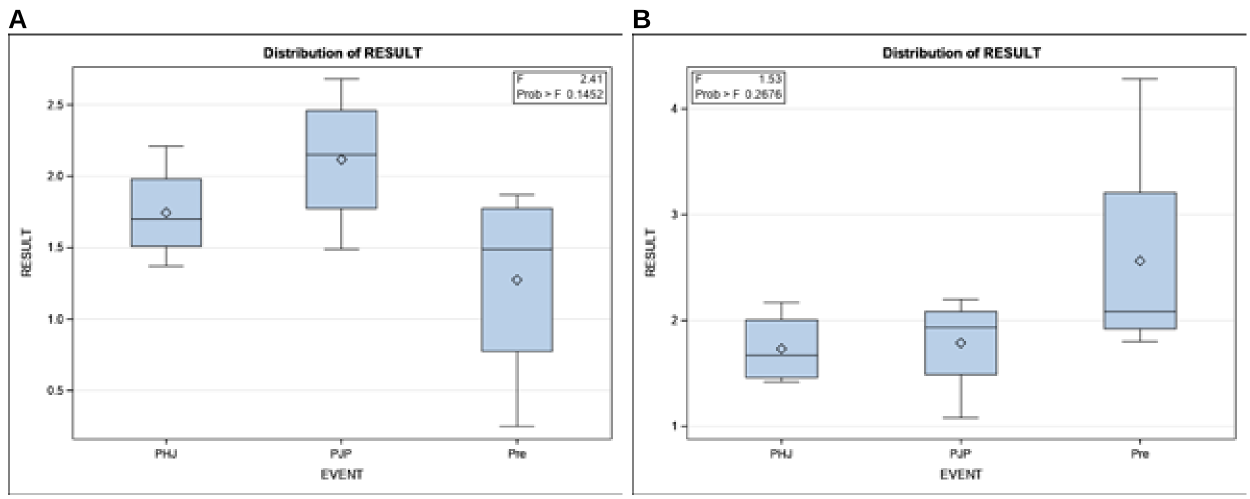
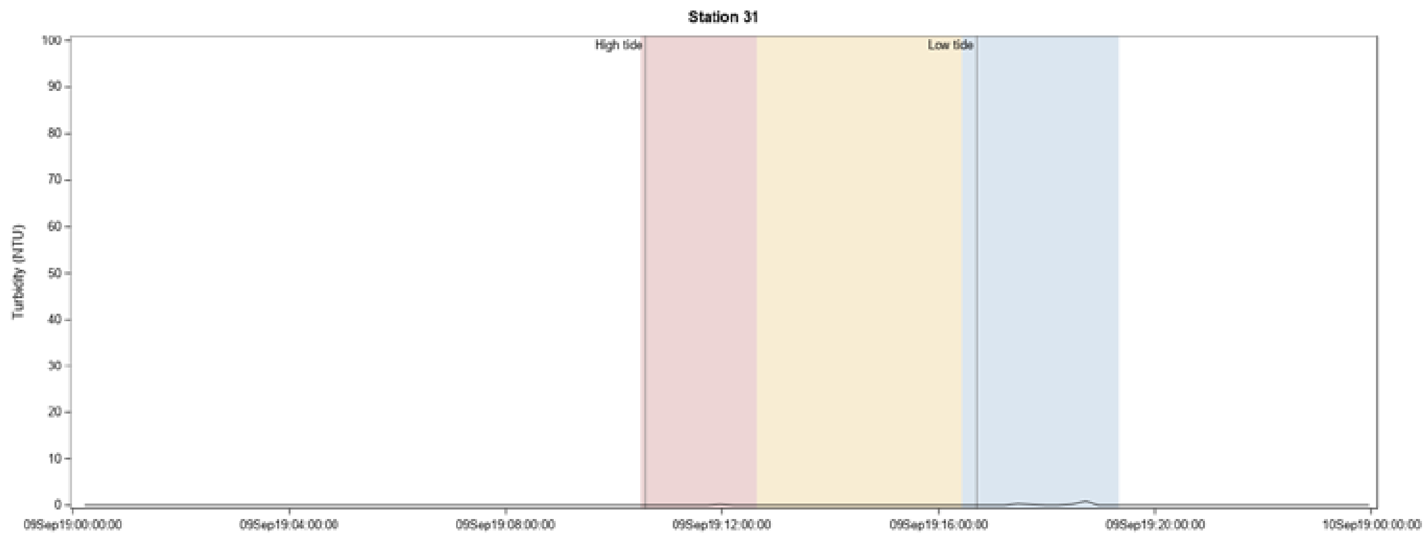
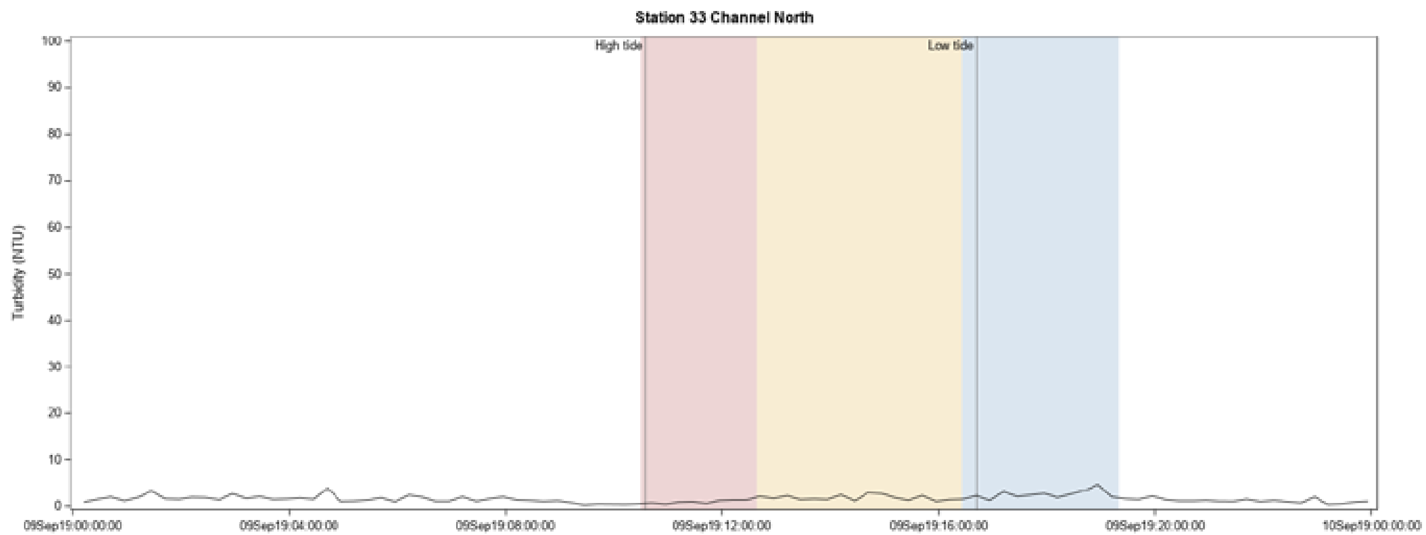


Figure E–10. Results of one-way ANOVA comparing preconstruction, post jet plow and post hand jet concentrations of 2,2',4,4',5,5' hexachlorobiphenyl (PCB 153) in oysters at stations SM1 (a) and SM2 (b).

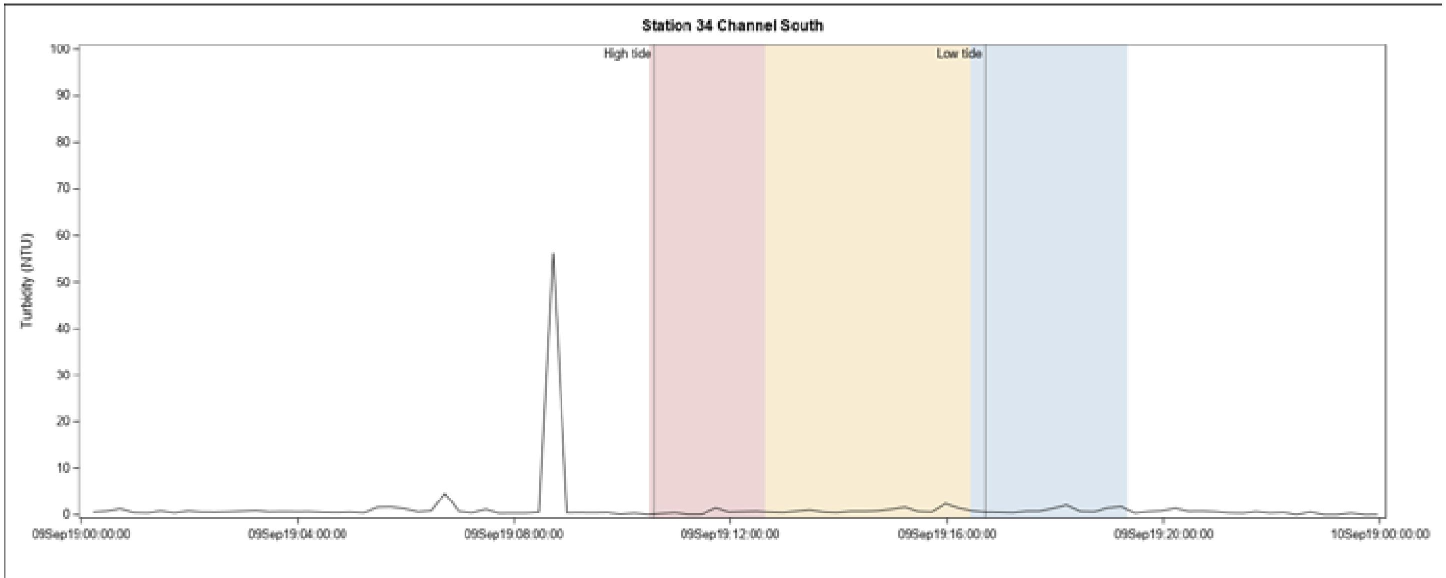
Appendix F. Fixed Station Turbidity Plots

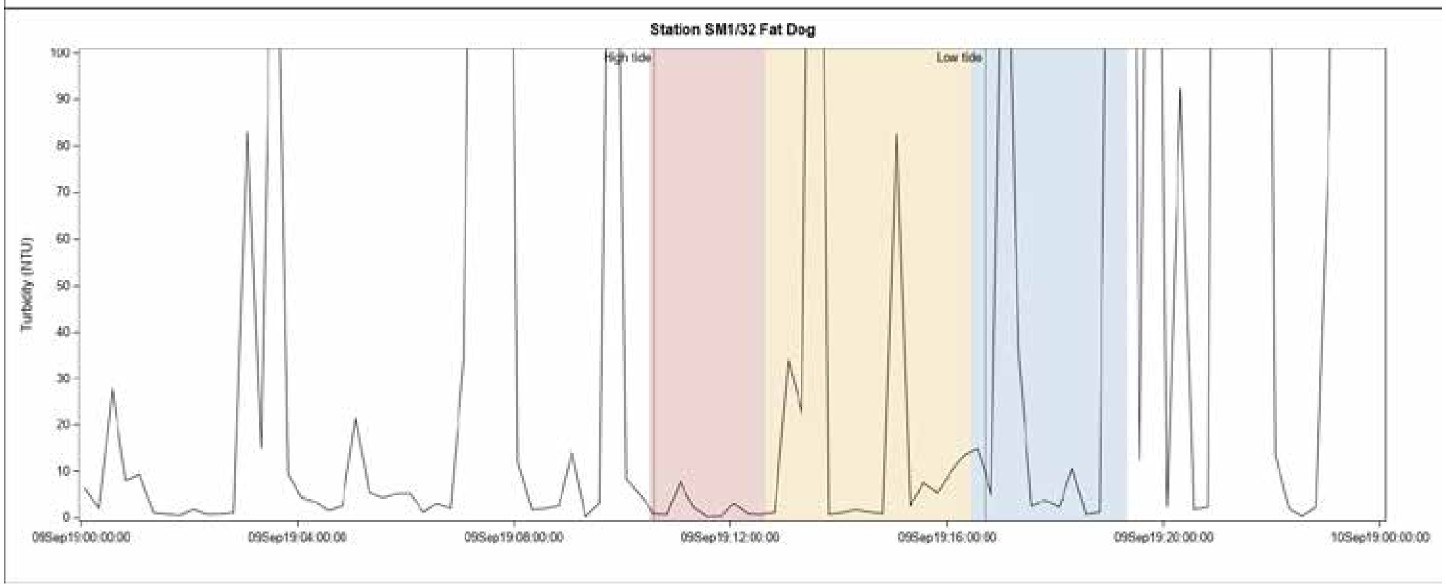
Jet Plow Trial



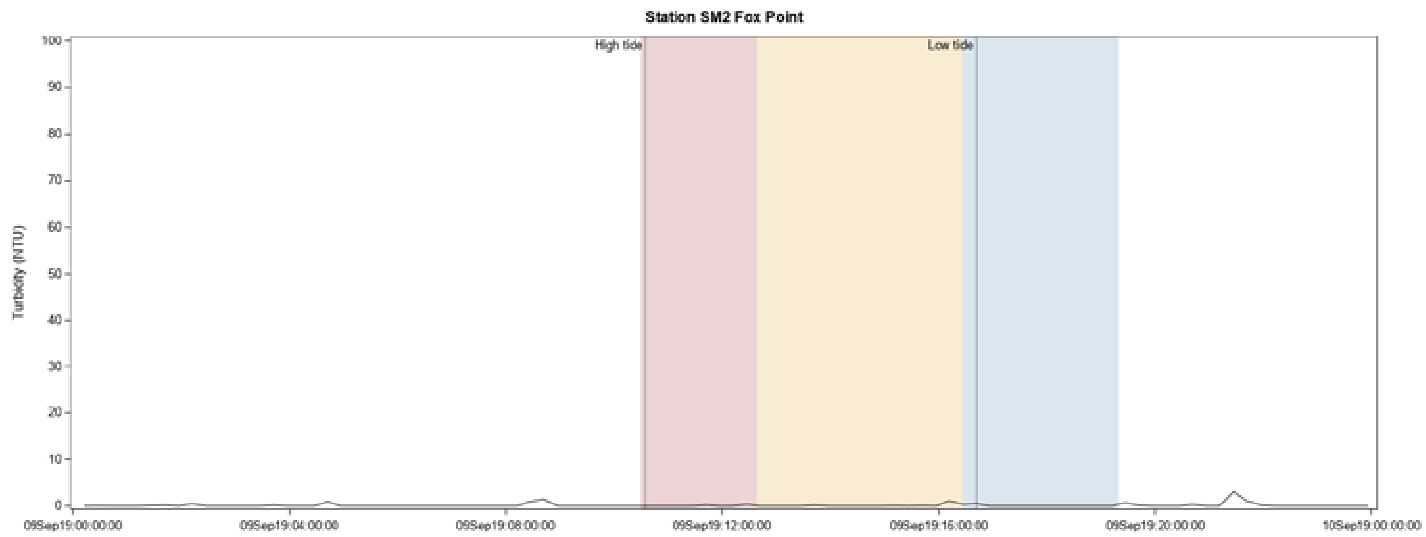


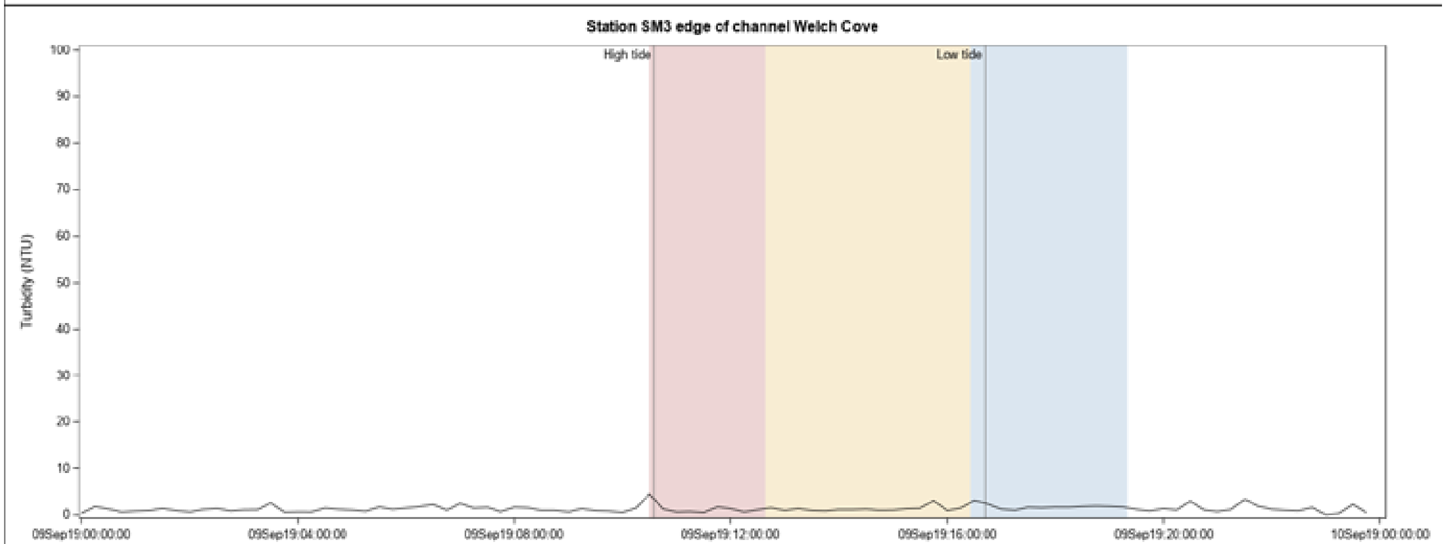
Pink shading indicates water quality monitoring prior to jet plowing; tan shading indicates active jet plowing; light blue shading indicates periods when jet plow was idling but not advancing. Vertical lines indicate high and low slack tides.



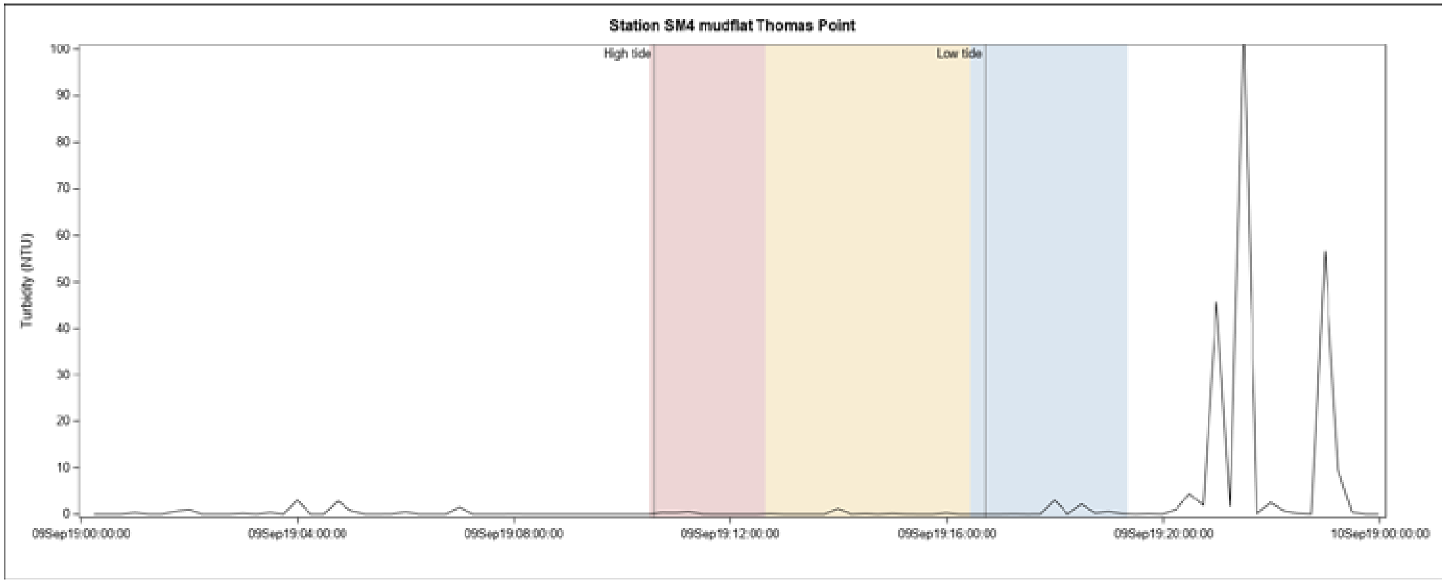


Pink shading indicates water quality monitoring prior to jet plowing; tan shading indicates active jet plowing; light blue shading indicates periods when jet plow was idling but not advancing. Vertical lines indicate high and low slack tides.



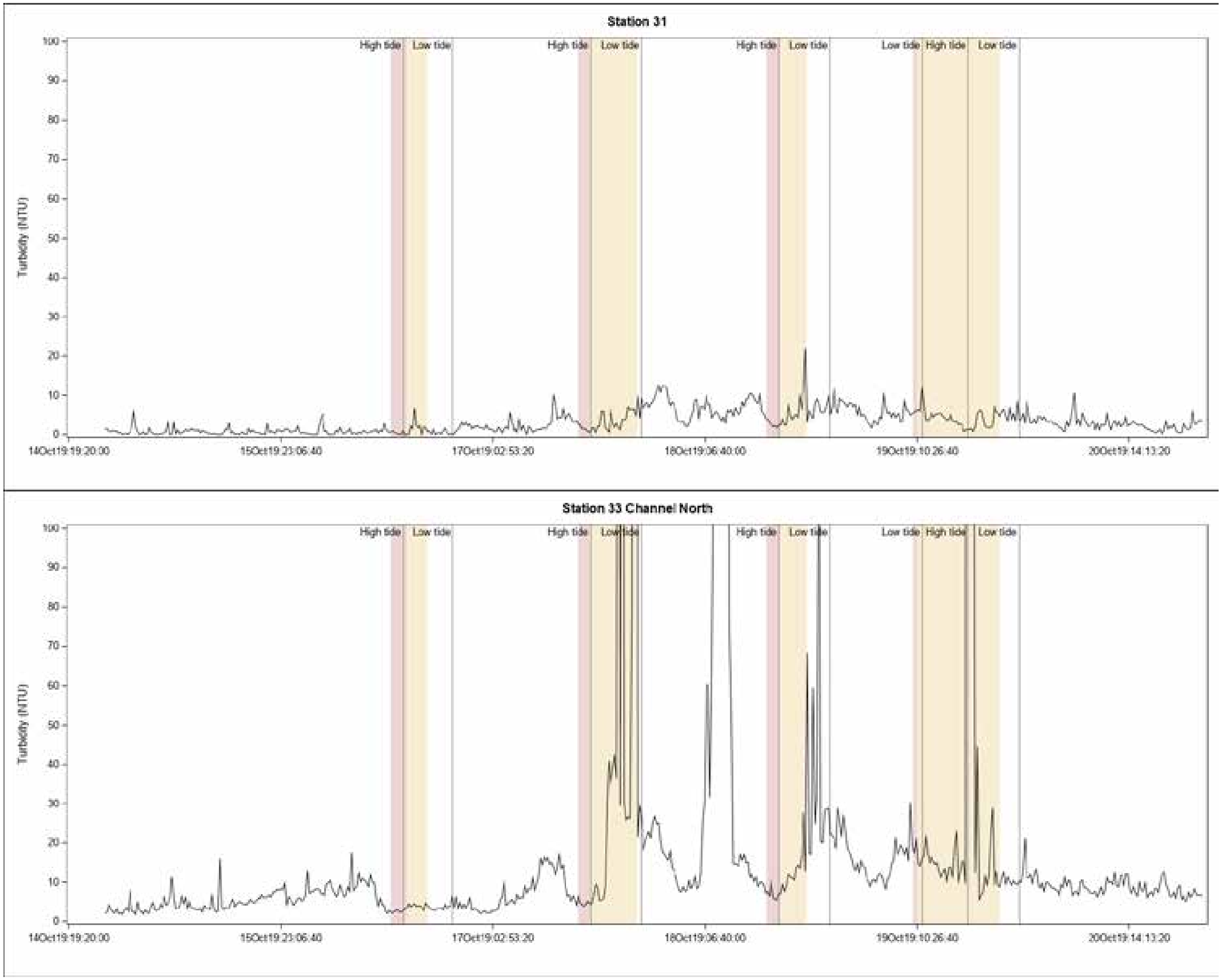


Pink shading indicates water quality monitoring prior to jet plowing; tan shading indicates active jet plowing; light blue shading indicates periods when jet plow was idling but not advancing. Vertical lines indicate high and low slack tides.

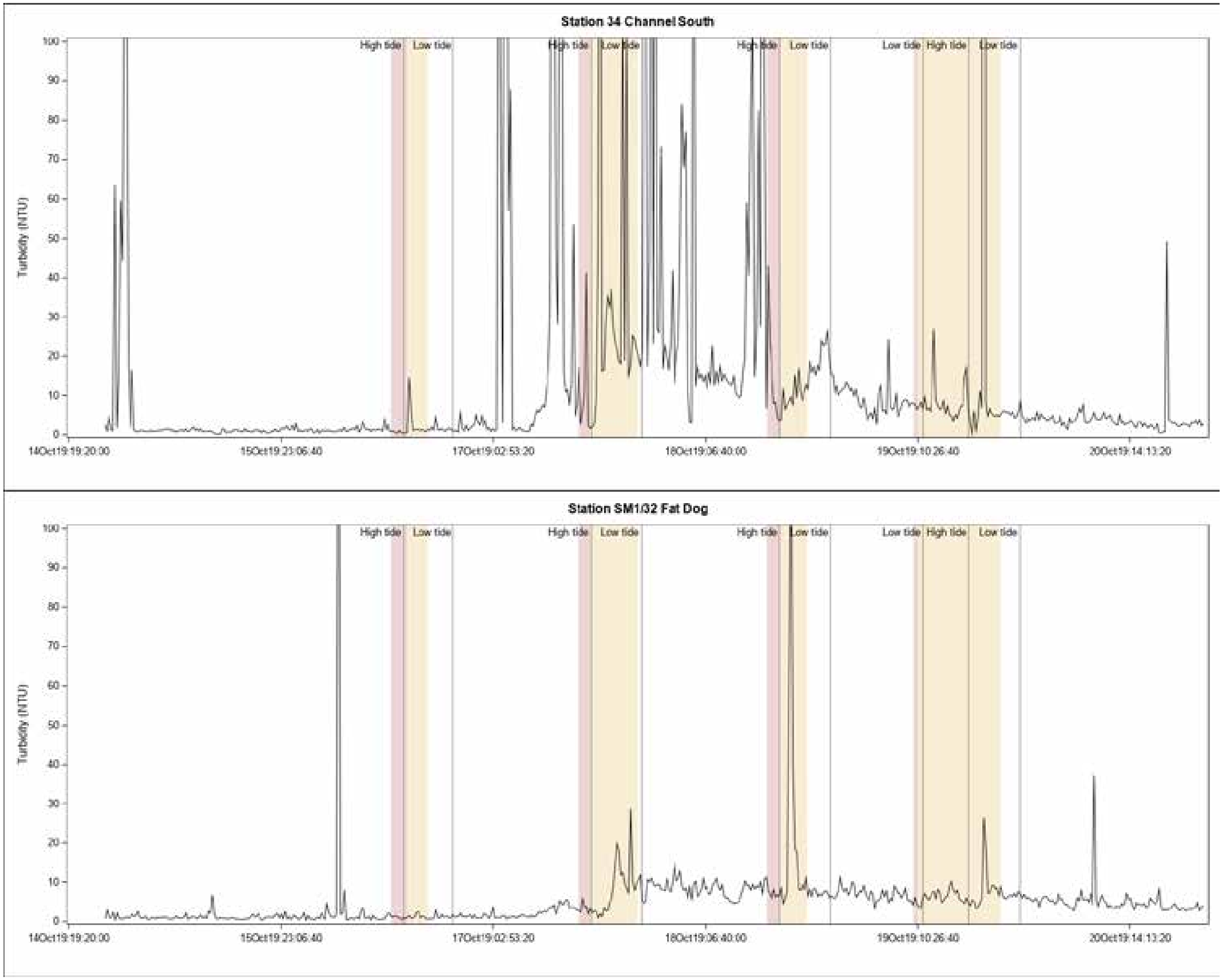


Pink shading indicates water quality monitoring prior to jet plowing; tan shading indicates active jet plowing; light blue shading indicates periods when jet plow was idling but not advancing. Vertical lines indicate high and low slack tides.

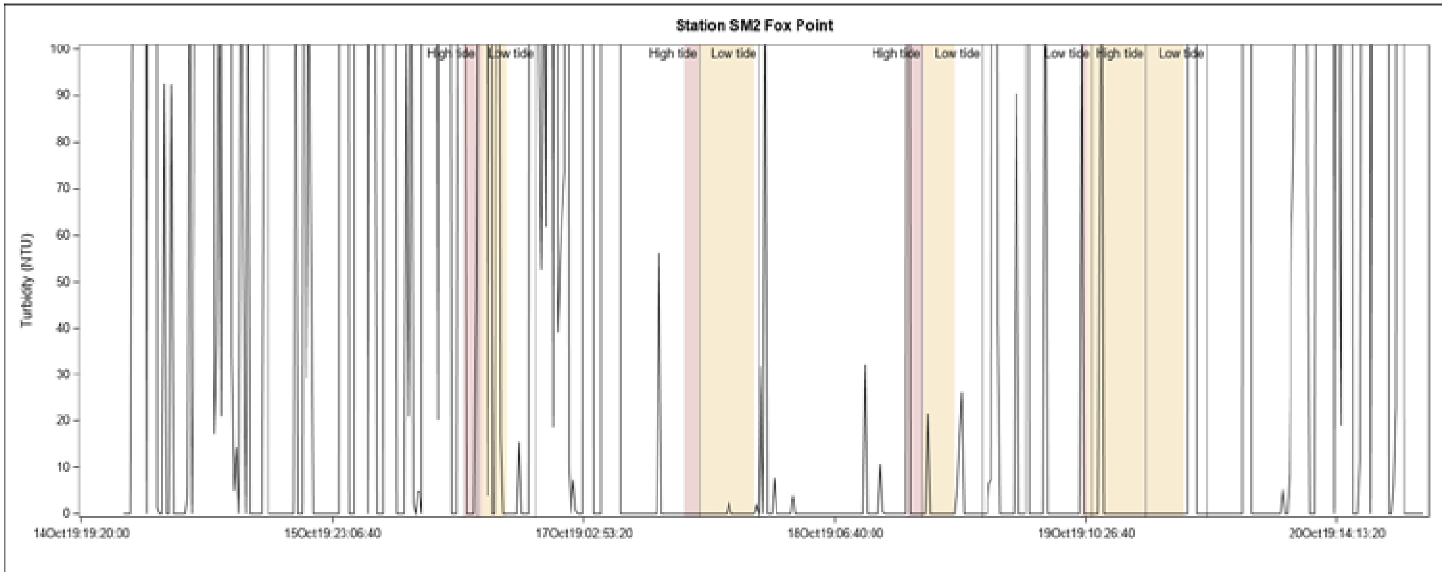
Cable 1

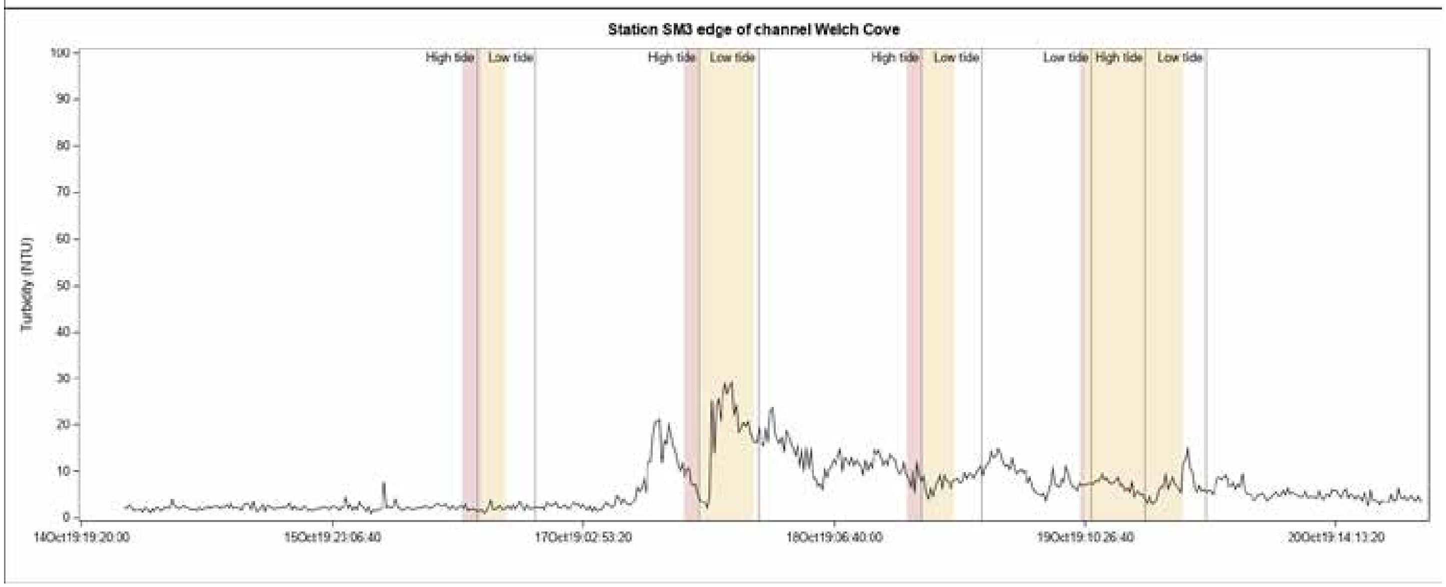


Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

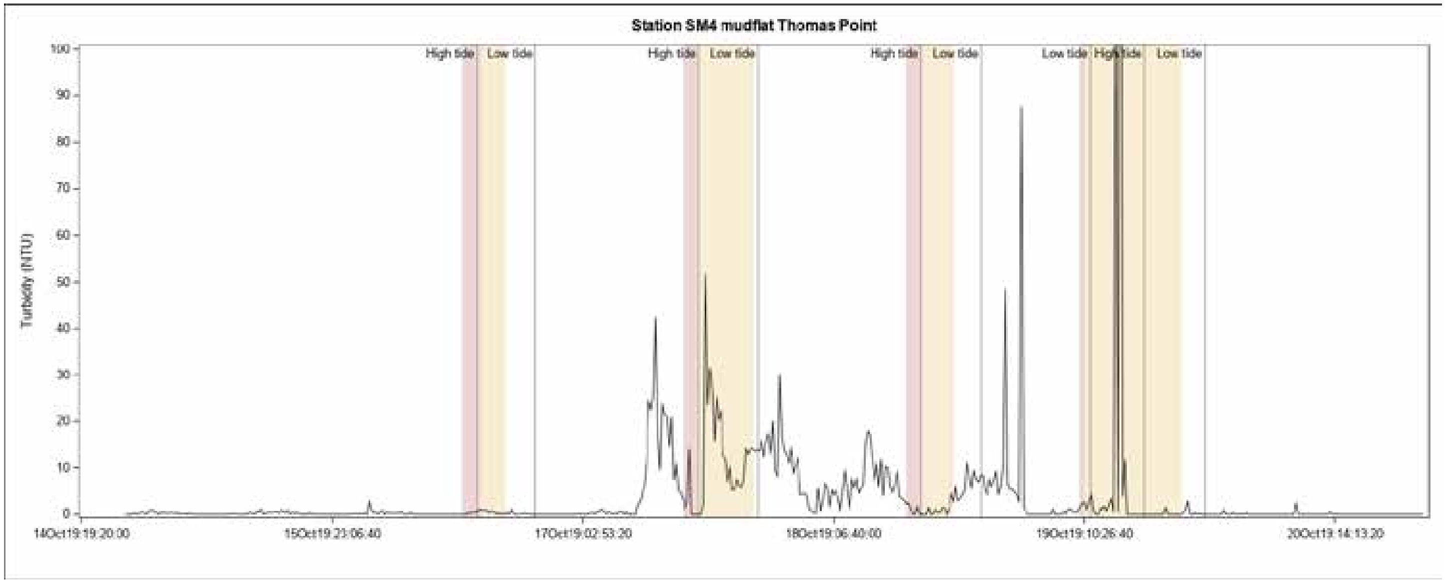


Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.



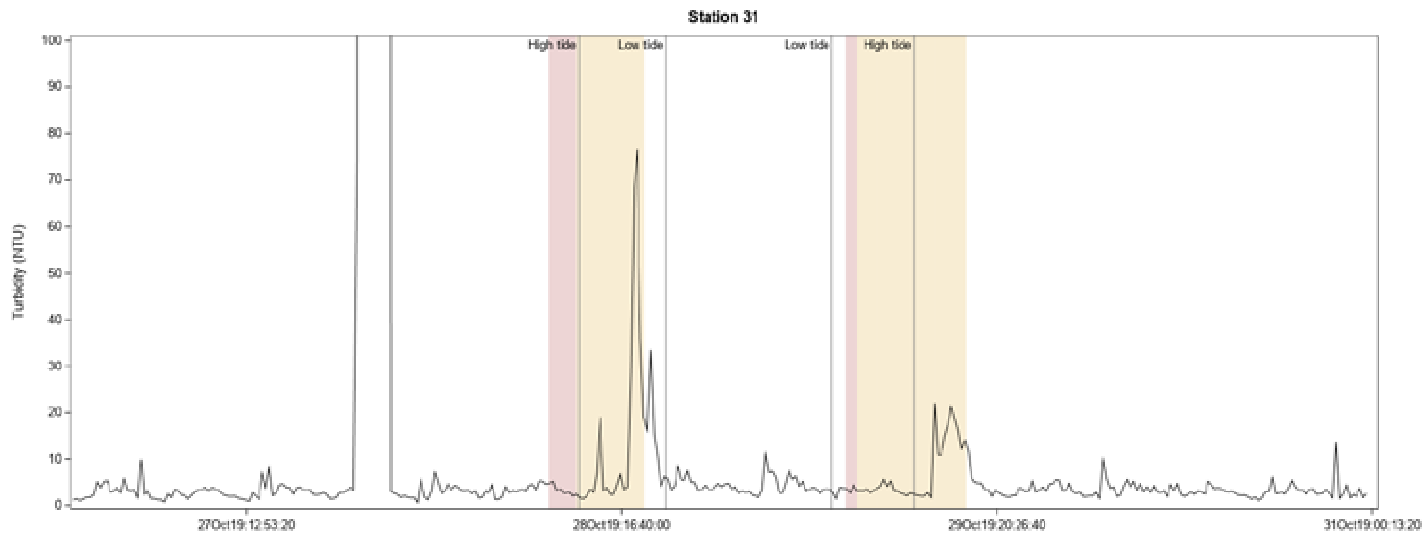


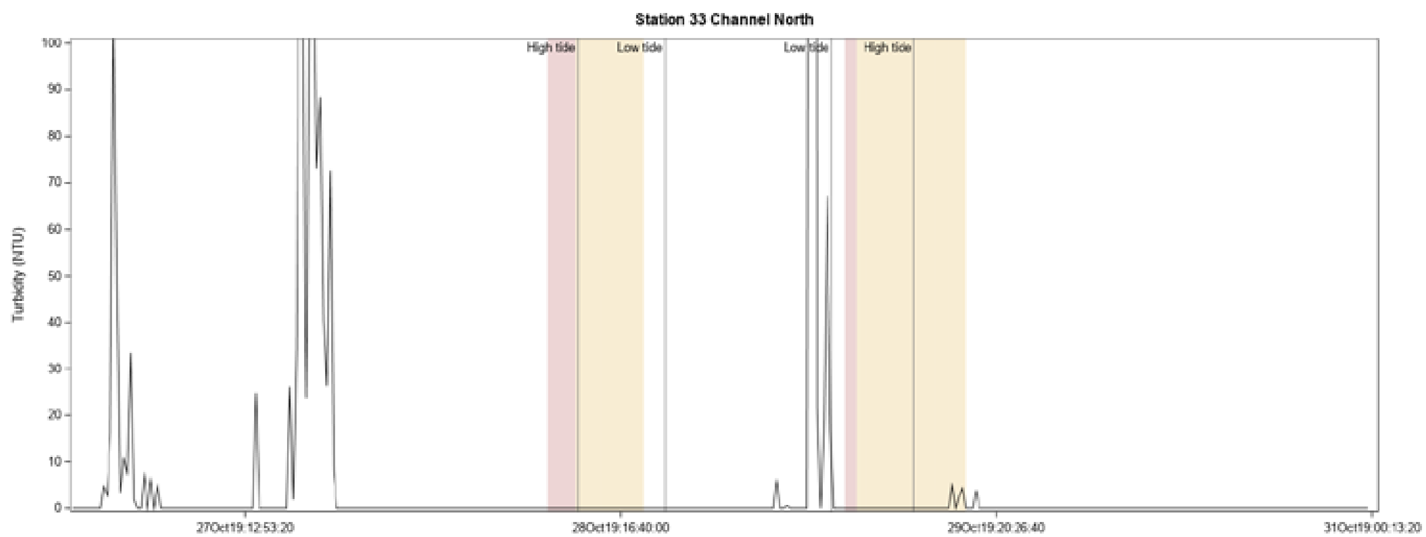
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.



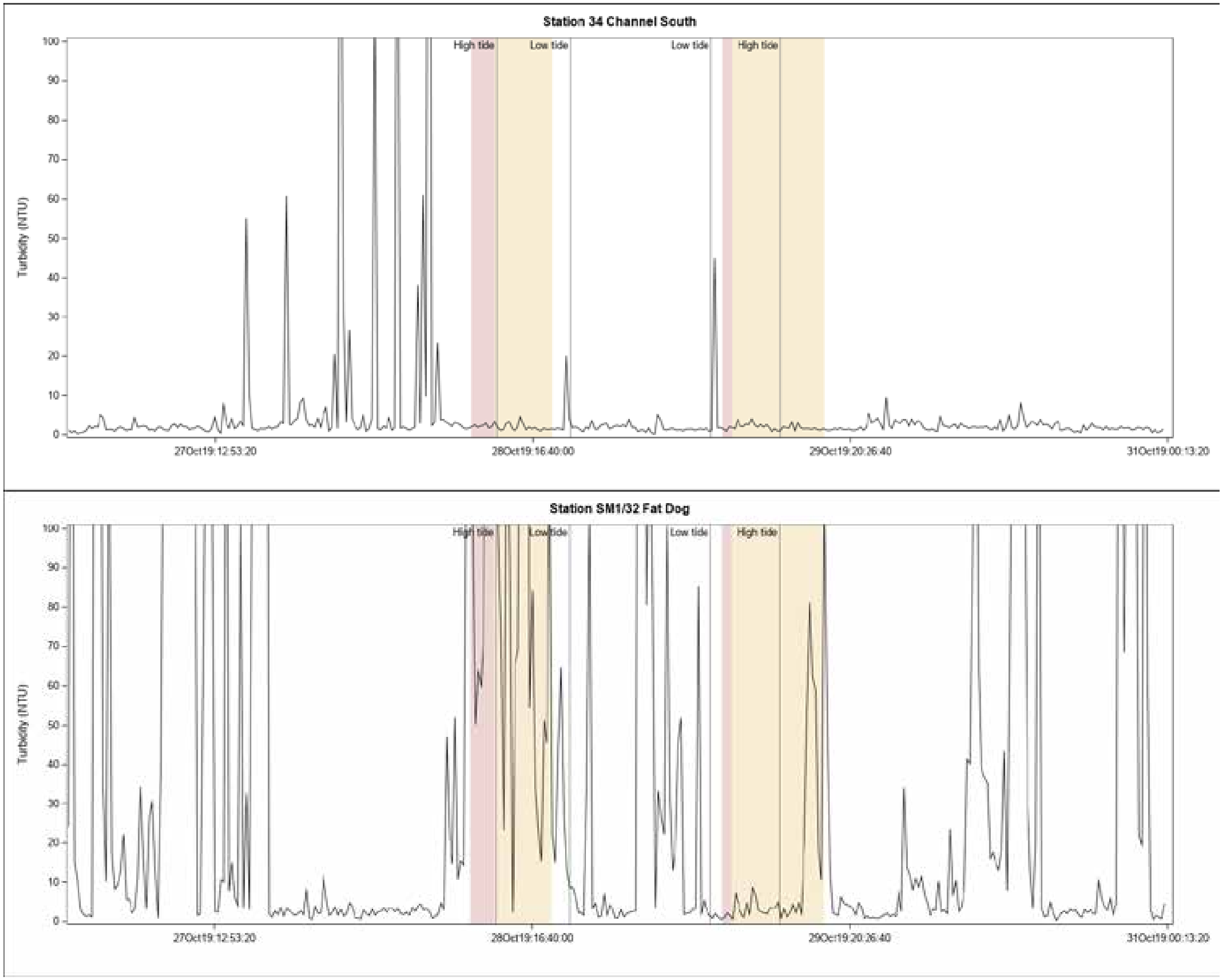
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

Cable 2

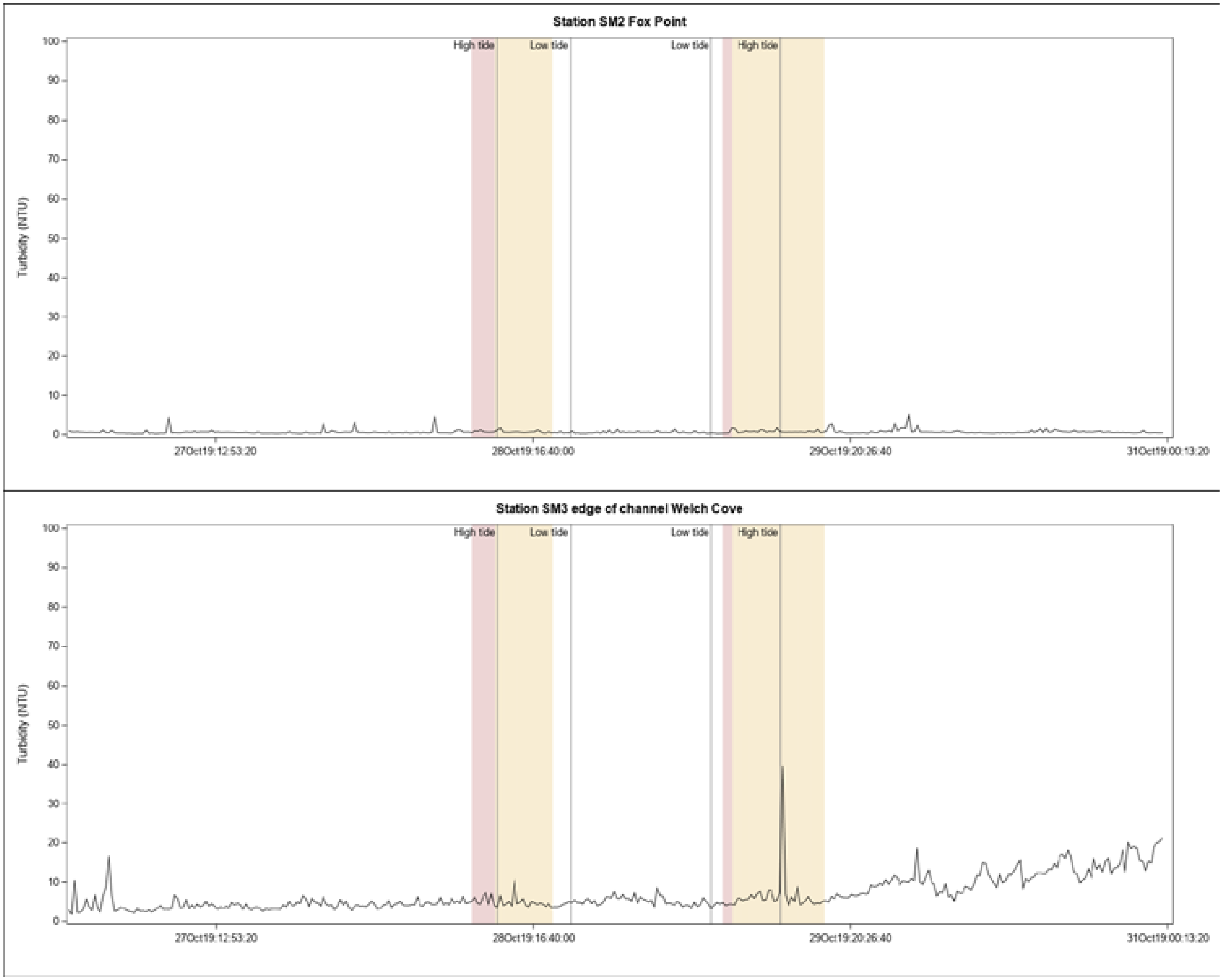




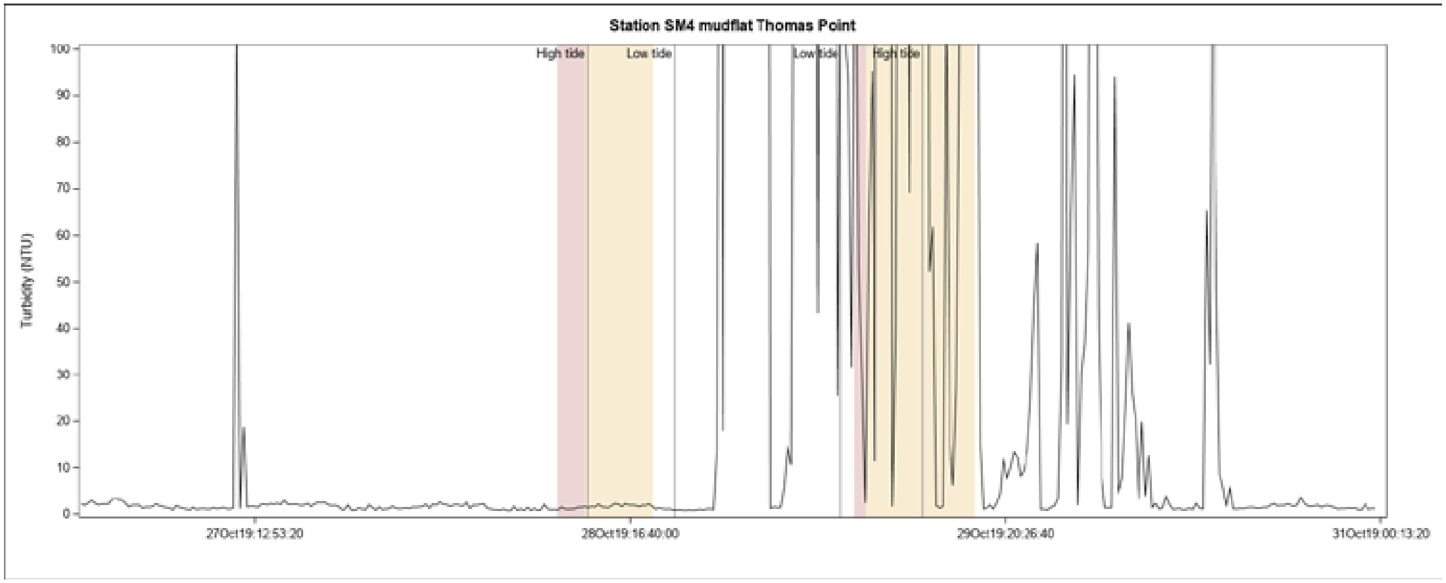
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.



Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

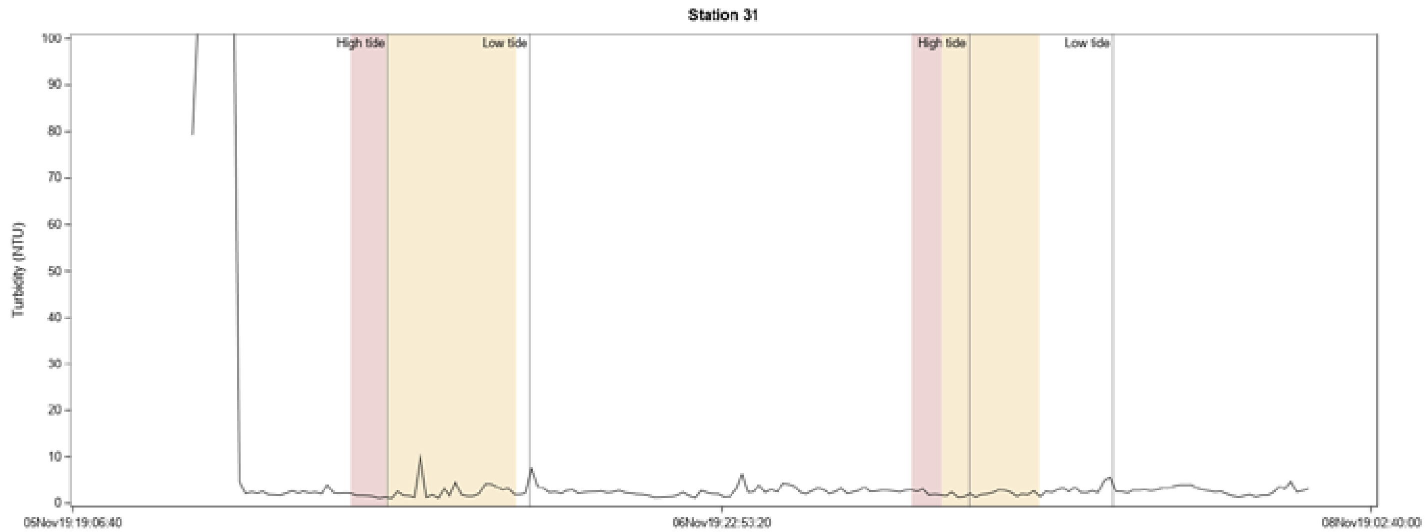


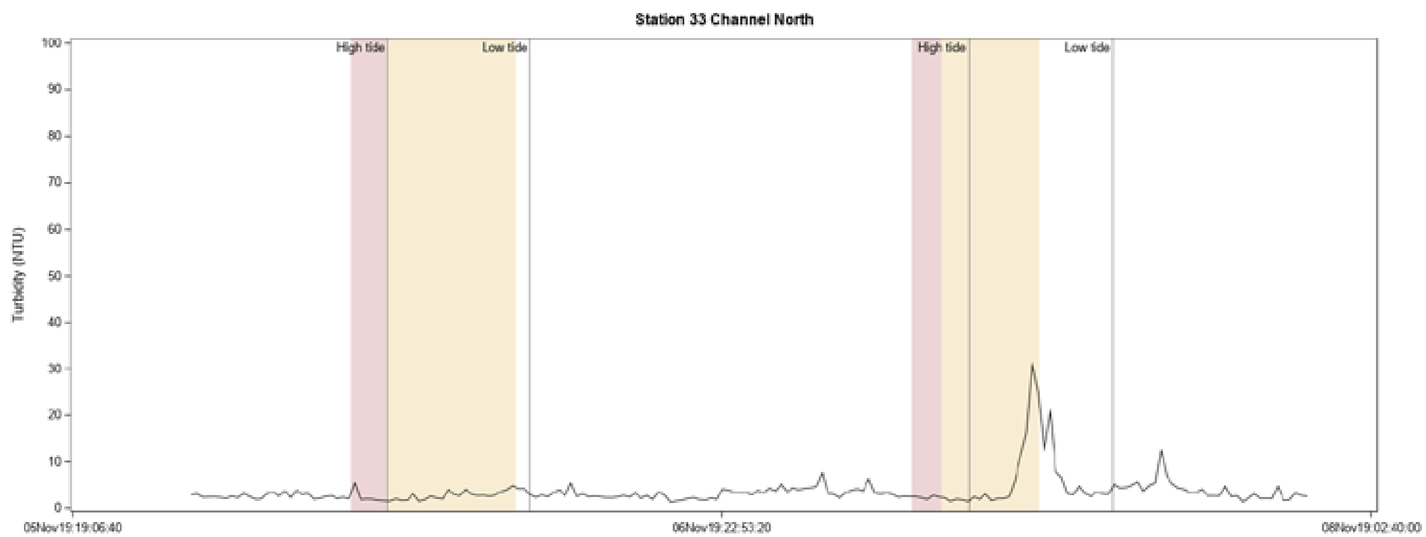
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.



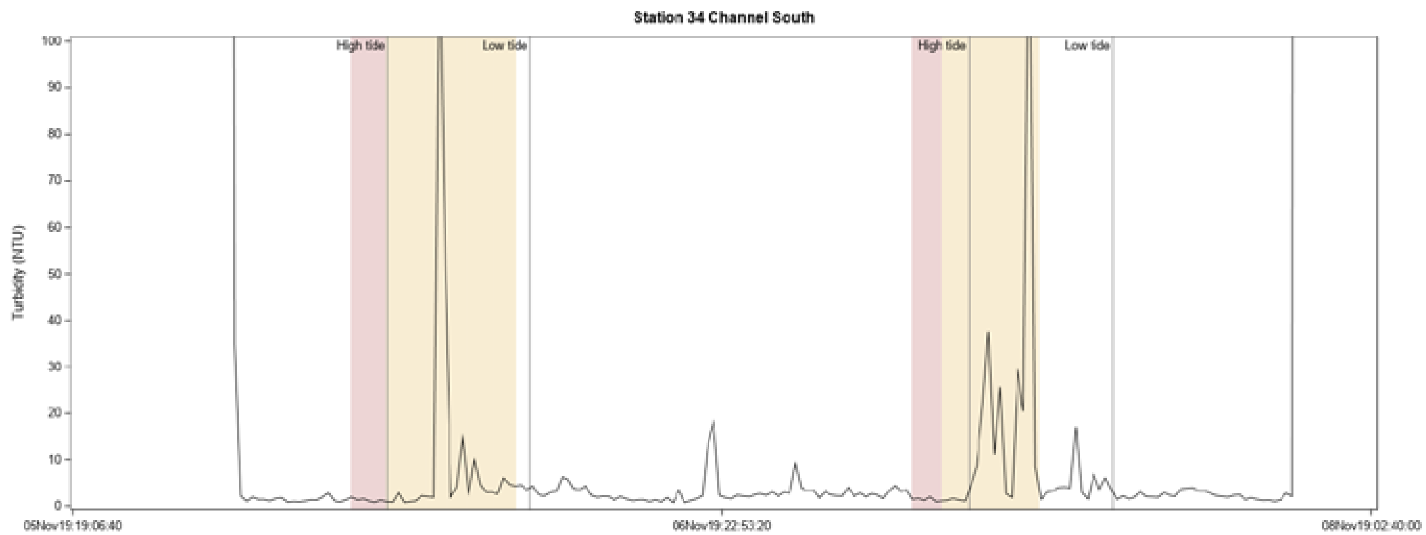
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

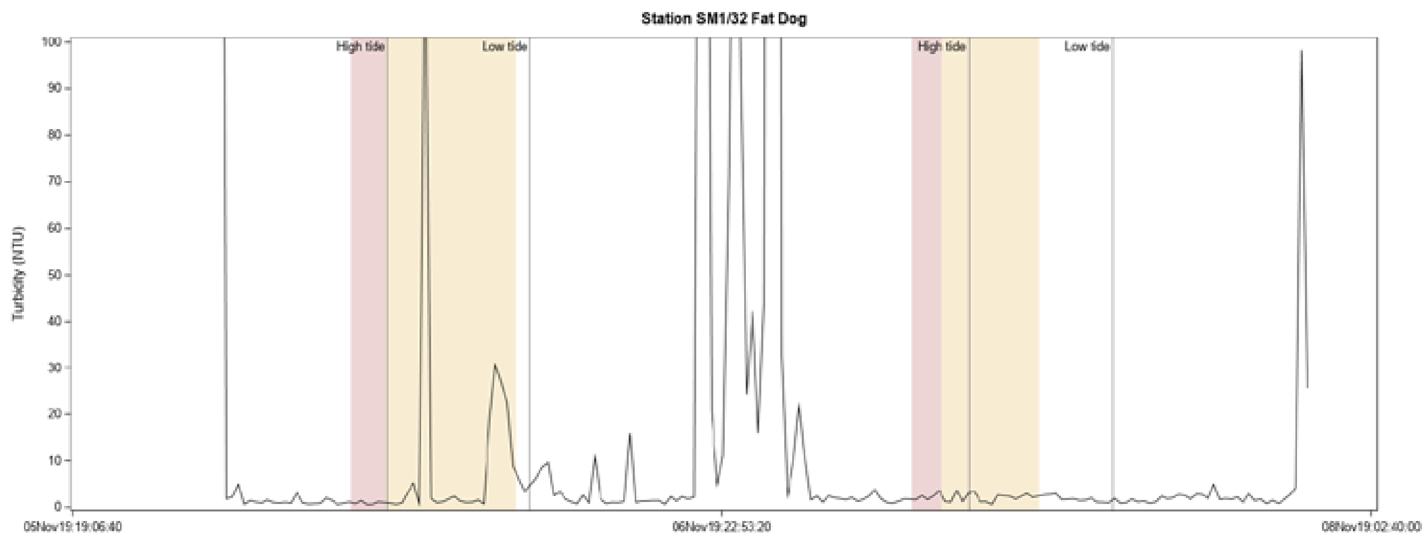
Cable 3



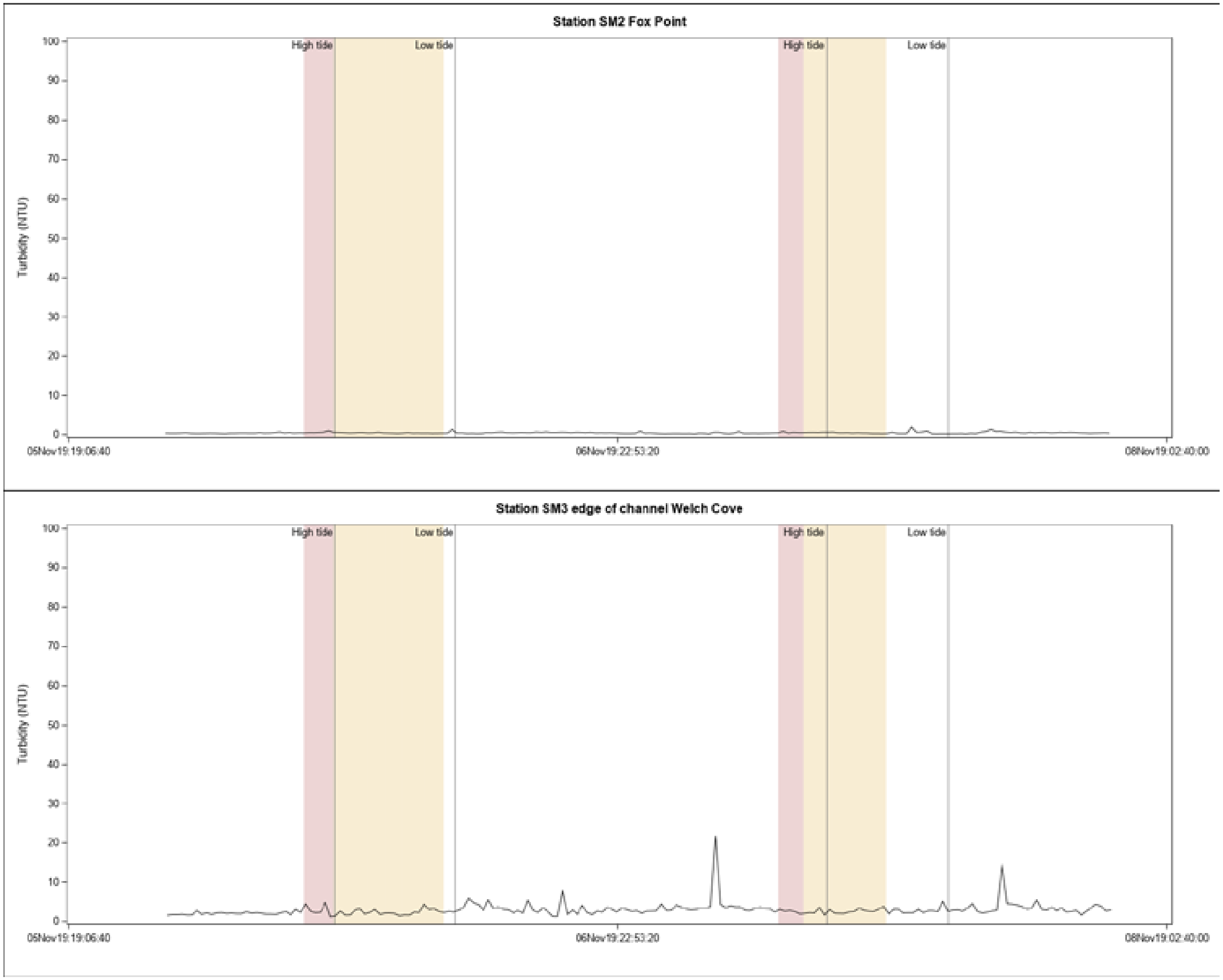


Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

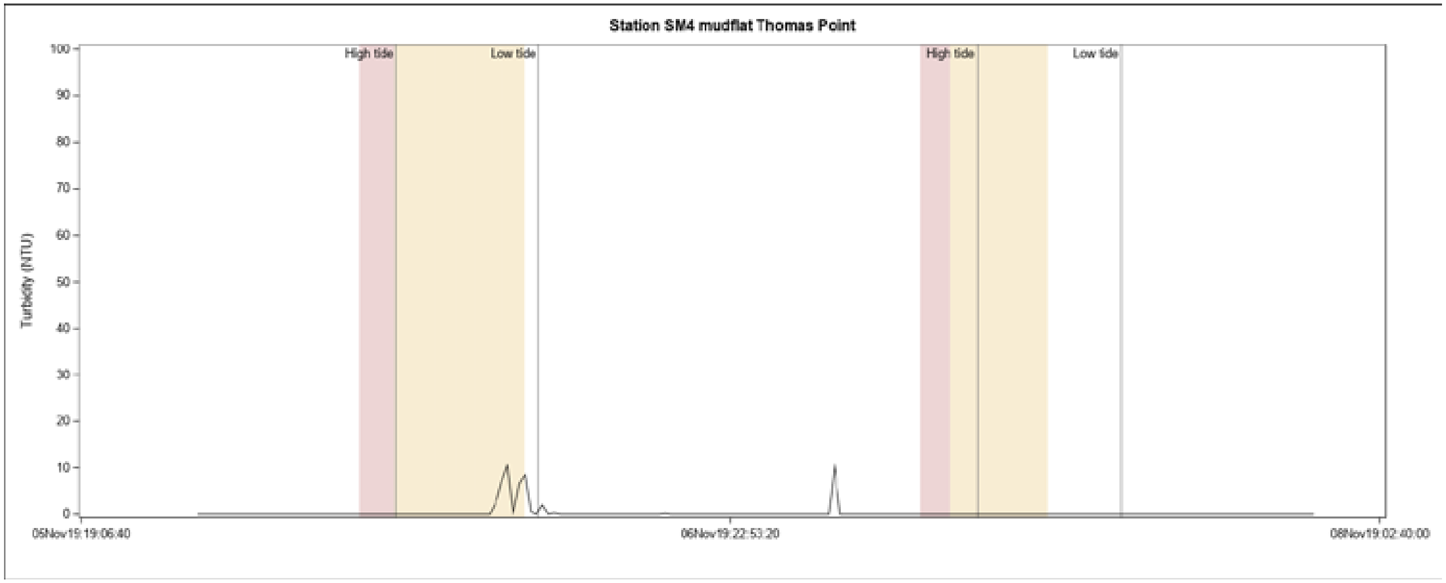




Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

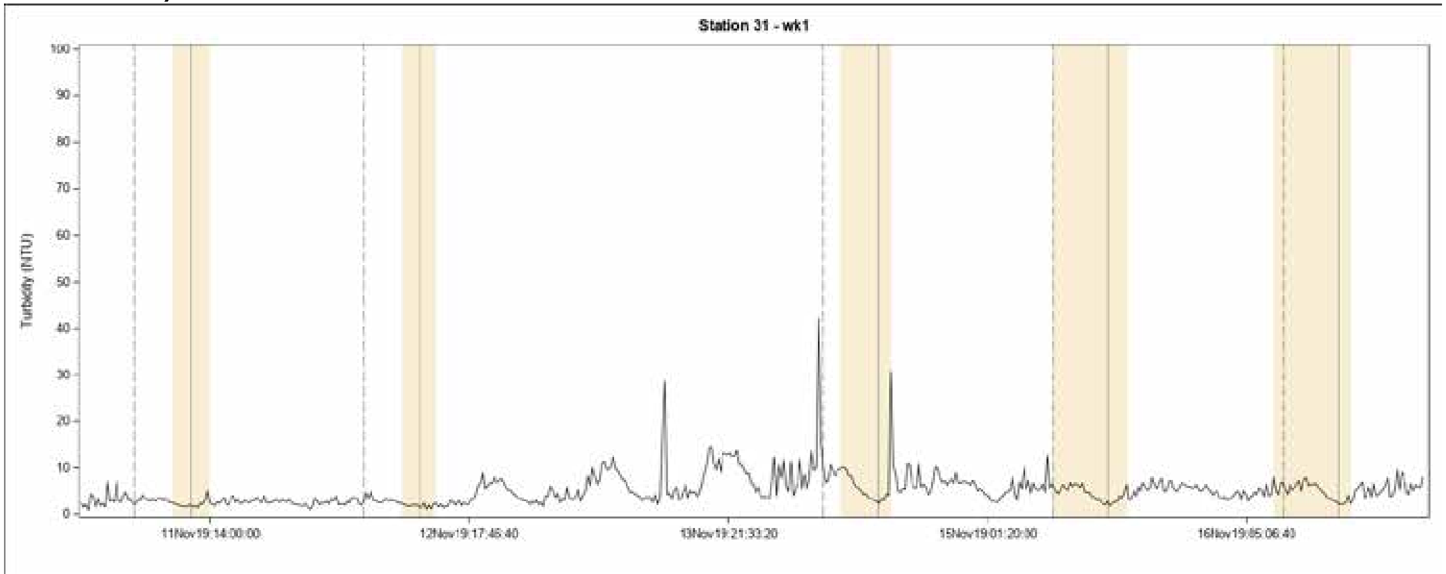


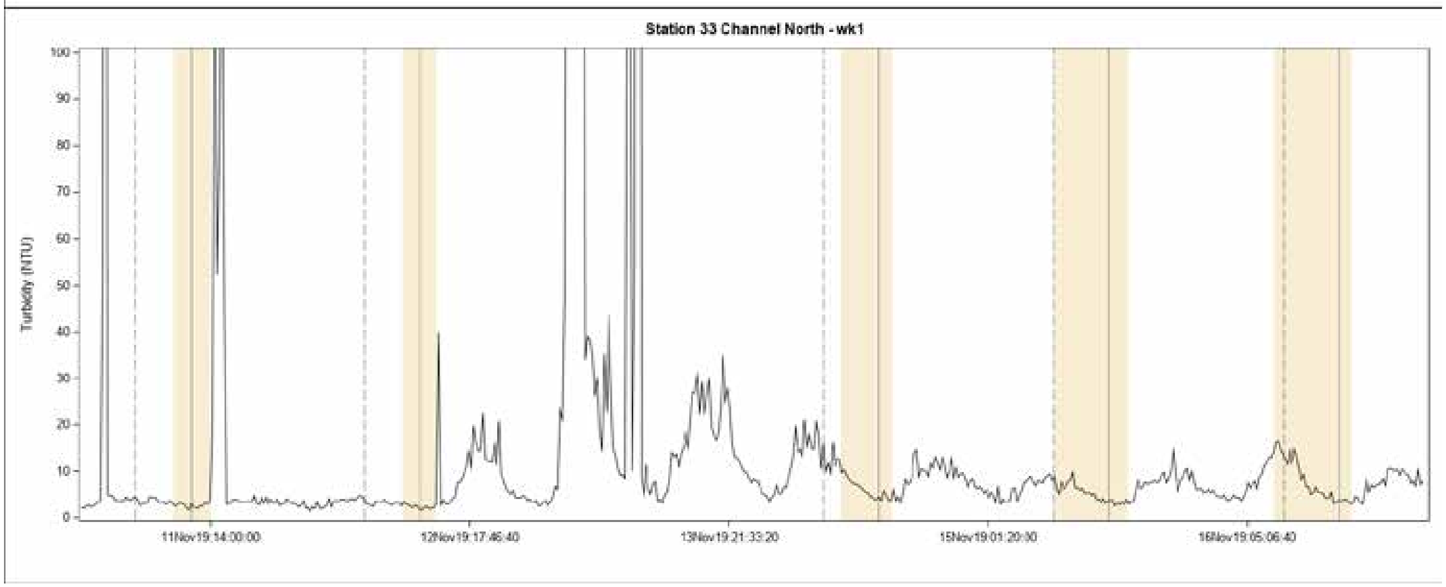
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.



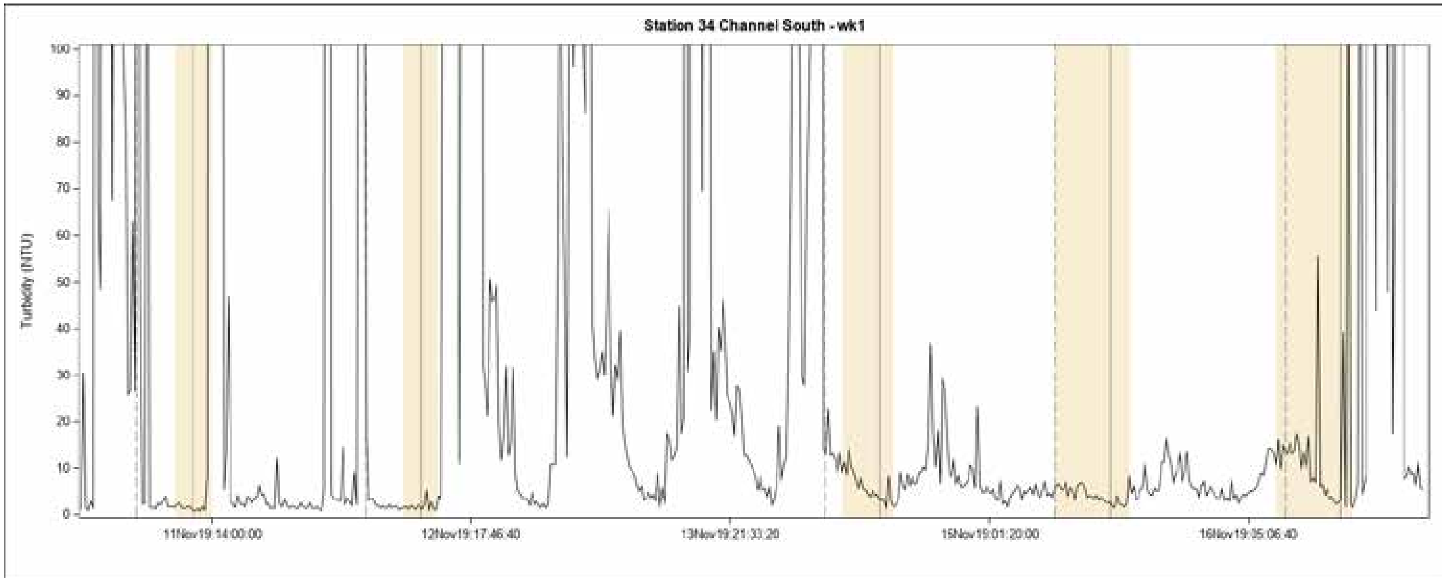
Pink shading indicates water quality monitoring prior to jet plowing and tan shading indicates active jet plowing. Vertical lines indicate high and low slack tides.

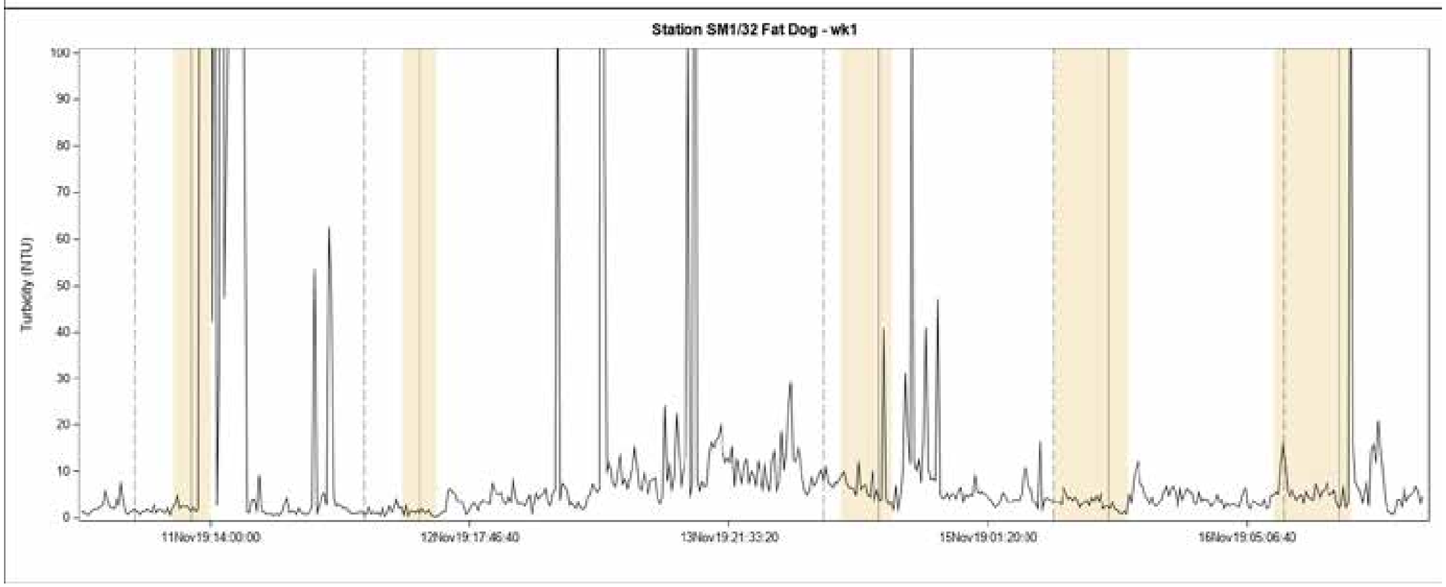
Hand Jet, Week 1



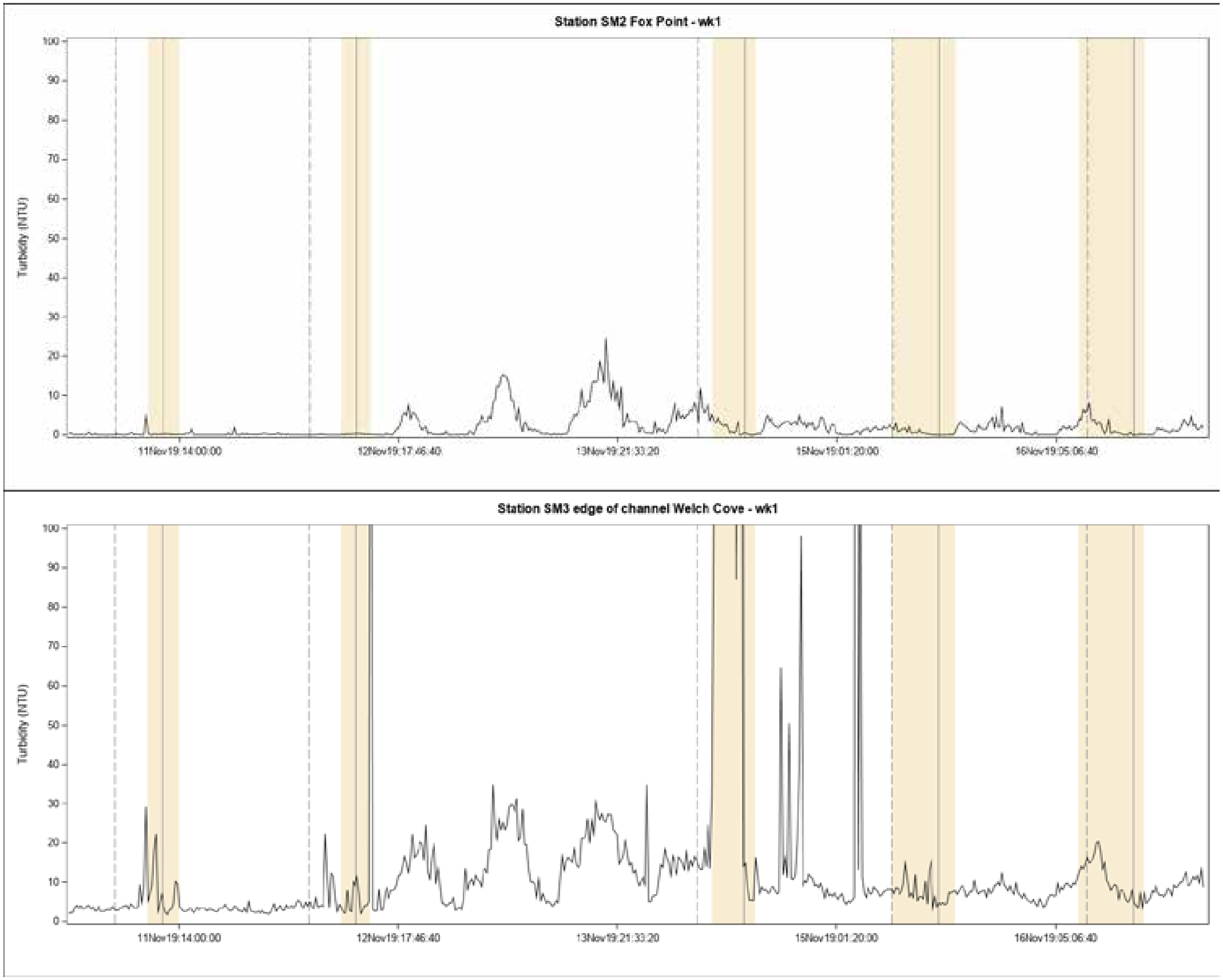


Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

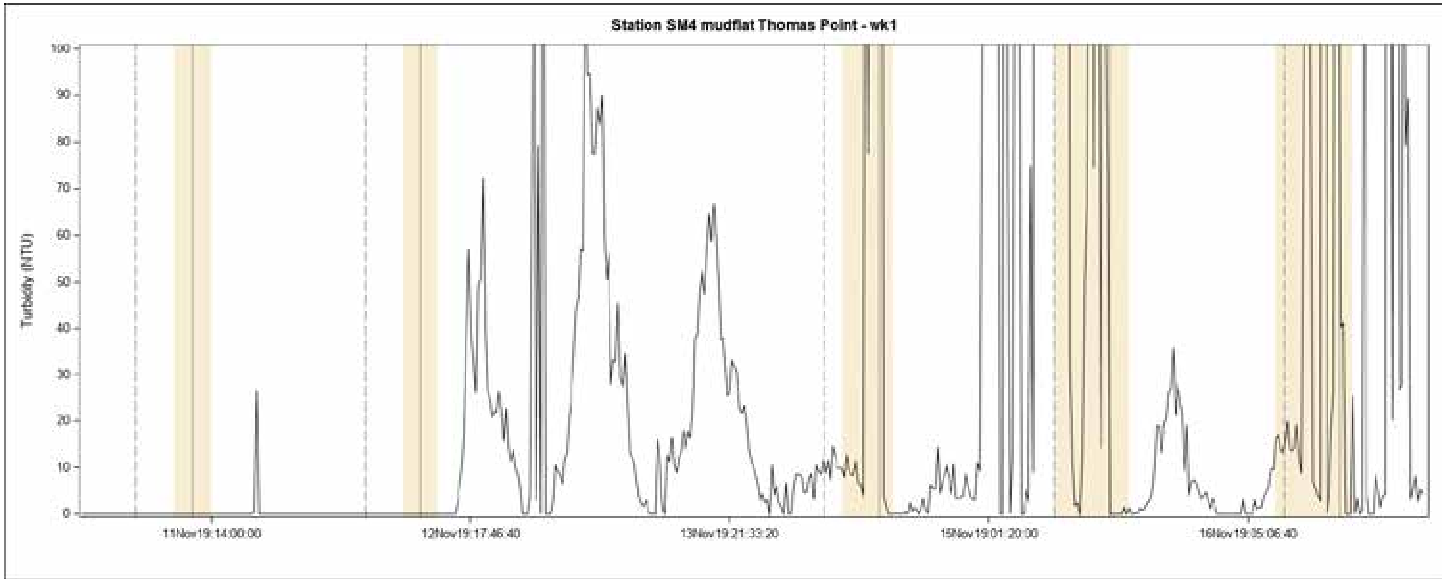




Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

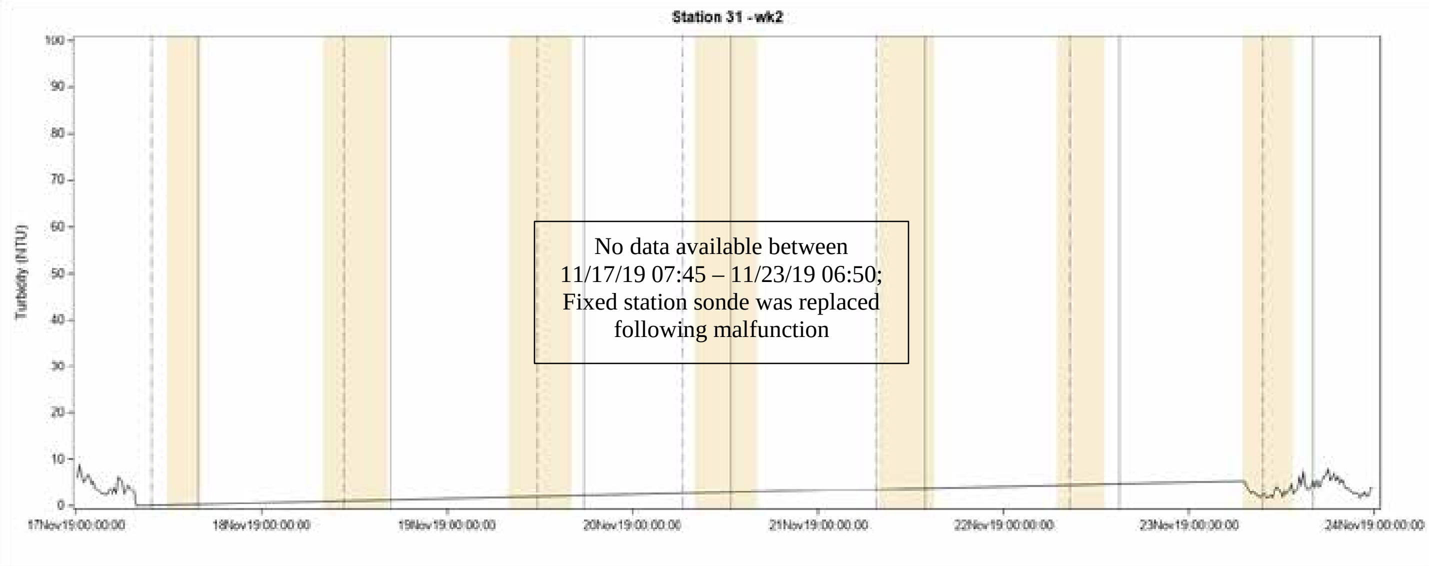


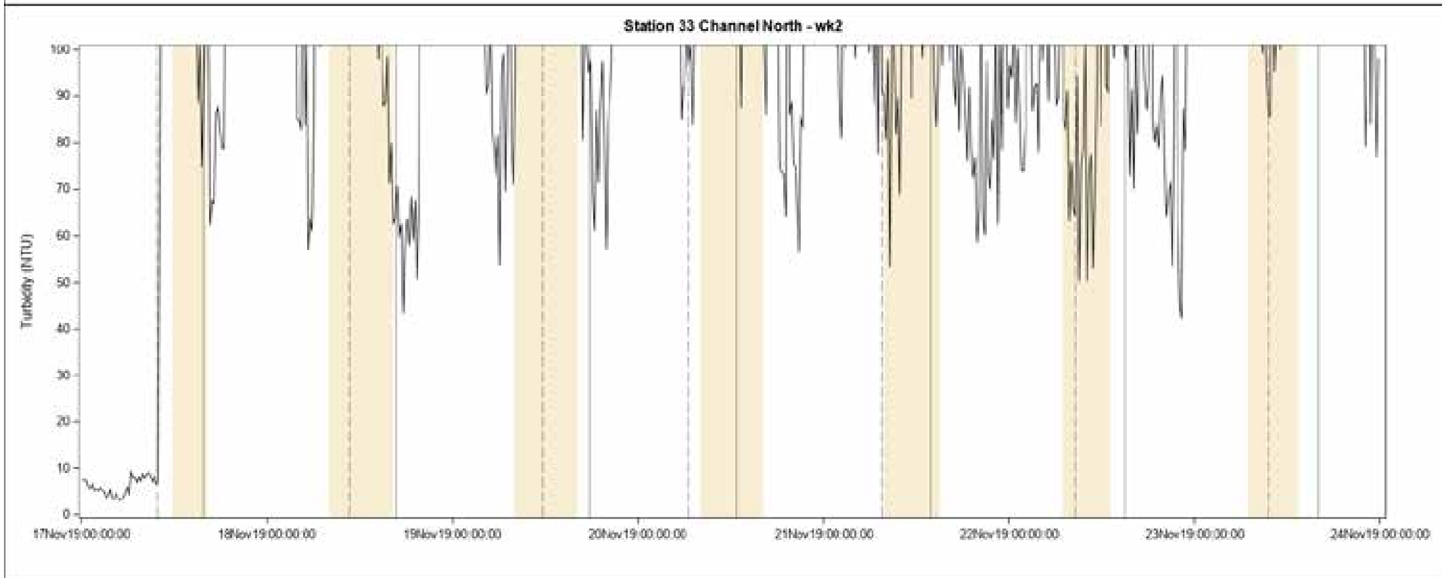
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



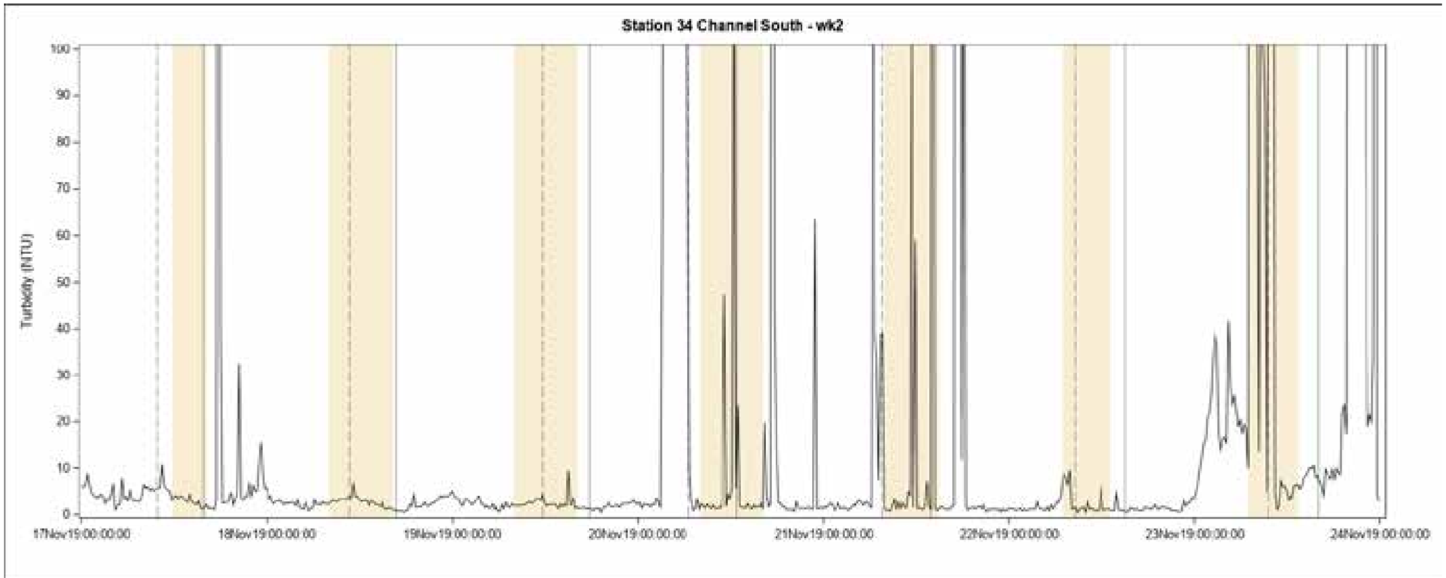
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

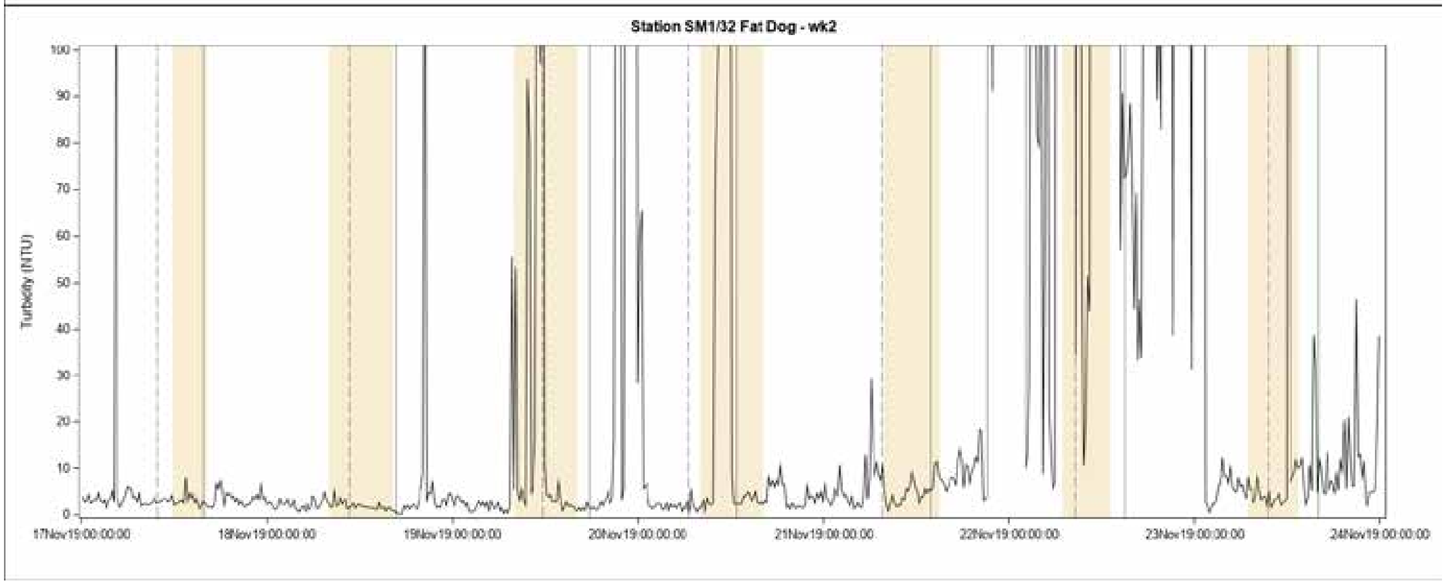
Hand Jet, Week 2



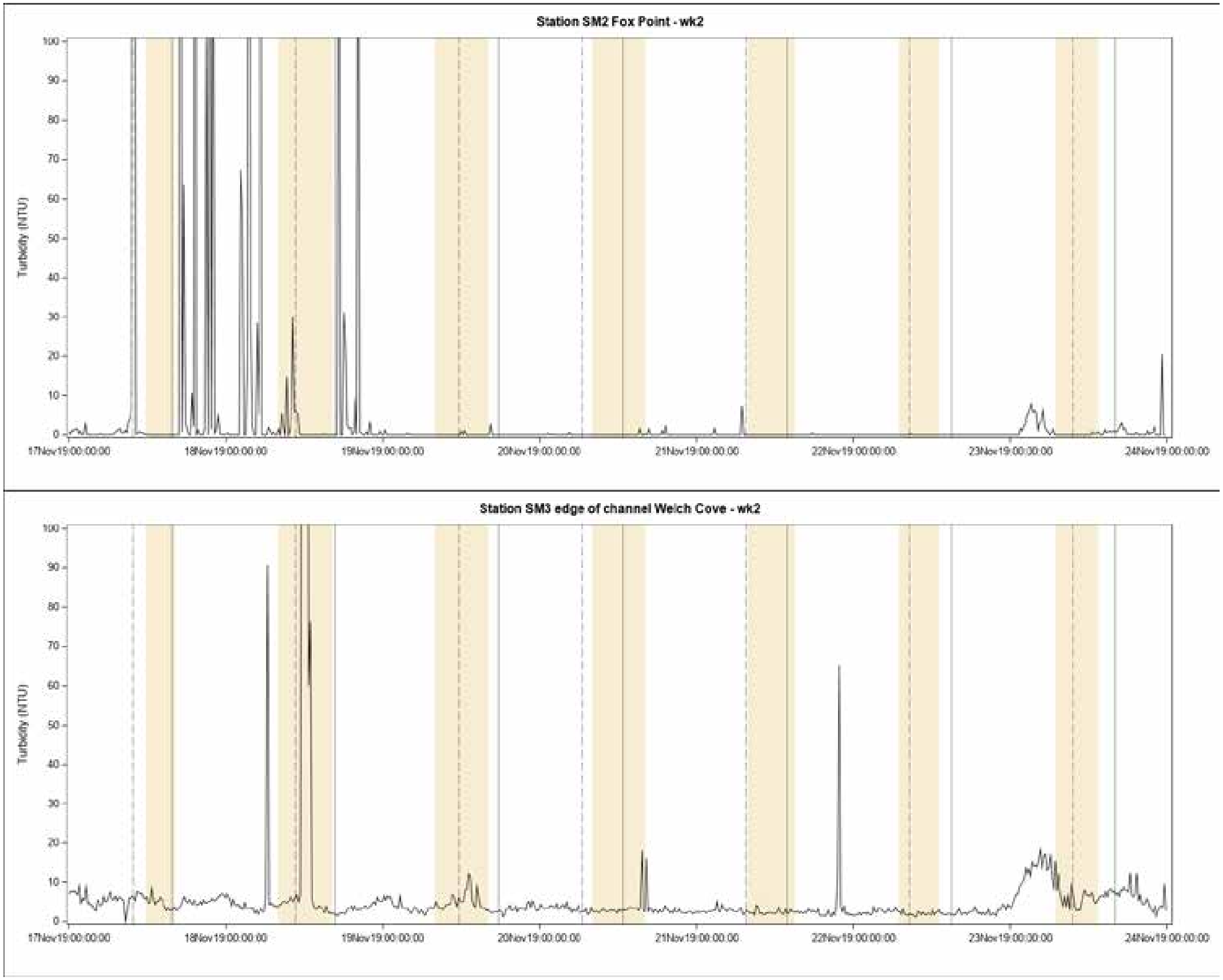


Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

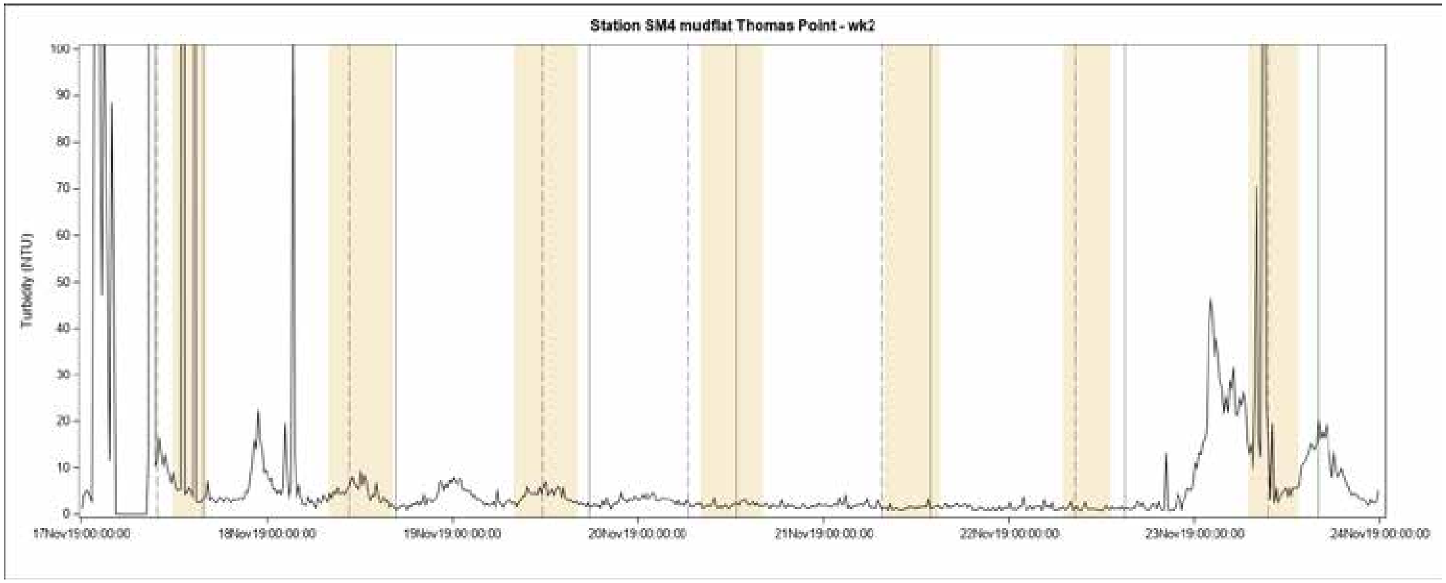




Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

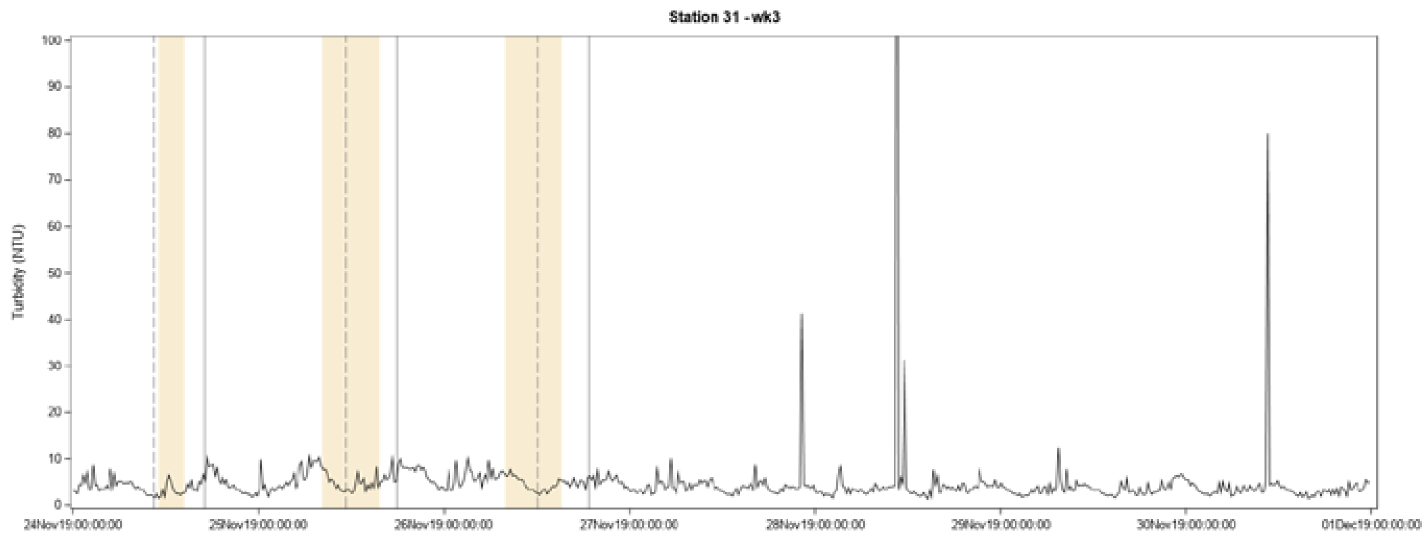


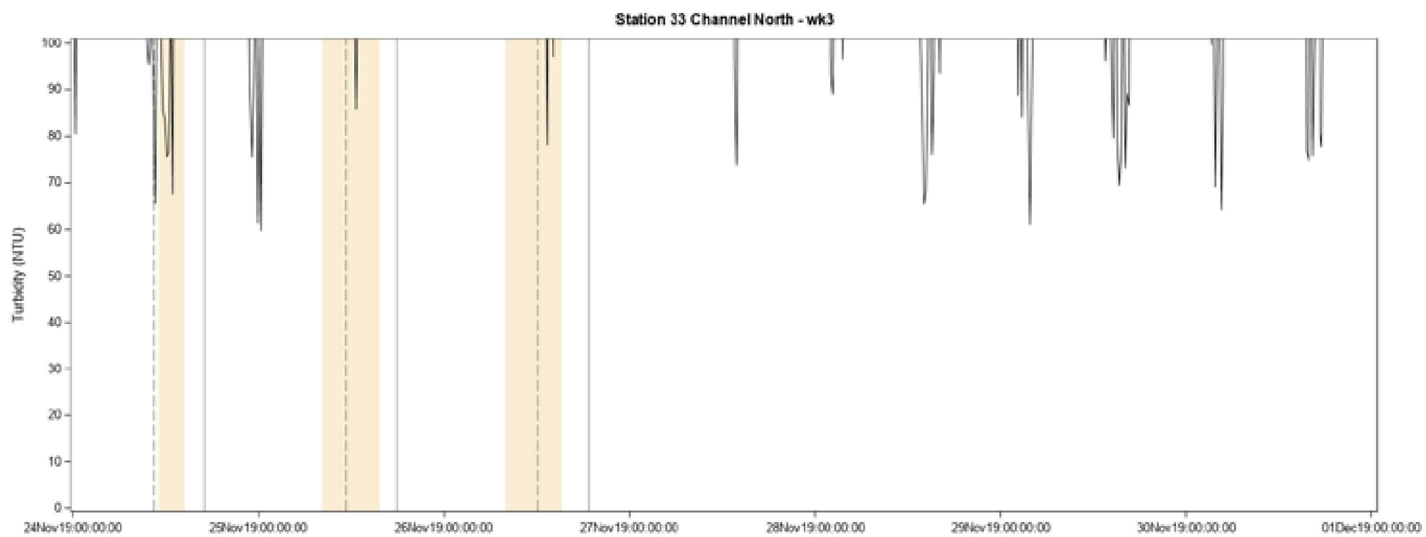
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



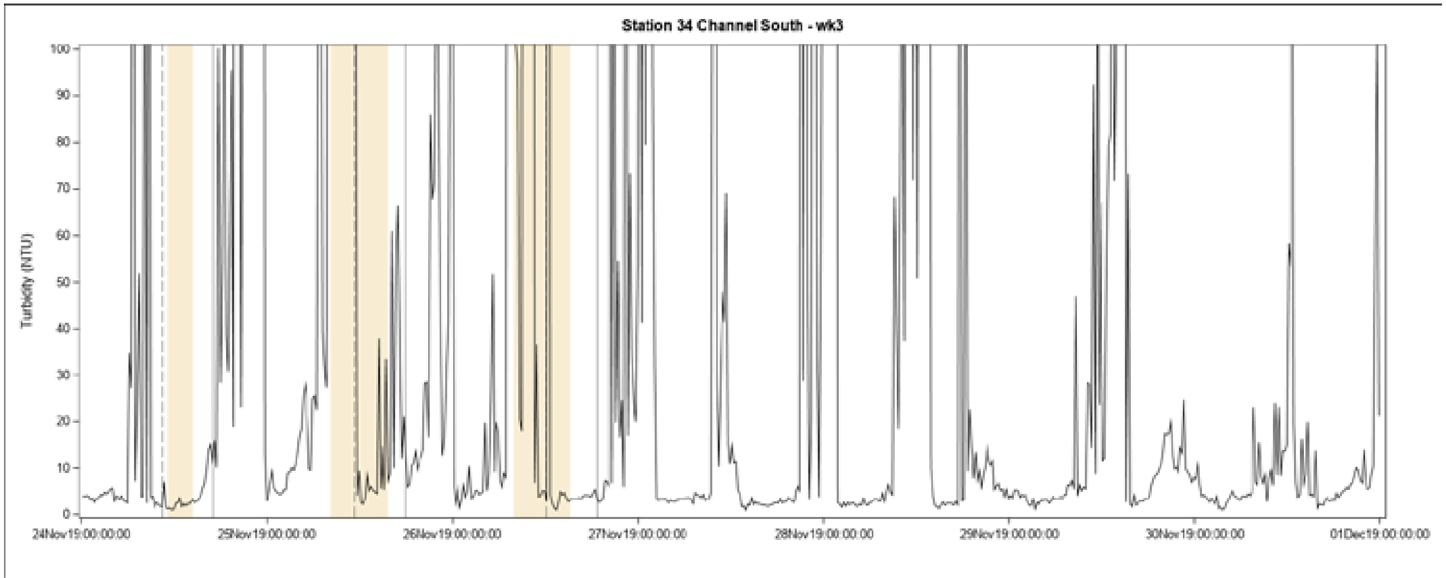
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

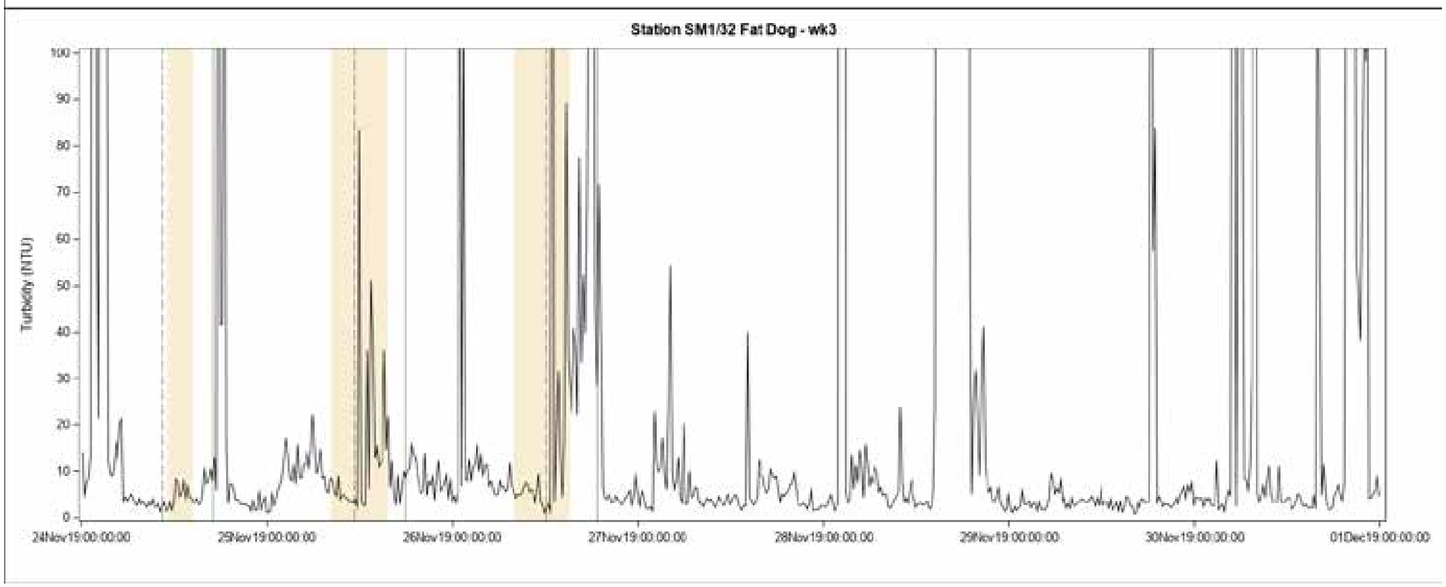
Hand Jet, Week 3



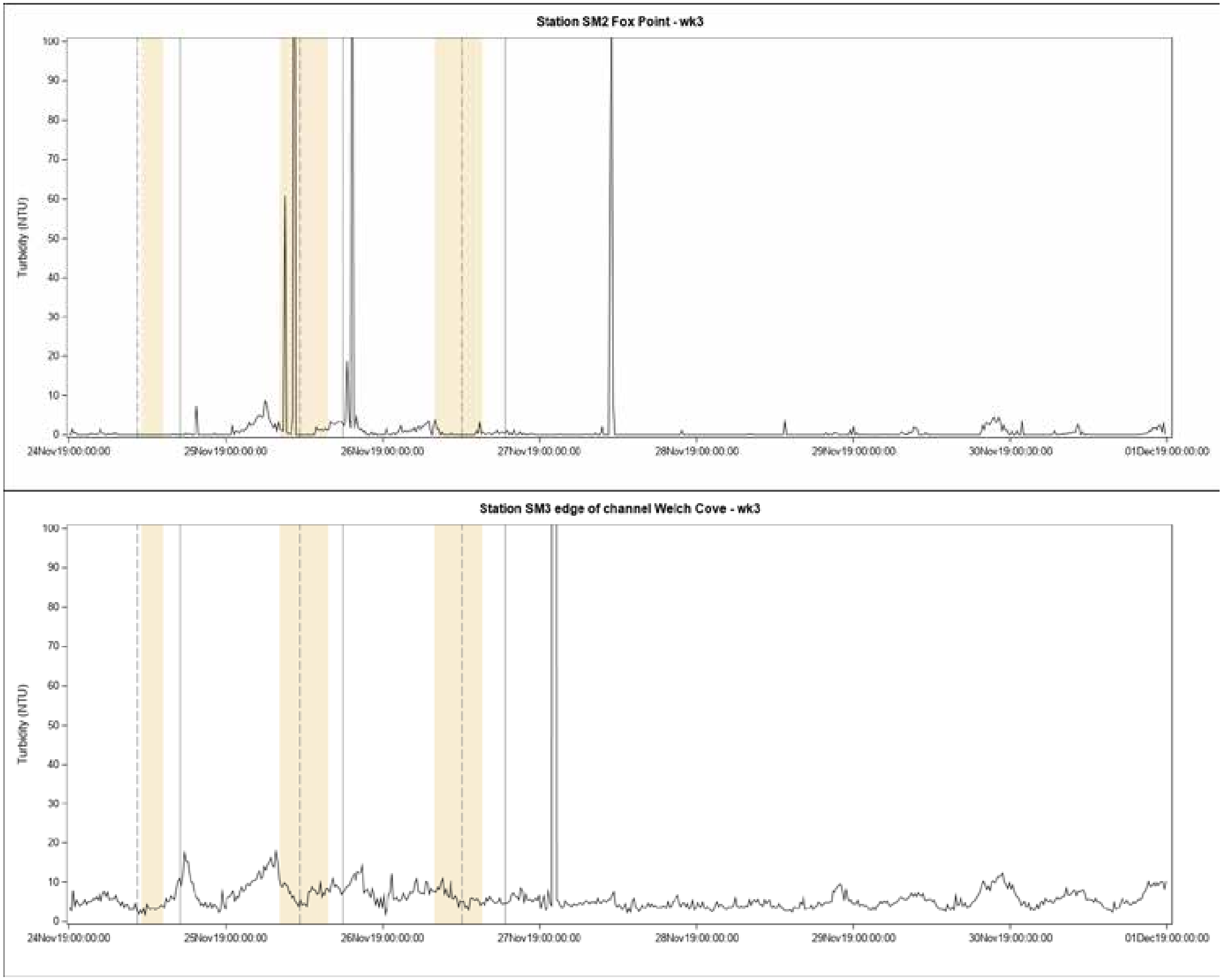


Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

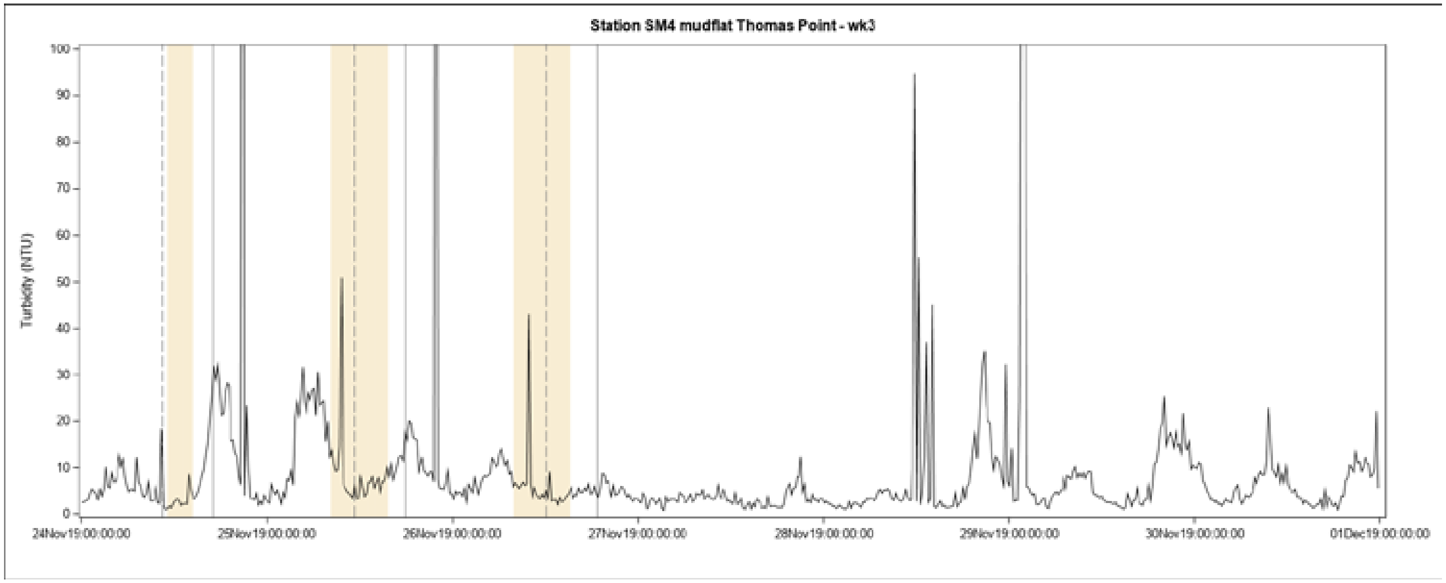




Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

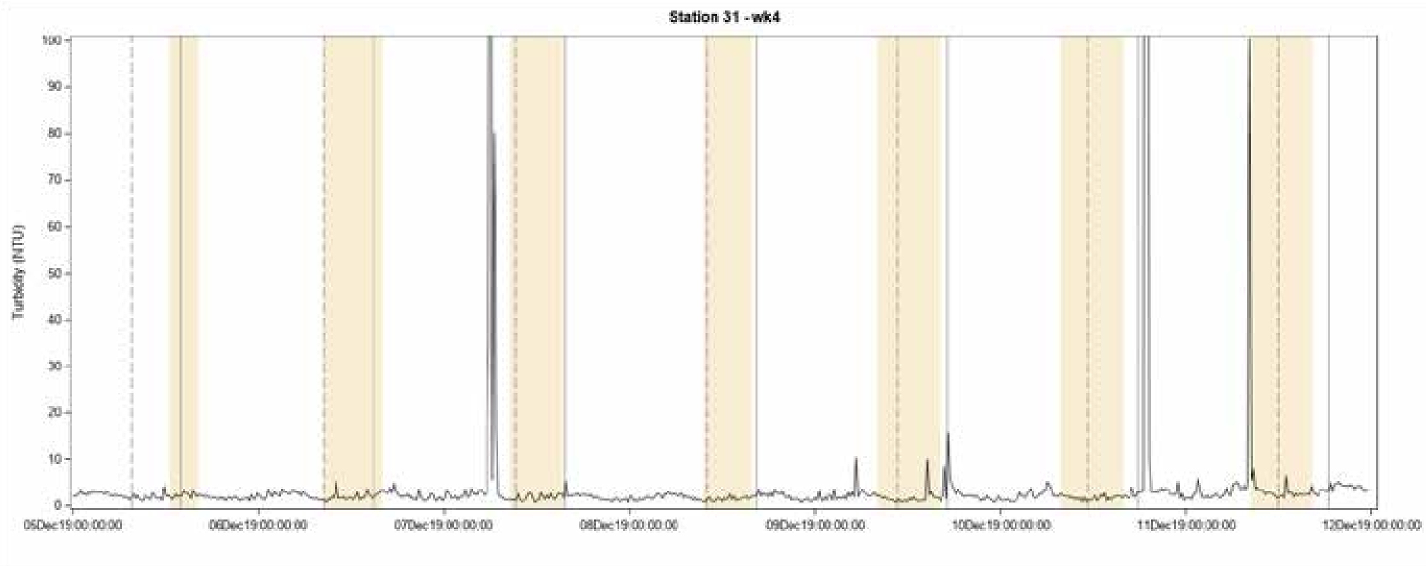


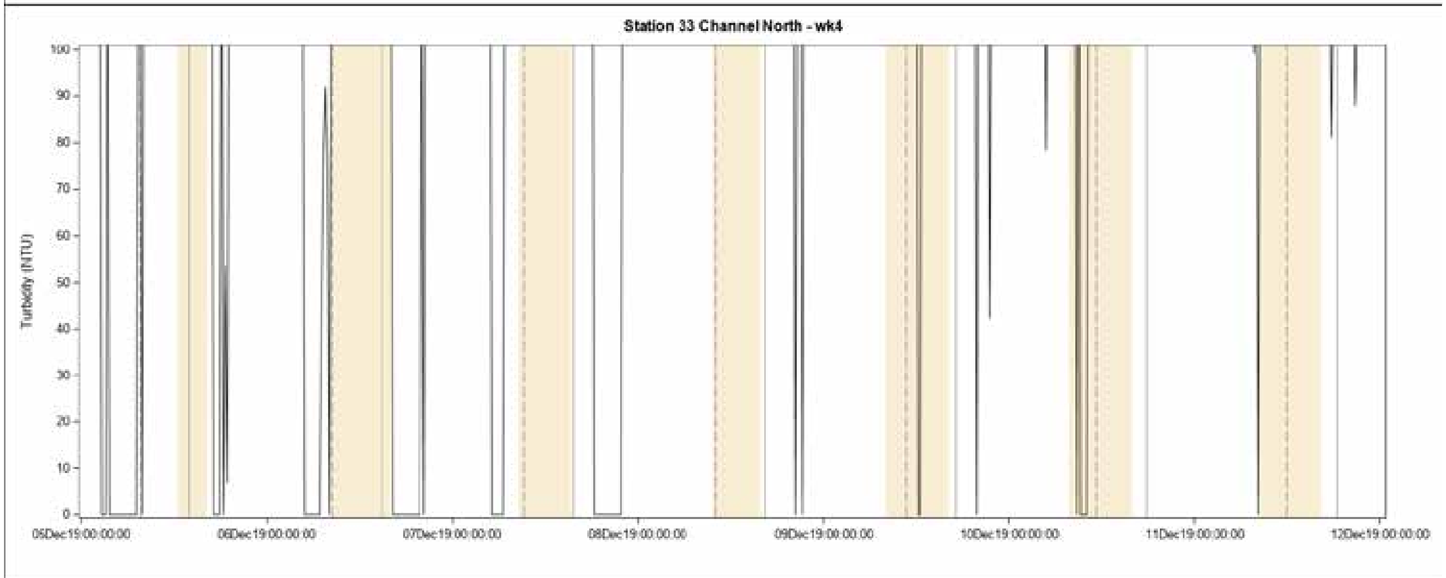
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



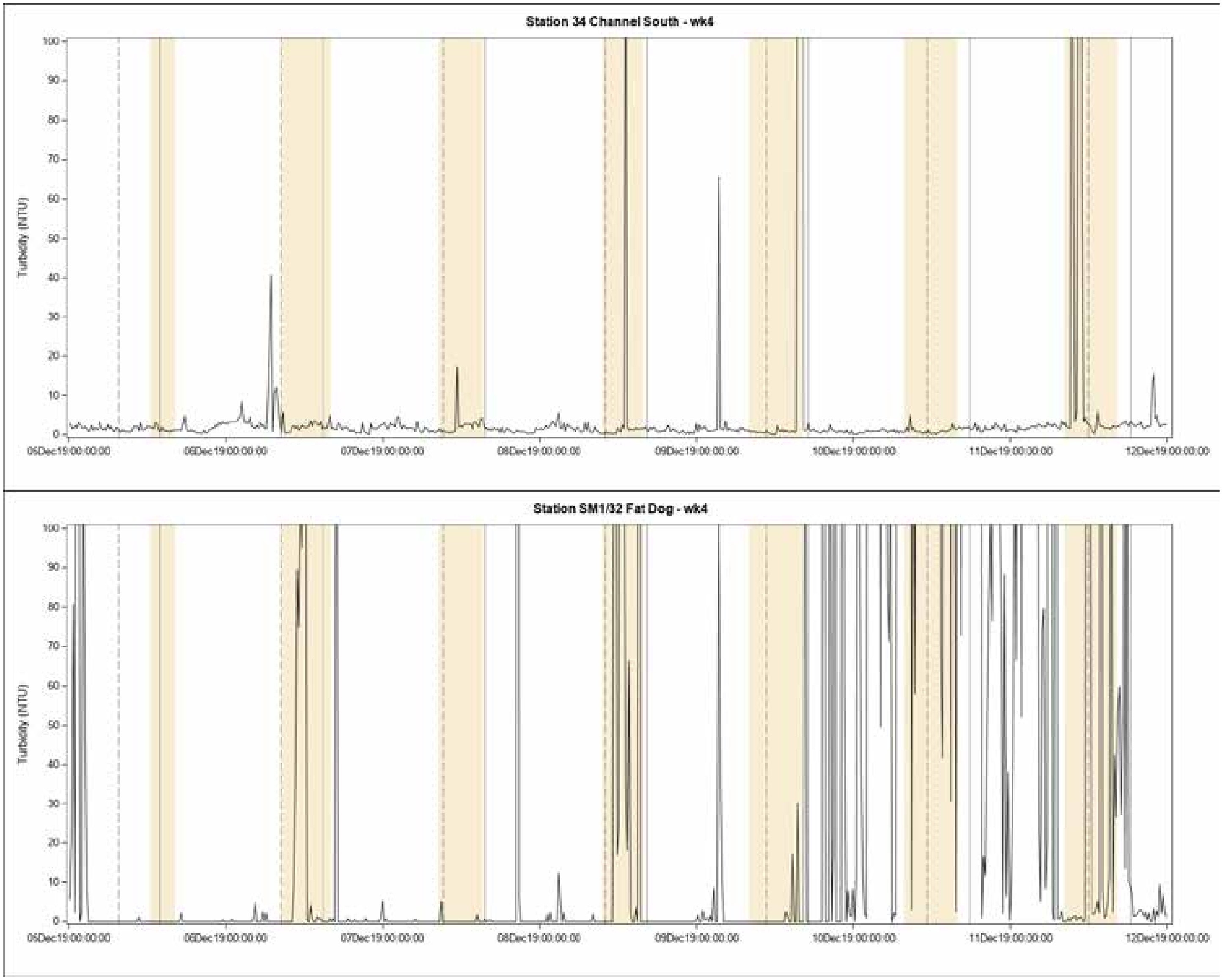
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

Hand Jet, Week 4

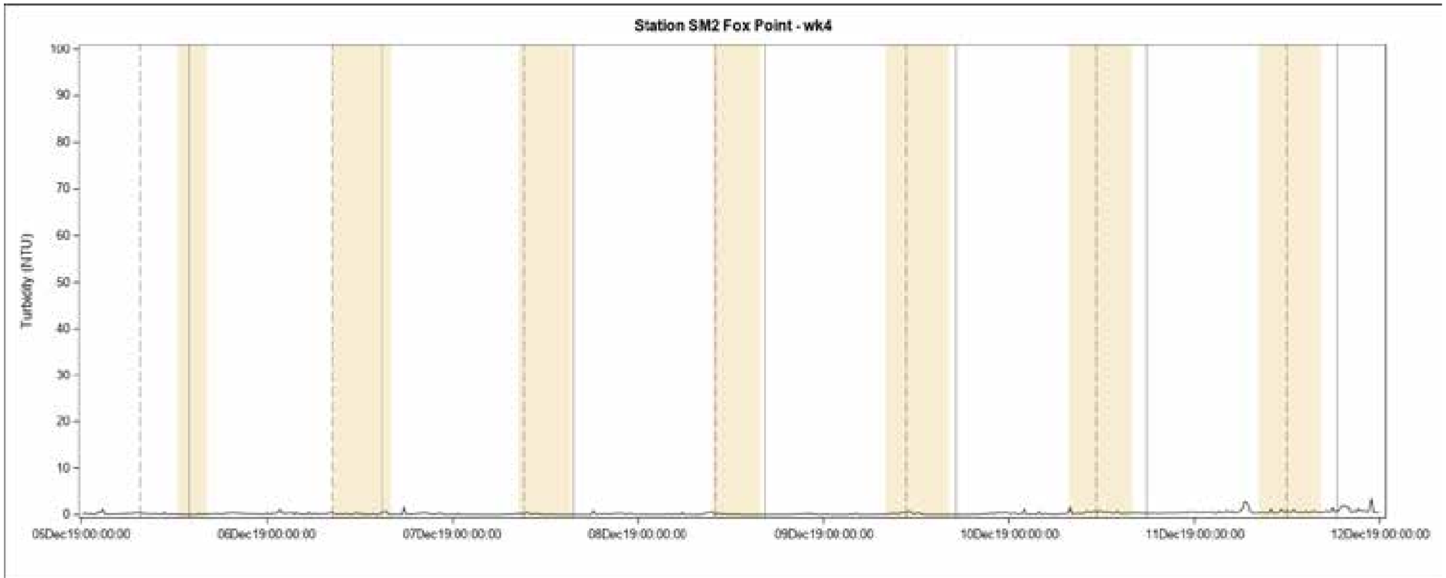


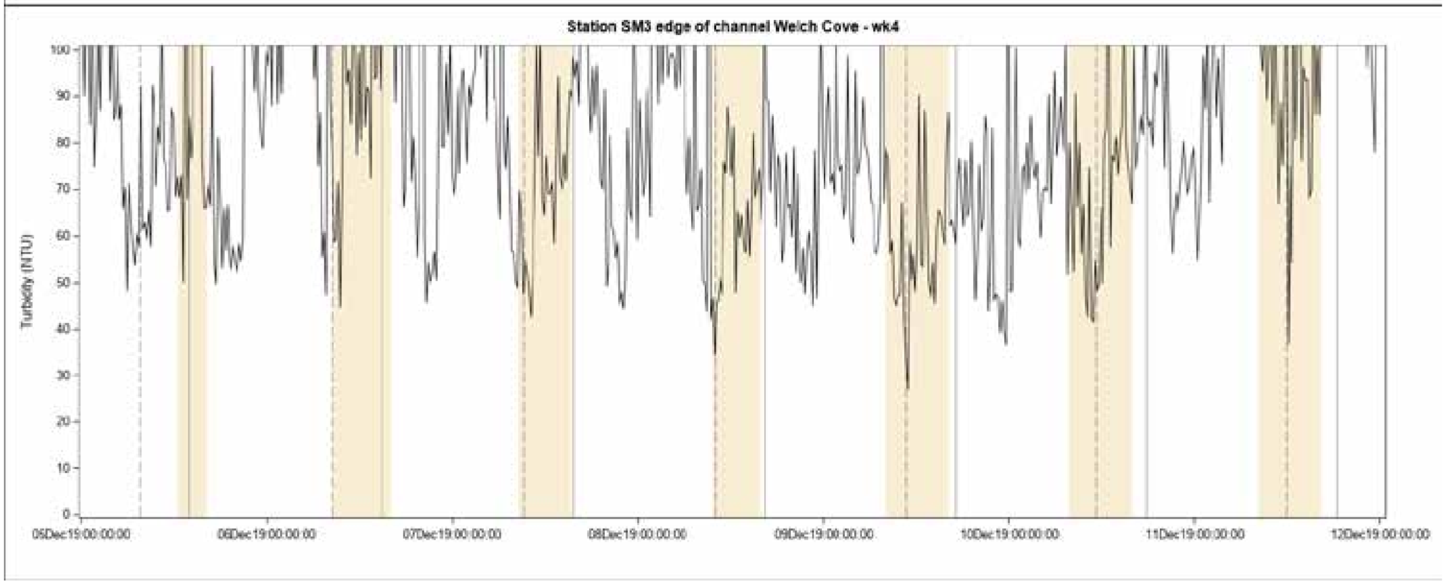


Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

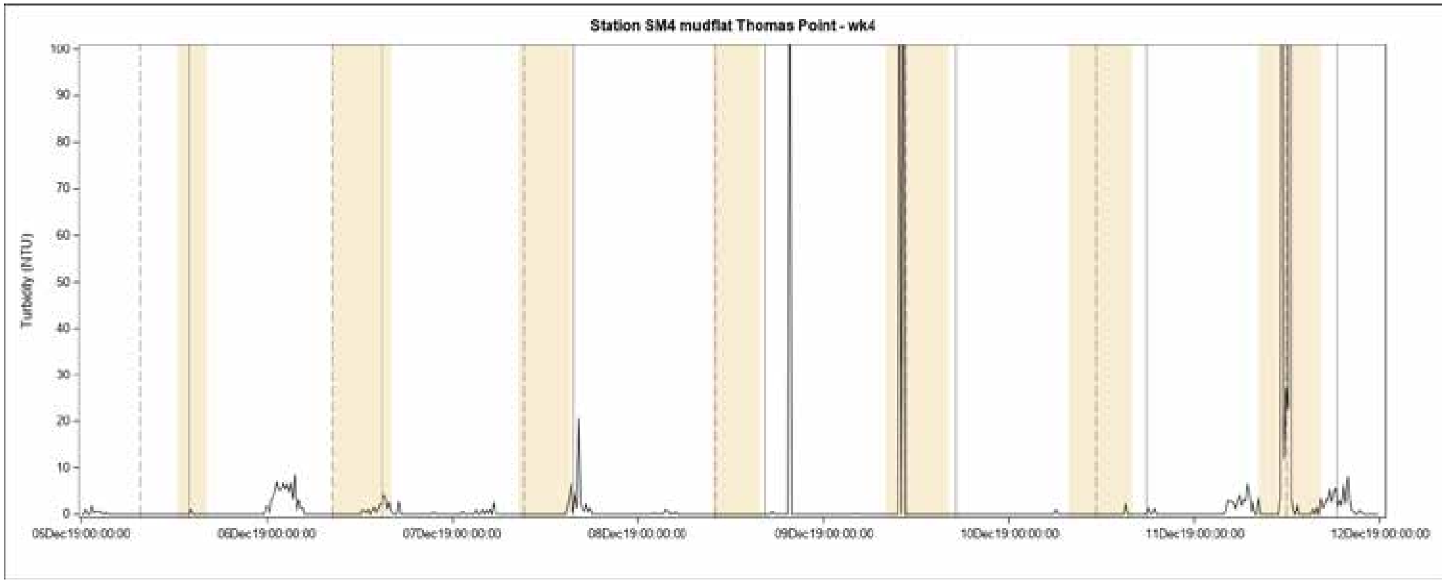


Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



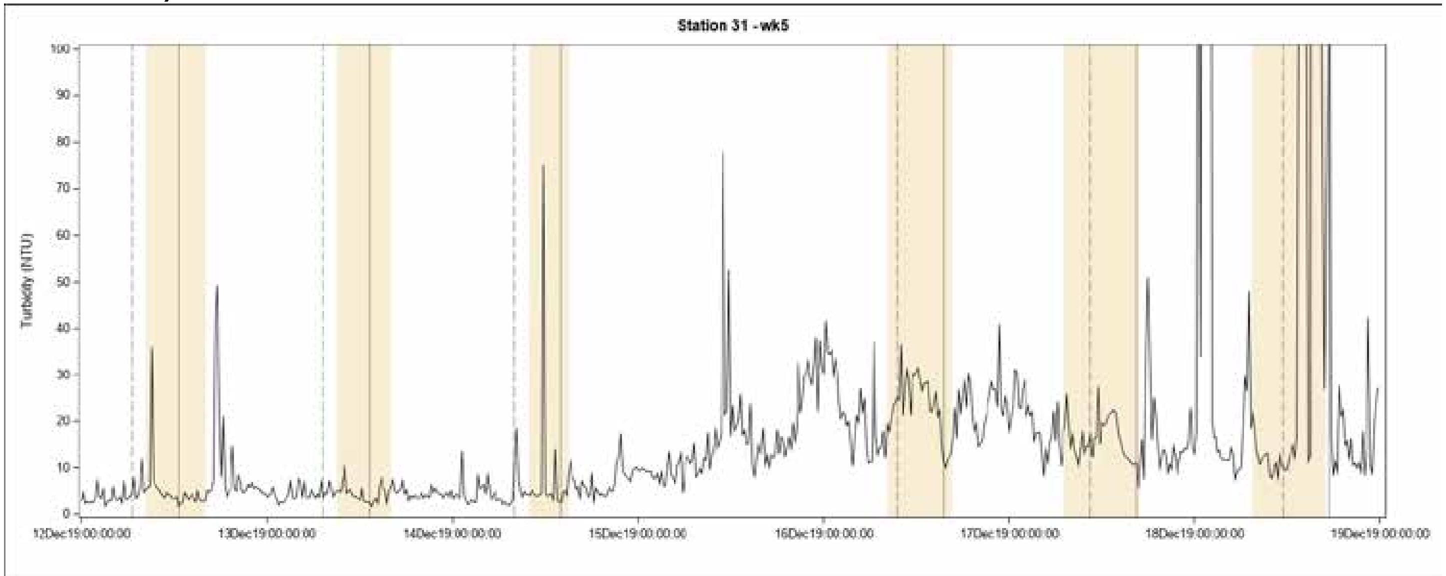


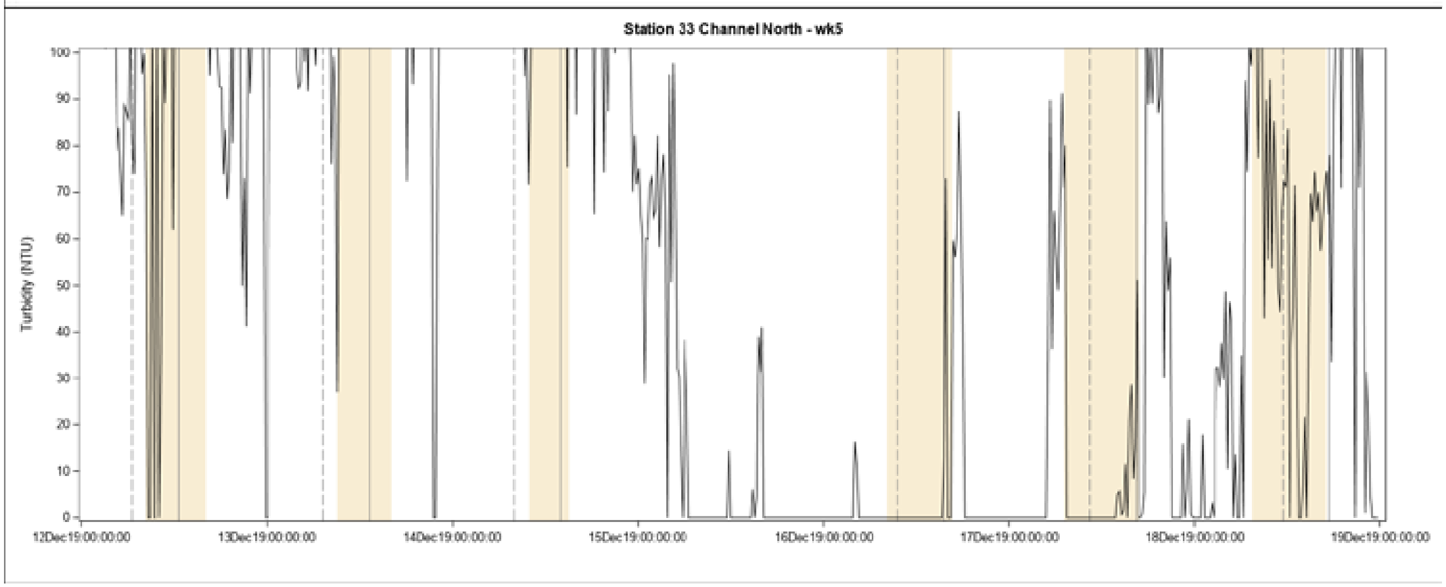
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



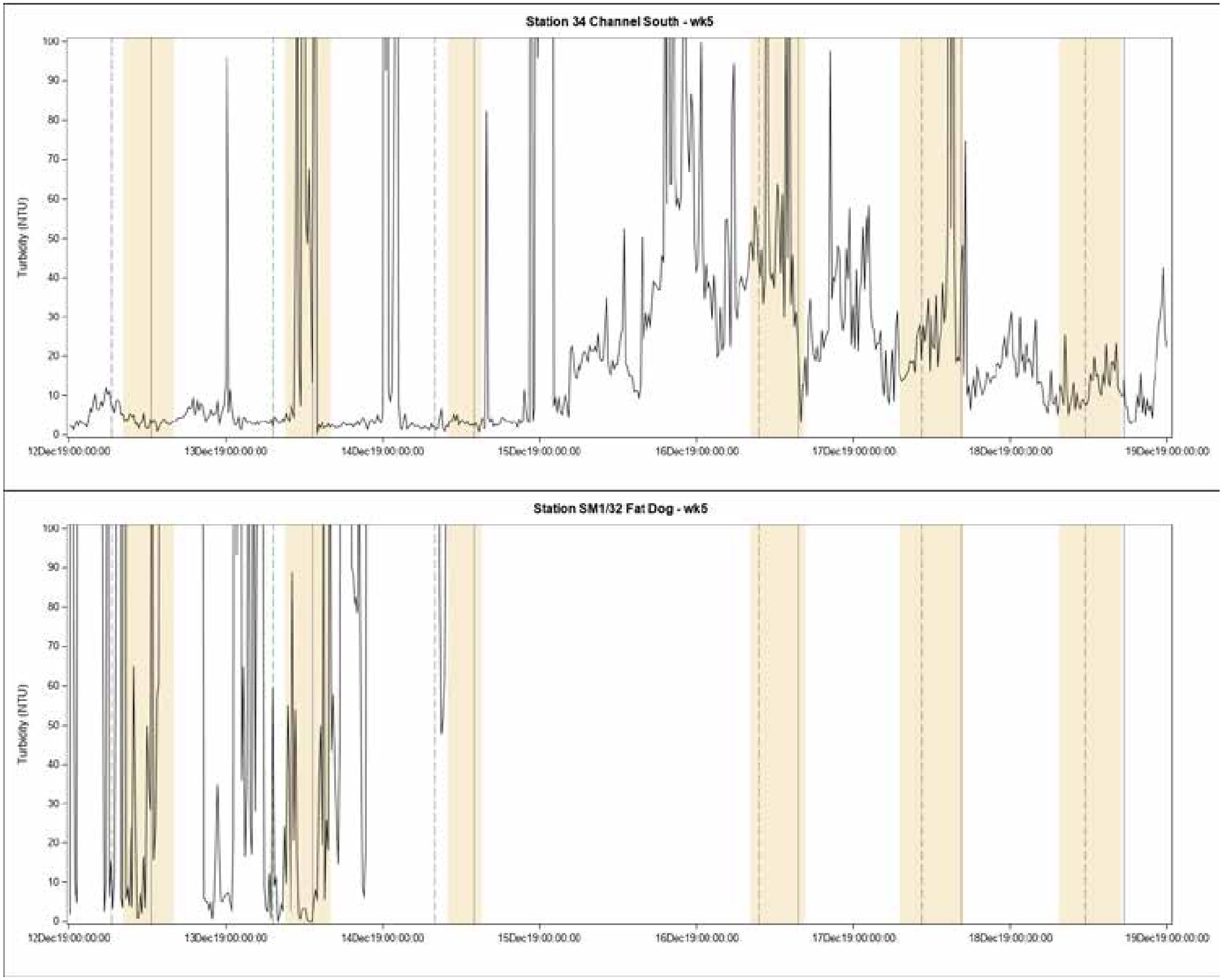
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.

Hand Jet, Week 5

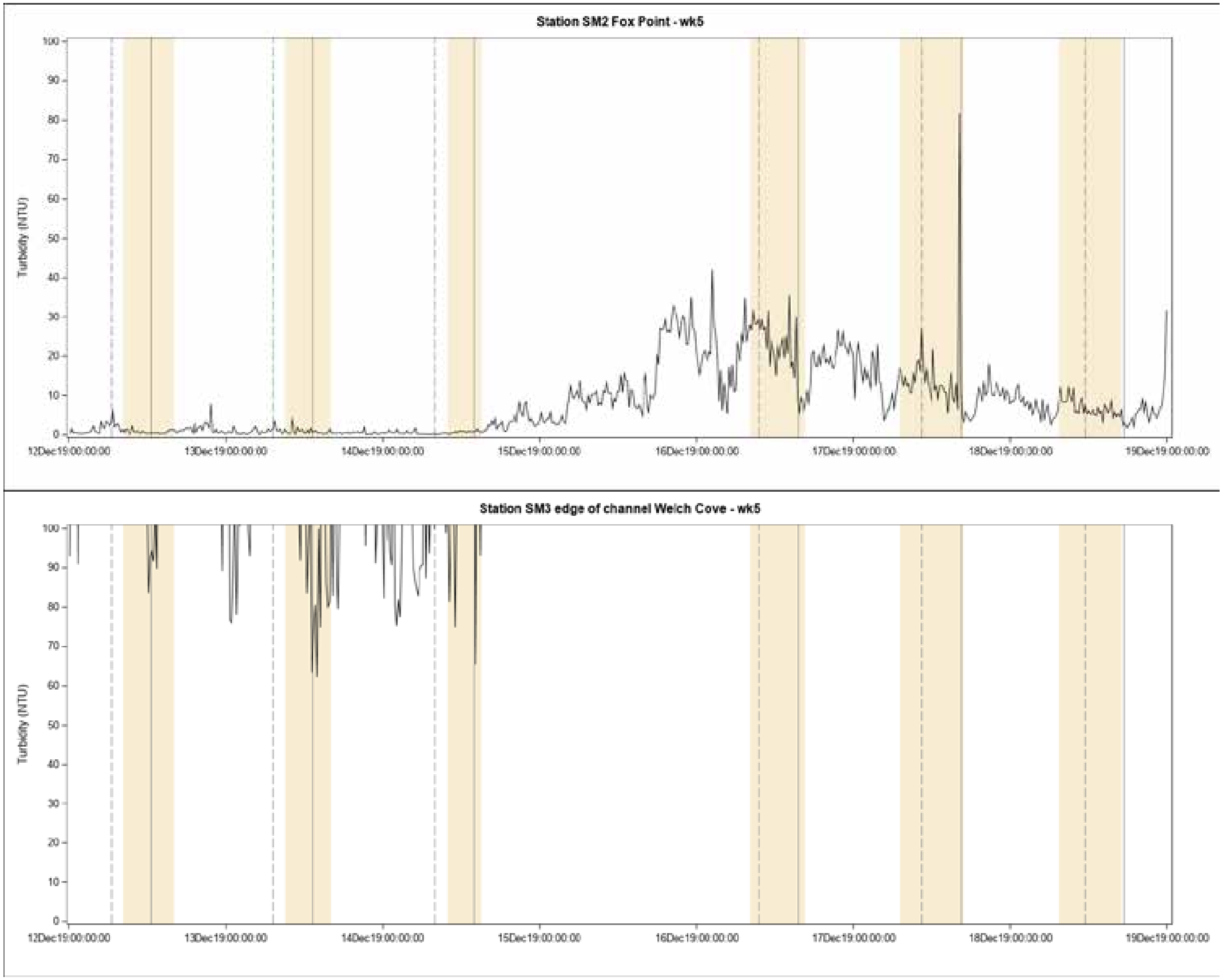




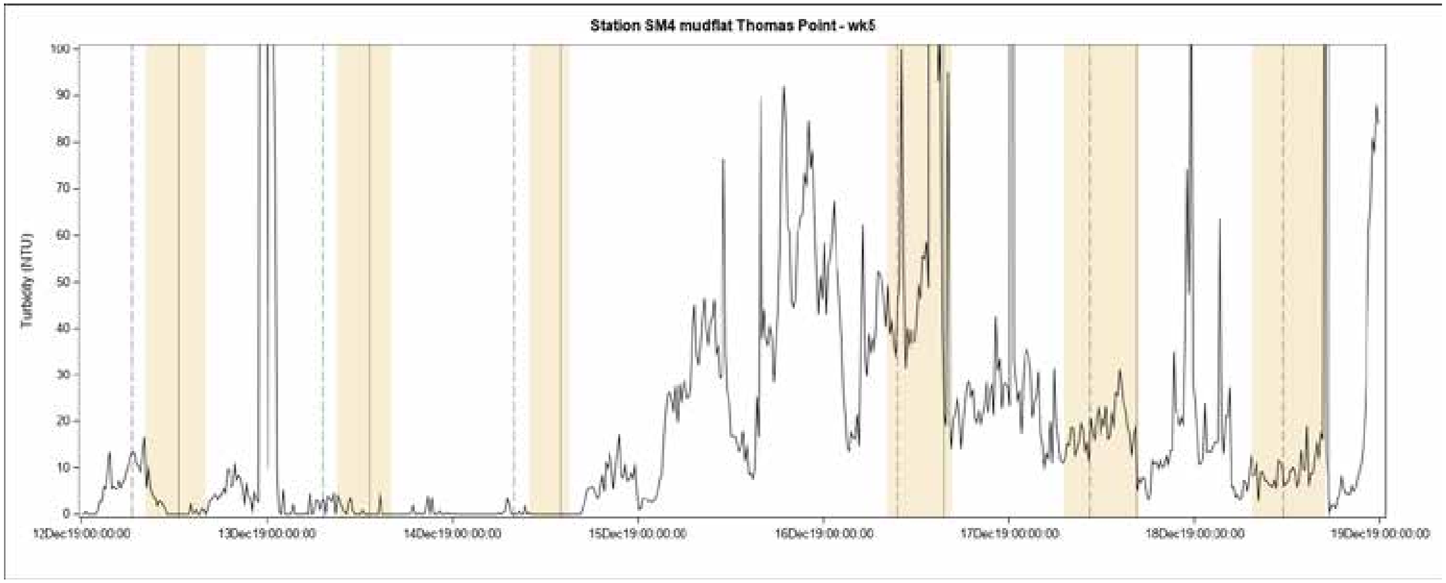
Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides.



Tan shading indicates active cable installation. Vertical lines indicate high and low slack tides