

Tufts Cove Ocean Alkalinity Enhancement Project Operations and Monitoring Report

Operational Period
January 1st 2024 - January 31st 2025

May 2025



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Summary

Table 1 - Project summary for the current operational period

Operational period	1 January 2024 - 31 January 2025
Project location	Nova Scotia Power Tufts Cove Generation Plant Halifax, Canada
Feedstock material	Magnesite calcination byproduct
Total tonnes feedstock dosed	1103.2
Equivalent hydroxide of feedstock [kg/t]	494.36
Projected net tonnes of CO₂ removal*	1020.5
Total in-pipe regulatory exceedances	0
Total ocean threshold exceedances	0

*Projected = at 10-year horizon, post-dosing

This report describes the operations and monitoring results from the second year of an Ocean Alkalinity Enhancement (OAE) field trial conducted by Planetary Technologies, as summarized in Table 1. The trial consisted of the controlled addition of an alkaline material into an existing ocean outfall, and the concomitant monitoring of the activities' impact on the chemistry in the outfall and receiving marine waters. Approximately 1100 tonnes of feedstock were dosed during the current operational period, which will result in approximately 1020 tonnes of net CO₂ removals.

The rate of alkalinity slurry addition, and the physical and chemical properties of the feedstock and slurry were closely monitored. Metallurgical testing revealed the equivalent hydroxide content of the feedstock to be 494.36 kg per tonne, on average, meaning a total of 547 tonnes of pure alkalinity equivalent was dosed into Halifax Harbour. After accounting for both the ocean CO₂ uptake efficiency and the embodied emissions incurred during the dosing period (avg. 140 kgCO₂e generated per tonne of feedstock dosed, quantified through Planetary's rigorous Life Cycle Assessment), a total of approximately 1020.5 tonnes of net CO₂ removal from the atmosphere is projected as a result of the dosing activities.

Prior to dosing, three types of ecotoxicity testing were conducted using the dry feedstock material: acute lethality testing, multitrophic effects testing and lobster larval effects testing. The acute lethality testing revealed an LC50 concentration of >10 g/L for threespine stickleback (*G. aculeatus*). The multitrophic effects testing, conducted on multiple species at different life stages, yielded no observable effects at concentrations of 2 g/L and below. These thresholds are over 10x greater than the maximum concentration of feedstock in the outfall during the operational period and over 100x higher than concentrations in the receiving ocean waters. The lobster larval testing assessed the effects of feedstock on Stage I larvae of the American lobster, revealing no effect at or below the maximum concentration tested (250 mg/L).

Chemical and environmental properties of the outfall were monitored continuously at locations up- and downstream of the alkalinity addition point to ensure regulatory compliance. pH and total suspended solids (TSS) perturbations remained within the regulated limits of 6.5-9, and <40 mg/L difference between up- and downstream sampling points, respectively. Bottle samples taken from the outfall monitoring sites



revealed that dosing led to measurable increases in pH and total alkalinity, but little-to-no detectable increase in trace metals.

Ocean properties in the receiving waters of Halifax Harbour and Bedford Basin were also monitored prior-to and during the project period. A sensor package installed on a shore-tethered mooring located ~10m from the outfall continuously recorded pH, turbidity, chlorophyll, temperature and salinity over the full duration of the operational period. Water column chemical and environmental properties (pH, turbidity, oxygen, temperature, salinity, TSS), water column trace metal content and sediment metal content were consistently measured on boat surveys of the harbour. The resulting data from these efforts revealed no negative impacts of OAE additions, with all measured properties remaining within historical ranges for Halifax Harbour and Bedford Basin, and/or below regulated thresholds.

Overall, the trial was deemed to have had no adverse effects on the marine chemistry of the receiving waters, and was not in breach of regulations set forth by Nova Scotia Environment and Climate Change, or the Canadian Council of Ministers of the Environment (CCME). A summary of the trial events and monitoring efforts is provided in Appendix 1.

1 Feedstock

The alkaline feedstock material used during the current operational period is a byproduct of magnesite calcination consisting primarily of magnesium oxide. The material was imported from Spain in approximately 1.2 metric tonne bulk bags. As described below, Planetary conducted significant testing on the material prior to, and during dosing activities.

1.1 Toxicity testing

The feedstock underwent three distinct phases of ecotoxicity testing: acute lethality testing, multitrophic effects testing and lobster larval effects testing.

The acute ecotoxicity study was conducted in April/May 2024 by Harris Industrial Testing Services (HITS), and sought to establish the LC50 of the feedstock for the threespine stickleback (*G. aculeatus*), the standard species used for testing in Canada. The LC50 endpoint was not achieved at any of the concentrations tested in the acute toxicity study, with the conclusion therefore established that the feedstock's LC50 to threespine stickleback falls above 10 g/L. Acute toxicity of a chemical that is greater than 100 mg/L generally results in a chemical classification of “practically non-toxic” within the Global Harmonised System (GHS).

The multitrophic effects testing was arranged in association with the Carbon to Sea Initiative and was conducted at accredited laboratories in France and Canada. Testing was conducted across six species, ranging from phytoplankton and copepods to fish (through both cultured cell lines and live whole organisms), as well as embryotoxicity testing on oysters and sea urchins. Organisms were exposed to a range of feedstock concentrations, up to a maximum of 68 - 250 g/L, depending on the species. Overall, a NOEC (No Observed Effect Concentration) of 2 g/L was established from the study, which was the NOEC recorded for whole fish, and which was the lowest NOEC value recorded for any of the six test species. However, this NOEC value was based on a single observation of individual mortality at 4 g/L, with 97% survival for other individuals at this treatment level. As such, it is not considered a statistically significant result. In contrast, the lowest statistically significant NOEC, across all organism types, was 4 g/L. Notwithstanding statistical robustness, the overall NOEC is taken as the highest concentration level at which no effects at all were observed and is therefore set at 2 g/L, which is in line with the precautionary principle and follows a maximally conservative approach. The results and data from this study are available in a public repository (Faucher and Kapsenberg, 2025¹) and are pending publication in an academic journal.

The lobster larval testing assessed the effects of the feedstock at up to 250 mg/L on Stage I larvae of the American lobster (*Homarus americanus*), and was carried out by the Huntsman Marine Science Centre (HMSC). The endpoints measured were larval survival, molting success and growth. The results did not show any significant reduction in survival or growth following exposure to the feedstock. There was also no evidence of reduced larval survival as feedstock concentration increased up to the maximum tested (250 mg/L). However, there were higher than expected levels of mortality and an absence of larval molting across all treatments in the study, including control treatments with no feedstock exposure. As such, these results are currently considered preliminary and further testing is planned for the summer of 2025.

¹ Faucher, G., and Kapsenberg, L. (2025): Assessing the effects and risks of ocean alkalinity enhancement on marine organisms through ecotoxicology tests [dataset]. PANGAEA, <https://doi.pangaea.de/10.1594/PANGAEA.977802>



The full reports provided by HITS and HMSC are provided as a supplement to this report. The results of the multitrophic effects testing are awaiting publication in an academic journal, whereupon they can be shared.

1.2 Dissolution

In the ocean, rapid dissolution of the feedstock is essential to avoid high levels of total suspended solids and/or accumulation of feedstock on the seabed, both of which may pose ecosystem concerns and result in inefficiencies in carbon removal. Accordingly, a series of laboratory experiments were conducted prior to the start of dosing. Experiments involved tracking the dissolution of varying feedstock concentrations in fixed seawater volumes over one hour. These experiments yielded dissolution rates on the order of 1×10^{-5} mol/m²/s. These measured rates are approximately 10x lower than prior published values for MgO dissolution (Mejias et al., 1999), possibly due to rapid saturation of seawater in our closed-system experiments, and thus may underestimate dissolution rates in the real ocean environment. Nevertheless, this rate corresponds to >95% of the feedstock dissolving in less than 24 hours, providing a high-degree of confidence that dissolution in Halifax Harbour would occur rapidly. Further details regarding pre-dosing dissolution experiments can be found in the Project Design Document (PDD) available on [Planetary's project page](#) on the Isometric credit registry.

Throughout the dosing period, regular sampling in Halifax Harbour further confirmed rapid dissolution. Briefly, levels of total suspended solids in both surface and bottom waters were consistently near background levels within 50 meters of the outfall, and coupled filtered/unfiltered total alkalinity samples taken throughout Halifax Harbour revealed no undissolved feedstock beyond the immediate vicinity of the outfall. Additional details are provided in section 3.

1.3 Ongoing testing for CDR efficacy and feedstock impurities

Planetary conducted regular feedstock sampling to quantify the CDR potential and impurities of the feedstock. Throughout the dosing period, each bulk bag that arrived on site was opened, visually inspected, and sampled. Samples were organized by 'lot numbers' received from the supplier; a composite sample for each lot was sent to an independent laboratory for third party analyses.

The capacity (or efficacy) of a feedstock to achieve carbon removal is quantified by its equivalent hydroxide content (EQOH). Planetary derived this value by applying an equation from the [Isometric OAE Protocol](#) to the metals scan and moisture content data from the third party analyses. The equation was revised slightly to account for the fact that carbonates present in the feedstock do not readily dissolve in seawater. Sampling and analyses were not conducted on lots where fewer than 10 tonnes of material were dosed. The average of all other EQOH values was applied to these samples, and to bulk bags that were received without an identifying lot number. The resulting EQOH values were weighted according to the total mass of material dosed under each lot, yielding a value of 494.36 kg/tonne. This value was then applied to the total mass of feedstock dosed (1103.2 t) to calculate the total mass of hydroxide dosed: 547 tonnes.

The relative safety of feedstock to the marine environment was assessed by testing the levels of various impurities. Following best practices for OAE research and specific recommendations from a local specialist environmental consultancy, Dillon Consulting Ltd, we conducted major and trace metals

analysis for 36 elements, with an increased focus on metals regulated under federal and provincial Canadian Water Quality Guidelines (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, vanadium and zinc). The average elemental concentration in the feedstock was determined for each lot. Results from these analyses revealed detectable levels of 33 metals parameters; however, the average concentrations of all metal parameters in the Tufts Cove outfall discharge stream (calculated based on the measured outfall effluent flow rate at Tufts Cove; avg. ~190,000 L/min) and receiving waters (calculated at 60 m from the outfall, based on a highly conservative dilution factor of approximately 10, and preliminary results from dye release studies at Tufts Cove) were below the respective Nova Scotia Environment Tier 1 or CCME surface water EQS thresholds at the maximum alkalinity addition rate. Effluent and ocean sampling for trace metal content (see section 3, below) confirmed these results.

A summary of the EQOH and impurities results are included in Appendix 2.



2 Dosing and Site Operations

Planetary's second year of field operations at the Nova Scotia Power (NSP) Tufts Cove Generation Plant commenced in July, 2024 (Fig. 2.1). Three main phases occurred:

1. Site setup, testing and optimization (July-October),
2. Operations ramping (November),
3. Continuous operations (December-January)

Additional preparations took place prior to the site being set up in July. Appendix Table A1 provides a timeline of all site activities over this period.

During the first phase, equipment was installed, and feedstock was dosed slowly and periodically to carefully assess the impacts of alkalinity additions on outfall and ocean chemistry (details below) and determine the optimal slurry concentration and handling procedures.

The ramping phase comprised increases in both the rate and daily dosing duration, enabling us to test the chemical and environmental impacts of increased dosing gradually, and the operational capacity of the dosing system.

The final phase comprised 24/7 dosing operations in December and January. Dosing occurred at the maximum system capacity (approx. 120 L/min), unless regulated thresholds for pH and TSS in the outfall were neared; in such cases, the dose rate was lowered to ensure that the thresholds were not exceeded. A two-week break occurred between late-December and early-January.

During dosing operations, a high-solids content alkaline slurry was produced on-site and subsequently dosed into the receiving waters of Halifax Harbour and Bedford Basin, via an existing ocean outfall at the power plant (Fig. 2.1). The slurry was produced in a tank by mixing ambient seawater from the outfall with dry material imported to site in approximately 1.2 metric tonne bulk bags. One bag was loaded per batch of slurry produced. The targeted slurry weight-by-weight concentration and density were approximately 25-28 % and 1.23-1.28 kg/L, respectively, with batch-to-batch variability due to variability in the mass of each bulk bag. The slurry was then dosed to the outfall via a peristaltic metering pump, controlled by Planetary's dosing system. Process data, including tank volume and volumetric slurry dose rate, were recorded continuously. Volumetric dosing rates (L/min) were calculated from changes in tank level over time, and gravimetric addition rates (kg/min) were calculated as the duration of time it took to drain a tank of slurry.

Figure 2.2 and Table 2.1 summarize the dosing activities and statistics for the current operational period.

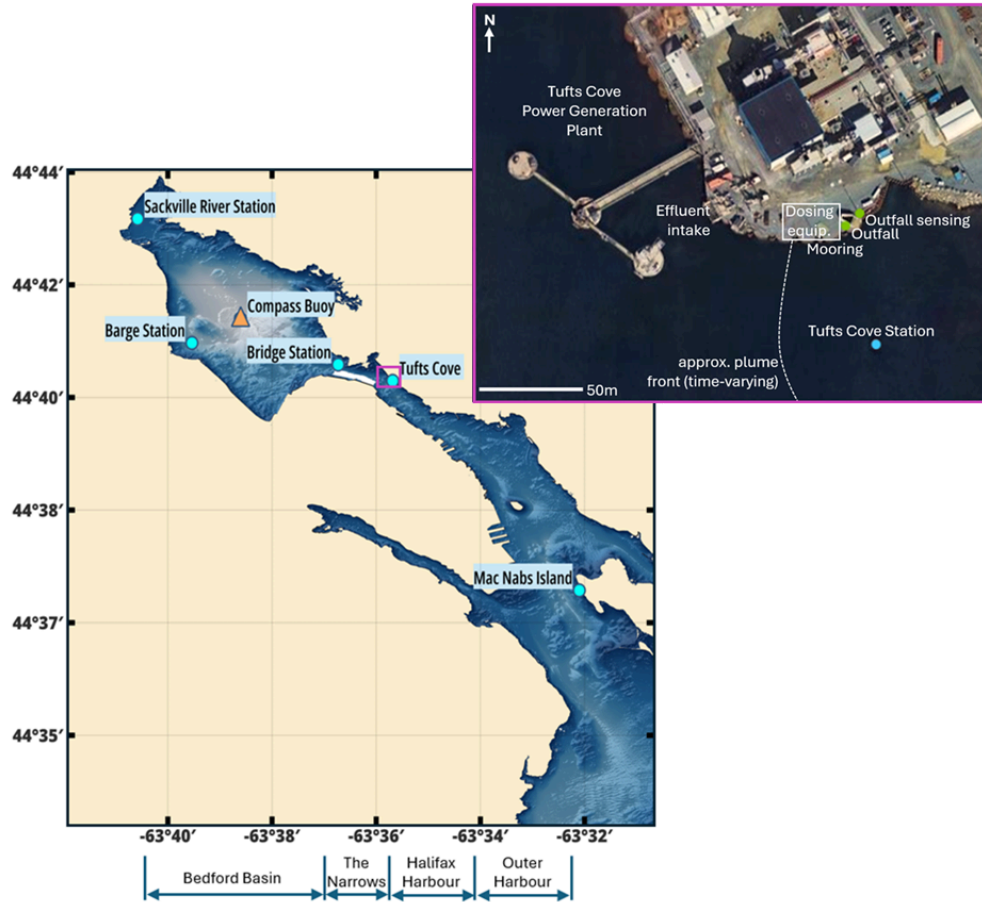


Figure 2.1 - Map of Bedford Basin and Halifax Harbour sampling stations.

All of Planetary's on-site dosing equipment (tank, pumps) were staged within a spill containment berm (~42 m³), located adjacent to the ocean outfall. Dry alkalinity feedstock was stored on-site in a dry, ventilated shelter. As described above (Section 1), samples were obtained from each bulk bag of material prior to dosing, in order to quantify the material's equivalent hydroxide and impurities content. Additional samples were obtained from the slurry tank to verify the approximate concentration and density of the slurry (measured densities ranging from 1.18-1.32 kg/L).

The impact of alkalinity additions on chemistry in the outfall and ocean was monitored using sensor packages installed up- and downstream of the alkalinity dosing point, and via routine ocean sampling (details in section 3).

Throughout the trial period, approximately 1113 tonnes of dry material was imported to the Tufts Cove site. Bulk bags of material were weighed by a calibrated scale at the intermediary warehouse in Dartmouth, NS before being transported to Tufts Cove. Approximately 10 tonnes was discarded as waste due to packaging defects, equipment failures requiring material to be pumped out, regular maintenance and minor spills.

A summary of feedstock dosing and waste is included in Appendix 3.

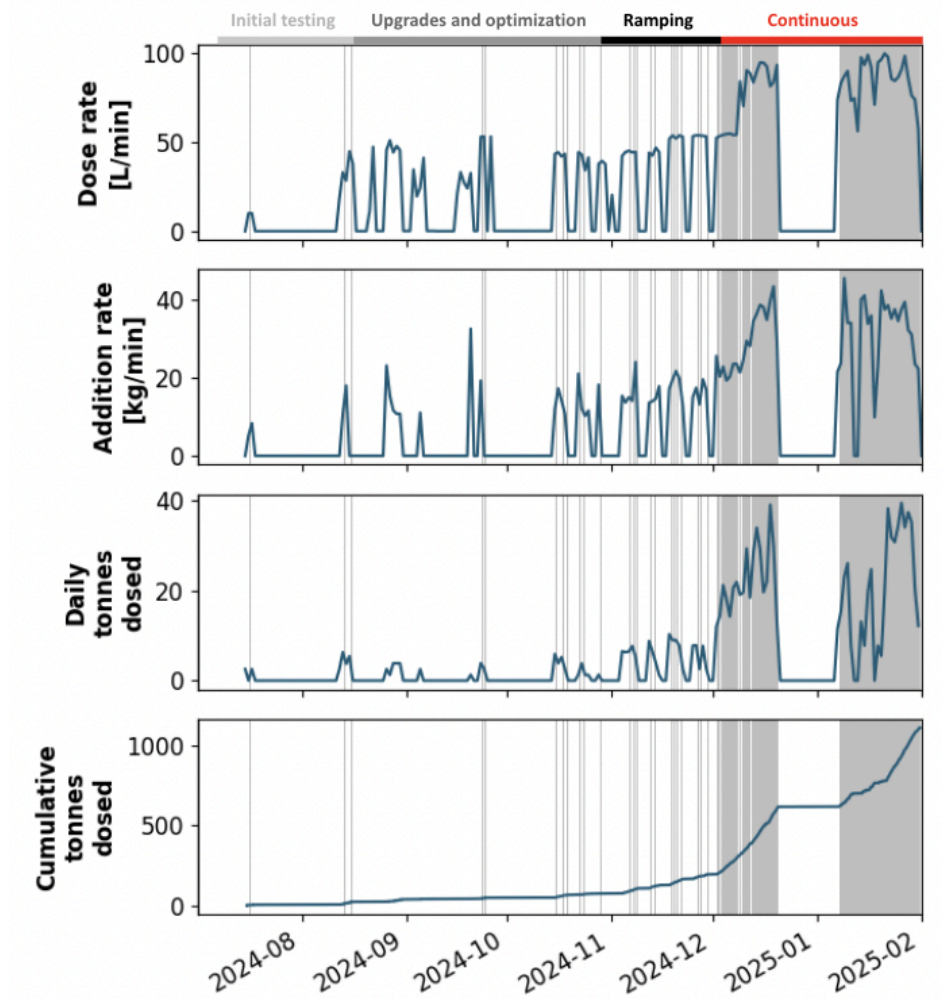


Figure 2.2 - Dosing time-series

Table 2.1 - Dosing summary statistics

Total tonnes feedstock imported	1113.4
Tonnes of feedstock discarded as waste	10.1
Total tonnes feedstock dosed	1103.2
Maximum volumetric dose rate [L/min]	99.4
Maximum gravimetric addition rate [kg/min]	45.4
Maximum outfall concentration [mg/L]*	239.1
Maximum daily additions [t/day]	39.4

*Outfall concentration calculated from the gravimetric addition rate and nominal effluent flow rate of 190,000 L/min.

3 Effluent and Ocean Monitoring

3.1 Effluent

Planetary's trial permit specifies limits on the pH and total suspended solids (TSS) content of water entering into the ocean via the outfall (effluent), as summarized in Table 3.1. The TSS limit is determined as the difference between measurements obtained from locations up- and downstream of the alkalinity discharge point (i.e., $\Delta TSS = \text{downstream TSS} - \text{upstream TSS}$). Both limits are calculated using the hourly median signals observed at the field site (i.e., hourly median of measured signal must be within tolerable range).

To ensure regulatory compliance, Planetary obtained continuous pH, turbidity, TSS, temperature and salinity measurements in the ocean outfall, using sensor platforms installed up- and downstream of the alkalinity dosing point. Both platforms consisted of a pumped, flow-through chamber containing a multiparameter sonde and supporting electronics for data collection and visualization. The upstream platform measured water immediately upstream of the dosing point, and therefore represented chemical and environmental properties of the unalkalized water used to produce slurry. The downstream platform measured conditions downstream of the dosing point, by drawing water from approximately one meter beyond the end of the outfall. Data were collected at approximately five-minute intervals, with periodic downtime for sensor servicing and calibration. Sensor data were displayed locally, in real-time on-site, and alerts were automatically transmitted to site operators if regulated thresholds were near. In such events, operators undertook action to reduce the dosing rate until effluent conditions stabilized.

The sensor pH data were calibrated using weekly discrete samples from the two sensing locations. Total suspended solids samples were also collected, and used to derive a turbidity-to-TSS relationship that was applied to the sensor turbidity data to calculate TSS in real-time. Additional samples for total trace metal content, salinity, and total alkalinity were also obtained weekly from both locations. The turbidity-vs-TSS relationship, and details on the effluent sample collection and processing are provided in Appendix 5.

Results from the effluent monitoring are summarized in Figure 3.1 and Table 3.1. Vertical grey lines in the figures correspond with dosing events. All bottle data are presented in appendix Table A5.1

No exceedances of the regulated pH or TSS limits occurred during the present operational period.

Table 3.1 - Summary of regulated parameters

Outfall pH limit	6.5 < pH < 9 (end of pipe)
Outfall / effluent TSS limit	$\Delta TSS < 40 \text{ mg/L}$ (difference)
Number of pH limit exceedances	0
Number of TSS limit exceedances	0
Maximum downstream pH	8.65
Maximum ΔTSS (mg/L)	39.8
Maximum ΔTA ($\mu\text{mol/kg}$)	316.6

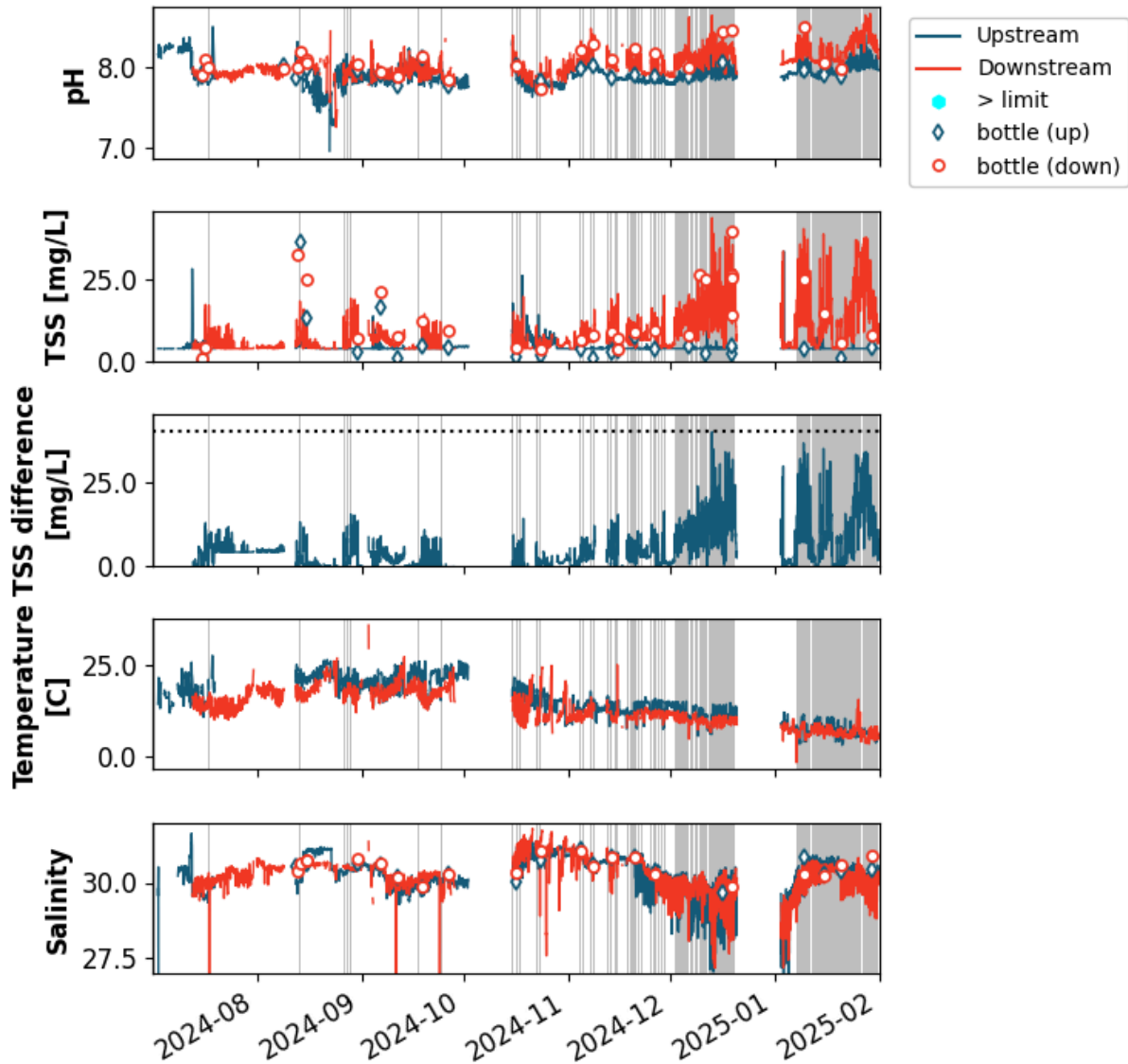


Figure 3.1 - Effluent monitoring time-series.

3.2 Receiving waters

Planetary regularly monitored the receiving waters (ocean) around the Tufts Cove deployment site prior to and during dosing. Boat sampling of up to five stations (see blue markers in Fig. 2.1) was conducted at weekly-to-monthly intervals since January 2024, and a shore-tethered mooring was deployed approximately 10 m away from the outfall.

During the boat surveys, vertically resolved water column measurements of pH, turbidity, dissolved oxygen, temperature and salinity were obtained, as well as discrete samples for pH, TSS and salinity (all surface and bottom water), and trace metal content in water (surface and bottom water) and sediments. The water column and TSS measurements were made at all five sampling stations, and the trace metal measurements were made at only two stations (Tufts Cove and Compass Buoy/Central Basin). The shore tethered mooring contained an instrument package containing a total alkalinity sensor, air and water pCO₂.

sensor, and multiparameter sonde, with pH, turbidity, temperature, salinity and chlorophyll sensors. Discrete calibration samples were obtained from the mooring on a weekly basis (pH, salinity, TSS, total alkalinity), and were processed as described in Appendix 5.

It should be noted that the mooring was deployed primarily for research/development purposes. Indeed, TA and in-situ air-sea $p\text{CO}_2$ sensor technology is in the early stages of development. Due to several challenges with those instruments and the R/D nature of the deployment, sensor TA and $p\text{CO}_2$ data are not presented in this report. The multiparameter sonde, however, collected data at approximately 30min intervals, continuously, since July 2024.

The measured ocean variables were judged against Planetary's self-imposed stop-trigger limits (Appendix 4), comprising guidelines from the Canadian Council of Ministers of the Environment (CCME) and limitations established from historical data records from the area. Historical water column records were primarily obtained from prior sampling efforts conducted by the Department of Fisheries and Oceans (weekly since 1992) and Dalhousie University (since 2008; carbonate system parameters added in 2015). Background sediment metals data were compiled from four sampling campaigns dating back to 1986² (over 2000 data points).

The results of Planetary's ocean monitoring efforts are summarized in the figures below. Vertical lines in the figures represent dosing events. **Notably, no limits were exceeded at any point during the present operations period.** Indeed, many observations remained within the range of background variability, including:

- Average water column biogeochemistry during dosing periods, remaining within background levels for all measured variables (Fig. 3.2)
- Sediment metals remaining within the background, or pre-dosing ranges (Fig. 3.3; the full array of observed metals is shown in Fig. A5.2)
- Off-shore TSS within pre-dosing ranges (Fig. 3.4). Note that TSS measured at the Tufts Cove station (red markers), approximately 60 m from the ocean outfall, was typically 5-10-fold lower in concentration than TSS measured directly at the outfall. This result indicates significant feedstock dilution, dispersion or dissolution within the immediate vicinity of Tufts Cove.

Note that the mooring TSS data (Fig. 3.5) are noisy due to the significant presence of bubbles that interfere with the optical turbidity measurements.

² References for background sediment metal data:

Buckley, D.E, Smith, J.N and Winters, G.V. (1995) Accumulation of contaminant metals in marine sediments of Halifax Harbour, Nova Scotia: Environmental factors and historical trends: *Applied Geochemistry*, vol. 10, no. 2, pp. 175-195.

Tay K-L, Doe KG, Wade SJ, Vaughan DA, Berrigan RE, Moore MJ. (1992). Sediment bioassessment in Halifax harbour. *Environ Toxicol Chem* 11: 1567–1581.

Williams, G., Parsons, M.B., Hellou, J. and Scott, D.B. (2010). Evaluating the effects of wastewater treatment on marine sediment chemistry in Halifax Harbour, Nova Scotia. *Atlantic Geology*, 46 (1).

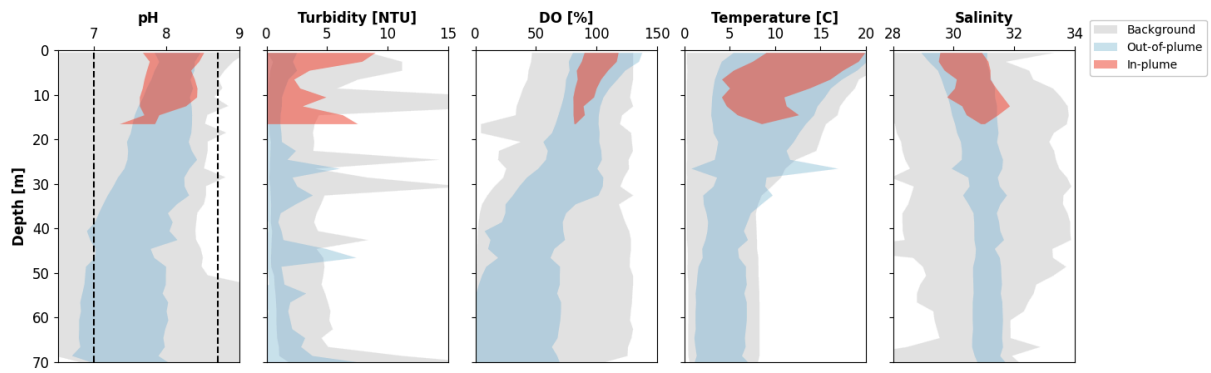


Figure 3.2 - Summary of water column observations.

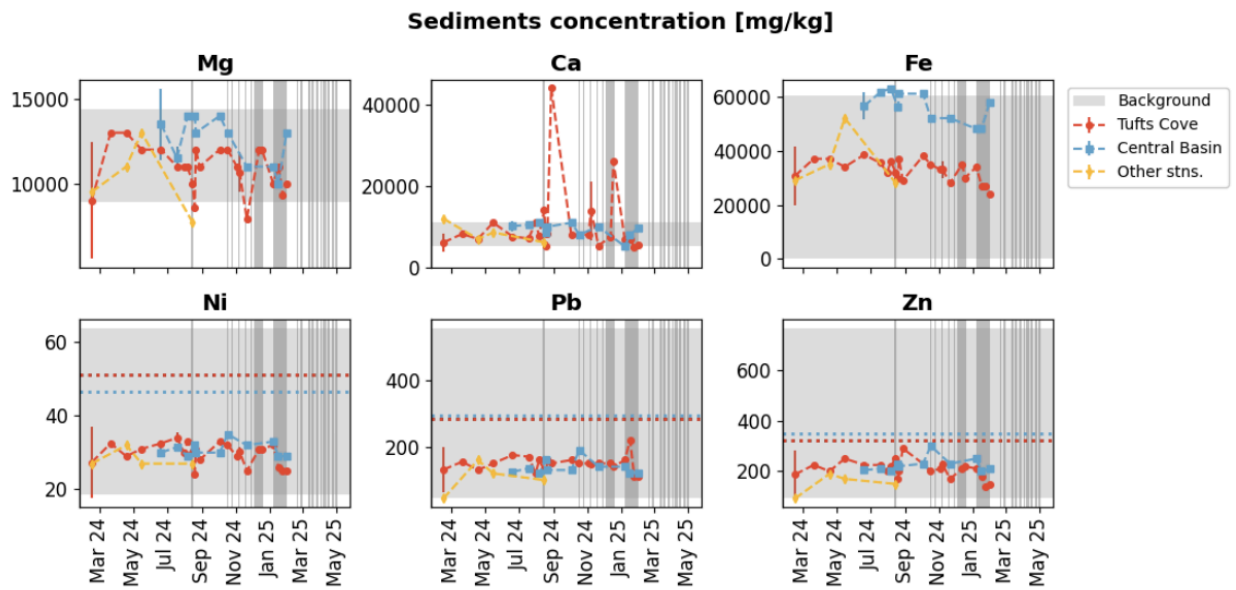


Figure 3.3 - Subset of sediment metal measurements.

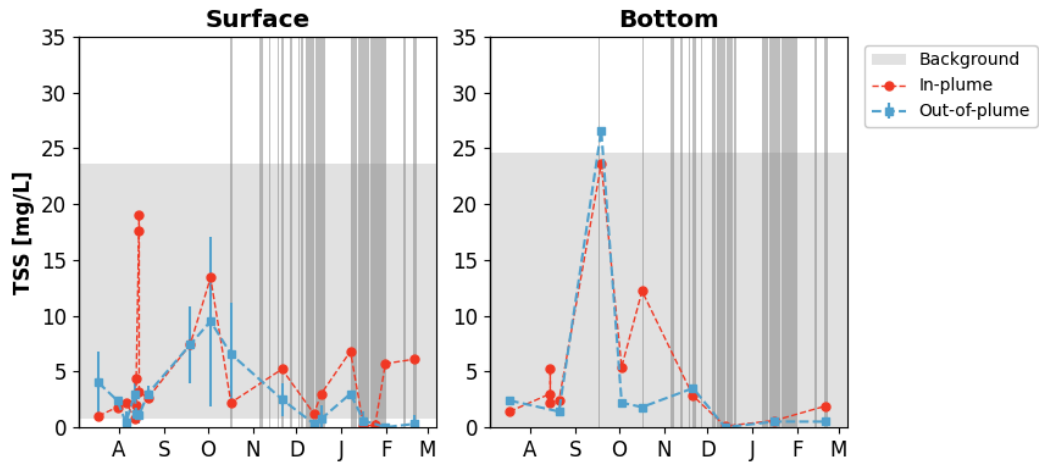


Figure 3.4 - TSS in the receiving waters

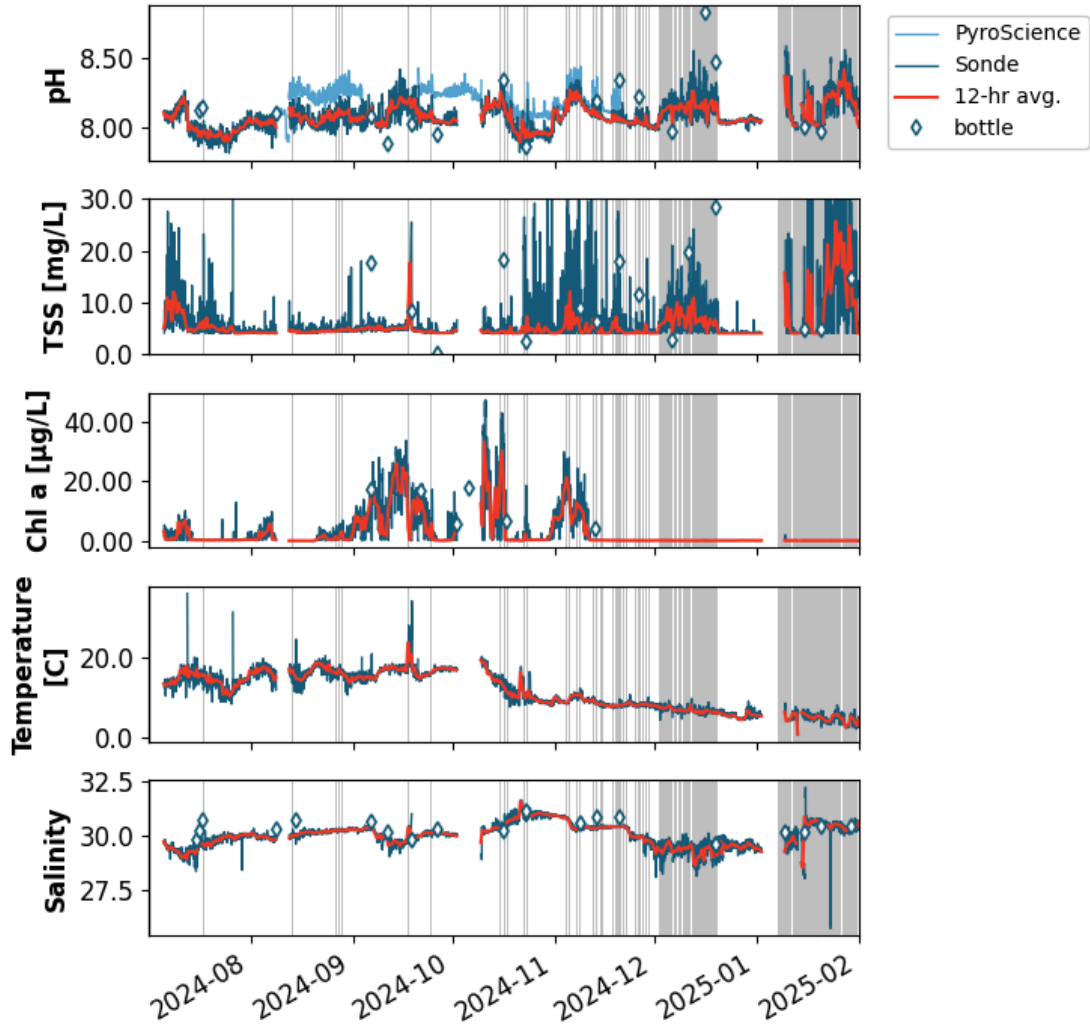


Figure 3.5 - Mooring observations

In addition to the routine ocean monitoring conducted throughout the dosing period, Planetary and Dalhousie University oceanographers conducted targeted ocean sampling during a week-long testing phase of the trial (12-15 August). During this period, alkalinity was dosed from the outfall at a rate of ~15-24 kg/min. Paired filtered and unfiltered water samples were obtained from stations near Tufts Cove for analyses of dissolved and total (particulate + dissolved) alkalinity, respectively. As shown in Figure 3.6 below, those samples indicated significantly higher levels of particulate alkalinity (total minus dissolved) at the sampling station immediately adjacent to the outfall at Tufts Cove (Station 1, ~60 m away). These results **imply high levels of feedstock dissolution** (or dilution/dispersion) in the immediate vicinity of the addition site, and are supported by concurrent vertical water column turbidity measurements showing high turbidity (a proxy for high particle content) near to the outfall, and diminishing values away from it (Fig. 3.6C).

Dalhousie University also led two dye-tracer experiments at Tufts Cove to examine dilution and dispersion of material discharged from the outfall. Those analyses are on-going, including the development of fine-scale mixing models for the region, but initial results suggest a conservative dilution factor on the order of 10 within 50-100 m of the outfall. Continued data analyses of particulate vs dissolved TA samples collected throughout the duration of the trial is also underway, and a targeted field sampling experiment is currently being planned for spring 2025 to further investigate feedstock dissolution and dispersion from the outfall.

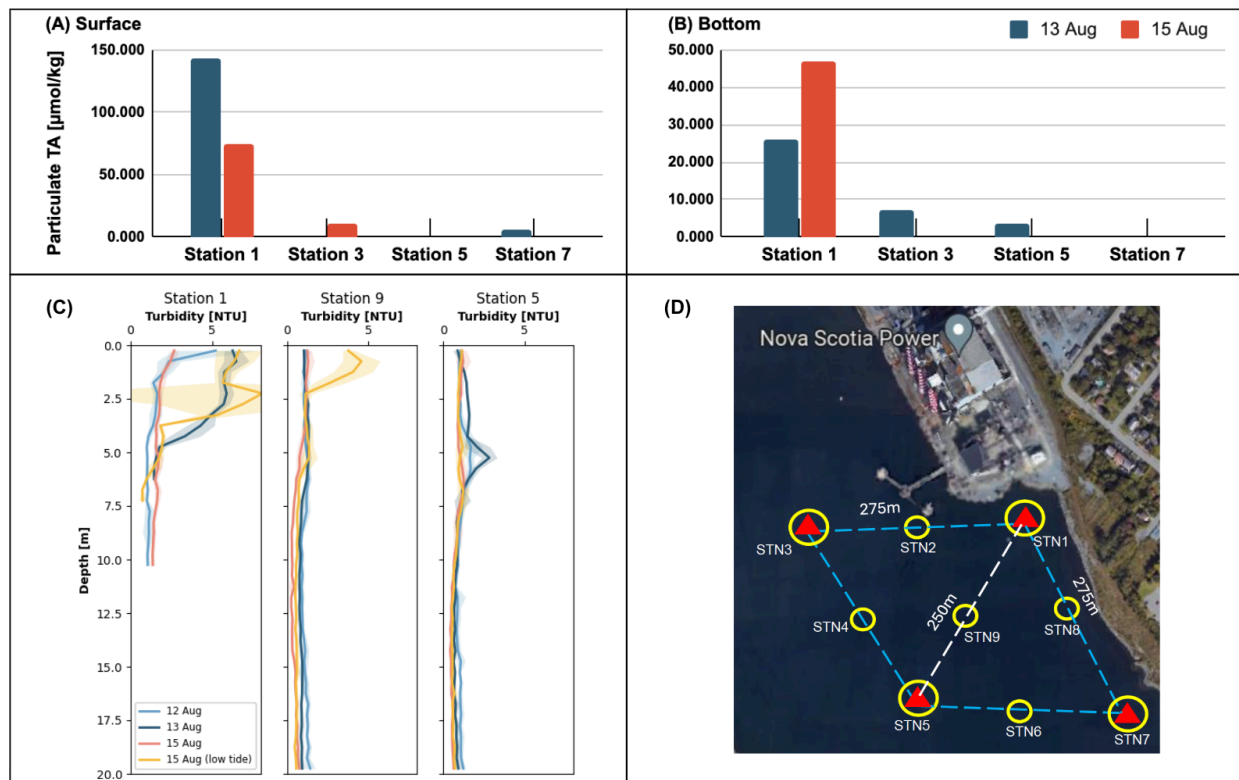


Figure 3.6 - Particulate alkalinity and water column turbidity near Tufts Cove during a testing period

3.3 Seabed surveys

Planetary also conducted periodic seabed camera surveys to obtain video and still images of the seabed and the biota present. Surveys were conducted prior to dosing (Jan-Apr. 2024), during the ramping phase (Nov. 2024) and during the continuous operations (Jan. 2025). Figure 3.7 shows a subset of images obtained at the Tufts Cove station prior to dosing, indicating a presence of various sessile, mobile and infaunal organisms:

- Common sea star (*Asterias rubens/vulgaris*) (throughout, e.g., A9)
- Cerianthid anemones (throughout, e.g., F4)
- Encrusting / coralline algae (B4, B5)
- Green sea urchin (*Strongylocentrotus sp.*) (C4)
- Blue mussel shell (D2)
- Mixed sessile organisms, including hydroids, sponges, bryozoans, barnacles (A3-6, E8-E10, F9)
- Unknown sponge (F9)
- Burrowing (infaunal organisms) indicated by presence of castings and excretions on sediment

Images obtained during dosing periods and at other sampling stations are still undergoing processing, but have revealed no significant changes to the benthic community following the onset of dosing. Ongoing, camera work will be conducted throughout 2025.

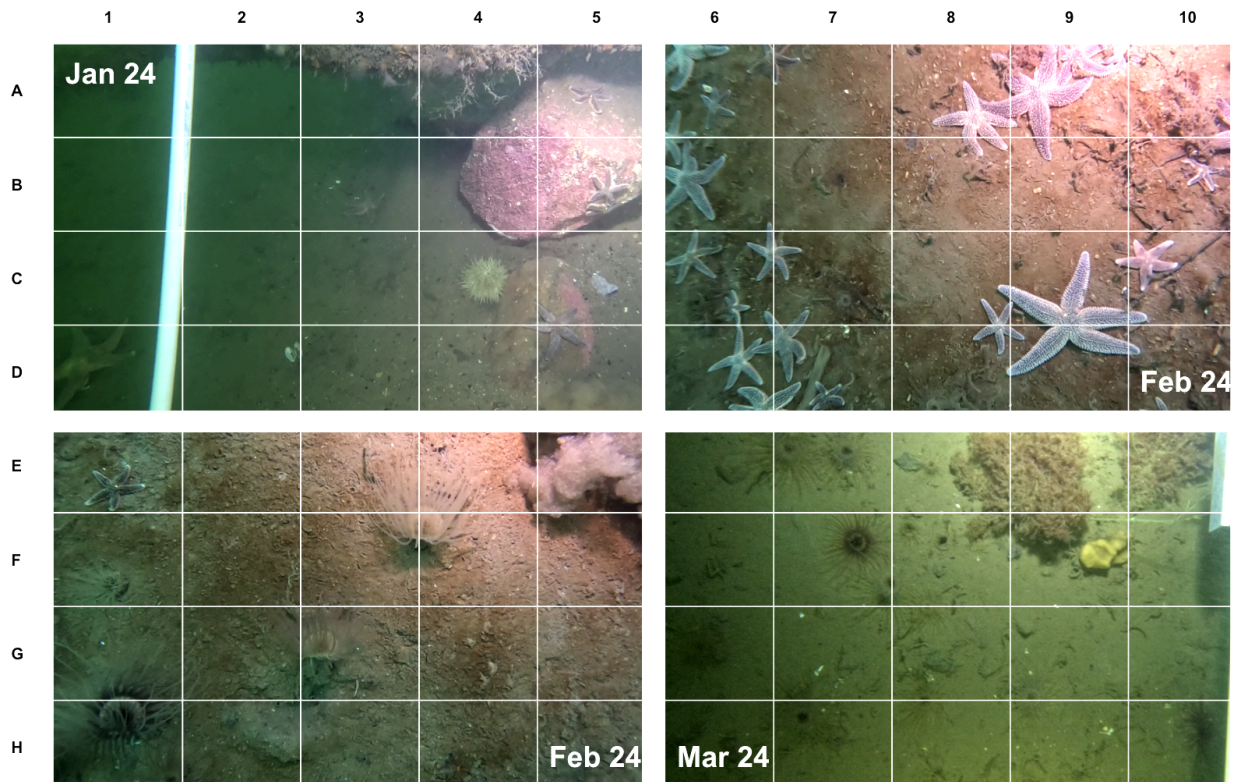


Figure 3.7 - Subset of seabed camera images obtained prior to dosing.



Appendix 1 - Summary of sampling and events

Table A1.1 - Summary of on-site events

January, 2024	Monthly ocean monitoring begins
February - May, 2024	Feedstock storage and dosing permit submitted Dosing system design
May, 2024	Permit amendment for MgO-based feedstock approved, allowing new feedstock to be stored and dosed onsite.
June, 2024	First shipment of feedstock shipped from Spain and stored in Halifax warehouse; ready for use. All ocean/effluent monitoring equipment set up on site for testing and baseline data collection.
June - September, 2024	Dosing equipment setup and testing. Site commissioning and upgrades, including grading of dosing area (July), re-design of dosing system layout (July), installation of new dosing equipment (July-Aug) and office trailer (September).
July 15, 2024	Dosing and continuous monitoring begin.
September - October, 2024	Dosing and material handling testing and site optimization. Effluent sensors offline for servicing (Sep. 28 - Oct. 15). No dosing.
September - November, 2024	Building permit for onsite shelter approved and build complete.
September, 2024	Second shipment of feedstock stored in warehouse, ready for use.
October 21, & 25, 2024	Dalhousie-led Dye tracer experiment conducted (dosing paused to facilitate experiment) to assess dilution and dispersion
November 4, 2024	Beginning of ramping phase - increasing dose rate and duration
December 2, 2024	Beginning of continuous operations
December 11, 2024	ECCC visit. Follow-up report outlining toxicity testing and monitoring sent 16 Jan. 2025.
December 20, 2024 - January 4, 2025	Pause for holiday break
January 21, 2025	Delivery of third shipment of feedstock, ready for use

Table A1.2 - Summary of samples and analyses supporting the current dosing period.

Type	Parameters	Freq.	Impact areas (- = no relevance, 'x' = low relevance, 'xxx' = high relevance)			Method overview	Significance
			Regulatory	netCDR	Eco-Impacts		
Eco-toxicity studies	Acute toxicity Multitrophic effects Lobster effects	Once, pre dosing	-	-	xx	Incubations performed by third party laboratories	LD50 > 10 g/L No effect on tested species below 2 g/L No effect below 250 mg/L
Feedstock Sampling	Elemental composition and impurities	Each bulk bag ¹	-	xxx	x	Sampled into composites per 'lot' of material	Weighted EQOH = 494.36
Dye release study (Dalhousie U.)	Dispersion / dilution	Ad-hoc	-	-	-	Rhodamine dye release at Tufts Cove	Dilution factor O(10) determined for Tufts Cove. Plume advection mapped.
Slurry Sampling	Density	Per batch	-	-	-	Slurry in bottle and weighed	Confirmation of desired concentration; operational constraint only
Dosing Pump Records	Flow rate	1-min	xx	xxx	xx (context)	Measured using flow meter and tank level sensor	Continuous data record
Effluent monitoring	Up- and downstream pH, turbidity, T, S	5-min	xxx	-	x	Flow-through sensor measurements	No regulatory thresholds exceeded
Effluent sampling	Up- and downstream pH, TA, TSS, S metals	Weekly	xxx	-	x	Bottles filled and stored for analysis	Sensor calibration; No regulatory thresholds exceeded
Boat - water column chemistry	pH, turbidity, TSS, TA, salinity, oxygen, metals	Weekly-monthly	xx (stop-triggers)	-	xx (context)	Profiling sensors and bottle collection	No stop-trigger thresholds exceeded; data within background range
Boat - sediment metals	various	Weekly-monthly	xx (stop-triggers)	-	xx	Sediment grab	No stop-trigger thresholds exceeded; data within background range
Mooring	T, S, pH, TA, pCO ₂	30-60 min	x (stop-triggers)	-	xx (context)	Sensor array and weekly bottle samples	No regulatory thresholds exceeded; co-benefits measured
Seabed camera surveys	Video / still images	Quarterly	-	-	xx (qual. only)	Camera submerged at sampling stations	No significant changes observed



Appendix 2 - Feedstock characterization

The feedstock was sampled and analyzed throughout the trial period to quantify its carbon removal potential (EQOH) and impurities content. Composite samples were collected for each lot (production batch) of feedstock, and were submitted for various assays by a third party lab (ALS Environmental Analytical Laboratory, Dartmouth, NS). The assays included the following: RBCA Tier 1BTEX/TPH, PAH, PCBs, moisture content, total inorganic carbon, total sulfur by LECO, mercury, hexavalent/ trivalent chromium, metal oxides through XRF, bioavailable metals through ICP-MS following aqua-regia digestion, and dioxins & furans.

Tables A2.1 and A2.2, below, summarize resulting EQOH and metals impurities analyses for the present operations period. Analyses for organic impurities resulted in trace or non-detectable concentrations of all parameters. The full suite of assay data and calculations can be made available on request.

The feedstock equivalent hydroxide content, EQOH, was calculated by applying the equations below:

$$\eta = \frac{\Delta DIC}{\Delta TA}$$

$$ALK_{pot}(\eta) = \left[\frac{CaO}{MW_{CaO}} + \frac{MgO}{MW_{MgO}} + \frac{Na_2O}{MW_{Na_2O}} + \frac{K_2O}{MW_{K_2O}} - \frac{SO_4}{MW_{SO_4}} - \frac{P_2O_5}{MW_{P_2O_5}} - \frac{CaCO_3}{MW_{CaCO_3}} - \left(\frac{\left(\frac{MgCO_3}{MW_{MgCO_3}} \right)}{\eta} \right) \right] \times \left(\frac{1000}{100} \right)$$

$$EQOH(\eta)_{moisture\ corrected} = ALK_{pot}(\eta) \times MW_{OH^-} \times 2\ mol \times \left(1 - \frac{moisture}{100} \right)$$

Here, “ η ” is the location-specific molar ratio of the seawater DIC (dissolved inorganic carbon) increase after air-sea equilibrium for a given divalent alkalinity released during feedstock dissolution, “MW” is the molar weight of each compound, and “moisture” is the moisture content of the feedstock sample.

EQOH was determined for each unique lot, and a weight factor was calculated for each lot based on the total mass dosed (i.e., weight = Lot tonnes dosed / total tonnes dosed). The final EQOH ascribed to the present operation period is taken as the weighted average of all lots’ unique EQOH values (i.e., weight-avg. EQOH = $\Sigma(\text{weight}) \times (\text{lot EQOH})$). Lots that have not been analyzed yet (due to an insufficient quantity of material being dosed) were assigned the arithmetic average EQOH value from all other lots. Super sacs of material that arrived on site without a lot identifier were composited into an “unknown lot” sample.

Table A2.1 - Summary of EQOH analysis

Lot	Analysis date	Tonnes dosed [t]	weight factor	Lot EQOH [kg/t]	Weighted EQOH [kg/t]
Unknown Lot	2025-Jan-09	87.31	7.84%	500.00	494.36
12033	2024-Sep-12	25.21	2.26%	528.00	
12113	2024-Nov-26	49.65	4.46%	471.00	
12143	2024-Nov-26	83.88	7.53%	467.00	
12153	2024-Dec-17	176.30	15.83%	494.00	
12183	2024-Nov-26	155.65	13.97%	467.00	
12193	2024-Nov-26	72.27	6.49%	481.00	
12213	2024-Dec-20	16.71	1.50%	547.00	
12063	2024-Dec-20	25.49	2.29%	527.00	
12203	2024-Dec-20	40.24	3.61%	532.00	
ZH2411003	2024-Dec-04	22.85	2.05%	474.00	
12133	2025-Jan-07	27.89	2.50%	502.00	
ZH24110017	2025-Jan-22	23.55	2.11%	496.00	
ZH2411017	2025-Jan-28	86.14	7.73%	503.00	
12223	N/A	5.13	0.46%	503.00	
01184	N/A	1.26	0.11%	503.00	
01194	2025-Feb-05	23.97	2.15%	518.00	
01224	2025-Feb-28	71.71	6.44%	521.00	
01234	2025-Feb-05	37.52	3.37%	491.00	
01254	2025-Feb-05	51.97	4.66%	506.00	
01264	N/A	5.09	0.46%	503.00	
12013	2025-Feb-28	13.44	1.21%	529.00	
12073	N/A	9.35	0.84%	503.00	
ZH2111019	N/A	1.40	0.13%	503.00	



Table A2.2 - Summary of feedstock impurities analysis for maximum metals loading

	Limits	Dry feed characterisation		
Metal	Tier 1 EQS Surface Water limit [µg/L]	Feedstock dry feed average [mg/kg]	Calculated max metal loading in pipe [µg/L]*	Calculated max metal loading in surface water (post dilution) [µg/L]**
Aluminium	-	922.20	232.98	23.30
Antimony	500.00	0.78	0.20	0.02
Arsenic	12.50	24.14	6.10	0.61
Barium	500.00	27.16	6.86	0.69
Beryllium	100.00	0.52	0.13	0.01
Boron	1,200.00	17.26	4.36	0.44
Cadmium	0.12	0.06	0.02	0.00
Chromium (hexavalent)	1.50	<0.1	ND	ND
Chromium (total)	-	11.17	2.82	0.28
Cobalt	-	20.20	5.10	0.51
Copper	2.00	13.07	3.30	0.33
Iron	-	15,460.00	3,905.68	390.57
Lead	2.00	14.90	3.76	0.38
Manganese	-	1,072.00	270.82	27.08
Mercury	0.02	0.13	0.03	0.00
Molybdenum	-	5.62	1.42	0.14
Nickel	8.30	108.00	27.28	2.73
Selenium	2.00	0.65	0.17	0.02
Silver	1.50	0.34	0.09	0.01
Strontium	-	51.94	13.12	1.31
Thallium	21.30	0.17	0.04	0.00
Tin	-	<2.0	ND	ND
Uranium	100.00	0.72	0.18	0.02
Vanadium	50.00	387.80	97.97	9.80
Zinc	10.00	13.78	3.48	0.35

*Maximum metal loading in pipe is based on the plant's average pipe flow rate of 190,000 L/min

**Maximum metal loading in surface water is based on a conservative dilution factor of 10, determined through dye release studies

Appendix 3 - Feedstock dosed

Table A3.1 - Summary of dosing totals

month	gross total imported [tonnes]	net total dosed (after waste) [tonnes]
Jul 2024	5.1	5.1
Aug 2024	33.5	33.2
Sep 2024	10.4	10.3
Oct 2024	26.5	26.2
Nov 2024	119.8	118.7
Dec 2024	423.4	419.5
Jan 2025	494.7	490.2
Total	1113.4	1103.2

Table A3.2 - Summary of waste feedstock removed from Tufts Cove

Service Date	Mass [kg]	Description
8/20/2024	1,770	Feedstock picked up by Mega Vacuum Truck on 18 August was disposed of at Halifax C&D Recycling Ltd.
09/30/2204	1,500	Feedstock picked up by Mega Vacuum Truck on 18 August was disposed of at Halifax C&D Recycling Ltd.
10/23/2024	200	1 x 40 gallon drum of waste feedstock (minor spills)
11/01/2024	1,500	Feedstock sludge at bottom of mix tank pressure washed and removed (1000L of MgO water)
15/01/2025	2,790	2 bad bulk bags of waste feedstock picked up
22/01/2025	2,780	2 bad bulk bags and 3 barrels of waste feedstock picked up
24/01/2025	4,400	2 bulk bags with broken straps plus tank clean out, includes water from tank cleanout and gravel from ruptured bags First bulk bag rupture from night shift included in 3,000 kg picked up with sludge from mix tank Second bulk bag rupture on the same day in the evening, 1,400 kg including gravel. Deduct weight of first bag from 3,000 kg to get total of 'dosed material' wasted collected from mix tank
Total Waste	14,940	
Subtract non-dosed bags removed	4,800	
Net waste removed	10,140	



Appendix 4 - Stop Trigger Limits

Table A4.1 - Stop triggers framework

Type	Trigger / threshold	Stop action ^(A)	Resumption requirements
Manual	Personnel injury	Stop dosing immediately	First aid administered to the injured worker (if necessary), and preventative measures put in place to ensure no repeat injury Sufficient number of fit operators on-site
	Equipment malfunction resulting in unsafe working conditions (e.g., leaks, sparks), un-monitored dosing or loss of dosing data	Stop dosing immediately	Equipment fixed and safety-tested
	Spill occurs	Stop dosing immediately Inform environmental regulator.	Spill cleaned up Regulator informed of cleanup
	Inclement weather (realized or forecasted)	Stop dosing immediately	Inclement weather subsides
Effluent	pH: rolling hourly-median value >9 or <6.5	Stop dosing immediately	Reduce dosing rate
	TSS: rolling hourly-median difference between up- and downstream stations >40 mg/L		Demonstrate values at lower dosing rate no longer exceed
	TA: total alkalinity >1000 umol/kg above background ^(C)		Regulator report sent within 48hrs of event
Ocean^(B)	pH: any measurement outside 7-8.7 range or >0.2 units above background when background exceeds that range ^(C)	Stop dosing immediately	Unless exceedance is definitively shown to be due to instrument noise, error, or a sporadic natural event, the dosing rate is decreased. The lowered rate must be confirmed by either the lead science or lead operations team member. After resuming, compliance is confirmed via boat sampling conducted on the same day.
	TSS: >25 mg/L difference between in- and out-of-plume		
	Dissolved oxygen: A) < 10% below background concentration range ^(C) in the alkalized plume when DO >8mg/L; or B) below natural DO when DO <8mg/L		
	Total metals: in-plume concentration > EQS limit ^(D) when out-of-plume concentration < EQS limit		Regulator report sent within 48hrs of event
Sed.^(B)	Total metals: Sediment metals concentrations for any of 9 metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) exceed stop-trigger thresholds determined as statistical outliers in long-term average	Stop dosing immediately Initiate follow-up	Regulator report sent within 48hrs of event Further analysis definitively rules out link between detected exceedance

	comparable dataset for Tufts Cove and immediate area.	sampling and analysis to verify observed exceedance.	and PT activities Reduce dosing rate and increase frequency of sediment monitoring
Bio./ Eco.	Abnormal wildlife activity observed	Stop dosing immediately	Once wildlife activity ends, dosing can resume at equal or reduced rate. Closely monitor the area, and if wildlife activity resumes soon after restart, dosing must stop until further analysis can be completed Activity must be noted in regular regulator reports
Other	Surface Residue: Area of residue consistently increases over multiple days. Affected area is reviewed daily using visual observations by the operations team and photographs with fixed FoV to detect temporal trends.	Stop dosing immediately	Regulator report sent within 48hrs of event Further analysis determines that the accumulation is likely to have been driven by other variables (e.g. wind, tide, weather events, plant operations) Reduce dosing rate, and demonstrate residue area no longer increases over time. If necessary, physical containment are deployed (e.g. containment booms)

(A) “stopping dosing immediately” is to be done ONLY when it is deemed safe to do so (e.g., if injury has occurred, the injured person must first be secured before taking further action). Stopping dosing must also be communicated clearly to the broader team via Slack.

(B) Ocean and sediment thresholds closely follow guidelines imparted by [CCME](#). The 9 metals parameters selected are those which CCME identifies as being of particular environmental concern and therefore provides guideline thresholds for marine sediments. Comparable data is defined as using similar sampling and analysis (e.g. digestion) techniques.

(C) Background conditions primarily determined from various baseline data sources (see Pre-deployment monitoring, section 2.4), including the long-standing time-series of Bedford Basin and Planetary monitoring activities. Out of plume data (derived from three additional stations located over 300 m away from the Tufts Cove plume) are also used to assess OAE impacts during dosing periods.

(D) EQS limits for metals are defined by [CCME](#) and the US-EPA when CCME definitions are not available.



Appendix 5 - Monitoring data

Weekly samples for pH, salinity, TSS, total alkalinity (TA) and dissolved trace metal content were obtained from both effluent sensor locations, the shore-tethered mooring, and from boat surveys (Table A5.1). Sediment samples were also collected from the boat surveys using a sediment grabber.

pH and TA samples were collected into borosilicate glass bottles by filtering seawater through a 0.2 µm filter, and subsequently measured by a third party laboratory (Dalhousie University). Salinity samples were collected into amber borosilicate bottles and analyzed by a third party laboratory (Dalhousie University). Water trace metal samples were collected into plastic sampling bottles containing a small aliquot of nitric acid (for preservation), and were analyzed by a third party laboratory (Bureau Veritas). Sediment trace metal samples were collected into glass jars using a plastic scoop, and were analyzed by a third party laboratory (Bureau Veritas).

Total suspended solids samples were obtained by filtering a known volume of seawater through a pre-weighed 1.6 µm filter. The filter was subsequently dried and TSS was calculated from the difference in filter mass (i.e., $TSS = (final\ mass - pre-weighed\ mass) / volume\ filtered$). Samples were filtered immediately after collection, in order to prevent feedstock dissolution in the sample container, and analyzed by a Planetary operator. A standard curve relationship between discrete TSS and the corresponding sensor turbidity measurements was derived to calculate a continuous TSS record; see below.

The sensor data (effluent, mooring and water column vertical profile) were calibrated using the discrete bottle data by calculating the mean bias between paired sensor and bottle measurements during a given calibration window, and applying the mean bias to the continuous sensor data time-series.

Table A5.1 - Sampling and instrument servicing events

Date	Event (BS = Boat survey; ES/S = effluent sampling & service; MS/S = mooring sampling & service)	Data collected
19-Jan-2024	BS	TSS, Drop Camera
16-Feb-2024	BS	TSS, Drop Camera
28-Mar-2024	BS	TSS, Drop Camera; Sediment grab (metals); Water metals
18-Apr-2024	BS	TSS, Drop Camera; Sediment grab (metals); Water metals
16-May-2024	BS	TSS; Sediment grab (metals); Water metals
20-Jun-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
3-Jul-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
15-Jul-2024	ES/S	TSS, TA, pH, S, trace metals
15-Jul-2024	MS/S	TSS, TA, pH, S
16-Jul-2024	ES/S	TSS, TA, pH, S, trace metals
16-Jul-2024	MS/S	TSS, TA, pH, S
17-Jul-2024	ES/S	TSS, TA, pH, S, trace metals
17-Jul-2024	MS/S	TSS, TA, pH, S
18-Jul-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
31-Jul-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
6-Aug-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
8-Aug-2024	ES/S	TSS, TA, pH, S, trace metals
8-Aug-2024	MS/S	TSS, TA, pH, S
12-Aug-2024	BS	Sensor profile; TSS
12-Aug-2024	ES/S	TSS, TA, pH, S, trace metals
13-Aug-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
13-Aug-2024	ES/S	TSS, TA, pH, S, trace metals
14-Aug-2024	MS/S	TSS, TA, pH, S
15-Aug-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
15-Aug-2024	ES/S	TSS, TA, pH, S, trace metals
21-Aug-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
28-Aug-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
30-Aug-2024	ES/S	TSS, TA, pH, S, trace metals
6-Sep-2024	ES/S	TSS, TA, pH, S, trace metals
6-Sep-2024	MS/S	TSS, TA, pH, S
11-Sep-2024	ES/S	TSS, TA, pH, S, trace metals
11-Sep-2024	MS/S	TSS, TA, pH, S
18-Sep-2024	ES/S	TSS, TA, pH, S, trace metals



18-Sep-2024	MS/S	TSS, TA, pH, S
19-Sep-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
20-Sep-2024	MS/S	TSS, TA, pH, S
21-Sep-2024	MS/S	TSS, TA, pH, S
25-Sep-2024	BS	Sensor profile
26-Sep-2024	ES/S	TSS, TA, pH, S, trace metals
26-Sep-2024	MS/S	TSS, TA, pH, S
2-Oct-2024	MS/S	TSS, TA, pH, S
3-Oct-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
6-Oct-2024	MS/S	TSS, TA, pH, S
16-Oct-2024	ES/S	TSS, TA, pH, S, trace metals
16-Oct-2024	MS/S	TSS, TA, pH, S
17-Oct-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
17-Oct-2024	MS/S	TSS, TA, pH, S
23-Oct-2024	ES/S	TSS, TA, pH, S, trace metals
23-Oct-2024	MS/S	TSS, TA, pH, S
4-Nov-2024	ES/S	TSS, TA, pH, S, trace metals
5-Nov-2024	MS/S	TSS, TA, pH, S
7-Nov-2024	BS	Sensor profile
8-Nov-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals; Drop camera
8-Nov-2024	ES/S	TSS, TA, pH, S, trace metals
8-Nov-2024	MS/S	TSS, TA, pH, S
13-Nov-2024	ES/S	TSS, TA, pH, S, trace metals
13-Nov-2024	MS/S	TSS, TA, pH, S
15-Nov-2024	ES/S	TSS, TA, pH, S, trace metals
20-Nov-2024	ES/S	TSS, TA, pH, S, trace metals
20-Nov-2024	MS/S	TSS, TA, pH, S
21-Nov-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
26-Nov-2024	ES/S	TSS, TA, pH, S, trace metals
26-Nov-2024	MS/S	TSS, TA, pH, S
4-Dec-2024	BS	Sensor profile
6-Dec-2024	ES/S	TSS, TA, pH, S, trace metals
6-Dec-2024	MS/S	TSS, TA, pH, S
9-Dec-2024	ES/S	TSS, TA, pH, S, trace metals
11-Dec-2024	ES/S	TSS, TA, pH, S, trace metals
11-Dec-2024	MS/S	TSS, TA, pH, S
13-Dec-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals

16-Dec-2024	ES/S	TSS, TA, pH, S, trace metals
16-Dec-2024	MS/S	TSS, TA, pH, S
18-Dec-2024	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
19-Dec-2024	ES/S	TSS, TA, pH, S, trace metals
19-Dec-2024	MS/S	TSS, TA, pH, S
7-Jan-2025	BS	Sensor profile; TSS; Sediment grab (metals); Water metals, Drop camera
9-Jan-2025	ES/S	TSS, TA, pH, S, trace metals
9-Jan-2025	MS/S	TSS, TA, pH, S
15-Jan-2025	ES/S	TSS, TA, pH, S, trace metals
15-Jan-2025	MS/S	TSS, TA, pH, S
16-Jan-2025	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
20-Jan-2025	ES/S	TSS, TA, pH, S, trace metals
20-Jan-2025	MS/S	TSS, TA, pH, S
24-Jan-2025	BS	Sensor profile; TSS; Sediment grab (metals); Water metals
29-Jan-2025	ES/S	TSS, TA, pH, S, trace metals
29-Jan-2025	MS/S	TSS, TA, pH, S
31-Jan-2025	BS	Sensor profile; TSS; Sediment grab (metals); Water metals

*Note: darker lines represent enhanced monitoring efforts during continuous operations.



Table A5.2 - Discrete effluent sample data

Sample Date and Time [UTC]	Sample Location	pH	Total Alkalinity [μmol/kg]	DIC [μmol/kg]	Salinity	TSS [mg/L]
2024-07-15 16:00	Upstream	7.89	2109.04	1981.49		0.40
2024-07-15 15:38	Downstream	7.89	2129.30	2015.56		1.20
2024-07-16 16:27	Upstream	7.98	2128.26	1989.15		3.80
2024-07-16 16:00	Downstream	8.09	2247.64	2054.68		4.20
2024-07-17 17:05	Upstream	7.87	2115.74	1985.46		
2024-07-17 16:13	Downstream	8.00	2188.52	2009.36		
2024-08-08 16:49	Upstream	8.01	2101.59	1899.66		
2024-08-08 16:38	Downstream	7.97	2149.41	1988.36		
2024-08-12 17:05	Upstream	7.86	2115.98	1972.18	30.53	
2024-08-12 17:35	Downstream	7.98	2101.75	1918.54	30.39	32.40
2024-08-13 17:30	Upstream	7.94	2124.58	1951.47	30.53	36.20
2024-08-13 17:49	Downstream	8.18	2253.71	1980.17	30.62	
2024-08-15 16:31	Upstream	7.97	2132.28	1947.44	30.66	
2024-08-15 16:46	Downstream	8.08	2173.02	1968.09	30.73	
2024-08-15 19:31	Upstream	7.97	2153.76	1967.44	30.66	13.12
2024-08-15 19:51	Downstream	8.05			30.73	25.00
2024-08-30 17:18	Upstream	7.96	2155.54	1979.39	30.64	3.00
2024-08-30 18:22	Downstream	8.02	2205.56	2033.99	30.82	7.20
2024-09-06 17:28	Upstream	7.89	2093.61	1935.96	30.60	16.40
2024-09-06 17:55	Downstream	7.93	2105.11	1953.76	30.66	21.40
2024-09-11 14:11	Upstream	7.77	2076.00	1960.33	30.17	1.20
2024-09-11 14:32	Downstream	7.87	2076.86	1936.26	30.18	7.80
2024-09-18 16:49	Upstream	8.10	2033.96	1821.50	29.80	4.60
2024-09-18 16:35	Downstream	8.13	2051.14	1828.70	29.85	12.40
2024-09-26 14:58	Upstream	7.76	2109.43	1993.55	30.27	4.20
2024-09-26 14:28	Downstream	7.83	2118.46	2000.77	30.27	9.60
2024-10-16 12:47	Upstream	8.01	2118.62	1941.70	30.03	1.60
2024-10-16 12:09	Downstream	8.01	2163.81	2014.48	30.36	4.40
2024-10-23 19:52	Upstream	7.81	2150.86	2058.12	30.74	2.00
2024-10-23 20:19	Downstream	7.72	2173.33	2106.93	31.04	4.00
2024-11-04 18:56	Upstream	7.97	2167.16	2033.73	31.08	3.60
2024-11-04 19:12	Downstream	8.19	2267.76	2054.72	31.07	6.60
2024-11-08 14:31	Upstream	8.01	2165.60	2003.23	30.58	1.10
2024-11-08 14:15	Downstream	8.27	2259.02	1988.95	30.56	8.30
2024-11-13 17:46	Upstream	7.86	2171.28	2061.13	30.87	3.10
2024-11-13 17:37	Downstream	8.09	2251.33	2077.79	30.87	9.10
2024-11-15 17:53	Upstream					4.60

2024-11-15 17:40	Downstream					7.10
2024-11-15 18:17	Upstream					3.30
2024-11-15 18:05	Downstream					3.70
2024-11-20 19:20	Upstream	7.89	2161.00	2056.83	30.85	7.80
2024-11-20 18:52	Downstream	8.21	2280.32	2063.48	30.84	8.80
2024-11-26 16:58	Upstream	7.87	2144.43	2029.37		3.60
2024-11-26 16:36	Downstream	8.15	2243.44	2046.71	30.29	9.50
2024-12-06 15:59	Upstream	7.88	2090.71	2005.57		4.70
2024-12-06 15:36	Downstream	7.98	2129.58	2016.16		8.00
2024-12-09 20:43	Upstream					
2024-12-09 20:29	Downstream					26.60
2024-12-11 19:36	Upstream					2.60
2024-12-11 19:22	Downstream					25.00
2024-12-16 19:27	Upstream	8.06	2147.78	1998.30	29.69	
2024-12-16 19:10	Downstream	8.43	2338.53	2023.81		
2024-12-19 10:07	Downstream	8.44	2431.28	2116.45	29.89	
2024-12-19 11:59	Downstream					26.40
2024-12-19 13:55	Downstream					14.20
2024-12-19 14:59	Downstream					39.70
2024-12-19 15:08	Downstream					25.60
2024-12-19 15:22	Upstream		2114.74	1951.32		2.40
2024-12-19 15:30	Upstream					4.90
2024-12-19 15:45	Downstream					
2024-12-19 15:54	Downstream					
2024-12-19 17:19	Upstream					
2024-12-19 17:27	Upstream					
2024-12-19 17:04	Downstream					
2024-12-19 17:10	Downstream					
2025-01-09 16:25	Downstream					25.30
2025-01-09 16:16	Downstream					
2025-01-09 16:45	Upstream	7.95	2202.46	2074.29	30.87	3.80
2025-01-09 16:32	Downstream	8.48	2489.31	2116.62	30.28	
2025-01-15 16:52	Upstream	7.90	2108.28	2023.00	30.29	
2025-01-15 16:25	Downstream	8.06	2212.89	2079.42	30.23	14.60
2025-01-20 17:52	Upstream	7.88	2129.74	2049.82	30.38	1.20
2025-01-20 17:26	Downstream	7.97	2162.80	2070.31	30.58	5.60
2025-01-29 18:48	Upstream		2198.83		30.44	4.50
2025-01-29 18:20	Downstream		2223.22		30.88	8.10



A5.1 Turbidity vs TSS relationship

Figure A5.1 below shows the standard curve relationship derived between sensor turbidity and bottle TSS. The blue line shows the applied equation and the corresponding 95% confidence bounds. The black and red markers represent all data collected since July, 2024, and data collected after 15 November 2024, respectively. The data collected prior to 15 November show significantly more noise at the lower range of observations, likely representing biological particles, which may confound the turbidity-vs-TSS relationship. For this reason, and because regression through all data points (not shown) tends to under-estimate TSS at the higher range of observations ($R^2 = 0.40$), we elected to use the post-November regression line ($TSS = 1.0 * Turb + 4.1 \text{ mg/L}$; $R^2 = 0.76$) as the best-fit predictor of TSS at Tufts Cove for the present operational period. This equation was applied to the continuous turbidity measurements to derive TSS in real-time. The non-zero intercept represents the sensors' apparent detection limit at low turbidity / TSS (i.e., turbidity readings of 0, indicate a TSS level of ~4 mg/L or below, on average).

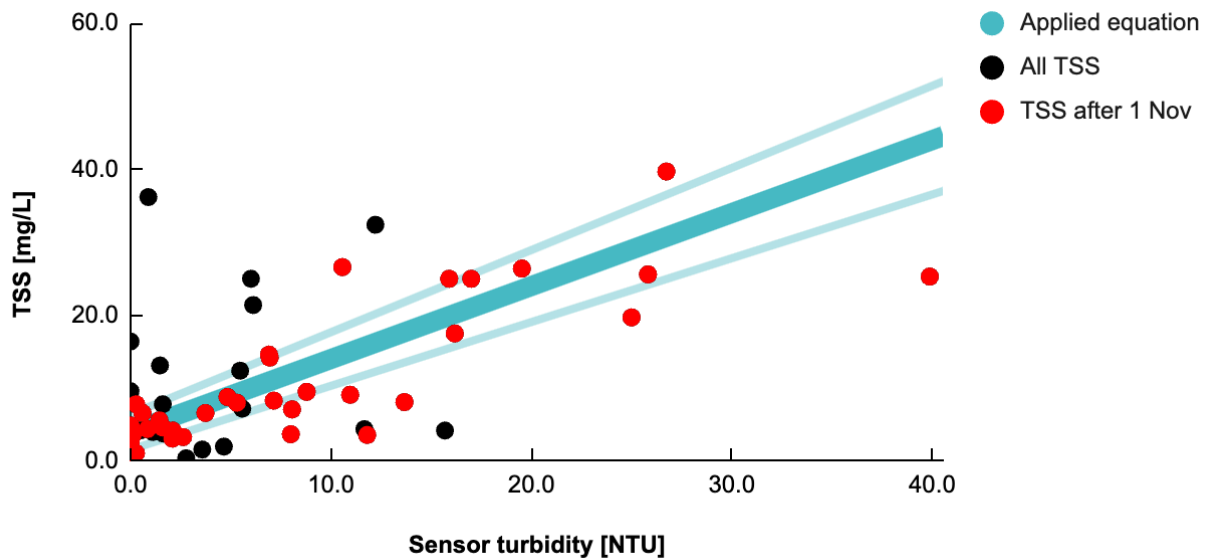


Figure A5.1 - Turbidity vs TSS relationship

A5.2 Metals

Figures A5.2 and A5.3 show the full results from Planetary's metals testing in sediment (A5.2) and the water column (A5.3) of the receiving waters. Figure A5.3 shows the average of surface and bottom water samples. Missing data points in these figures indicate measurements below the analytical limit of detection. Effluent metal samples were obtained and analyzed, but are not shown here as most results came back below detection limits. All raw data are available on request.

Stop-triggers are only defined for 9 sediment metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn), shown in the lower three rows of Figure A5.2. The highlighted markers in that figure indicate when an exceedance of the sediment mercury (Hg) threshold occurred. However, subsequent analysis revealed that that sample, obtained from Tufts Cove, was anomalous, and un-related to Planetary's dosing activities. Note that results from the subsequent sampling event one week later, received by the third party laboratory at the same time, revealed that Hg levels had returned to within background levels. Also of note are the two instances of high calcium levels in sediments, which were deemed to be unrelated to Planetary's activities. The September sample was taken during negligible dosing, while the December sample saw no other notable increases in other metals. In both instances, data from the subsequent sample (received on the same day) saw values return to background.

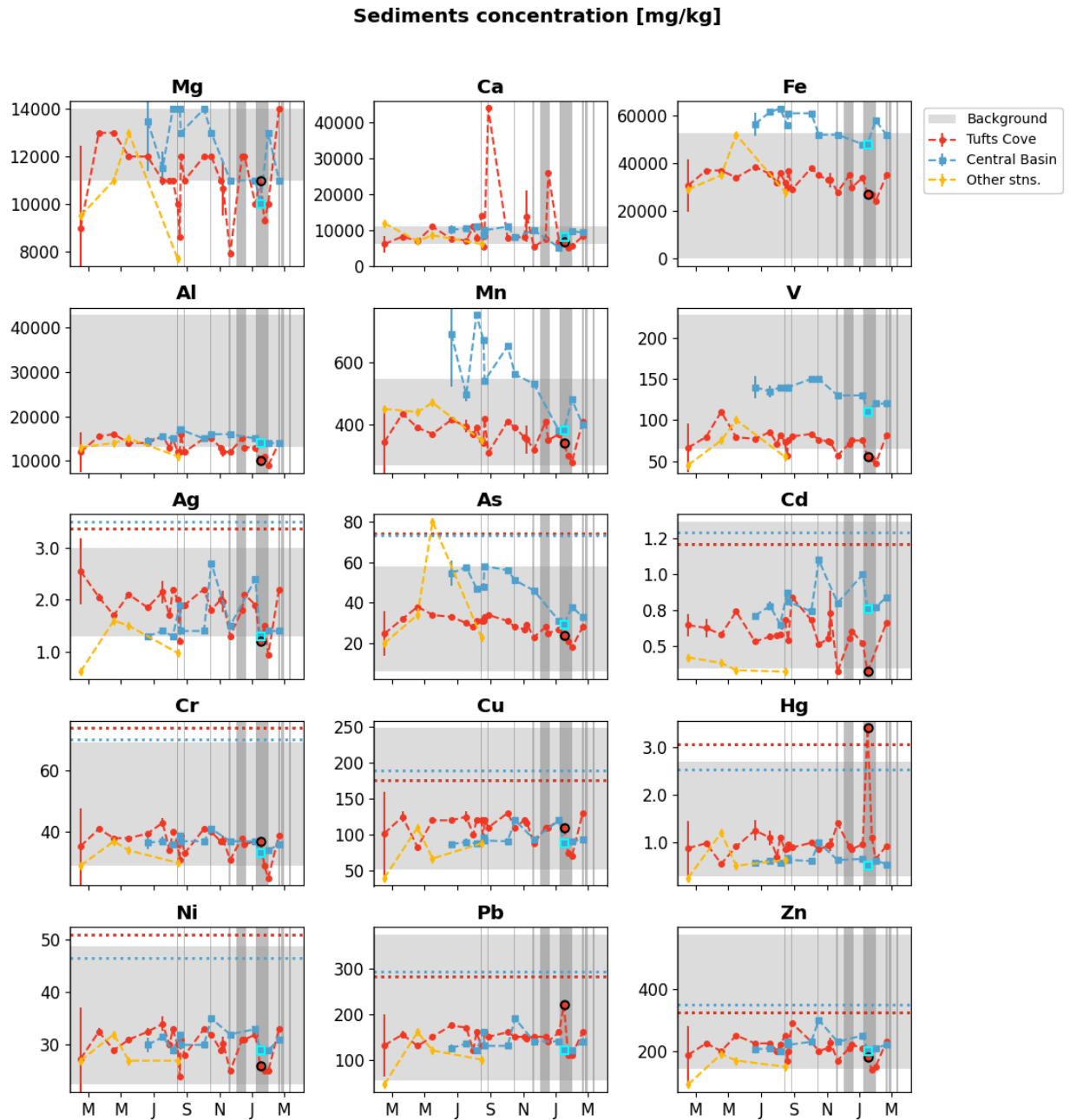


Figure A5.2 - Metal concentrations in sediments of the receiving waters.

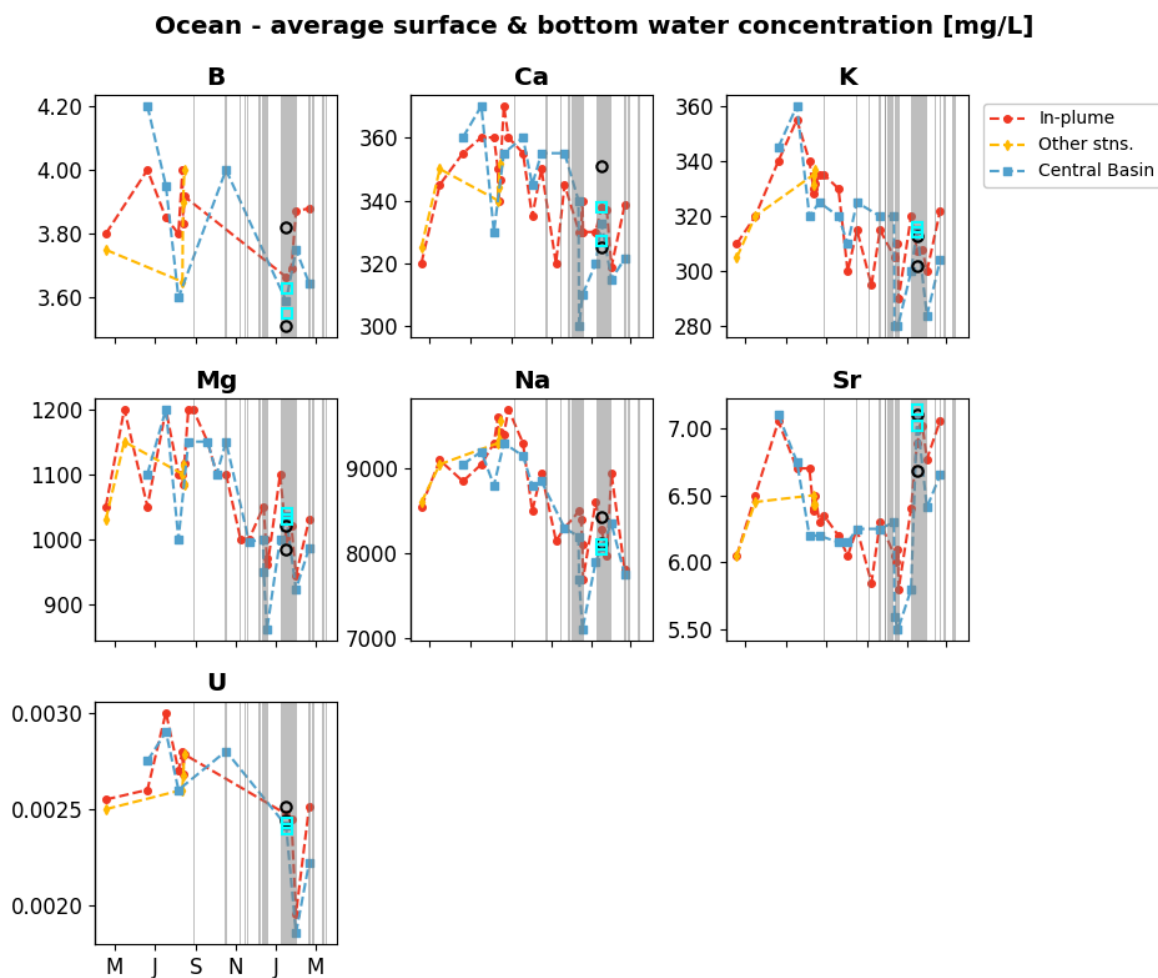


Figure A5.3 - Metal concentrations in the water column of the receiving waters.