

Port of Brisbane Dredge Plume Monitoring 2026 In Situ and Satellite Derived Turbidity

Final

Chern'ee Sutton
Indigenous artist



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Executive Summary

Background

Port of Brisbane Pty Ltd (PBPL) undertakes routine maintenance dredging to maintain safe navigation depths within the Brisbane River, approach channels and berth areas. The Dredge Plume Monitoring Program (DPMP) characterises the extent, intensity and duration of dredging-related suspended sediment plumes and assesses their potential to reach nearby sensitive environmental receptors.

This report presents the 2026 DPMP results for maintenance dredging by the trailing suction hopper dredge (TSHD) *Brisbane*, with monitoring focused on the Spitfire Realignment Channel, Inner Bar and Mud Island Dredge Material Placement Area (DMPA).

Field monitoring included turbidity profiling, TSS and particle size sampling, in-situ particle size measurements and vessel-mounted ADCP transects to describe plume structure through the water column. Sentinel-2 and Landsat imagery from January 2025 to June 2026 was reviewed against the 2011–2025 satellite derived turbidity baseline to provide broader surface-water context.

Findings

At the Spitfire Realignment Channel, waves and tidal currents continually rework the mobile sandy seabed, producing elevated near-bed ambient TSS of about 60–100 mg/L compared with 0–20 mg/L through most of the water column. Dredging-related TSS was typically 20–40 mg/L, with short lived plume cores exceeding 100 mg/L near the dredge path. Concentrations returned rapidly toward background outside the immediate dredge path.

At the Inner Bar and MIDMPA, ambient background TSS concentrations outside active plume zones remained generally low, typically under 15 mg/L. Against this measured background, dredging and placement generated detectable but localised plumes. Inner Bar plume concentrations were typically about 30 to >100 mg/L in the plume core and reduced toward background over short distances. At the DMPA, disposal plume concentrations were initially about 50–300 mg/L before settling, advection and dispersion reduced concentrations toward background.

These results are consistent with previous PBPL plume monitoring extending back to the 1990s, which has shown that dredging and placement plumes are generally confined to the immediate operational area, attenuate over short timescales and become difficult to distinguish from background turbidity within the naturally dynamic lower Brisbane River and western Moreton Bay system.

The satellite derived analysis assessed surface turbidity during active dredging using coincident Sentinel-2 and Landsat imagery from Fisherman Islands Swing Basin and Inner Bar operations between March 2025 and March 2026. Where visible, surface turbidity features were low intensity and spatially constrained to the berth pocket, dredge channel or immediate vicinity of the dredger, with observed turbidity generally in the order of 6–24 FNU.

Satellite imagery is useful for identifying the surface expression and regional context of turbidity; however, it represents surface optical conditions only. It does not fully resolve near-bed plume components, which were the main dredging-related feature identified by the in-situ and ADCP monitoring, particularly where suspended sediment remained concentrated close to the seabed.

Overall, the combined field and satellite evidence indicates that the monitored dredging and placement activities generated localised, short-term turbidity responses. The strongest dredging-related signals were generally near-bed or close to the dredge path, while surface expressions observed in satellite imagery were limited in extent. There was no evidence that dredge plumes extended to sensitive receptor sites, including seagrass meadows at Fisherman Islands or reefs at Mud Island.

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1 Introduction

1.1 Background

The Port of Brisbane Pty Ltd (PBPL) is responsible for the maintenance of 90 km of navigational shipping channel stretching from the northern reach of Bribie Island, across Moreton Bay, and into the Brisbane River. Maintenance dredging along the Entrance Channel off Fisherman Islands and the Hamilton Reach of the Brisbane River is also undertaken to enable safe passage of vessels visiting berths upstream. All dredging is conducted within approved navigation channels, berths and swing basins. The maintenance dredged material is either placed within the Port of Brisbane Future Port Expansion (FPE) reclamation area or Mud Island Dredge Material Placement Area (DMPA), depending on dredged material properties and PBPL operational needs.

Dredging and disposal activities create turbid plumes of suspended sediment. Once disturbed by dredging activities, seabed sediments become entrained in the water column, creating plumes of turbid water. The nature and extent of the turbid plumes depends on a range of factors including the type of dredge, the depth of dredging, the nature of the dredged material, the magnitude and direction of tidal currents, the surrounding bathymetry and the prevailing weather. PBPL has implemented the Dredge Plume Monitoring Program (DPMP) to investigate the spatial and temporal patterns and behaviour of dredge plumes, and to characterise their extent, intensity and duration to inform an understanding of the potential exposure of sensitive receptors. The DPMP builds on earlier plume monitoring studies undertaken for the port's dredging fleet (e.g., WBM Oceanics Australia 1995, 1997, 2002a, 2002b, 2004; BMT WBM 2008, 2011, 2014, 2017; BMT 2020; BMT 2023). BMT (2023) summarises the findings of previous dredge plume monitoring studies in the lower Brisbane River and Mud Island DMPA (MIDMPA).

The DPMP provides detailed information on dredge plume behaviour during active dredging and disposal operations, particularly through the water column. To complement these methods, the 2026 monitoring program includes a satellite derived turbidity assessment focused on imagery coincident with active dredging operations. This provides a broader surface-water perspective on the spatial expression of dredging-related turbidity, while recognising that satellite imagery does not resolve near-bed plume components and may be affected by artefacts such as shoals, tidal flats, vessel wake, propeller wash and floating infrastructure.

Historical satellite derived turbidity data from 2011–2025 (BMT 2025) are used as contextual information to support interpretation of whether observed surface turbidity features fall within the range of expected estuarine variability. The historical assessment shows a persistent land-to-sea turbidity gradient, episodic rainfall-related turbidity responses and no evidence of a persistent long-term shift in baseline surface turbidity conditions over the assessment period.

Together, the field and satellite components provide complementary lines of evidence for interpreting dredge-related turbidity during the 2026 monitoring period.

1.2 Aim and Objectives

The aim of the 2026 DPMP is to characterise turbid plumes generated by typical operations of the trailing suction hopper dredger (TSHD) Brisbane, and to interpret field observations alongside satellite derived surface turbidity information. The specific objectives of this study are to:

- Quantify the behaviour, extent and intensities of plumes of suspended dredged sediments at and adjacent to the dredging (loading) sites within Spitfire Realignment Channel, off the Fisherman Islands Wharves in the Brisbane River Entrance Channel (called 'Inner Bar') and the MIDMPA
- Assess satellite derived surface turbidity observations coincident with active dredging operations and interpret these in the context of rainfall, field observations and known remote-sensing limitations
- Use historical satellite derived turbidity information as contextual baseline data to help interpret whether observed surface turbidity features are consistent with expected estuarine variability
- Based on the measurements assess the potential exposure of existing sensitive receptors to sediment plumes.

1.3 Description of the Activity

The Brisbane is the largest vessel in PBPL's dredging fleet and is an 85 m long ocean-going trailing arm suction hopper dredge (TSHD). The Brisbane performs maintenance and capital dredging works within the Port of Brisbane for around three months of the year and contract maintenance dredging services for Central and North Queensland ports for the remainder of the year. The Brisbane is equipped with two trailing arm suction heads, on the port and starboard sides of the vessel, which are typically lowered and dragged along the seafloor, simultaneously dredging the bed sediments either side of the vessel as it progresses forward. The drag heads are lifted clear of the seabed when moving astern. To efficiently fill the hopper (volume 2,900 m³) with dredged material, the vessel is usually operated in an overflowing mode whereby the dredged sediments are concentrated within the hopper over time. A telescoping weir within the centre of the hopper can be elevated to maximise the retention of dredged material before discharge from the hopper occurs. Excess water and suspended sediments are ultimately discharged from the hopper via the weir to the underside of the keel, approximately five metres below the water line. Depending upon the nature of sediments to be dredged, dredging to effectively fill the dredge hopper generally lasts around one hour, typically without any overflow from the hopper occurring in the first 15—20 minutes.

Subsequently, a dredging overflow plume of turbid water is usually obvious as the overflow water and suspended sediments discharged from the underside of the keel are entrained to the water surface by the action of the vessel's propellers operating near the stern of the vessel as it moves ahead. This results in an obvious surface plume of dredged sediment astern of the Brisbane for the remainder of the dredging cycle.

Following cessation of dredging, the Brisbane typically delivers its load of material to a designated disposal area, either the Mud Island DMPA or onshore at the FPE. For offshore disposal, the dredger typically slows to a speed of a few knots on arrival at the DMPA and the dredged sediment loaded within the hopper is deposited over the required placement area by opening a series of five valves set within the bottom of the hopper, allowing for gravitational settlement of dredged material from the vessel through the water column to the seafloor. Alternatively, the dredged material can be pumped ashore from the hopper for settlement within bunded reclamation areas, for example at the Port of Brisbane FPE area.

1.4 Maintenance Dredging Activities Undertaken

Monitoring of the turbid plumes around the Brisbane took place on 26 May and 2 June 2026 whilst the Brisbane was performing the following duties:

- Maintenance dredging in the Spitfire Realignment Channel on 26 May from 10:30 to 11:30 am on a late ebbing tide approaching a low tide
- Maintenance dredging in the Inner Bar of Brisbane River on 2 June from 8:00 to 9:30 am on a flooding tide.
- Material placement at the MIDMPA on 2 June from 10:06 – 10:49 am from the end of the flood tide and into the ebbing tide (Figure 1.1).



Figure 1.1 TSHD *Brisbane* during active disposal at MIDMPA on 2 June 2026

The measured tide at the Queensland Department of Transport and Main Roads (TMR) Brisbane Bar Tide Station and the respective monitoring periods are presented in Figure 1.2. Additionally, the field monitoring locality plan, and dredge activity and monitored transecting locations are shown in Figure 1.3 and Figure 1.4 respectively.

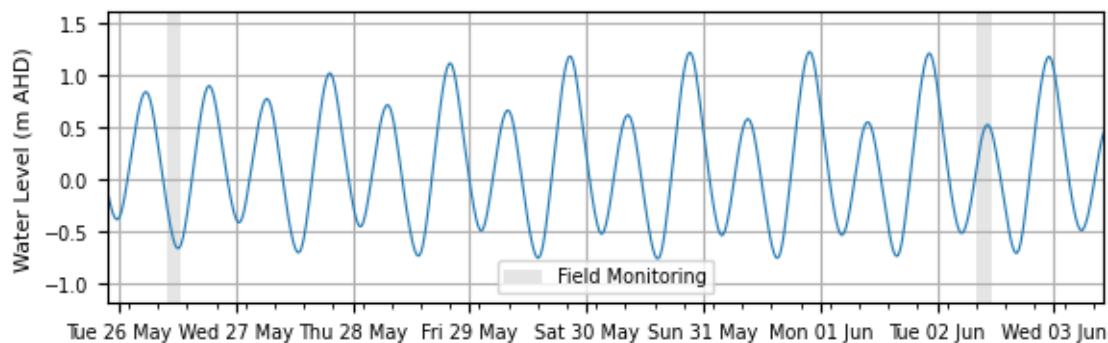
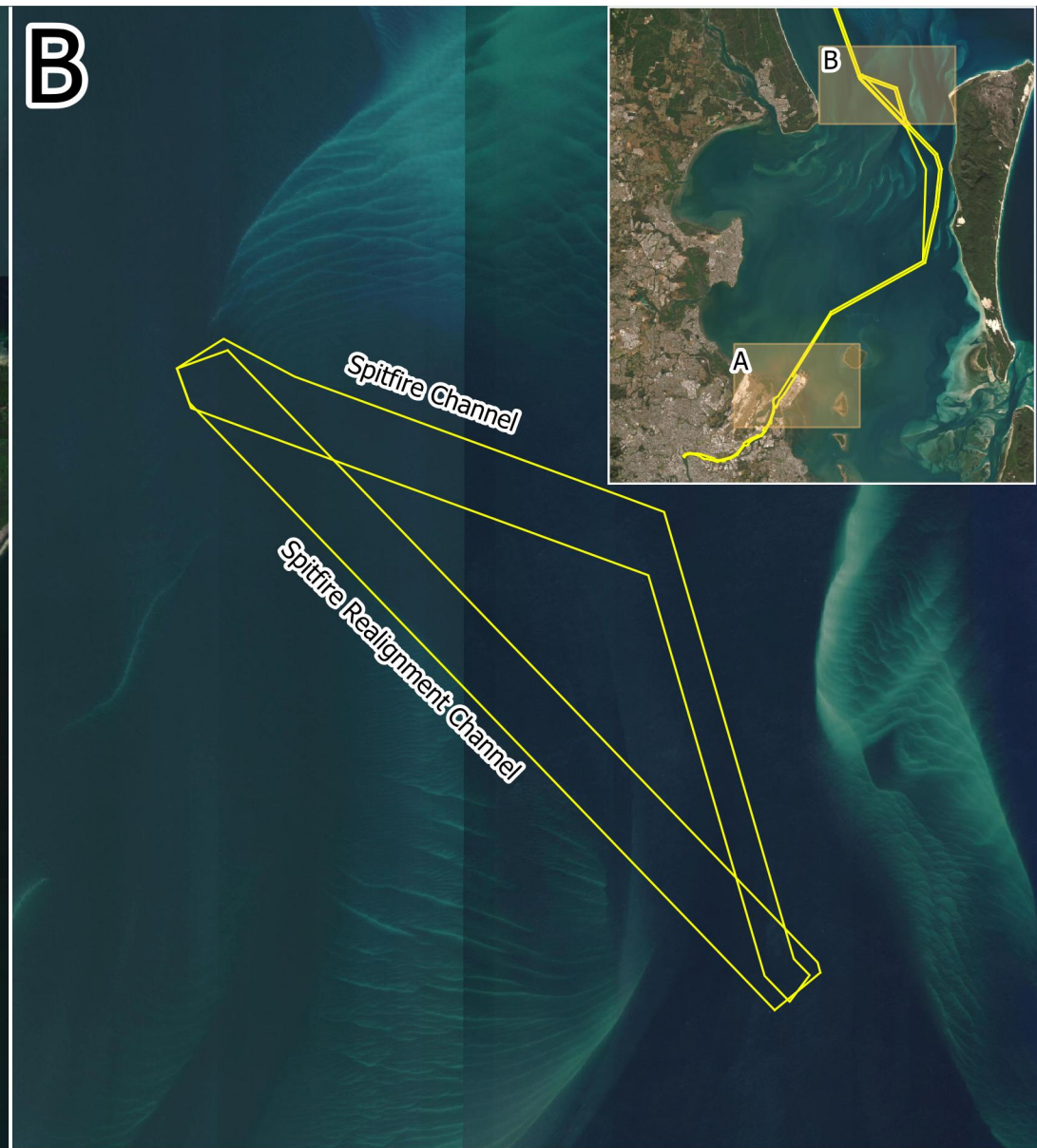
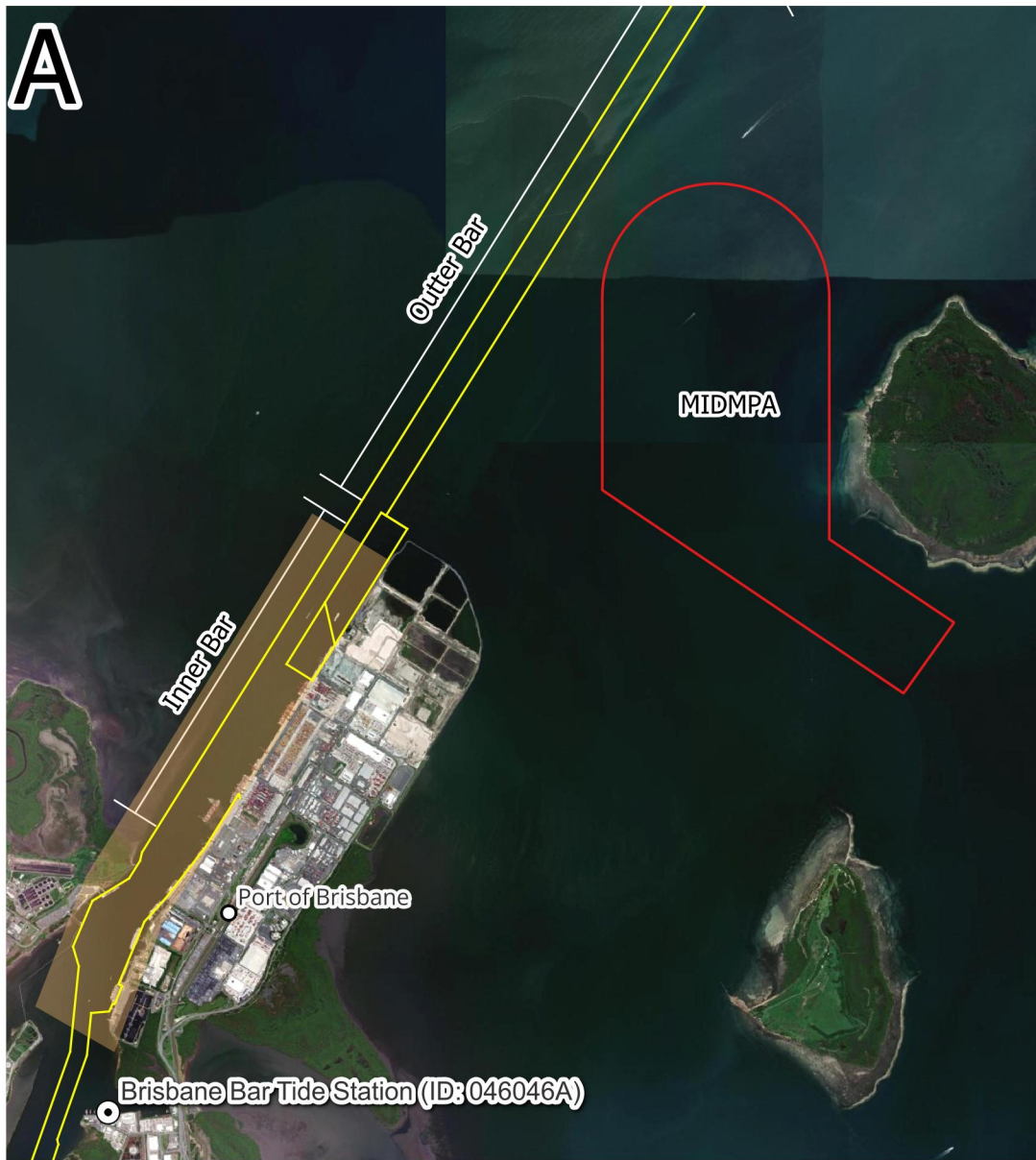


Figure 1.2 Measured water level at the Brisbane bar tide gauge over May to June field monitoring campaign (Source: TMR 2026)



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- Dredging extent
- Dredge material placement area
- Zone 2 (BMT 2025)

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Dredge Turbidity Monitoring Locations

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2 Methods

2.1 In-Situ Dredge Turbidity Monitoring

2.1.1 Field Data Acquisition

All field measurements were conducted using BMT's six metre research vessel *Resolution II* operating in the vicinity of the dredging operations. During the dredge plume monitoring, BMT communicated and co-ordinated measurement and sampling activities with the dredging plant via mobile telephone or VHF marine radio.

The following field measuring instrumentation and techniques were employed during the dredge plume monitoring:

- Turbidity profiling, using a Yellow Spring Instrument (YSI) EXO3 turbidity probe, within and beyond the extents of the dredge plumes for use in the calibration of the Acoustic Doppler Current Profiler (ADCP) and in assessments of the dredge plumes. Concurrent in-situ PSD measurements were collected using a Sequoia LISST-100 submersible particle size analyser. Due to an equipment malfunction resulting in the YSI not recording depth data at irregular intervals, available intervals with time-steps were used.
- Water sampling for laboratory analysis of total suspended solids (TSS) concentrations to be used in the calibration of the turbidity probe and in assessments of the dredge plumes. Selected samples were also analysed for particle size distribution (PSD). Water samples were sent to the laboratories of ALS for analysis of the TSS and PSD. In total, 17 TSS samples and 17 PSD samples were taken. Due to safety considerations relating to vessel operations in close proximity to maritime infrastructure, sampling at Inner Bar was limited to a single sample location. Refer to Annex A for the raw TSS results, and Annex B and Annex C for the raw and summarised PSD results, respectively. PSD results are discussed in Section 3.5.
- Transect data collection of the dredge plumes with a vessel mounted downward facing 500 kHz Nortek VM ADCP to record the acoustic backscatter intensity, providing an insight into the otherwise hidden plume characteristics across the various transects.

An example of the co-located YSI, LISST-100 and pump sampling frame are shown in Figure 2.1.



Figure 2.1 Plume monitoring equipment setup including the ADCP mounting pole, and the profiling array including the co-located LISST, YSI and pump sampler frame (BMT 2023).

2.1.2 Post Processing

Processed ADCP measurements were used to remotely measure the suspended sediment in the water column with sufficient resolution to provide pictorial views of the suspended sediment associated with dredging. ADCP measurements can be used to estimate suspended sediment concentrations throughout the water column, however an ADCP instrument does not directly measure TSS. The principle of ADCP operation is that a pulse of sound is propagated through the water column and is reflected/backscattered off suspended particles such as suspended sediments. The Doppler shift of the backscattered acoustic signal is used to directly determine the water currents throughout the water column. The intensity of the backscattered echo can be translated into TSS values through a series of steps as detailed below.

Laboratory analysis of the TSS in water samples spanning a wide range of sediment concentrations provided the means to calibrate the measurements from the YSI EXO3 turbidity profiling instrument. By pairing the TSS values with the Nephelometric Turbidity Units (NTU) recorded in the field by the YSI sonde, the site and date specific NTU-TSS relationship was determined using linear regression analysis.

The turbidity profiles measured with the YSI, once converted to TSS, were then used to derive a relationship between the ADCP acoustic signal volumetric backscatter intensity and TSS. Model post processing operations were conducted to derive this relationship for the concurrent YSI turbidity-derived TSS and ADCP bin backscatter at the corresponding sample depth using linear regression analysis. Once this relationship has been determined for each monitoring day, the volumetric backscatter transect profiles were then converted to TSS. ADCP backscatter measurements are prone to occasional spikes/elevated values that are unrelated to TSS in the water column. These spikes may arise due to several sources of interference, including bubbles and turbulence generated near the surface by the dredge, survey vessel, third-party vessel or other objects 'ensnified' in the water-column such as plankton, fish or seaweed. Transect data were visually screened to determine erroneous backscatter signatures, where the corresponding transects were subsequently excluded from the formulation of the backscatter-to-TSS regression analysis.

2.1.3 Result Interpretation

To characterise the turbid plume behaviour in terms of extent, intensity and longevity, spatial plots of the estimated suspended sediment concentration are presented for the respective monitoring locations and times in Section 3. An example of these plots is provided in Figure 2.2. Due to the complexity of such plots, the layout and interpretation is described in detail below.

The plots are comprised of two components, an upper and a lower component. The upper component depicts the depth averaged plume concentrations in plan-view along the transect. The lower component is a profile-view of the ADCP transect which depicts the TSS concentrations along the transect and through the water column.

The coloured pentagons in the lower component depict the YSI TSS (based on turbidity) profile measured on the transect. The colour of each pentagon represents the TSS concentration returned by the YSI which align with those returned by the ADCP. The YSI profiles are plotted directly onto the elevation-chainage axes. As the YSI instrument is lowered down through the water column, a process which can take over a minute, the monitoring vessel often drifts with the wind/currents and hence the chainage along the transect increases with depth. Hence the YSI profiles do not appear vertical.

The green 'x' plotted in the upper component identifies the start of the ADCP transect which extends from left to right in the lower profile-view component of the plot. All ADCP transects have been presented with a green 'x' at the start of the transect (0 m chainage) and a red 'x' at the termination of the transect. The timing of the measurement within the tidal cycle is depicted in the upper left-hand corner of the plot (time-of-day shown on x-axis). The operations of the TSHD Brisbane are represented by small, coloured circles in the upper pane.

They depict the Brisbane's position at the time the transect was conducted and where and how the dredge had been operating for the past 10-minutes prior to the start of the transect and up until the end of the transect.

To capture the hydrodynamics over the period of measurement, the depth-averaged current magnitudes and directions along the sampled transect are superimposed in the form of quiver arrows in the upper panel.

TSS estimates are capped at a maximum value due to the uncertainty surrounding the backscatter-TSS relationship above that value. It should also be noted that due to its mounting location and a measurement "blanking-distance", the ADCP was only able to resolve TSS profiles below approximately 2.5 m depth. Due to "sidelobe" interference, the ADCP was also unable to estimate the TSS within approximately 0.5 m from the bed. Background concentrations have not been removed from the data. Several of the data sets include a transect conducted before the dredge commenced operations and hence depict the background concentrations at that time. Where possible, the transects extend beyond the extents of the dredge plume and hence can be used to quantify the background concentrations at the time of the transect.

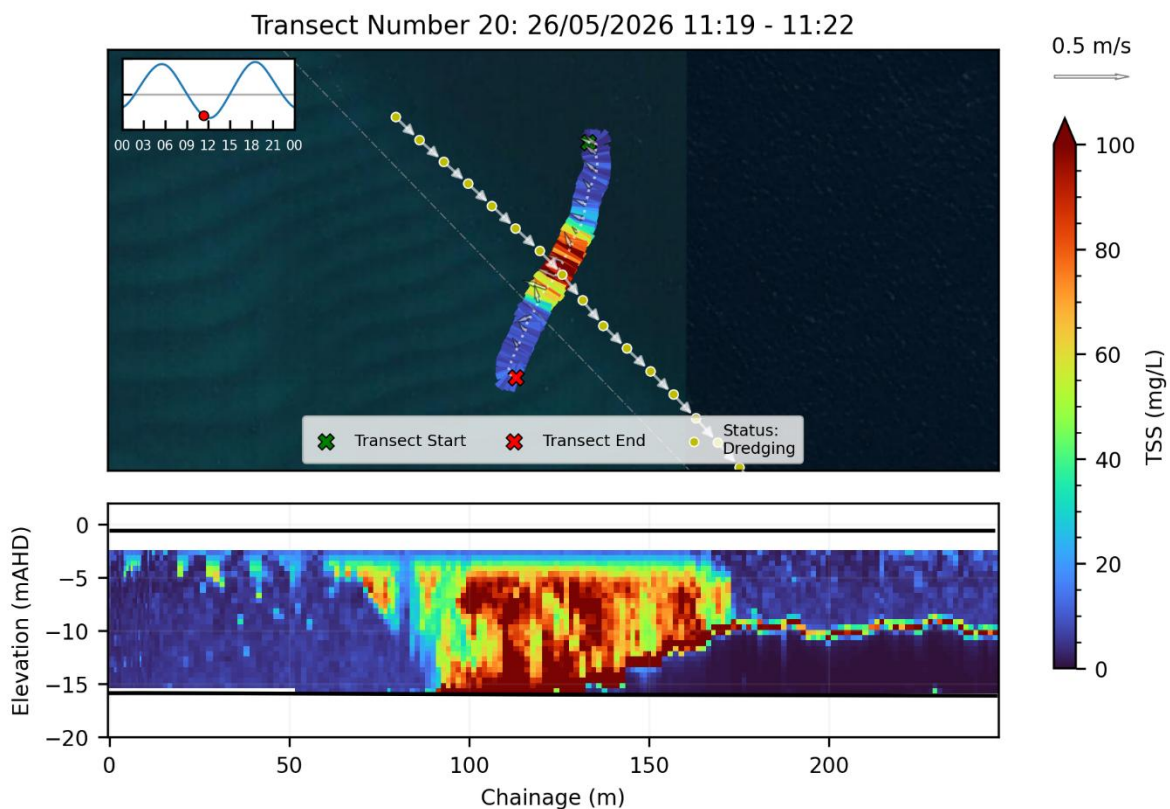


Figure 2.2 Example of turbid plume transecting following dredging event

2.2 Satellite Derived Turbidity

2.2.1 Dredge Log and Satellite Imagery Acquisition

Daily dredge logs were obtained from PBPL for the period January 2025 to 2 June 2026. The logs comprised time-stamped records of dredging activities, including dates, dredged volumes (load amounts), and associated disposal locations.

Satellite imagery from the Landsat and Sentinel-2 constellations was reviewed for the period January 2025 to 2 June 2026. Dredge log records were used to identify periods of dredging activity within the Inner Bar and Spitfire Realignment Channel, and these were cross-referenced against available satellite imagery suitable for post processing. Suitable imagery captured active dredging at the Inner Bar; however, no suitable imagery captured active dredging at the Spitfire Realignment Channel. As such, satellite based turbidity analysis and reporting was undertaken for the Inner Bar only.

Dredge log records of disposal activities at MIDMPA were also reviewed in conjunction with satellite image availability. However, no suitable imagery capturing disposal events was identified, and satellite based turbidity analysis for disposal activities was therefore not undertaken.

2.2.2 Post Processing

All satellite imagery was processed using a consistent workflow to retrieve water-leaving reflectance and exclude pixels affected by land, clouds, cloud edges, cirrus, sun glint prior to turbidity estimation.

Atmospheric Correction

Top-of-atmosphere imagery was atmospherically corrected using a dark spectrum fitting approach developed for aquatic applications (Vanhellemont 2019). Ancillary meteorological information from the MERRA-2 reanalysis dataset was used to support atmospheric characterisation and improve retrieval consistency across the satellite archive (Gelaro *et al.* 2017).

Masking and Artefact Removal

A suite of spectral masks and threshold tests was applied to exclude non-water and contaminated pixels. Land and bright artefacts were screened using short-wave infrared reflectance thresholds, high-altitude atmospheric interference was screened using a cirrus band, and pixels returning unphysical negative water-leaving reflectance were excluded.

Sun Glint Correction

Residual sun glint was mitigated using short-wave infrared bands to estimate surface reflection contributions and remove this signal from the visible wavelengths.

Turbidity Derivation

Turbidity was estimated using a semi-analytical approach based on the Nechad formulation, which relates water leaving reflectance to turbidity (Nechad *et al.* 2010; 2016). A band selection strategy was applied to maintain sensitivity across a broad turbidity range, using red wavelengths for clear to moderately turbid waters and near infrared wavelengths where red-band reflectance may saturate under highly turbid conditions. Turbidity is reported in Formazin Nephelometric Units (FNU). While FNU is approximately equivalent to NTU (1:1) under controlled laboratory conditions, differences may arise in natural waters, and satellite retrievals represent a surface optical signal rather than a depth specific point measurement.

2.2.3 Historical Satellite Turbidity Context

Under the historical reporting (BMT 2025), to support spatially resolved interpretation, zones were created representing distinct hydrodynamic settings and varying levels of exposure to catchment influence and anthropogenic activity, ranging from inner estuarine waters to offshore bay environments. For the purpose of this assessment the following zone(s) are applicable:

- Zone 2—Port of Brisbane / Bulwer Island / Crab and Lytton Creeks—under the *Environmental Protection Policy 2019* the water type is considered an enclosed coastal to lower estuary (MD). It is a shallow port and industrial creeks with restricted flushing and very high baseline turbidity.

Monthly turbidity statistics for Zone 2 were derived for the 2011–2025 period, with a long-term median turbidity of approximately 8.2 FNU. Monthly distributions are presented in Figure 2.3 , with summary monthly mean and medians provided in Table 2.1.

Satellite imagery capturing dredging within Inner Bar was qualitatively compared against the corresponding historical monthly turbidity statistics for Zone 2 to provide contextual interpretation of observed turbidity conditions.

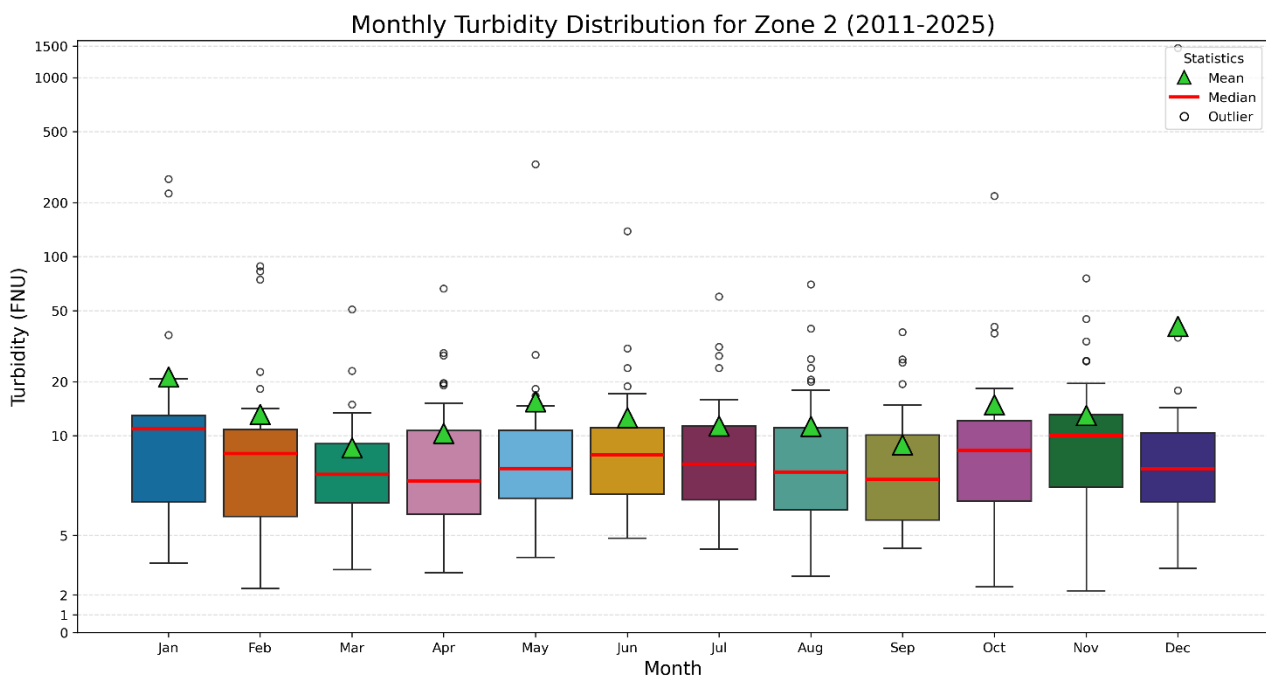


Figure 2.3 Monthly Turbidity Distribution for Zone 2—2011-2025

Table 2.1 Historical Turbidity (2011-2025) within Zone 2

Month	Mean (FNU)	Median (FNU)
January	63.06	9.70
February	21.87	10.72
March	21.02	9.38
April	9.20	7.84
May	9.12	6.93
June	8.00	7.22
July	8.41	6.58
August	7.10	6.52
September	11.80	10.47
October	15.44	10.56
November	13.87	10.71
December	11.97	9.07

2.2.4 Rainfall Comparison

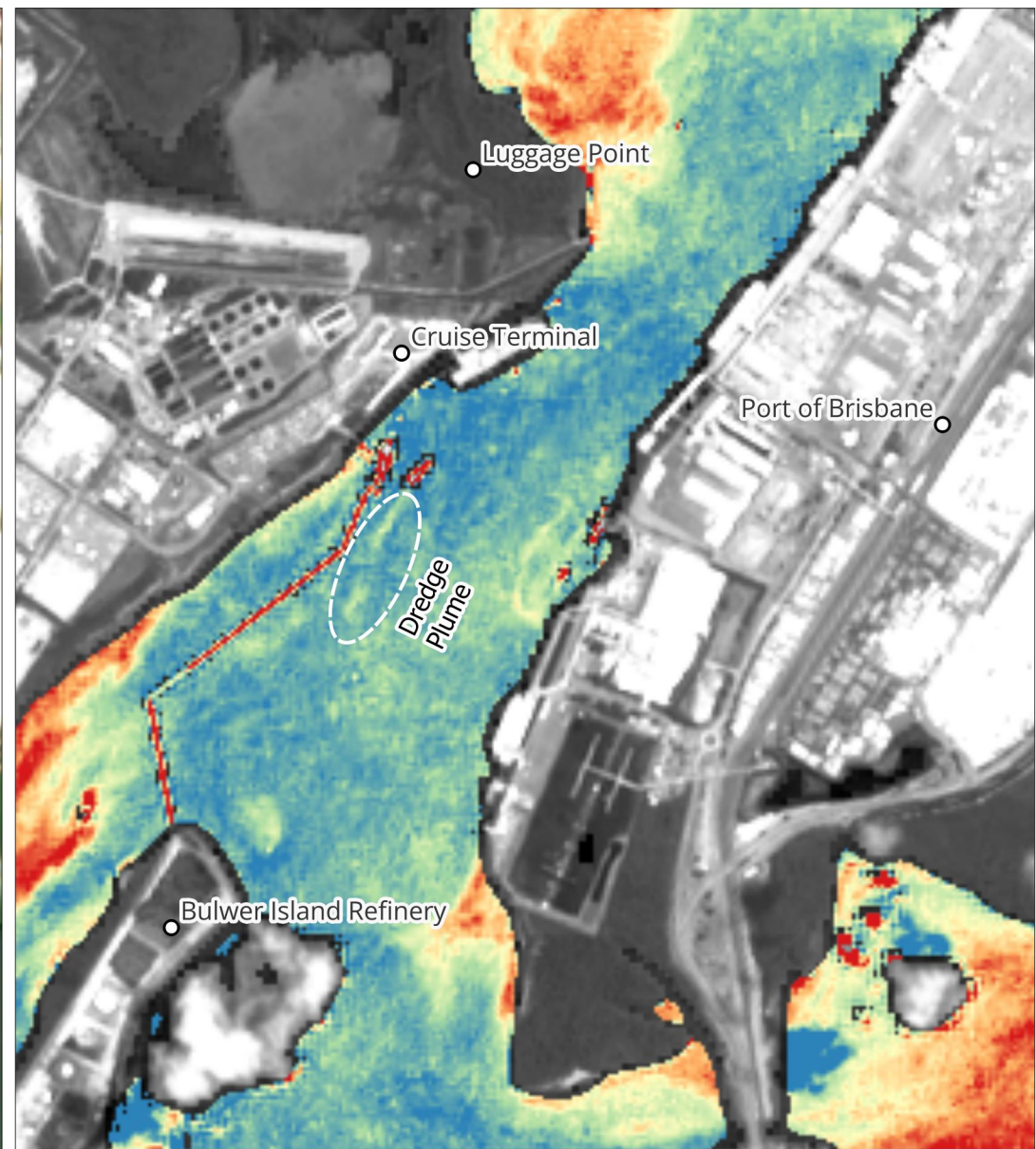
Daily rainfall (mm) totals were obtained from five BOM stations representing key areas within the Brisbane River catchment or the period January 2025 to 2 June 2026. To capture spatial variability stations selected include Wivenhoe Dam (Station:40763), Helidon TM (Station:40829), Brisbane Aero (Station: 040842), Ipswich (Station: 40831), and Greenbank (Station:140009). Rainfall data were reviewed qualitatively to characterise antecedent conditions within approximately 48 hours of dredging activities, providing context to distinguish satellite derived dredging-related turbidity from rainfall driven variability.

2.2.5 Limitations

Key limitations relate to the observational characteristics of satellite remote sensing and the complexity of turbidity processes in estuarine–coastal systems. Satellite-derived turbidity represents surface conditions at the time of image acquisition and therefore captures only a snapshot of conditions rather than the full temporal evolution of dredging or natural turbidity events. As a result, observed patterns may reflect short-lived or transient conditions and may not be representative of sustained activity.

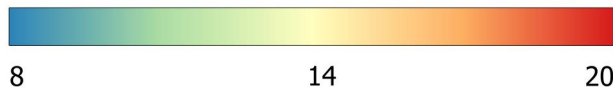
Satellite retrievals reflect surface optical conditions, while *in situ* sensors measure turbidity at fixed depths. Differences are therefore expected where vertical variability in the water column influences the relationship between surface and subsurface conditions. In addition, satellite observations represent spatially averaged conditions over each pixel, whereas *in situ* monitoring provides point-based measurements. Comparisons are therefore focused on consistency in overall patterns and event presence rather than direct equivalence in absolute values.

Interpretation of imagery during dredging periods is also subject to potential artefacts. Features such as vessel traffic, boat wake, natural variability driven by tidal advection, sediment resuspension and background conditions can influence surface reflectance. These factors may result in surface turbidity appearing elevated in satellite imagery, independent of dredging-related plumes. Examples of these artefacts are illustrated in Figure 2.4.



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Turbidity (FNU)



Note: Localised red linear features represent surface water disturbances (such as vessels and boat wakes) or land artefacts, rather than elevated turbidity.

Title:

Example of artefacts on satellite turbidity (Sentinel-2B: 04 February 2025, 10:04 AEST)

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3 Results

3.1 TSS and Turbidity Relationship - 26 May 2026)

Figure 3.1 shows the relationship between turbidity and TSS from background and plume samples generated by TSHD *Brisbane* collected at Inner Bar and MIDMPA across the monitoring campaign. A strong positive linear relationship was observed between turbidity and TSS, with the regression model fitted through the origin ($R^2 = 0.98$).

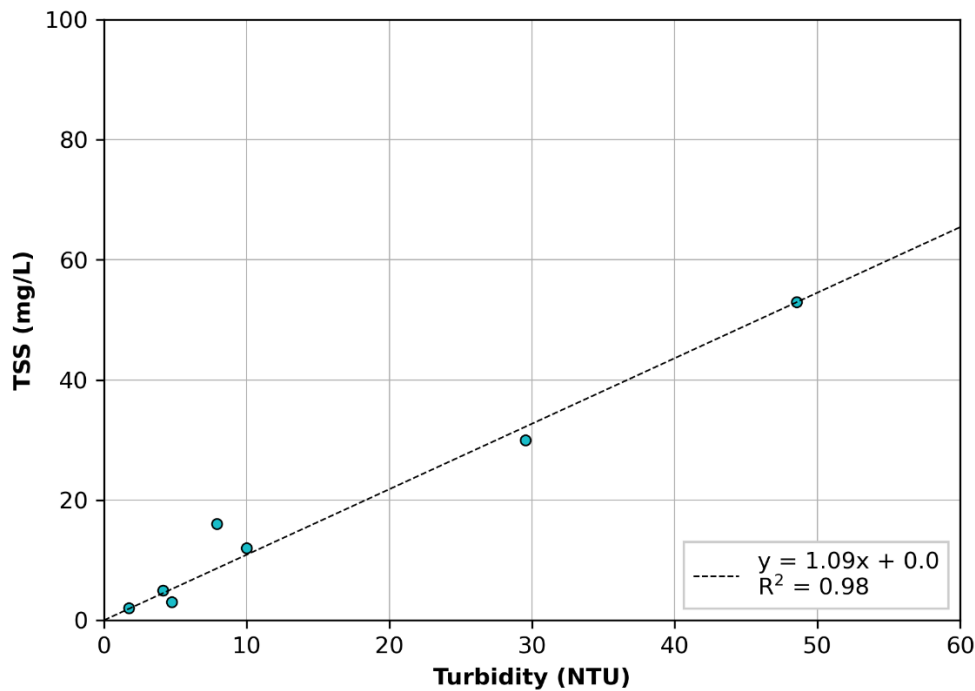


Figure 3.1 Water Sample TSS and Turbidity Correlation Plot on 26 May 2026 at Inner Bar and MIDMPA

3.2 TSS and Turbidity Relationship - (2 June 2026)

Figure 3.2 shows the relationship between turbidity and TSS from background and plume samples generated by TSHD *Brisbane* collected at Spitfire Realignment Channel across the monitoring campaign. A strong positive linear relationship was observed between turbidity and TSS, with the regression model fitted through the origin ($R^2 = 0.98$).

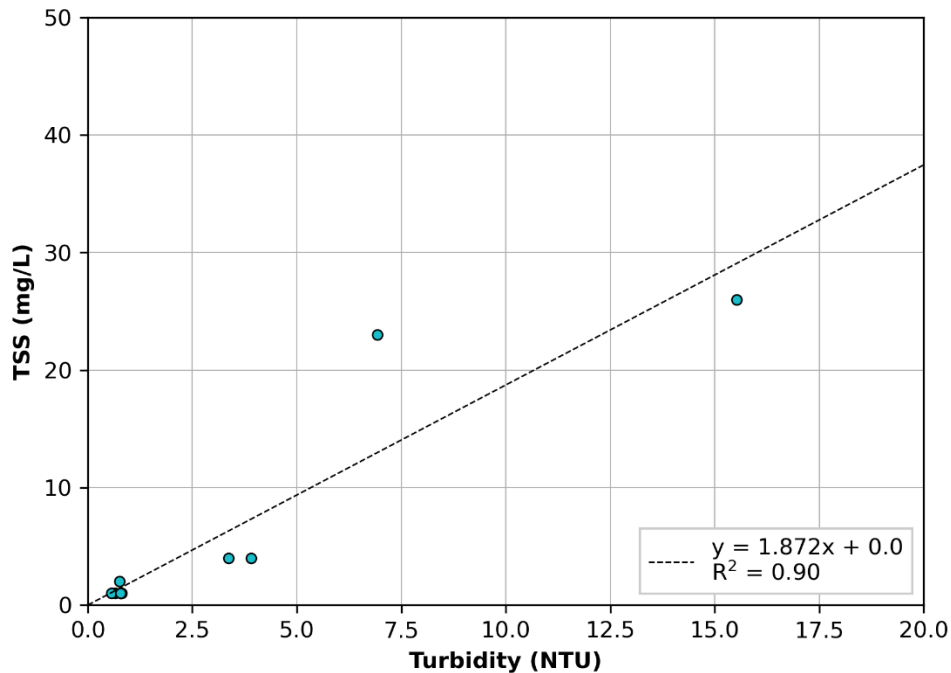


Figure 3.2 Water Sample TSS and Turbidity Correlation Plot on 2 June 2026 at Spitfire Channel

The conversion factor from turbidity to TSS differed between the 2014, 2017, 2020, 2023 and 2026 studies – based on a y intercept at 0, the lines of best fit for the respective years are:

- TSS (2014) = $1.3 \times$ turbidity. This relationship was based on measurements undertaken at the Swing Basin and Outer Bar Cutting.
- TSS (2017) = $2.9 \times$ turbidity. This relationship was based on measurements undertaken at the Pelican Banks Swing Basin and Inner Bar.
- TSS (2020) = $1.9 \times$ turbidity. This relationship was based on measurements undertaken at the Hamilton Reach.
- TSS (2023) = $1.8 \times$ turbidity. This relationship was based on measurements undertaken in this present study at the Inner Bar/Entrance Channel and DMPA.
- TSS (2026) = $1.87 \times$ turbidity. This relationship was based on measurements undertaken in this present study at Spitfire Realignment Channel.
- TSS (2026) = $1.09 \times$ turbidity. This relationship was based on measurements undertaken in this present study at the Inner Bar and DMPA

The difference among years reflects both the broader range (i.e. higher concentrations) of TSS measured and differences in dredged material properties between years (and related to this, different areas dredged).

3.3 TSS and Volumetric Backscatter Relationships

As described in Section 2.2, conversion of the Nortek VM ADCP volumetric backscatter to SSC was conducted using a derived relationship linking the inferred YSI SSC measurement (adopting the relationship shown in Figure 3.1) and the concurrent backscatter at the corresponding ADCP bin. Based on acoustic theory, a log-linear model was fitted to produce the ADCP suspended sediment concentration relationship. Due to the varying contextual conditions of each monitoring day (i.e., different site locations, sediment types, etc.), separate relationships were derived for each day.

3.3.1 TSS and Volumetric Backscatter Relationships - 26 May 2026

The full set of Volumetric Backscatter – SSC relationships derived for the 26 of May shown in Figure 3.3. Here, the point density is illustrated in the colour-scale, where dark blue represents a high frequency of occurrence (and thus a larger weighting to the fitted relationship). Although this relationship assumes that the variation of volumetric backscatter is by proxy of suspended sediment concentration, the passive nature of the backscatter measurements means that the backscatter signal could also include artefacts such as bubble interference, or other particulates in the water column. Subsequently, the trends are inherently characterised by substantial ‘noise’ and are reflected by lower regression coefficients (r^2 values). The regression coefficient shown in Figure 3.3 indicates a moderate agreement between ADCP volumetric backscatter and SSC, with 67.5% of the variation of SSC explained by the log-linear prediction. While varying correlations were returned for the other monitoring days, the derived relationships followed similar acoustic regression trends¹.

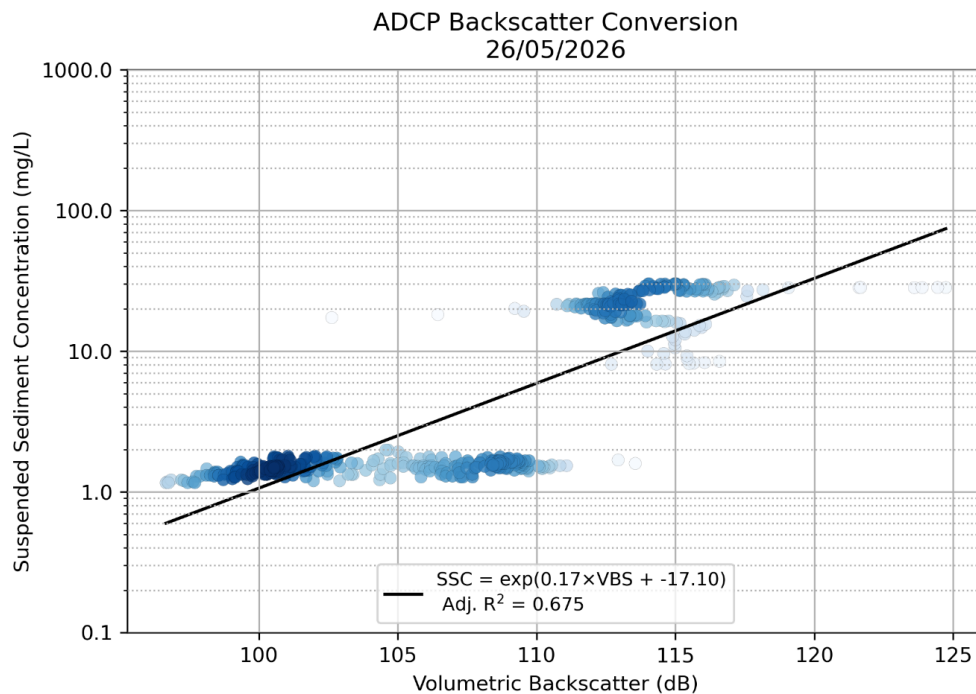


Figure 3.3 ADCP Volumetric Backscatter and Predicted Suspended Sediment Concentration for Sampling Conducted at Spitfire Realignment Channel on 26/05/2026. Colour Scale is Based on Sampling Point Density (Darker = More Points)

¹ Due to an equipment malfunction on 26/05/2026, depth measurements from the YSI instrument were not recorded at the intended intervals. Therefore, only time steps with complete depth and water quality records were retained for analysis.

3.3.2 TSS and Volumetric Backscatter Relationships - 2 June 2026

The full set of Volumetric Backscatter – SSC relationships derived for the 2 June shown in Figure 3.4. The regression coefficient shown in Figure 3.4 indicates a moderate agreement between ADCP volumetric backscatter and SSC, with 73% of the variation of SSC explained by the log-linear prediction. While varying correlations were returned for the other monitoring days, the derived relationships followed similar acoustic regression trends.

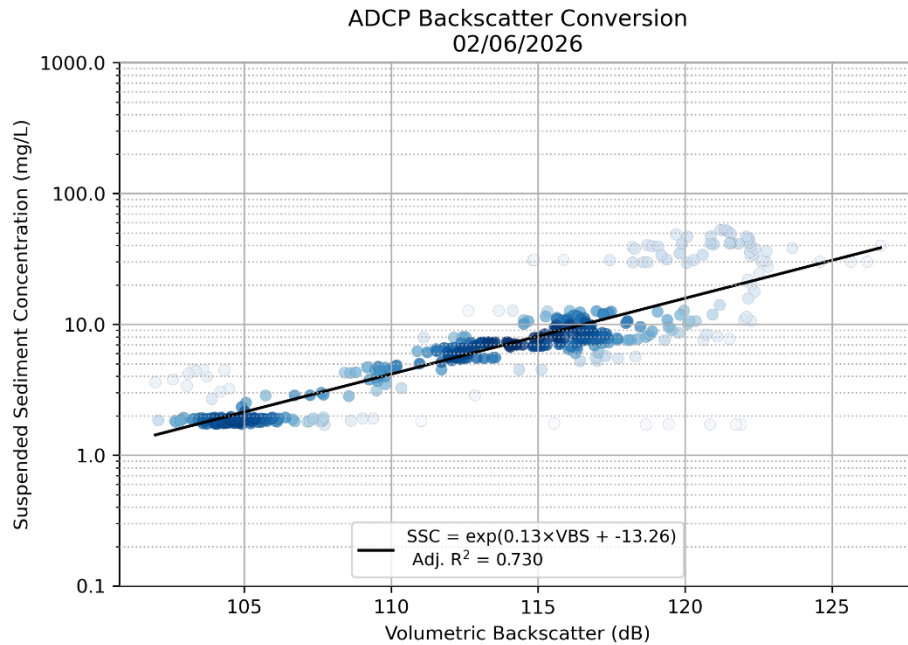


Figure 3.4 ADCP Volumetric Backscatter and Predicted Suspended Sediment Concentration for Sampling Conducted at the DMPA on 02/06/2026. Colour Scale is Based on Sampling Point Density (Darker = More Points)

3.4 Turbid Plume Transects

3.4.1 Spitfire Channel Dredging (26 May 2026)

The *Brisbane* undertook dredging of the Spitfire Realignment Channel from 2:46 to 19:13 on 26 May 2026. A summary of the *Brisbane* dredge activity during monitoring over the course of this period is shown in Table 3.1. Weather at the time of monitoring was mostly clear, with winds ranging 3 – 6 km/h from the SSW to NE.

Table 3.1 Summary of Dredge Cycle Activity During Monitoring on 26 May 2026 – Spitfire Channel

Cycle No.	Dredging Start	Dredging End	Disposal Start	Disposal End	Hopper Mass (tonnes)
69	10:31	11:37	14:37	15:41	3,835

Figure 3.5 shows a longitudinal background transect at Spitfire Channel. Ambient depth-averaged Total Suspended Solids (TSS) concentrations were generally low, ranging between 0 and 20 mg/L throughout most of the water column. However, elevated TSS concentrations reaching up to 60–100 mg/L were noted near the seabed (at an elevation of approximately -15 mAHd to -17 mAHd) between 150 m and 250 m chainage, as well as near the end of the transect past 400 m chainage. While these elevated concentrations are consistent with resuspension of mobile sandy sediments, interpretation of the strongest near-bed signals is subject to greater uncertainty due to the proximity of the measurements to the seabed and potential ADCP near-bed measurement limitation. The inset tidal graph indicates the measurements were captured during an ebbing tide.

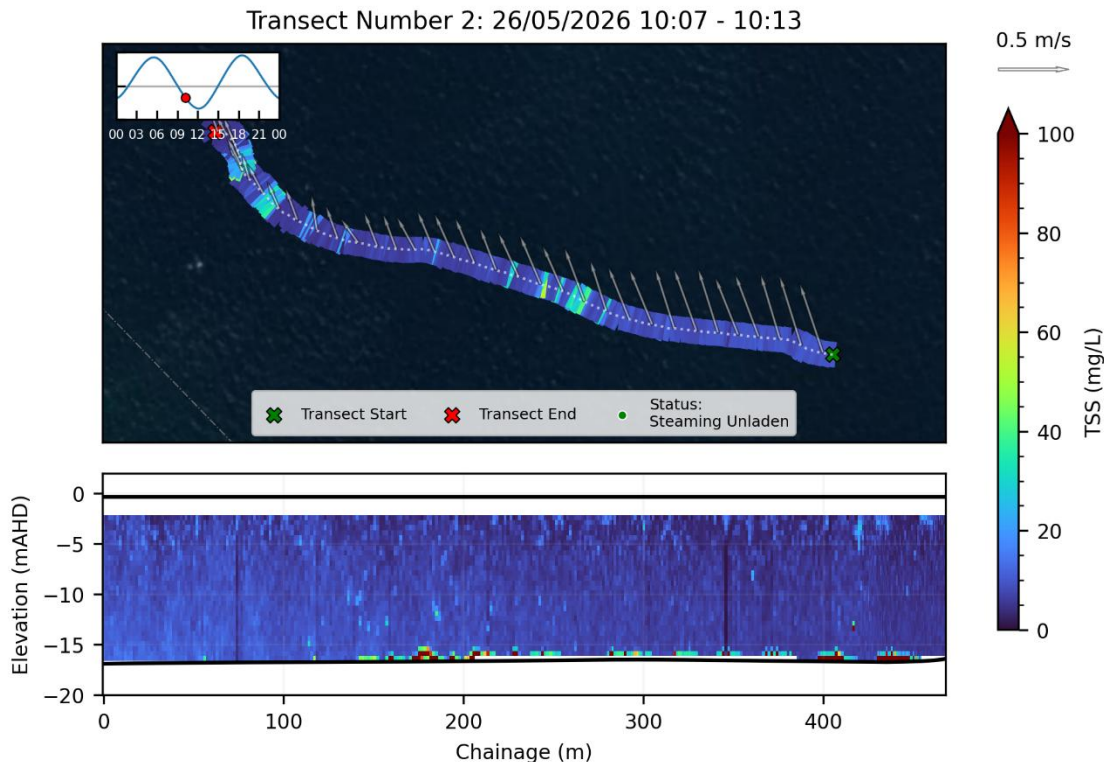


Figure 3.5 Background Transect off Spitfire channel from 10:07 – 10:13 26 May 2026

Figure 3.6 shows a cross-sectional transect at Spitfire Channel captured between 10:20 and 10:31, during an ebbing tide close to low slack water with surface current vectors flowing generally northwest. A low-intensity dredging-related plume was observed near the surface and upper water column (0 m to -5 mAHd) at the dredge site, with TSS concentrations of about 20–40 mg/L and a narrow lateral extent of approximately 30 m between 150 m and 180 m chainage. However, the most prominent feature was the near-bed TSS associated with ambient sand resuspension. This near-bed signal exceeded 80–100 mg/L along the seabed (-15 mAHd to -17 mAHd) across the first 250 m of chainage, consistent with the elevated near-bed resuspension also observed under background conditions, noting increased uncertainty in measurements collected immediately adjacent to the seabed.

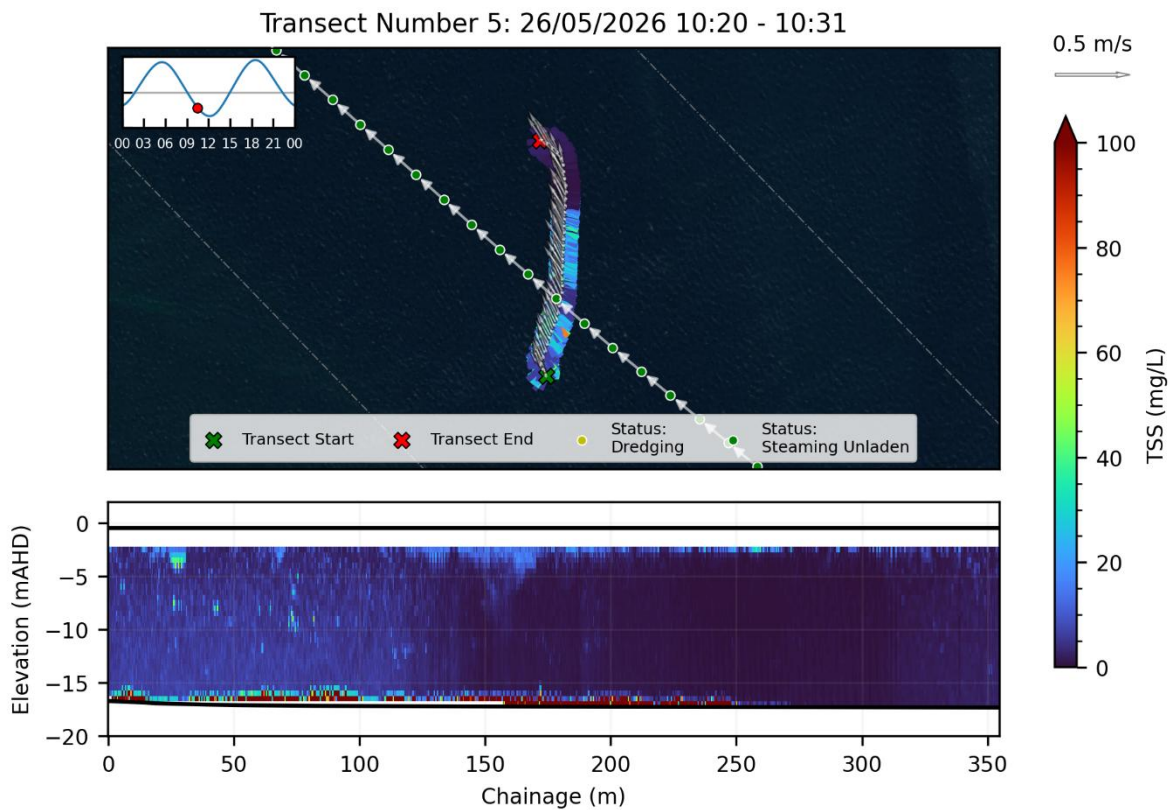


Figure 3.6 Transect off Spitfire Realignment Channel from 10:20 – 10:31 26 May Proceeding Dredge Pass (Dredging – No Overflow) at 10:25

Figure 3.7 shows a second cross-sectional transect intersecting the dredge path at Spitfire Channel, captured between 11:08 and 11:10. The transect was collected near low slack water as the tide began to flood, with surface current vectors directed generally northwest. A narrow (50 m and 85 m chainage) dredging-related plume was observed across the full water column, where the transect intersected the dredge path. Within this plume core, TSS exceeded 100 mg/L from near-surface waters to the channel bed, spanning approximately -3 mAHD to -13 mAHD. A weaker near-bed plume signature of about 20–40 mg/L was also observed between 0 m and 40 m chainage. Outside these plume zones, suspended sediment concentrations returned rapidly to ambient levels below 10 mg/L. This indicates that the dredge plume was a highly localised feature.

The full set of ADCP transects for monitoring conducted on 26 May are presented in Annex D. The depth-averaged suspended sediment concentrations for all ADCP tracks and the dredge coordinates and status over the course of monitoring conducted on 26 May 2026 are presented in Figure 3.8

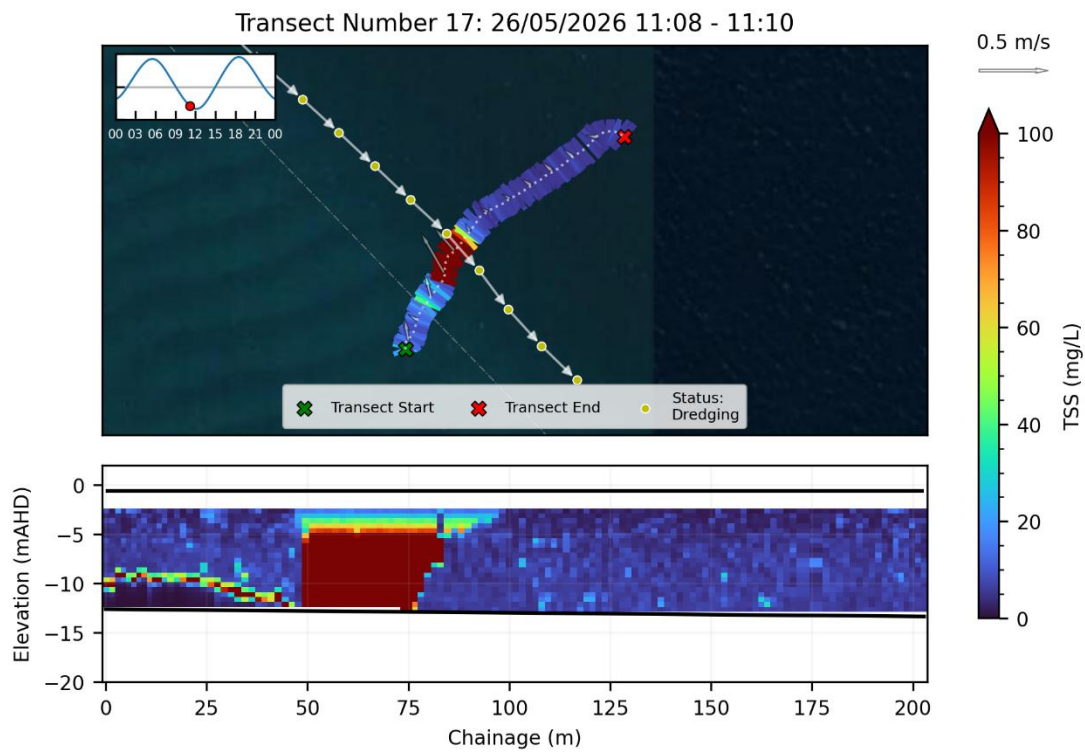
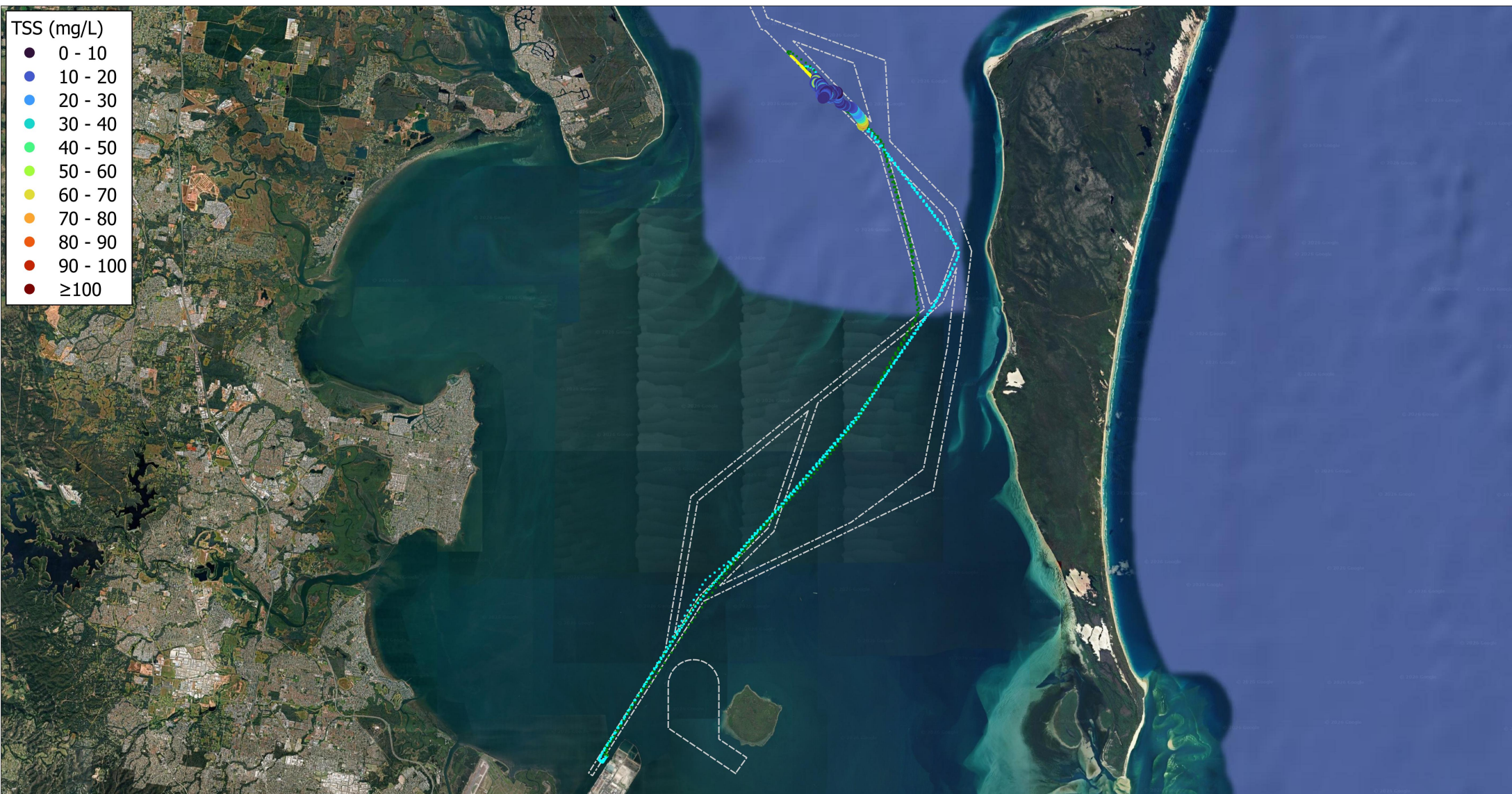


Figure 3.7 Transect off Spitfire Realignment Channel from 11:08 – 11:10 26 May Proceeding Dredge.



Legend

DMPA

Spitfire Channel

Dredge Status

Dredging

Dumping

Standby

Steaming Laden

Steaming Unladen

Title:

Depth-Averaged Suspended Sediment Concentration
26/05/2026

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3.4.2 Inner Bar Dredging and MIDMPA Disposal (2 June 2026)

The *Brisbane* conducted dredging in the Inner Bar on 2 June 2026 in various navigational channels. A summary of the *Brisbane* dredge activity in Inner Bar and disposal at MIDMPA during monitoring over the course of this period is shown in Table 3.2.

Table 3.2 Summary of Dredge Cycle Activity During Monitoring on 2 June 2026

Cycle No.	Dredging Start	Dredging End	Disposal Start	Disposal End	Hopper Mass (tonnes)
92	8:02	9:26	10:06	10:49	3,489

Weather at the time of monitoring was mostly clear, with winds ranging 7 – 19 km/h from the NNW to NEE.

Figure 3.9 to Figure 3.11 present a sequential time-series of transects observing the development and advection of the sediment plume produced during dredging operations (Cycle No. 92). The monitoring was captured during a flood and early ebbing tide, with surface currents moving generally north-westward relative to the 0.5 m/s reference indicator. Ambient background Total Suspended Solids (TSS) concentrations outside the active plume zones remained generally low, typically under 15 mg/L.

Figure 3.9 shows a cross-sectional transect captured approximately 27 minutes after the dredging cycle commenced, while the *Brisbane* was actively dredging adjacent to the transect path. A localised dredging-related plume was observed between 150 m and 170 m chainage. The plume was concentrated in the lower half of the water column, with core TSS concentrations of 60 mg/L to >100 mg/L between approximately -5 mAHD and -13 mAHD.

Figure 3.10 shows the next transect, captured immediately after Figure 3.9 as dredging continued. The plume had expanded to form a full-depth feature between approximately 50 m and 120 m chainage. Within this zone, TSS exceeded 100 mg/L from near-surface waters to the riverbed at about -15 mAHD. A lower-concentration near-bed layer of about 20–40 mg/L extended laterally along the channel floor beyond 150 m chainage, and an isolated near-bed feature of about 60 mg/L was observed near the end of the transect, beyond 250 m chainage.

Figure 3.11 shows a subsequent cross-channel transect along the edge of the active dredging pocket. By this time, the main plume had advected into the latter half of the transect and was defined between 210 m and 360 m chainage. Elevated TSS was largely below the upper 3 m of the water column, with the strongest concentrations at mid-depth and near the bed. Within this zone, TSS ranged from 60 mg/L to >100 mg/L. The first 150 m of chainage had returned to ambient background levels of <15 mg/L, except for a minor near-bed signal at the start of the channel slope, indicating rapid advection and dilution away from the dredging pocket.

The full set of ADCP transects for monitoring conducted at Inner Bar and MIDMPA are presented in Annex E. The depth-averaged suspended sediment concentrations for all ADCP tracks and the dredge coordinates and status over the course of monitoring conducted on 2 June 2026 are presented in Figure 3.12.

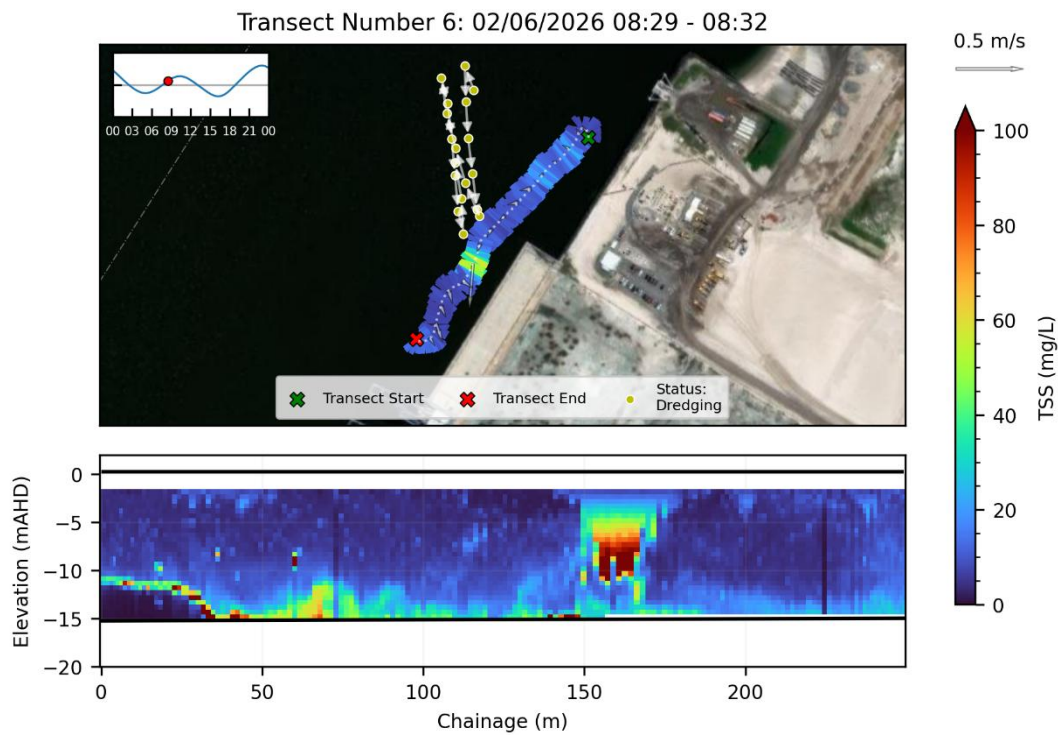


Figure 3.9 Transect off Inner bar from 08:29 – 08:32 2 June Proceeding Dredge

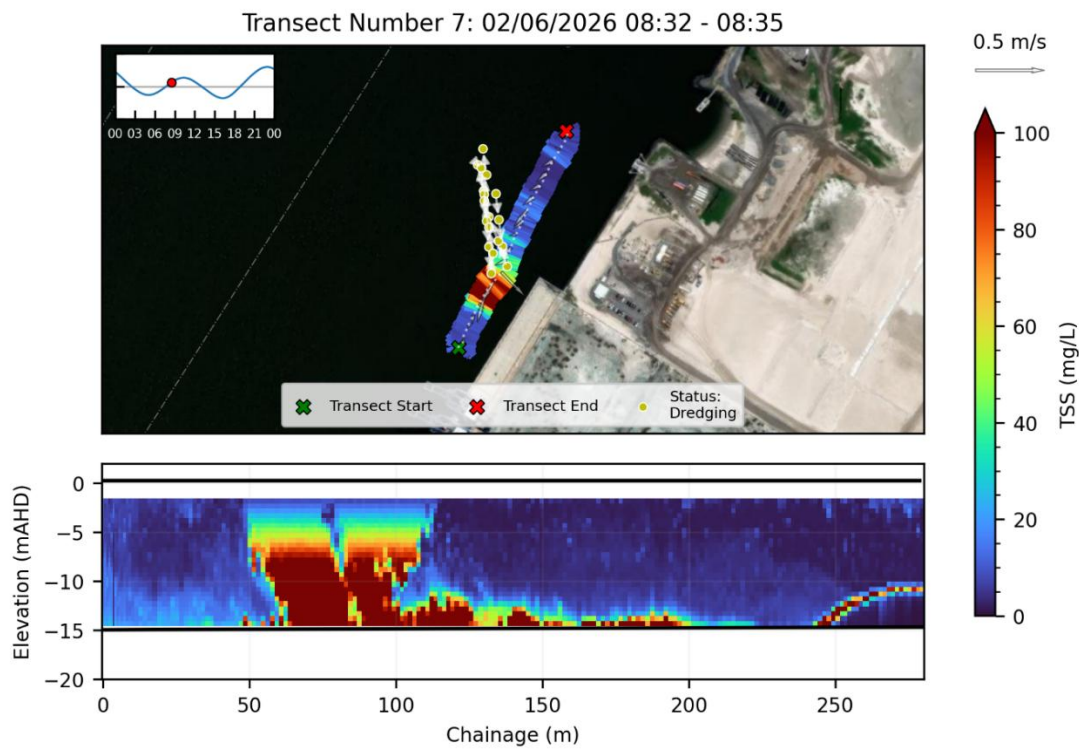


Figure 3.10 Transect off Inner bar from 08:32 – 08:35 2 June Proceeding Dredge

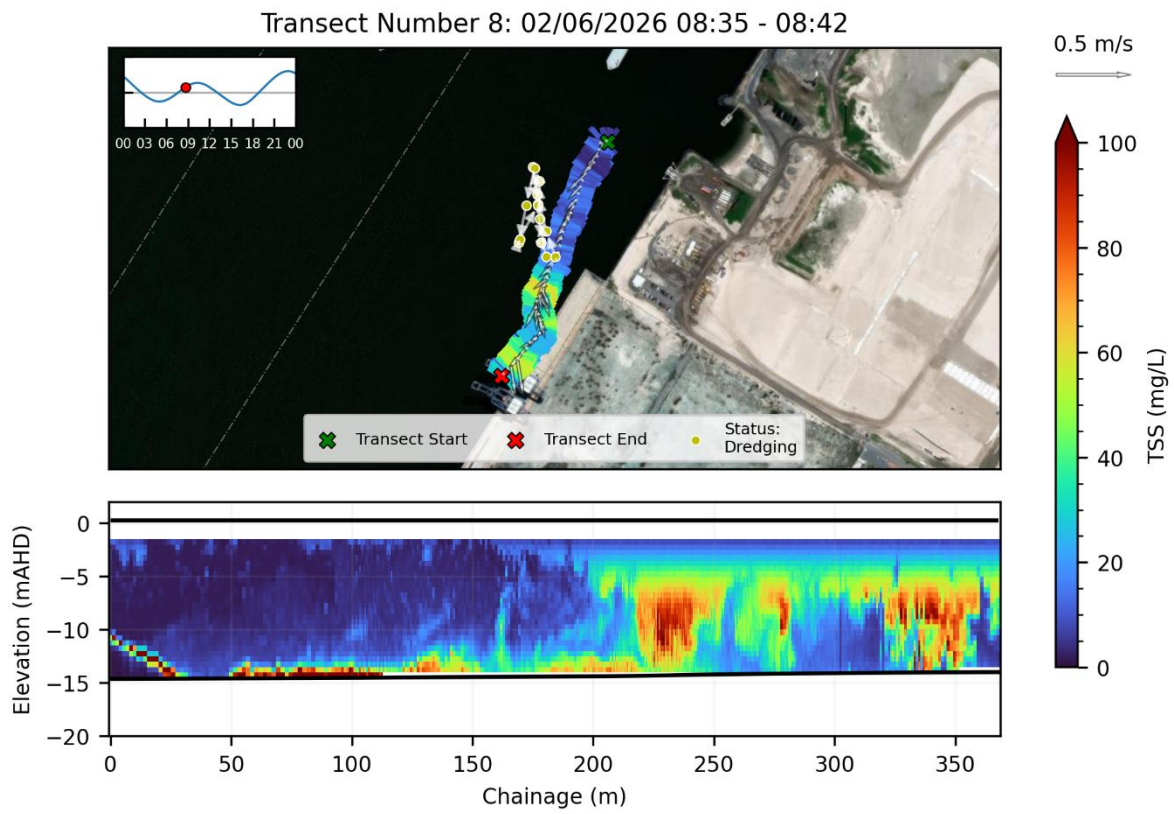


Figure 3.11 Transect off Inner bar from 08:35 – 08:42 2 June Proceeding Dredge



Legend

DMPA

Spitfire Channel

Dredge Status

Dredging

Dumping

Standby

Steaming Laden

Steaming Unladen

Title:
Depth-Averaged Suspended Sediment Concentration
02/06/2026

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3.5 Particle Size Distribution

A total of 17 water samples collected on the 26 May and 2 June 2026 were analysed for PSD². The raw laboratory PSD results for each sample are shown in Annex B.

A summary of particle sizes at the different locations for the various phases of the dredge cycle is presented in Table 3.3. The laboratory-processed particle size distributions for all samples collated for each monitoring day are presented in Figure 3.13 (26/05/2026) and Figure 3.15 (02/06/2026). Correspondingly, the in-situ LISST measurement distributions are shown in Figure 3.14 (26/05/2026) and Figure 3.16 (02/06/2026).

In general, laboratory results for samples collected on 26 May 2026 show a distinct bimodal (two-peak) distribution. The primary peaks are observed in the fine-to-medium silt range (centred around 10 μm) and the fine sand range (centred around 100 μm), indicating a complex mix of fine suspended sediments and coarser material.

In contrast, samples from 2 June 2026 exhibit a highly consistent, unimodal (single-peak) distribution predominated almost entirely by silts, with the mean peak tightly focused between 8 μm and 10 μm . A very minor secondary trace of fine sand is present near 100 μm , but it is significantly less pronounced than the previous week.

The raw laboratory results shown in Annex B generally reflect that a lower Total Suspended Solids (TSS) concentration is characterised by a larger relative proportion of sands (with particle sizes generally >100 μm). Conversely, higher TSS values were accompanied by an elevated composition of fine silts.

Comparing the laboratory results (Figure 3.13 and Figure 3.15) with the in-situ LISST measurements (Figures 3.14 & 3.16) demonstrates the influence of in-situ particle aggregation. Individual LISST PSD profiles for each sample are provided in Annex F.

LISST measurements generally shift toward higher proportions of coarser particle size classes relative to laboratory measurements. Fine sediment particles (nominally finer than 63 μm) suspended in the marine environment tend to combine into flocs or aggregations of individual particles that physically behave like larger-diameter, lower-density single particles. The LISST instrument records these flocs as single larger particles in their natural state, whereas laboratory sample processing breaks these fragile flocs back down into their finer constituent particles. The discrepancy between the LISST and laboratory PSD estimates provides key insight into the proportion of fine sediment aggregated into flocs that will settle relatively rapidly in the water column.

Table 3.3 Laboratory PSD Result Summary Showing the Particle Sizes (Median Across Samples) at Each Location During the Different Phases of the Dredge Cycle

Location	Description	No. Samples	D10 (μm)	D50 (μm)	D90 (μm)
Spitfire Realignment	Background	2	5.585	56.346	157.933
Spitfire Realignment	Dredge Overflow	8	4.313	38.342	190.094
Inner Bar	Dredge Overflow	1	2.197	7.849	90.835
DMPA	Dredge Disposal	6	2.816	9.260	76.353
Overall		17	3.7	27.9	128.8

² Note that no dispersant was added to the laboratory PSD samples.

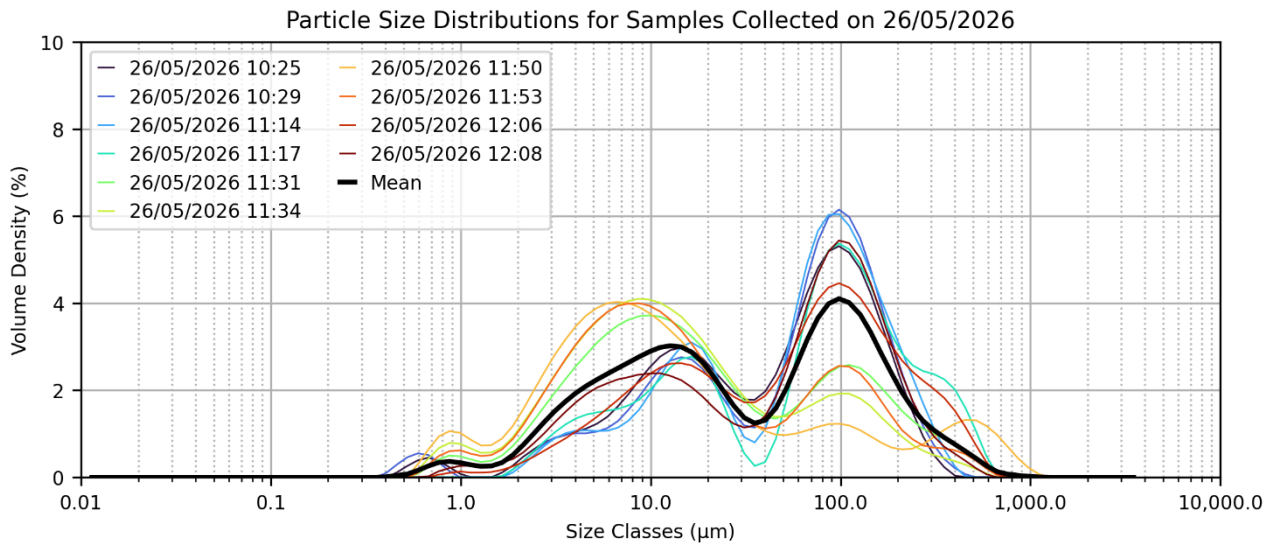


Figure 3.13 Laboratory Particle Size Distributions for all PSD Samples Collected on 26 May

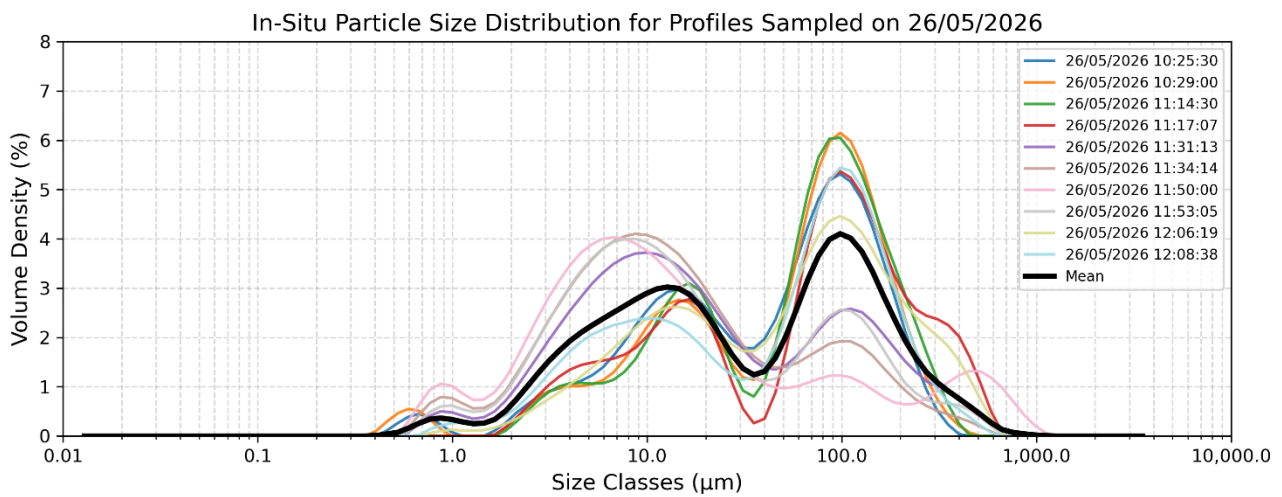


Figure 3.14 In-situ LISST 100 Distributions for all PSD Samples Collected on 26 May

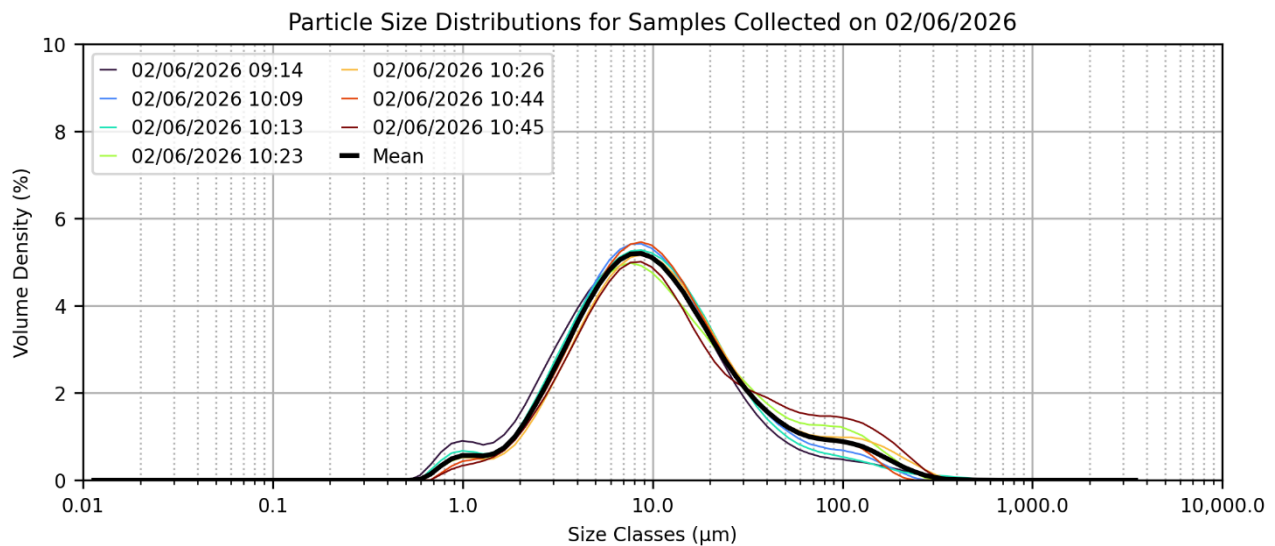


Figure 3.15 Laboratory Particle Size Distributions for all PSD Samples Collected on 2 June

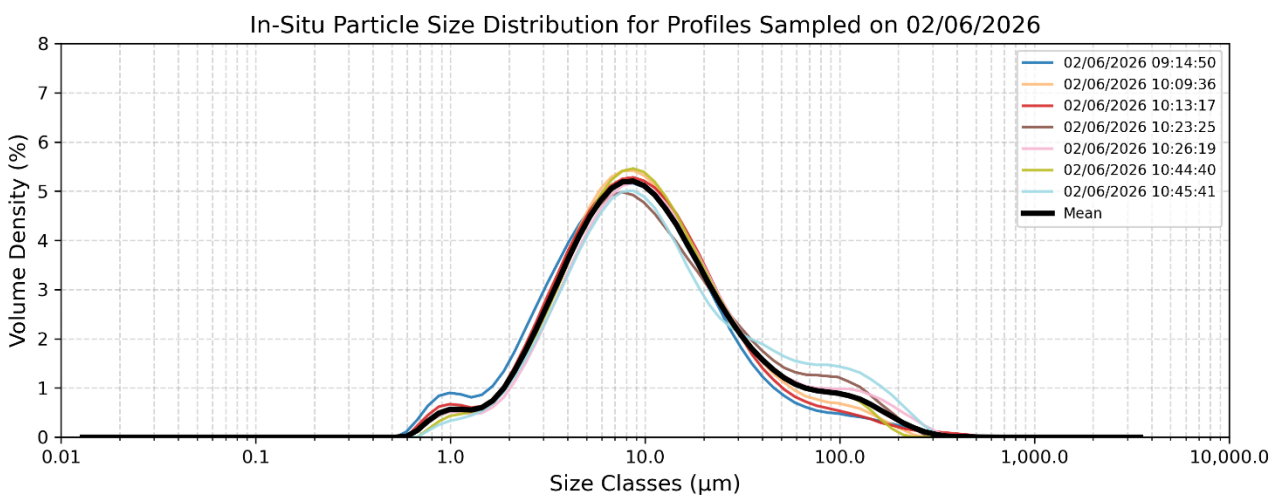


Figure 3.16 In-situ LISST 100 Distributions for all PSD Samples Collected on 2 June

3.6 Satellite Turbidity

3.6.1 Rainfall Conditions During the Monitoring Period

Rainfall is presented to provide context for ambient turbidity during the monitoring period. Runoff from rainfall events is a key source of catchment sediment loads to the lower Brisbane River and western Moreton Bay and can influence the surface turbidity patterns observed in the satellite imagery. Figure 3.17 shows daily rainfall at four Bureau of Meteorology stations in the Brisbane River catchment.

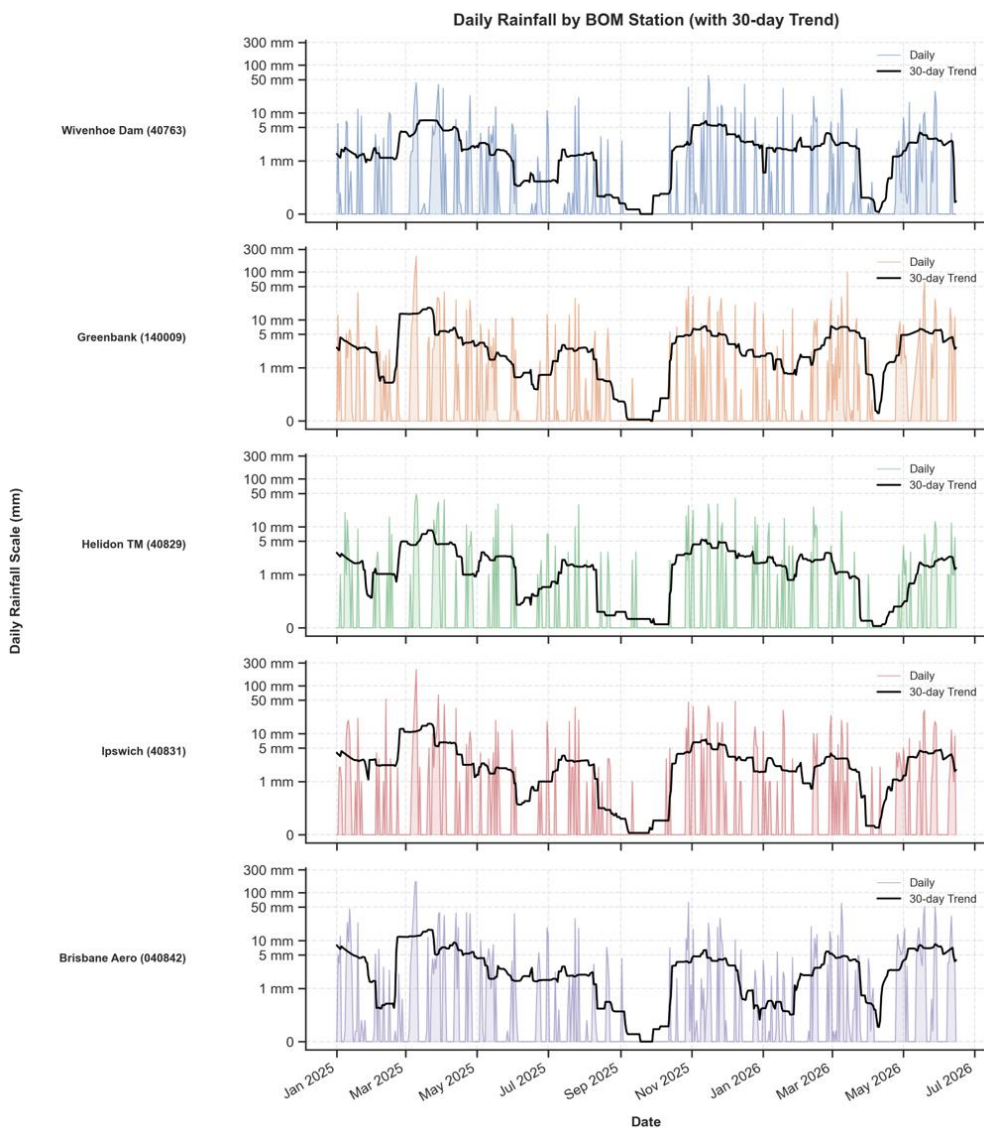


Figure 3.17 Daily rainfall (mm) between January 2025 and 2 June 2026 at regional meteorological monitoring stations

Rainfall between January 2025 and 2 June 2026 was episodic across the catchment (Figure 3.17). The 30-day trend showed wetter conditions in March–April 2025, late 2025 and early 2026, and comparatively drier conditions around September–October 2025 and parts of April–May 2026. Rainfall timing was broadly consistent across the gauges, although event totals varied among stations. This indicates that the main wet periods were catchment-wide, with local variation in rainfall intensity rather than rainfall being confined to a single part of the catchment. This rainfall context is used below to support interpretation of satellite derived turbidity during dredging activities.

3.6.2 Satellite Derived Turbidity Periods

Four satellite images coincident with active dredging were identified between January 2025 and 2 June 2026 within Zone 2 (Table 3.4). These are further discussed below.

Table 3.4 Summary of active dredging operations coinciding with satellite overpasses (2025–2026)

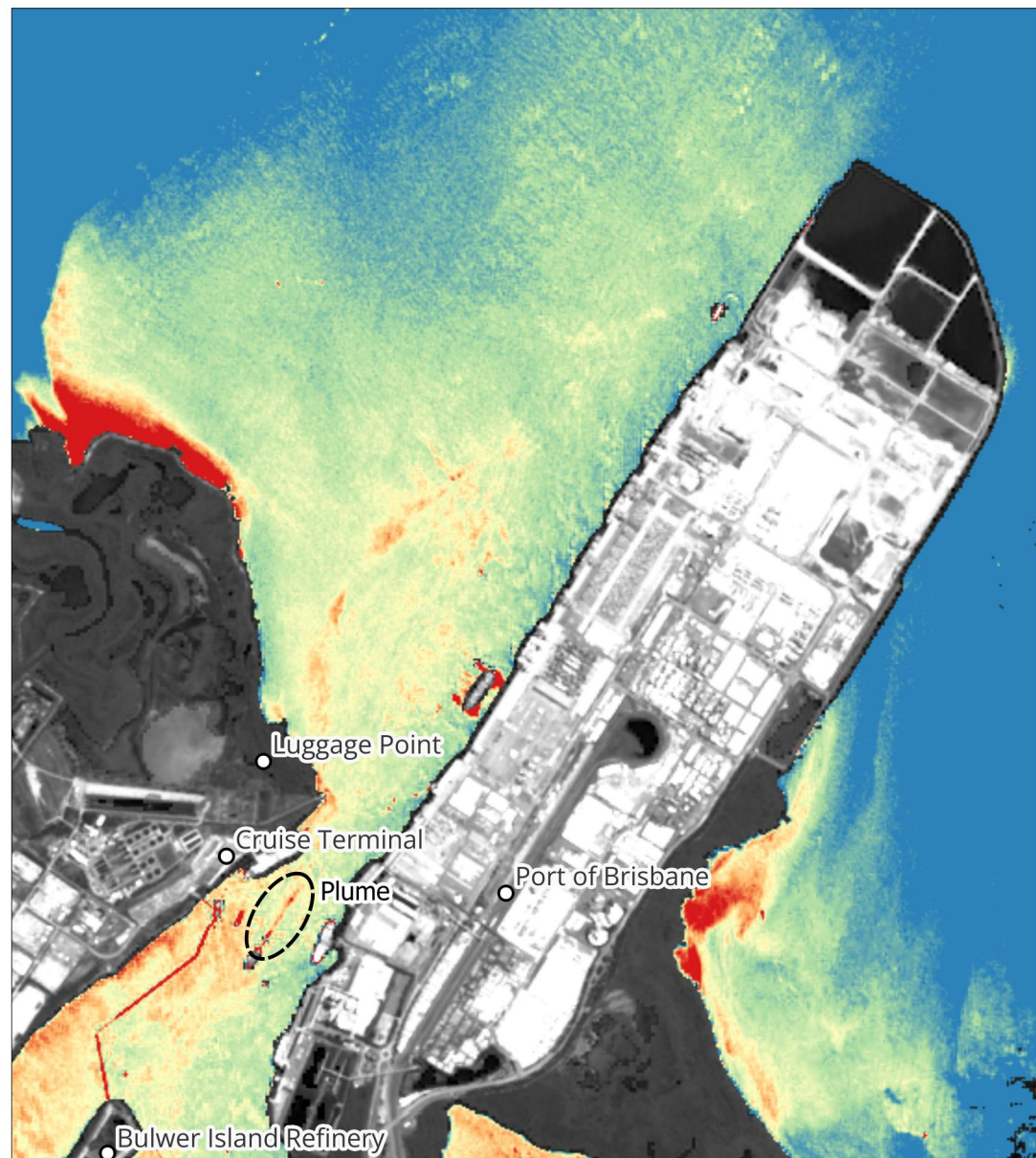
Date	Dredge Location	Dredging Start Time (AEST)	Dredging End Time (AEST)	Satellite Platform	Satellite Overpass Time (AEST)
15 March 2025	Inner Bar	06:09	10:20	Sentinel-2C	10:04
13 April 2025	Inner Bar	08:59	11:22	Landsat-8	09:41
5 March 2026	Fisherman Island Swing Basin	07:19	10:39	Sentinel-2B	10:04
11 March 2026	Fisherman Island Swing Basin	08:24	18:58	Sentinel-2B	10:04

Inner Bar (15 March 2025)

Figure 3.18 shows the Sentinel-2C image captured at 10:04 AEST on 15 March 2025, near the end of the Inner Bar dredging window (06:09–10:20 AEST). The image was captured during the late ebb tide at the Brisbane Bar, approaching the subsequent low tide.

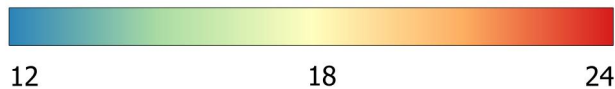
At the time of capture, the dredger was within the dredged channel and a low-intensity surface plume extended astern along the channel. The plume was approximately 300 m long and less than 50 m wide, with surface turbidity of about 12–24 FNU compared with surrounding channel waters of approximately 14–18 FNU. The plume remained confined to the dredged channel and was aligned with the dredger track and ebb-tide flow, with no distinct surface plume evident beyond the immediate channel-aligned feature.

When compared with the 2011–2025 Zone 2 baseline, the dredge plume turbidity was slightly greater than the March median of 9.38 FNU. Negligible rainfall was recorded in the 48 hours before dredging; however, substantial rainfall earlier in the week (8–11 March 2025), with peak daily totals exceeding 170–220 mm across multiple stations, likely contributed to the elevated background turbidity visible across the broader waterway.



Legend

Turbidity (FNU)



Note: Localised red linear features represent surface water disturbances (such as vessels and boat wakes) or land artefacts, rather than elevated turbidity.

Title:

Sentinel-2C Surface Water Turbidity: 15 March 2025, 10:04 AEST

Dredging operations were conducted in the Inner Bar from 6:09 AM to 10:20 AM

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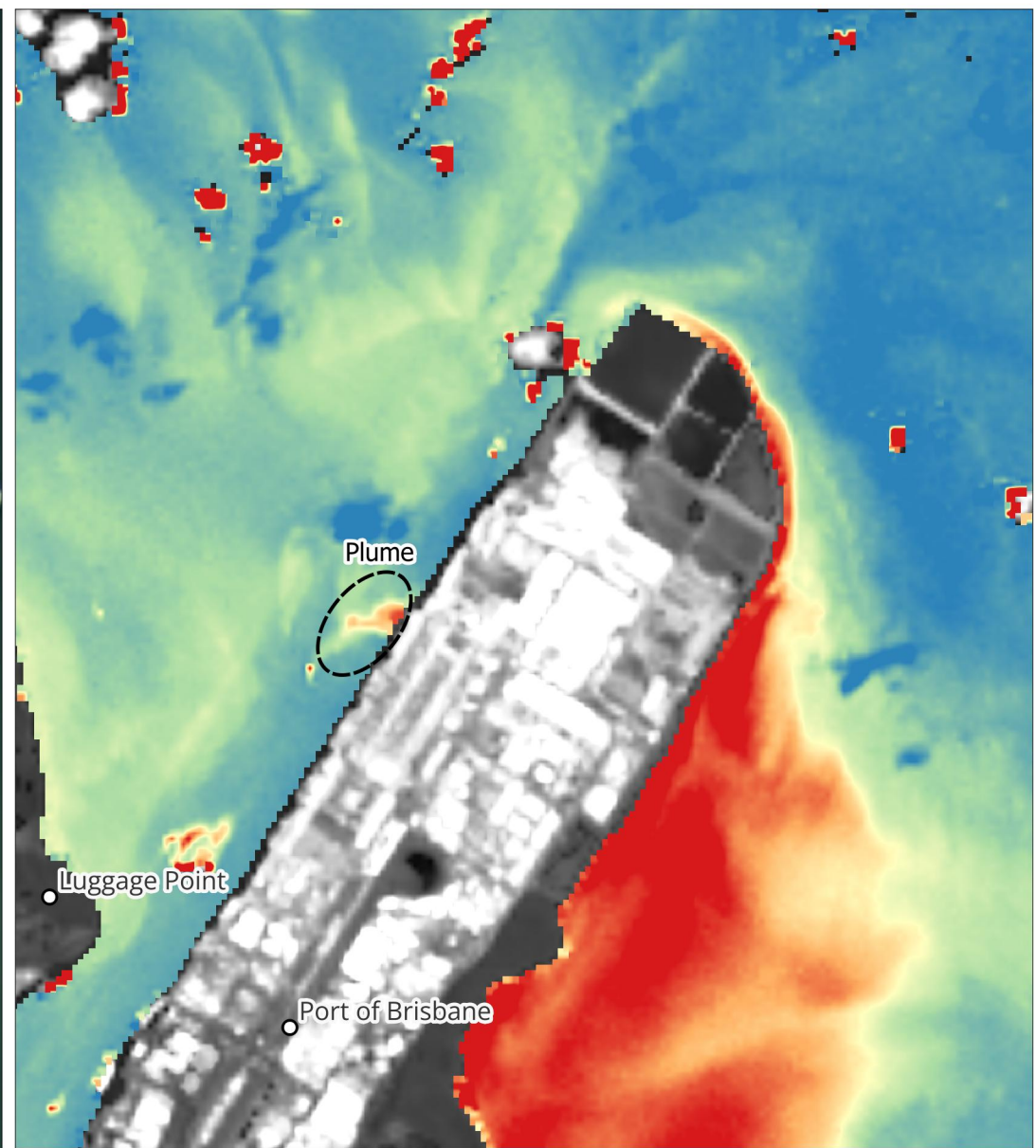
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Inner Bar (13 April 2025)

Figure 3.19 shows the Landsat 8 image captured at 09:41 AEST on 13 April 2025, during the early to mid-stage of the Inner Bar dredging window (08:59–11:22 AEST). The image was captured on the ebb tide at the Brisbane Bar, after the morning high tide and moving toward the subsequent low tide.

At the time of capture, the dredger was operating within the Inner Bar berth pocket adjacent to the FPE wall. A higher-intensity surface plume was visible immediately behind the dredger and extended southeast from the berth pocket into the main channel. The plume was widest within the berth pocket, where it was approximately 100–150 m across, before narrowing to less than about 50 m along the channel-aligned section. The visible plume extended for approximately 300–400 m, with surface turbidity of about 10–22 FNU. The plume remained confined to the berth pocket and adjacent channel, with no broader surface plume evident across the wider waterway.

When compared with the 2011–2025 Zone 2 baseline, the plume turbidity was greater than the April median of 7.84 FNU. Rainfall in the 48 hours before dredging was minor; however, moderate to high rainfall was recorded across the catchment on 13 April 2025, with daily totals up to 34–38 mm at multiple stations. As the satellite image was captured during this rainfall period, the plume was interpreted against an elevated background turbidity setting influenced by ongoing runoff.



Legend

Turbidity (FNU)



5 15 25

Note: Localised red linear features represent surface water disturbances (such as vessels and boat wakes) or land artefacts, rather than elevated turbidity.

Title:

Landsat 8 Surface Water Turbidity: 13 April 2025, 09:41 AEST

Dredging operations were conducted in the Inner Bar from 8:59 AM to 11:22 AM

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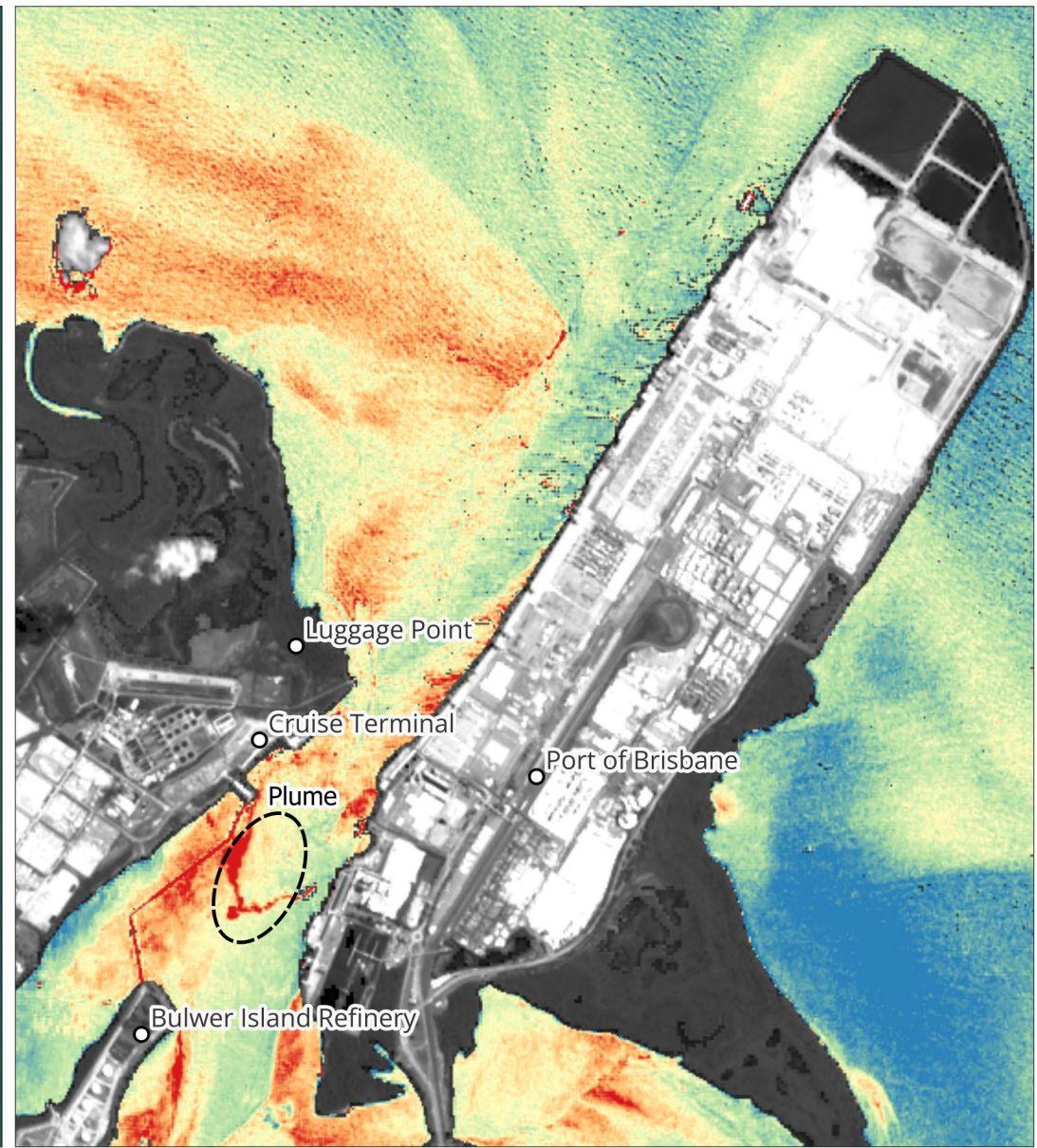
Fisherman Island Swing Basin (5 March 2026)

Figure 3.20 shows the Sentinel-2B image captured at 10:04 AEST on 5 March 2026, near the end of the Fisherman Island Swing Basin dredging window (07:19–10:39 AEST). The image was captured on the ebb tide at the Brisbane Bar, after the morning high tide and moving toward the subsequent low tide.

At the time of capture, the dredger was operating near the Fisherman Island Swing Basin. A low- to moderate-intensity surface plume extended astern from the dredger and followed a channel-aligned curvilinear path, initially trending south before turning east. The visible plume extended approximately 700–900 m from the dredger and was generally narrow, mostly less than about 50–75 m wide, with local broadening to approximately 100–150 m along the channel margin. Surface turbidity within the plume was approximately 6–24 FNU. No broad surface plume was evident across the wider river.

Elevated turbidity of approximately 16–22 FNU was also observed along the eastern margin of Bulwer Island Refinery and adjacent to the mudflat margins near the Coal Loader. These features were spatially distinct from the dredge plume and were likely associated with shallow-bank resuspension or tidal processes rather than direct dredging activity.

Compared with the 2011–2025 Zone 2 baseline, plume turbidity was variable around the March mean of 21.02 FNU and exceeded the March median of 9.38 FNU at peak values. Rainfall in the 48 hours before dredging was negligible, so recent catchment runoff was unlikely to have materially influenced background turbidity at the time of image capture. The surface plume was therefore interpreted as a localised dredging-related feature superimposed on ambient turbidity, with separate areas of higher turbidity over nearby shoals likely reflecting sediment resuspension.



Legend

Turbidity (FNU)



6 15 24

Note: Localised red linear features represent surface water disturbances (such as vessels and boat wakes) or land artefacts, rather than elevated turbidity.

Title:

Sentinel-2B Surface Water Turbidity: 05 March 2026, 10:04 AEST

Dredging operations were conducted in the FI Swing Basin from 7:19 AM to 10:39 AM

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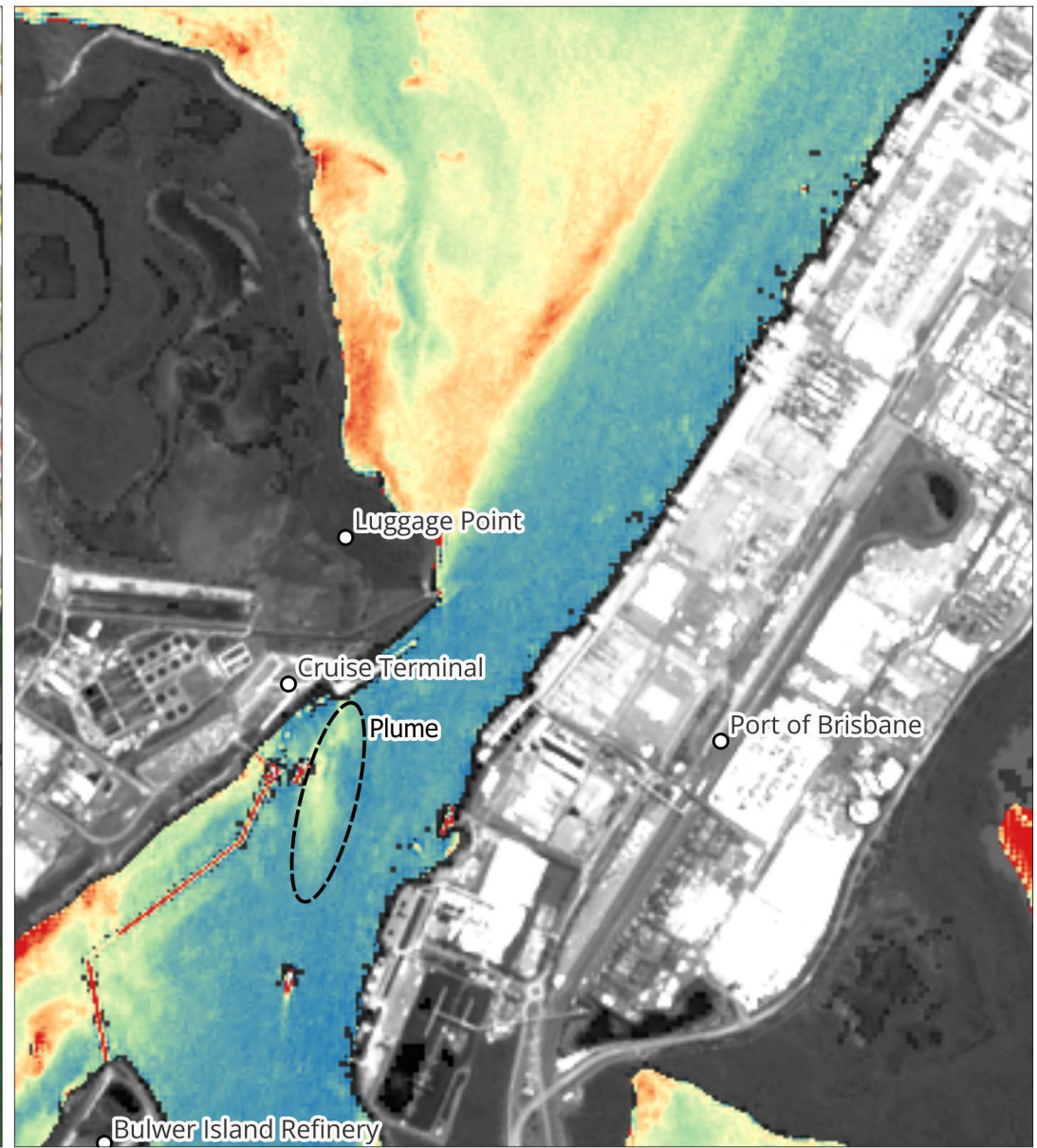
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Fisherman Island Swing Basin (11 March 2026)

Figure 2.1 shows the Sentinel-2B image captured at 10:04 AEST on 11 March 2026, during the early stage of the Fisherman Island Swing Basin dredging window (08:24–18:58 AEST). The image was captured on the flood tide at the Brisbane Bar, after the morning low tide and moving toward the late-morning high tide.

At the time of capture, the dredger was operating in the Fisherman Island Swing Basin and only a minor surface turbidity response was visible immediately adjacent to the vessel. The visible feature was small and poorly developed, extending no more than approximately 100–200 m from the dredger and remaining less than about 50 m wide. Surface turbidity in the localised plume area was approximately 6–14 FNU. The feature remained confined to the dredger vicinity, with no distinct plume extending across the river or along the channel.

When compared with the 2011–2025 Zone 2 baseline, plume turbidity was generally below or comparable to the March mean of 21.02 FNU and only marginally above the March median of 9.38 FNU at peak values. The 48 hours before dredging included a broader catchment rainfall event, with accumulated rainfall exceeding approximately 60–80 mm at multiple stations. The minor dredging-related surface signal was therefore interpreted within an elevated runoff and background turbidity setting.



Legend

Turbidity (FNU)



6 13 20

Note: Localised red linear features represent surface water disturbances (such as vessels and boat wakes) or land artefacts, rather than elevated turbidity.

Title:

Sentinel-2B Surface Water Turbidity: 11 March 2026, 10:04 AEST

Dredging operations were conducted in the FI Swing Basin from 8:24 AM to 18:58 PM

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0 250 500 m



Figure:

3.21

Rev:

A



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4 Discussion

4.1 Spitfire Realignment Channel

Monitoring at the Spitfire Realignment Channel showed a naturally mobile sandy seabed with low TSS through most of the water column, but elevated near-bed TSS where waves and currents reworked bed sediments. Against this background, dredging-related plumes were localised and varied with the operational phase and the position of the transect relative to the dredge path.

Background TSS at Spitfire was generally 0–20 mg/L through most of the water column. Elevated near-bed concentrations of about 60–100 mg/L occurred between approximately 150 m and 250 m chainage and near the end of the transect past 400 m chainage, consistent with ambient sand resuspension along the mobile seabed although interpretation of the strongest near-bed signals is subject to the measurement limitations described in Section 3.4.

During the no-overflow dredging pass, the dredging-related signal was limited to a low-intensity surface to upper-water-column plume of about 20–40 mg/L between 150 m and 180 m chainage. The plume was approximately 30 m wide and was less prominent than the near-bed ambient resuspension signal, which exceeded 80–100 mg/L along the seabed across the first 250 m of chainage.

Where the subsequent transect intersected the dredge path, a narrow full-depth plume was observed between 50 m and 85 m chainage. TSS exceeded 100 mg/L from near-surface waters to the channel bed, from approximately -3 mAHD to -13 mAHD. A weaker near-bed signal of about 20–40 mg/L occurred between 0 m and 40 m chainage, while concentrations outside the plume zones returned rapidly to ambient levels below 10 mg/L.

The Spitfire results indicate that dredging-related increases were short lived and spatially constrained, with the strongest dredging signal occurring where transects intersected the dredge path. Elevated near-bed TSS was also a feature of the ambient sandy seabed environment, where waves and currents reworked mobile bed sediments.

Historical monitoring at the Spitfire Realignment Channel (BMT WBM, 2006; BMT WBM, 2008; BMT WBM, 2015), summarised in Table 4.1, shows a consistent pattern: plumes associated with sand dredging are typically localised, short lived and strongly influenced by tidal advection and seabed mobility.

This behaviour reflects the sediment characteristics and hydrodynamic setting of the northern Moreton Bay tidal delta. Mobile fine to medium sands are readily reworked near the bed by waves and currents, while the finer suspended fraction attenuates over short distances under tidal advection and settling. The 2026 observations were consistent with this setting: near-bed resuspension was prominent, while dredging-related water-column plumes remained localised.

Table 4.1 Historical dredge turbidity monitoring

Study Year	Background Turbidity	Plume Magnitude	Plume Duration	Plume Extent	Key Controlling Factor
2006	~2–4 NTU	Minor increases; occasional localised spikes near dredger. First monitoring exceeded turbidity criterion (within 10 NTU of background), with the second monitoring event not exceeding turbidity criterion	~2–3 hours	Mainly contained within the dredge footprint. Plume distance within ~600–1.7 km	Tidal advection and natural sediment processes
2008	~1–3 NTU	No exceedance in water turbidity criterion (within 10 NTU of background)	~1–2 hours	Mainly contained within the dredge footprint. Plume distance between ~1.5–3 km	Tidal advection, natural sediment processes, vessel and equipment position
2015	~2–5 NTU	No exceedance >20 NTU	Short-lived; difficult to distinguish from background variability influenced by tidal currents	Mainly contained within the dredge footprint with the exception of a plume approximately ~2 km outside the dredge area attributed to tidal currents over the sand banks	Tidal advection and natural sediment processes

4.2 Inner Bar and MIDMPA

The Inner Bar and MIDMPA results showed localised dredging and placement plumes against generally low ambient TSS outside active plume zones. During the Inner Bar transects, background concentrations were typically below 15 mg/L.

During Inner Bar dredging, the initial plume was concentrated in the lower half of the water column between 150 m and 170 m chainage. Core TSS ranged from 60 mg/L to >100 mg/L between approximately -5 mAHd and -13 mAHd, indicating a localised near-bed to mid-water response rather than a broad surface plume.

As dredging continued, the plume expanded into a full-depth feature between approximately 50 m and 120 m chainage, with TSS exceeding 100 mg/L from near-surface waters to the riverbed at about -15 mAHd. A lower-concentration near-bed layer of about 20–40 mg/L extended beyond 150 m chainage, and an isolated near-bed feature of about 60 mg/L was observed beyond 250 m chainage.

Later in the sequence, the main plume had advected into the latter half of the transect and was defined between 210 m and 360 m chainage. Elevated TSS was mostly below the upper 3 m of the water column, with the strongest concentrations at mid-depth and near the bed. The first 150 m of chainage had returned to background levels of <15 mg/L, indicating rapid advection and dilution away from the dredging pocket.

At MIDMPA, placement generated a short-term disposal plume, with initial concentrations of about 50–300 mg/L reducing toward approximately 10–20 mg/L within about one hour as material settled and dispersed. Together, the Inner Bar and DMPA results indicate localised plume generation followed by rapid attenuation toward measured background conditions.

4.3 Sediment Behaviour and Particle Size Distribution

Particle size results were consistent with the observed differences in plume behaviour between Spitfire, Inner Bar and the MIDMPA.

Spitfire samples showed a bimodal distribution, with a fine-to-medium silt mode centred around 10 µm and a fine sand mode centred around 100 µm. This was consistent with field observations of mobile sandy bed material contributing to near-bed resuspension.

Inner Bar and MIDMPA samples were dominated by fine silts, with the main mode between about 8 µm and 10 µm and only a minor fine sand component near 100 µm. This finer material was more likely to remain in suspension, consistent with the vertically persistent plumes observed during Inner Bar dredging and disposal.

The raw laboratory results also indicate that lower TSS samples generally contained a larger relative proportion of sand-sized material (>100 µm), while higher TSS samples were dominated by finer silts. This pattern is consistent with rapid settling of coarser material and longer suspension of finer particles.

4.4 Summary of Plume Behaviour

Across the field monitoring events, plume behaviour was controlled by sediment type, operational phase, plume position relative to the dredge path and tidal advection.

At Spitfire, the most persistent signal was near-bed ambient sand resuspension, while dredging-related increases were confined to the immediate dredge path or narrow surface to full-depth plume features. At the Inner Bar, dredging generated stronger but still localised plumes, including lower-water-column, full-depth and advected near-bed to mid-depth features. At the DMPA, disposal plumes reduced from about 50–300 mg/L toward 10–20 mg/L within about one hour.

Overall, the 2026 results are consistent with previous monitoring in showing that maintenance dredging and placement plumes were localised, short-term and strongly influenced by local hydrodynamic conditions and sediment properties.

The contrasting plume behaviour observed between Spitfire Realignment Channel, Inner Bar and the MIDMPA appears to have been primarily controlled by sediment characteristics and the local hydrodynamic setting rather than dredging activity alone. At Spitfire, dredging occurred within a naturally energetic environment characterised by mobile sandy sediments that are regularly reworked by waves and tidal currents. These conditions resulted in elevated background suspended sediment concentrations and was consistent with more rapid settling of dredged material, producing localised and short lived plume responses. In contrast, sediments sampled at Inner Bar and the MIDMPA were dominated by fine silts that are more readily maintained in suspension. Consequently, dredging and disposal generated plume signatures that extended through a greater proportion of the water column than those observed at Spitfire. However, despite this increased vertical persistence, plume extent

remained spatially constrained to the operational area. These observations indicate that plume extent and persistence were primarily governed by the interaction between sediment type and local hydrodynamic conditions, with sandy sediments producing short lived responses against an already dynamic background environment and finer silts producing more persistent but still localised plume features.

4.5 Satellite Derived Turbidity

Satellite-derived turbidity provided a complementary view of the surface expression of dredging-related plumes. Across the four image capture events, visible dredging-related surface features generally ranged from about 6–24 FNU and were spatially constrained to berth pockets, dredged channels, the immediate dredger vicinity or channel-aligned transport pathways.

At the Inner Bar on 15 March 2025, the visible plume was approximately 300 m long and less than 50 m wide, with surface turbidity of about 12–24 FNU compared with surrounding channel waters of about 14–18 FNU. On 13 April 2025, the plume was wider within the berth pocket adjacent to the FPE wall, at approximately 100–150 m across, then narrowed to less than about 50 m along the channel-aligned section. The visible plume extended approximately 300–400 m and had surface turbidity of about 10–22 FNU.

At Fisherman Island Swing Basin on 5 March 2026, the visible plume extended approximately 700–900 m from the dredger along a channel-aligned curvilinear path. It was mostly less than about 50–75 m wide, with local broadening to approximately 100–150 m along the channel margin, and surface turbidity of about 6–24 FNU. Separate areas of elevated turbidity of about 16–22 FNU occurred along nearby shoals and mudflat margins and were spatially distinct from the dredge plume. On 11 March 2026, only a minor surface feature was visible near the dredger, extending no more than approximately 100–200 m and remaining less than about 50 m wide, with surface turbidity of about 6–14 FNU.

The satellite results should be interpreted as surface observations only. Field monitoring showed that several of the strongest dredging-related signals occurred near the bed or through the water column, particularly at Spitfire and Inner Bar. These near-bed components are not fully resolved in satellite imagery, so the satellite analysis is most useful for confirming surface extent and regional turbidity context, rather than defining plume intensity through the full water column.

Overall, the satellite results align with the field observations: surface plumes were localised and did not form broad turbidity features across the lower Brisbane River or western Moreton Bay. Broader turbidity patterns in the imagery were influenced by background conditions, including rainfall, tidal advection and shallow-bank resuspension, and should not be attributed to dredging alone.

4.6 Sensitive Receptor Exposure

Sensitive receptors near the dredging and placement areas include seagrass adjacent to Fisherman Islands and reef communities around Mud Island. During the monitored events, neither field nor satellite observations showed dredging-related plumes extending to these receptor areas. Observed plumes were generally confined to the dredge path, berth pocket, dredged channel, placement area or immediate downstream transport pathway and attenuated toward background over short distances or timescales.

5 References

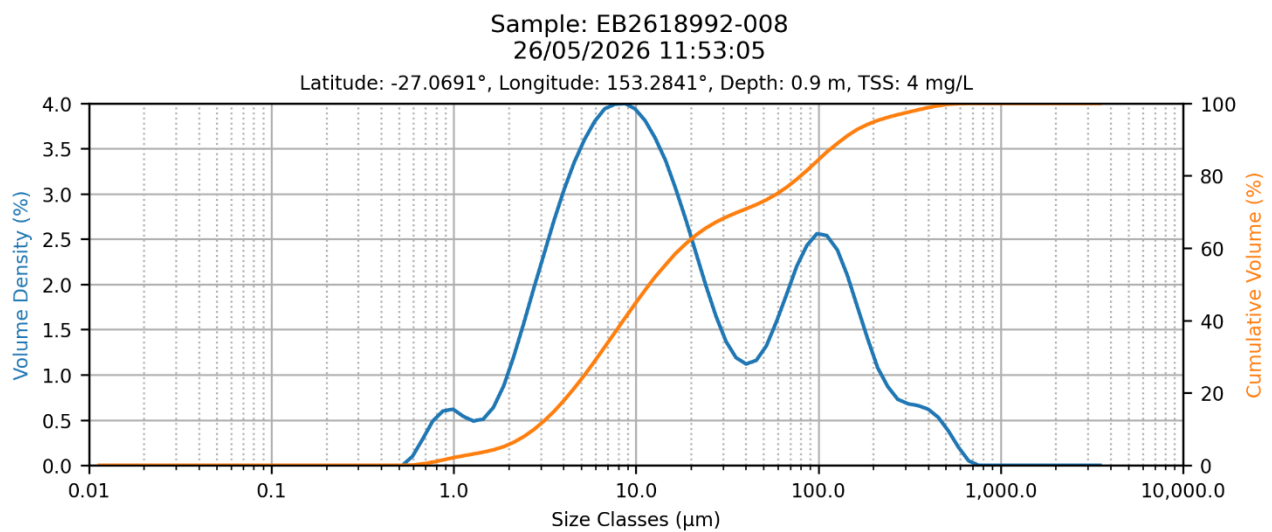
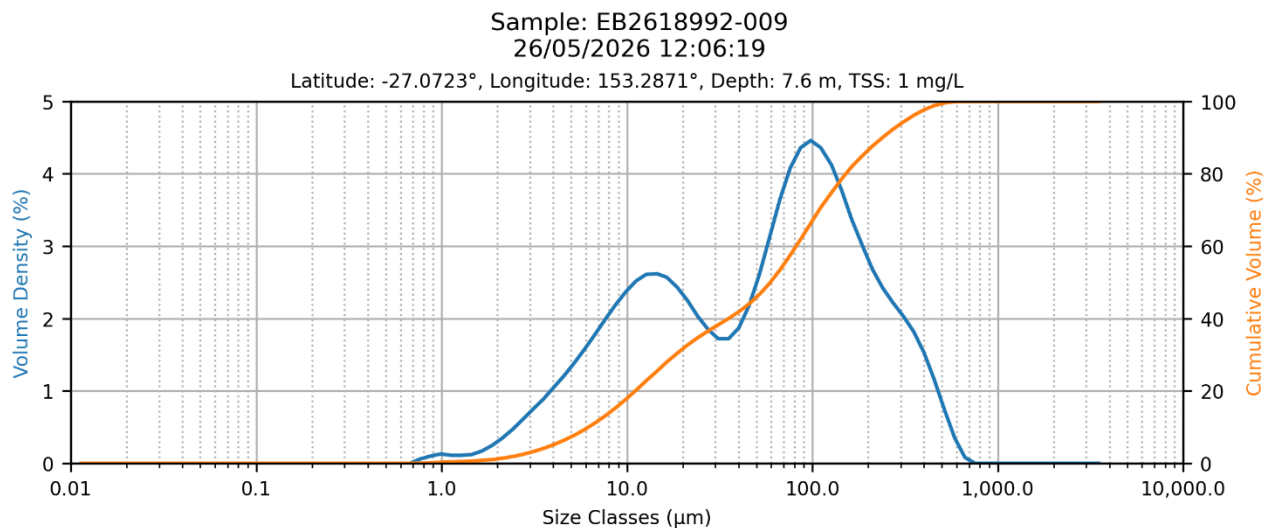
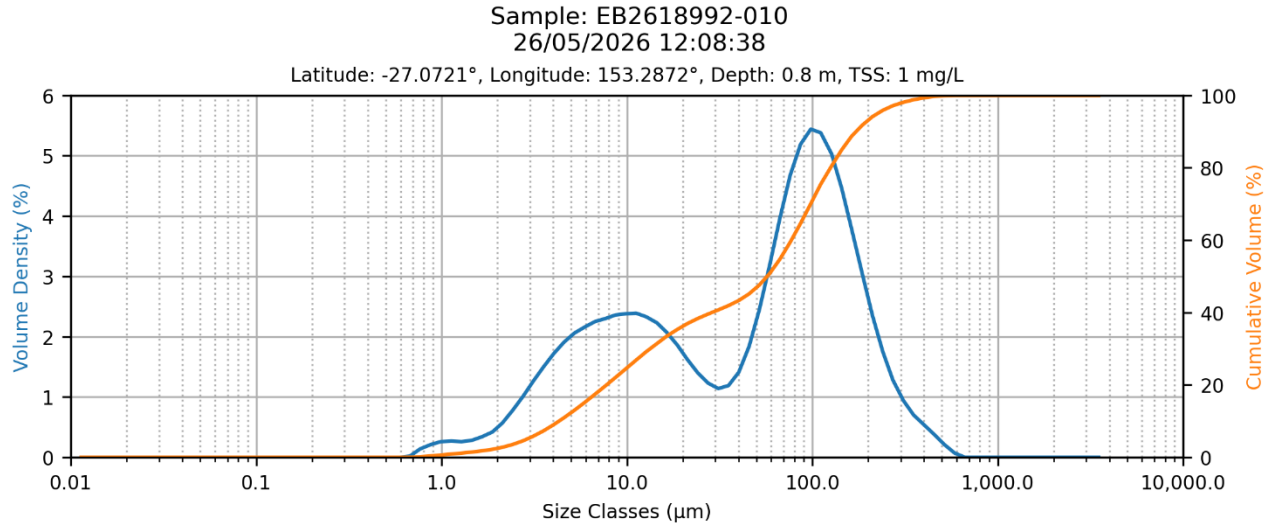
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Annex A TSS Results

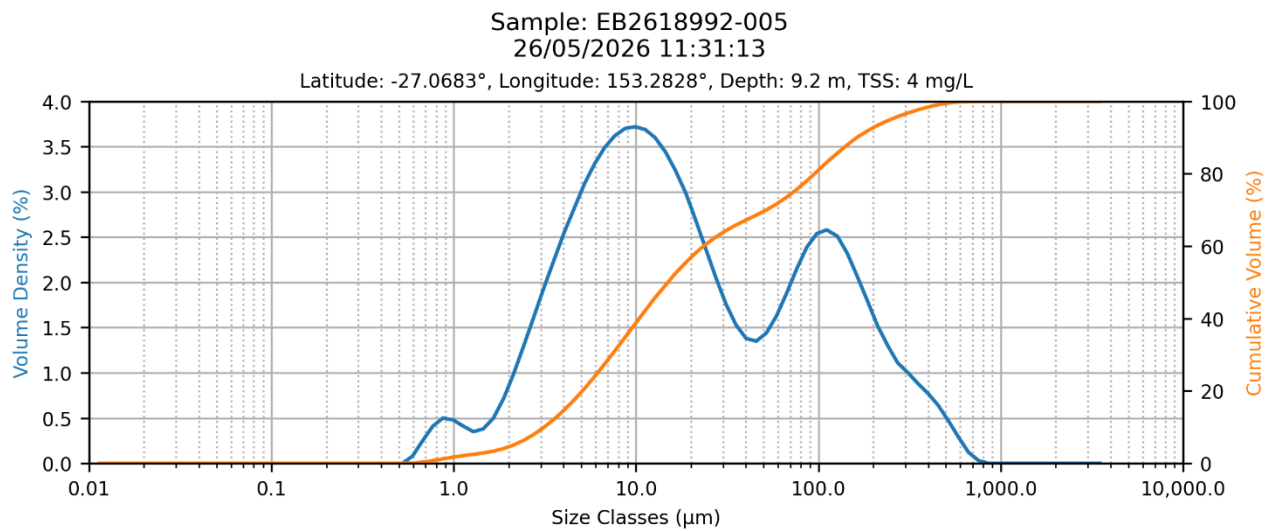
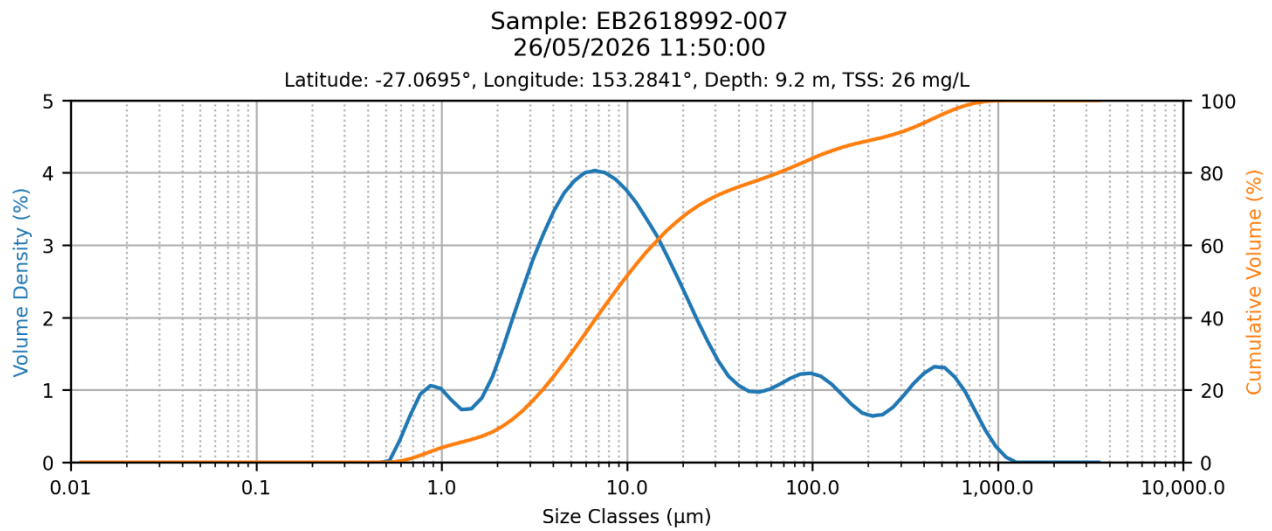
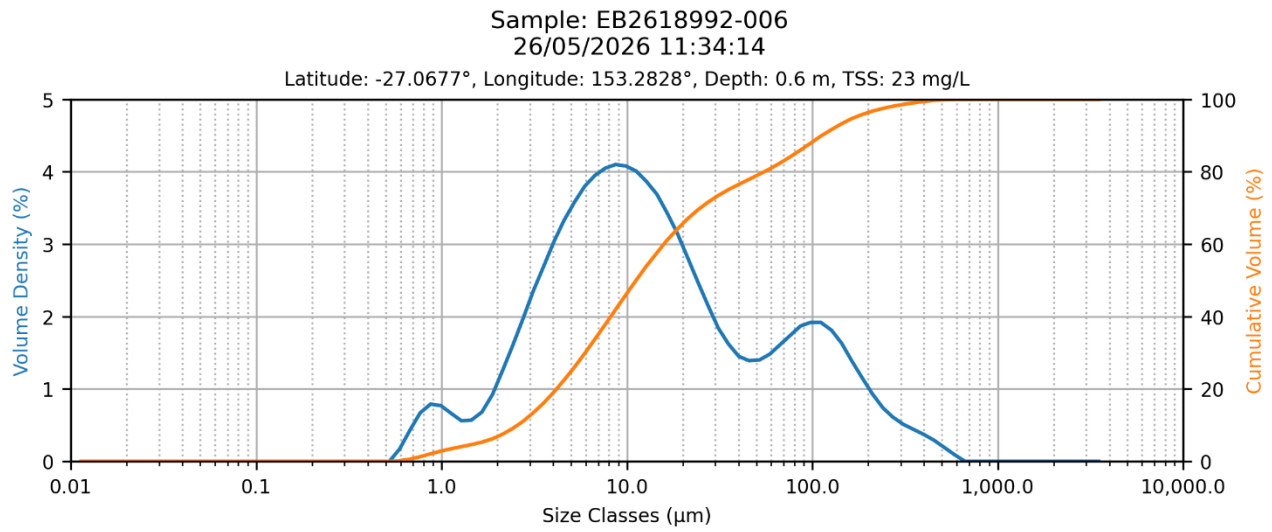
Table A.1. Summary of all TSS Results Collected Over the Monitoring Campaign

Time (AEST)	Location	Latitude (°)	Longitude (°)	Depth (m)	TSS (mg/L)	Description
26/05/2026 10:25	Spitfire Realignment Channel	-27.0713	153.2905	14.65	2	Background
26/05/2026 10:29	Spitfire Realignment Channel	-27.0705	153.2906	0.63	1	Background
26/05/2026 11:14	Spitfire Realignment Channel	-27.065	153.2805	10.94	1	Dredge Overflow
26/05/2026 11:17	Spitfire Realignment Channel	-27.0645	153.2804	0.79	1	Dredge Overflow
26/05/2026 11:31	Spitfire Realignment Channel	-27.0682	153.2829	9.17	4	Dredge Overflow
26/05/2026 11:34	Spitfire Realignment Channel	-27.0676	153.2827	0.63	23	Dredge Overflow
26/05/2026 11:50	Spitfire Realignment Channel	-27.0694	153.2841	9.17	26	Dredge Overflow
26/05/2026 11:53	Spitfire Realignment Channel	-27.069	153.2841	0.95	4	Dredge Overflow
26/05/2026 12:06	Spitfire Realignment Channel	-27.0722	153.2872	7.56	1	Dredge Overflow
26/05/2026 12:08	Spitfire Realignment Channel	-27.072	153.2873	0.79	1	Dredge Overflow
2/06/2026 9:14	Inner Bar	-27.3574	153.1798	0.15	30	Dredge Overflow
2/06/2026 10:09	MIDMPA	-27.3351	153.2206	6.27	53	Dredge Disposal
2/06/2026 10:13	MIDMPA	-27.3358	153.2214	0.15	12	Dredge Disposal
2/06/2026 10:23	MIDMPA	-27.3359	153.2206	5.79	16	Dredge Disposal
2/06/2026 10:26	MIDMPA	-27.3363	153.2212	0.15	3	Dredge Disposal
2/06/2026 10:44	MIDMPA	-27.3366	153.2237	4.98	2	Dredge Disposal
2/06/2026 10:45	MIDMPA	-27.3367	153.2238	0.95	5	Dredge Disposal

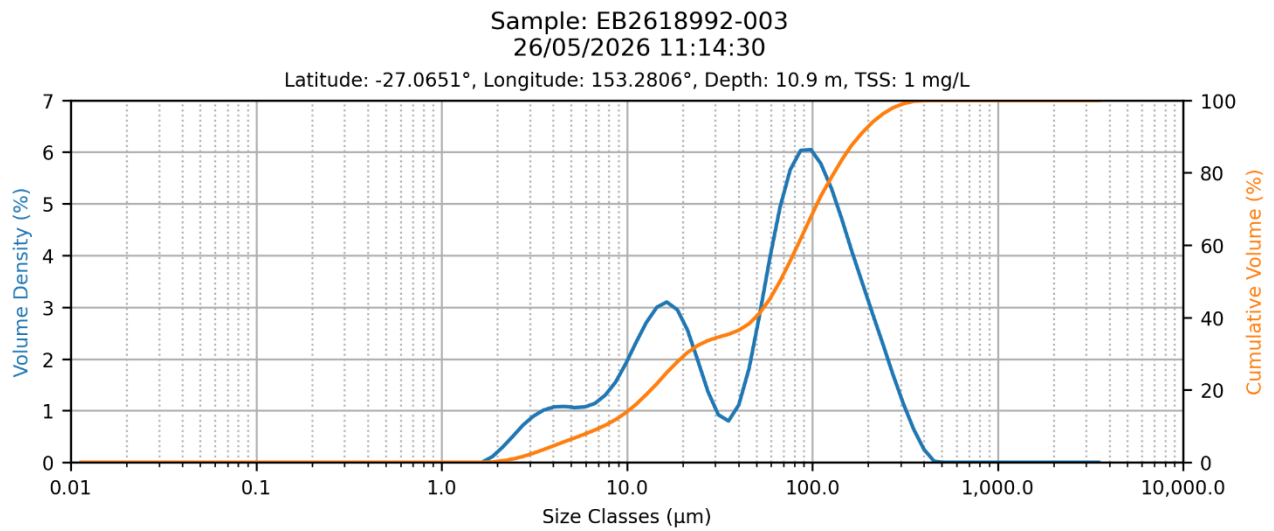
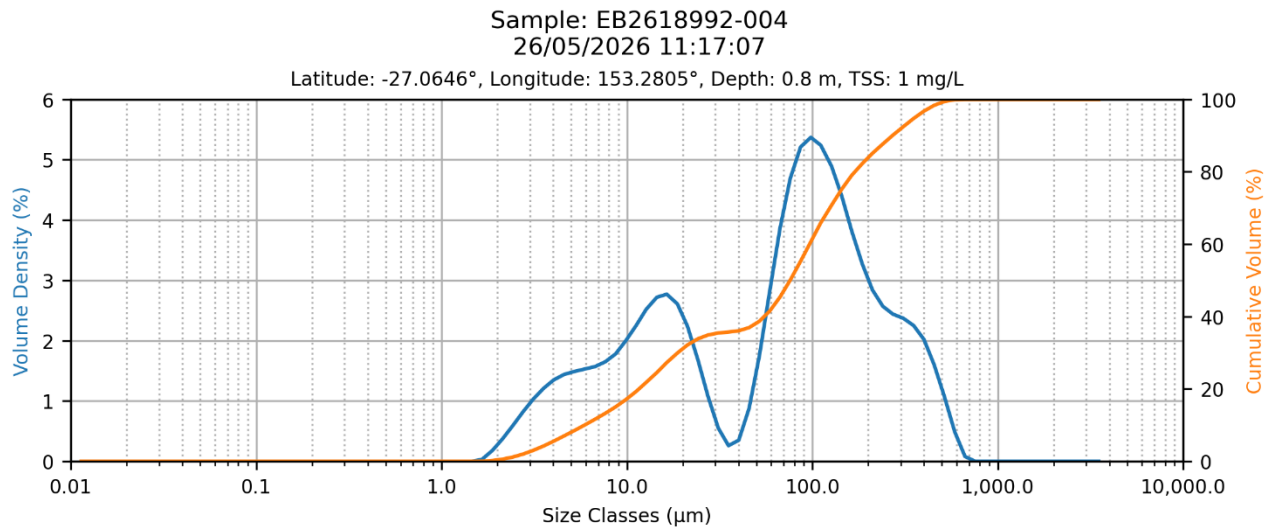
Annex B PSD Results



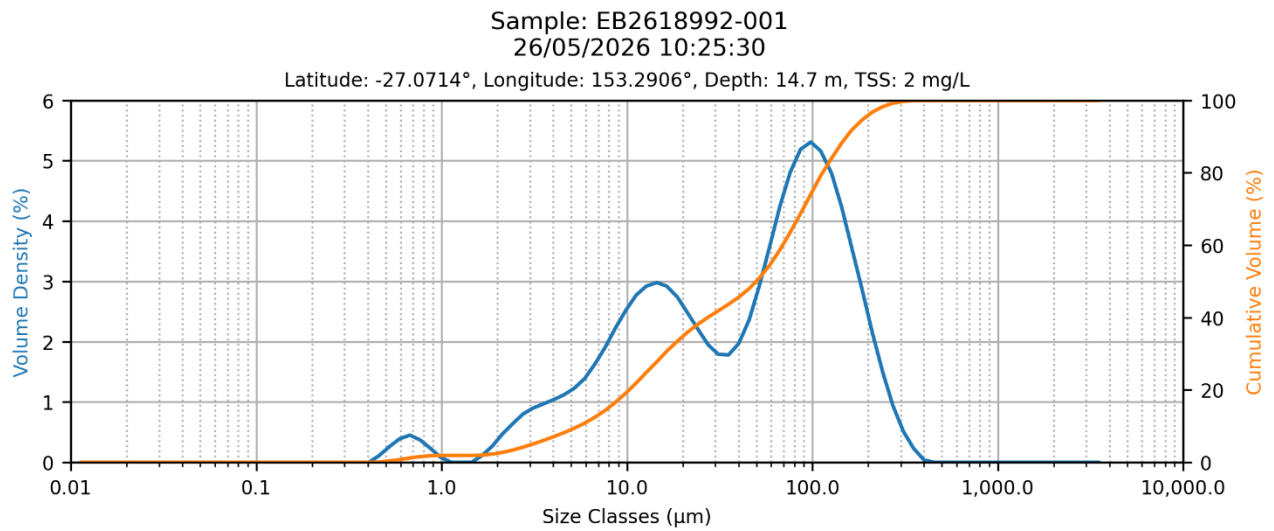
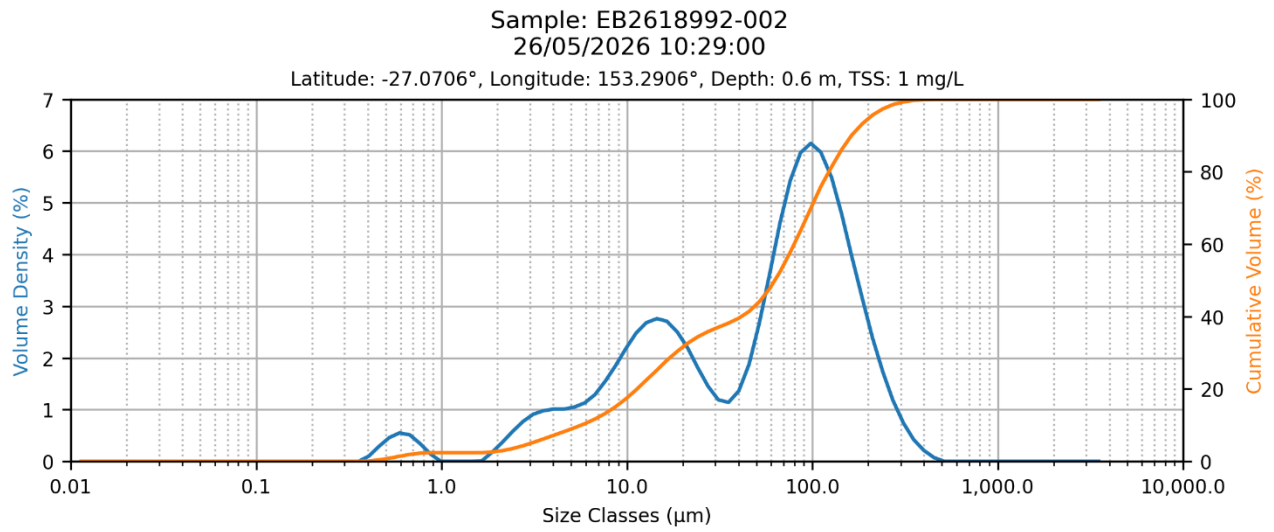
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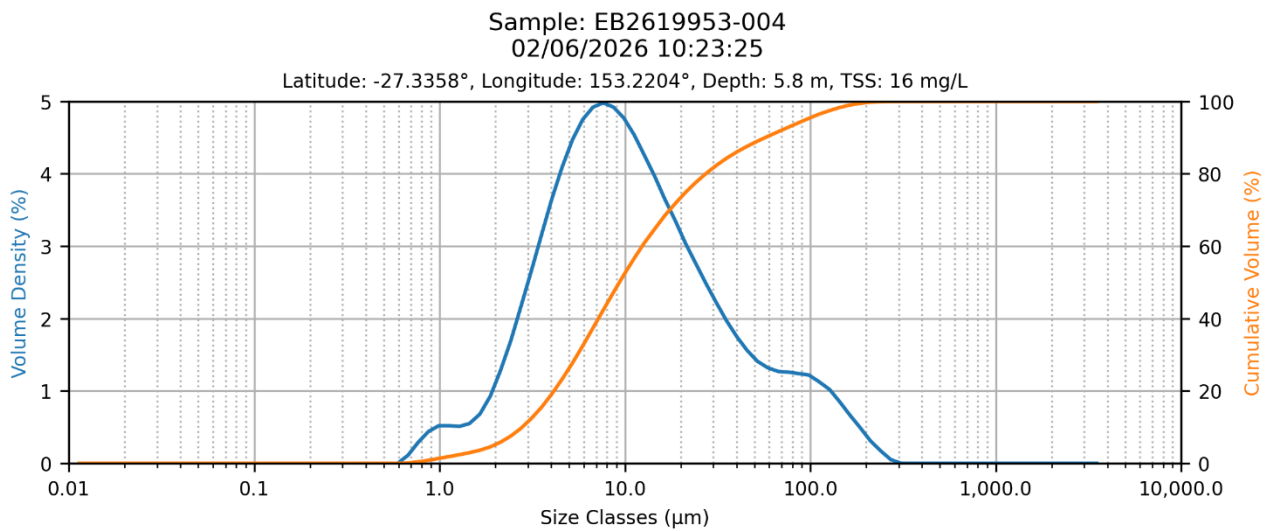
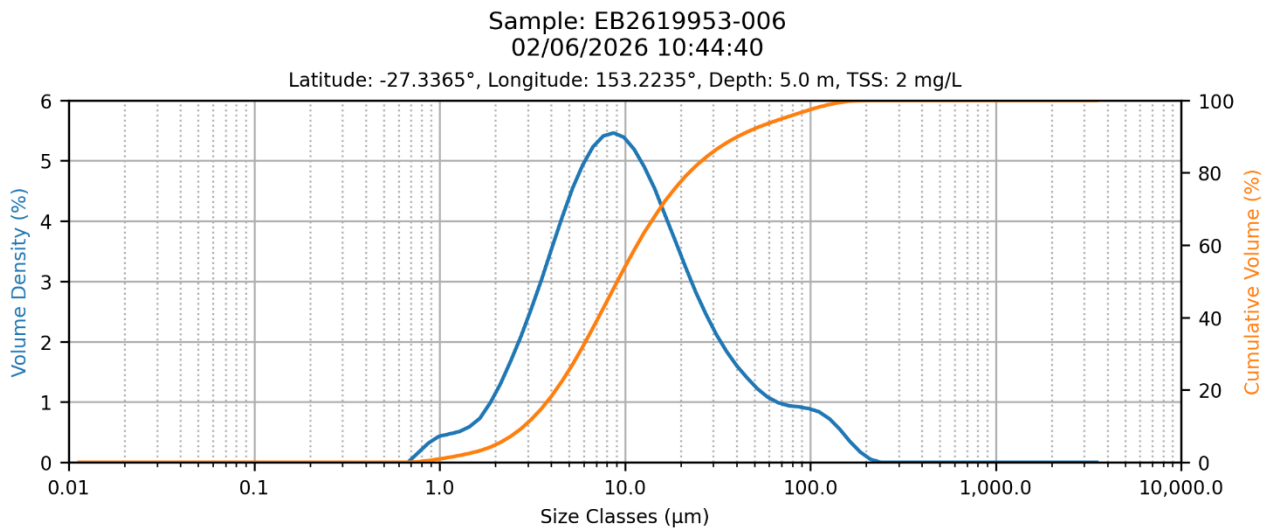
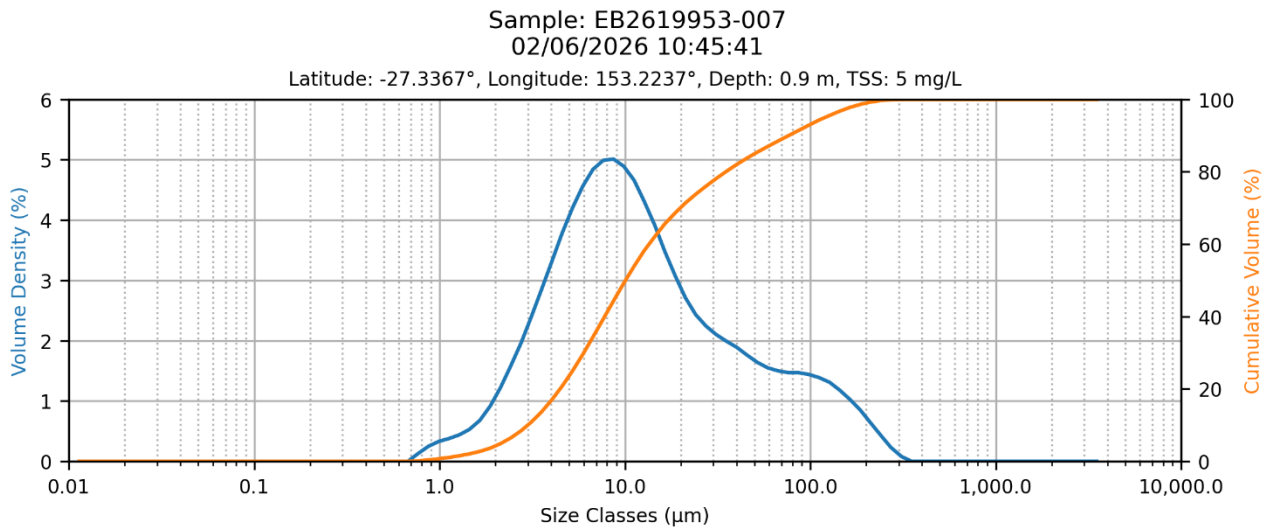
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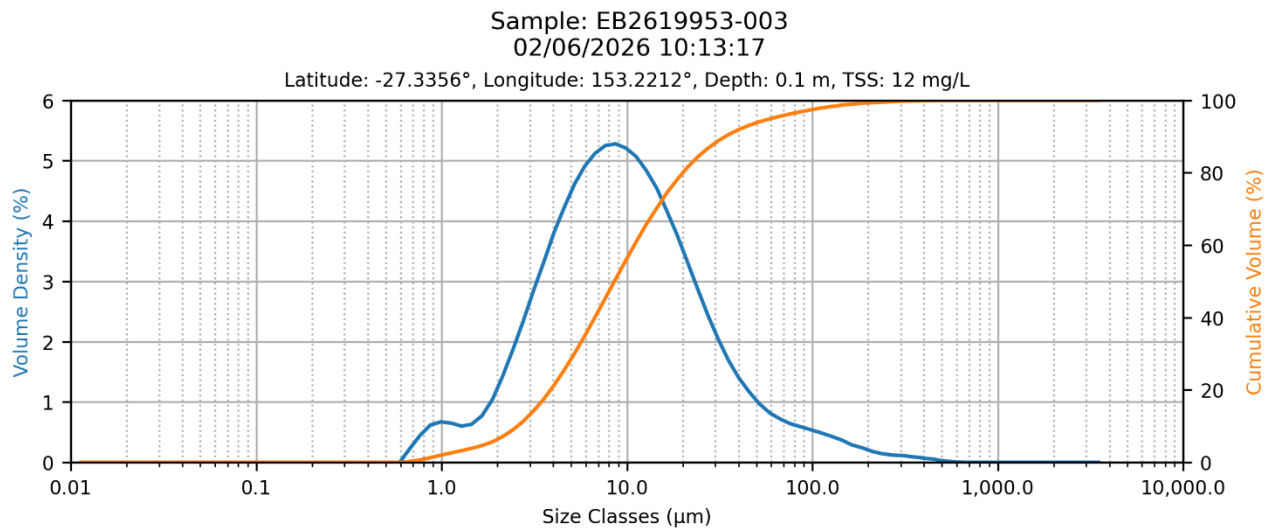
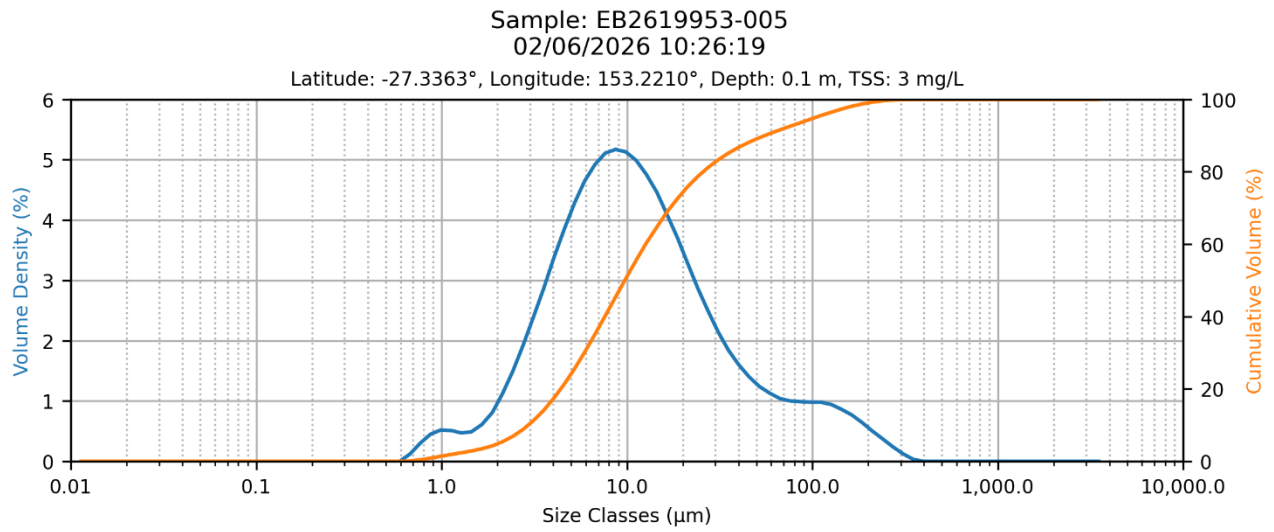
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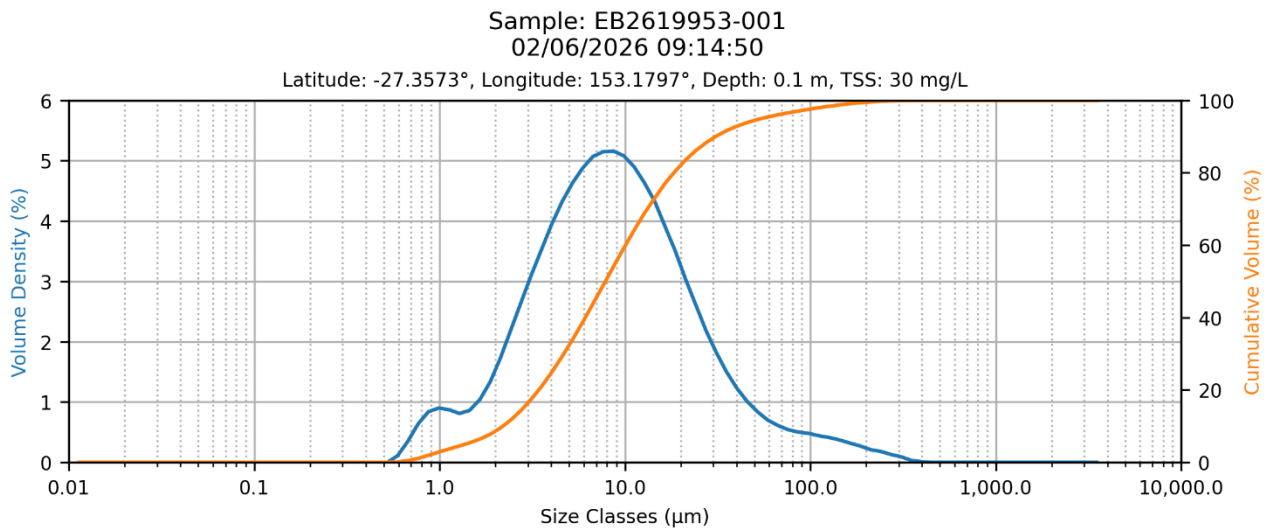
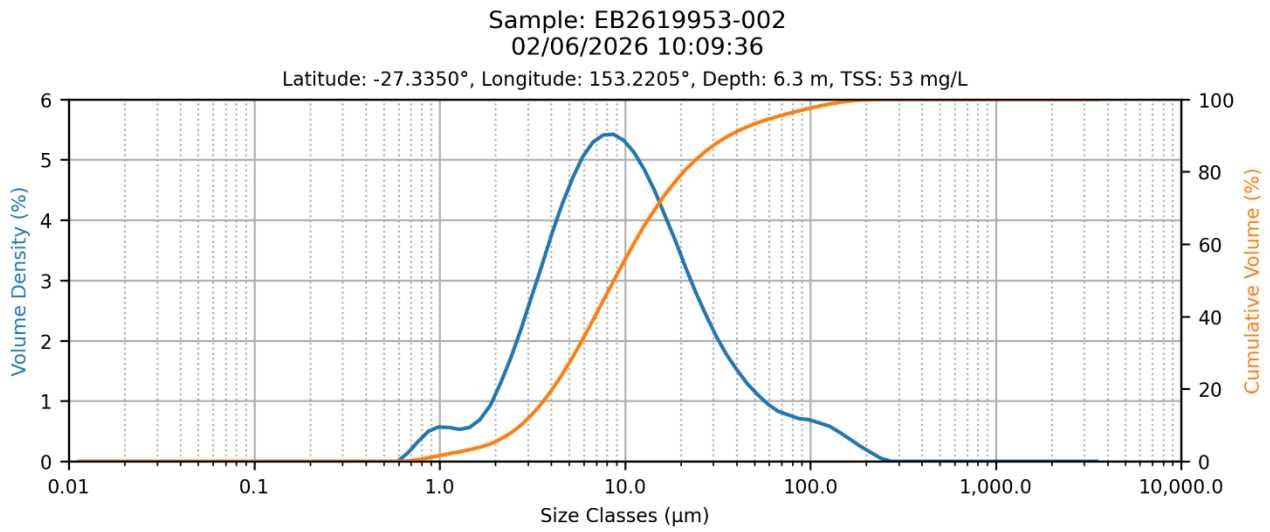
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Annex C PSD Summary

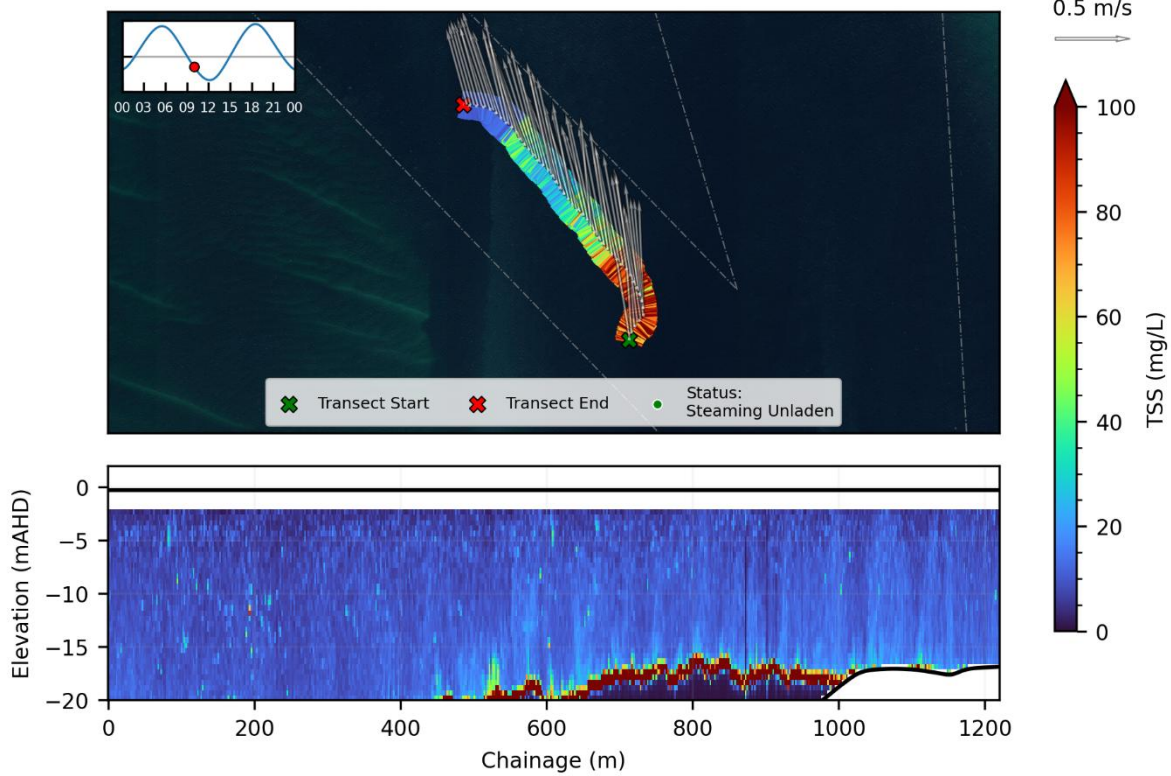
Table C.1. Particle Size Summary Statistics for all PSD Results Collected Over the Monitoring Campaign

Date	Location	Latitude (°)	Longitude (°)	Depth (m)	D10 (µm)	D50 (µm)	D90 (µm)	Description
26/05/2026 10:25	Spitfire Realignment Channel	-27.0713	153.2905	14.65	5.50	49.85	153.39	Background
26/05/2026 10:29	Spitfire Realignment Channel	-27.0705	153.2906	0.63	5.67	62.84	162.47	Background
26/05/2026 11:14	Spitfire Realignment Channel	-27.065	153.2805	10.94	7.47	66.88	178.78	Dredge Overflow
26/05/2026 11:17	Spitfire Realignment Channel	-27.0645	153.2804	0.79	5.90	75.86	270.43	Dredge Overflow
26/05/2026 11:31	Spitfire Realignment Channel	-27.0682	153.2829	9.17	3.13	14.96	162.27	Dredge Overflow
26/05/2026 11:34	Spitfire Realignment Channel	-27.0676	153.2827	0.63	2.58	11.20	112.33	Dredge Overflow
26/05/2026 11:50	Spitfire Realignment Channel	-27.0694	153.2841	9.17	2.14	9.52	249.68	Dredge Overflow
26/05/2026 11:53	Spitfire Realignment Channel	-27.069	153.2841	0.95	2.77	11.86	135.58	Dredge Overflow
26/05/2026 12:06	Spitfire Realignment Channel	-27.0722	153.2872	7.56	6.21	59.36	239.16	Dredge Overflow
26/05/2026 12:08	Spitfire Realignment Channel	-27.072	153.2873	0.79	4.31	57.10	172.53	Dredge Overflow
2/06/2026 9:14	Inner Bar	-27.3574	153.1798	0.15	2.20	7.85	30.84	Dredge Overflow
2/06/2026 10:09	MIDMPA	-27.3351	153.2206	6.27	2.75	8.72	36.53	Dredge Disposal

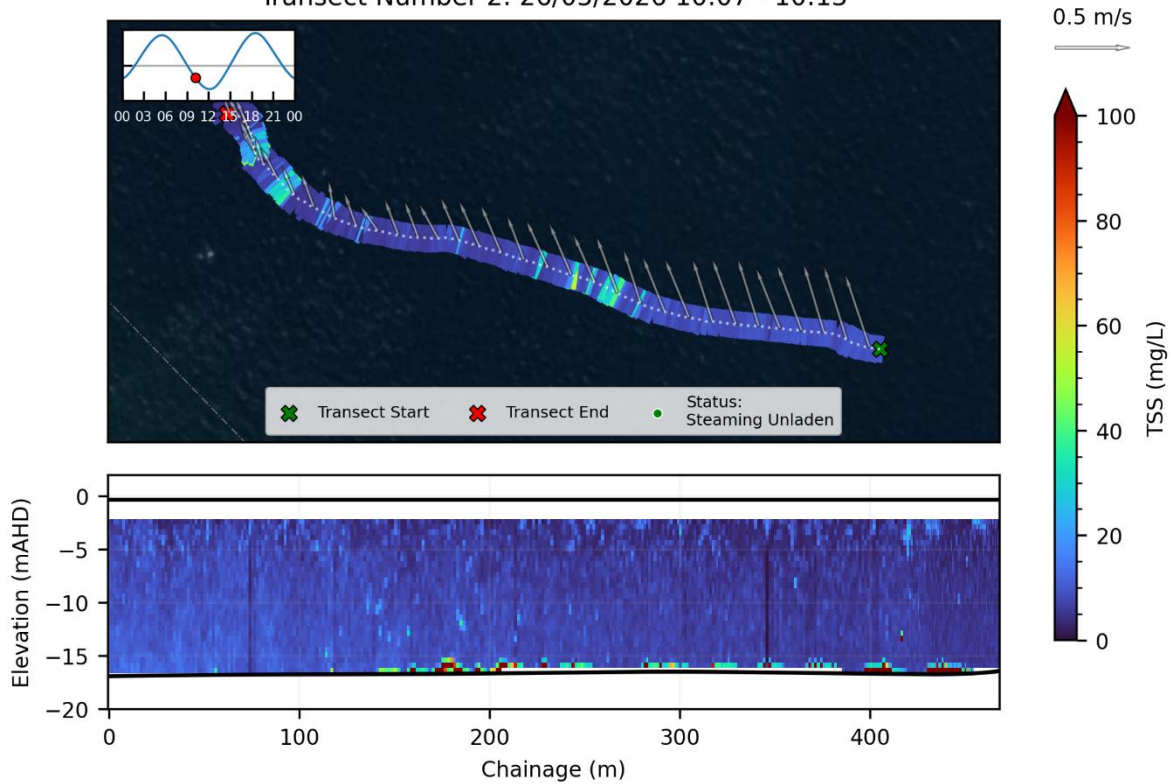
Date	Location	Latitude (°)	Longitude (°)	Depth (m)	D10 (µm)	D50 (µm)	D90 (µm)	Description
2/06/2026 10:13	MIDMPA	-27.3358	153.2214	0.15	2.57	8.56	33.96	Dredge Disposal
2/06/2026 10:23	MIDMPA	-27.3359	153.2206	5.79	2.79	9.35	57.18	Dredge Disposal
2/06/2026 10:26	MIDMPA	-27.3363	153.2212	0.15	2.94	9.74	55.51	Dredge Disposal
2/06/2026 10:44	MIDMPA	-27.3366	153.2237	4.98	2.86	9.11	40.57	Dredge Disposal
2/06/2026 10:45	MIDMPA	-27.3367	153.2238	0.95	2.99	10.08	76.35	Dredge Disposal

Annex D Transect Plots – 26/05/2026

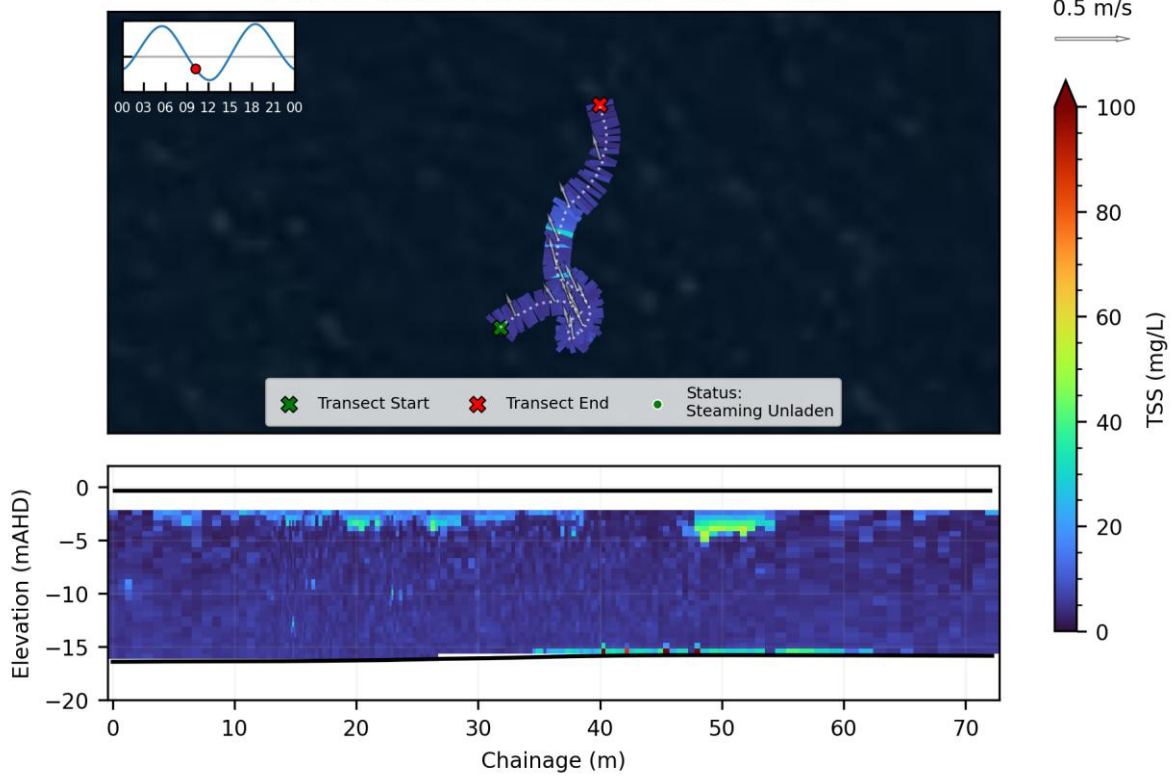
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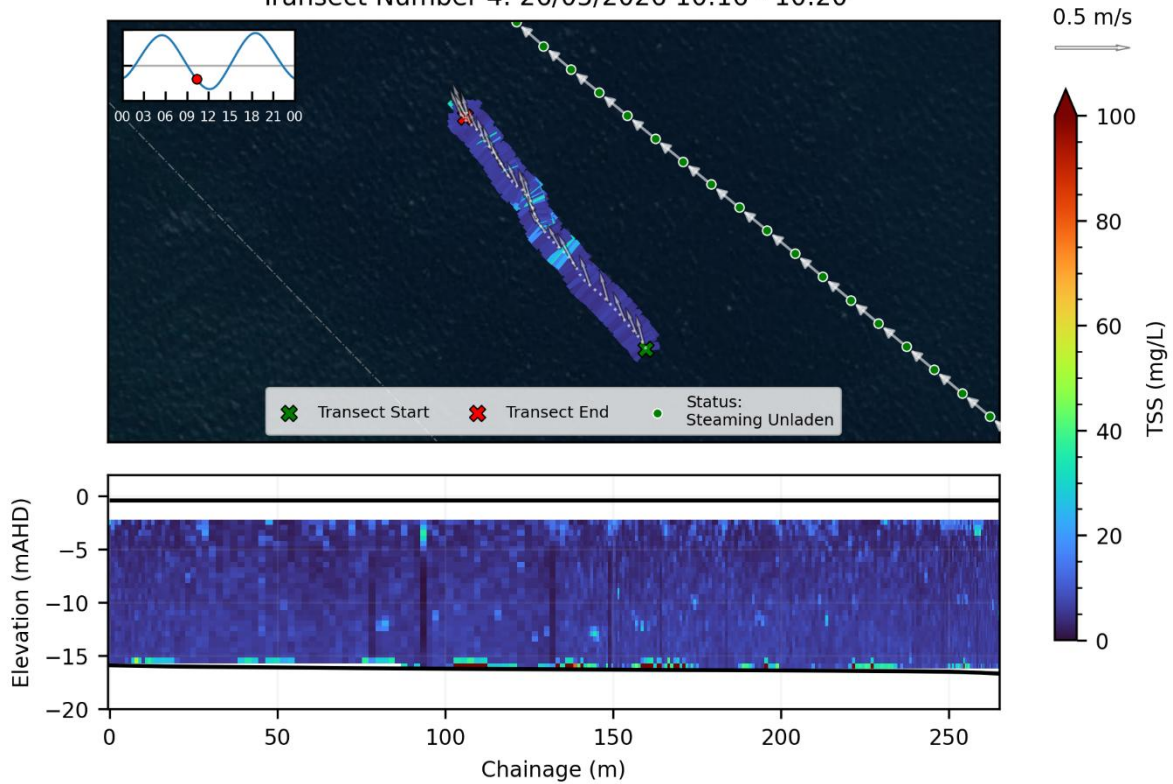
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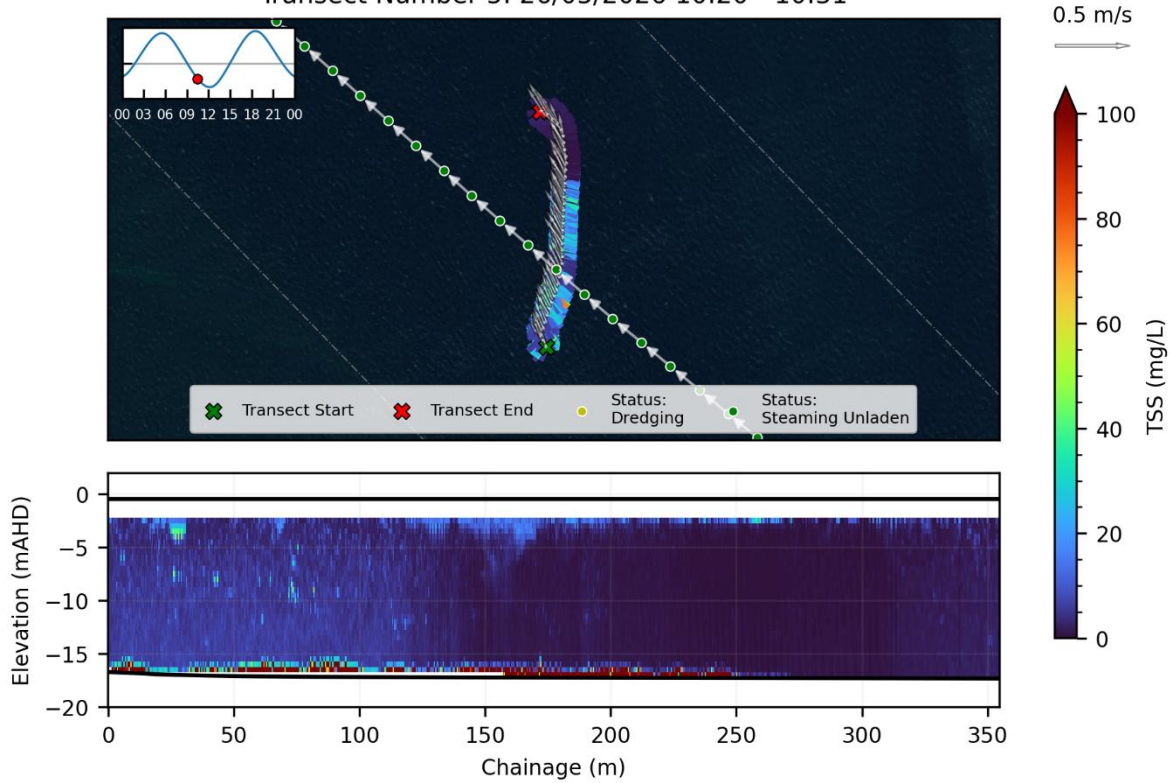
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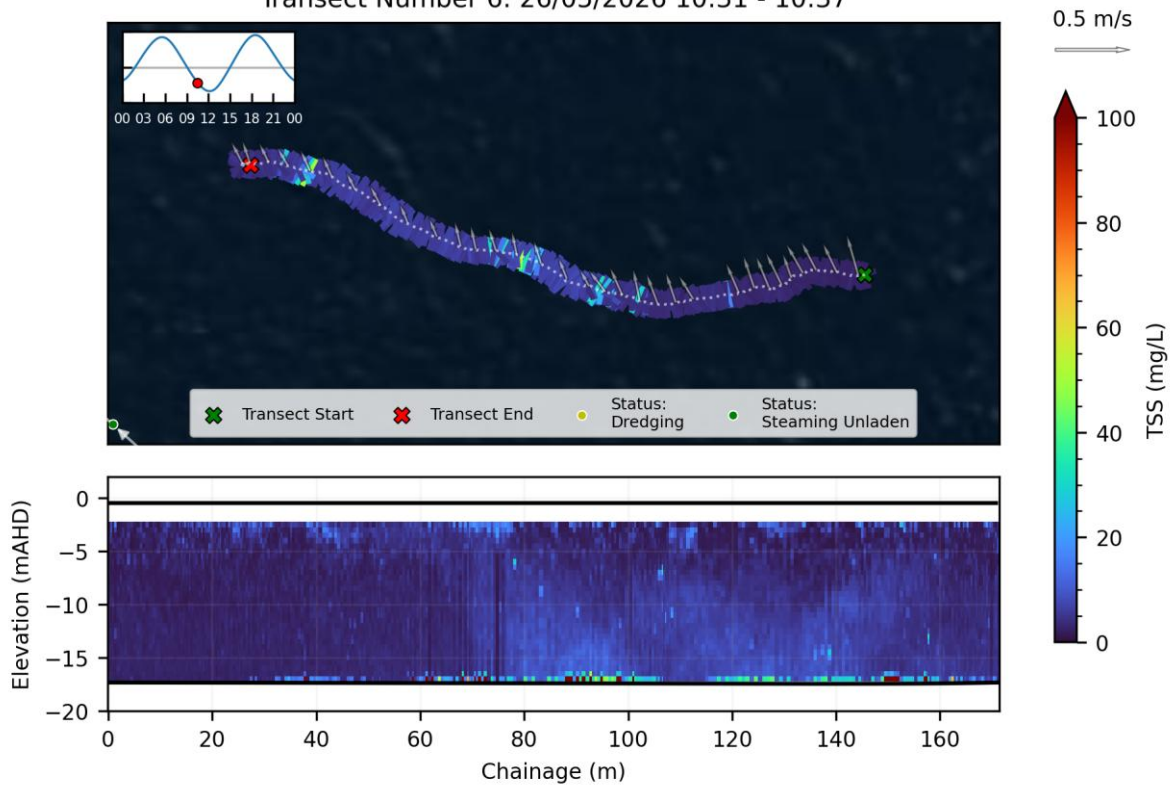
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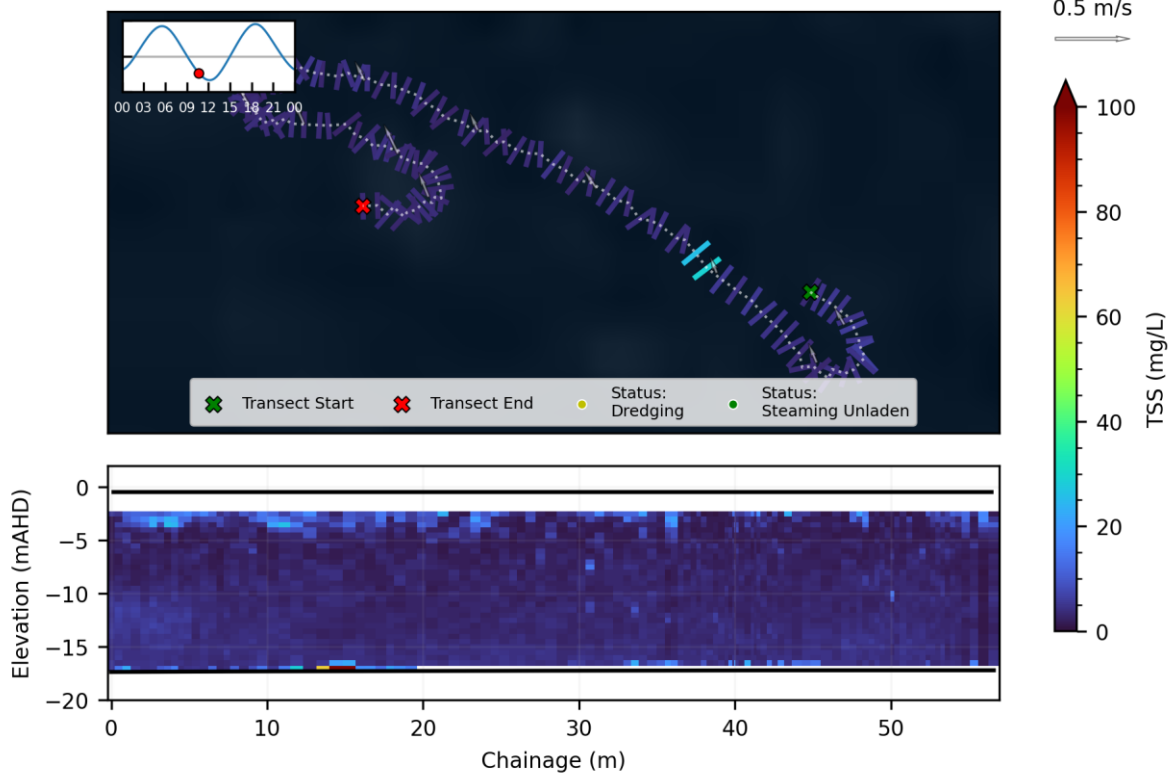
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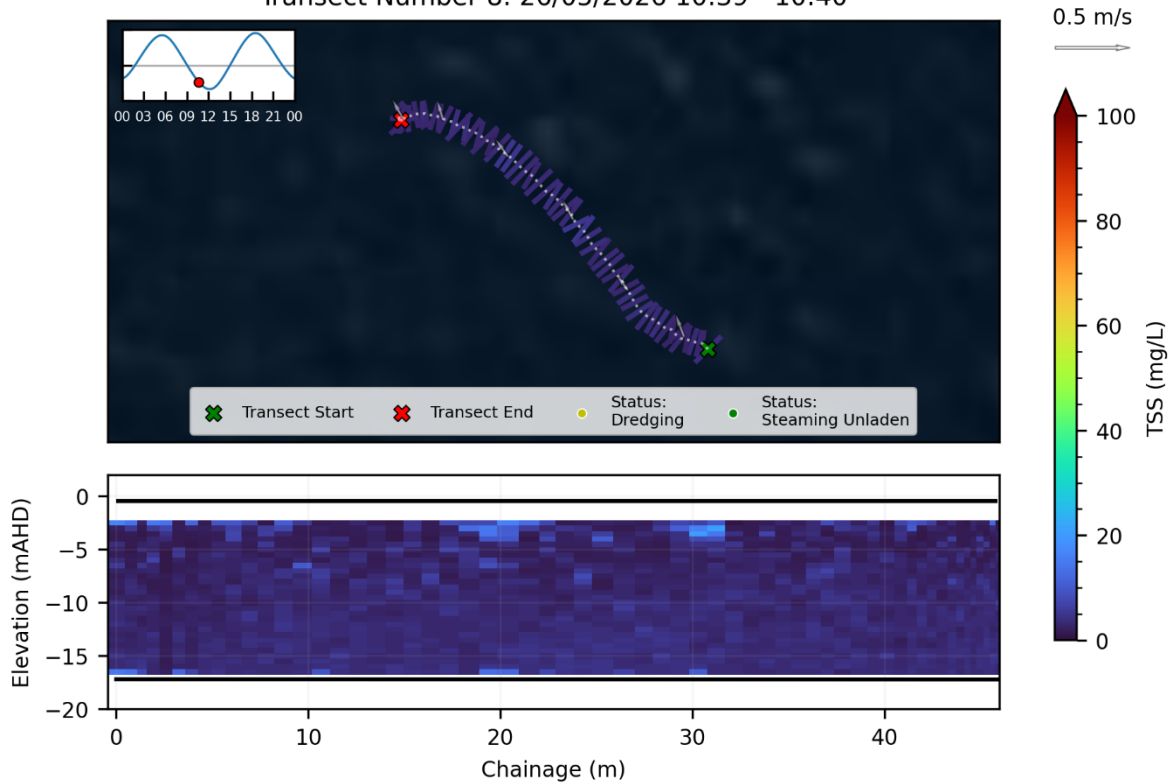
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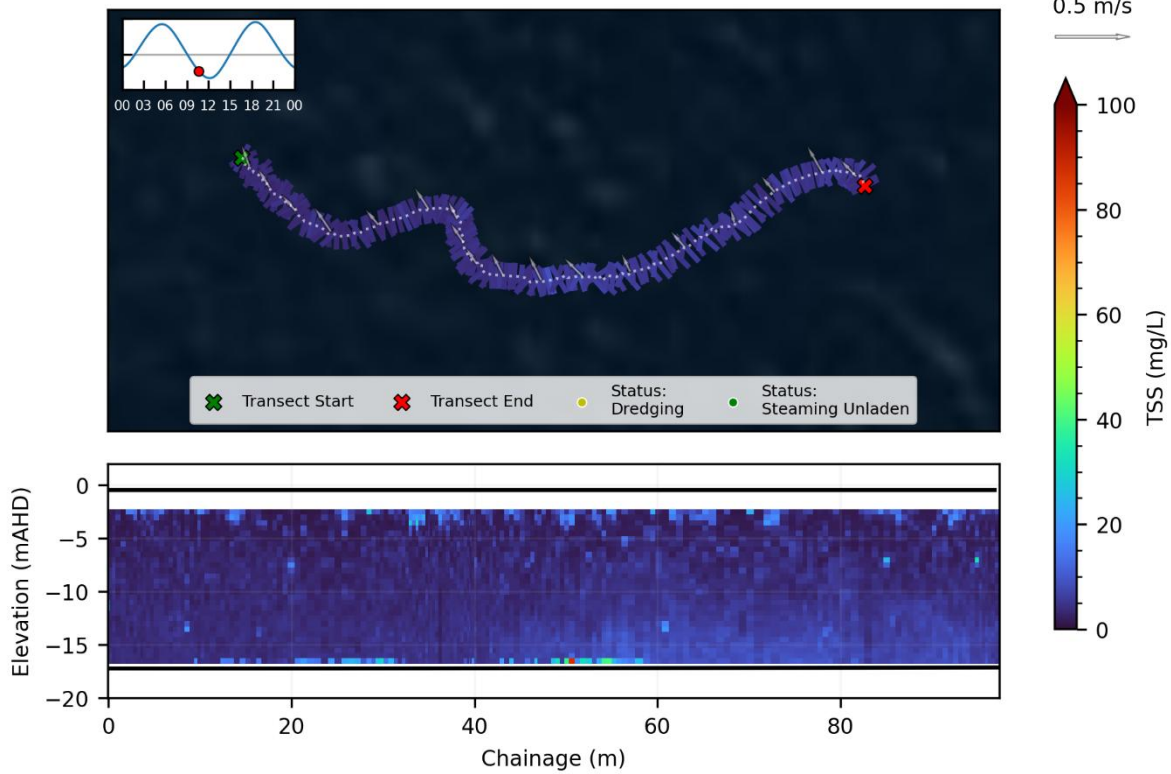
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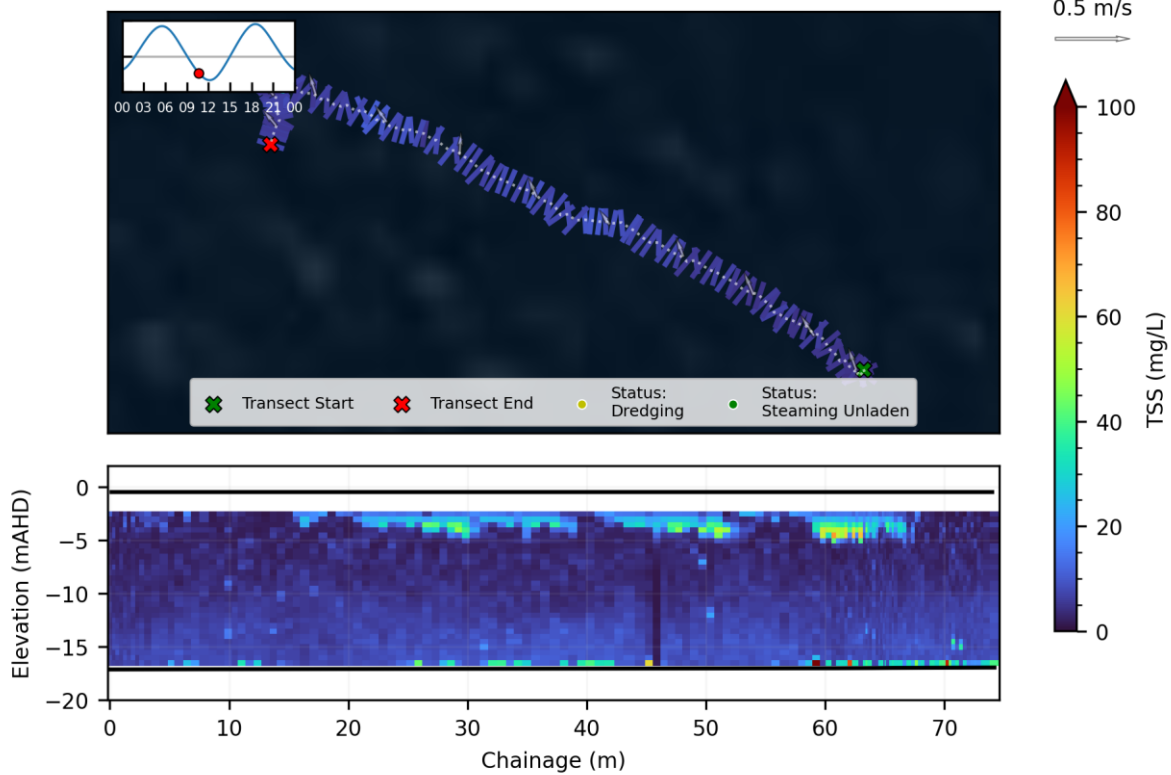
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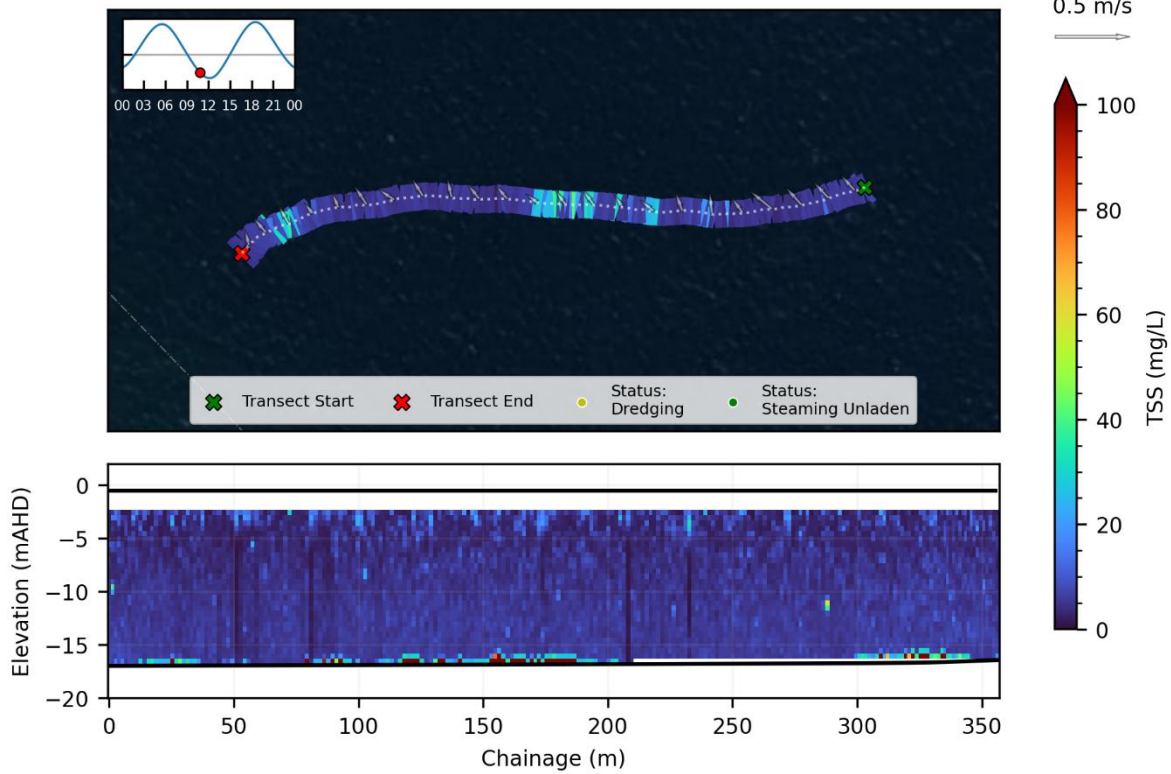
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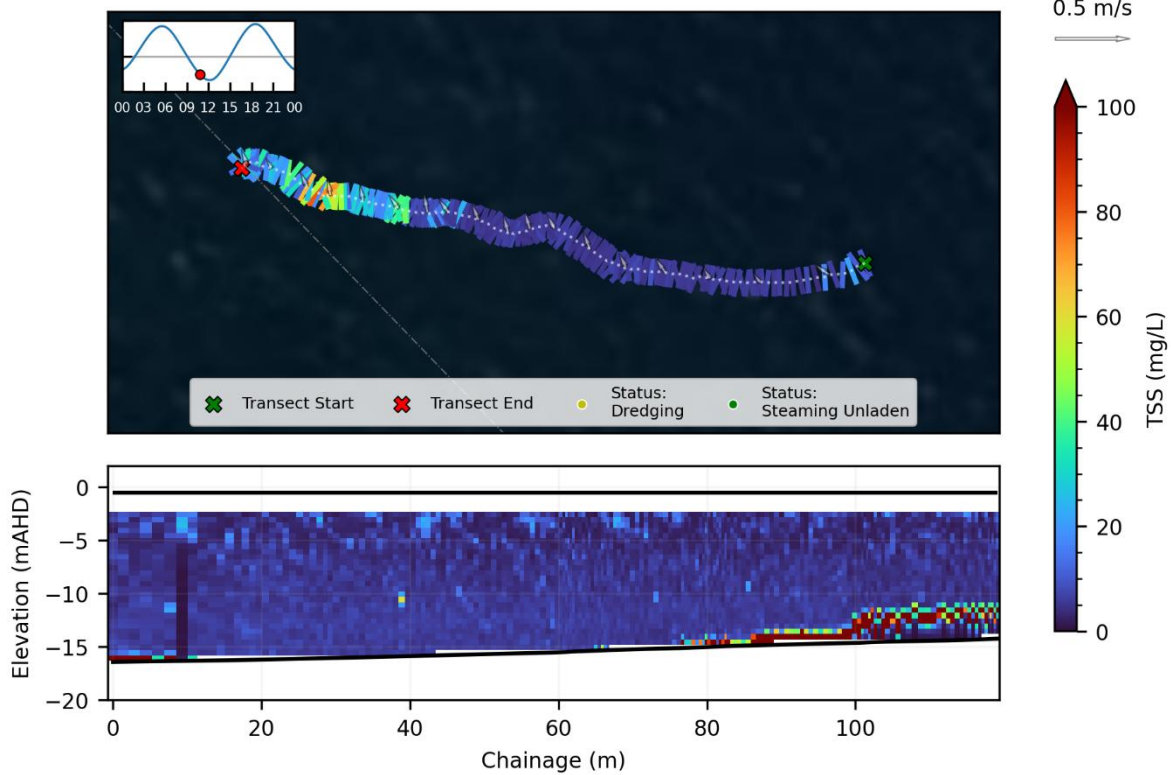
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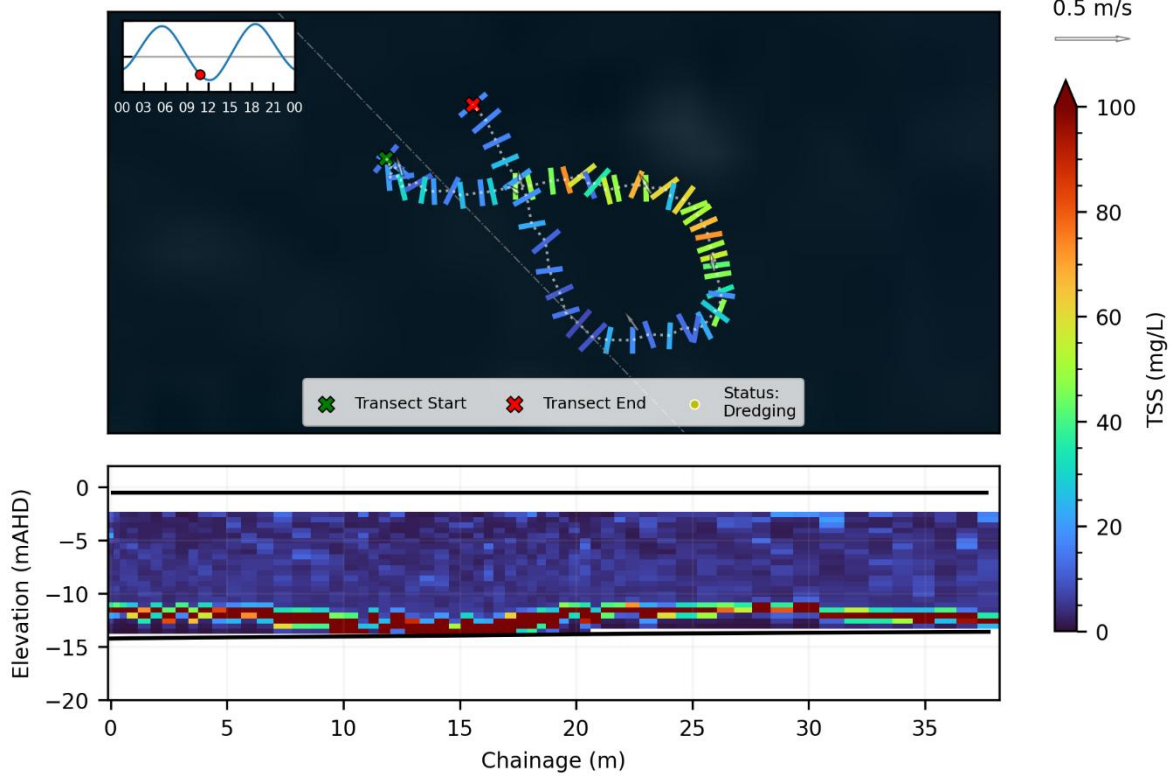
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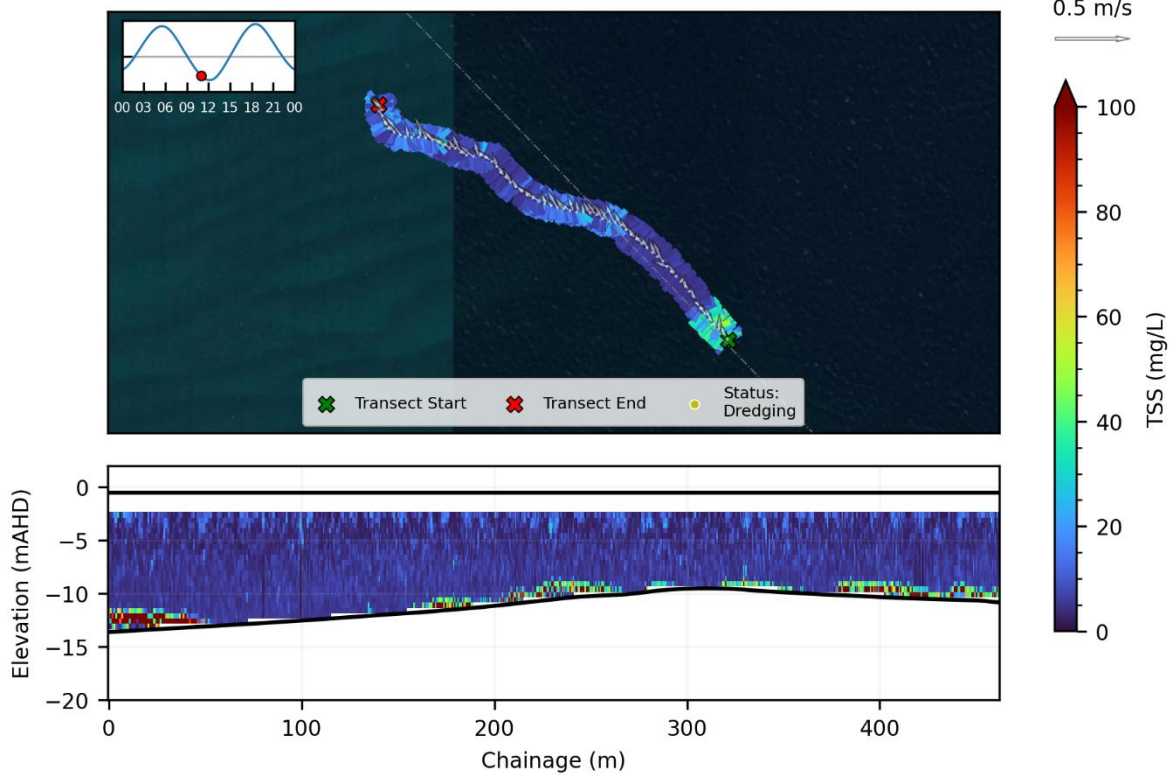
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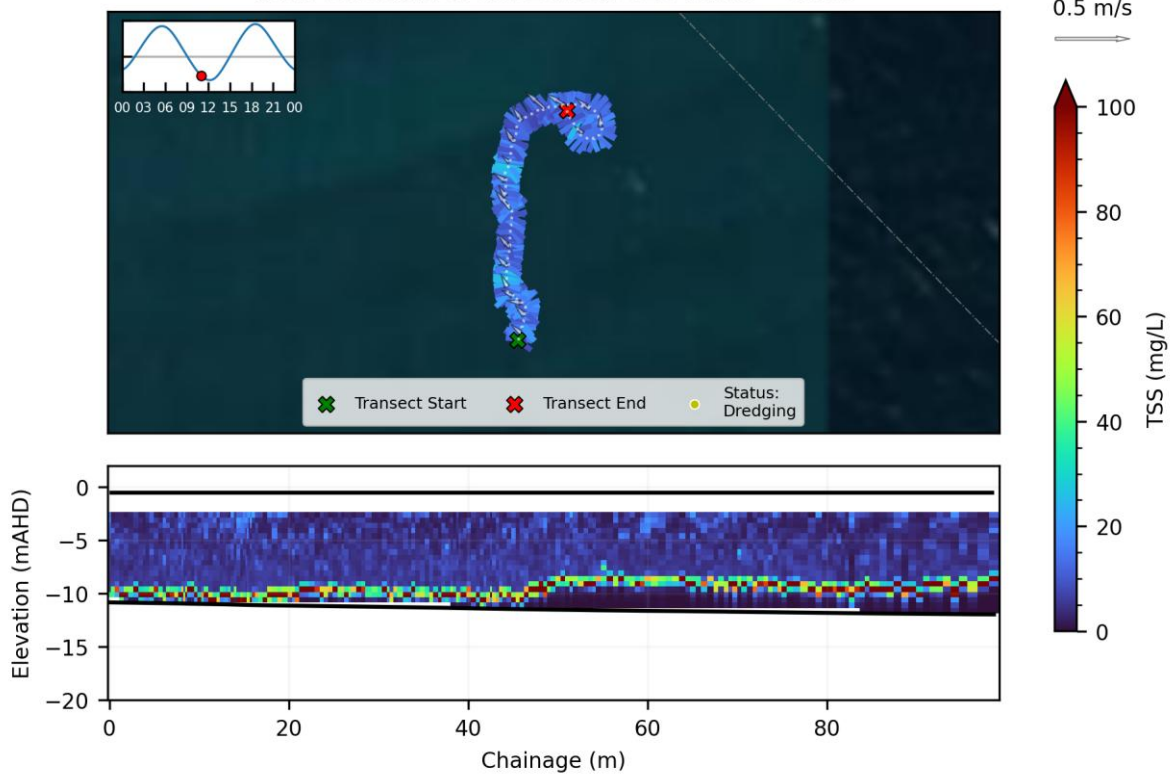
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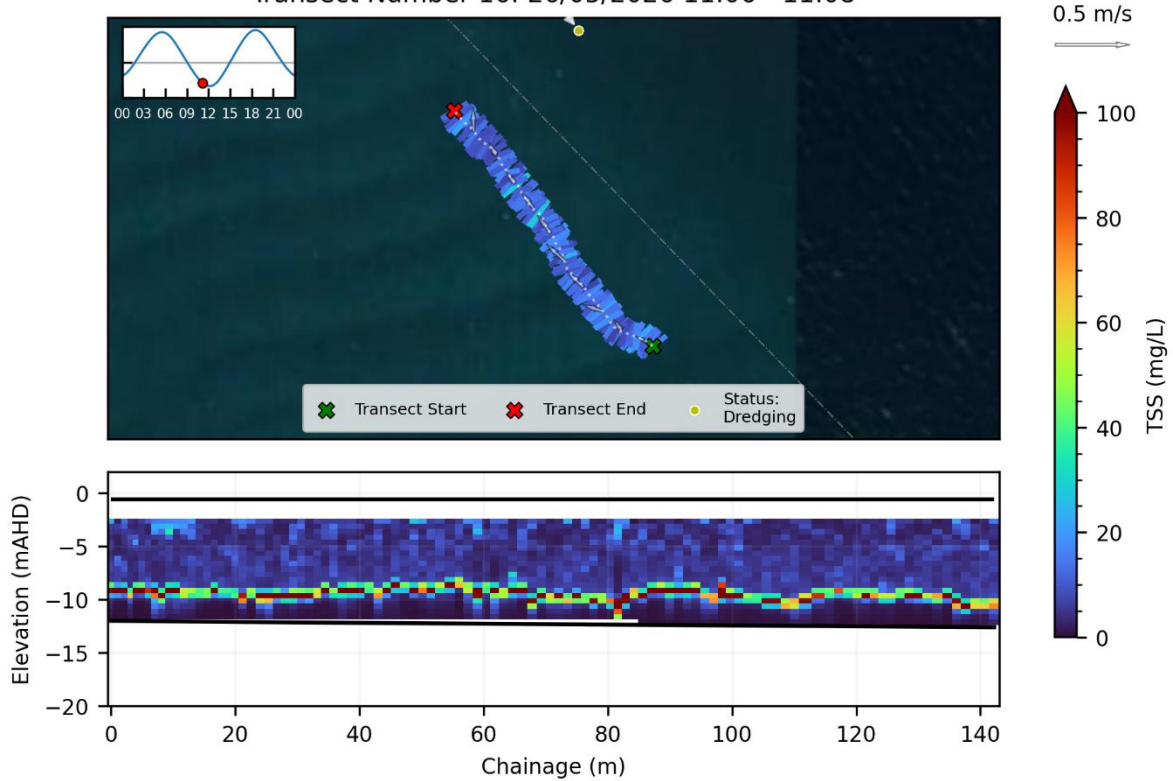
Transect Number 14: 26/05/2026 10:53 - 11:03



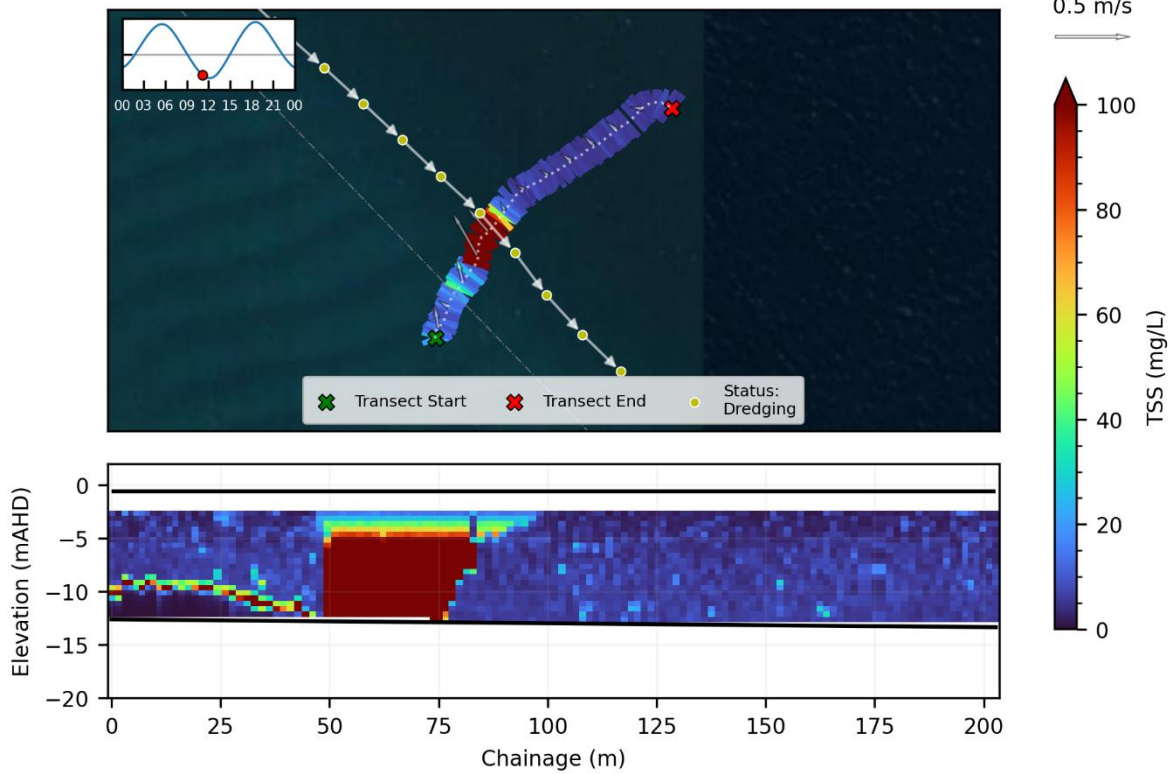
Transect Number 15: 26/05/2026 11:03 - 11:06



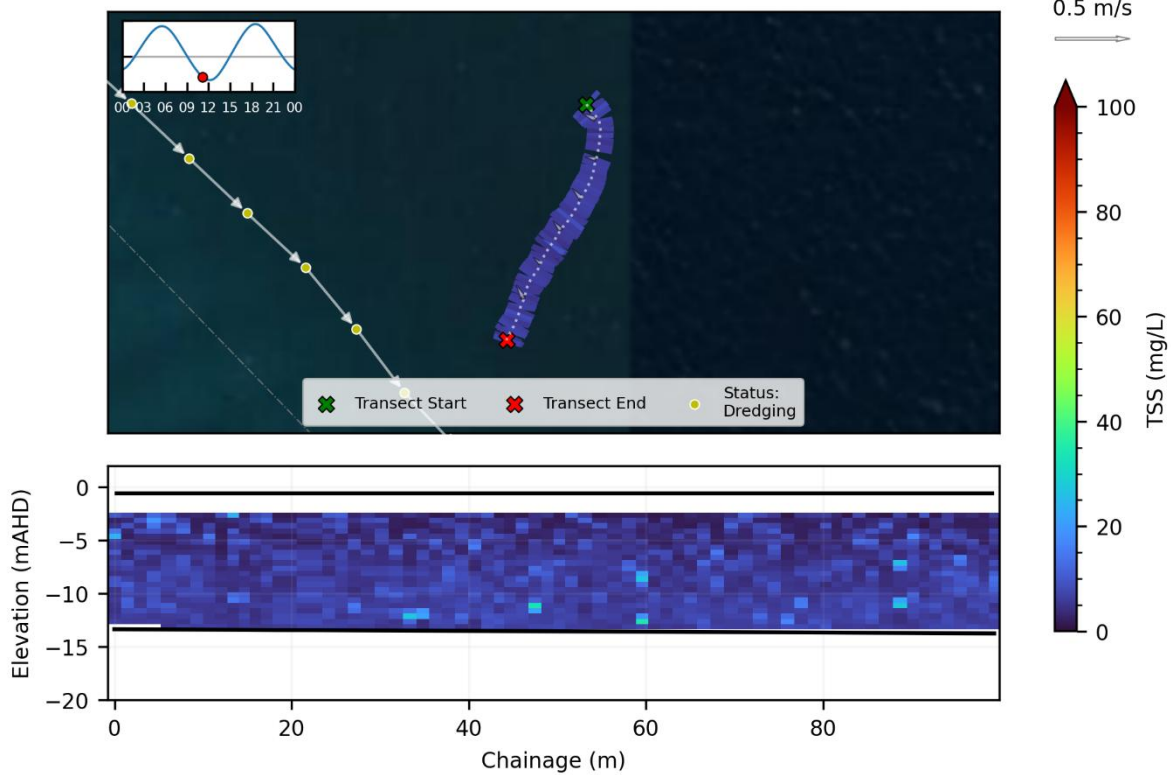
Transect Number 16: 26/05/2026 11:06 - 11:08



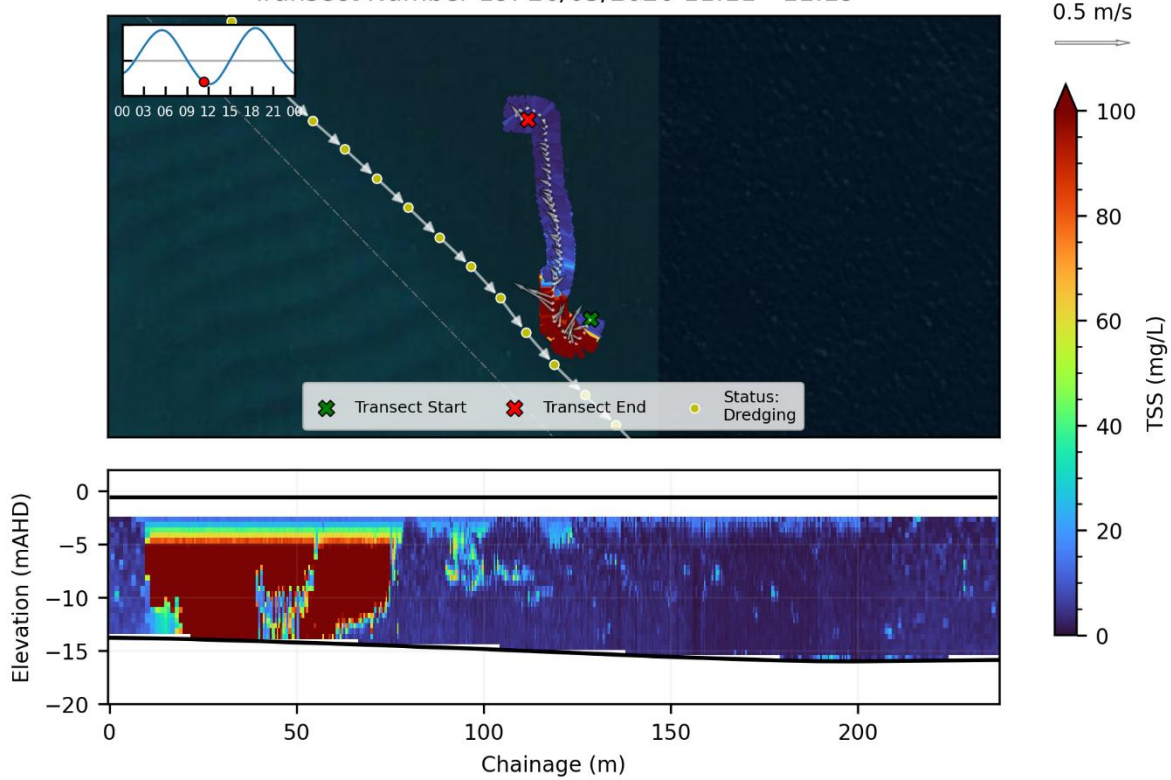
Transect Number 17: 26/05/2026 11:08 - 11:10



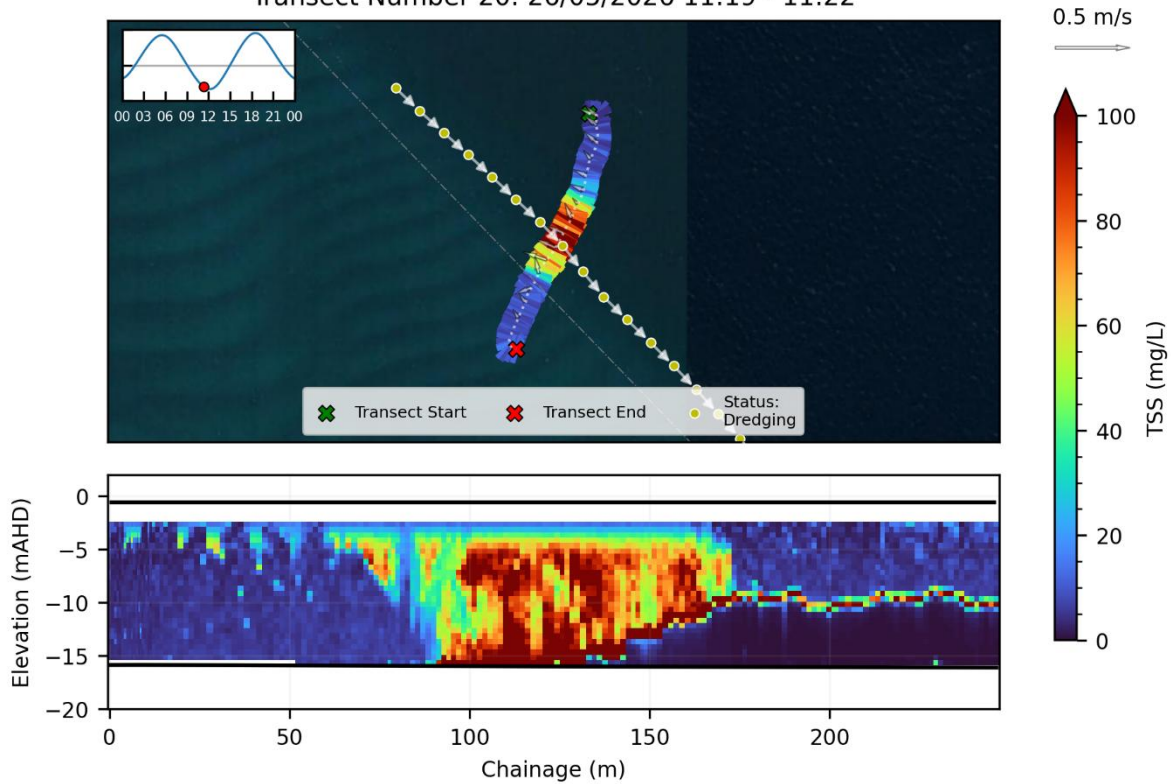
Transect Number 18: 26/05/2026 11:10 - 11:11



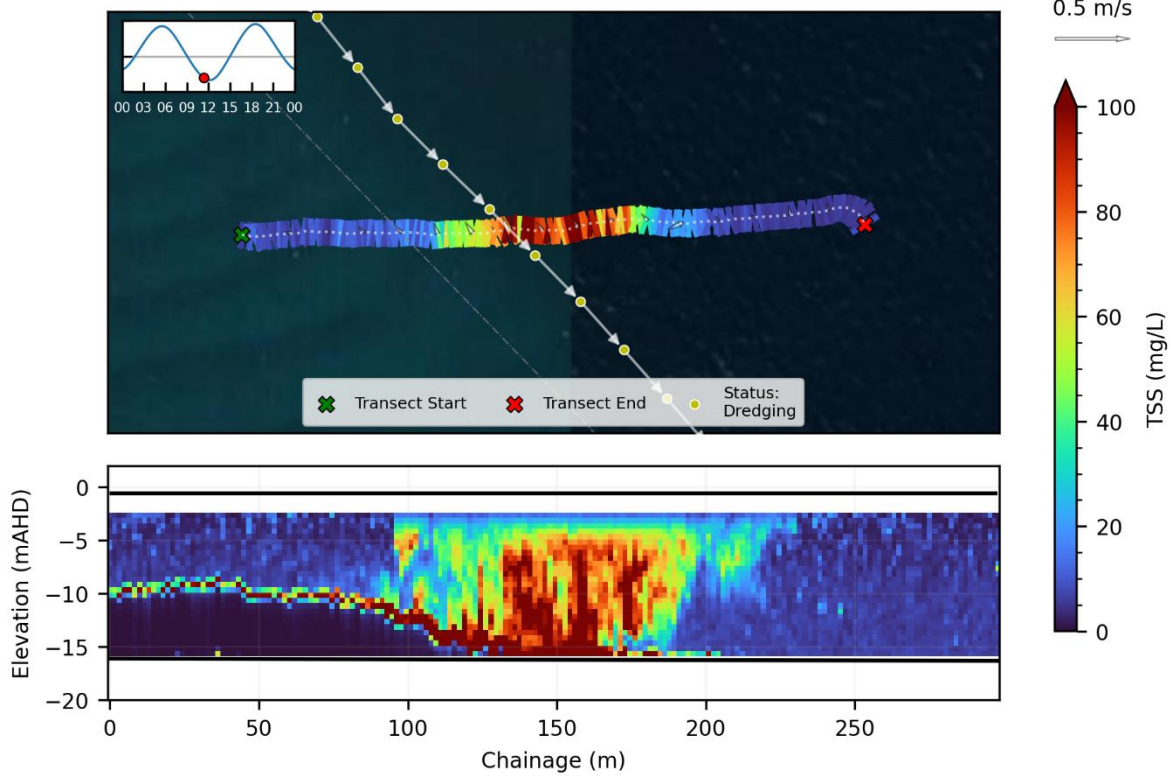
Transect Number 19: 26/05/2026 11:11 - 11:19



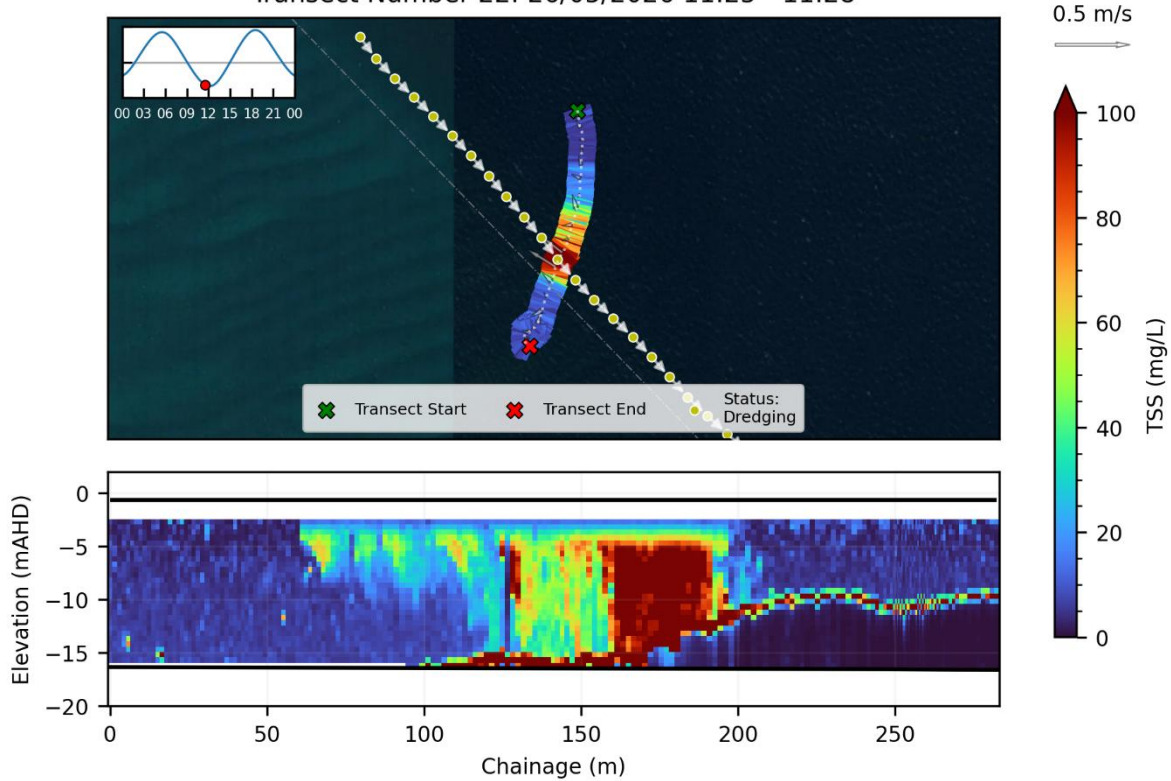
Transect Number 20: 26/05/2026 11:19 - 11:22



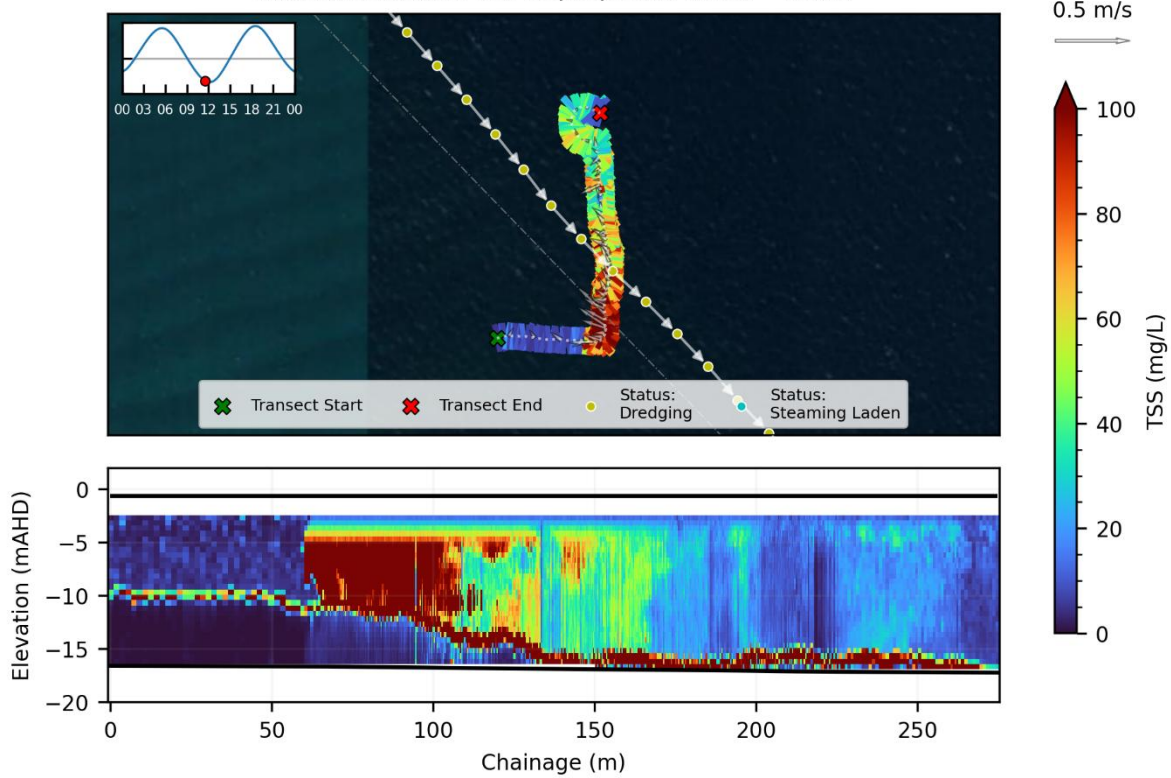
Transect Number 21: 26/05/2026 11:22 - 11:25



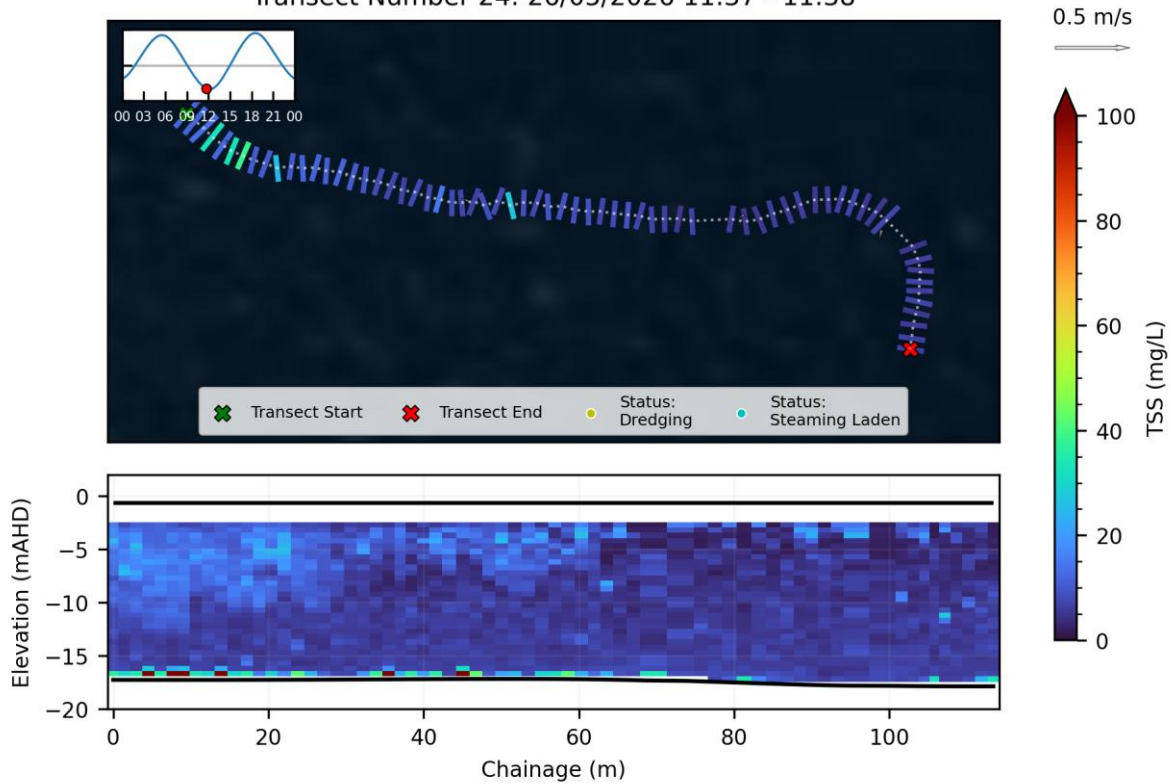
Transect Number 22: 26/05/2026 11:25 - 11:28



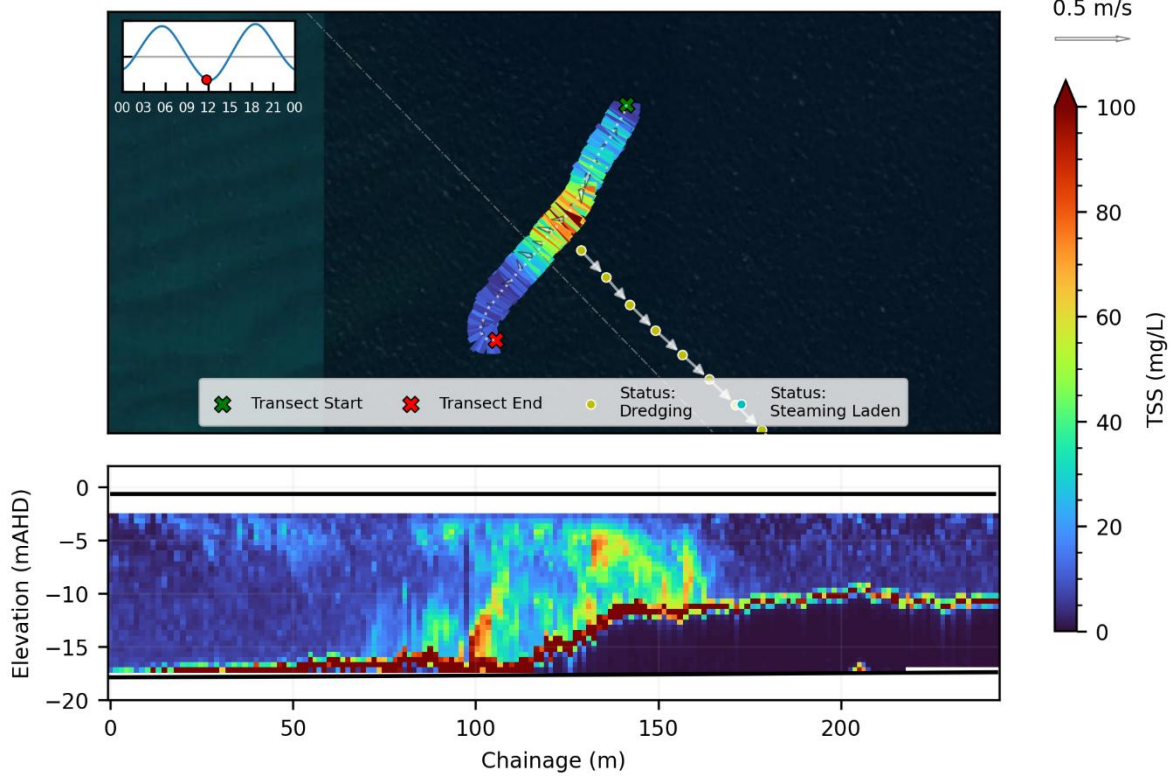
Transect Number 23: 26/05/2026 11:28 - 11:37



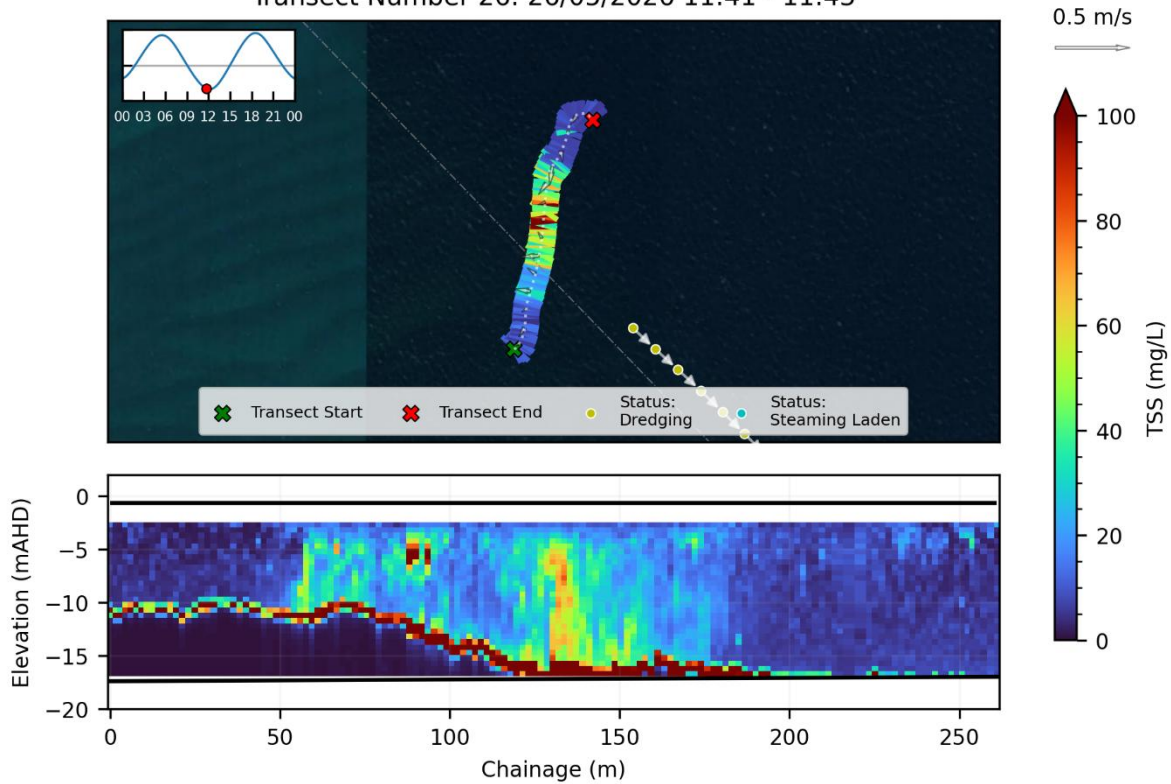
Transect Number 24: 26/05/2026 11:37 - 11:38



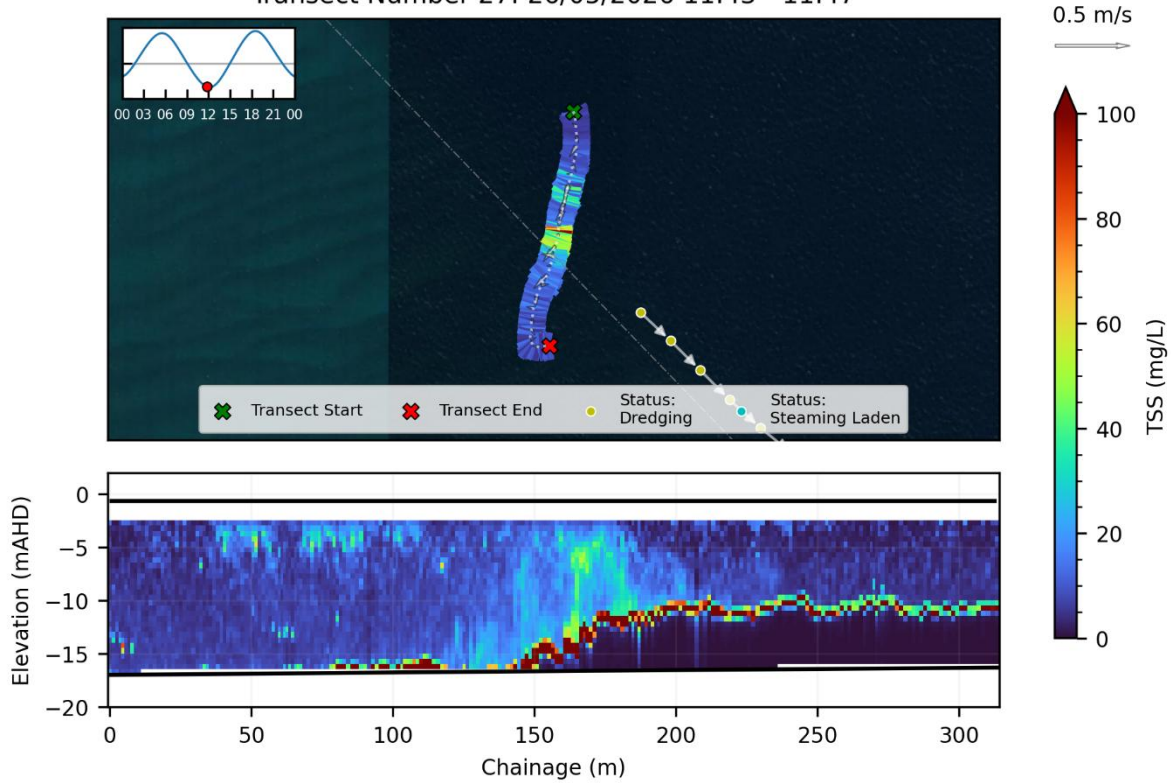
Transect Number 25: 26/05/2026 11:38 - 11:41



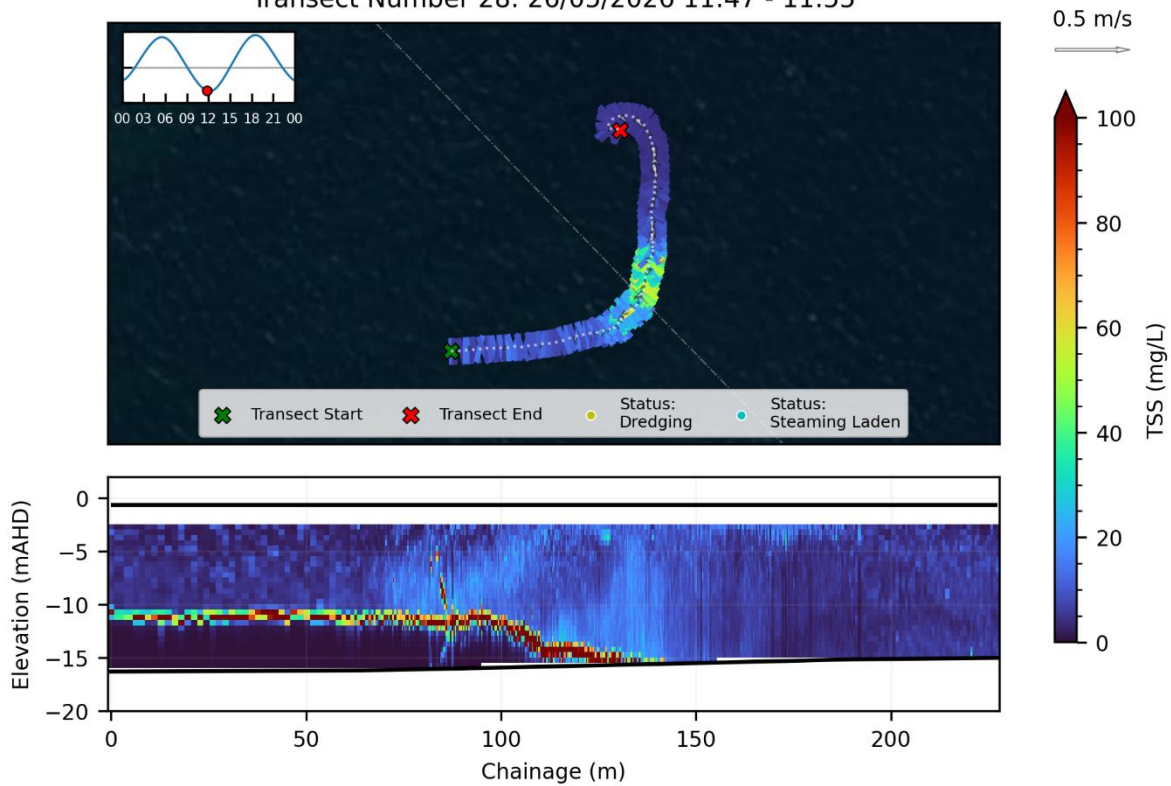
Transect Number 26: 26/05/2026 11:41 - 11:43



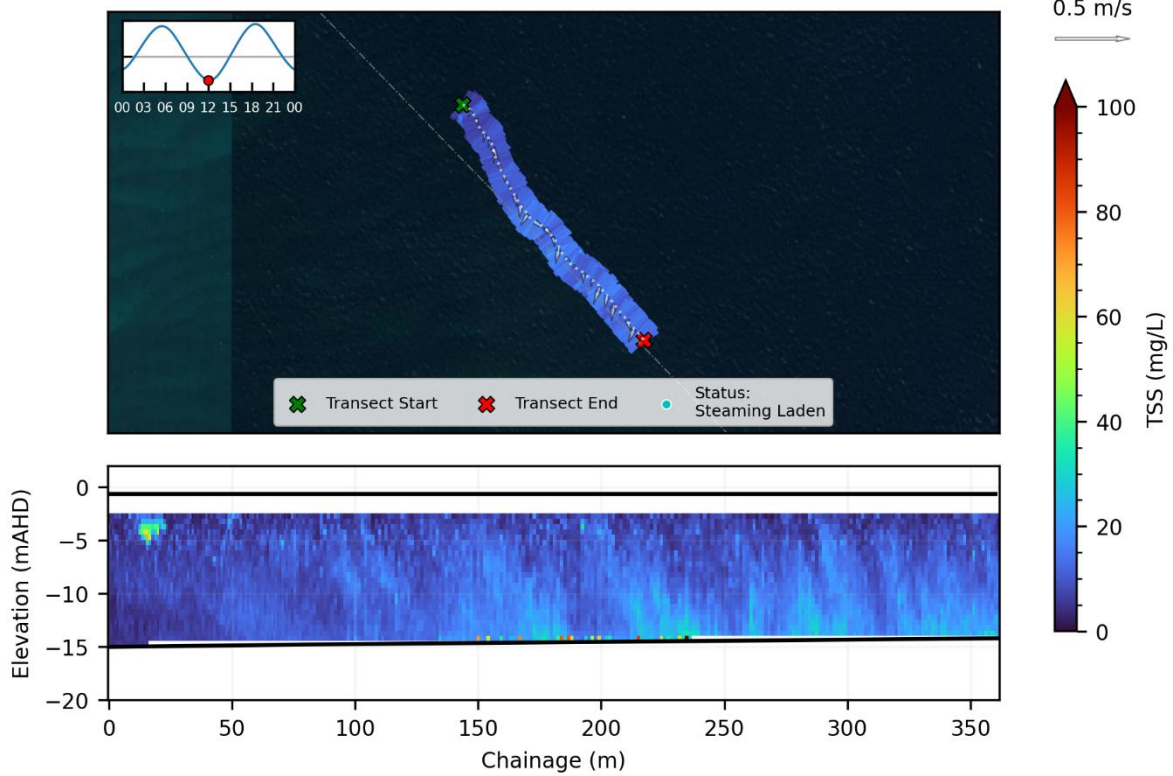
Transect Number 27: 26/05/2026 11:43 - 11:47



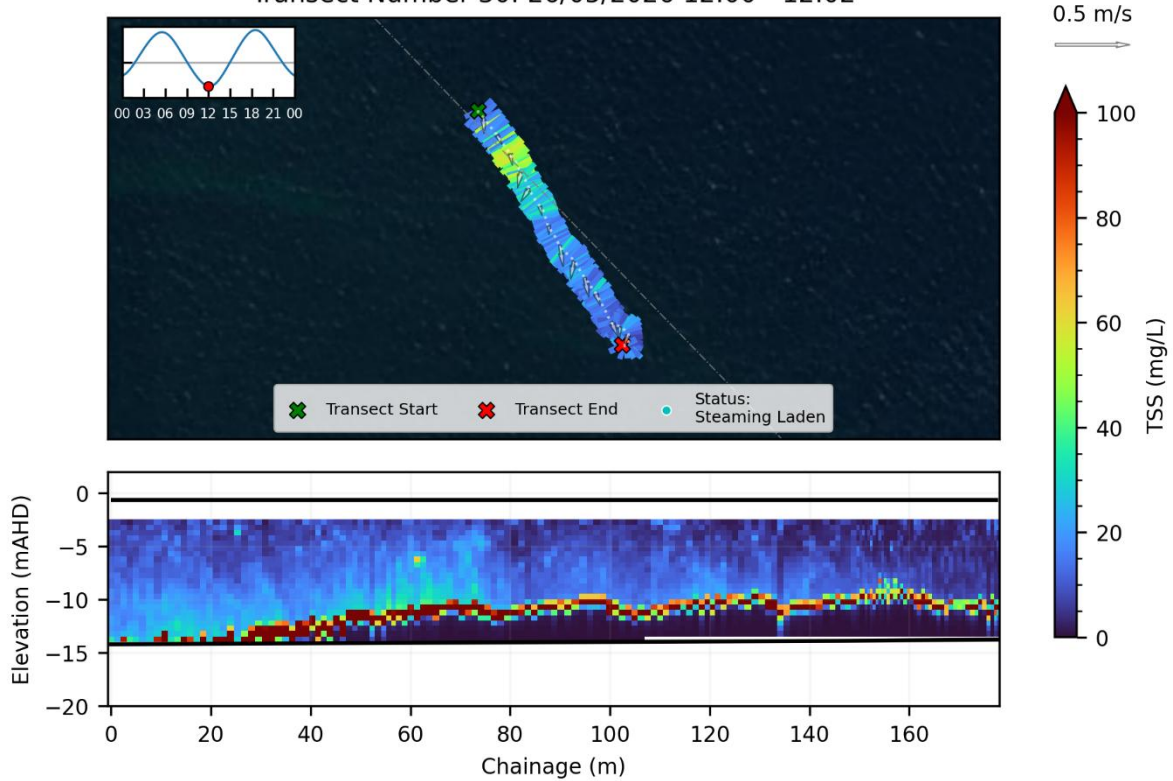
Transect Number 28: 26/05/2026 11:47 - 11:55



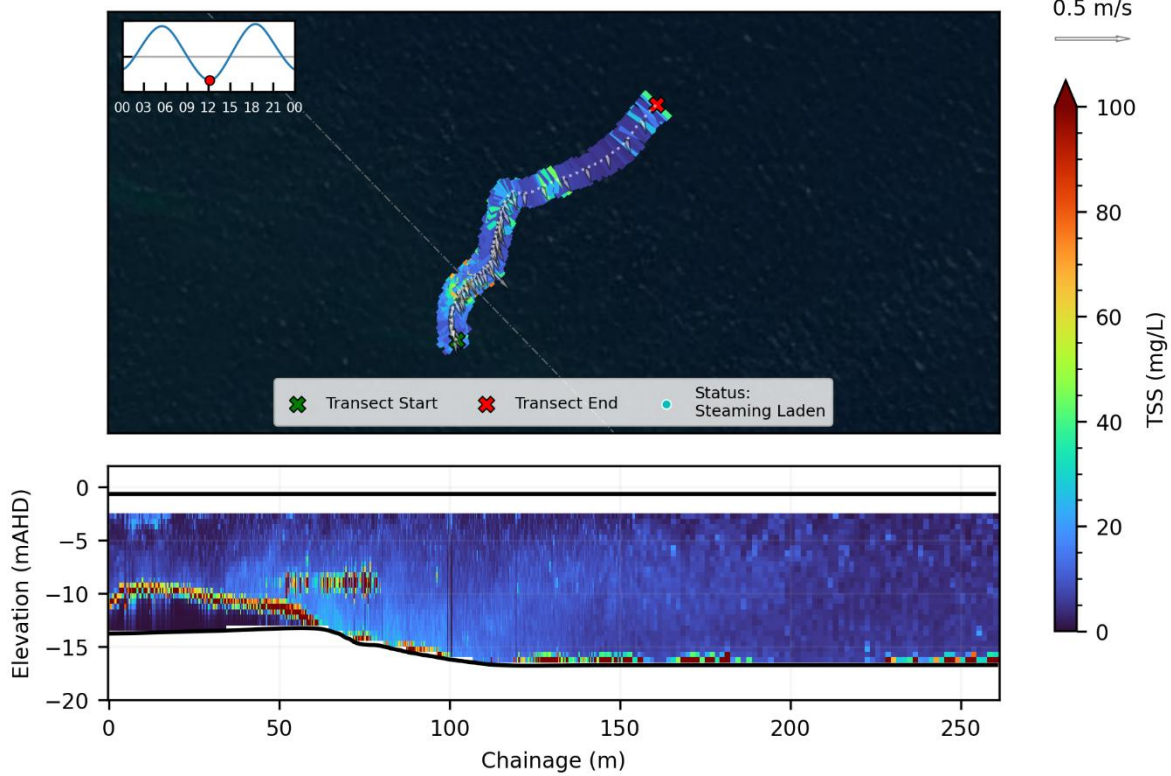
Transect Number 29: 26/05/2026 11:55 - 12:00



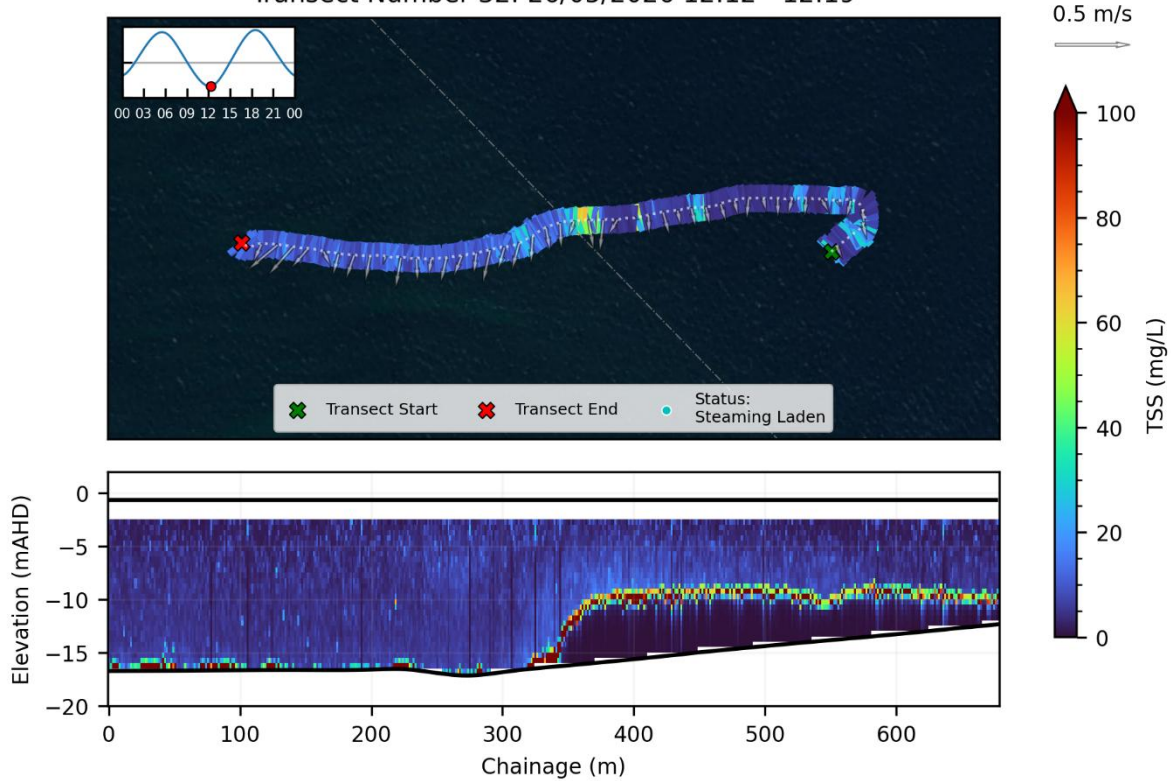
Transect Number 30: 26/05/2026 12:00 - 12:02



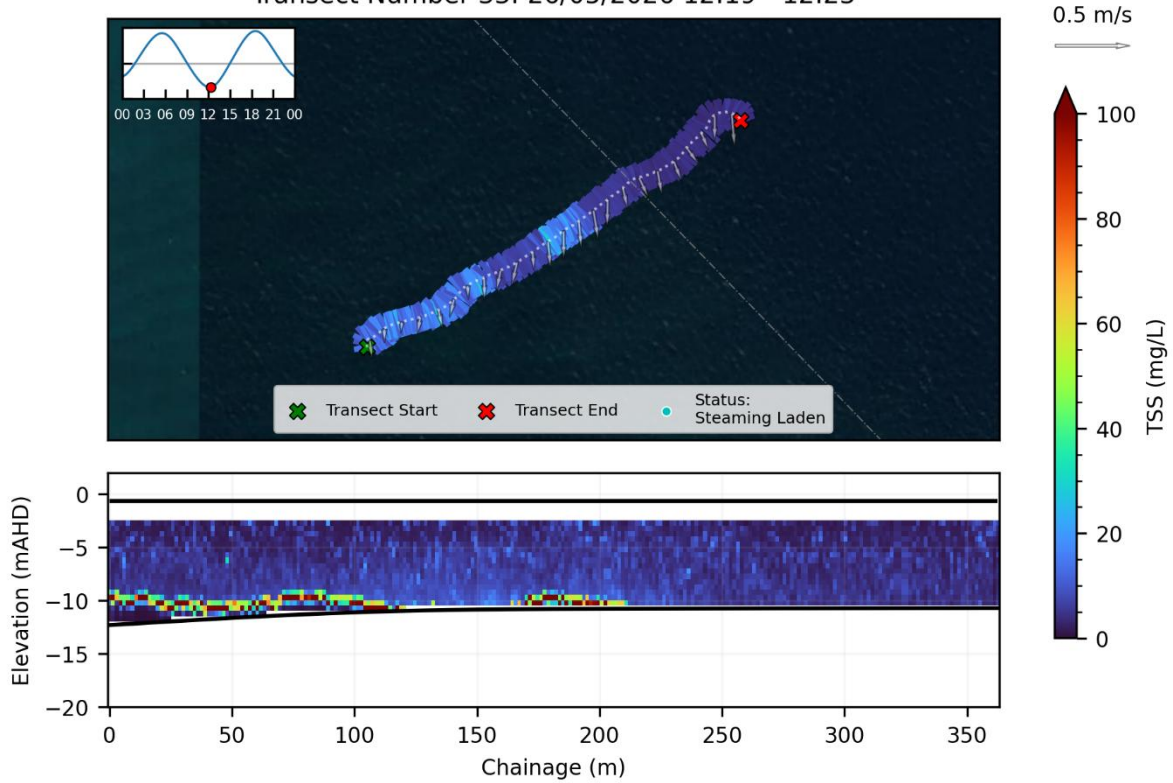
Transect Number 31: 26/05/2026 12:02 - 12:12



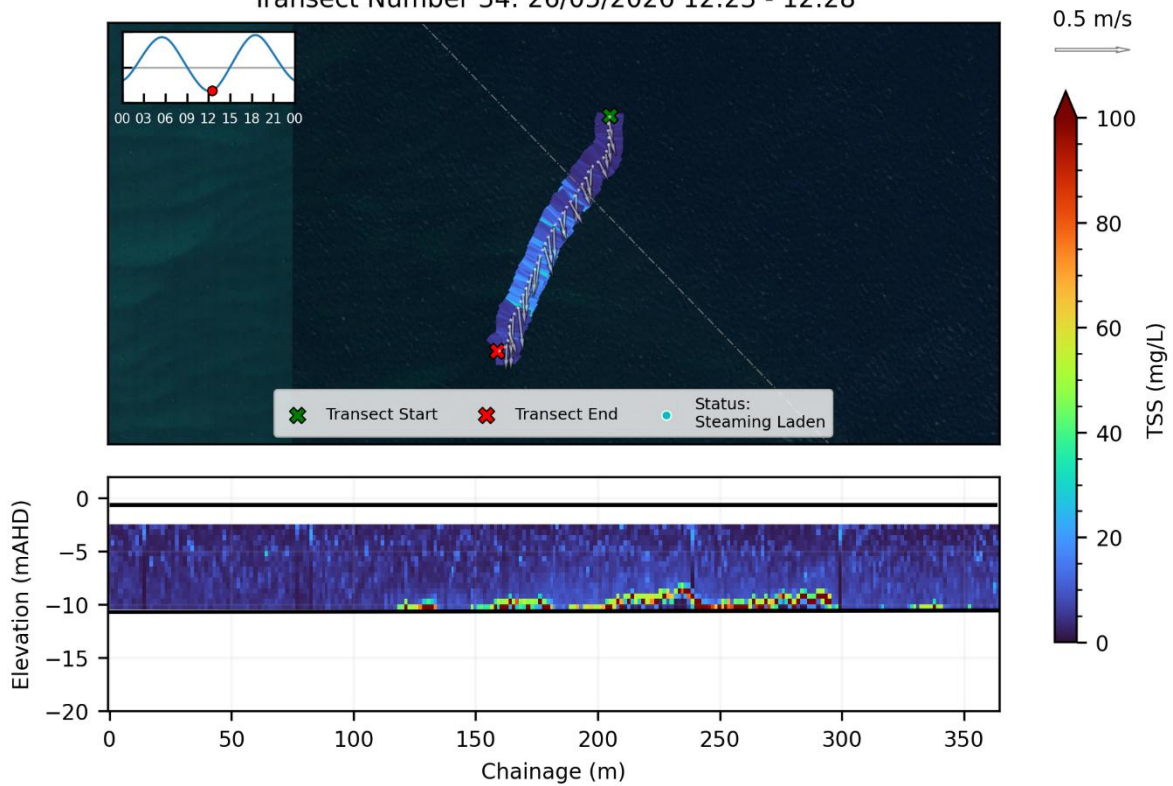
Transect Number 32: 26/05/2026 12:12 - 12:19

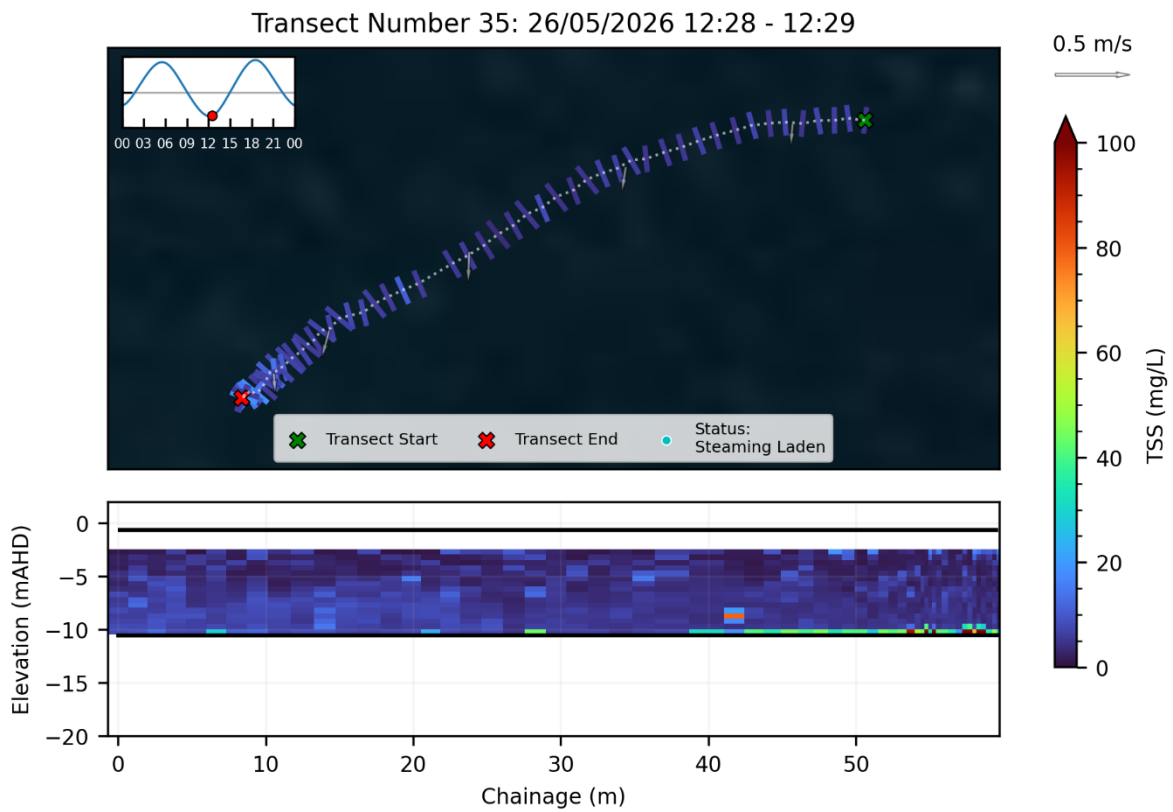


Transect Number 33: 26/05/2026 12:19 - 12:23



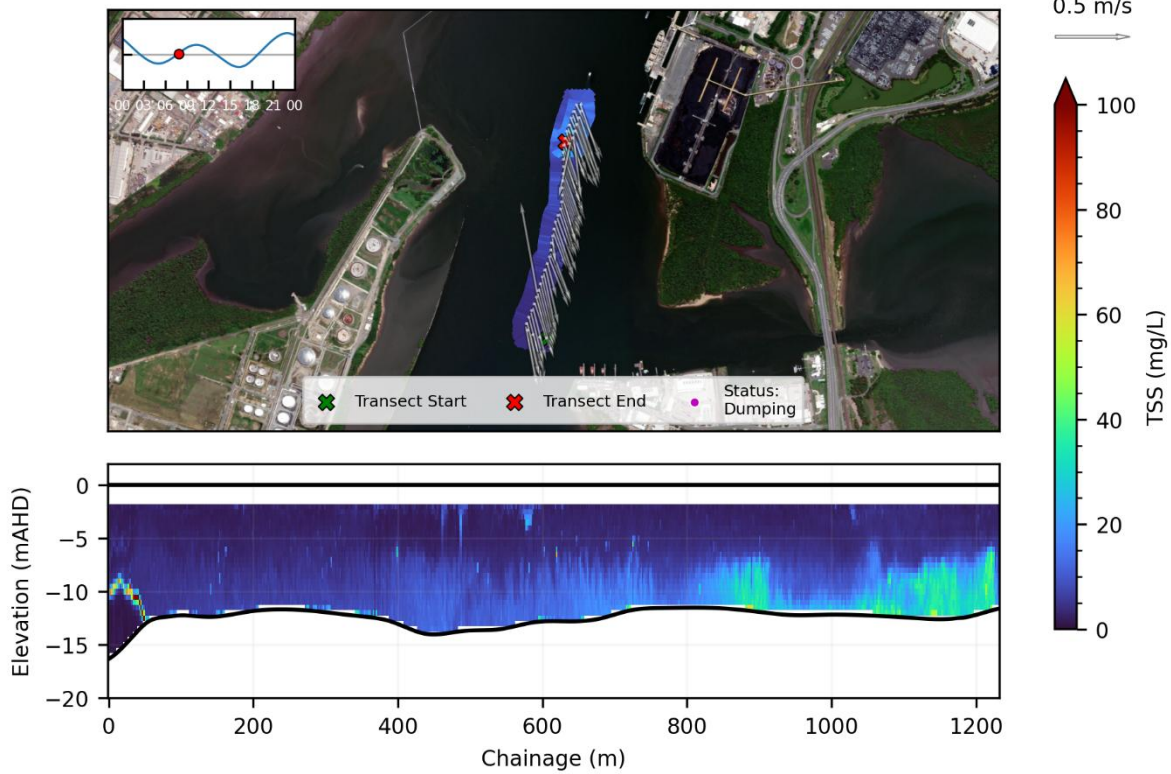
Transect Number 34: 26/05/2026 12:23 - 12:28



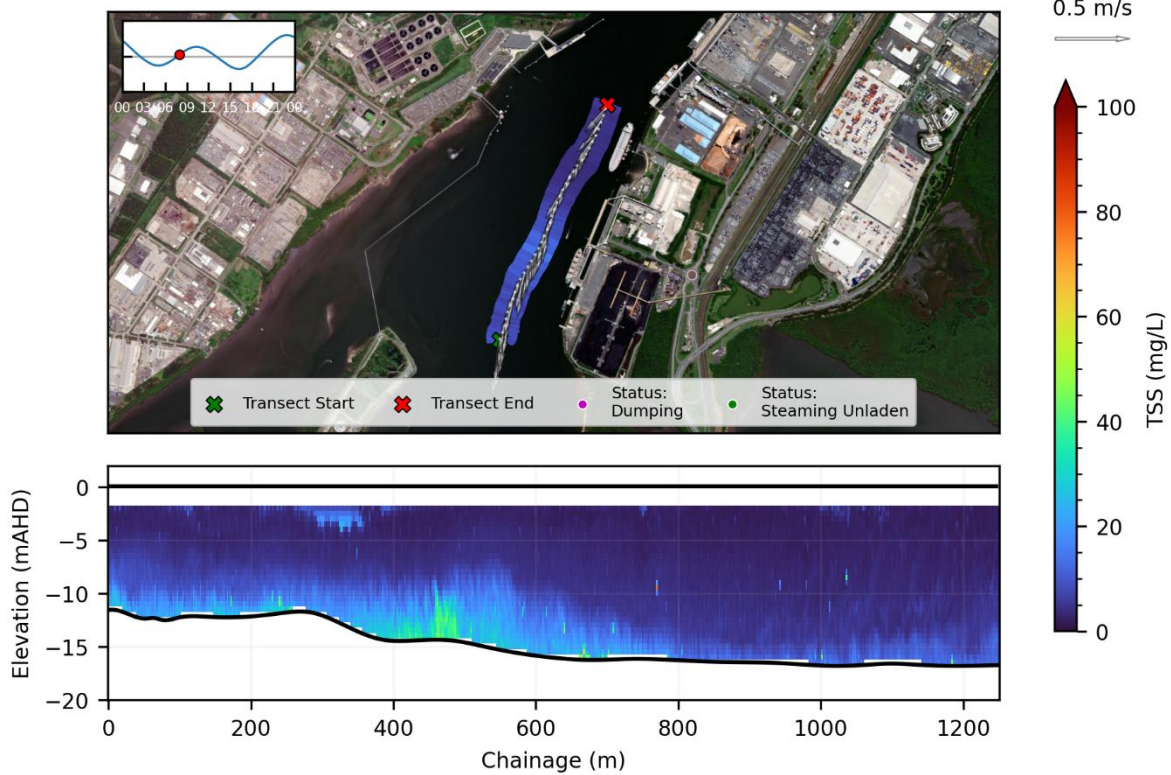


Annex E Transect Plots – 2/06/2026

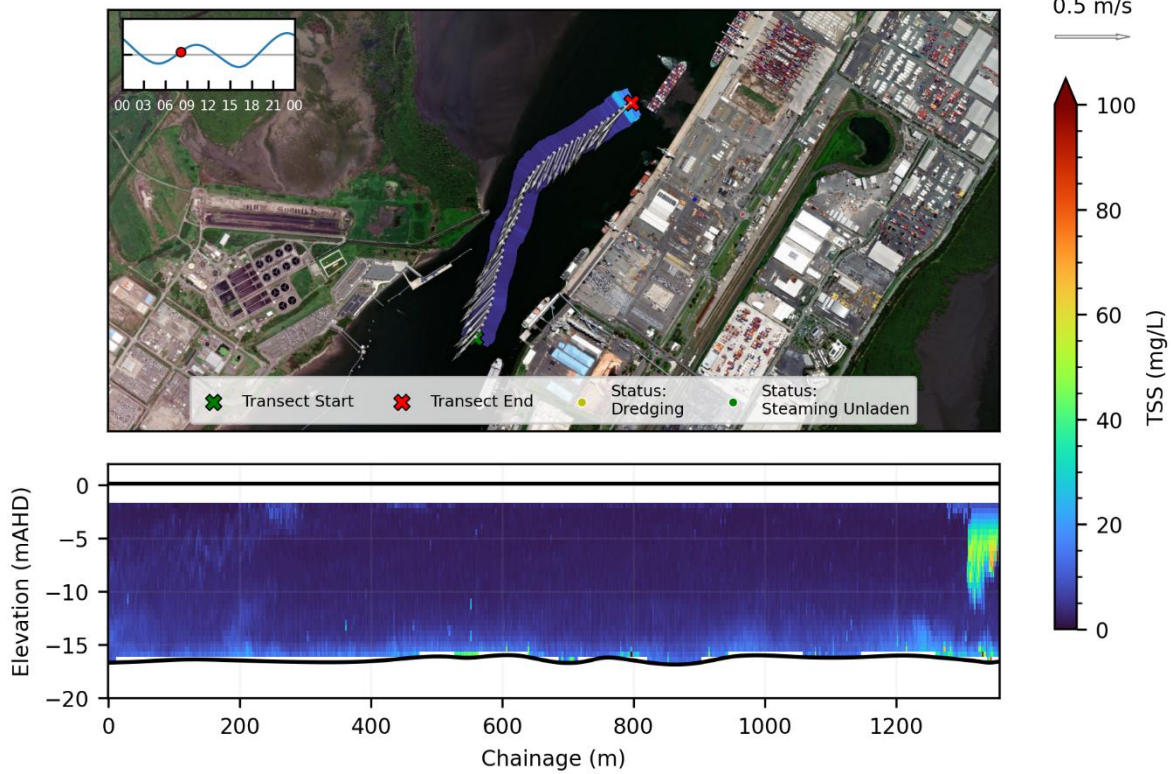
Transect Number 1: 02/06/2026 07:40 - 07:50



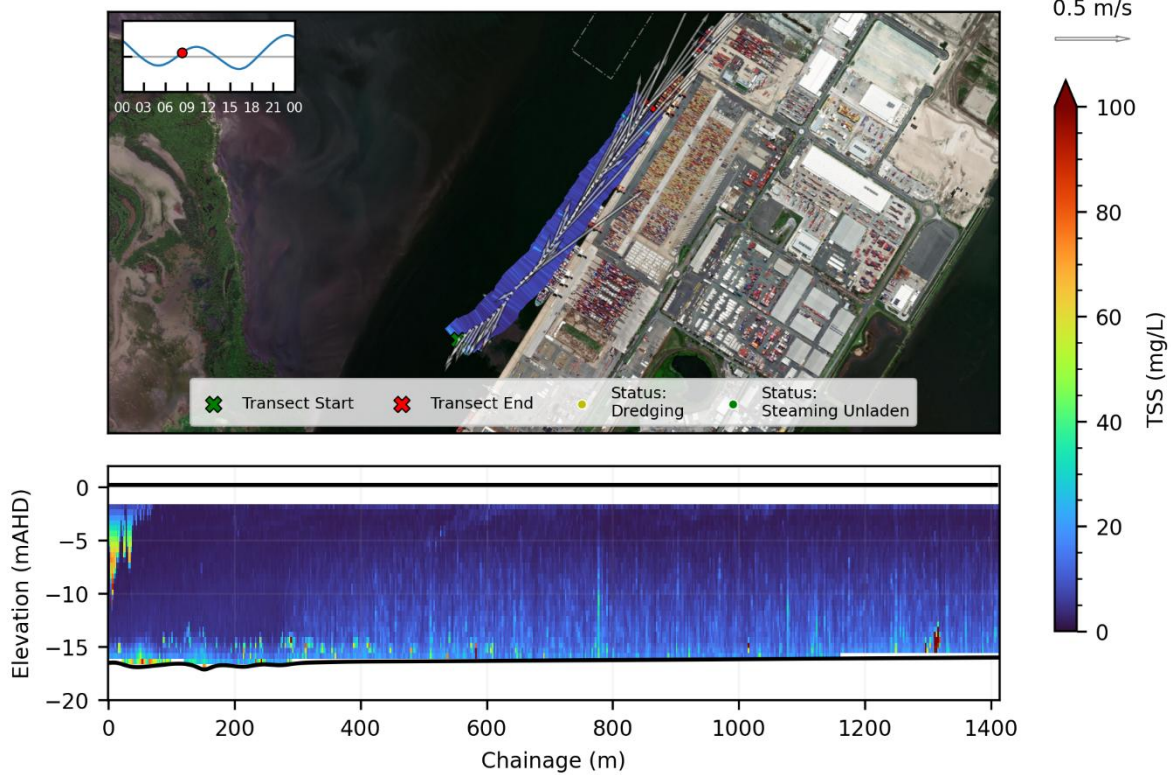
Transect Number 2: 02/06/2026 07:50 - 08:00



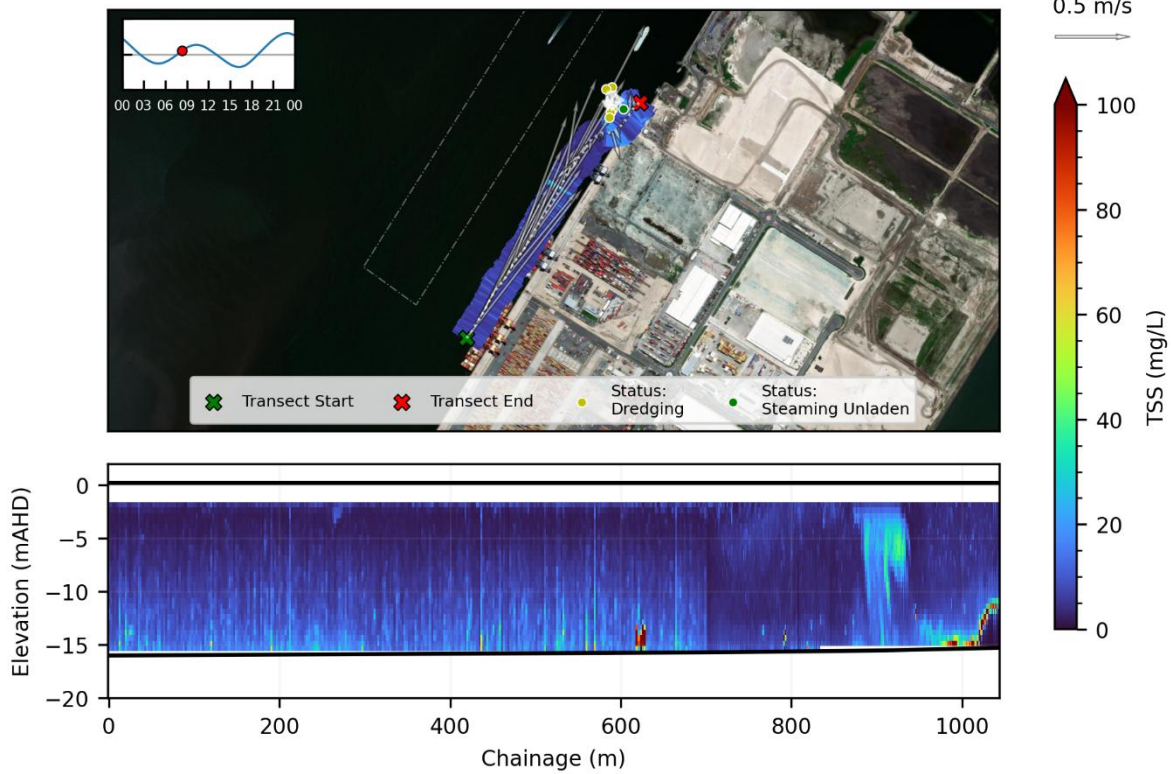
Transect Number 3: 02/06/2026 08:00 - 08:10



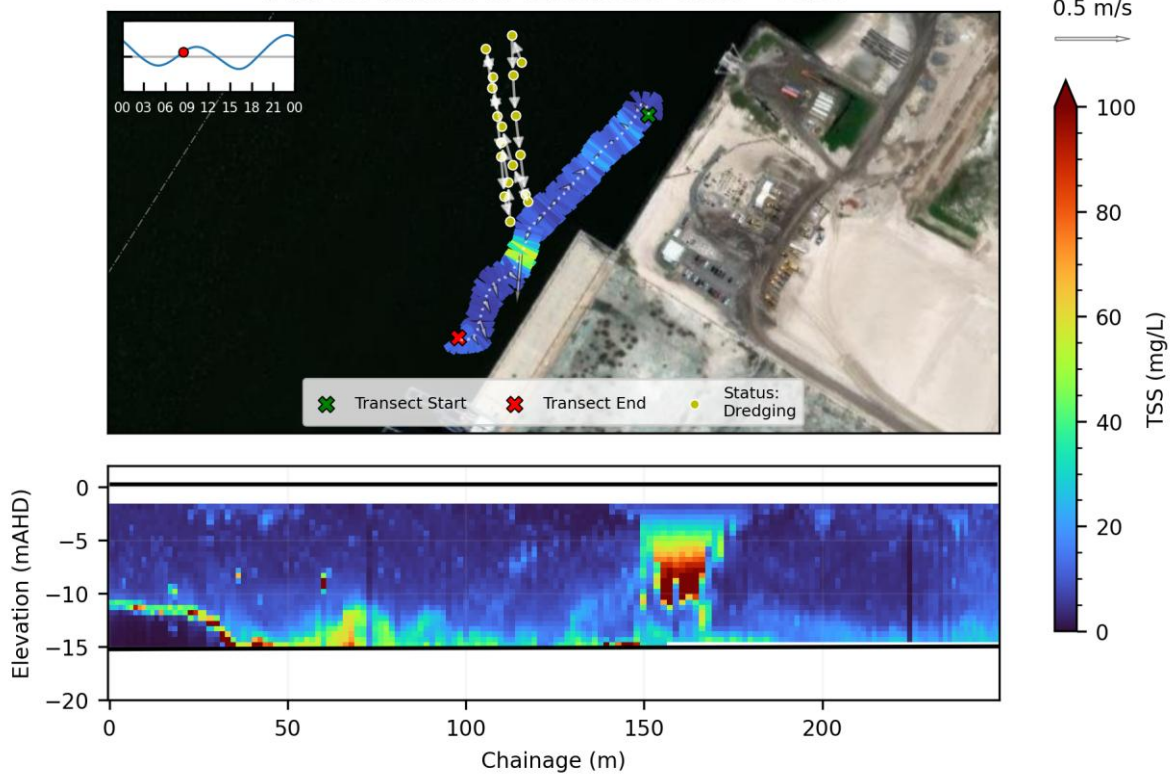
Transect Number 4: 02/06/2026 08:10 - 08:20



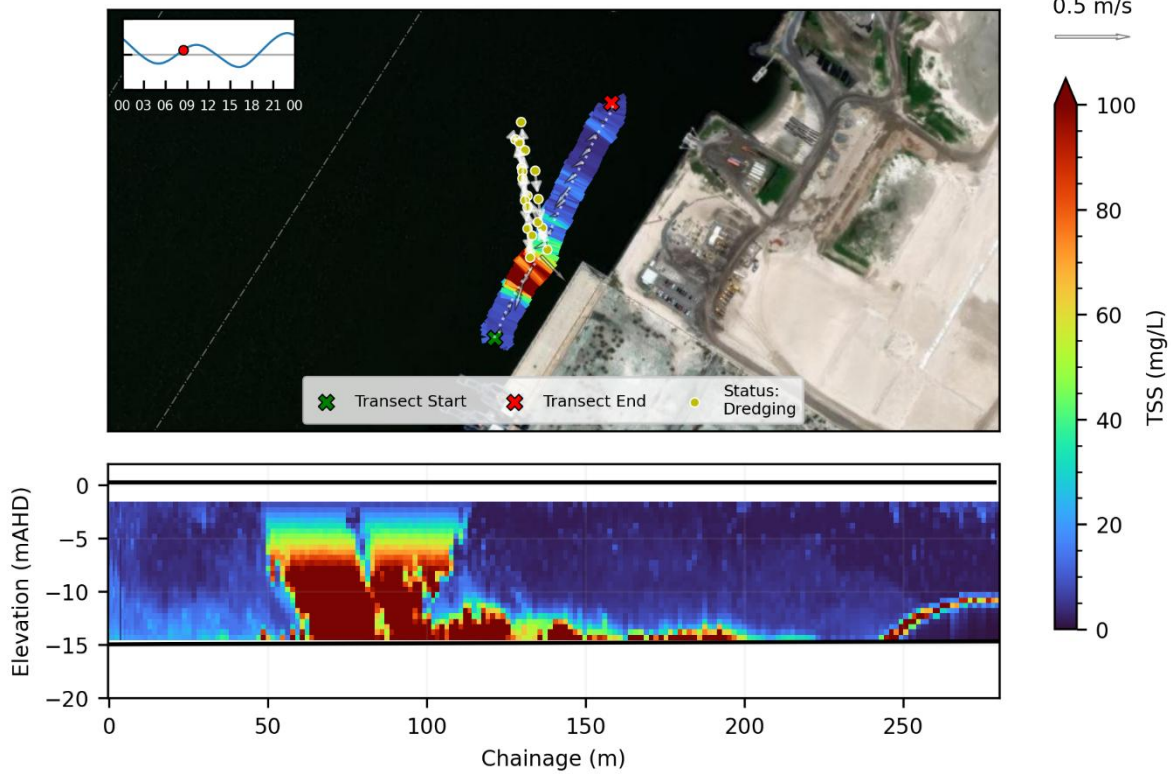
Transect Number 5: 02/06/2026 08:20 - 08:29



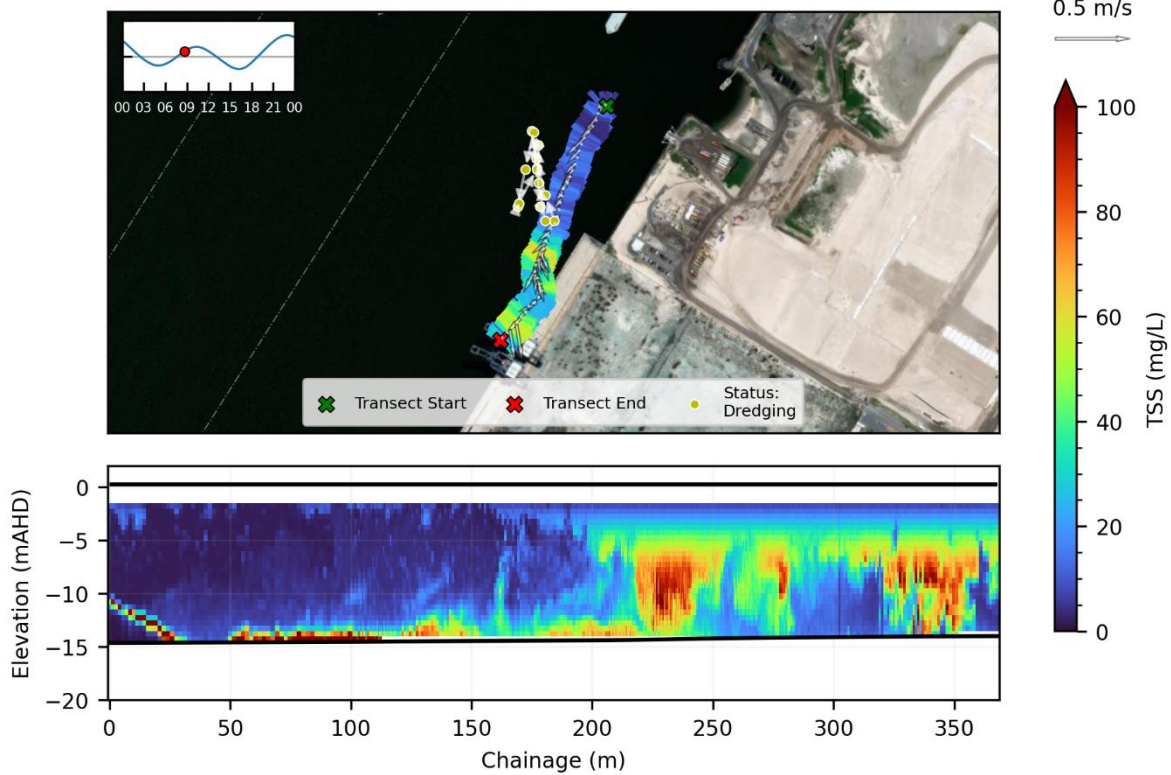
Transect Number 6: 02/06/2026 08:29 - 08:32



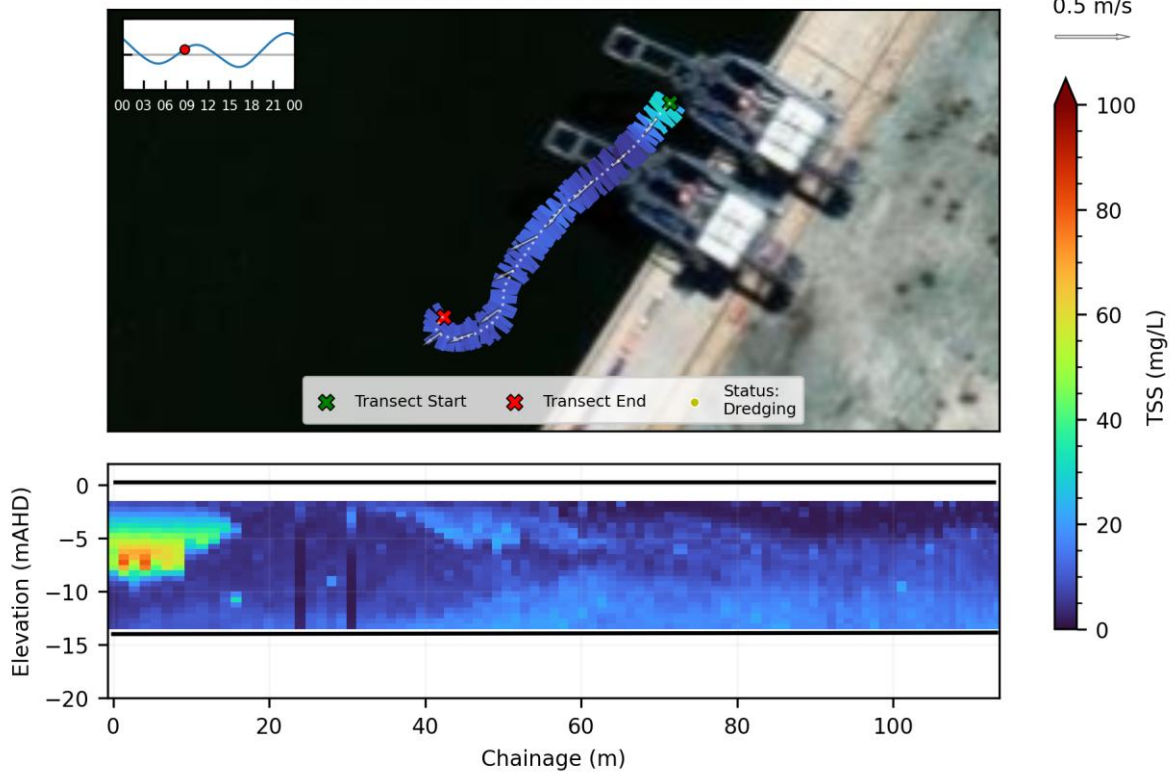
Transect Number 7: 02/06/2026 08:32 - 08:35



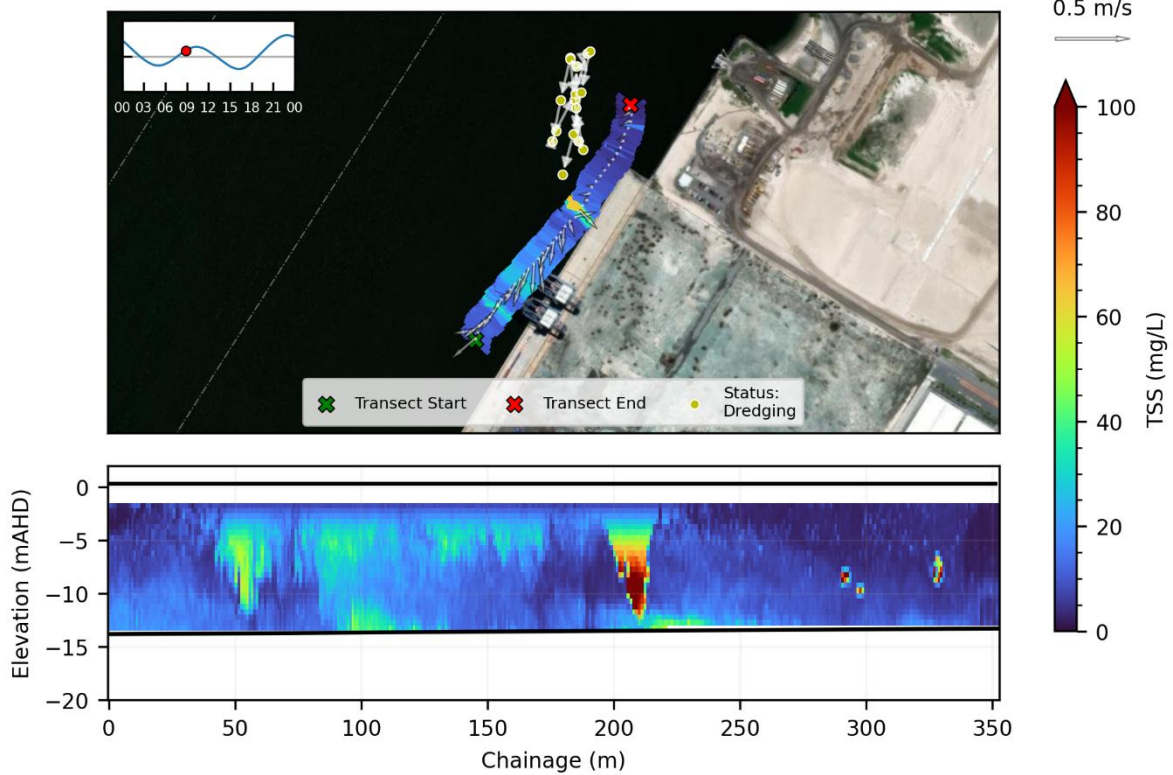
Transect Number 8: 02/06/2026 08:35 - 08:42



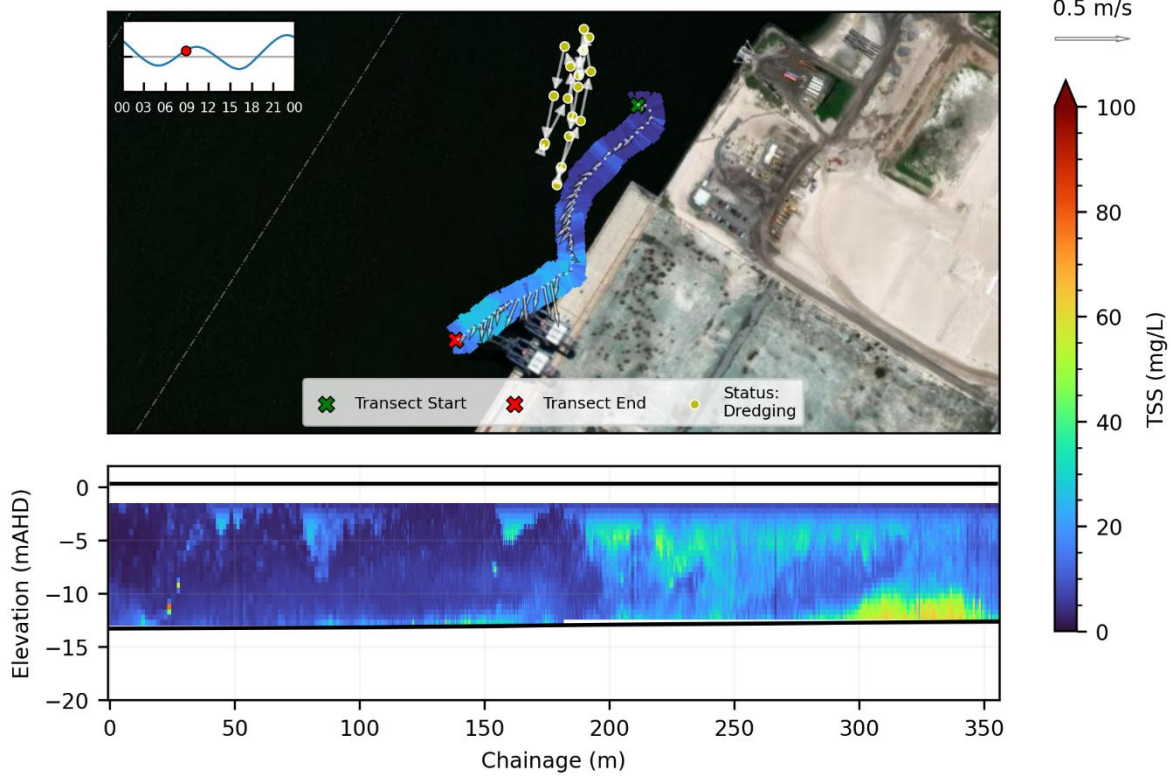
Transect Number 9: 02/06/2026 08:42 - 08:44



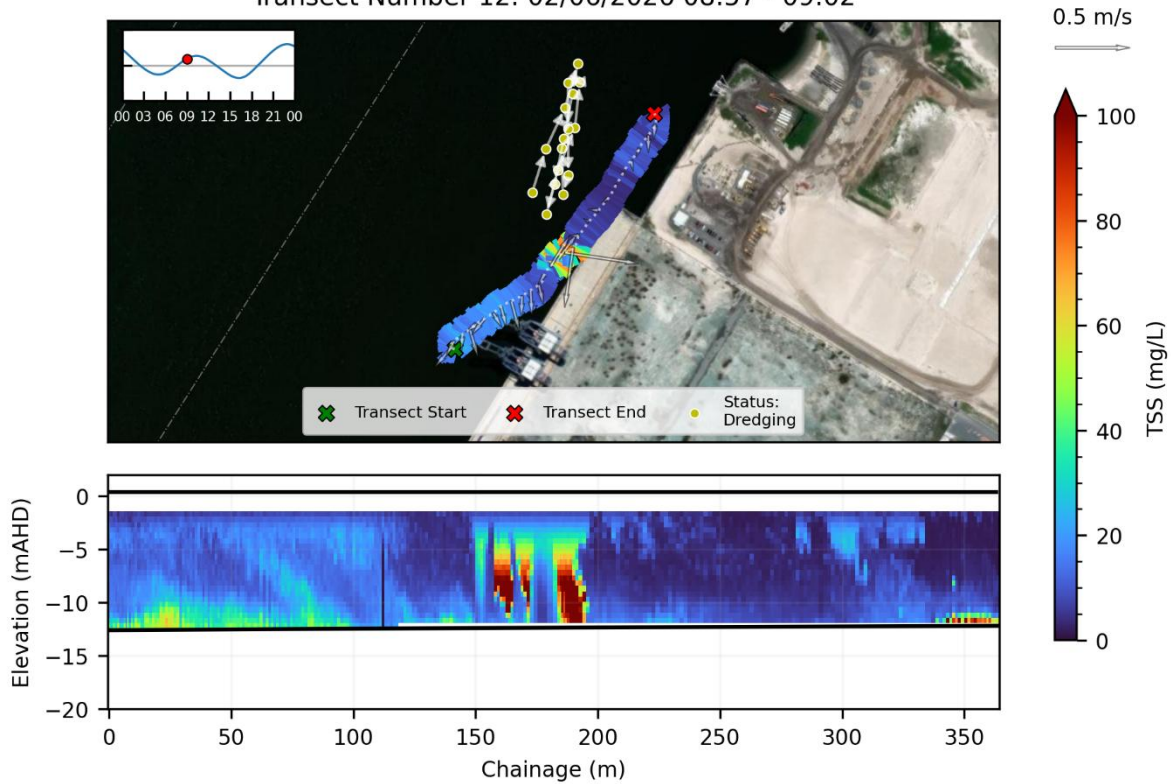
Transect Number 10: 02/06/2026 08:44 - 08:50



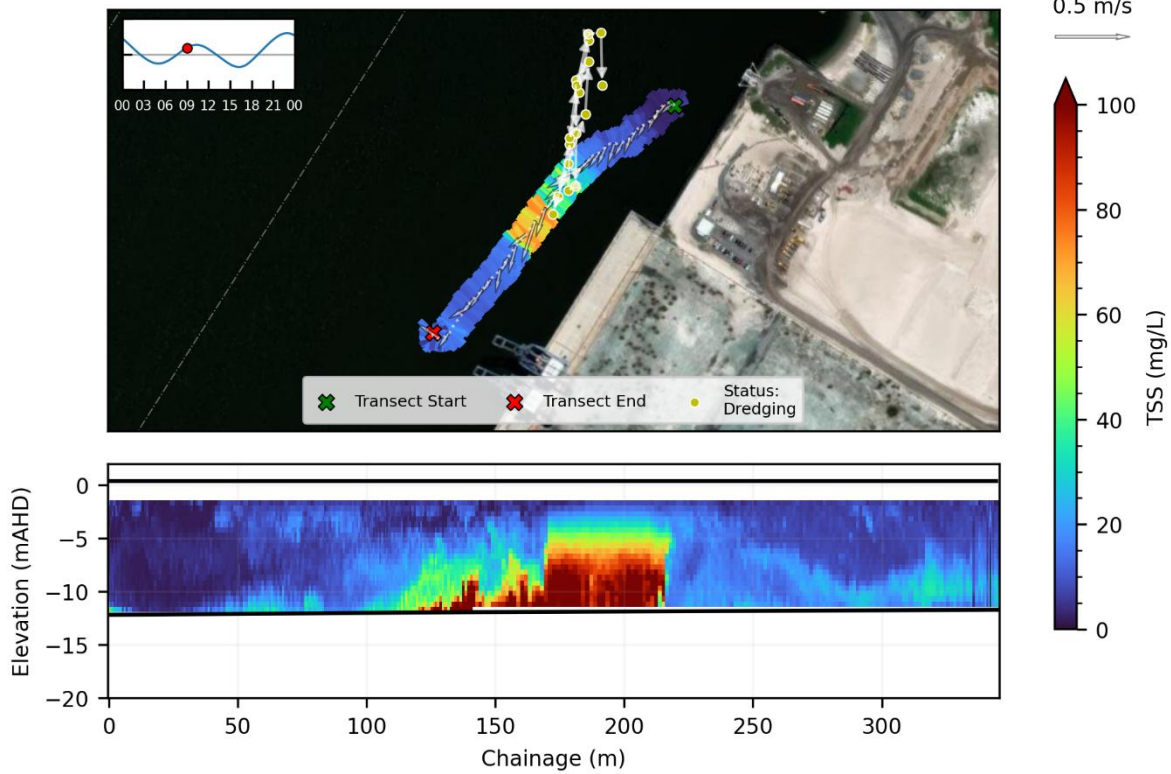
Transect Number 11: 02/06/2026 08:50 - 08:57



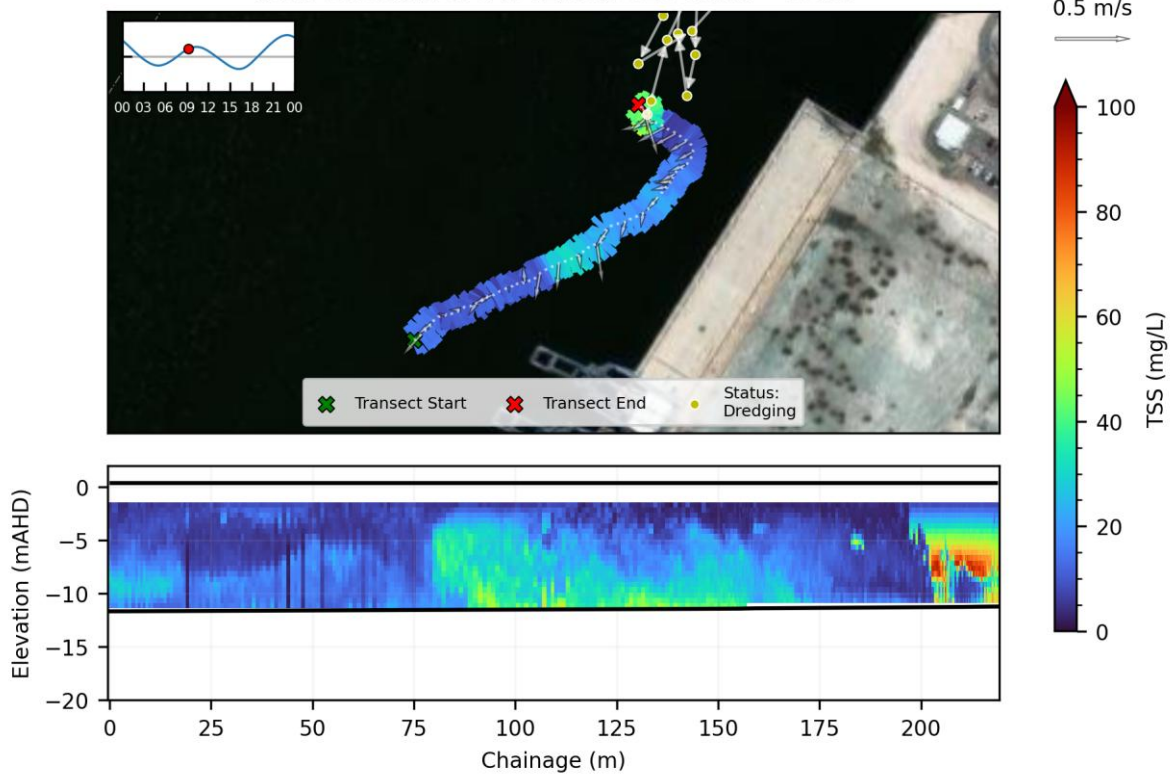
Transect Number 12: 02/06/2026 08:57 - 09:02



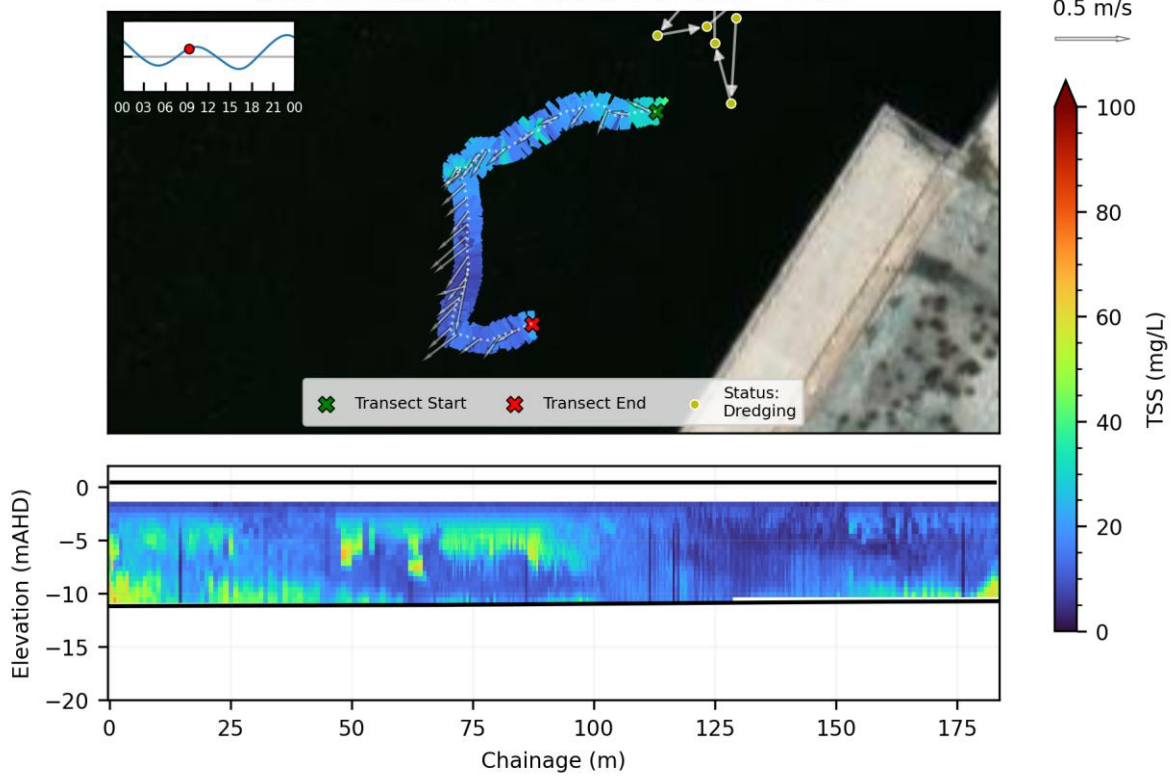
Transect Number 13: 02/06/2026 09:02 - 09:07



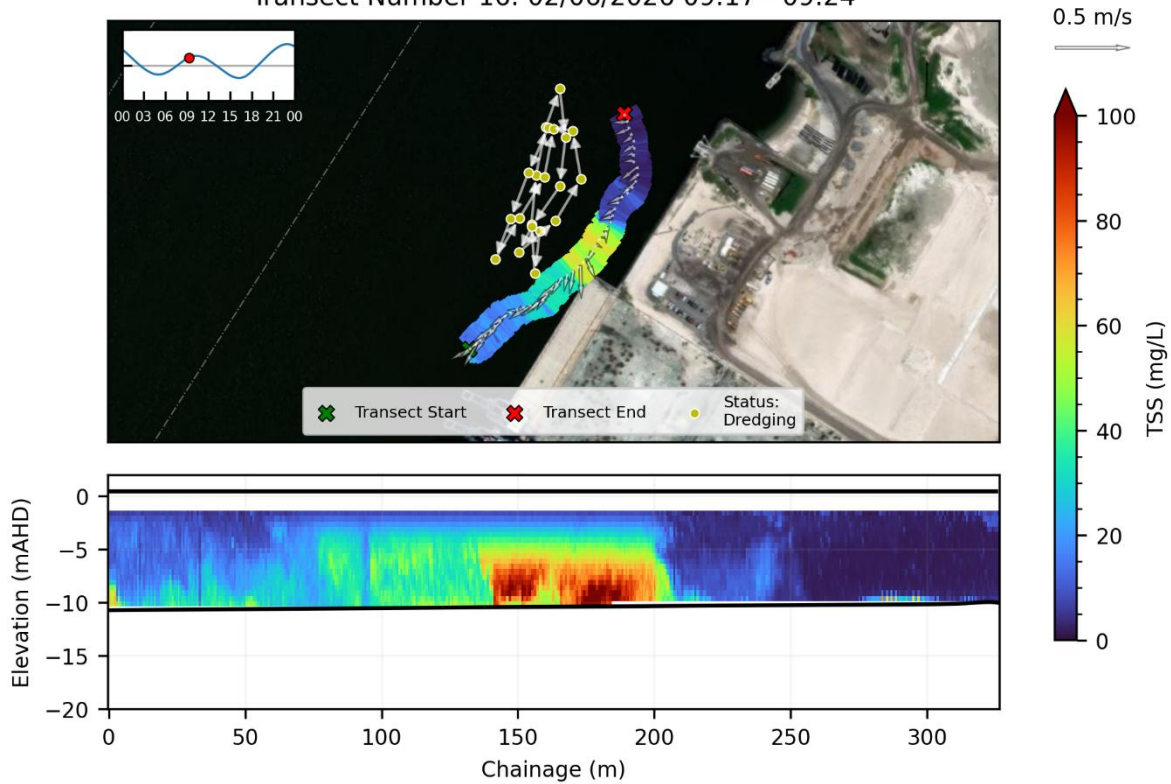
Transect Number 14: 02/06/2026 09:07 - 09:12



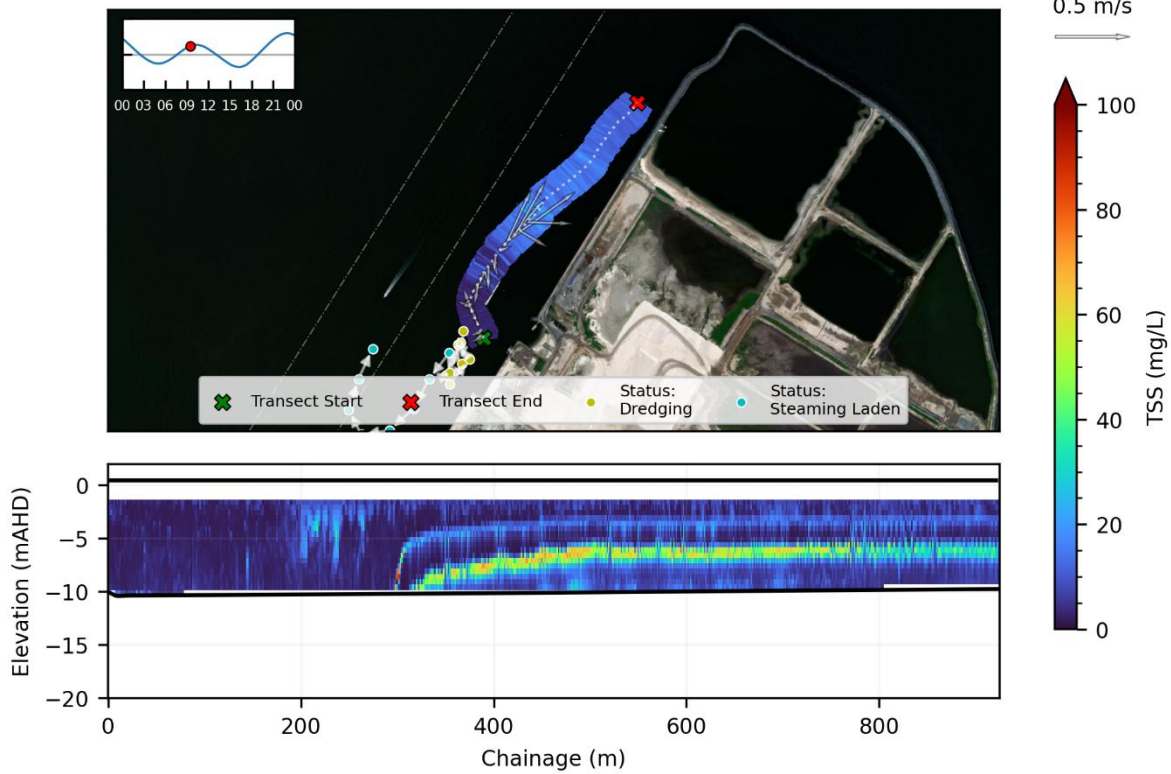
Transect Number 15: 02/06/2026 09:12 - 09:17



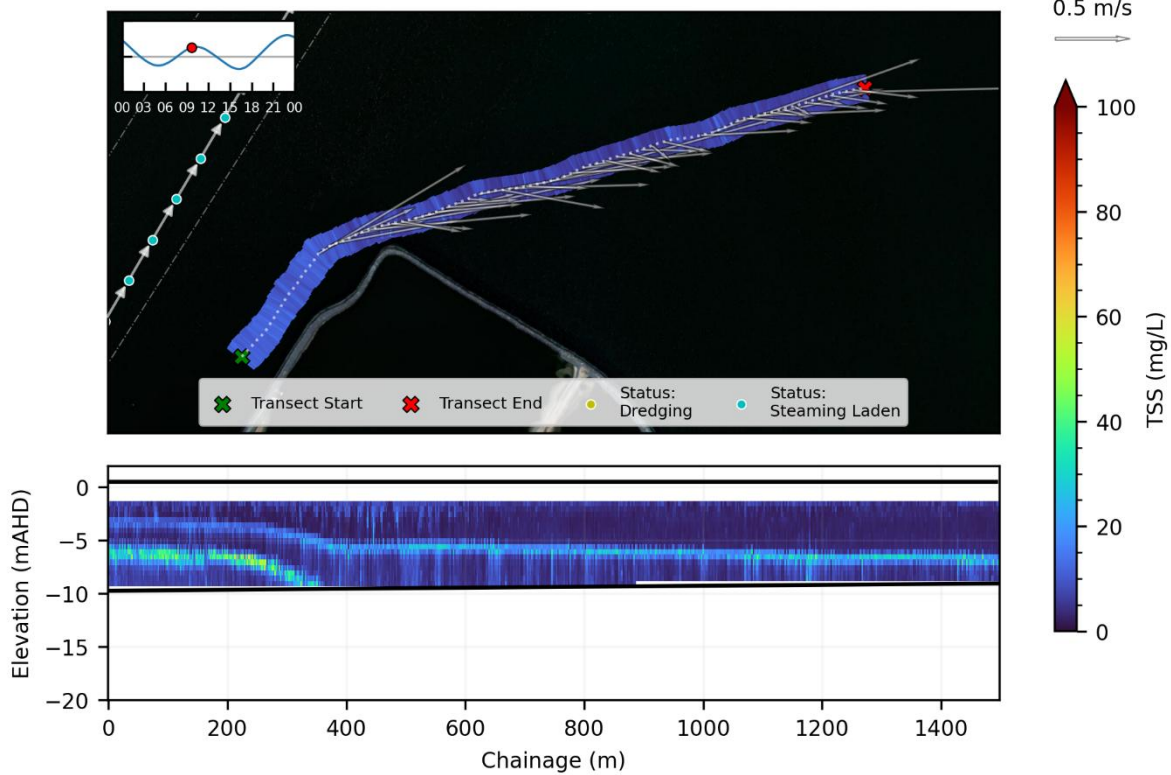
Transect Number 16: 02/06/2026 09:17 - 09:24



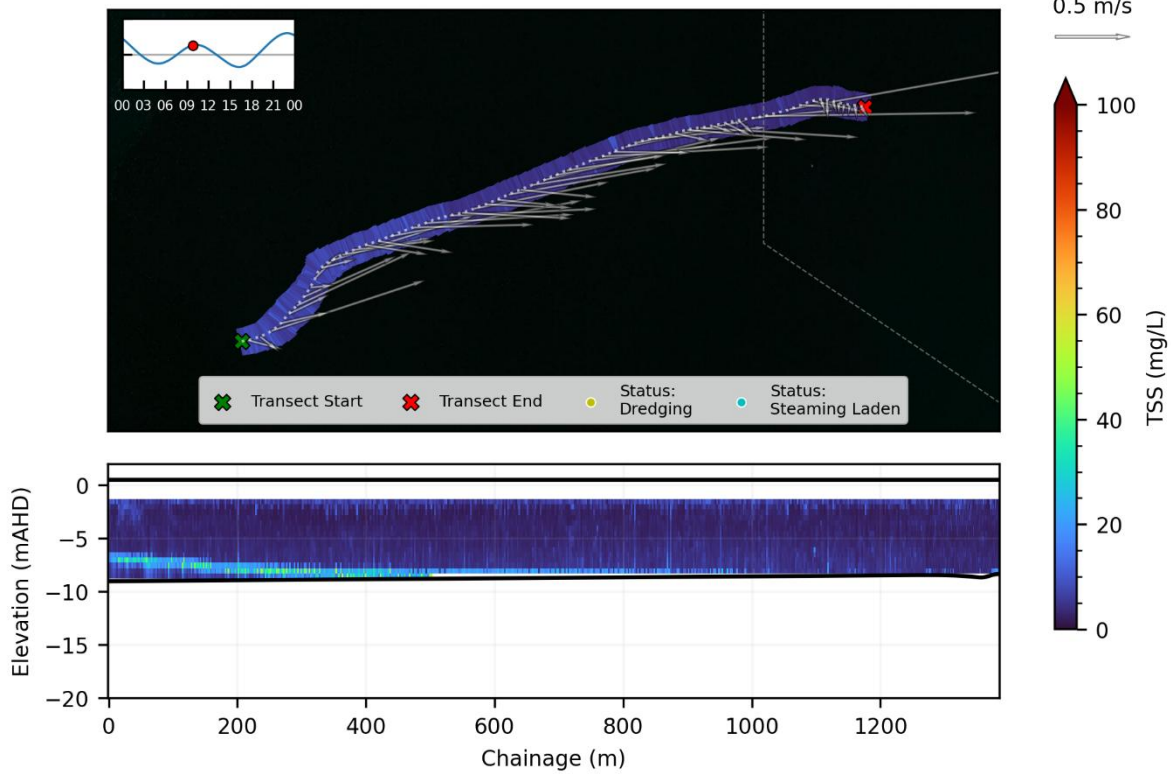
Transect Number 17: 02/06/2026 09:24 - 09:34



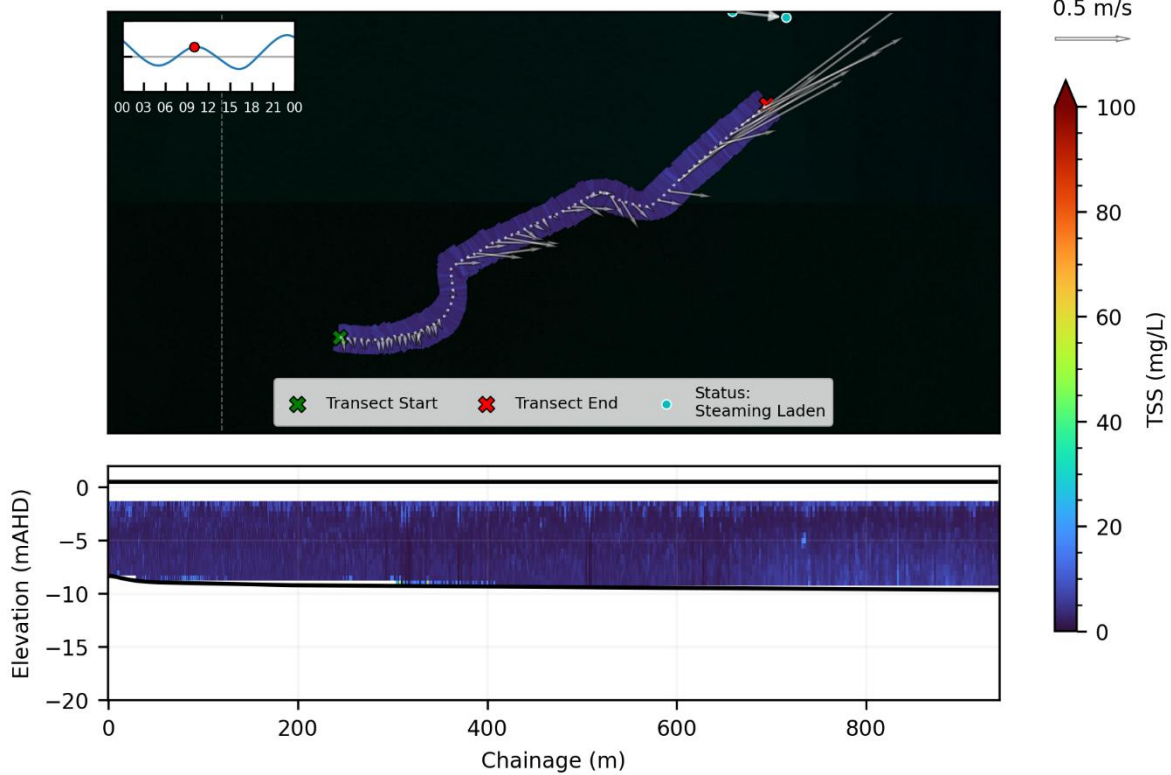
Transect Number 18: 02/06/2026 09:34 - 09:44



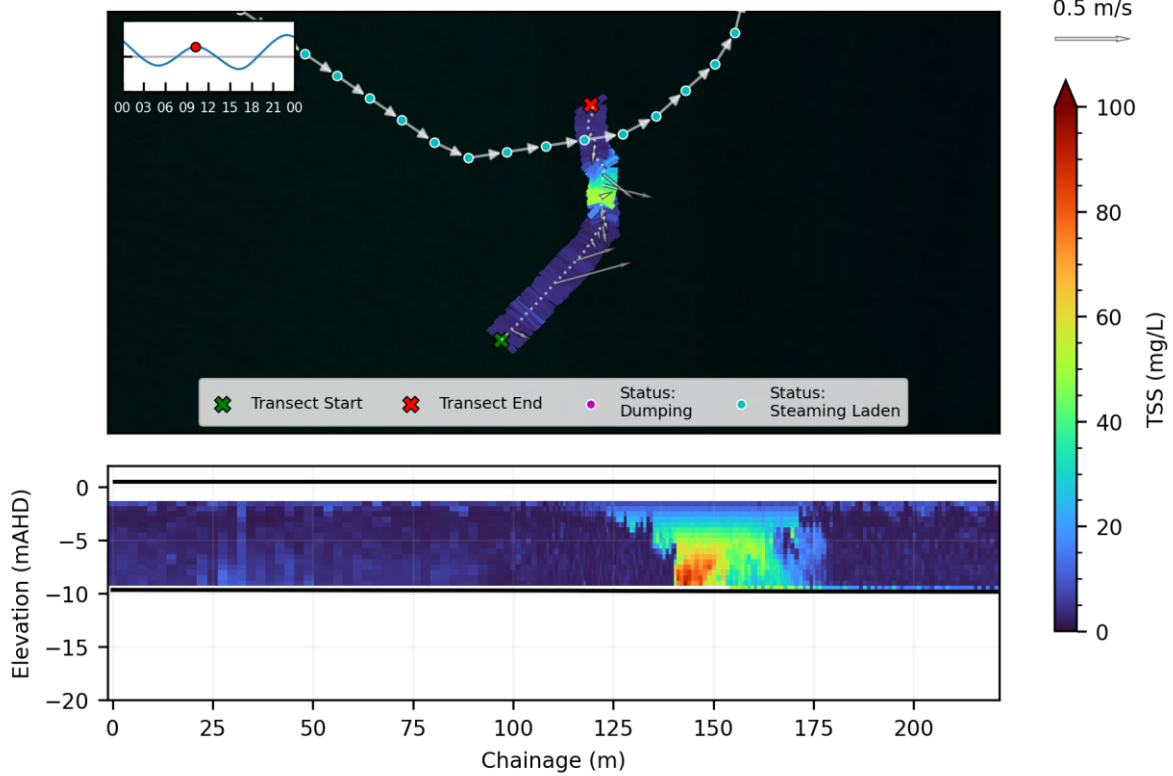
Transect Number 19: 02/06/2026 09:44 - 09:54



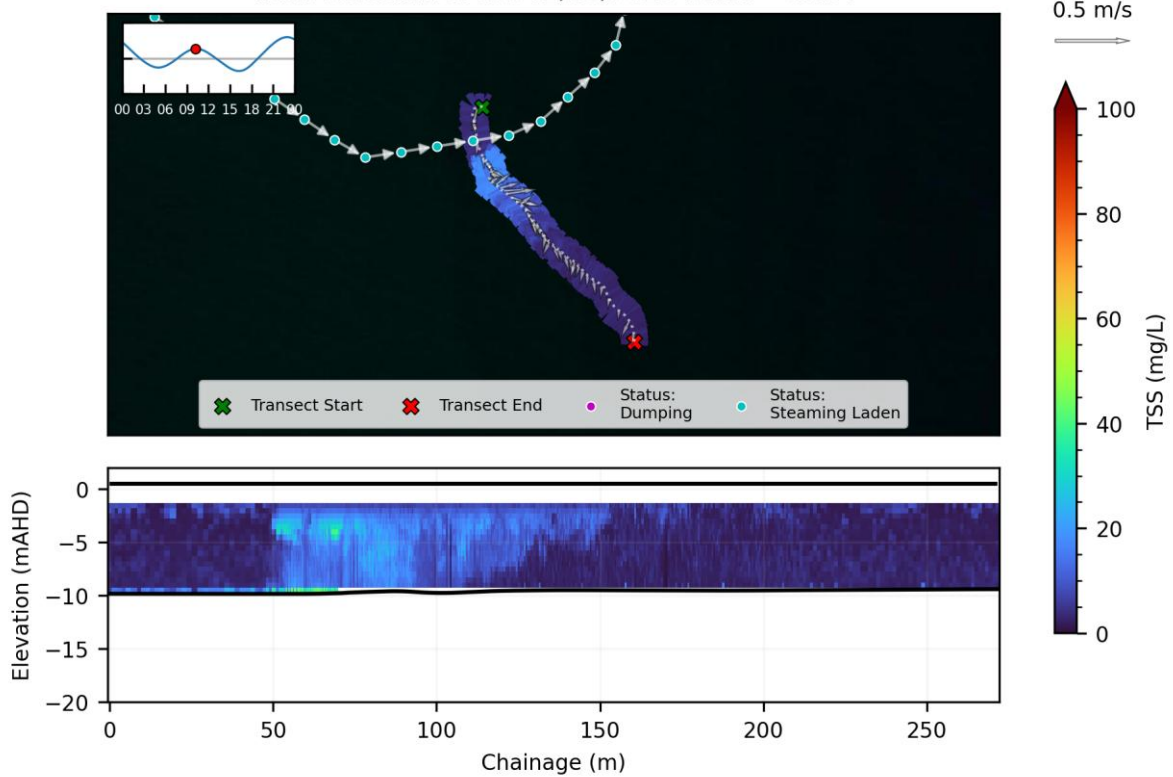
Transect Number 20: 02/06/2026 09:54 - 10:04



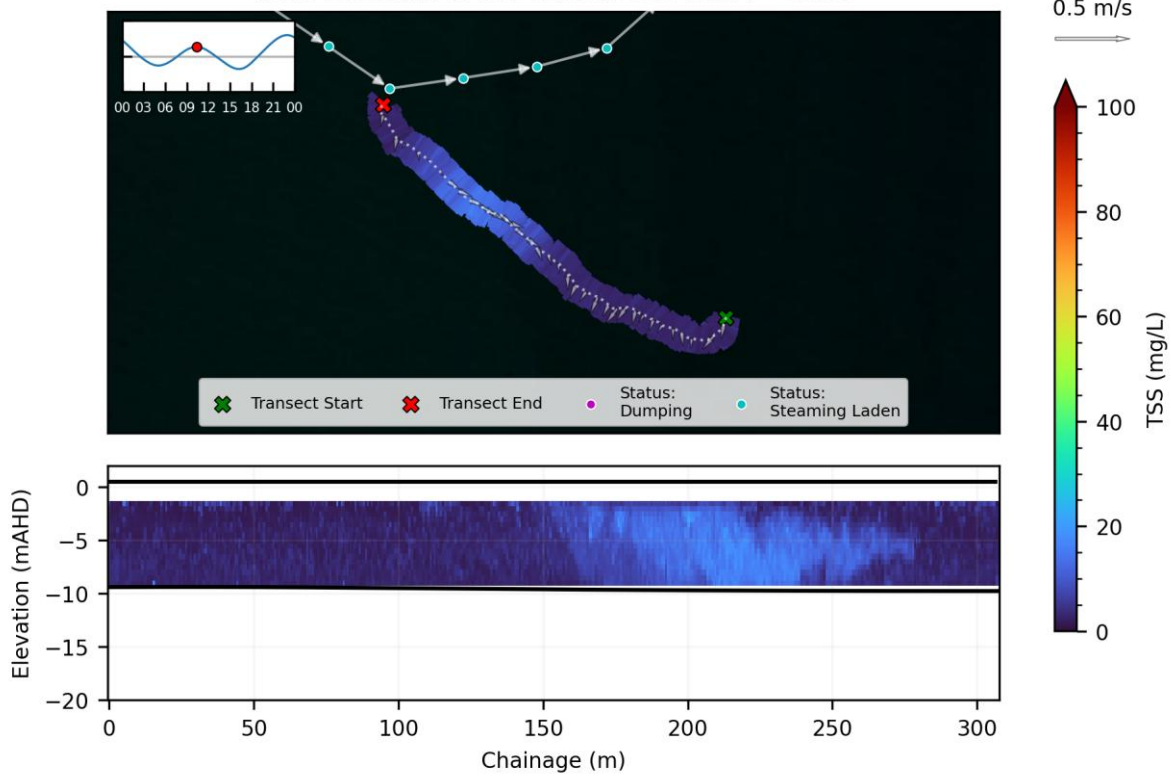
Transect Number 21: 02/06/2026 10:04 - 10:07



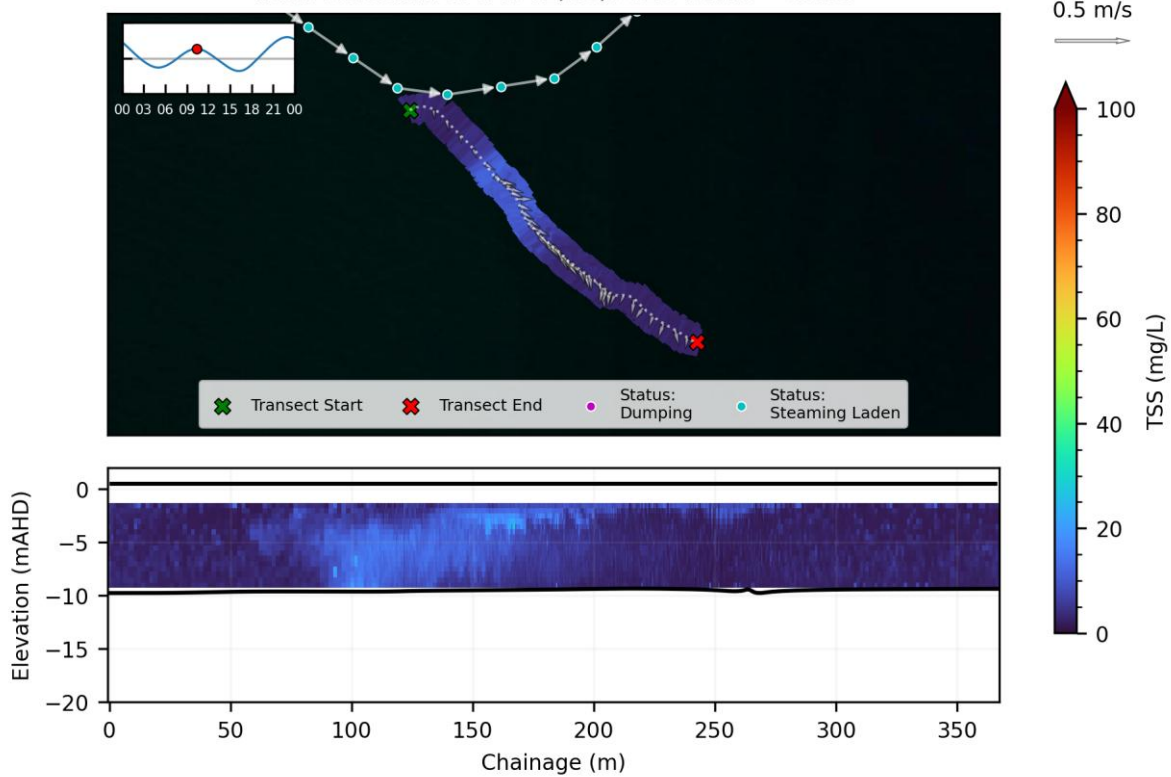
Transect Number 22: 02/06/2026 10:07 - 10:14



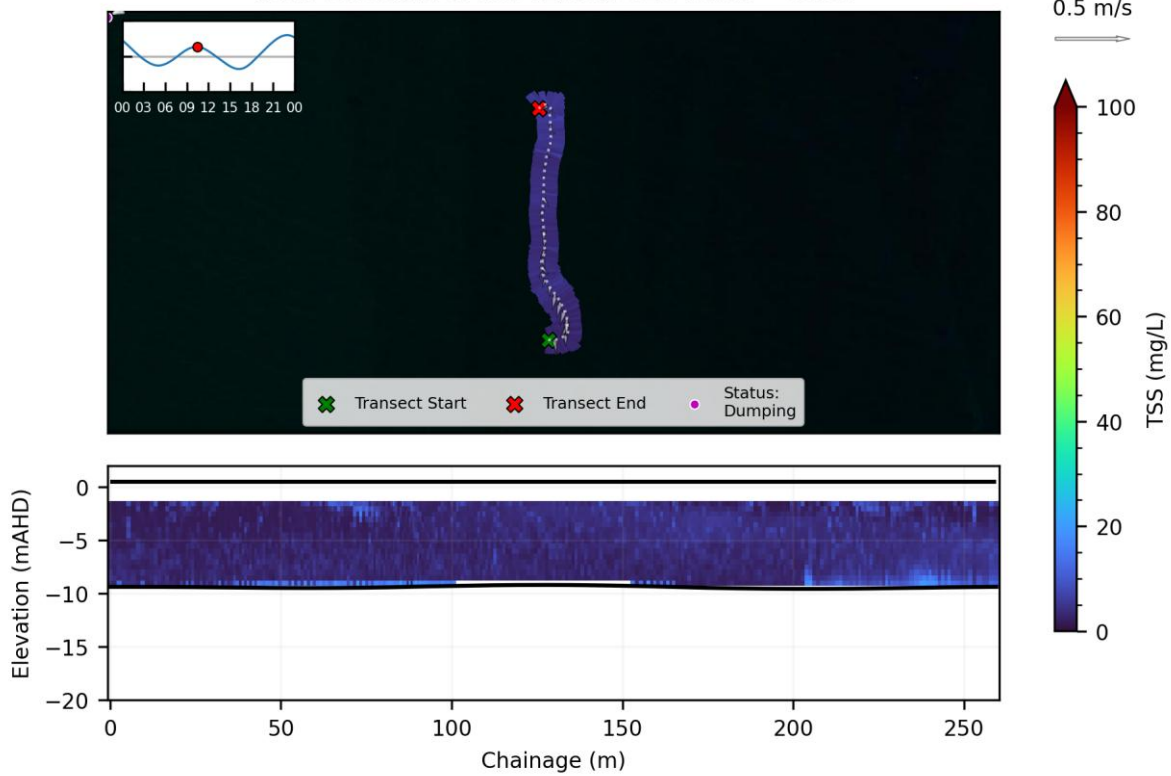
Transect Number 23: 02/06/2026 10:14 - 10:20



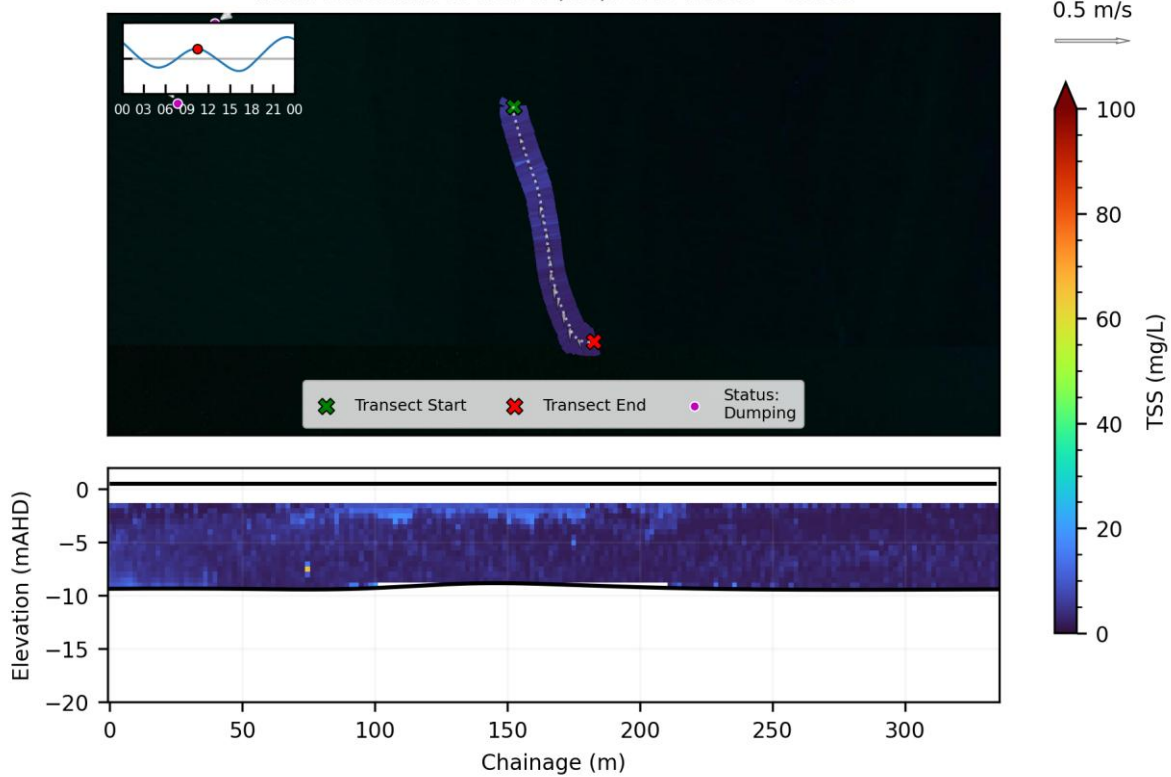
Transect Number 24: 02/06/2026 10:20 - 10:28



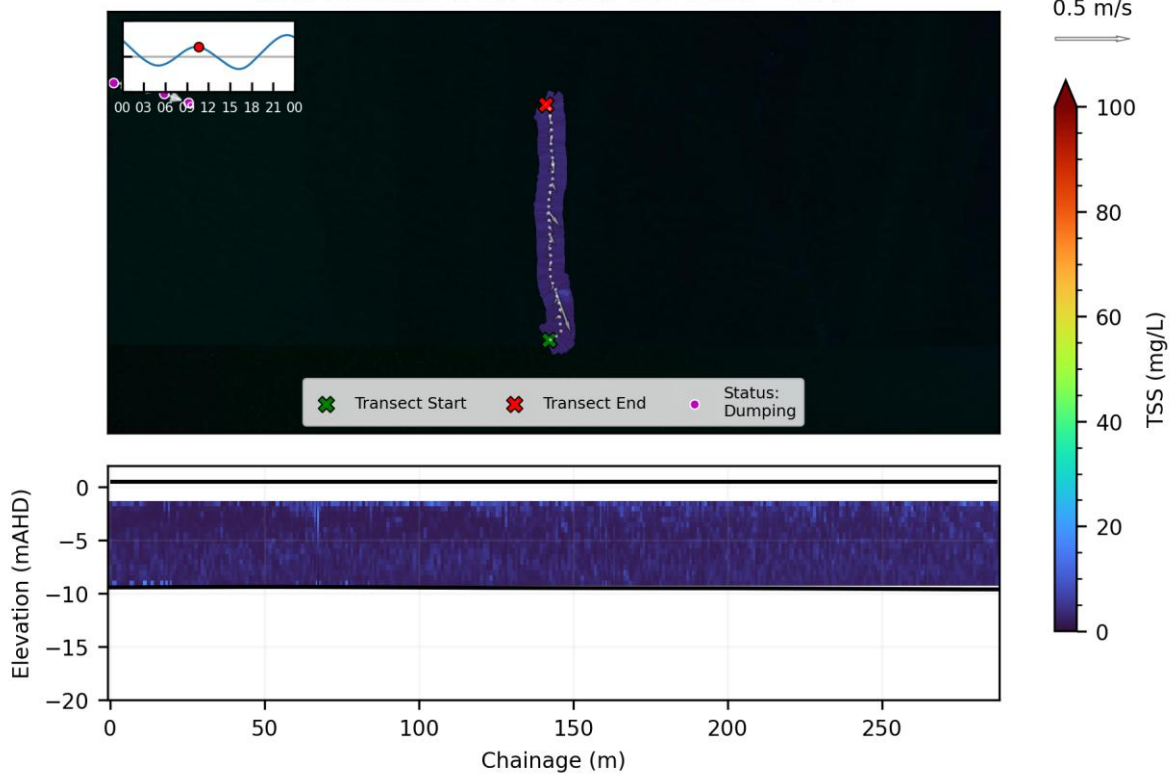
Transect Number 25: 02/06/2026 10:28 - 10:33



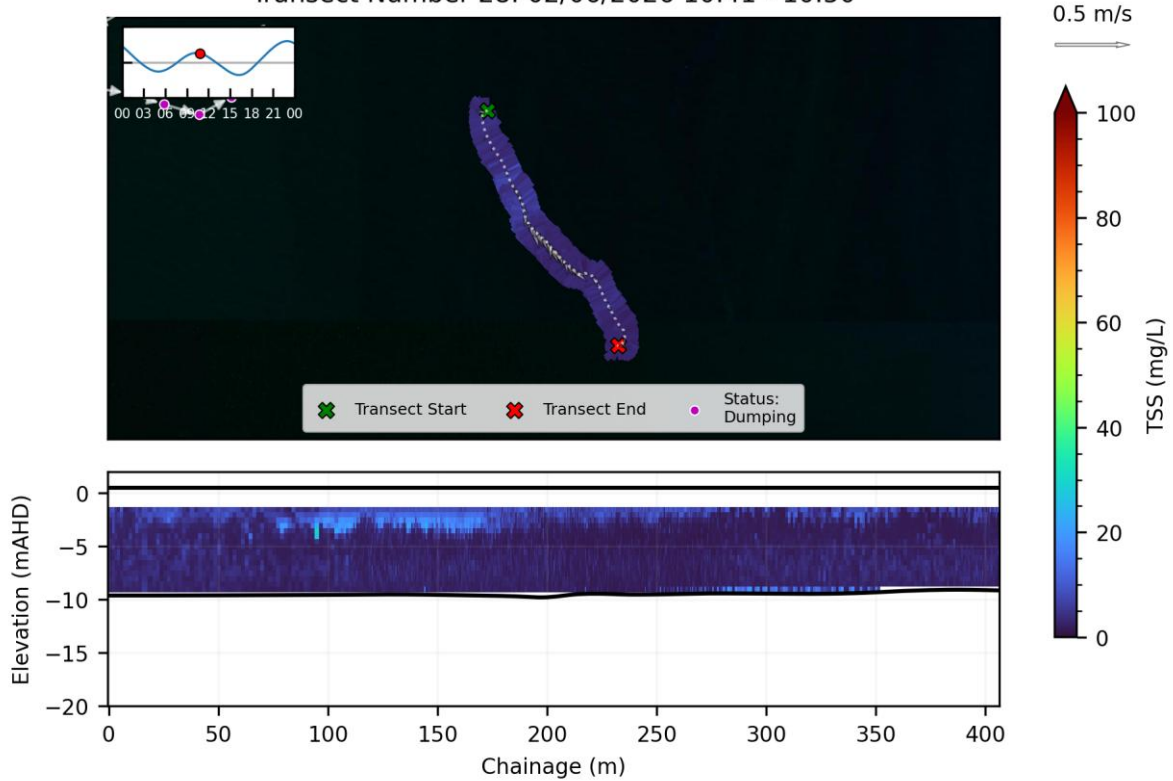
Transect Number 26: 02/06/2026 10:33 - 10:36



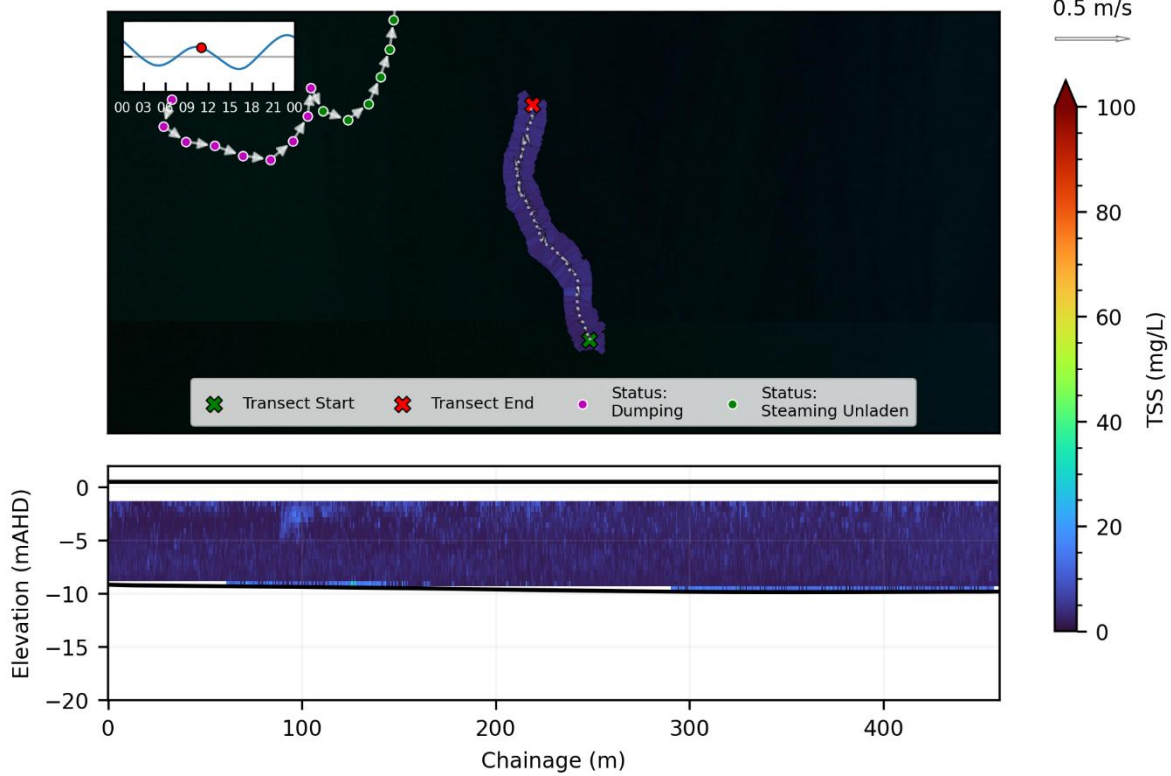
Transect Number 27: 02/06/2026 10:36 - 10:41



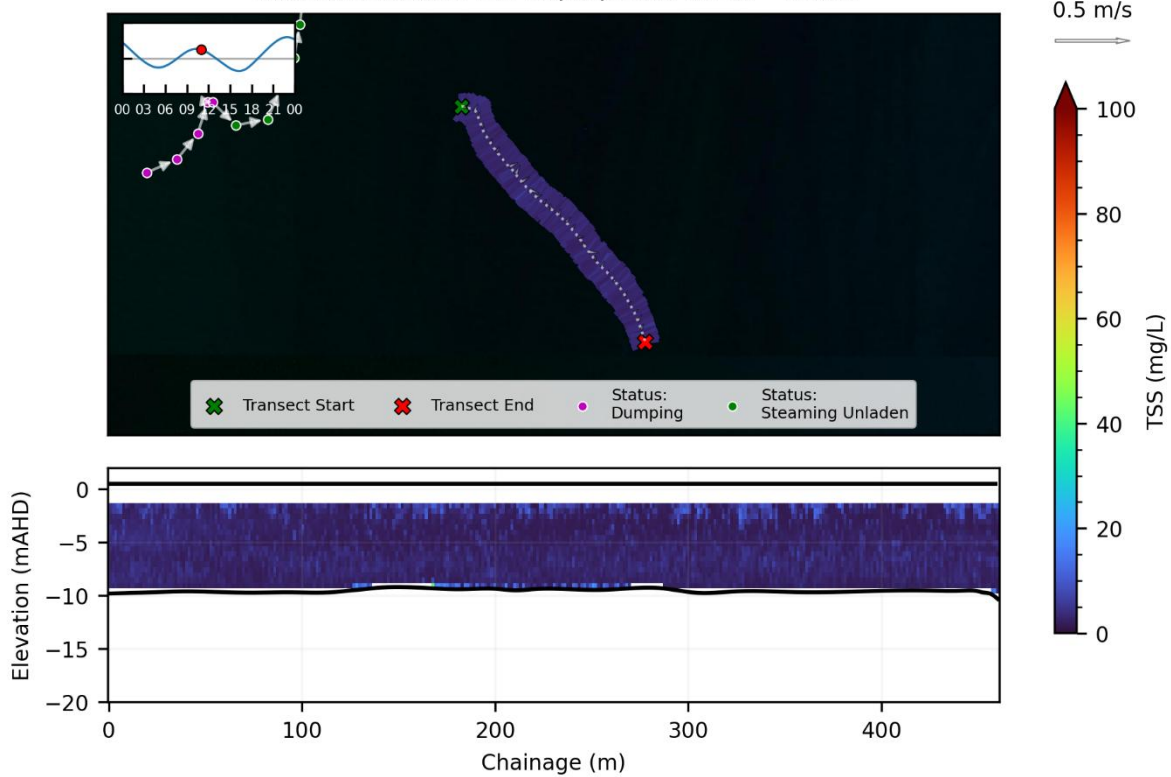
Transect Number 28: 02/06/2026 10:41 - 10:50



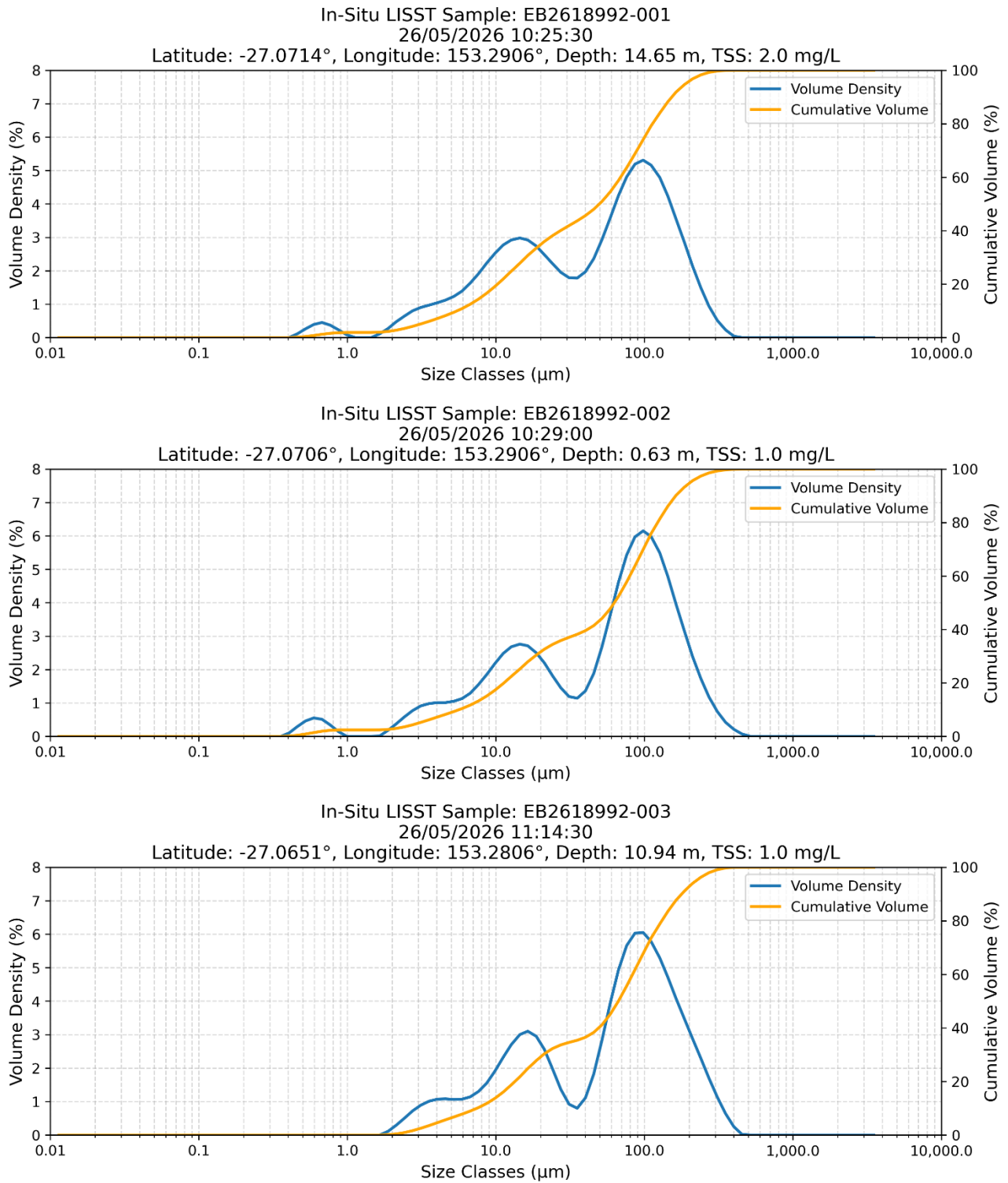
Transect Number 29: 02/06/2026 10:50 - 11:00



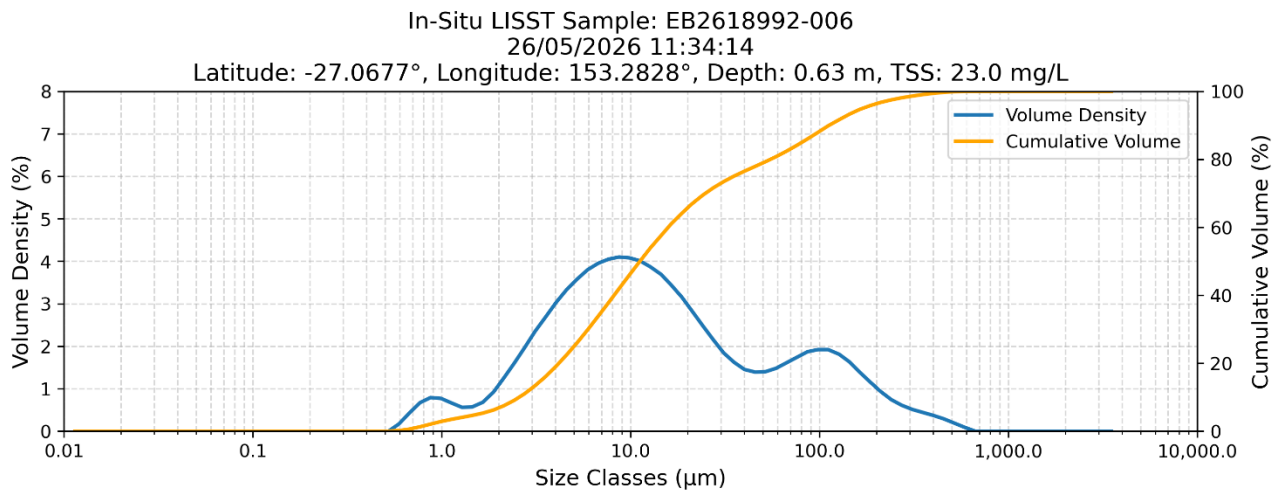
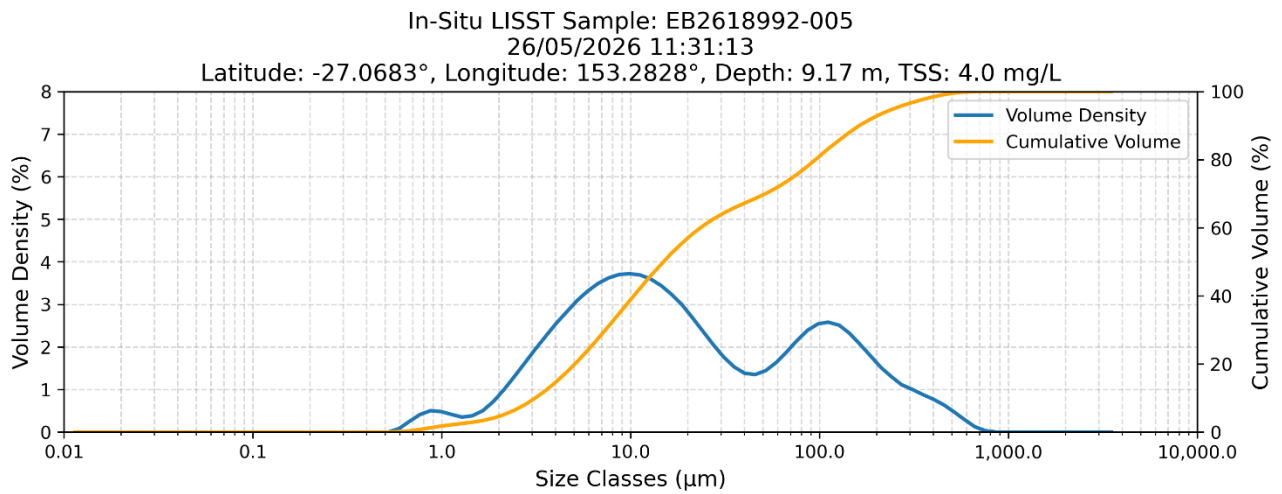
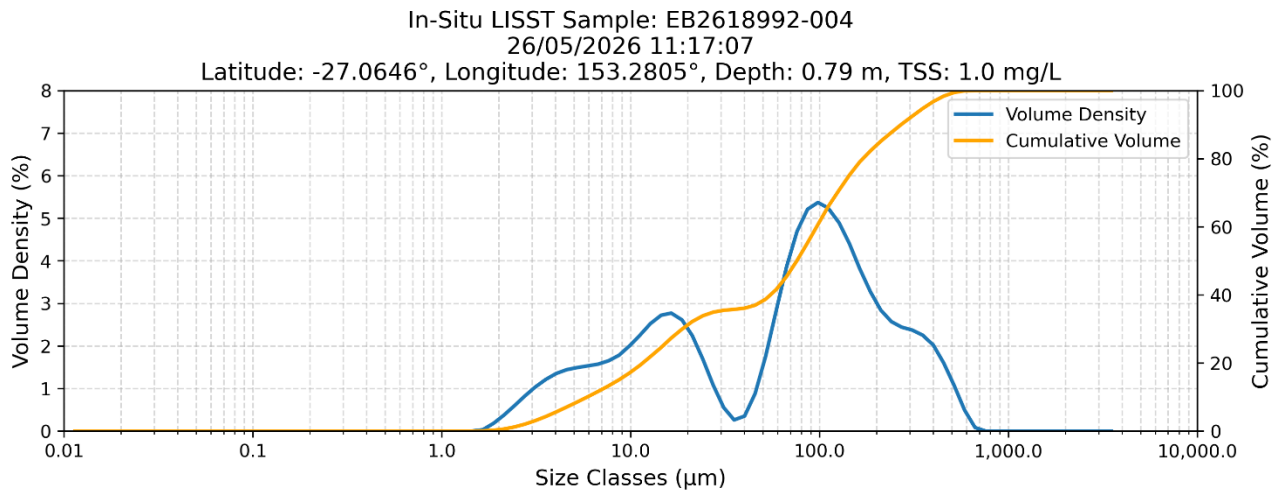
Transect Number 30: 02/06/2026 11:00 - 11:05

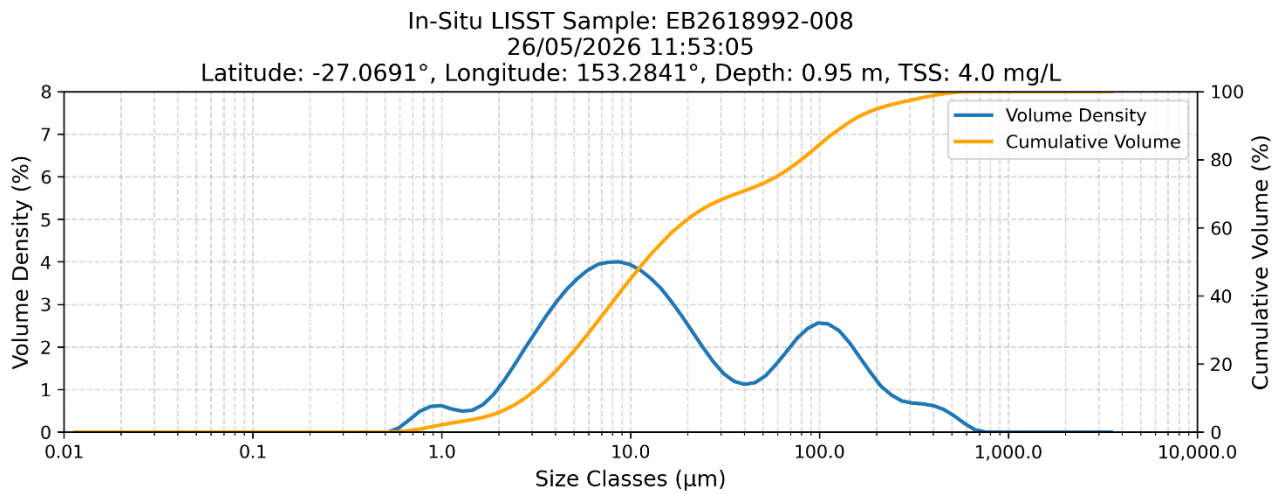
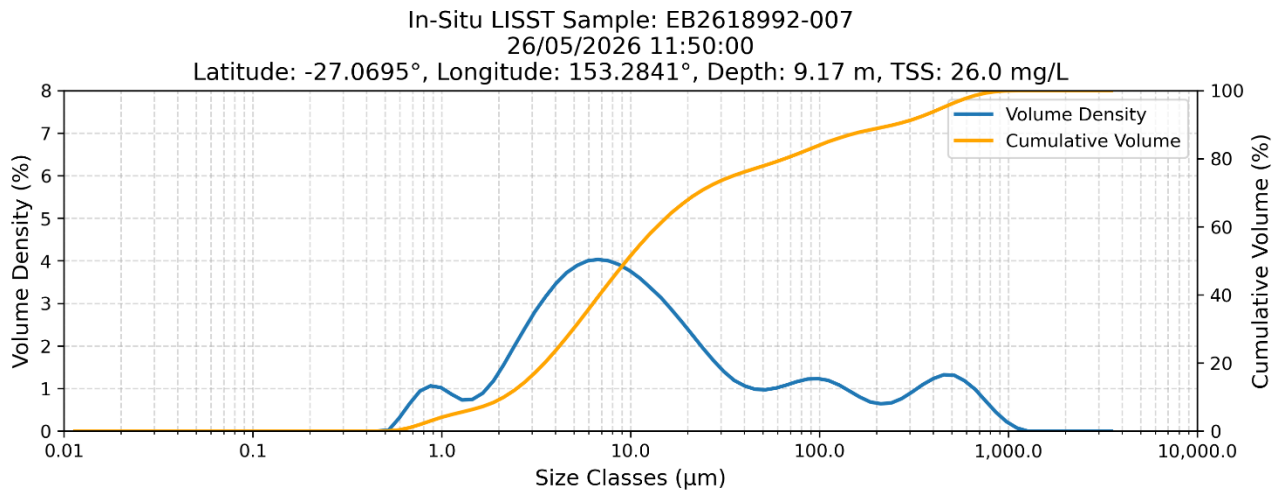


Annex F LISST PSD Results

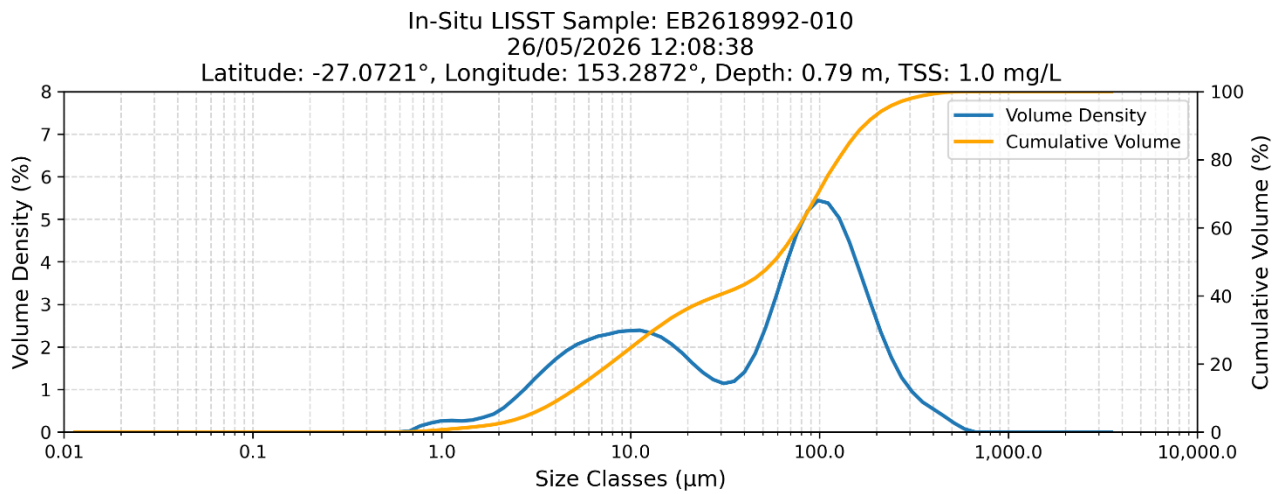
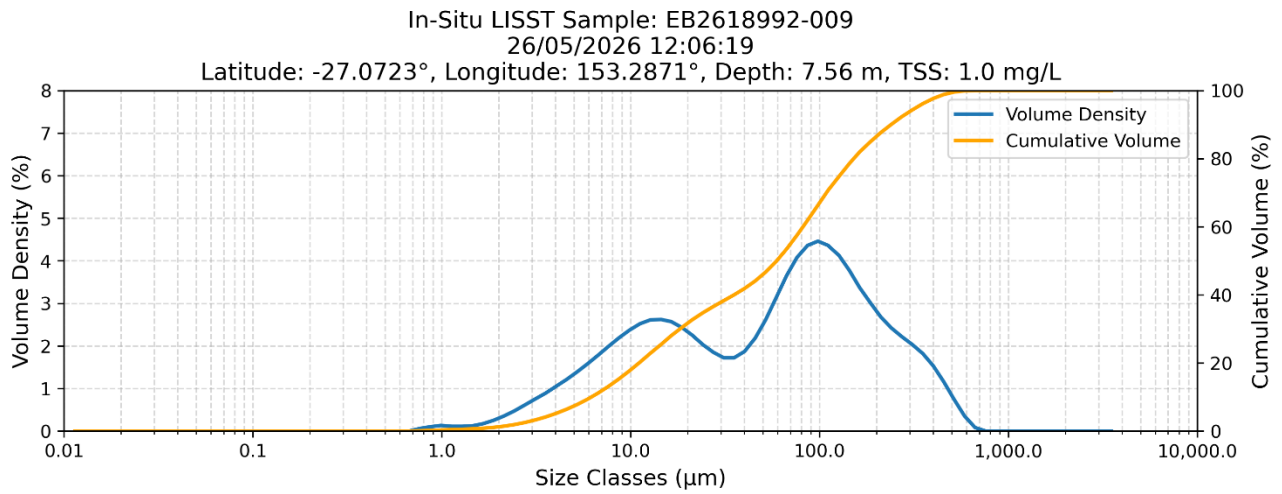


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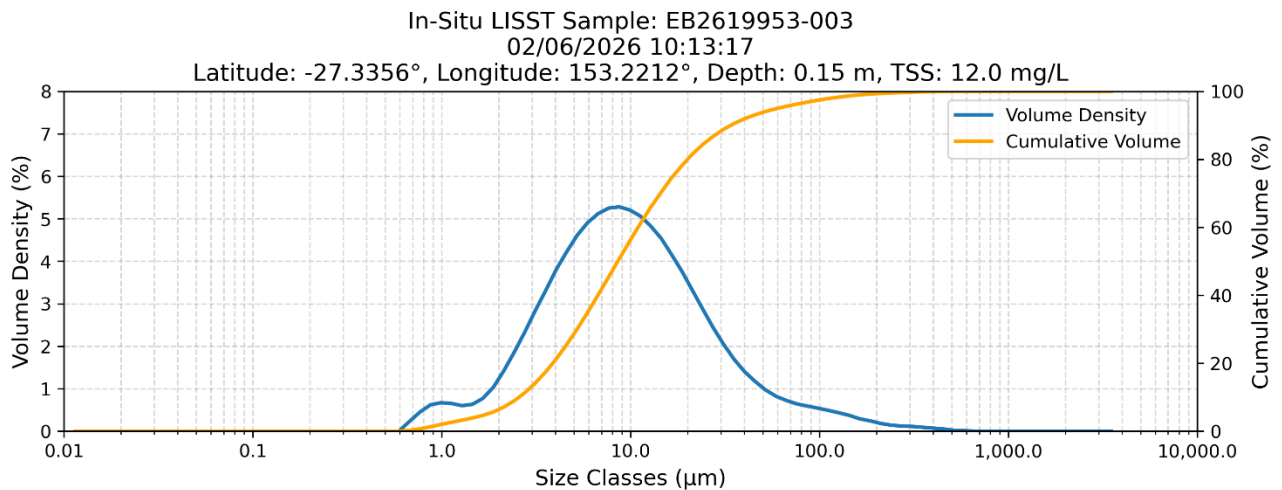
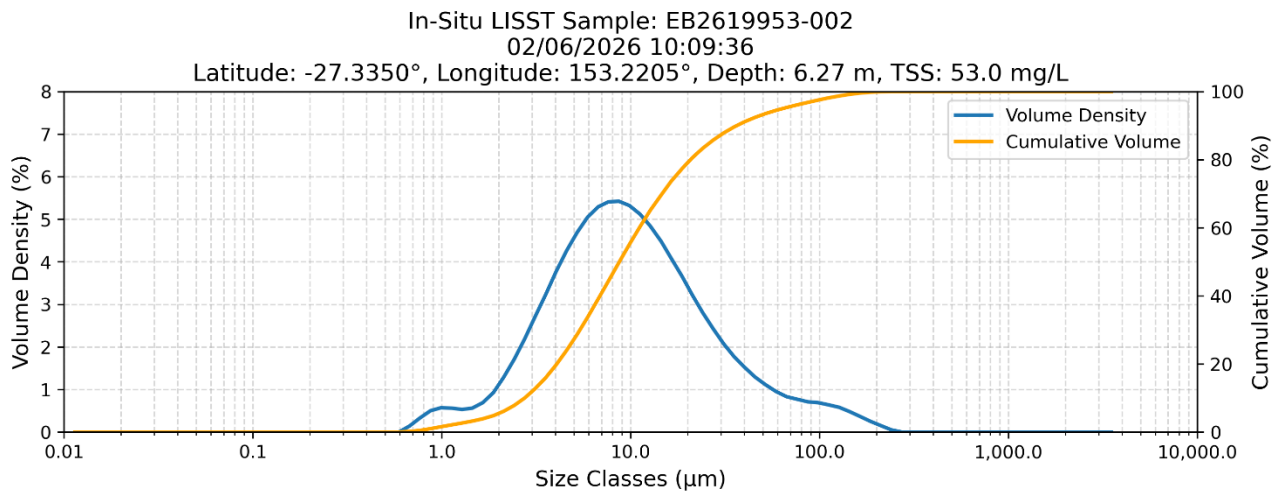
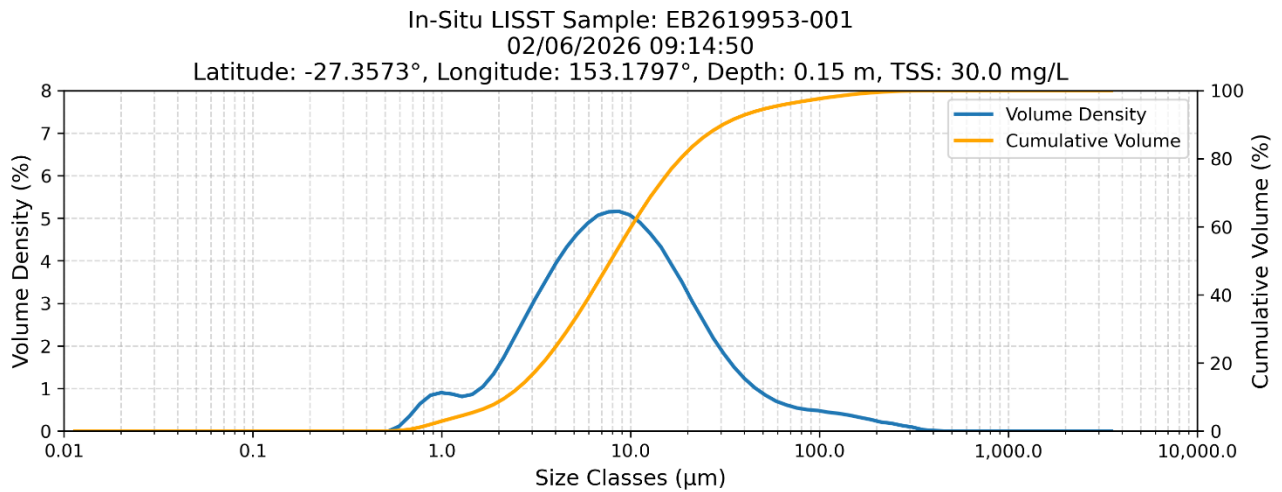




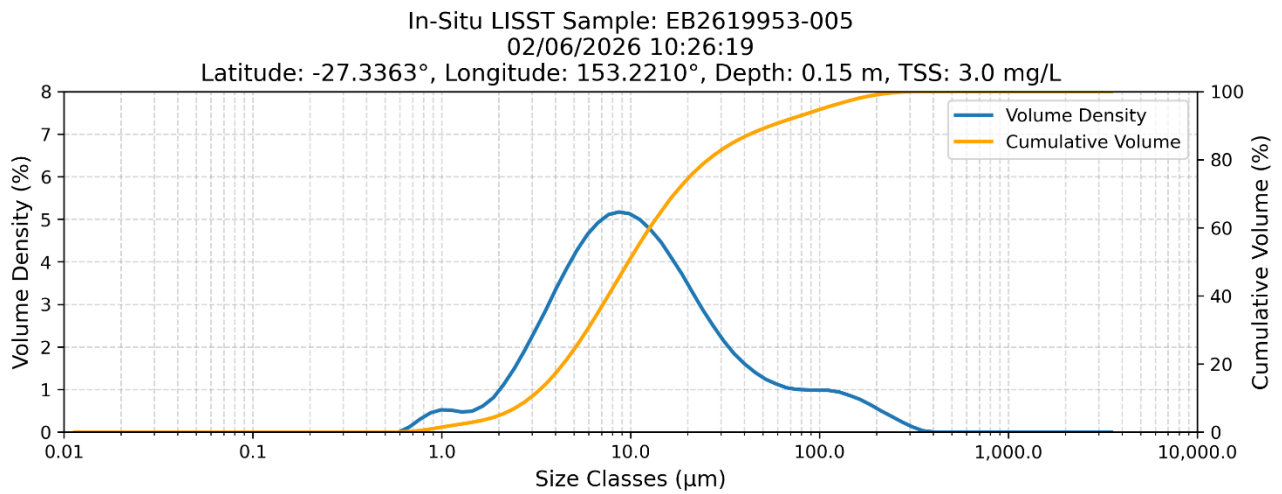
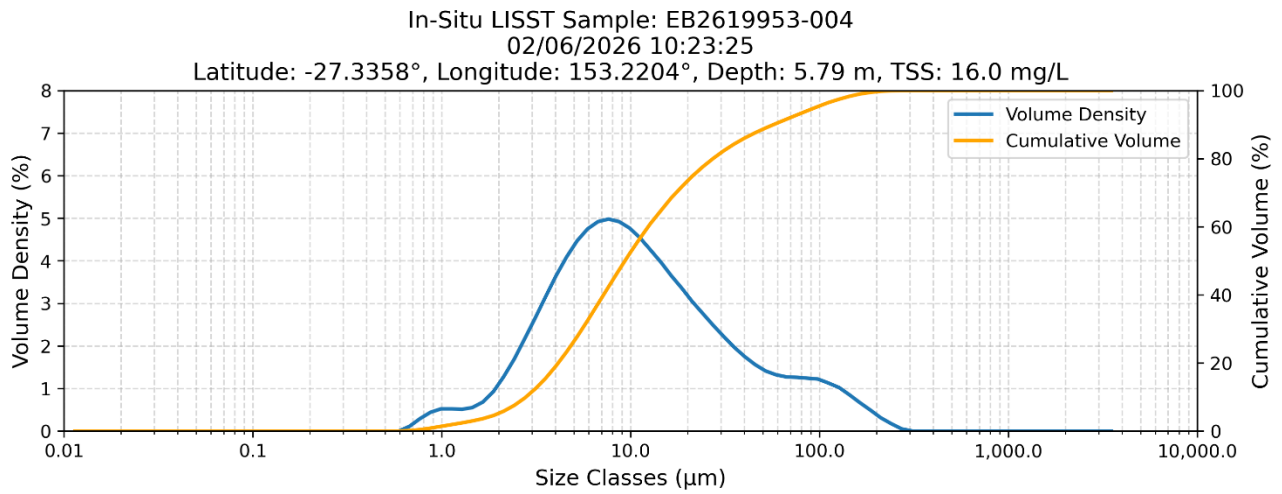
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