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COMPLIANCE WATER QUALITY MONITORING FOR PORT OF GLADSTONE MAINTENANCE DREDGING: SEPTEMBER TO NOVEMBER 2022

GLADSTONE PORTS CORPORATION (GPC)

VISION ENVIRONMENT
A Trinity Consultants Company

PRIMARY OFFICE (AUSTRALIA) | +61 7 4972 7530
Unit 3, 165 Auckland Street, Gladstone
PO BOX 1267, GLADSTONE QLD 4680

NEW ZEALAND OFFICE | +64 273 053 353
35/115 Bamford Street, Woolston
CHRISTCHURCH, NEW ZEALAND, 8023

E office@visionenvironment.com.au | www.visionenvironment.com.au

REPORT CONTRIBUTORS

Role	Team member
Project Management	Felicity Melville
Fieldwork	Lucy Georgiou, James Hayman, Ralph Alquezar, Anna Skillington, Michael Shanahan
Reporting & Review	Anna Skillington, Felicity Melville

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19012023 FINAL Compliance Water Quality Monitoring for PoG Maintenance Dredging Campaign September to November 2022_VE

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ACRONYMS

ALS	Australian Laboratory Services
APHA	American Public Health Association
AWQG	Australian Water Quality Guidelines
BOM	Bureau of Meteorology
BPAR	Benthic Photosynthetically Active Radiation
EBSDS	East Banks Sea Disposal Site
EWMA	Exponentially Weight Moving Average
GPC	Gladstone Ports Corporation Ltd
HSEQ	Health Safety Environment and Quality
LAT	Lowest Astronomic Tide
LMDMP	Long-term Maintenance Dredge Management Plan
LOR	Limits of Reporting
MS	Management System
NTU	Nephelometric Turbidity Units
PAR	Photosynthetically Active Radiation
QA/QC	Quality Assurance/Quality Control
SMART	Self-Monitoring Algorithm in Real Time
RA	Rolling Average
TBT	Tributyltin
TDP	Total Daily PAR
TV	Trigger Value
VE	Vision Environment ANZ
WBDDP	Western Basin Dredge and Disposal Project
WQO	Water Quality Objectives

1 INTRODUCTION

Gladstone Ports Corporation Ltd (GPC) undertook maintenance dredging in the Port of Gladstone (PoG) from 11 October to 15 November 2022. Approximately 211,726 m^3 of material was dredged across Gladstone harbour shipping channels, swing basins and berth pockets, and relocated to the East Banks Sea Disposal Site (EBSDS).

As per GPC's Long-term Maintenance Dredge Management Plan (LMDMP) (GPCL 2019), linked to Environmental Authority EPPR00570813, Sea Dumping Permit SD2018/3762 and PoG Maintenance Dredging Environmental Monitoring Procedure (GPCL 2022b), GPC was required to measure continuous water quality (turbidity) at one compliance site (WB50) and one support site (MH10) before, during and after dredge operations. Benthic Photosynthetically Active Radiation (BPAR), or the light reaching benthic primary producers such as seagrass, was measured at another compliance site (WB25) as per the approved monitoring procedure (GPCL 2022b).

The objective of the monitoring was to detect changes in turbidity and/or BPAR due to the potential effects of dredge operations, while considering the natural influences of winds, tides, and cloud cover. This would enable adaptive management responses to be enacted in a timely manner in response to trigger values exceedances, in order to avoid harm to sensitive ecological receptors (GPCL 2022a). Turbidity trigger values for water quality, and light requirement trigger values for intertidal seagrass species (Chartrand et al. 2012), had been established in the Western Basin Dredging and Disposal Project (WBDDP) and were utilised in this and previous maintenance dredge monitoring programs (Vision Environment 2015b, a, 2016, 2017b, a, 2019a, 2020b, a, 2021a). The monitoring program was designed based on the outputs of plume modelling and verification (impact assessment and hydrodynamic modelling) undertaken in previous maintenance dredge campaigns (BMT 2017, 2019).

This report presents the results of the 2022 Gladstone harbour maintenance dredge monitoring program undertaken by Vision Environment ANZ (VE).

2 METHODOLOGY

Monitoring was undertaken prior to, during and after dredging operations (Table 1). The monitoring sites are displayed in Figure 1, while GPS locations are listed in the Appendix (Table A1).

Table 1 Monitoring phases during the maintenance dredge monitoring program.

Dredge phase	Dates
BPAR Pre-dredge	11 September to 10 October 2022
Pre-dredge	27 September to 10 October 2022
Dredge	11 October to 15 November 2022
Post-dredge	16 November to 29 November 2022

2.1 Telemetered Monitoring Equipment and Data Management

2.1.1 Water Quality Equipment

At sites WB50 and MH10, two antifouled multi-parameter sondes (YSI EXO3) were placed into secured antifouled PVC tubes attached to the base of a modified Special Marker buoy.

Figure 1 Monitoring sites for Gladstone maintenance dredge monitoring program from 11 September 2022 to 29 November 2022.

Telemetered loggers programmed the sondes to record turbidity (NTU), temperature (°C), conductivity (mS/cm), pH and dissolved oxygen (% saturation), every 15 minutes at approximately 0.75 m below the water surface. The central wiper was set to clean the sonde probes prior to each data log. The loggers were attached to solar powered telemetry units installed within the buoy. Parameter data was transferred via telemetry to the VECloud database every 15 minutes.

All sondes were scheduled to be maintained as required based on examination of real time data. Each sonde was calibrated, and log-tested prior to deployment as per VE Health Safety Environment and Quality (HSEQ) Management System (MS) protocols.

2.1.2 Water Quality Data Management

Management of physicochemical logger data was undertaken as per VE HSEQ MS protocols, developed and peer reviewed during the WBDDP (Vision Environment 2013) and multiple maintenance dredge campaigns from 2014 onwards (Vision Environment 2015b, a, 2016, 2017b, a, 2019a, 2020b, a, 2021a). Once in the VECloud database, data underwent Self-Monitoring Algorithm in Real Time (SMART) deconfounding. SMART was developed by VE as an initial automatic data deconfounding process to filter out erroneous raw real time data from multiple instruments, in order to provide a more accurate and instantly usable real time data set. Following the initial deconfounding, the SMART data was manually validated by VE personnel for daily reporting after having undergone QA/QC review. Erroneous data was identified by SMART (and manually) using VE HSEQ MS protocols.

Although turbidity statistics have been reported using mean data from the dual loggers, a smoothing technique was applied, with the smoothed values utilised for comparison against licence trigger values, as specified in the approved monitoring procedure (GPCL 2022b). The 6 hourly Exponentially Weighted Moving Average (EWMA) is a weighted average of (i) the mean of the edited turbidity data for the most recent 6-hour period and (ii) the previous EWMA. The weights applied to these two components were 0.6 and 0.4, respectively. This approach, developed by Environmetrics Australia Ltd (2010), removes outliers while maintaining true data trends, but also incorporates an element of background history to the calculations.

2.1.3 BPAR Equipment

At intertidal site WB25, two LI-COR LI192 Underwater Quantum Sensors were attached to a benthic frame and placed on the benthos (datum depth of approximately 1.0 ± 0.3 m LAT). The benthic frame was attached by cable to a telemetry station buoy on the surface. BPAR (in addition to depth) was logged every 15 minutes (summed from 1 min readings), with data transferred to VECloud every 15 minutes. Wiper units cleaned the PAR sensors every 15 minutes.

In order to record daily ambient changes in total available PAR, a telemetered PAR station also operated at Vision Base (VB). The inclusion of the VB data allowed for variation in daily ambient PAR (e.g., due to cloud cover) to be accounted for, thus aiding in interpretation of PAR levels within Port Curtis waterways and acting as a ‘control’ PAR.

2.1.4 BPAR Data Management

PAR values from each LI-COR during the non-daylight period (according to sunrise and sunset times, reported by the Bureau of Meteorology (BOM 2022)), were zeroed. As WB25 is an intertidal site, exposure periods of the PAR loggers were detected using depth measurements from a pressure level sensor. BPAR values during these exposure times were automatically adjusted by dividing the BPAR value by 1.3, as per Collier et al. (2009). Subsequent calculations were performed on the accumulated 15 min PAR readings recorded from both LI-

COR to calculate the mean total daily PAR or TDP (mol/m²/day). Using the TDP values, the 14-day rolling average (14-day RA) was calculated daily (Chartrand et al. 2012). Similar to the water quality loggers, all PAR data was deconfounded as per VE HSEQ MS protocols in order to maintain the continuity of accurate data.

2.2 Water Sampling and Analysis

Water sampling, which is conducted for due diligence purposes, was carried out as per the VE HSEQ MS protocols on the following occasions:

- 27 September 2022: Pre-dredge phase;
- 24 October 2022: Dredge phase; and
- 21 November 2022 – Post-dredge phase.

Samples were collected in accordance with standard protocols derived from worldwide authorities, including:

- Australian and New Zealand Standards for water quality sampling (AS/NZS 1998a, b, c);
- The American Public Health Association Standard Methods for the Examination of Water and Wastewater (APHA 2017);
- Australian and New Zealand Water Quality Guidelines (ANZG 2018);
- The Queensland Water Quality Guidelines (DERM 2009); and
- The Department of Environment and Science Monitoring and Sampling Manual (DES 2018).

Water samples for analyses were collected at a depth of 0.5 m using a perspex pole sampler to which a 1 L Nalgene bottle was attached. Nalgene bottles were acid-washed with hydrochloric acid in the VE laboratory clean room prior to sampling, and triple rinsed in ambient water prior to sample collection at each site. Powder free gloves were worn to avoid contamination. Samples which required filtration (dissolved metals: aluminium, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc) were immediately filtered through a 0.45 µm sterile surfactant free cellulose acetate membrane syringe filter (Minisart 16555K) into an acid-washed sample bottle provided by the analysing laboratory. Each pre-packaged syringe and filter were flushed with site water prior to sample collection. For samples which did not require filtration (tributyltin and chlorophyll *a*), water samples were decanted directly into the laboratory provided sample bottles.

In order to extend holding times for chlorophyll *a*, samples were pre-processed in the VE laboratory (within 24 h of collection) through 0.45 µm glass fiber filters, using a manifold and vacuum pump with the volume of water passed through the filter recorded (500 mL). Filter papers were folded, placed in aluminium foil within airtight plastic bags then frozen to extend the holding period of these samples to 28 days, in accordance with American Public Health Association method 12000H (APHA 2017).

Samples were stored on ice for transport to the NATA accredited analysing laboratory (ALS). A duplicate water sample for all parameters was collected at one site per survey as per established protocols, with a field and laboratory blank also collected. Analytical laboratory quality control measures included laboratory duplicates, laboratory blanks, analysis of certified reference material and matrix spikes.

2.2.1 Water Quality Objectives

Dissolved metal, tributyltin and chlorophyll *a* concentrations were compared to 95% species protection trigger level Australian Water Quality Guidelines or AWQG (ANZG 2018) for due diligence purposes.

2.3 Compliance Trigger Values

Specific EWMA compliance trigger values (TV) outlined by the Monitoring Procedure (GPCL 2022b) and utilising the 80th and 95th percentiles of data ranges of previously collected baseline data for both the Wet and Dry Season, were applicable to turbidity EWMA measurements (Table 2).

The 80th percentile TV is exceeded when the EWMA value is greater than the 80th percentile value for a minimum of 36 consecutive values (e.g. six consecutive EWMA values) and is for internal management purposes only. The 95th percentile TV is exceeded when the EWMA value is greater than the 95th percentile value for a minimum of 24 consecutive values (e.g. four consecutive EWMA values). Compliance TV for physicochemical parameters and BPAR were only applicable during the Dredge period.

Similar to the WBDDP (Vision Environment 2013) and previous maintenance dredge campaigns (Vision Environment 2015b, a, 2016, 2017b, a, 2019a, 2020b, a, 2021a), the Dry Season was classified from 1 April to 30 September with Wet Season TV applicable from 1 October to 31 March. As such, only Wet Season TV were applicable during the current maintenance dredge project (refer Table 1).

The 14-day RA BPAR data collected from compliance site WB25 was compared to the seagrass minimum light requirement TV (Chartrand et al. 2012), an approach established for the WBDDP by the Centre for Tropical Water and Aquatic Ecosystem Research (James Cook University), based on shading experiments conducted in Port Curtis on locally relevant species (Vision Environment 2013). A summary of the compliance status of monitoring sites and the type of monitoring that was undertaken is listed in Table 2.

Table 2 Maintenance dredging monitoring sites and compliance status.
Note that Dry Season trigger values for turbidity were applicable from 1 April to 30 September with Wet Season trigger values applicable from 1 October to 31 March under the GPC Sea Dumping Permit (GPCL 2022b, a).

Site	Status	Parameters	Dry Trigger levels (Dredge phase only)	Wet Trigger levels (Dredge phase only)
WB50	Compliance	Turbidity (NTU)	EWMA = 17 NTU (80th percentile) - Internal EWMA = 27 NTU (95th percentile) - External	EWMA = 30 NTU (80th percentile) - Internal EWMA = 48 NTU (95th percentile) - External
MH10	Support	Turbidity (NTU)	-	-
WB25	Compliance	Benthic PAR 14-day RA	> 6 mol/m^2/day	> 6 mol/m^2/day
NW70, WB50, IH15, MH40, MH50	Support	Water Sampling (dissolved metals, tributyltin & chlorophyll *a*)	-	-

3 RESULTS

3.1 Dredge Volumes

The Trailing Suction Hopper Dredge (TSHD) “Brisbane” operated from 11 October to 15 November 2022. Approximately 211,726 m^3 of material was dredged across Gladstone harbour shipping channels (Figure 2), and relocated to the EBSDS (Figure 3), (data provided by GPC).

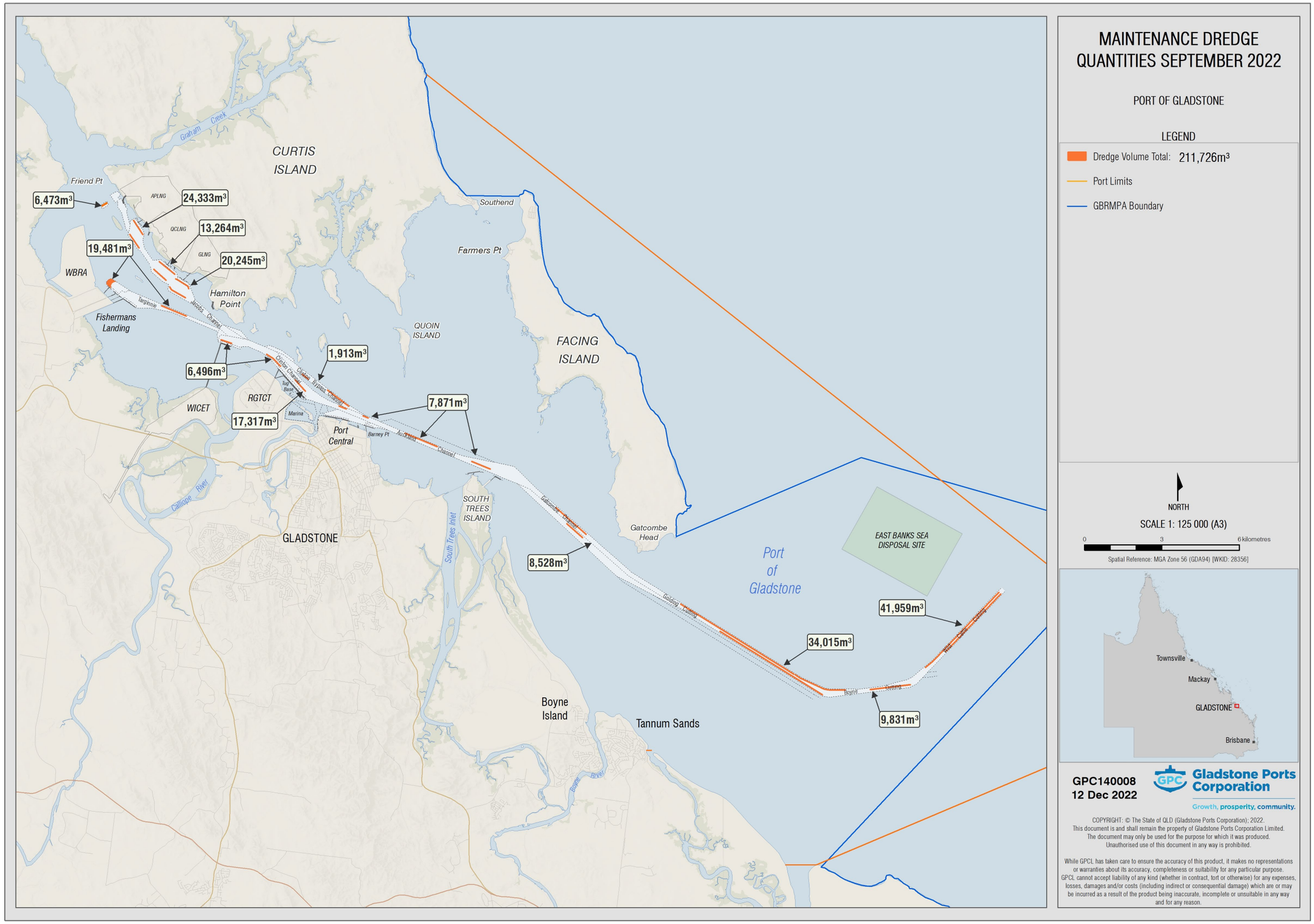

Figure 2 Maintenance dredge hopper volumes October/November 2022.
Image provided by GPC.

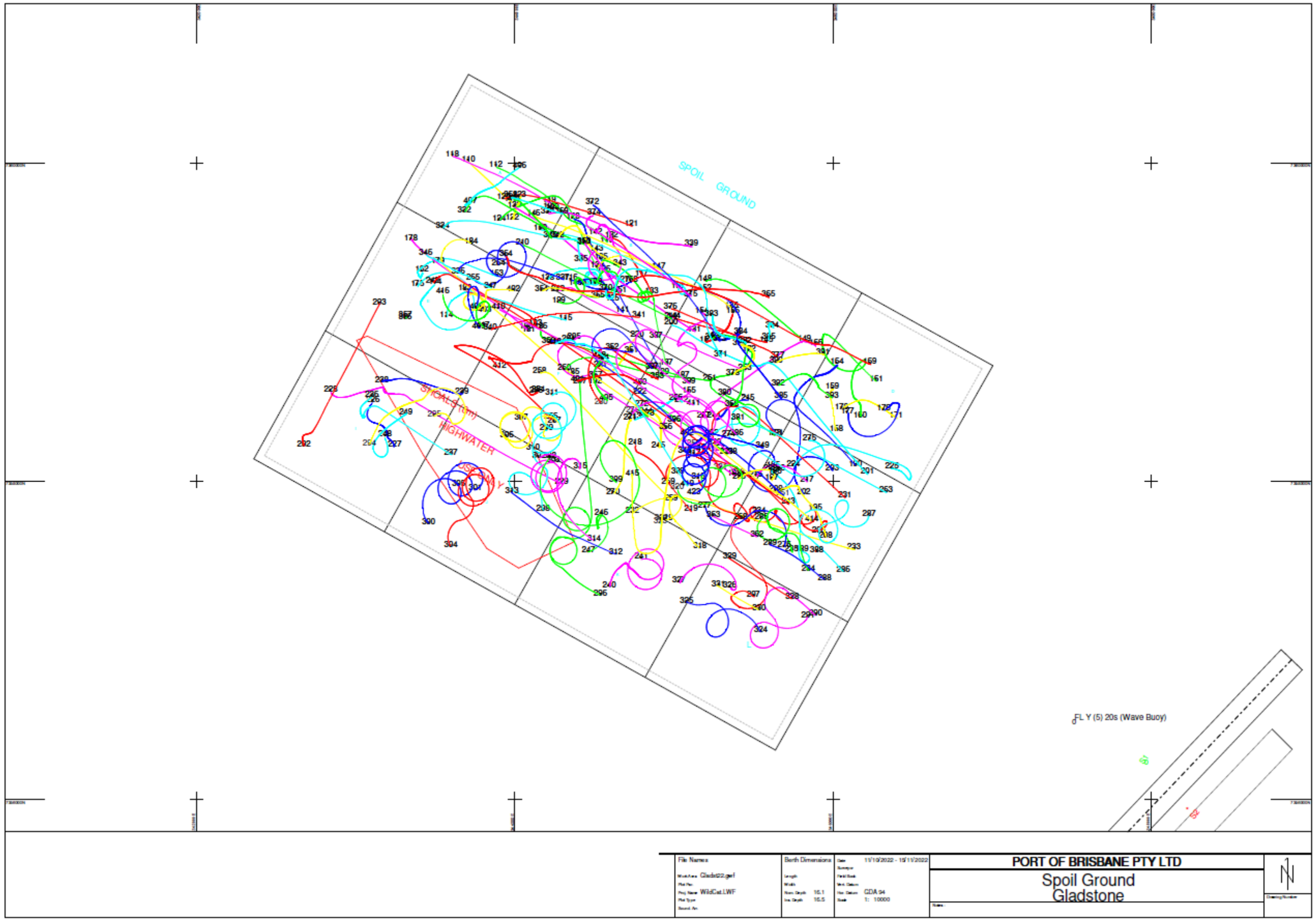

Figure 3 Maintenance dredge spoil disposal at EBSDS during operations from 11 October to 15 November 2022.
Image provided by GPC.

3.2 Metocean Conditions

Approximately 280 mm of rainfall was recorded over the monitoring period (11 September 2022 to 29 November 2022). Totals of 73 mm, 178 mm and 28 mm (BOM 2022) were recorded during the Pre-dredge, Dredge and Post-dredge phases at Gladstone Airport (Station 039326), respectively (Figure 4).

Maximum wind gusts across the monitoring period reached 67 km/h (BOM 2022), with wind gusts above 50 km/h recorded during the Dredge phase (27 and 28 October; 5 and 6 November 2022). Spring tides associated with the full and new moons occurred on 26 September (3.59 m tidal range), 10 and 25 October (3.93 and 3.59 m tidal ranges, respectively) and 8 and 24 November 2022 (3.74 and 3.92 m tidal ranges, respectively) (BOM 2022).

3.3 Turbidity

At compliance site WB50, turbidity EWMA TV were applicable only during the Dredge phase (11 October to 15 November 2022). The 80th percentile Wet Season value (30 NTU), was exceeded on three consecutive occasions on 7 November (EWMA: 35 to 41 NTU), corresponding with spring tides associated with the full moon and wind gusts ≥50 km/h from an east south-easterly direction. However, this did not constitute an exceedance of the 80th percentile TV (internal alert trigger) as only three consecutive values were greater than the 80th percentile value. No EWMA values were above the 95th percentile value (48 NTU) during the entire project. Turbidity EWMA values during the Pre- and Post-dredge phases remained below 20 NTU (Table 3, Figure 5).

Table 3 Sub-surface turbidity statistics for continuous logger monitoring sites during phases of the maintenance dredge monitoring period: 27 September 2022 to 29 November 2022.
N = 1332 to 1344, 3350 to 3456 and 1331 to 1344; EWMA N = 56, 144 and 56, for Pre-dredge, Dredge and Post-dredge respectively.

Site	Dredge phase	Statistic	Turbidity (NTU)	Wet Season EWMA Trigger value
WB50	Pre-dredge	Mean ± se	9.5 ± 0.1	N/A
		Range	3 – 35	
		EWMA Range	4 – 17	
	Dredge	Mean ± se	11 ± 0	30 NTU (80th percentile) 48 NTU (95th percentile)
		Range	2 – 70	
		EWMA Range	3 – 41	
	Post dredge	Mean ± se	9.8 ± 0.1	N/A
		Range	3 – 31	
		EWMA Range	3 – 18	
MH10	Pre-dredge	Mean ± se	5.0 ± 0.1	N/A
		Range	2 – 25	
		EWMA Range	3 – 10	
	Dredge	Mean ± se	6.8 ± 0.1	
		Range	1 – 43	
		EWMA Range	3 – 16	
	Post dredge	Mean ± se	5.5 ± 0.1	
		Range	2 – 15	
		EWMA Range	3 – 8	

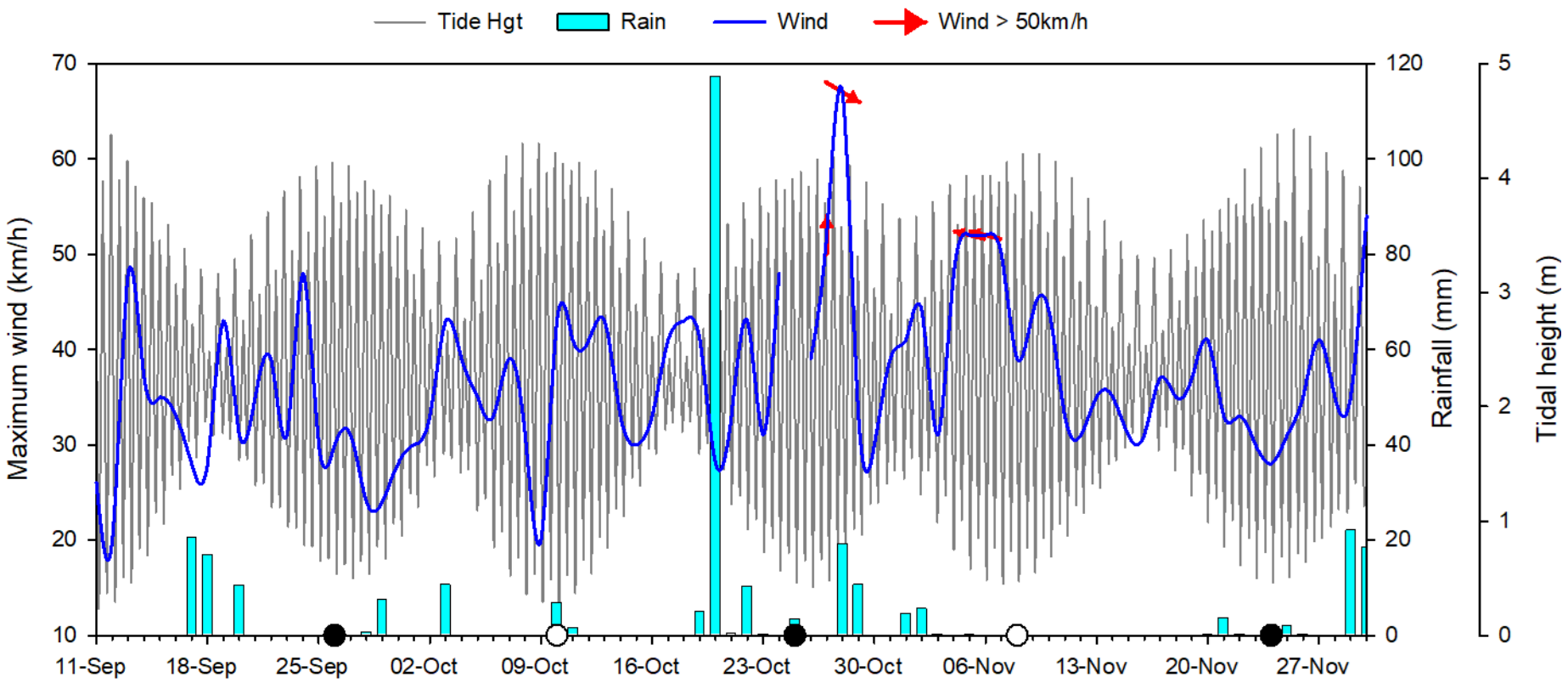

Figure 4 Wind speeds and direction, rainfall and tidal range during the maintenance dredge monitoring program from 11 September 2022 to 29 November 2022.
Clear and solid circles indicate full and new moons, respectively, indicating spring tide periods. Note that no wind records were available from the Gladstone airport stations on several days in October.

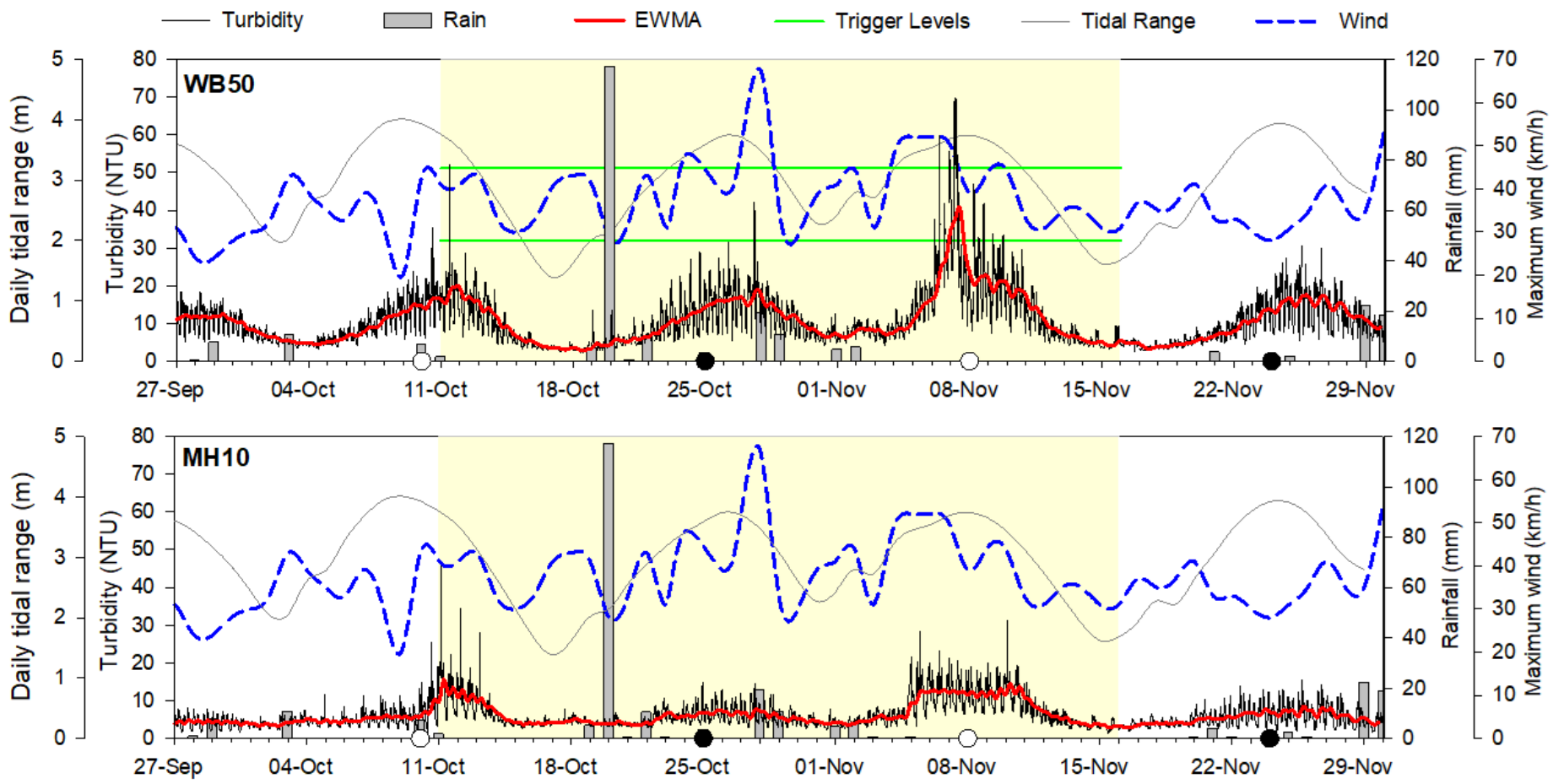

Figure 5 Turbidity at monitoring sites WB50 and MH10 from 27 September 2022 to 29 November 2022.
Yellow shaded area indicates dredge operations period. Clear and solid circles indicate full and new moons, respectively, indicating spring tide periods. Green lines indicate WB50 80th and 95th percentile Wet Season TV applicable during the Dredge phase only.

Turbidity at both sites increased during spring tide periods. Higher tidal ranges associated with spring tides at inshore sites contribute to a higher level of mixing and resuspension of particles within the water column. When tidal ranges are lower, such as during neap tides associated with the quarter moon phases, turbidity levels tend to decrease accordingly. Highest turbidity at WB50 (70 NTU) was recorded during the new moon spring tide on 7 November, with EWMA values reaching up to 41 NTU (Table 3, Figure 5).

Wind-driven turbidity can often be observed in Gladstone with high winds resuspending benthic sediments. However, the highest wind gusts of 67 km/h recorded on 28 October did not result in notably increased turbidity, which may be due to the north westerly direction of the wind on that occasion. However, the ≥ 50 km/h winds recorded in early November were predominantly from an easterly direction which may have contributed to increased turbidity at WB50 and MH10 during the advent of the full moon spring tide.

Mean turbidity during the Dredge phase at WB50 was 11 NTU, similar to the mean turbidity recorded during the Pre- and Post-dredge phases (9.5 and 9.8 NTU, respectively). All mean turbidity values were well below the applicable 80th percentile WQO (29 NTU) for the Western Basin zone of the harbour (EHP 2014). Note that comparison of mean turbidity to WQO is made for due diligence purposes only, whereas the EWMA is compared to the TV for compliance purposes as per the approved monitoring procedure (GPCL 2022b).

Site MH10 was not a compliance site and TV did not apply. Turbidity EWMA values at this site remained lower than WB50 values, ranging from 3 to 16 NTU. Mean turbidity (Table 3) (5.0, 6.8 and 5.5 NTU, respectively for Pre-, Dredge and Post-Dredge phases) remained below the applicable 80th percentile WQO for the Mid Harbour zone (16 NTU). In contrast to WB50, highest turbidity at MH10 (43 NTU) was evident in mid-October, likely driven by the >40 km/h easterly winds and the approaching full moon spring tide.

Maintenance dredge operations undertaken from 11 October to 15 November 2022 did not appear to have an impact on turbidity at the telemetered water quality monitoring sites, with natural tidal cycles, in addition to winds, appearing to have greater influence.

3.4 Benthic PAR

Mean TDP at site WB25 across the entire monitoring period (7.9 mol/m^2/day) was in the range recorded (3.9 to 12.6 mol/m^2/day) during previous maintenance dredge campaigns (Vision Environment 2015b, a, 2016, 2017b, a, 2019a, 2020b, a, 2021a).

Table 4 PAR statistics for WB25 and Vision Base during maintenance dredge monitoring period (11 September to 29 November 2022).
N = 79.

Site	Statistic	PAR (mol/m^2/day)
Vision Base	TDP Mean ± se	40.7 ± 1.4
	TDP Range	7.1 – 65.8
WB25	TDP Mean ± se	7.9 ± 0.6
	TDP Range	1.0 – 25.7
	14-day RA Range	4.9 – 11.9

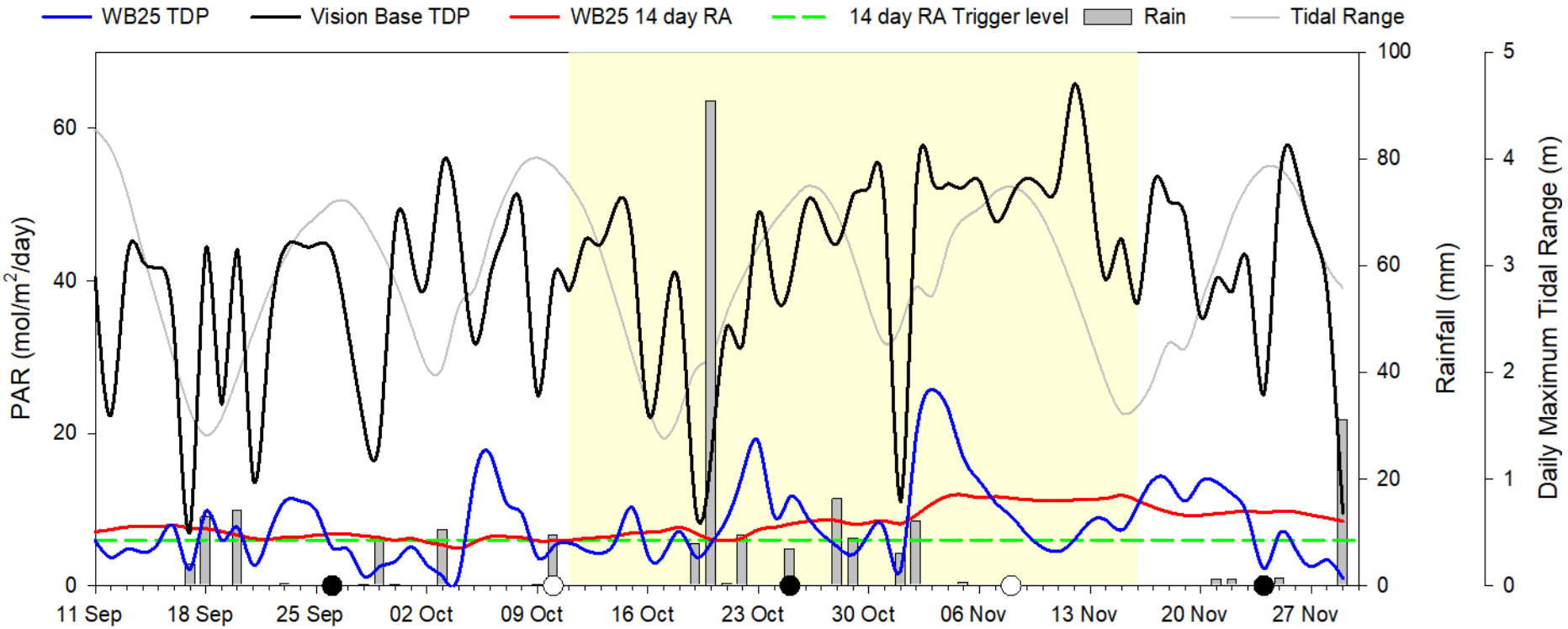

Figure 6 WB25 total daily BPAR and 14-day rolling average (RA), Vision Base total daily PAR, daily tidal ranges, and rainfall from 11 September to 29 November 2022.
Yellow shaded area indicates dredge period. Clear and solid circles indicate full and new moons, respectively indicating spring tide periods.

Site WB25 14-day RA ranged from 4.9 to 11.9 mol/m^2/day and was below the TV of 6 mol/m^2/day on one occasion only (21 October) during the Dredge phase (Figure 6). During the Pre-Dredge phase (when TV were not applicable), 14-day RA values <6 mol/m^2/day were recorded on six occasions (2 to 5 October and 9 to 10 October). The lower 14-day RA values on these occasions were attributable to the lower TDP values (< 6 mol/m^2/day) recorded prior to and during these days (26 September to 4 October, and 9 to 20 October), which were a consequence of midday high tides (27 September to 2 October, and 11 to 16 October) and high ambient cloud cover, as indicated by VB TDP values of <40 mol/m^2/day (12 September to 11 October, 16 to 22 October). Turbidity remained low at water quality monitoring sites, indicating that water clarity remained high and suspended particles within the water column did not contribute to the low TDP.

As recorded in previous maintenance dredge campaigns (Vision Environment 2015b, a, 2016, 2017b, a, 2019a, 2020b, a, 2021a), TDP was mainly impacted by tidal changes in water depth and the amount of ambient PAR available. Tidal changes in water depth have a large impact on the amount of PAR reaching the benthos. When high tides are during the middle of the day, TDP will be considerably lower than days when the low tide is in the middle of the day. During the 33 days of the 80-day monitoring period when the high tide occurred between 10 am and 2 pm, TDP at WB25 ranged from 1.0 to 10.3 mol/m^2/day. In contrast, on the 24 days of the 80-day monitoring period when the low tide occurred between 10 am and 2 pm, TDP ranged up to 25.7 mol/m^2/day.

Apart from water depth, benthic PAR was also impacted by the amount of ambient PAR available, as recorded by the Vision Base (VB) PAR unit. Rainfall and associated cloud cover recorded intermittently throughout the entire monitoring period resulted in decreased ambient PAR values (<30 mol/m^2/day) at VB, and consequently lower TDP at WB25 (Figure 6).

3.5 Water Analysis

Water sampling for due diligence purposes was conducted for dissolved metals, tributyltin and chlorophyll *a* on one occasion each during the Pre-dredge (27 September 2022), Dredge (24 October 2022) and Post-dredge (21 November 2022) phases at selected sites (Table 5). A summary of QA/QC across the three surveys can be found in the Appendix. Recorded metal, tributyltin and chlorophyll *a* concentrations are listed in Table 5.

Most dissolved metal concentrations across the three surveys were below laboratory limits of reporting (LOR), with only dissolved aluminium and nickel recorded occasionally across the sites, similar to what has been observed in previous surveys within Gladstone Harbour (Vision Environment 2017c, 2018, 2019b, 2020c, 2021b, a). All dissolved metal concentrations remained well below the AWQG 95% species protection trigger levels.

Tributyltin (TBT) was <LOR during all three surveys, while chlorophyll *a* concentrations ranged from 0.4 to 2.0 µg/L, not exceeding the WQO (DSITIA 2014).

Overall, and similar to physicochemical parameters, maintenance dredge operations did not appear to impact water column dissolved metal, tributyltin and chlorophyll *a* concentrations.

Table 5 Contaminant concentrations during Pre-dredge (27 September 2022), Dredge (24 October 2022) and Post-dredge (21 November 2022) monitoring.
N = 1. 95% species protection AWQG trigger values listed. Chlorophyll a WQO derived from DSITIA (2014). Field values highlighted when exceeding AWQG/WQO.

Parameter (µg/L)	Survey	NW70	WB50	IH15	MH40	MH50	AWQG/WQO
Dissolved Aluminium	Pre-dredge	<5	<5	<5	<5	<5	24
	Dredge	<5	<5	<5	<5	<5	
	Post-dredge	8	11	8	8	8	
Dissolved Cadmium	Pre-dredge	<0.2	<0.2	<0.2	<0.2	<0.2	5.5
	Dredge	<0.2	<0.2	<0.2	<0.2	<0.2	
	Post-dredge	<0.2	<0.5	<0.2	<0.2	<0.2	
Dissolved Chromium	Pre-dredge	<0.5	<0.5	<0.5	<0.5	<0.5	III 27.4, VI 4.4
	Dredge	<0.5	<0.5	<0.5	<0.5	<0.5	
	Post-dredge	<0.5	<2.5	<0.5	<0.5	<0.5	
Dissolved Copper	Pre-dredge	<1	<1	<1	<1	<1	1.3
	Dredge	<1	<1	<1	<1	<1	
	Post-dredge	<1	<5	<1	<1	<1	
Dissolved Lead	Pre-dredge	<0.2	<0.2	<0.2	<0.2	<0.2	4.4
	Dredge	<0.2	<0.2	<0.2	<0.2	<0.2	
	Post-dredge	<0.2	<1.0	<0.2	<0.2	<0.2	
Dissolved Mercury	Pre-dredge	<0.1	<0.1	<0.1	<0.1	<0.1	0.4
	Dredge	<0.1	<0.1	<0.1	<0.1	<0.1	
	Post-dredge	<0.1	<0.1	<0.1	<0.1	<0.1	
Dissolved Nickel	Pre-dredge	0.7	<0.5	<0.5	<0.5	<0.5	70
	Dredge	0.5	0.5	<0.5	<0.5	<0.5	
	Post-dredge	0.8	9.4	0.6	<0.5	<0.5	
Dissolved Silver	Pre-dredge	<0.1	<0.1	<0.1	<0.1	<0.1	1.4
	Dredge	<0.1	<0.1	<0.1	<0.1	<0.1	
	Post-dredge	<0.1	<0.1	<0.1	<0.1	<0.1	
Dissolved Zinc	Pre-dredge	<5	<5	<5	<5	<5	8
	Dredge	<5	<5	<5	<5	<5	
	Post-dredge	<5	<25	<5	<5	<5	
Tributyltin (ngSn/L)	Pre-dredge	<2	<2	<2	<2	<2	6
	Dredge	<2	<2	<2	<2	<2	
	Post-dredge	<2	<2	<2	<2	<2	
Chlorophyll *a*	Pre-dredge	1.6	2.0	1.3	0.9	0.5	2.0
	Dredge	1.3	1.4	1.4	1.4	0.9	
	Post-dredge	1.3	1.5	0.9	0.7	0.4	

4 SUMMARY

During the Dredge phase when turbidity trigger values were applicable at WB50, turbidity EWMA values were higher than the 80th percentile value on three concurrent occasions, attributable to high water movements due to spring tides and strong easterly winds. However, the 80th percentile TV was not exceeded on any occasion. Turbidity EWMA values higher than the 95th percentile TV were not recorded at WB50.

Turbidity at both water quality monitoring sites appeared to be more influenced by metocean factors such as tides and winds, than from dredge activities, as observed during previous maintenance dredge monitoring campaigns in Gladstone (Vision Environment 2015b, a, 2016, 2017b, a, 2019a, 2020b, a, 2021a).

BPAR 14-day RA values at compliance site WB25 were below the TV on one occasion during the Dredge phase, attributable to low ambient TDP due to midday high tides attenuating light through the water column and reduced ambient PAR due to cloud cover. Turbidity at the water quality monitoring sites remained low during this period, indicating that water clarity remained high. As such, maintenance dredge operations were unlikely to be the cause of the reduced BPAR.

No WQO exceedances were recorded during the due diligence discrete water sampling, indicating maintenance dredging operations did not impact measured contaminant or chlorophyll *a* concentrations.

5 REFERENCES

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Vision Environment. 2021b. PCIMP Water and Sediment Quality Monitoring: 2020 Annual Report., Gladstone, Australia.

6 APPENDIX

6.1 Monitoring Sites

Table A1. Location of water quality monitoring sites (WGS84).

Site	GPS location
WB50	151° 12.555' E, 23° 48.304' S
MH10	151° 18.380' E, 23° 46.973' S
WB25	151° 11.133' E, 23° 47.072' S
NW70	151° 10.703' E, 23° 44.351' S
IH15	151° 14.323' E, 23° 47.700' S
MH40	151° 20.481' E, 23° 50.779' S
MH50	151° 22.648' E, 23° 52.887' S

6.2 Quality Assurance/Quality Control

Samples sent to ALS were analysed within recommended holding periods (Tables A2, A4 and A6). ALS laboratory blanks were all below detection limits, and acceptable differences (Relative Percent Difference, or RPD) were found between laboratory duplicates (split samples).

VE field and laboratory blank concentrations were below LOR during Pre-dredge and Dredge surveys, with some minor metal contamination of Post-dredge QA samples evident (Tables A3, A5 and A7). This indicates some contamination of the MilliQ water used for the QA samples, but field concentrations were not impacted.

Table A2 Summary of ALS QA/QC data during Pre-dredge sampling: 27 September 2022.

Report of analysis number	EB2228447
Date Samples Collected	27 September 2022
Date Samples Analysed	Acceptable
Lab blank concentrations	Acceptable
RPD Laboratory duplicates	Acceptable
Recovery from laboratory control sample	Acceptable, except aluminium was slightly higher than acceptable limits
Recovery from matrix spike samples	Acceptable

Table A3. Summary of ALS QA/QC data during Dredge sampling: 24 October 2022.

Report of analysis number	EB2231402
Date Samples Collected	24 October 2022
Date Samples Analysed	Acceptable
Lab blank concentrations	Acceptable
RPD Laboratory duplicates	Acceptable
Recovery from laboratory control sample	Acceptable
Recovery from matrix spike samples	Acceptable

Table A4. Summary of ALS QA/QC data during Post-dredge sampling: 21 November 2022.

Report of analysis number	EB2234743
Date Samples Collected	21 November 2022
Date Samples Analysed	Acceptable
Lab blank concentrations	Acceptable
RPD Laboratory duplicates	Acceptable
Recovery from laboratory control sample	Acceptable
Recovery from matrix spike samples	Acceptable

Table A5 Summary of VE quality control data during pre-dredge sampling: 27 September 2022.
ND = not determined as one or more samples was below LOR.

Parameter (µg/L)	VE Field Blank	VE Lab Blank	Replicate		Variation %
			IH15-A	IH15-B	
Aluminium	<5	<5	<5	<5	ND
Cadmium	<0.05	<0.05	<0.2	<0.2	ND
Chromium	<0.2	<0.2	<0.5	<0.5	ND
Copper	<0.5	<0.5	<1	<1	ND
Lead	<0.1	<0.1	<0.2	<0.2	ND
Mercury	<0.1	<0.1	<0.1	<0.1	ND
Nickel	<0.5	<0.5	<0.5	0.5	ND
Silver	<0.1	<0.1	<0.1	<0.1	ND
Zinc	<1	<1	<5	<5	ND
Tributyltin (ngSn/L)	<2	<2	<2	<2	ND
Chlorophyll *a*	<0.02	<0.02	1.27	1.29	1.6

Table A6. Summary of VE quality control data during Dredge sampling: 24 October 2022.
ND = not determined as one or more samples was below LOR.

Parameter (µg/L)	VE Field Blank	VE Lab Blank	Replicate		Variation %
			MH50-A	MH50-B	
Aluminium	<5	<5	<5	<5	ND
Cadmium	<0.05	<0.05	<0.2	<0.2	ND
Chromium	<0.2	<0.2	<0.5	<0.5	ND
Copper	<0.5	<0.5	<1	<1	ND
Lead	<0.1	<0.1	<0.2	<0.2	ND
Mercury	<0.1	<0.1	<0.1	<0.1	ND
Nickel	<0.5	<0.5	<0.5	<0.5	ND
Silver	<0.1	<0.1	<0.1	<0.1	ND
Zinc	<1	<1	<5	<5	ND
Tributyltin (ngSn/L)	<2	<2	<2	<2	ND
Chlorophyll *a*	<0.02	0.02	0.94	0.81	14.9

Table A7 Summary of VE quality control data during Post-dredge sampling: 21 November 2022.
ND = not determined as one or more samples was below LOR.

Parameter (µg/L)	VE Field Blank	VE Lab Blank	Replicate		Variation %
			MH40-A	MH40-B	
Aluminium	38	40	8	8	0.0
Cadmium	<0.05	<0.05	<0.2	<0.2	ND
Chromium	52.4	52.1	<0.5	<0.5	ND
Copper	1.8	1.9	<1	<1	ND
Lead	<0.1	<0.1	<0.2	<0.2	ND
Mercury	<0.1	<0.1	<0.1	<0.1	ND
Nickel	21.8	22.1	<0.5	<0.5	ND
Silver	<0.1	<0.1	<0.1	<0.1	ND
Zinc	6	7	<5	<5	ND
Tributyltin (ngSn/L)	<2	<2	<2	<2	ND
Chlorophyll *a*	<0.02	<0.02	0.67	0.53	23.3

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2228447**	Page	: 1 of 6
Client	: **VISION ENVIRONMENT ANZ**	Laboratory	: Environmental Division Brisbane
Contact	: FELICITY MELVILLE	Contact	: Customer Services EB
Address	: OFFICE 3 165 AUCKLAND STREET GLADSTONE 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Maintenance Dredge	Date Samples Received	: 29-Sep-2022 10:30
Order number	: ----	Date Analysis Commenced	: 30-Sep-2022
C-O-C number	: ----	Issue Date	: 07-Oct-2022 12:59
Sampler	: Lucy Georgiou		
Site	: ----		
Quote number	: BN/327/22		
No. of samples received	: 8		
No. of samples analysed	: 8		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Don Sirimanne	Senior Biologist - Water	Microbiology / Biology, Fyshwick, ACT
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Matt Frost	Assistant Laboratory Manager	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG093-F (Dissolved Metals in Saline Water by ORC-ICP-MS): The high failing laboratory control standard for Aluminium is deemed acceptable as all results are less than the limit of reporting.
- EG093: Samples containing high levels of sulfate may precipitate barium under the acidic conditions of this method and may therefore bias results low.

Analytical Results

Sub-Matrix: **FRESH WATER** (Matrix: **WATER**)				Sample ID	**FB**	**LB**	**----**	**----**	**----**
				Sampling date / time	27-Sep-2022 00:00	27-Sep-2022 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EB2228447-007**	**EB2228447-008**	**--------**	**--------**	**--------**
					Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	**----**	**----**	**----**
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	<5	**----**	**----**	**----**
Cadmium	7440-43-9	0.05	µg/L		<0.05	<0.05	**----**	**----**	**----**
Chromium	7440-47-3	0.2	µg/L		<0.2	<0.2	**----**	**----**	**----**
Copper	7440-50-8	0.5	µg/L		<0.5	<0.5	**----**	**----**	**----**
Lead	7439-92-1	0.1	µg/L		<0.1	<0.1	**----**	**----**	**----**
Nickel	7440-02-0	0.5	µg/L		<0.5	<0.5	**----**	**----**	**----**
Silver	7440-22-4	0.1	µg/L		<0.1	<0.1	**----**	**----**	**----**
Zinc	7440-66-6	1	µg/L		<1	<1	**----**	**----**	**----**
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	<2	**----**	**----**	**----**
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		<0.02	<0.02	**----**	**----**	**----**
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**99.3**	**88.3**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: **SEAWATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	NW70	WB50	IH15 - A	IH15 - B	MH40
				Sampling date / time	27-Sep-2022 00:00	27-Sep-2022 00:00	27-Sep-2022 00:00	27-Sep-2022 00:00	27-Sep-2022 00:00
					EB2228447-001	EB2228447-002	EB2228447-003	EB2228447-004	EB2228447-005
					Result	Result	Result	Result	Result
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	<5	<5	<5	<5
Cadmium	7440-43-9	0.2	µg/L		<0.2	<0.2	<0.2	<0.2	<0.2
Chromium	7440-47-3	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Copper	7440-50-8	1	µg/L		<1	<1	<1	<1	<1
Lead	7439-92-1	0.2	µg/L		<0.2	<0.2	<0.2	<0.2	<0.2
Nickel	7440-02-0	0.5	µg/L		**0.7**	<0.5	<0.5	**0.5**	<0.5
Silver	7440-22-4	0.1	µg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	5	µg/L		<5	<5	<5	<5	<5
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	<2	<2	<2	<2
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		**1.61**	**1.98**	**1.27**	**1.29**	**0.94**
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**85.6**	**84.8**	**101**	**87.7**	**80.6**

Analytical Results

Sub-Matrix: SEAWATER (Matrix: WATER)				Sample ID	MH50	----	----	----	----
				Sampling date / time	27-Sep-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2228447-006	--------	--------	--------	--------
					Result	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	----	----	----	----
Cadmium	7440-43-9	0.2	µg/L		<0.2	----	----	----	----
Chromium	7440-47-3	0.5	µg/L		<0.5	----	----	----	----
Copper	7440-50-8	1	µg/L		<1	----	----	----	----
Lead	7439-92-1	0.2	µg/L		<0.2	----	----	----	----
Nickel	7440-02-0	0.5	µg/L		<0.5	----	----	----	----
Silver	7440-22-4	0.1	µg/L		<0.1	----	----	----	----
Zinc	7440-66-6	5	µg/L		<5	----	----	----	----
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	----	----	----	----
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		**0.54**	----	----	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**88.7**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **FRESH WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	24	116

Sub-Matrix: **SEAWATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	24	116

Inter-Laboratory Testing

Analysis conducted by ALS Canberra, NATA accreditation no. 992.

(WATER) EP008CA: Chlorophyll a

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2231402**	Page	: 1 of 6
Client	: **VISION ENVIRONMENT ANZ**	Laboratory	: Environmental Division Brisbane
Contact	: FELICITY MELVILLE	Contact	: Customer Services EB
Address	: OFFICE 3 165 AUCKLAND STREET GLADSTONE 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Maintenance Dredge	Date Samples Received	: 25-Oct-2022 10:00
Order number	: ----	Date Analysis Commenced	: 26-Oct-2022
C-O-C number	: ----	Issue Date	: 03-Nov-2022 09:15
Sampler	: LUCY GEORGIOU		
Site	: ----		
Quote number	: BN/327/22		
No. of samples received	: 8		
No. of samples analysed	: 8		

Accreditation No. 825
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Signatories	*Position*	*Accreditation Category*
Don Sirimanne	Senior Biologist - Water	Microbiology / Biology, Fyshwick, ACT
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Matt Frost	Assistant Laboratory Manager	Brisbane Organics, Stafford, QLD

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Where moisture determination has been performed, results are reported on a dry weight basis.

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Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG093: Samples containing high levels of sulfate may precipitate barium under the acidic conditions of this method and may therefore bias results low.

Analytical Results

Sub-Matrix: **FRESH WATER** (Matrix: **WATER**)				Sample ID	**FB**	**LB**	**----**	**----**	**----**
				Sampling date / time	24-Oct-2022 00:00	24-Oct-2022 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EB2231402-007**	**EB2231402-008**	**--------**	**--------**	**--------**
					Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	**----**	**----**	**----**
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	<5	**----**	**----**	**----**
Cadmium	7440-43-9	0.05	µg/L		<0.05	<0.05	**----**	**----**	**----**
Chromium	7440-47-3	0.2	µg/L		<0.2	<0.2	**----**	**----**	**----**
Copper	7440-50-8	0.5	µg/L		<0.5	<0.5	**----**	**----**	**----**
Lead	7439-92-1	0.1	µg/L		<0.1	<0.1	**----**	**----**	**----**
Nickel	7440-02-0	0.5	µg/L		<0.5	<0.5	**----**	**----**	**----**
Silver	7440-22-4	0.1	µg/L		<0.1	<0.1	**----**	**----**	**----**
Zinc	7440-66-6	1	µg/L		<1	<1	**----**	**----**	**----**
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	<2	**----**	**----**	**----**
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**106**	**103**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: **SEAWATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	NW70	WB50	IH15	MH40	MH50 - A
				Sampling date / time	24-Oct-2022 00:00	24-Oct-2022 00:00	24-Oct-2022 00:00	24-Oct-2022 00:00	24-Oct-2022 00:00
					EB2231402-001	EB2231402-002	EB2231402-003	EB2231402-004	EB2231402-005
					Result	Result	Result	Result	Result
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	<5	<5	<5	<5
Cadmium	7440-43-9	0.2	µg/L		<0.2	<0.2	<0.2	<0.2	<0.2
Chromium	7440-47-3	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Copper	7440-50-8	1	µg/L		<1	<1	<1	<1	<1
Lead	7439-92-1	0.2	µg/L		<0.2	<0.2	<0.2	<0.2	<0.2
Nickel	7440-02-0	0.5	µg/L		**0.5**	**0.5**	<0.5	<0.5	<0.5
Silver	7440-22-4	0.1	µg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	5	µg/L		<5	<5	<5	<5	<5
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	<2	<2	<2	<2
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		**1.26**	**1.39**	**1.37**	**1.40**	**0.94**
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**88.7**	**102**	**82.0**	**105**	**106**

Analytical Results

Sub-Matrix: SEAWATER (Matrix: WATER)				Sample ID	MH50 - B	FB	LB	----	----
				Sampling date / time	24-Oct-2022 00:00	24-Oct-2022 00:00	24-Oct-2022 00:00	----	----
Compound	CAS Number	LOR	Unit		EB2231402-006	EB2231402-007	EB2231402-008	--------	--------
					Result	Result	Result	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	----	----	----	----
Cadmium	7440-43-9	0.2	µg/L		<0.2	----	----	----	----
Chromium	7440-47-3	0.5	µg/L		<0.5	----	----	----	----
Copper	7440-50-8	1	µg/L		<1	----	----	----	----
Lead	7439-92-1	0.2	µg/L		<0.2	----	----	----	----
Nickel	7440-02-0	0.5	µg/L		<0.5	----	----	----	----
Silver	7440-22-4	0.1	µg/L		<0.1	----	----	----	----
Zinc	7440-66-6	5	µg/L		<5	----	----	----	----
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	----	----	----	----
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		**0.81**	<0.02	**0.02**	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**78.8**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **FRESH WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	24	116

Sub-Matrix: **SEAWATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	24	116

Inter-Laboratory Testing

Analysis conducted by ALS Canberra, NATA accreditation no. 992.

(WATER) EP008CA: Chlorophyll a

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2234743**	Page	: 1 of 6
Client	: **VISION ENVIRONMENT ANZ**	Laboratory	: Environmental Division Brisbane
Contact	: FELICITY MELVILLE	Contact	: Customer Services EB
Address	: OFFICE 3 165 AUCKLAND STREET GLADSTONE 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Maintenance Dredge	Date Samples Received	: 23-Nov-2022 11:15
Order number	: ----	Date Analysis Commenced	: 25-Nov-2022
C-O-C number	: ----	Issue Date	: 02-Dec-2022 13:45
Sampler	: LUCY GEORGIOU		
Site	: ----		
Quote number	: BN/327/22		
No. of samples received	: 8		
No. of samples analysed	: 8		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Don Sirimanne	Senior Biologist - Water	Microbiology / Biology, Fyshwick, ACT
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Timothy Creagh	2IC Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG093F (Dissolved Metals in Saline Water by ORC-ICP-MS): Limit of reporting raised for WB50 (EB2234743-002) due to matrix interference.
- EG093: Samples containing high levels of sulfate may precipitate barium under the acidic conditions of this method and may therefore bias results low.

Analytical Results

Sub-Matrix: **FRESH WATER** (Matrix: **WATER**)			Sample ID	**FB**	**LB**	**----**	**----**	**----**
			Sampling date / time	21-Nov-2022 00:00	21-Nov-2022 00:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2234743-007**	**EB2234743-008**	**--------**	**--------**	**--------**
				Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	**----**	**----**	**----**
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS								
Aluminium	7429-90-5	5	µg/L	**38**	**40**	**----**	**----**	**----**
Cadmium	7440-43-9	0.05	µg/L	<0.05	<0.05	**----**	**----**	**----**
Chromium	7440-47-3	0.2	µg/L	**52.4**	**52.1**	**----**	**----**	**----**
Copper	7440-50-8	0.5	µg/L	**1.8**	**1.9**	**----**	**----**	**----**
Lead	7439-92-1	0.1	µg/L	<0.1	<0.1	**----**	**----**	**----**
Nickel	7440-02-0	0.5	µg/L	**21.8**	**22.1**	**----**	**----**	**----**
Silver	7440-22-4	0.1	µg/L	<0.1	<0.1	**----**	**----**	**----**
Zinc	7440-66-6	1	µg/L	**6**	**7**	**----**	**----**	**----**
EP090: Organotin Compounds (Soluble)								
Tributyltin	56573-85-4	2	ngSn/L	<2	<2	**----**	**----**	**----**
EP008CA: Chlorophyll a								
Chlorophyll a	----	0.02	µg/L	<0.02	<0.02	**----**	**----**	**----**
EP090S: Organotin Surrogate								
Tripropyltin	----	5	%	**75.7**	**90.3**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: **SEAWATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	NW70	WB50	IH15	MH40 - A	MH40 - B
				Sampling date / time	21-Nov-2022 00:00	21-Nov-2022 00:00	21-Nov-2022 00:00	21-Nov-2022 00:00	21-Nov-2022 00:00
					EB2234743-001	EB2234743-002	EB2234743-003	EB2234743-004	EB2234743-005
					Result	Result	Result	Result	Result
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		**8**	**11**	**8**	**8**	**8**
Cadmium	7440-43-9	0.2	µg/L		<0.2	<0.5	<0.2	<0.2	<0.2
Chromium	7440-47-3	0.5	µg/L		<0.5	<2.5	<0.5	<0.5	<0.5
Copper	7440-50-8	1	µg/L		<1	<5	<1	<1	<1
Lead	7439-92-1	0.2	µg/L		<0.2	<1.0	<0.2	<0.2	<0.2
Nickel	7440-02-0	0.5	µg/L		**0.8**	**9.4**	**0.6**	<0.5	<0.5
Silver	7440-22-4	0.1	µg/L		<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	7440-66-6	5	µg/L		<5	<25	<5	<5	<5
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	<2	<2	<2	<2
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		**1.32**	**1.45**	**0.92**	**0.67**	**0.53**
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**69.4**	**106**	**94.0**	**44.6**	**72.0**

Analytical Results

Sub-Matrix: SEAWATER (Matrix: WATER)				Sample ID	MH50	----	----	----	----
				Sampling date / time	21-Nov-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2234743-006	--------	--------	--------	--------
					Result	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		**8**	----	----	----	----
Cadmium	7440-43-9	0.2	µg/L		<0.2	----	----	----	----
Chromium	7440-47-3	0.5	µg/L		<0.5	----	----	----	----
Copper	7440-50-8	1	µg/L		<1	----	----	----	----
Lead	7439-92-1	0.2	µg/L		<0.2	----	----	----	----
Nickel	7440-02-0	0.5	µg/L		<0.5	----	----	----	----
Silver	7440-22-4	0.1	µg/L		<0.1	----	----	----	----
Zinc	7440-66-6	5	µg/L		<5	----	----	----	----
EP090: Organotin Compounds (Soluble)									
Tributyltin	56573-85-4	2	ngSn/L		<2	----	----	----	----
EP008CA: Chlorophyll a									
Chlorophyll a	----	0.02	µg/L		**0.39**	----	----	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	5	%		**85.1**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **FRESH WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	24	116

Sub-Matrix: **SEAWATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP090S: Organotin Surrogate			
Tripropyltin	----	24	116

Inter-Laboratory Testing

Analysis conducted by ALS Canberra, NATA accreditation no. 992.

(WATER) EP008CA: Chlorophyll a