Gladstone Marina Maintenance Dredging Alternative Dredged Sediment Management Monitoring Plan

Customer	Gladstone Ports Corporation
Project	A11723
Deliverable	002
Version	01
	30 May 2022

Document Control

Document Identification

Title	Gladstone Marina Maintenance Dredging Alternative Dredged Sediment Management Monitoring Plan
Project No	A11723
Deliverable No	002
Version No	01
Version Date	30 May 2022
Customer	Gladstone Ports Corporation
Classification	BMT (OFFICIAL)
Synopsis	A plan for monitoring suspended sediment plumes during Gladstone Marina maintenance dredging activities to validate the environmental impact assessment.

Author	Dr Paul Guard
Reviewed By	Dr Darren Richardson
Project Manager	Dr Paul Guard

Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
1	30 May 2022	GPC	Draft
2	02 June 2022	GPC	Updated Plan

Contents

Figures

1 Introduction

1.1 Background

Gladstone Ports Corporation Limited (GPC) is responsible for maintenance dredging at the Port of Gladstone (PoG). The maintenance dredged material from the shipping channels is currently disposed at sea at the East Banks Sea Disposal Site (EBSDS) in accordance with Sea Dumping Permits issued by the Commonwealth Department of the Agriculture, Water and the Environment (DAWE). Although it can be taken to the EBSDS, historically the dredged material from the Gladstone Marina has been placed on land, and this disposal site is reaching capacity.

GPC is proposing to trial the alternative beneficial reuse of maintenance dredging material as part of the Sustainable Sediment Management Project. One proposed option involves an alternative in-channel Dredge Material Placement Area (DMPA) option for relocation of predominantly fine dredged sediment from the Gladstone Marina. The proposed dredging activity involves the use of a Cutter Suction Dredge (CSD) working in the Marina, pumping a slurry of dredged sediment to a discharge location on the edge of the Clinton Channel (see Figure 1.1 for the location).

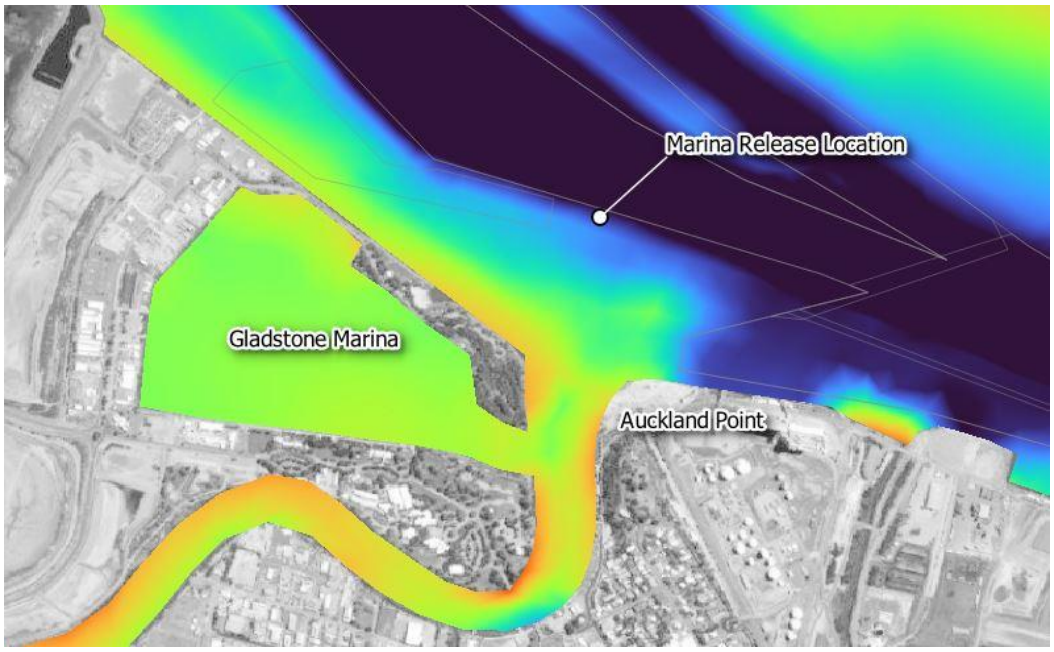


Figure 1.1 Marina Sediment Relocation Outlet

BMT undertook a predictive environmental assessment of potential maintenance dredging impacts to marine waters associated with the alternative relocation of material from the Marina, with two (2) different levels of placement at the Clinton Channel Placement Area (BMT, 2021a). The environmental assessment was based on desktop assessments involving the review and analysis of existing information, and hydrodynamic modelling. This study used the same methodology as the most recent assessment of regular maintenance dredging activities at the PoG (BMT, 2021b).

Numerical modelling (BMT 2021a) concluded that:

- Spatial and temporal extent of plumes – modelling indicates that turbid plumes will be short-term features (measured in tens to hundreds of minutes duration) of limited spatial extent (largely within and directly adjacent to dredged areas).

- Plume behaviour – dredge plumes primarily migrate with tidal currents and are mostly maintained within channels. Any increase in turbidity at nearby seagrass meadows was predicted to be short-term and therefore not at a level where impacts could occur.

1.2 Objectives of this Monitoring Plan

The aim of this monitoring plan is to describe field work activities that will collect appropriate data to validate the results of the plume dispersion modelling and impact assessment work described above.

The objectives of this study are to:

1. Measure sediment concentrations in plumes created during dredging and sediment relocation activities, their dispersion and extent, and their degradation over time.
2. Validate the numerical modelling results presented in the impact assessment study (BMT, 2021a).
3. Confirm that the conclusions of the environmental impact assessment are valid, i.e. that sediment plumes created by dredging and relocation of dredged sediment are unlikely to cause impacts to sensitive marine habitats such as seagrass and reef communities.

2 Field Work Activities

2.1 Synopsis

- **Scope** - The proposed field activities involve the measurement of suspended sediment properties (longevity and extent) in turbid plumes generated by dredging and the relocation of dredged sediment. In addition, self-logging instrumentation will be deployed at fixed locations to measure time series of turbidity and suspended sediment concentration before and during the dredging activity.

- **Timeframes and Location:**

  - Fixed turbidity and suspended sediment concentration instrumentation will be deployed for two (2) weeks prior to the commencement of dredging and will continue for two (2) weeks during dredging.
  - A plume measurement campaign involving:
    - three (3) days of boat-based field measurements. One (1) day of baseline measurement will be conducted, followed by two (2) days of plume monitoring while material is being pumped and discharged at the Clinton Channel Placement Area.
    - sampling on neap tides when ambient TSS concentrations are typically lowest. This will maximise the capacity for plumes to be detected above background.

- **Methodology:**

  - The boat-based field work will primarily involve the indirect measurement of sediment concentrations using an Acoustic Doppler Current Profiler (ADCP) instrument, together with collection of water samples for laboratory analysis of total suspended solids (TSS) and particle size distribution (PSD), and *in situ* measurement of water quality profiles using Optical Back Scatter (OBS) and Laser In-Situ Scattering Transmissometry (LISST) measurement instruments. The ADCP measures acoustic backscatter in the water column, which is converted to an equivalent TSS using a detailed calibration procedure (refer to Section 2.3). Sampling will be undertaken in accordance with the Queensland Water Monitoring and Sampling Manual (DES, 2018), where applicable.
  - the fixed instrument component will involve the deployment of turbidity (NTU) and suspended sediment (LISST) measurement equipment up-current and down-current of the relocation site. Measurements will be collected at 15-minute intervals to develop turbidity and suspended sediment concentration time series.

Methodology Summary	
Field Work	Technical Report
Liaise with dredging contractor and GPC on timing	Present monitoring data
Mobilise field team and carry out monitoring tasks	Validate model predictions and assess any potential impacts on sensitive receptors
Complete lab testing and process collected data	

2.2 Fixed Monitoring Stations

The objectives of this component are to:

- quantify temporal patterns in turbidity at two fixed sites located near the relocation site.
- determine the frequency/duration of any periods of high turbidity, and whether these turbidity spikes are coincident with dredging activities.
- on the basis of the measurements, evaluate whether periods of high turbidity potentially attributable to dredging activities are consistent with the numerical modelling results.

Patterns in turbidity will be monitored at two (2) fixed monitoring stations located approximately 500 m to the northwest and 500 m to the southeast of the dredge relocation site (see Figure 2.1 for approximate locations). The instruments will be deployed for two (2) weeks prior to the commencement of dredging and will continue measurements for two (2) weeks during the dredging/pumping activity.

The fixed instrumentation will consist of a LISST (measuring suspended sediment concentrations) and two (2) sondes measuring turbidity levels. The instruments will measure turbidity and suspended sediment concentrations at 15-minute intervals. The instruments will be deployed on benthic frames on the seafloor, near the top of the batter of the shipping channel.

The measured time series data will be compared to equivalent model output time series to determine whether the magnitude and frequency of the potential dredging-related signal is consistent with the model outputs. Any inconsistencies will be identified, and any implications for the conclusions of the impact assessment will be discussed.

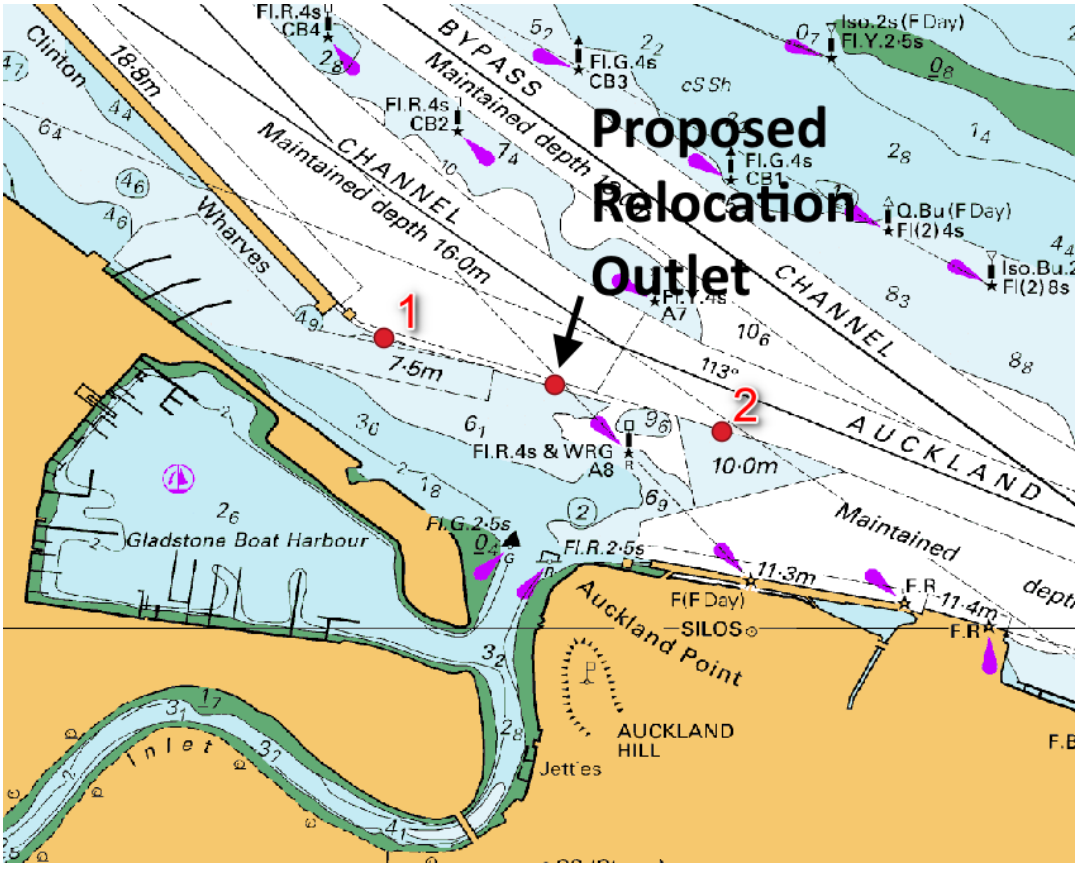


Figure 2.1 Proposed Approximate Locations for Fixed Turbidity and Suspended Sediment Concentration Monitoring (Locations 1 and 2)

2.3 Plume Tracking

The objectives of this component are to:

- quantify two-dimensional (through the water column and perpendicular to the visible plume) patterns in dredge plume properties and persistence.
- produce a 'map' of typical plume extents based on the measurements.

Baseline Data Collection

The baseline monitoring will be undertaken as part of the same field work campaign as the plume measurements. Baseline measurements will be undertaken before the dredge commences work (if possible), or alternatively at a location sufficiently far away and therefore unaffected by dredge activity. The baseline assessment is proposed to include:

- Two-dimensional (through the water column along a transect) profiles of suspended sediment concentrations using ADCP measurements of acoustic backscatter (see below for methodology).
- Collection of 15 water samples from various depths along the ADCP transects using a van Dorn water sampler and/or pump system. All samples will be analysed for Total Suspended Solids concentration by a NATA accredited laboratory. Five (5) of these samples will be analysed for particle size distribution of suspended sediments by a NATA accredited laboratory.
- *In situ* measurements of physical water quality parameters through the water column on the ADCP transects, using an Optical Back Scatter (OBS) instrument and LISST instrument (TSS and PSD). Refer below for methodology.

Plume Measurements

Based on a review of literature and experience undertaking similar monitoring programs for the Cairns Shipping Development Project and Gladstone Clinton Vessel Interaction Project, the following monitoring approach is proposed for the monitoring of the alternative relocation of maintenance dredging material at the Port of Gladstone.

The proposed field component of the monitoring program will begin shortly after the commencement of the dredging program. This will involve ADCP transects, water sampling and water quality profiling measurements in daylight hours during dredging. Vessel based monitoring will be undertaken over two (2) full days, monitoring while material is being pumped through the discharge location adjacent to the Clinton Channel. While the focus of the monitoring will be on the plumes generated at the relocation location, some measurement of plumes generated during the dredging activity within the Marina will also be included if time and resources permit.

The vessel-based transecting will be the platform for a number of monitoring techniques, including; water column sampling and subsequent laboratory analysis, discrete profiling with optical backscatter instrument/s and continuous acoustic profiling with the ADCP. The proposed techniques are described in further detail below.

The vessel-based plume monitoring will primarily target the sampling of cross-sections through the dredge plume at transects positioned down-current of the pipeline discharge location, and will seek to characterise the extents of the plume and the sediment concentration within the plume as it advects and disperses following discharge. Transects will be undertaken repeatedly across the plume as it migrates, and where possible the cross-sections will start and finish outside the plume extent.

Profiling of the water column using LISST and OBS instruments will be performed from the vessel at various times, with approximately one (1) profile for every two (2) transects. This will ensure that there

is sufficient profile data to enable ADCP calibration, while also allowing some transects to be uninterrupted by any profiling activity. The LISST profiling instrument measures the volumetric concentration of suspended solids along with the associated in-situ Particle Size Distribution (PSD). The OBS provides an alternative measure of suspended sediment concentration in Nephelometric Turbidity Units (NTU). Laboratory analysis of the water samples will measure the dry weight concentration of Total Suspended Solids (in mg/L) as well as laser particle sizing analysis (down to 2 micron) for select samples. The laboratory TSS will be used to convert the LISST and OBS instrument measurements to TSS units. The converted LISST and OBS profile datasets will subsequently be used to derive a calibration relationship for the calculation of TSS concentration from measured ADCP backscatter intensity. Samples will be collected at various depths, within and outside the dredge plumes at various locations from the dredge in order that a full range of TSS is sampled, including samples that represent the background (ambient) conditions.

The monitoring will be undertaken when the dredge is operating at a typical production rate, so that the measured plume dispersion is representative of the overall dredging and relocation operation. The monitoring campaign will involve two (2) full days of vessel-based monitoring with at least 30 transects measured and 20 water samples collected for laboratory analysis per day.

The ADCP will provide the most comprehensive set of measurements used to provide the quantitative dredge plume estimates, however the calculation of TSS from the ADCP backscatter signal requires calibration using the data collected by the LISST, OBS and water column sampling. The ADCP continuously samples the water column across each monitoring transect, and during the discrete profile measurements to enable calibration of the TSS calculation algorithm.

Data Processing

Following the vessel-based monitoring campaign, processing of the data will be completed in the office and would include:

- Calibration and conversion of OBS NTU to TSS;
- Calibration and conversion of LISST volumetric concentration to TSS;
- Processing of ADCP data, including:
  (1) Calibration of ADCP backscatter to TSS-estimate;
  (2) Censoring of ADCP data corrupted by entrained bubbles;
  (3) Calculation of above-ambient TSS associated with each transect;
  (4) Calculation of transect above-ambient TSS flux associated with the relocation discharge plume.

A map of the measured depth-averaged above-ambient TSS will be produced from the collation of the data from monitoring the pipe discharge. This map will indicate the typical extent and concentration of the plumes associated with the alternative dredged sediment relocation activity. Comparisons will be made with the output of the numerical modelling presented in the environmental impact assessment (BMT, 2021a). BMT will follow standard QA/QC procedures in accordance with the Queensland Water Monitoring and Sampling Manual (DES, 2018).

2.4 Field Work Planning and Coordination

Comprehensive planning and co-ordination with the dredging contractor will be undertaken to ensure that dredging is undertaken during daylight hours under the tidal conditions with the highest risk of potential impacts at the nearest sensitive marine communities.

3 Technical Report

Based upon the monitoring data collected, a report will be prepared detailing the monitoring program methodology and the measured water quality impacts of the alternative relocation of maintenance dredging material based on the results of the field campaign (both fixed time series measurements and boat-based transect measurements). The report will discuss any differences between the measured suspended sediment plumes and those that were anticipated in the impact assessment for the activity. The comparisons will include estimates of the release rate (spill budget) associated with the dredged sediment relocation activity, as well as the temporal and spatial evolution of the plumes released following discharge in relation to nearby sensitive receptor locations.

The report will assess whether the measured plume characteristics are consistent with the modelling results presented in the environmental impact assessment (BMT, 2021a). If the agreement is good then the conclusions of the impact assessment will be confirmed. If the results indicate that revision of the modelling is required, additional work will be undertaken to assess the overall impact of the alternative sediment relocation activity and provide guidance on any mitigation measures that may be needed for future dredging programs to minimise impacts to nearby sensitive marine communities.

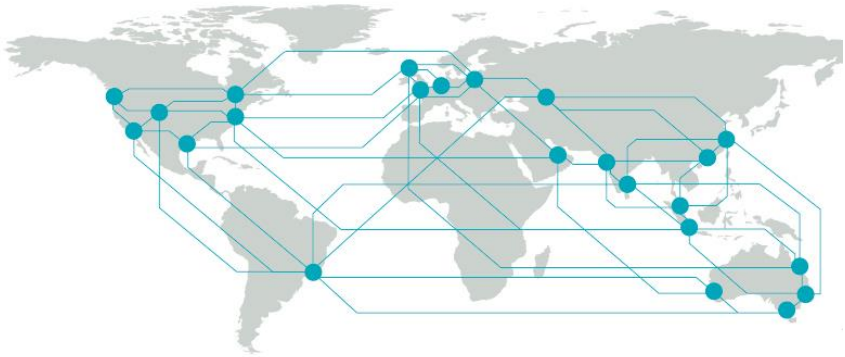
The draft technical report should be completed within two (2) months of the completion of all field work.

4 References

BMT, 2021a. Gladstone Marina Maintenance Dredging Impact Assessment. Report prepared for Gladstone Ports Corporation, December 2021.

BMT, 2021b. Port of Gladstone Maintenance Dredging Impact Assessment. Report prepared for Gladstone Ports Corporation, August 2021.

DES, 2018. Monitoring and Sampling Manual: Environmental Protection (Water) Policy. Brisbane: Department of Environment and Science Government.



BMT is a leading design, engineering, science and management consultancy with a reputation for engineering excellence. We are driven by a belief that things can always be better, safer, faster and more efficient. BMT is an independent organisation held in trust for its employees.

Level 5
348 Edward Street
Brisbane
QLD 4000
Australia
+61 7 3831 6744

Registered in Australia
Registered no. 010 830 421
Registered office
Level 5, 348 Edward Street,
Brisbane QLD 4000 Australia

For your local BMT office visit www.bmt.org

Contact us

enquiries@bmtglobal.com

www.bmt.org

Follow us

www.bmt.org/linkedin

www.bmt.org/youtube

www.bmt.org/twitter

www.bmt.org/facebook