6

WHARF

WATER QUALITY MANAGEMENT PLAN

HBRC Certified July 2019

NAPIER PORT

DOCUMENT CONTROL

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ASSOCIATION	
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MANA WHENUA HAPŪ	YES

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CONSENT CL180009E – REFERENCES

CONDITION	PAGE REFERENCE WITHIN THE PLAN
11 (a)	Page 16. Tiered Trigger System
11 (b)	Page 11. Pania Reef Turbidity Monitoring
11 (c)	Page 10. Sensitive Receptors – Town Reef/Others
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11 (e)	Page 17. Water Quality Trigger Level Flowchart
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11 (j)	Page 23. Benthic Surveys

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List of Abbreviations

ADM	Adaptive Dredge Management
BHD	Backhoe Dredger
EWMA	Exponentially Weighted Moving Average
HBRC	Hawkes Bay Regional Council
NTU	Nephelometric Turbidity Units
ODA	Off-shore Disposal Area
PAR	Photosynthetically active radiation
QA	Quality Assurance
QC	Quality Control
SSC	Suspended Sediment Concentration
TSHD	Trailing Suction Hopper Dredger
TSS	Total Suspended Solids
VDV	Vista Data Vision
WQMP	Water Quality Management Plan

Fisheries Liaison Group input

The Water Quality Management Plan (WQMP) originally submitted with the Resource Consent Application has now been updated following the granting of the consents in November 2018.

Napier Port has provided the Fisheries Liaison Group (FLG) the opportunity to provide input into WQMP.

Napier Port shall provide any written recommendations from the FLG to the Hawke's Bay Regional Council (Manager Compliance) at the same time the management plan requiring certification is lodged with an explanation as to how the recommendations (from the FLG) have been included in the plan, and if they have not, the reasons why.

1. INTRODUCTION

1.1. GENERAL BACKGROUND

This Water Quality Management Plan (WQMP) has been developed for Napier Port's 6 Wharf and Dredging Project to manage the impacts of turbidity generated by the Project dredging activities, in particular at Pania Reef which Napier Port recognises as being both environmentally and culturally significant to the local region.

This WQMP covers the dredging and disposal activities, specifically:

- The dredging associated with creation of the berth pocket and swing basin
- The dredging associated with the widening and lengthening of the approach channel.
- Approximately 3.2 Mm^3 of dredge material will be dredged from the Project area.
- Disposal of dredge material at the offshore disposal area, approximately 5km east of the port.

1.2. PROJECT AREA AND LOCATION

Figure 1 shows the dredge footprint for all stages of the Project. *Figure 2* shows the offshore disposal area for the Project.

1.3. PURPOSE OF WQMP

The purpose of the WQMP is to manage the potential ecological and water quality impacts of the Project.

This Plan also has the aim of limiting and managing the impact of turbidity on sensitive receptors, in particular at Pania Reef.

The Plan will also act as a reference, to guide and provide Key Performance Indicators (KPI's) for the Port's Project Management Team and Contractors working on dredging and offshore disposal activities for the Project.

Outputs of the WQMP will provide input into the Marine Cultural Health Programme (MCHP), and similarly the MCHP may provide inputs into any future modifications to the WQMP.

1.4. REVIEW OF WQMP

The Plan will be reviewed annually after initial certification by HBRC for the first five years as a minimum.

1.5. OBJECTIVES

The objectives of this Plan are to:

- Manage the impacts of the Projects activities on water quality.

- Implement an integrated plan which incorporates ongoing research and monitoring programs for the management of water quality impacts, due to dredging and disposal activities
- Develop and implement a monitoring program for dredging and disposal activities that includes the health of Pania Reef.

1.6. KEY PERFORMANCE OBJECTIVES

The Key Performance Objectives of this Plan include:

- No exceedance of environmental limits as a result of suspended sediment from dredging and disposal of dredge spoil associated with Project above the increases predicted by the dredge plume modelling.
- Assurance that significant ecological effects attributable to the Project are not occurring on Pania Reef, shoreline reef areas or their environs, or within and adjacent to the disposal area.

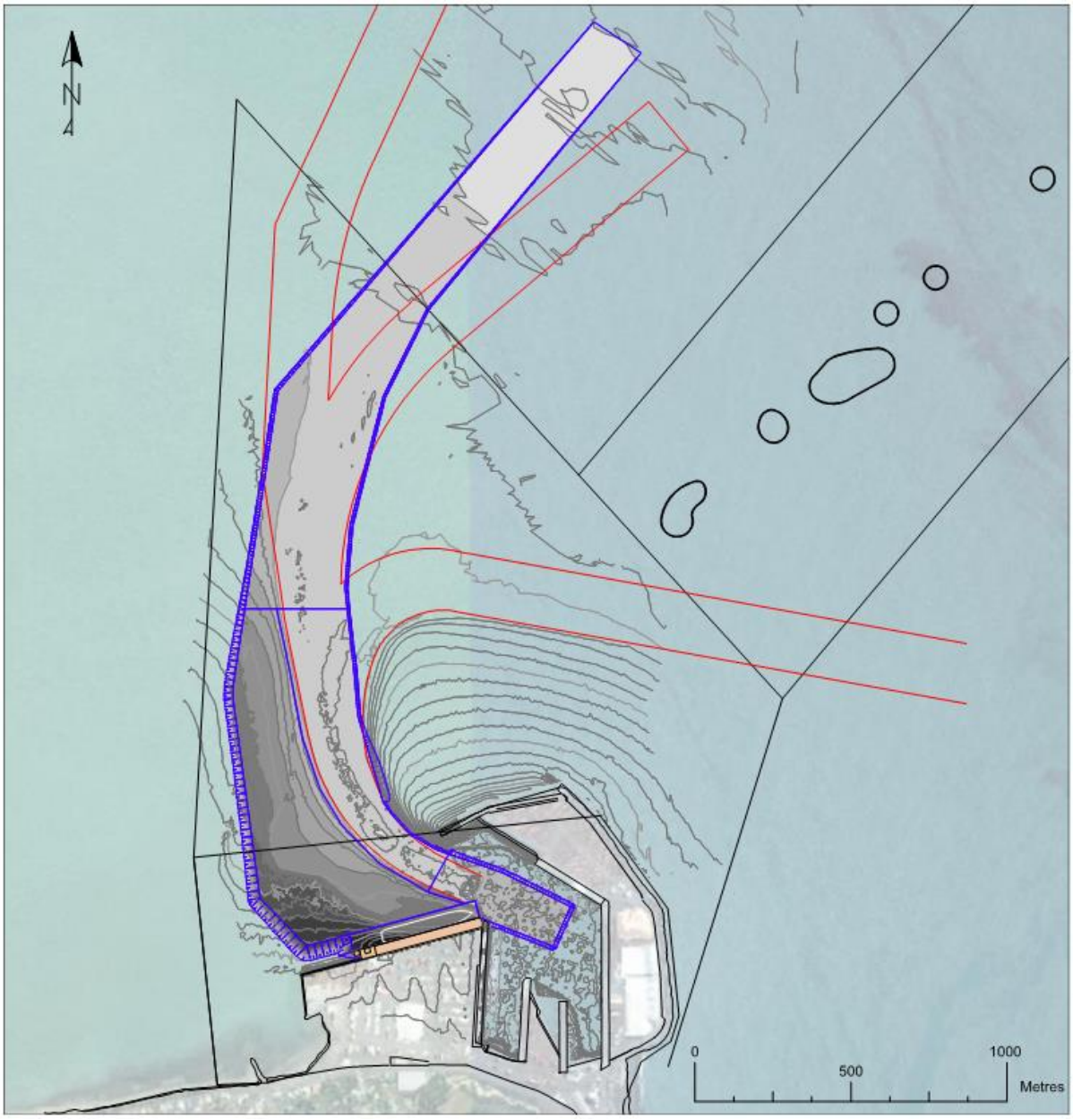

Figure 1 – Location of dredging activities

Figure 2 - Offshore Disposal Area

1.7. SPECIFIC CONDITIONS OF RESOURCE CONSENT CL180009E

Condition – 10: A Water Quality Management Plan (WQMP) for the integrated management of sediment plumes and turbidity, and monitoring of benthic ecological effects, shall be provided as an appendix to the DDMP. The WQMP shall be part of the documentation certified by the Council prior to this stage of the capital dredging commencing (Stage 1).

Condition – 11: The WQMP shall include, but not be limited to:

(a) Establishment of appropriate environmental limits (specified as turbidity at specified locations) in the water column during and immediately following dredging and disposal activities.
(b) Specifying methods of measuring and determining turbidity levels at any time.

(c) Identification of sensitive localities, if any, at which longer-term ecological monitoring is required (other than at Pānia Reef (see (f) below).
(d) Linking of the specified environmental limits to pre-determined response steps through trigger levels and environmental response levels.
(e) Establishing reporting of trigger exceedances, including any response if the exceedance is determined to be due to dredging or disposal of dredged material.
(f) A detailed programme of dive surveys relating to Pānia Reef, to commence within six months of the commencement of consent, and to continue until completion of Stage 5 dredging.
(g) A detailed programme of benthic surveys in and around the disposal location prior to and following completion of Stage 1 dredging.
(h) Reporting requirements for the various components of the WQMP.
(i) Sediment contaminant monitoring for the material being taken from the inner port basin, and at the proposed disposal site. As a minimum, contaminants should include the heavy metals/metalloids arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc.
(j) Sediment texture analysis and monitoring at the disposal site.

Any changes to a certified WQMP shall be discussed in advance with the Council and the change is to be submitted and certified prior to any activity associated with the change commencing.

2. MANA WHENUA ENGAGEMENT

A partnership with mana whenua hapū was formed during the consent application process. Engaging and fostering of this relationship resulted in a series of hui-a- hapū.

A cultural impact assessment report capturing the aspirations of mana whenua hapū was developed, along with the desire for cultural monitoring and information sharing.

The Napier Port, Pou Tikanga – Environmental and Cultural Advisor has established a mana whenua based committee as a part of the Marine Cultural Health Programme. The Advisor will be working in partnership with the mana whenua committee having specific regard to the environmental and cultural aspects of the 6 Wharf Project, including the Water Quality Management Plan.

A summary of the Water Quality Management Plan was provided at the inaugural Marine Cultural Health Programme hui conducted on the 10 April 2019 and 07 May 2019.

The following recommendations have been endorsed:

- Where practicable, an Iwi and/or committee member to assist as an observer/kaitiaki on survey's associated with this plan.
- The frequency and nature of any specific marine cultural health surveying and monitoring shall, where practicable, be carried out alongside other related surveying and monitoring of Pānia Reef.
- The committee provide input into the annual reviews of the Water Quality Management Plan.

3. KEY SENSITIVE RECEPTORS

3.1. PANIA REEF

Pania Reef has been identified as the key marine ecological receptor due to proximity, high ecological, cultural and amenity values and the very limited occurrence and extent of such habitats in southern Hawke Bay. The importance of the reef is supported through its identification as a Special Conservation Area.

While the key marine ecological receptor in the vicinity of the proposed project is Pania Reef, shoreline reef areas are also potentially vulnerable by virtue of proximity to plume propagation paths (Town Reef) or limited flushing characteristics (the embayment immediately west of the Port reclamation). While no soft sediment benthic habitats have been identified as being unique or limited in the wider area, these are potentially locally important as foraging grounds for recreationally and/or commercially targeted fisheries species. (Cawthron 2017).

Cawthron (2017) describes the potential impacts of elevated turbidity at the Reef:

Impacts to reef communities can result when sediment deposition occurs to the extent of covering over encrusting, sedentary or less-mobile biota. The amount of deposition required to lead to significant adverse effects will vary with the specific habitat and community assemblage. However, such smothering impacts generally do not occur in areas of high wave energy.

Pania Reef communities are accustomed to periodically elevated turbidity, but the exposure of the Reef to persistent wave action also ensures that sediments tend to remain in suspension until settlement can occur in quiescent zones in deeper waters. Even where silt veneers deposit on Reef surfaces during periods of high turbidity and calm conditions, these will be easily resuspended and removed by subsequent wave events hence variable silt conditions are part of the natural conditions of the Reef. This mechanism will prevent or limit the build-up of settled silt even under increased sediment loading from dredging plumes. At peak levels of suspended solids (from all sources), silt veneers may be more prevalent at lower energy sites on the Reef, but these will still be rapidly resuspended and dispersed by swell events.

High turbidity reduces light levels (as photosynthetically active radiation – PAR) reaching the seabed. When this is sustained, photosynthetic organisms can be adversely affected. On reefs, a reduction in PAR may affect structurally and trophically important seaweeds.

Reef-dwelling suspension feeders vary in their tolerance to suspended inorganic particulates based on their ability to selectively remove organic food particles to maintain growth. The predominant filter feeders observed on Pania Reef were green-lipped mussels (Perna canaliculus), ascidians and sponges, most of which are relatively tolerant of elevated concentrations of inorganic particulates.

All filter feeding bivalves are affected by the quality and quantity of seston. Mussels are relatively tolerant of high levels of suspended particulates, but feeding efficiency will be affected if the proportion of useable organic particulates relative to the inorganic fraction drops below a certain level.

Negative effects from sedimentation on the abundance of gastropod grazers have been documented in numerous observational and manipulative studies. Deposited sediment can impair the movement

and attachment of grazers. The reduction in grazing activity by sedimentation has been postulated as one of the mechanisms through which sedimentation controls algal structure on rocky shores.

Sedimentation plays a significant role in structuring rocky reef communities, both intertidal and subtidal. However, it is important to recognise that gradients in sedimentation rates and water turbidity are a natural feature of coastal systems. Specific areas of the New Zealand coast feature naturally large sediment loads (e.g. South Canterbury) and, increasingly, natural inputs are augmented by those associated with catchment modification.

Advisian (2017) reports that only isolated peaks of SSC above background of 1 mg/L are predicted to occur for the project with the predicted SSC above background remaining less than 5 mg/L for Stage 1 works and less than 7 mg/L above background for subsequent stages.

Cawthron (2017) observes that background concentrations of 10 mg/L may be reasonably typical of Reef waters, and this level may be considerably exceeded during swell or run off events and remain elevated for several days.

Cawthron (2017) also report that natural sediment deposition may be significant, especially at deeper points of the inshore Reef sections, and the project plumes predicted by Advisian (2017) are likely to add only incrementally to existing background deposition. The amount of sedimentation occurring naturally on the Reef will furthermore be in equilibrium from episodic events that lift and disperse material that has settled in calm periods. This mechanism will prevent or limit the build-up of settled silt even under increased sediment loading from dredging plumes. (Cawthron 2017).

3.2. TOWN REEF

Cawthron (2017) describes the potential impacts of elevated turbidity on Town Reef:

Town Reef is located adjacent to the base of the main Port breakwater at the northern end of Marine Parade Beach. It is approximately 2 km to the south of the proposed Fairway dredging operations and represents a well-flushed, high-energy environment due to considerable exposure to both wave action and along-shore currents. While not surveyed for this assessment, the ecological communities it supports are expected to be well-adapted to highly turbid conditions. Natural sediment transport processes operating at this exposed location are expected to be significant, with considerable volumes of shoreline and near-shore sediments likely to move through the area.

The orientation of the currents identified in the vicinity of the Port Fairway makes inshore areas more likely to experience elevated turbidity from the proposed dredging than Pania Reef, and this is a notable feature of the modelling outputs. However, Town Reef is at sufficient distance from the proposed dredging and spoil disposal operations that the SSC exceedance envelopes show potential exposure which is unlikely to be ecologically significant relative to expected background levels for this location.

The shoreline morphology at this location indicates no potential for sediment plumes to be entrained and trapped within the area of Town Reef and its shallow, wave-exposed nature is expected to preclude the accumulation of settled fine sediments.

3.3 OTHERS

Cawthron (2017) identified the Western Embayment as being potentially affected by elevated turbidity, however, it does not receive complete shelter from wave energy and would experience periodic flushing and disturbance as a result of storm and swell events. For this reason, while there is potential for short-term adverse ecological effects from increased fine sediment deposition to these areas if such conditions are sustained, shifts in community structure are unlikely to exceed those associated with natural perturbations and recovery is likely to occur within seasonal timeframes.

Rangitira Reef was similarly identified as being potentially affected, although Plume modelling conducted by Advisian indicated that this location would be unlikely to be exposed to SSC exceeding 10 mg/L above background and it is likely to be resilient to any sediment plume effects arising from the project.

4. BASELINE MONITORING

4.1. SEDIMENT CONTAMINANT MONITORING

Napier Port will conduct due diligence sediment sampling for metals from the material being taken from the inner Port Basin, and at the ODA. Contaminants to be tested include heavy metals/metalloids arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

There are no limits for compliance on the metal results however Napier Port will compare results to the Australian and New Zealand Guidelines for Marine Water Quality (ANZECC 2000).

4.2. PANIA REEF TURBIDITY MONITORING

Two fixed monitoring buoys have been deployed at Pania Reef as per table 1 below. These buoys have been deployed to assist in:

- Establishing the long term trends in turbidity.
- Establishing an understanding of drivers for fluctuations in turbidity.
- Establishing seasonal trends (if any).
- Establishing differences between the northern and southern portion of the reef.
- Establishing an appropriate set of trigger levels to inform operational response during dredging.

These buoys have been in position since February 2016 and March 2017, remain in place and will continue to be monitored to provide additional baseline data up to when dredging commences, in particular to continue to determine the full range of natural occurring turbidity. Since the installation

there has been a number of significant events, including large swell and heavy rainfall events, these have clearly demonstrated the effect of these natural events on Pania Reef.

Data collection from each of the buoy-mounted sensors is on a fifteen minute schedule with turbidity being an average of 30 readings collected at one Hertz. Water quality and buoy performance data (i.e. solar recharge, battery level, position, leak alarm etc.) are logged internally and telemetered back to shore every 15 minutes via cellular communications. (Cawthron 2017). The data is viewed on the ports internal Enview system and Vista Data Vision (VDV) the data will be made available to key stakeholders.

Cawthon (2017) reports and subsequently confirmed through ongoing monitoring:

- Generally low turbidity (<10NTU)
- High turbidity events of up to 30NTU
- Analysis of the turbidity and salinity data from the Pania West Buoy following these events demonstrates clearly the influence on background water clarity from riverine inputs and terrestrial runoff as well as sediment resuspension via waves.
- The turbidity readings from each buoy can be seen to track one another reasonably well, any differences can clearly demonstrate the presence of a moving line of changing conditions.

Table 1 - Monitoring Buoys locations

Buoy	Location (Approx.)	Parameters
Pania East	**39° 27.01' S** **176° 57.00' E**	Turbidity (NTU), Salinity, Sea Temperature, Conductivity
Pania West	**39° 27.28' S** **176° 55.80' E**	Turbidity (NTU), Salinity, Sea Temperature, Conductivity

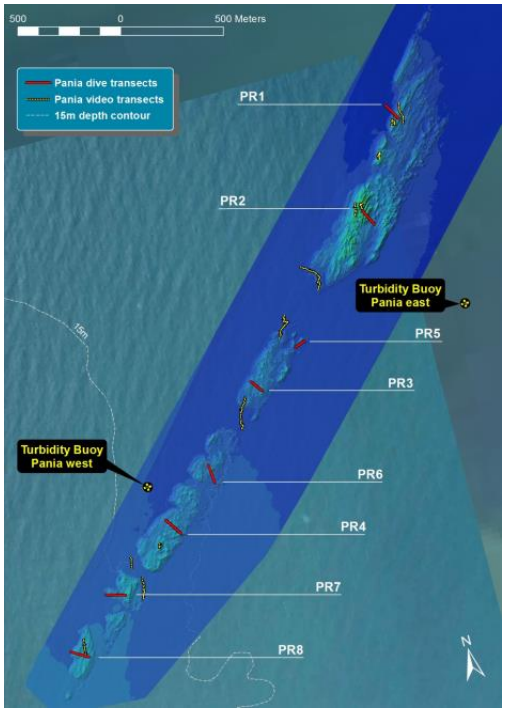

Figure 3 - Monitoring Locations (Cawthron 2017)

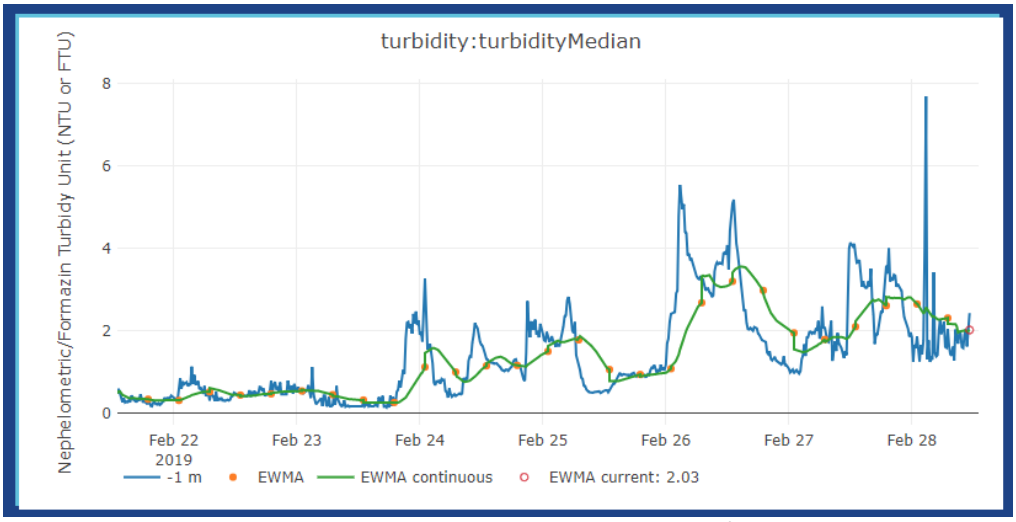

Figure 4. Example of Pania West turbidity/EWMA

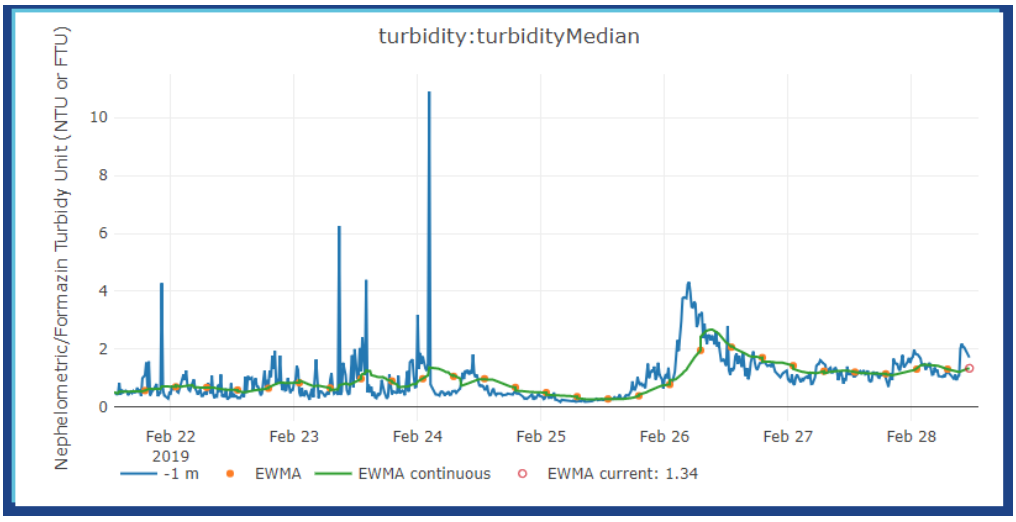

Figure 5. Example of Pania East turbidity/EWMA

5. ADAPTIVE DREDGE MANAGEMENT

Adaptive Dredge Management (ADM) will be used throughout the operational phases of the project to ensure that water quality - in particular turbidity related to the dredging and disposal - do not exceed that modelled and hence meet the environmental effects predicted by Cawthron (2017). The existing water quality monitoring buoys East and West of Pania Reef will be utilised during the project for Adaptive Dredge Management through a tiered response system to protect the sensitive receptor Pania Reef.

5.1. PLUME MODELLING

As part of the proposed development and to inform the potential effects, Advisian (2017) performed dredge plume modelling. This dredge plume modelling is based on a fully calibrated hydrodynamic model and indicates that even under the worst case scenario turbidity levels or sedimentation are not expected to reach levels that would have effects at Pania Reef (Cawthron, 2017).

Notwithstanding the predictive modelling, there is some uncertainty amongst stakeholders, including the recorded and modelled predominately southerly currents at and near the ODA, and the potential for turbidity to affect Pania Reef. Highlighted in the consent application, an adaptive management approach will be undertaken to ensure that plume dispersal and potential effects during the project align with that predicted, and that appropriate actions are taken to ensure turbidity levels as a result of dredging activities do not reach levels that may result in significant effects on the reef.

5.2. REAL-TIME MONITORING

Turbidity is a measurement of water clarity, and is influenced by suspended matter (organic and inorganic) and dissolved organic matter. Turbidity is an expression of the optical property of light to be scattered and absorbed rather than transmitted through the water sample, with a greater amount of matter within the water column leading to a higher amount of light scattering, and thus higher turbidity. Dredging activity has the capacity to introduce excess turbidity leading to environmental harm. Therefore turbidity is an important parameter to measure during dredge operations.

Both water quality buoys provide real time water quality data at 15 minute intervals and a system will be developed to provide the Project Management Team, the Contractor and key stakeholders with both real time turbidity and the rolling 6 Hourly EWMA. This data will allow the monitoring of trends and the effectiveness of changes in dredging practices or prevailing metrological conditions driving natural background turbidity.

The turbidity sensor's (instruments) can be affected by debris such as seaweed or marine growth. Each turbidity sensor has a unique bio-wiper that is used to clean the sensor before any readings. As the data is live, it will not have undergone any QA/QC procedures to provide a validated dataset, and as such may require validation at the time that trigger actions need to be taken. To limit the chance of unreliable data and to assist in confirming a valid dataset, the two existing buoys will be replaced prior to the commencement of dredging with buoys that have dual turbidity sensors. Both sensors will be providing data simultaneously and by comparing a reading to the adjacent sensor and that of the other buoys erratic data can be eliminated. This will be performed in a totally transparent manner, and any data 'cleansing' performed can be made available to key stakeholders.

Figure 6. Turbidity Sensors

Figure 7. Example of Bio-foul build up on the turbidity buoy

The 6 Hourly EWMA, as described in the following section will be calculated and reported at 6 hourly intervals (00:00, 06:00, 12:00 and 18:00) after undergoing QA/QC through an automated system or by an independent third party.

The Port shall undertake a programme of routine maintenance of the buoys to limit the loss of any data, and although proven reliable, failures of the monitoring equipment may and can occur. The dual sensor arrangement will provide a good level of redundancy for instrument failure, although other systems may fail resulting in loss of live data. Repairs of monitoring equipment may be delayed due to weather conditions and associated safety concerns. A 95% availability rate of data is to be targeted for each monitoring buoy location, this will be achieved through the holding of strategic spares, a spare buoy complete with instrumentation (single turbidity sensor) to minimise any loss of each continuous dataset during the project. In many cases even if not transmitting live data, all datasets are retained in the buoys on Campbell Scientific loggers that can be retrieved at a later date and then the data gap rectified.

During instances where a monitoring buoy is not able to provide data in real time, alternative options to provide data include:

- Utilisation of the data from the alternate buoy, where a good correlation is known to exist
- The use of hand held turbidity measurements (although not at 15 minute intervals) to confirm readings at the sensitive receptor, subject to satisfactory weather conditions.
- Daily visual observations of any turbidity plume created by dredging.

The live data is sent via various service providers to the ports IT network where it is retrieved by Vista Data Vision (VDV) the ports chosen platform for monitoring environmental data for the project. Dashboards for live water quality at Pania Reef, currents and wave conditions at the ODA and live weather from the Ports weather station will be made available for key stakeholders. These dashboards will also provide the current status of trigger levels as described in following sections. The VDV System is cloud based and is available on any device that is web enabled.

5.3. TIERED TRIGGER SYSTEM

Adaptive Dredge Management will be implemented through a system of triggers with management responses depending on the trigger level. The establishment of these trigger levels is based on the baseline data and ecological investigations undertaken as part of the development, and in particular the work of Cawthron (2017) The approach recognises that Pania Reef is exposed to and is resilient to periods of high natural turbidity and is based on maintaining the existing natural turbidity patterns and ensuring that dredge related turbidity effects do not result in large elevated turbidity levels or long periods of elevated turbidity. This is described further by Cawthron (2017).

The Trigger Levels are set based on the application of a 6 hourly Exponentially Weighted Moving Average (EWMA) to the raw turbidity data from the buoys, which is current industry best practice for the smoothing of the raw data[1], being applied to projects throughout Australia and more recently in New Zealand. The 6 Hour EWMA is calculated by using a 60:40 weighting system, where the current EWMA (Z_i) is computed by adding 60% of the mean turbidity readings during the preceding 6 hours (X_i) to 40% of the preceding 6 hour EWMA value (Z_{i-1}). Mathematically, 6-hourly values of the EWMA statistic are computed using the following equation:

$$Z_i = 0.6\ X_i + 0.4 Z_{i-1}$$

Where *i* is the mean of the data for the ith period (in this case, the current 6-hour period).

5.4. TRIGGER LEVELS

Table 2 below provides the proposed Trigger Levels based on the advice of Cawthron (2017). Trigger Levels are reached when the relevant 6 Hourly EWMA are exceeded for the respective duration. The trigger levels are very conservative and are designed to protect the sensitive receptors.

The Trigger Level ceases to be in place once the 6 Hourly EWMA drops below the respective turbidity level for any 6 hourly reporting period. As the 6 Hourly EWMA uses data for the past 12 hours, with a weighting towards the most recent 6 hours, this 'smoothing' can be considered conservative and cessation of a Trigger Level will be associated with a long term trend rather than a short term lowering.

Vista Data Vison (VDV) will be set up to provide notification via email of alerts to the trigger levels. The status of the alerts/alarms can be seen on the dashboards.

Table 2. Trigger Levels

Trigger Level	Turbidity (NTU) (6 Hourly EWMA)	Duration
Normal	<10 NTU	
Response Level 1	10 NTU	24 Hours
Response Level 2	14 NTU	12 Hours
Environmental Response Level	17 NTU	6 Hours

[1] Turbidity data measured continuously *in situ* is typically highly variable over small time-scales and must be smoothed to allow useful interpretation and comparability.

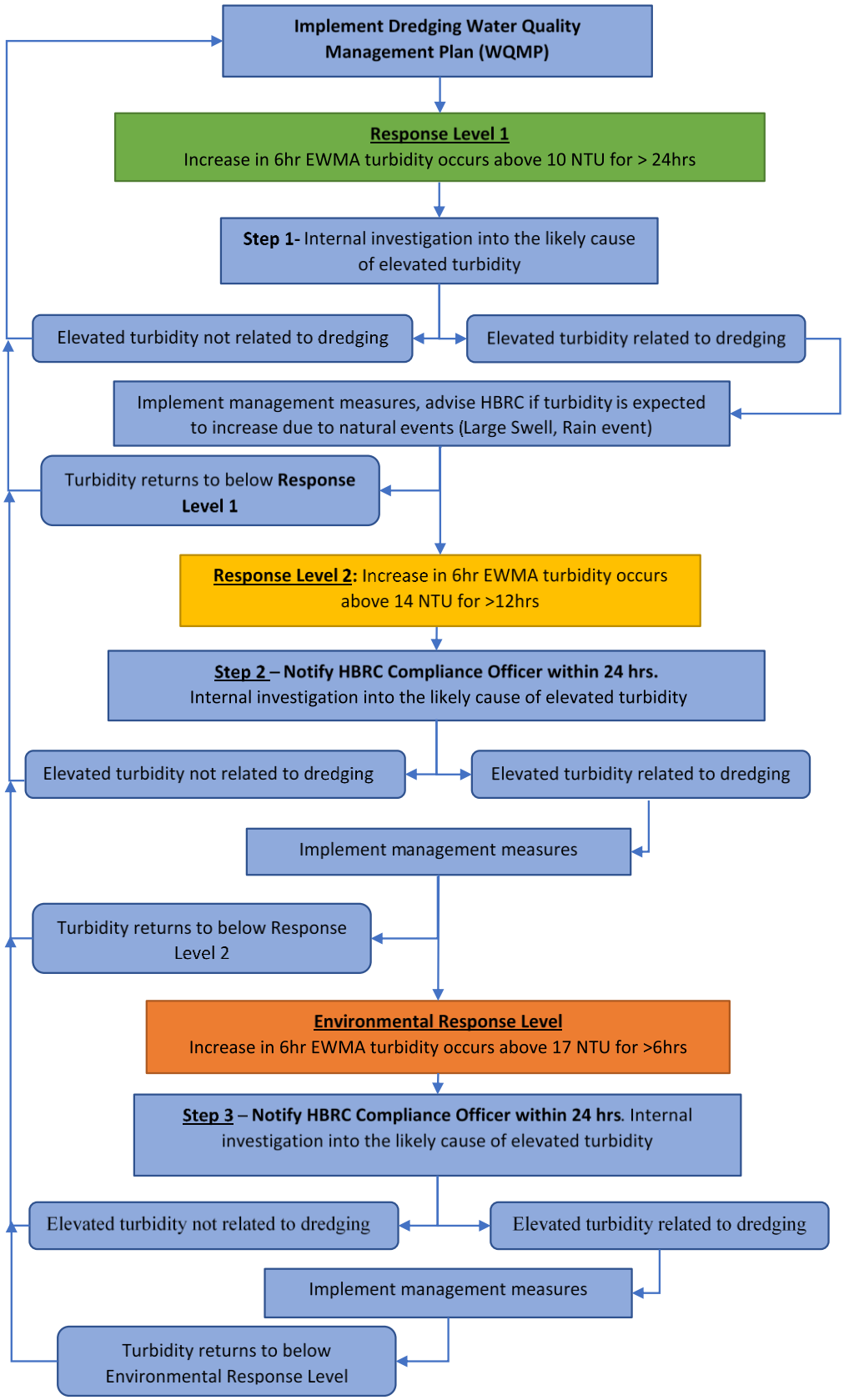

Figure 8. Water Quality Trigger Level Flowchart

5.5. DREDGE RELATED EFFECTS

The turbidity levels associated with the Trigger Levels and responses are, based on available baseline data, expected to be exceeded naturally under certain conditions. Analysis performed by the port and by Cawthron (2017) indicate that swell and riverine run-off associated with high rainfall are two principal drivers for elevated turbidity, at times significantly higher than normal ambient conditions.

When a Trigger Level is reached, an analysis shall be undertaken to determine if the exceedance is dredge related or non-dredge related. Sources of information for the analysis may include:

- Port supplied meteorological data
- Metservice sourced meteorological data
- Port supplied wave and current data
- HBRC supplied river level and flow data
- HBRC supplied water quality data (HAWQi)
- Satellite imagery
- Dredge location and activities
- Current direction at ODA

Various methods may be developed to assist in determining the likely natural background turbidity during an exceedance and hence the level of dredge-related effects:

- Statistical models that correlate elevation in natural background turbidity to key drivers such as, but not limited to wind, swell or riverine flows.
- The use of one or more 'reference sites' which are outside the predicted area of influence from dredging, and through analysis of background data is shown to have a good correlation with the monitoring sites;
- Hand held turbidity sensor to confirm water quality of any additional inputs into the harbour at predetermined locations; and
- Napier Port has a newly consented current/wave buoy located at the ODA. The buoy will supply real-time data of the current direction/speed through the water column at the ODA.

5.6. REPORTING

Exceedance of the relevant Trigger Levels will require reporting in accordance with below. For Response Level 2 and above, notification to the Consent Authority will be required within 24 hours after data validation[2] processes are confirmed and will include a determination of whether the exceedance is dredge-related. Notification to the FLG is required when a trigger is breached for longer than three consecutive days or more than two times in a 30 day period.

In the case that the exceedance is determined to be dredge-related, the notification shall include details of management measures that have been, or will be, implemented to decrease the turbidity levels at the exceedance location.

[2] Validation means that confirmation that the data is not onerous due to fouling of the sensors or other malfunction. This is expected to take less than one hour.

Table 2 - Trigger Level Reporting

Trigger Level	Internal	Notify Consent Authority	Exceedance Report (if dredge related)
Normal			
Response Level 1	√		
Response Level 2	√	√ (within 24 hours)	
Environmental Response Level	√	√ (within 24 hours)	√ (within 1 month)

5.7. MANAGEMENT MEASURES

In response to an exceedance of Response Level 2 or Environmental Response Level Trigger Values, management measures shall be implemented. The management measures will depend on many factors and may include, but will not be limited to, the following:

- Reduction in the rate of dredging and disposal.
- If practical, relocation of the dredge to a different area with more coarse material.
- Disposal in an alternative part of the offshore disposal area.
- Utilisation of the existing consented inshore disposal area (R and Rext), subject to meeting the consent conditions.
- Cease dredging operations.

6. ASSURANCE MONITORING

The purpose of assurance monitoring is to ensure that the underlying assumptions and ongoing management of the project is achieving the objectives of the Water Quality Plan, in particular to ensure that the effects of the project are no greater than anticipated and to provide protection to the physical, ecological and cultural environment.

The assurance monitoring is not intended to underpin management actions which are implemented through the Adaptive Dredge Management portion of this Water Quality Plan; rather it is intended to adapt and, if required, improve aspects of the Adaptive Dredge Management plan between stages of the project.

6.1. PLUME MODELLING VALIDATION

The predicted dredge-related impact is based on extensive numerical modelling and material analysis. The purpose of the plume modelling validation is to ensure that the resulting plume intensity and spatial distribution are generally in accordance with that predicted by the model.

Plume modelling validation shall be performed for the following situations, within 6 months of commencement of the dredging activity.

- BHD dredging – Stage 1
- Barge disposal at Offshore Disposal Area – Stage 1

Plume model validation has been completed for the TSHD during the latest maintenance dredging carried out in November 2017.

- TSHD dredging – Stage 1
- TSHD disposal at Offshore Disposal Area – Stage 1

6.2. NTU – TSS RELATIONSHIP

As there is a disconnect between the modelling performed in Total Suspended Solids (TSS) and the physical measurement being performed in NTU, a relationship is required to be established so that the predicted effects can be verified in the field.

Through a programme of sampling at the Pania West Buoy Cawthron (2017) has determined the relationship to be:

$$TTS = 1.63(NTU) + 1.01$$

$$r^2 = 0.936$$

The data-set will continue to be expanded through additional sampling so that the correlation can be extended to higher values of turbidity, and has been supplemented with tank testing by Cawthron using dredge sediments to confirm.

Additional samples will be taken to confirm the TSS-NTU relationship throughout the project.

6.3. BATHYMETRIC SURVEYS

Bathymetric surveys of the offshore disposal ground will be undertaken in accordance with *Table 3*. The purpose of the surveys are to compare them against the predicted sediment dynamics from the sediment transport modelling. A multi beam survey of the ODA has been completed (see figure 9 below)

Table 3 - Bathymetric Surveys

Stage	Interval	Coverage
During Execution	6 Monthly	Areas of disposal +50m
Stage Completion	Within 6 Months	100% + 50m
Between Stages	Annually	100% + 50m
Post Development	5 Yearly	100% + 50m

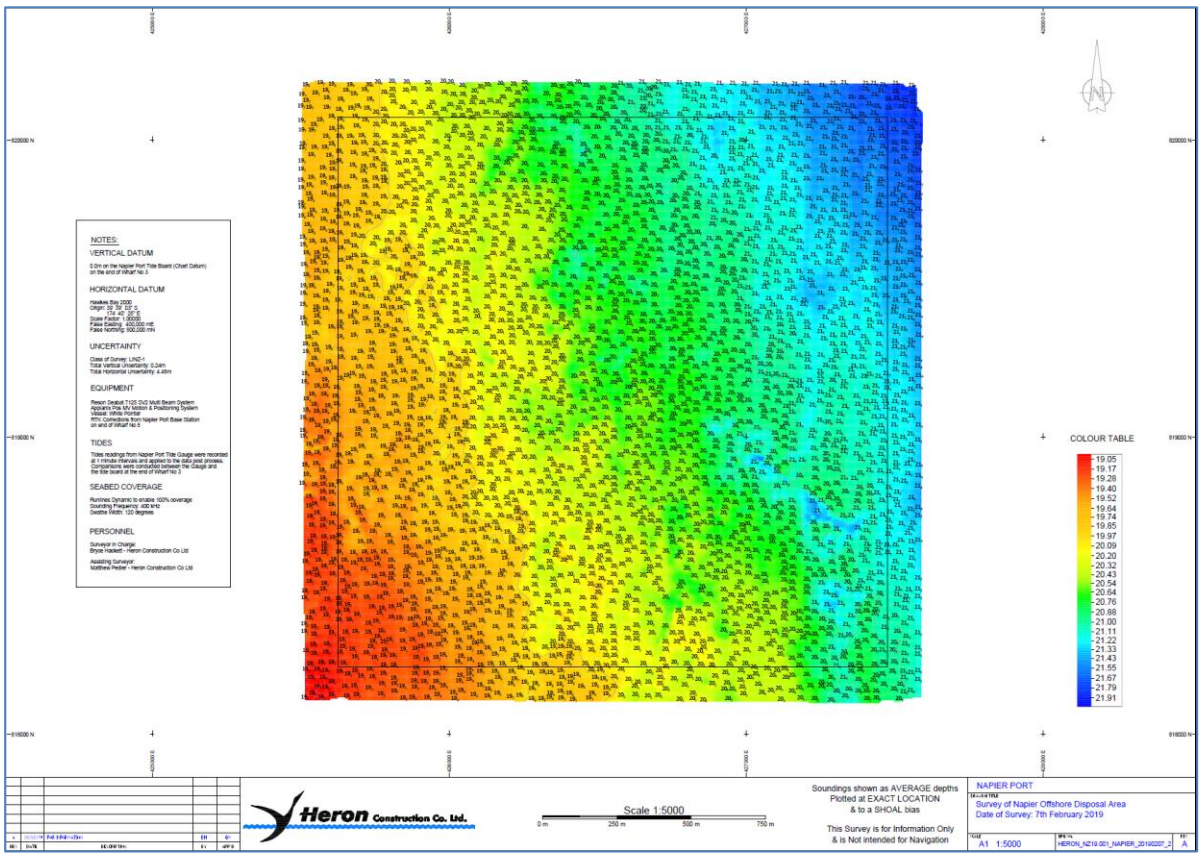

Figure 9. Multi Beam survey imagery from the Off-Shore Disposal Ground (February 2019)

6.4. PANIA REEF DIVE SURVEYS

Surveys of the communities at Pania Reef shall be undertaken by way of dive surveys by suitably qualified scientists at the following intervals:

- Survey conducted during 2016 will be used as a baseline
- Within 6 months of the commencement of the consent
- Annually up to the commencement of Stage 1
- Within 6 months after the completion of Stage 1
- 1 year after the completion of Stage 1
- Prior to commencement of subsequent stages
- 1 year after the completion of each subsequent stage.

Depending on the actual timing of the stages, it may be necessary to slightly adjust the timing of surveys so that the results remain comparable over time. Such variations in timing will be determined on the advice of the scientists involved, and will be advised to Hawke's Bay Regional Council and the FLG.

The surveys shall be generally conducted in accordance with the 2016 survey as reported by Cawthron (2017), in particular the surveys shall be conducted on the same transects PR1 to PR8 (Figure 8, Below).

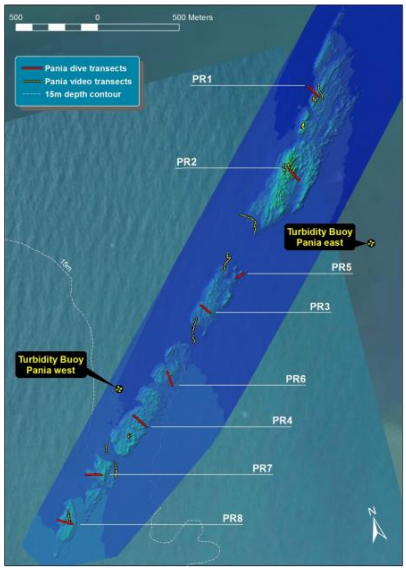

Figure 10. Dive Transect Locations (after Cawthron 2017)

It is noted that natural background turbidity and diving conditions have in the past made it difficult to obtain suitable conditions to conduct the surveys, and hence the times are approximate. Similarly it is also recognised that natural fluctuations occur at the Reef due to varying ambient conditions, storms and the like.

7. OFF-SHORE DISPOSAL AREA

7.1. BENTHIC SURVEYS

The primary aim of the survey work is to better establish the nature and spatial distribution of benthic habitat and communities within the vicinity of the ODA.
It is proposed that the baseline survey will be structured around 28 individual benthic sample stations which will be grouped according to the following three classifications:

- Spoil ground: 12 stations within the designated disposal area boundary
- Spreading zone: Ten stations at 350 m from the disposal area boundary
    - Three stations (300-400 m apart) at each end of an approximate isobath running through the spoil ground centre
    - Two stations (400-500 m apart) at each of locations inshore and offshore from the NE and SW vertices of the spoil ground
- Far-field: Three stations (300-400 m apart) at each end of an approximate isobath running through the spoil ground centre, located 1500 m from the disposal area boundary.

The proposed spatial arrangement of these stations is depicted in Figure 9 below; however, their exact placement may be adjusted on the basis of Multibeam echo sounder (MBES) imagery (recently completed).
Survey components will be as follows:

- Benthic samples, collected via van Veen grab from each sample station (as below). These will be sub-sampled for analysis of benthic macrofaunal communities, sediment texture and indicative trace metal contaminants. Single grab samples at each station, with stations outside the spoil ground boundary grouped within 500-700 m in similar water depths. This provides for pseudo-replication over smaller spatial areas. In the event of

indications of distinctly different seabed conditions occurring across a particular site (e.g. from MBES imagery), efforts would be made in the field to better establish their spatial distribution and sample accordingly.

- Eight epifaunal dredge trawls, each covering a distance of approximately 400 m. These will be used to ground-truth the habitats identified by grab sampling and seabed imaging:
    - 4 trawls distributed across the disposal area
    - 2 trawls from the vicinity of each of the two far-field areas subject to grab sampling for macrofauna and sediments
- Drop-camera and/or video sled coverage of the seabed (where underwater visibility allows) to provide additional information on habitat and epifaunal communities.

Figure 9 below provides a recommended spatial layout of the benthic sampling components (although epifaunal dredge trawl locations are indicative only). This is principally a spatial gradient design rather than a strict BACI (before-after-control-impact) approach. True control sites are nearly impossible to establish in coastal marine environments due to the complexity of coastal morphology and its influence upon near-shore hydrodynamics.

Figure 11. Spatial layout of principal survey elements. Approximate 20 m depth contour from hydrographic chart NZ571.

Interpretation of the survey's results will focus on:

- Establishing baseline benthic conditions
- Establishing the relative uniformity of the seabed in the vicinity
- Comparison with the 2005 survey data of the area
- Identifying and delineating any high-value habitats and communities
- Recommendation of an appropriate survey design for subsequent monitoring.

7.2. FISHERIES BASELINE AND MONITORING

The general principle is to use one commercial fisher as a proxy for all commercial effort at and around the OSD. The fisher is to be contracted by Napier Port

7.2.1 BASELINE FISHERIES DATA

Subject to agreement to release historical catch data held by Fisheries New Zealand to the contracted fisheries scientist in order to establish the baseline fisheries data set that relates to the project area, and the estimated area of potential effects – the use of the data is restricted to the purposes of undertaking the work set out above

This data, and that from other commercial fishers working in the area, to be analysed and reported by a recognised fisheries scientist agreed to by the FLG

Data to be analysed to determine:

- Whether the work related to above is typical of the wider commercial fleet
- What other fishers catch effort data may be useful
- The consistency of the data over time
- Patterns over the last decade that may provide a baseline activity pattern
- Any major changes to catch methods, such as net size
- Useful signals based on previous disposal activities at the consented inshore disposal areas
- Any gaps in data which may need to filled from alternative sources.

Baseline Fisheries Report to be prepared

7.2.2 FISHERIES ONGOING MONITORING

The appointed commercial fisher using the same method and endorsed by the consulting scientist and approved by the FLG is to continue to provide catch data in a reporting method consistent with historical data, noting that the commercial industry is currently transitioning from paper to electronic reporting – catch data is likely to include species composition, effort, time, location etc as set out in the survey design and method).

Where practical the commercial fisher to record and provide additional data, such as full trawl tracks which will enable a better understanding of the spatial extents of the fisheries and full catch including returns to the sea. If requested by the commercial fisher the level of specificity of detail shared is too aggregated and will remain confidential to the members of the FLG.

This data is to be revised and reported on annually by the FLG agreed fisheries scientist and presented to the FLG, before being made publically available on the Napier Port website.

Napier Port will fund the preparation and presentation of the annual report.

7.2.3 OSD BASELINE AND ONGOING MONITORING

In addition to the fisheries monitoring in 7.2.1 and 7.2.2, targeted monitoring at the OSD is proposed in order to collect more detailed structured information on fish by:

- Establishing species and location specific baseline data

- Establishing if there any seasonal variations in fish and immediately adjacent to the OSD including spawning status, size and structure of the school.
- Monitor the recovery at the OSD following disposal activities.
- Establishing relationships between the results of benthic surveys and fisheries at and adjacent to the OSD.

In order to achieve the desired goals:

- The survey method (protocols and design) to be dictated by the aims of the survey
- The survey shall be overseen by an independent technical fisheries scientist
- Surveys shall be performed by an appointed Napier based commercial fisher utilising gill netting or an alternative agreed suitable method in line with the aims of the survey and agreed to be the oversight fisheries scientist responsible for reporting
- The cost of the surveys shall be borne by Napier Port
- Discussion is required as to how the commercial catch will be covered, where this falls outside the fishers ACE availability – opportunities exist for a special permit to be applied – this is to overseen by the technical fisheries scientist with guidance by Area 2 Fisheries Inshore New Zealand
- Surveys shall be conducted at regular intervals and set out in the survey design, but likely not less than one survey two weeks prior and one survey within two weeks following a new dredging/disposal period, and for a subsequent three years following conclusion of the significant dredging/disposal activity.
- Subsequent frequency of surveys may be reduced with agreement of the FLG between campaigns.
- The proposed method of survey shall developed by the independent scientist working with the FLG

7.2.4 REPORTING

In accordance with the conditions of consent, baseline and subsequent survey reports are to be made available publically on the Napier Port website. It is recognised that the reports may contain information that is commercially sensitive.

- The overarching intent is to have all reports available to the public, as this builds community knowledge, awareness and understanding. That said, it is understood that the Reports resulting from 7.2.1 and 7.2.2 contain confidential and commercial information which may be tracked back to individuals. A commitment is made to obtain the expressed permission of persons or organisations to which the data relates each year, prior to presentation at the FLG and publication on websites, or to provide edited public versions of the reports where data is significantly aggregated in order not to reveal private and commercial information.
- Data resulting from the activities of 7.2.3 are considered not to be commercially sensitive and shall be made available publically in accordance with the conditions of consent.

7.2.5 LONGEVITY

The Port consent is for 35 years, and this fisheries baseline monitoring is envisaged to span this period. Given the duration of time, it is anticipated that critical people or fishing methods may change over this time. This includes fishers, science advice, membership of the FLG and Napier Port personnel.

- Critical elements of the baseline survey to be identified and when necessary contracted in
- The independent fisheries scientist will take responsibility to oversee transition to other fishers, and fishing method.