Technical assessment of Fast Track Application (FTAA-2504-1048 Taranaki VTM Project)

Prepared for

Taranaki Regional Council

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PATTLE DELAMORE PARTNERS LTD
Level 2, 109 Fanshawe Street,
Auckland Central 1010
PO Box 9528, Auckland 1149, New Zealand

Tel +64 9 **523 6900**
Web www.pdp.co.nz

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DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Becky Shanahan   Anna Madarasz-Smith   Wayne Westcott

Reviewed and approved by

SIGNATURE

Hayden Easton

Limitations:

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Executive Summary

Trans-Tasman Resources Limited (TTR) have applied for a marine consent under the Fast-track Approvals Act 2024 to allow for activities associated with iron sand extraction. The proposed project site lies 22 to 36 km offshore, beyond the 12 nautical miles (nm) Territorial Sea boundary, and covers an area of 65.76km^2 in water depths ranging from 20 to 50 m.

Taranaki Regional Council (TRC) engaged Pattle Delamore Partners Limited (PDP) to provide technical advice on the potential environmental effects of the proposed activity that may support the Council to provide informed feedback when sought for comment by the Environmental Protection Authority (EPA). Specifically, PDP were asked to focus on the following key areas:

- Current state of knowledge of benthic habitats of the Pātea Bank and Pātea Shoals and whether this has been accurately reflected in the current application and assessment of effects.
- Information on the updated optical effects and effects of primary production and the assessment of ecological effects for areas within the Taranaki coastal marine area, specifically for sensitive rocky outcrop communities including those identified in the Taranaki Regional Coastal Plan (Project Reef, North and South Traps).
- Potential effects of the proposed activity on seabirds, marine mammals, and flow on effects of the reduction in food sources (polychaete worms) in the mining area.

To undertake this review, PDP has reviewed considerable information supporting the application through the various stages of approvals, and hearings within time and budget provisions.

The review has identified several areas where information is considered insufficient to make an informed determination on the expected levels of effects on the areas described above.

In reviewing the TTR application and associated evidence, we consider it important that the expert panel reflect on the extent to which current gaps in information constrain the ability to confidently determine the scale and significance of potential impacts. Specifically, we highlight the following areas where uncertainty may limit the robustness of conclusions. These areas are:

Environmental Setting

- It remains unclear whether the current application adequately addresses potential impacts on newly identified reefs, particularly under the latest worst-case scenario testing for optical and primary production effects (Pinkerton et al., 2017).

- In addition, there is uncertainty around whether the most appropriate sediment plume modelling approach has been applied. As noted by Dr Michael Dearnaley (2024, para. 18), if new reefs located near Pātea Shoals fall within approximately 3 km of the mining operations, then potential impacts on these reefs would be more accurately informed by near-field plume modelling rather than the far-field approach undertaken by NIWA.
- The panel may wish to consider how these uncertainties regarding reef identification and modelling approaches affect confidence in conclusions about the scale of potential impacts on reef ecosystems.

Sediment plume – Optical, primary production and sedimentation effects

- The calibration of the sediment plume model across different years and timeframes introduces potential uncertainty. The panel may need to weigh how this affects confidence in whether the model accurately reflects oceanic conditions.
- There remains a lack of clarity around the interaction of two sediment discharge sources, particularly the mechanism by which de-ored sand is expected to trap finer sediment. The panel may need to reflect on how this uncertainty affects the weight given to conclusions about sediment dispersal.
- The size and extent of the depositional area is not fully defined, limiting the ability to accurately assess the magnitude of sedimentation effects on the receiving environment.
- The absence of an updated assessment of localised impacts on reef habitats and associated species (e.g., Morrison, 2022) creates uncertainty that the panel may wish to consider in its evaluation of ecological effects.

Seabirds

- The 2017 Decision-Making Committee (DMC) noted “a lack of detailed knowledge about habitats and behaviour of seabirds in the STB,” and there is little indication that these knowledge gaps have been substantially filled since the 2016 application. The panel may wish to consider how this limits confidence in assessing potential impacts.
- Based on the evidence provided, there does not appear to be sufficient information to fully and confidently assess the impacts of the mining activity on seabirds in the South Taranaki Bight (STB).
- Site-specific data on seabird presence, distribution, foraging areas, and behavioural patterns remain limited, which makes it difficult to quantify potential population-level or long-term impacts.

- There are potential mitigations available to reduce the attractiveness of the mining vessel to birds.

Marine mammals

- The panel may wish to consider whether the existing baseline data on marine mammal populations and behaviours are sufficient to evaluate the potential impacts of the proposed mining activities.
- The panel may wish to take into account that the described uncertainty could influence the ability to fully assess the magnitude and significance of potential noise-related impacts on marine mammals.

Legislative Context

Notwithstanding the specific policies in each of the following documents that provides for extraction of minerals (outside of the current scope), the uncertainty noted above needs to be considered in the context of determining whether the proposed activity is consistent with:

New Zealand Coastal Policy Statement (2010)

- Policy 11 – Indigenous biological diversity.
- Policy 13 – Preservation of natural character.
- Policy 15 – Natural features and natural landscapes.
- Policy 22 – Sedimentation.
- Policy 23 – Discharge of contaminants.

Taranaki Regional Policy Statement (2010)

- CNC Policy 2 – The protection of natural character.
- CNC Policy 4 – Protection of areas of importance to the region.
- CWQ Policy 2 – Discharges from ships and other installations.
- BIO Policy 2 – Adverse effects on indigenous biodiversity.
- BIO Policy 5 – Ecosystems, habitats or areas with indigenous biodiversity values.

Taranaki Regional Coastal Plan (2023)

- Policy 1(a) – Coastal management areas of outstanding value.
- Policy 1(d) – Coastal management areas of the open coast for marine systems and habitats.
- Policy 3 – to adopt a precautionary approach where effects are uncertain, unknown or little understood but potentially significantly adverse.

- Policy 9 (a) – avoiding adverse effects of activities on the values of areas identified in Schedules 1 & 2.
- Policy 15 & 16 – Indigenous biodiversity.

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1.0 Introduction

Trans-Tasman Resources Limited (TTR) have applied for a marine consent under the Fast-track Approvals Act 2024 to allow for activities associated with iron sand extraction. The proposed project site lies 22 to 36 km offshore, beyond the 12nm Territorial Sea boundary, and covers an area of 65.76 km^2 in water depths ranging from 20 to 50 m.

TTR was originally granted consent by the Environmental Protection Agency (EPA), however the decision was subsequently appealed to the High Court, the Court of Appeal and ultimately to the Supreme Court who quashed the consent and referred the matter back to the EPA for reconsideration.

Pattle Delamore Partners Limited (PDP) understands that the primary technical issues raised in appeals related to the adequacy of information supporting the application, including but not limited to:

- The potential impacts of the sediment discharge resulting from the activity.
- The extent that seabirds and marine mammals may be affected by proposed mining activities.

2.0 Scope

Taranaki Regional Council (TRC) engaged PDP to provide technical advice on the potential effects of the proposed activity that may support the Council in providing informed comment on the proposal when sought by the EPA.

PDP has been requested to undertake a targeted review of the technical assessments completed during the initial EPA application process, and incorporate any additional information obtained in the intervening years that may be relevant to understanding the environmental effects of the proposed activity.

TRC has specifically asked PDP to focus on the following key areas:

- The description of the receiving environment provided in the application in comparison to current knowledge of the receiving environment.
- Sites scheduled under the Taranaki Regional Coastal Plan.
- The potential ecological effects of reduced visibility and light penetration due to the sediment plume, and the implications of this on primary production and the wider food web. The potential effects of the sediment plume and deposition of fine sediments on sensitive rocky outcrop communities including the North and South Traps. This

is with specific reference to recent information on the occurrence of subtidal reefs within the South Taranaki Bight (STB).

- Any potential effects on marine mammals and seabirds.
- Any potential effects of a reduction in polychaete worms in the proposed mining area.

This review was completed within the time and budget constraints agreed with TRC. PDP considered a substantial body of information from the application, focusing on the key areas identified by TRC. Given the volume of material, a full review of all available information was not feasible.

2.1 Structure

There is extensive literature that support the TTR application. To assist TRC in understanding the relevant information from the literature reviewed, the following assessment has been structured to address potential effects related to the aspects described in Section 3.0.

While there are overlaps across potential effects, this assessment informs the following:

- Is the information provided sufficient to ascertain the effects of the activity?
- Are the conclusions reached supported by the data presented?
- Are there any areas outstanding that need addressing?
- Are there any recommendations for future monitoring/investigations that would assist in understanding the effect of the activity on the receiving environment?

PDP has reviewed considerable information supporting the application through the various stages of approvals, and hearings. Considering this, the information sources referenced in this document may not be exhaustive and additional sources are listed under section 8.0.

2.2 Taranaki Regional Council

TRC has statutory functions under the Resource Management Act (RMA) 1991, including regulatory oversight of the Coastal Marine Area (CMA), which extends from the mean high-water springs (MHWS) out to 12 nautical miles (nm) offshore. In addition to its regulatory role, TRC has a responsibility to advocate on matters of regional significance and concern.

TRC is required by the RMA to prepare a Regional Coastal Plan that sets out how activities in the CMA are managed to promote sustainable management of the area's natural and physical resources. TRC's second generation Coastal Plan become operative in 2023, and has key objectives regarding the environment including (amongst others):

- The life-supporting capacity and mauri of coastal water, land and air are safeguarded from the adverse effects.
- Water quality in the coastal environment is maintained where it is good and enhanced where it is degraded.
- Indigenous biodiversity in the coastal environment is maintained and enhanced and significant indigenous biodiversity in the coastal environment is protected.
- The public's use and enjoyment of the coastal environment, including amenity values, traditional practices and appropriate public access to and within the coastal environment, is maintained and enhanced.

TRC's CMA includes the South Taranaki Bight (STB), an area characterised by a shallow continental shelf that extends over 40 km offshore. This area includes known reef habitats such as the Traps and Project Reef, which are listed as Areas of Outstanding Natural Character (both areas) and Outstanding Natural Landscapes and Features (Traps only) in TRC's Coastal Plan (Figure 1).

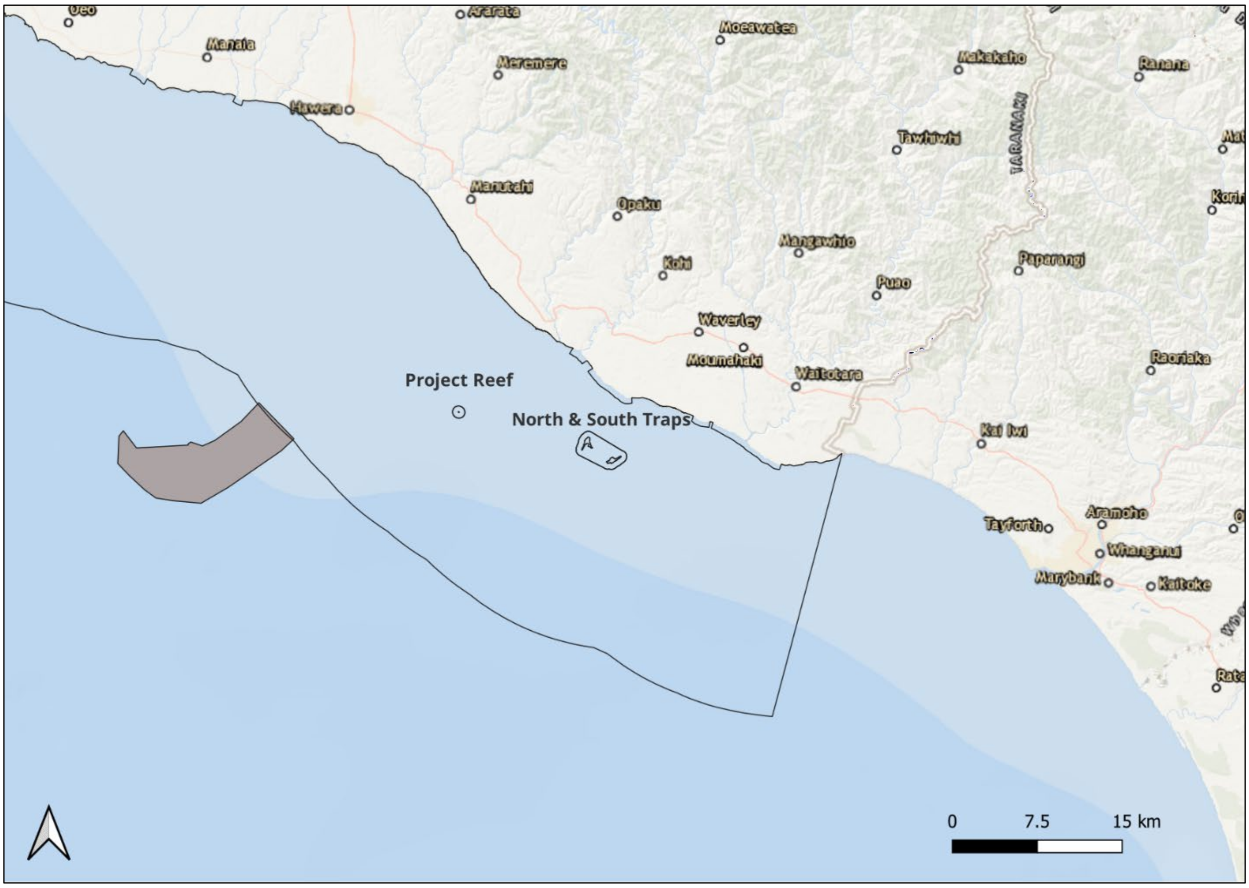

Figure 1-1. Map of southern end of Taranaki Regional Council's CMA (black boundary) including the proposed mining area (grey) and Areas of Outstanding Value; Project Reef and The Traps.

Although the proposed mining area sits adjacent to the 12 nm territorial sea, within the exclusive economic zone (EEZ), it is such that actual and/or potential adverse effects may arise in the Taranaki CMA due to movement of the sediment plume in currents and motile fauna within the STB.

PDP understands that the primary technical issues raised in previous Council submissions related to the adequacy of information supporting the application, including but not limited to:

- Potential impacts of the sediment plume on primary productivity.
- Potential impacts of the sediment plume on sensitive benthic habitats; and
- Whether the effects considered recent information on the offshore subtidal rocky reef habitats on Pātea Bank.

2.3 The proposed activity

TTR proposes to extract up to 50 million tonnes (Mt) of seabed material annually, with 10% (5 Mt) retained as iron concentrate for export. The remaining material would be redeposited roughly four metres above the seabed within the extraction zone. The company is seeking a 35-year consent term, during which the extraction vessel would operate for up to 6,200 hours per year (approximately 258 days or 71% of each year) over a 20-year operational period. The remaining 15 years of the consent term would be allocated to pre- and post-extraction monitoring and decommissioning activities.

Each designated extraction block is approximately 300 by 300 metres in size. Up to six blocks can be extracted before the vessel's anchors must be repositioned to access the next planned area. Annually, the total area directly impacted by extraction is approximately 5 km^2. This is achieved by working within multiple 900 by 600 metre blocks (0.54 km^2 each), with each block typically extracted over a 30-day period.

The proposed extraction methodology is detailed in TTR's Fast-track application, however a brief summary is provided below.

TTR will initiate the mining process with the first phase of grade drilling. Grade drilling is closely spaced seabed sampling to further define the extraction area and understand the seabed characteristics. The process is a single pass drilling system that requires a drill rig that uses air and water to control the drill head. The second phase of the mining is the extraction of seabed sediments. Targeted material will be extracted using seawater jets to mobilise free flowing sediment in front of the submerged subsea sediment extraction device / seabed crawler (SBC) (Figure 1-2). The maximum depth of sediment recovered will be no more than 11 m, but, on average, will be 5 m. Material will be extracted in a single pass from the seabed and delivered from the SBC to the Integrated Mining Vessel (IMV). The IMV will remain in place during the course of the extraction operation and can run uninterrupted up to a four-metre significant wave height. On the IMV, recovered sediment is screened by size, removing anything greater than 3.5 mm. Magnets separate out the iron ore in a first pass. Larger particles are sent to a grinding circuit that mills material to a smaller size where is it passed through magnets a second time. De-ored sediment is then sent down a deposition pipe which will be 4 m above the seabed. Material will be redeposited near the area it was extracted from. Product recovered from the seabed is dewatered and transferred to the Floating Storage and Offshore Vessel (FSOV) for further processing and then on to export.

The primary potential direct environmental effects of the proposed mining activities can be summarised as:

- Removal of the top 5 m of the seabed on average, or up to 11 m maximum, for onboard metal extraction causing loss and physical disturbance of seabed habitat and the associated mortality of captured faunal communities.
- Deposition of de-ored material approximately 4 m above the seabed, leading to smothering of benthic communities in previously undisturbed areas, with potential effects on respiratory and feeding structures.
- Creation of an operational sediment plume causing potential effects on optical properties affecting photosynthetic organisms, potential effects on predator behaviour.
- Noise and light pollution of the largely permanent IMV and SBC disrupting current marine fauna and seabirds foraging, breeding and migratory patterns.

In addition to the direct loss and modification of benthic habitats, the proposed extraction has the potential to generate indirect ecological effects through persistent changes to the optical environment and sedimentary regime. Changes in benthic habitat structure and sediment composition may reduce habitat suitability for recolonising invertebrate and fish species, affecting food-web dynamics beyond the immediate extraction blocks. Smothering of adjacent habitats could lead to shifts in community composition over time, favouring more sediment-tolerant taxa.

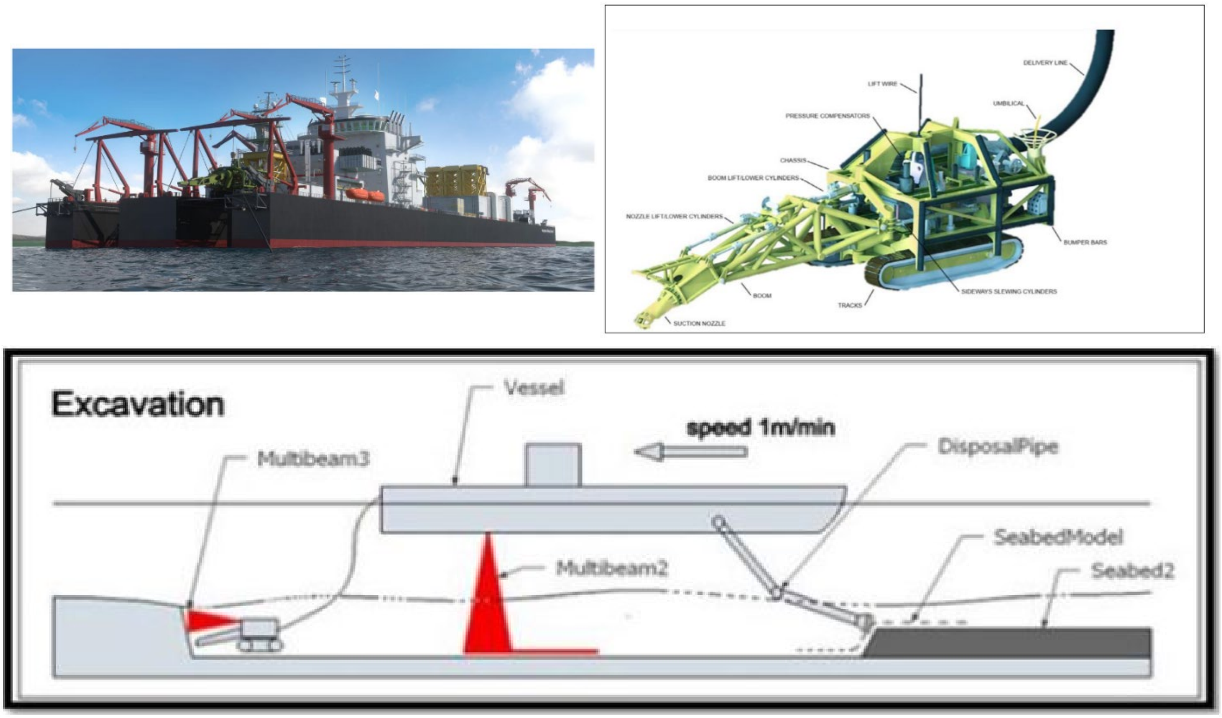

Figure 1-2. Seabed extraction vessels and process (taken from TTR's Fast-track application). Top left is the integrated mining vessel (IMV), top right is the seabed crawler (SBC), and the bottom shows the process for the sediment from extraction to re-deposition.

3.0 The South Taranaki Bight receiving environment

TRC's CMA includes the STB which is characterised by a shallow continental shelf that extends over 40 km offshore. Habitats in the STB (particularly rocky reefs) are relatively unique in New Zealand (NZ), particularly reefs that are distant to the coastline.

The STB includes known reef habitats such as the Traps and Project Reef, both cited as Areas of Outstanding Value (Schedule 1 & 2), and Significant Outstanding Biodiversity Areas (Schedule 4B) in TRC's Coastal Plan due to their high biodiversity, minimal human activity, and high sense of wilderness and remoteness (Taranaki Regional Council, 2023). An significant biodiversity area exists for pelagic seabirds in the area from South Taranaki Bight to the Cook Straight (Taranaki Regional Council, 2023)

Under the Taranaki Regional Coastal Plan, Project Reef is listed as an area of Outstanding Natural Character due the complex habitat that supports a diverse range of marine invertebrates and fish. This area is considered to have a 'very high' degree of biotic natural character, notably due to the clear offshore waters and shallow depth which provides for the growth of beds of *Ecklonia radiata*. This area is also considered of 'very high' natural character due to the minimal human activity and sense of wilderness and remoteness.

Similarly, North and South Traps are listed as areas of Outstanding Natural Character and Outstanding Natural Features or Landscape due the complex habitat that supports a diverse range of marine invertebrates and fish. These areas are considered to have a 'very high' degree of biotic natural character, notably due to the clear offshore waters and shallow depth which again provides for the growth of beds of *E. radiata*. This area is also considered of 'very high' natural character due to the minimal human activity and sense of wilderness and remoteness, and naturally functioning and healthy ecosystems.

Several policies in the Taranaki Regional Coastal Plan outline the region's approach to resource management in a way that maintains or enhances specific values within the coast.

Policy 9 addresses the protection of the *visual quality* and the *physical, ecological* and *cultural integrity* of coastal areas of outstanding value identified in Schedules 1 and 2 (Project Reef – ONC 6, and North and South Traps – ONC 7). Significant adverse effects are required to be avoided, and adverse effects are required to be avoided, remedied or mitigated at those areas identified in Schedule 4B(15iii).

Given that the proposed activity has potential to impact these values, specific consideration is given to these sites in the assessment below.

Application description of the environmental setting

The 2025 application outlines the environmental setting for the proposed activity. It is acknowledged that considerable work has been undertaken to describe the baseline state of the proposed activity area, covering the geological setting, climate, oceanography (including wave climate, currents and suspended sediment concentrations), seabed morphology and sediments including sediment chemistry, natural features, landscapes and seascapes, benthic ecosystems, primary productivity, fish, marine mammals and seabirds.

The existing environmental setting is detailed in the original ecological impact assessment by AES (2016), and again in the 2025 application (Trans-Tasman Resource Ltd, 2025). Both documents describe the seabed habitat types within the Pātea Shoals (Figure 4-1).

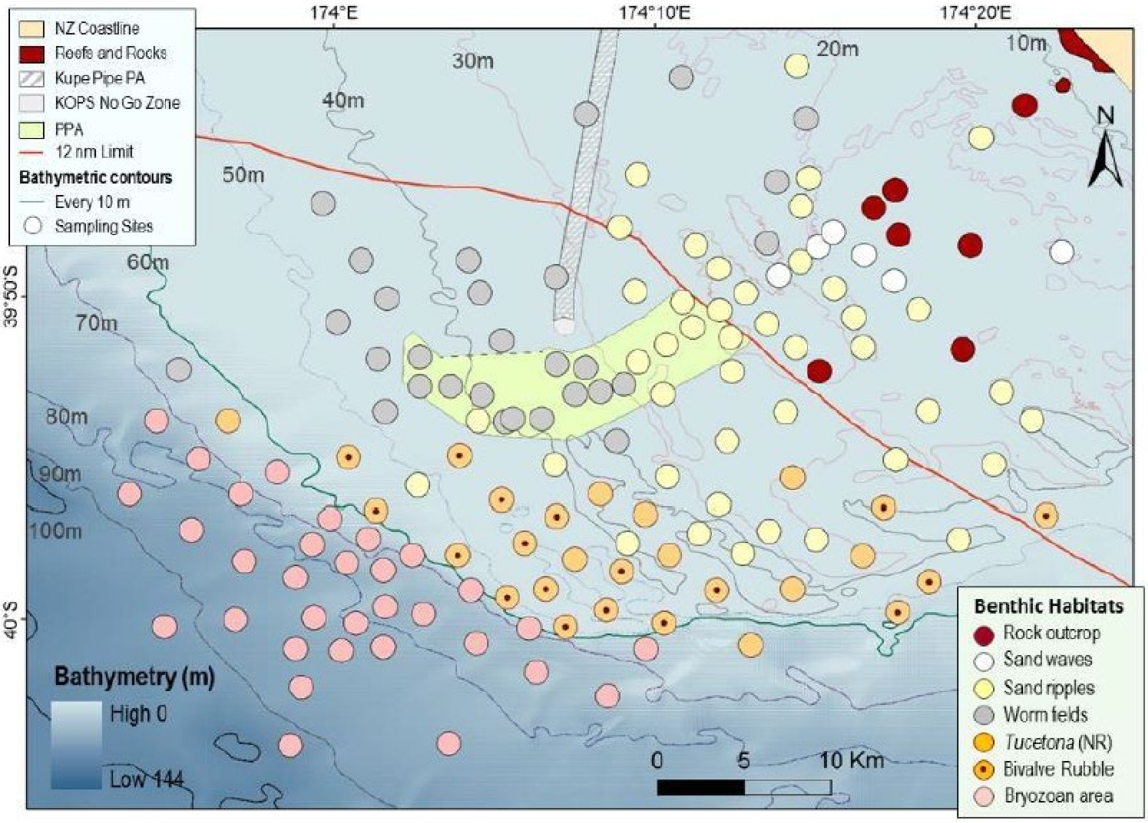

Figure 3-1 Map of the South Taranaki Bight benthic habitats with the location of TTR's Proposed Project Area (PPA) beyond the 12 nm limit and location of reefs (from AES, 2016).

In addition to the surveys undertaken for the original consent application, further mapping and characterisation of subtidal reefs in the South Taranaki Bight (STB) have been conducted. In 2020, following engagement with the Project Reef citizen science team, NIWA extended an existing research programme on juvenile blue cod habitats to include previously uncharted reef systems on the Pātea Bank (Morrison et al., 2020).

Field sampling and mapping events in 2020 and 2021 revealed a 'mosaic' of individual reefs with rich biodiversity (fish, invertebrates, and macroalgae; Morrison et al., 2022). These reefs contain extensive biogenic habitats including macroalgae (*Ecklonia* forests, *Caulerpa* meadows, and mixed macroalgal meadows), bryozoan fields, and sponge garden (areas of higher sponge cover more than 5 m in width). They also support several fish species including blue cod, scarlet wrasse, butterfly perch, leatherjackets and terakihi. Other species are likely to be common (e.g., snapper, trevally, kingfish, and kahawai).

The 2022 mapping demonstrated that subtidal reefs are relatively common along the Pātea Bank and noted that there are likely many more that have not yet been identified (Morrison et al., 2022). The Benthic Terrain Model presented in the report provides evidence of reefs that form 'extensive, linear features several kilometres long'. The report concludes that the reefs are unusual in their distance offshore, making them relatively unique in a New Zealand context, and therefore worthy of careful management (Morrison et al., 2022).

The Pātea Shoals have been identified as a potential Habitat of Particular Significance by Fisheries New Zealand (Fisheries New Zealand, 2024) due to its ecological importance. It "supports diverse benthic and suspension feeding assemblages" and is a "known nursery ground for some finfish species and may also be a spawning ground for some finfish species, including John Dory."

While the studies supporting the TTR application have been comprehensive, the 2025 application does not appear to include more recent information on the presence of offshore subtidal rocky reef habitats on Pātea Bank (*outlined in* Morrison et al., 2022). Concluding that rocky reef habitat is more common and widespread on the Pātea Banks than previously documented, it is important that the presence of subtidal rocky reef habitat within, and adjacent to, the application area is defined and subsequently considered, given the potential effects of the proposed activity on these systems.

The potential for significant ecological impact to occur if large reefs were identified close to the proposed mining site (within 1-2 km of the near field plume modelling area) was agreed in the Joint Statement of Experts in the Fields of: Sediment plume modelling; and effects on benthic ecology (2024). This agreement in paragraphs 51-52, is followed by agreement that additional survey effort around PPA is necessary to identify sensitive benthic habitats within 2 km of the mining area (para. 53).

4.0 Potential Effects – Sediment Plume

As part of the mining operation, de-ored sediment is returned to the seabed in two ways. One is from the hydro-cyclone overflow (a discharge of mostly fine sediment with a large flow (8.8 m^3/s) of water) and the other is the de-ored sand discharge (de-watered, de-ored fine-medium sand being released from a pipe with a view to depositing it as compactly as possible, usually into a pit that has been excavated earlier). These two discharges will be close together to minimise the spatial footprint of the impact. The sediment laden water and deposited sediment can affect suspended sediment concentrations (SSCs), visual clarity and light climate, and the dispersal of sediment across the water column.

4.1 Suspended sediment concentrations

Once mining is underway, a sediment plume will be generated. As part of its application, TTR has modelled the potential sediment plume from its operation including its concentration (in mg/L), distance and direction of travel given different scenarios (environmental conditions, extraction practices, and sediment properties; Hadfield & Macdonald, 2015; Macdonald & Hadfield, 2017), and optical effects (Cahoon, et al., 2015; Pinkerton, 2017; Pinkerton & Gall, 2015). The sediment model has considered both the <63 µm sediments coming from the hydro-cyclone overflow and the de-ored sand discharge. Modelling was over a nested grid setup and the focal Sediment Modelled Domain (SMD) was a large area from Cape Egmont to Kapiti (13,000 km^2). While the model provides a useful tool to help understand the potential effects of the sediment plume, the true plume dimensions and scale, and therefore impact, can only be predicted until the mining activity commences.

While modelling is a necessary tool to assist in understanding the likely scale and magnitude of effects, models are inherently uncertain, based on the limitations of the input data, the assumptions and the structure of the model itself. When models are used to inform other models (e.g., the outputs of one model become the inputs of another), the uncertainties are not only carried forward but can also compound, as any bias, error, or simplification in the first model propagates into subsequent models. This can amplify both the magnitude and the complexity of uncertainty. It is therefore important that model assumptions, uncertainty (e.g., sensitivity analysis etc) is transparent when using models for decision-making.

Modelling of the potential effects of the proposed project on optical properties was informed by applying the mining activity to two primary sites within the project area for plume dispersion: Site A, located adjacent to the coastal marine area boundary at a depth of 31 m, and Site B, situated on the seaward side of the project area at a depth of 42 m (Figure 4-1).

According to the sediment model (Hadfield and MacDonald, 2015), the prevailing winds and residual currents will direct the plume in an east-southeasterly direction, meaning that the majority of the plume will drift into the Taranaki Coastal Marine Area. At times, the plume may also pool around the mining site or move west or south. The sediment modelling states that the greatest impact of the sediment plume is nearest to the mining site (2-3 km), however net differences between 'background' and 'extraction plus background' at the two model sites (Site A and Site B) were also assessed for locations 2km, 8km and 20km from the extraction locations. These data show:

- An increase in median suspended sediment concentrations (SSC) at the 2km location from 0.4 to 1.5 mg/L and an increase at the 99th percentile from 5.5 to 6.8 mg/L.
- An increase in median SSC at the 8 km location from 0.5 to 1.3 mg/L and an increase at the 99th percentile from 6.9 to 7.1 mg/L.
- An increase in median SSC at the 20 km location from 0.9 to 1.4 mg/L and an increase at the 99th percentile from 10.5 to 10.8 mg/L. (TTR, 2025 - section 5.3.2.3).

Updated worst-case model (Maconald and Hadfield, 2017; Figure 3-5), describes changes in SSC at specific locations of interest including:

- An increase in median SSC at **Project Reef** from 1.6 to 2.2 mg/L and a decrease[1] at the 99th percentile from 12.3 to 11.7 mg/L.

[1] It is unclear how a reduction in SSC is achieved.

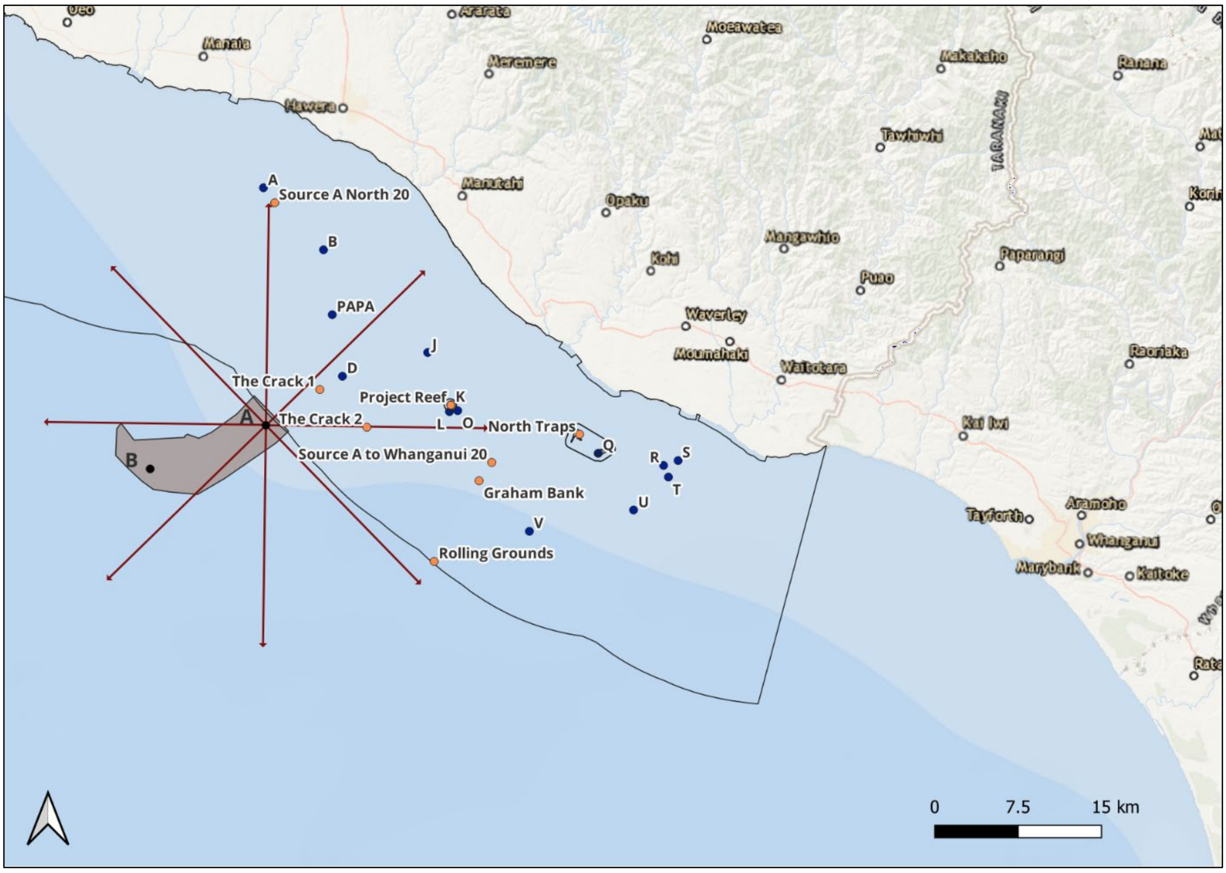

Figure 4-1. Map of project area and sites of interest. Proposed mining site is grey. Red lines are 20km distance in all directions from Site A to understand potential scale of impact on reefs. Blue dots represent known rocky reef sites from Morrison et al., 2022. Orange dots are sites with modelled optical effects from Pinkerton (2017).

4.2 Visibility and light penetration from the sediment plume

Impacts on optical properties of the sediment plume and the associated impacts on primary productivity were assessed in Pinkerton & Gall (2015), Cahoon et al. (2015), and then further updated by request of the Decision-Making Committee (DMC) in Pinkerton (2017).

Optical properties of the water are of specific relevance to TRC due to the linkage between water quality and the habitat forming species present in the Areas of Outstanding Value, and more recently identified reef structures. The reefs contain extensive biogenic habitats including macroalgae (*Ecklonia* forests, *Caulerpa* meadows, and mixed macroalgal meadows), bryozoan fields, and sponge garden (areas of higher sponge cover more than 5 m in width), and support several fish species including blue cod, scarlet wrasse, butterfly perch, leatherjackets and terakihi. Other species are likely to be common (e.g., snapper, trevally, kingfish, and kahawai).

The persistence of these features, particularly macroalgal growth, are highly reliant on water clarity that sufficiently provides for light penetration and photosynthesis.

As expected, effects were shown to be greatest close to the mining operation and decrease with distance from the project area with mining at Site A creating a greater impact.

While the original (Pinkerton and Gall, 2015) mean reductions in light in the water column were estimated to range across a $1km^2$ cell from a maximum of 27% (from mining at Site B) to 46% (from mining at Site A), new estimates based on the worst case scenario altered this to range from a maximum of 32% (from mining at Site B) to 52% (from mining at Site A) (Pinkerton, 2017).

When averaged across the SMD, the original reductions of 1.6% (at Site B) and 1.9% (at Site A), increased to a reduction of 2.4% from mining at site B and 2.9% from mining at site A.

Similarly, the reduction in light at the seabed was modelled, and updated with worst case estimates in Pinkerton (2017). As expected, reductions in the original model were most significant at the location of the mining, from 91% at Site B and 95% at Site A. However, these appear to reduce in the updated modelling to 87% at Site B and 92% at Site A. This may be accounted for by the increased movement of sediments away from the site as the average reductions in light at the seabed increase from the original reductions of 16% (at Site B) and 23% (at Site A), to 21% (at Site B) and 30% (at Site A) (Pinkerton, 2017).

Pinkerton (2017) also included impacts of optical effects on key sites in TRC's CMA. These results are collated in Tables 1 to 4 below. The following effects were included:

- The euphotic zone (vertical distance) is the depth in the water which allows enough light for photosynthesis. Generally, deeper euphotic zones are expected further from the coast over deeper water because the higher suspended sediment load on the coast (Aksnesa & Ohman, 2009) and high phytoplankton in shallower water (Pinkerton, 2017) decrease visibility in the water column at shallower depths close to the shore.
- The proportion of time that light at the seabed exceeds 1% gives an indication of time for potential benthic primary production.
- Horizontal visibility is a measure of water clarity using a black disk.
- "Good visibility days" are the number of days horizontal visibility is more than 5 m

Optical effects at all key stations were 2.19 times greater mining at Site A compared to Site B (except for at Rolling Grounds).

4.3 Assessment of ecological effects from the sediment plume

TTR have undertaken a number of studies, and models have been developed to attempt to understand the impact of its mining operation on the environment including characterising the substrate of the mining site and soft sediment habitats in the surrounding area. These studies have also used complex models to determine the sediment plume suspended sediment concentrations and its optical effects to try and understand the potential impacts on the benthic ecology.

4.3.1 Is the information provided sufficient to ascertain the effects of the activity?

Optical effects

The Manawatu-Wanganui region, managed by the Horizons Regional Council (HRC), is the southern neighbour to the Taranaki region. HRC's regional plan, One Plan, has a coastal water quality target of no change in visual clarity greater than 20% or less than 1.6 m (Horizons Regional Council, 2014). Horizons One Plan also contains provision for no change of greater than 10% in the euphotic zone, however this refers to the region's estuaries rather than the open coastal waters. It is this change in euphotic zone that is likely to have the most impact on values associated with the indigenous biodiversity of the scheduled sites, Project Reef and the Traps.

While there is no specification of visibility or euphotic depth outlined in TRC's Coastal Plan, this target is a reasonable guideline for interpreting mining impacts on water clarity, particularly for habitats with important biodiversity features. Mining would exceed that limit at six of the eight sites investigated.

TTR asserts in both its application and supporting documents that because the STB is an energetic environment, primary producers are used to short-term fluctuations in light availability (Trans-Tasman Resources Ltd Consent Application: Ecological Assessments, 2016). Dr. Cahoon highlights that the STB is affected by several processes including, "coastal currents driven by Tasman Sea circulation as well as flows through Cook Strait, tidal flows, river discharges, and storm events" (C*ahoon*, 2016). The exact direction of the plume will change in its direction and intensity depending on the conditions on the day. However, rocky reefs are spread throughout the southern side of the CMA in the predicted predominant direction of the sediment plume. This means reefs may be impacted regardless of minor shifts in the plume direction. Additionally, unlike the frequent changes in processes affecting the STB, the mining operation is proposed to run for 24 hours a day, 7 days a week, 258 days per year for

20 years. This presents a steady concentration of sediment and reduces a species ability to recover in between pulses of sediment. An intermittent input of sediment from to a river discharge from a high rainfall event, for example, allows for communities to recover between pulses of sediment. This is unlikely to be the case given the consistent inputs from the proposed activity, and given that the discharge is occurring from offshore, an area with typically greater water clarity than the nearshore environment.

Cahoon, et al. (2015) states that optical effects are likely to cease quickly after mining stops. When suspended sediment from mining has been flushed out of the STB region (a process expected to take a few months) optical properties may be expected to return to pre-mining levels within a few days (Pinkerton & Gall, 2015). Considering the planned run time of the operation, it's unlikely the sediment from mining will be flushed out of the STB during the 20-year operation unless the 107 days of proposed 'down time' each year happen consecutively. If that were the case, it would allow for the few months necessary to flush the sediment from the STB. Without that consecutive down time, the optical effects are proposed to last throughout the majority of the 20-year operation. Additionally, that consecutive 'down time' would mean that the plume would persist for 258 days continuously which is likely to provide chronic sediment impacts on the receiving environment.

Primary production

Primary productivity regulates key ecological processes in the coastal ocean including nutrient cycling, variability in trophic structure, and climate change (Salgado-Hernanz et al., 2022). Coastal primary productivity supports the first order of consumers whose abundance influences species at the top of the food chain (Fermepin et al., 2024). The production on continental shelves supports 90% of global fishing (Pauly et al., 2002) and can support populations of marine mammals and seabirds (Cox et al., 2018; Poupart et al., 2017).

Pinkerton (2017) presented updated optical property results at key sites with TRC's CMA. However, TTR's evaluation of the impacts on primary production were not updated following Cahoon, et al. (2015) and the AES ecological assessment. Even though optical properties were modelled at a higher resolution, TTR interpreted the impacts on primary production over the 13,000 km^2 SMD. The justification for this approach was that the resolution for the model is 1 km and any smaller resolution would result in higher impacts to optical properties. Therefore, "mean change in water column light averaged over a large region is a more reliable measure of the predicted effect of mining on primary production in the water column." While this approach allows for an assessment of primary productivity across the SMD, averaging across a large area makes it challenging to detect localised impacts of mining, as the effects of mining become diluted over the wider region. It is noted that this has been consistent feedback on the approach taken since the application was lodged (*see also* Chiffings, 2016).

Given the patchy nature of rocky reefs in the CMA, determining localised impacts is key to understanding the impacts of mining on biodiversity.

Another implication of averaging the impact on primary production across the SMD is that averaging across such a large area makes the overall impact appear reduced. For example, the reduction in light in the water column ranges from 27% (mining at Site B) to 46% (at Site A). When averaged across the SMD, those reductions become 1.6% (mining at Site B) and 1.9% (at Site A).

Despite averaging across the SMD, TTR's assessment concludes that benthic primary production by the microphytobenthos (MPB) will be reduced by 19% (mining at Site A) and 13% (mining at Site B). It also states that the "median plume" moving east over the Pātea Banks is expected to reduce carbon flux to the benthos by up to 40% which could impact higher trophic levels.

TTR also states that the amount of light reaching the seabed in the SMD varies naturally by an average of 32-36% meaning receiving communities are predisposed to variability in photosynthesis like that expected from mining (15-23%; Cahoon, et al., 2015). For communities not adapted to low light conditions, a persistent sediment plume is likely to have adverse impacts. Communities in turbid environments have either been reduced to species that can tolerate that environment or can adapt. However, communities not adapted to long-term sediment disturbance, are unlikely to be predisposed and will be highly impacted by a persistent reduction in light reaching the seabed. Furthermore, differences in localised impacts on light in the water columns are relevant for patch reefs containing *E. radiata* (kelp). It has been demonstrated that a 63% decrease in light in the water column resulted in a 95% decline in kelp productivity (Blain et al., 2021).

TTR's assessment on primary production impacts based on optical modelling states that mining will have small effects on macroalgal production. This assessment is based on two factors. One is that the distribution of macroalgae is poorly known, but where it exists (i.e., the Traps) the impacts from mining are predicted to be small (Cahoon, et al., 2015). Given the updated information regarding macroalgal distribution, and its proximity to the project area, localised assessments of macroalgal primary productivity from the sediment plume are warranted (see Table 1). The second factor is that macroalgae on continental shelves have mechanisms to adapt to low light by, for example, storing photosynthetic products (*Cahoon* 2016). However, increasing turbidity reduces productivity and biomass accumulation of kelp, having implications for successful carbon storage with most of it going to growth and then eroded away (Blain et al., 2021).

Table 1: Adapted summary of macroalgae observations from Morrison et al. (2022), including reefs where *Ecklonia radiata* was present, and reefs where macroalgal species (including E. radiata) were present in sufficient abundance and extent to be considered biogenic landscape elements (i.e. forests and meadows) based on a semi-quantitative assessment of towed video recordings.

Site	Ecklonia radiata presence (section 3)	Ecklonia forest (Table 14)	Caulerpa meadow (Table 14)	Macroalgae meadow (Table 14)
Site A	Yes	Yes	Yes	-
Site B	Yes	-	-	Yes
Site Papa	-	-	-	-
Site D	*	-	-	-
Site J	Yes	-	-	Yes
Site K (Project Reef)	Yes	-	-	-
Site L	Yes	Yes	-	-
Site O	Yes	Yes	-	Yes
Site Q (South Trap)	Yes	Yes	-	-
Site R	Yes	Yes	Yes	-
Site S	Yes	-	Yes	-
Site T	Yes	-	-	-
Site U	Yes	Yes	-	Yes
Site V	Yes	-	-	-

Note:
** Drift plants observed*

4.3.2 Potential effects on macroalgae

As described above, optical properties are highly relevant to the growth and persistence of the ‘important kelp (*Ecklonia radiata*) beds’ identified in ONC 6 – Project Reef and ONC 7 – North and South Traps).

Given its dependence on adequate water clarity and its role as a habitat-forming species, *E. radiata* is both ecologically significant and sensitive to increases in suspended sediment and reductions in underwater light climate, making it a key indicator for assessing the ecological consequences of the proposed mining plume on Areas of Outstanding Value identified in the Taranaki Coastal Plan.

Most species of large brown macroalgae are typically restricted to depths where irradiance is 0.7 – 1.4% of the surface irradiance, and therefore reductions in the amount of time that these conditions are met or exceeded may affect the growth and coverage of these species.

In the assessment on the impacts of changes in seabed light on macroalgae, Cahoon et al. (2015) uses the applied optical model (Pinkerton and Gall, 2015) on the sediment transport model (Hadfield and MacDonald, 2015) to assess the impact on macroalgae. It is noted that given that the model predictions suggest that this area will be reduced to approximately 50% of the background irradiance during mining at site A and 75% during mining at site B, though the shallowest parts of Graham Bank will continue to receive more than 1 mol m-2 d-1, on average. Cahoon et al., 2015 conclude that "*Mining impacts can thus at times be expected to significantly impact on growth of any macroalgae on Graham Bank, though elimination is unlikely".*

Cahoon et al, 2015 also note that the impact of mining on the area of the Traps is expected to reduce the median number of days that more than 1% of incident light reaches the seabed from 138 days/year (background) to 106 days/year (mining at site A) and 127 days/year (mining at site B – taken from Pinkerton and Gall, 2015). Cahoon et al, 2015 conclude that "*some reduction in macroalgae and coverage may occur at the Traps*".

The amount of time that incident light reaches the seabed is an important factor in photosynthetic production versus respiration loss. At lower levels photosynthetic production matches respiratory losses, and species have the potential to reach net negative production. Light availability that exceeds respiratory losses is required for growth and persistence. Additionally, different algae have different light requirements, suggesting that species specific consideration should be given to the key habitat forming species growing within, and down plume, of the proposed site.

Given this conclusion, it is not immediately clear why these predicted effects were not updated to reflect the worst-case scenario modelling, which increased the predicted reductions in incident light days at Areas of Outstanding Value from a background of 141 median days/year (background) to 96 and 124 days (mining at sites A and B respectively) at North Trap, and an increase in the reduced incident light days from 140 median days/year (background) to 76 and 111 days (mining at sites A and B respectively) at Project Reef (Appendix 1 – Table 2).

The potential effects on macroalgal primary productivity resulting from the reductions of incident light days on reefs closer to the operations than Project and North and South Traps, have not been considered.

It is noted that although an update to the assessment was not undertaken, Dr Cahoon did provide supplementary evidence in April of 2017 that considered the Pinkerton, 2017 report. However, in contrast to the previous assessment, no comment was made on benthic macroalgae (Cahoon, 2017).

The AES ecological assessment states that, "There would be some reduction in growth of macroalgae but because most of these are found inshore where background suspended sediment concentrations are high, any effects are likely to be no more than minor and indistinguishable from background." However, the location of the macroalgae in TRC's CMA has not been fully determined, with increasing evidence of unique offshore reefs (Morrison et al., 2022), and specific tolerances of algal species to light level reductions do not appear to have been considered.

4.3.3 Are the conclusions reached supported by the data presented?

High sediment loads can have major impacts on rocky reef species growth, survival and/or photosynthetic activity which can result in distinct morphological or life history traits, weakened species interactions, or direct smothering (Airoldi, 2003). Sediment can also cause indirect effects including limiting a predator's ability to see their prey (Airoldi, 2003).

The AES ecological assessment highlights some limits of periodic SSCs for species in the STB. However, some of these species are located within the intertidal zone (*Zeacumantus lutulentus*) or less than 10 m depth (*Paphies australis*) and do not adequately represent species likely to be affected by the sediment plume.

TTR states that, "For larvae of rocky reef species that occur near-shore, the mining will only slightly increase suspended sediment concentrations or decrease light conditions in the water column thus effects will be minimal on their larval and adult populations." However, it's unclear which species they are referring to and how the impacts of increasing SSCs and/or decreased light conditions are assessed to determine the impact is minimal.

Sediment deposition effects have been assessed as, "virtually indistinguishable from naturally occurring background levels and will have negligible, if any, effects on benthic communities outside the excavation pit and immediate surrounding area." However, as mentioned in TTR's application, "attachment of [macroalgal] germlings can be impacted by a light dusting of sediment (Schiel et al., 2006)." Additionally, Wernberg et al. (2019), found that while adult kelp (*E. radiata)* can survive under a range of sediment loads, attachment and burial of microscopic stages is limited by sediment and competition from more sediment tolerant, but less habitat forming turfing algae (Connell, 2007). This implies that a large area impacted by depositional thicknesses less than 0.05 mm could result in reduced algal recruitment and cover over time, impacting biodiversity on subtidal reefs.

There are current gaps in information which constrain the ability to confidently determine the scale and significance of potential impacts. The lack of updated primary production assessment based on information regarding the presence of key reef features along the STB, and in conjunction with worst-case scenario testing, has resulted in insufficient detail to assess the scale and magnitude of effects on the growth and persistence of important kelp forests on these reefs.

4.3.4 Are there any areas outstanding that need addressing?

The sediment model setup is complex and includes many data sources. The oceanographic data was collected at 10 sites in and around the mining area (Macdonald et al., 2015). The deployments lasted for 7 months in total with uneven coverage across seasons and variable conditions across a year (i.e., all of spring and summer, 6 weeks of autumn and one month of winter). Oceanographic conditions are known to vary across seasons (de Burgh-Day et al., 2019), and within larger temporal scales such as oscillation and interdecadal scales. Additionally, not all sites were sampled at the same time. Conditions at Site A and Site B were observed at different times of the year and for different length surveys which suggests the sediment plume modelling is calibrated to different conditions across sites.

The AES ecological assessment specifies that, "at the local scale close to the site, reductions in benthic primary production would exceed natural variability and there could be localised flow on effects, but productivity would return to previous levels once activities ceased." This highlights the importance of determining localised impacts, particularly for areas not considered in previous assessments.

The size of the depositional area is not provided, except that it is, "extensive." The figures used in the application are at too coarse of a scale to determine the total area size and location. This makes it difficult to assess the impact of the sediment deposition on the receiving environment.

TTR's application mentions the presence of rocky reefs in their Environmental Setting section but does not address the impact on these reefs in the assessment of effects or provide evidence relevant to species on those reefs. Morisson et al., (2022) and evidence from TTR's court proceedings state that areas of rocky reefs are common and are highly likely present but have yet to be formally mapped. Members of the community have shared their fishing and diving spots with TRC include some reefs that have not been formally mapped. These are in the potential path of the plume.

Summary - Reefs and modelling approach:

- The current application does not appear to fully address potential impacts on reefs identified since the initial assessment of effects, or whether these have been assessed under the latest worst-case scenario testing for optical and primary production effects (Pinkerton et al., 2017) and using the most appropriate plume modelling approach (e.g., near-field versus far-field).

- This issue is highlighted in the rebuttal evidence of Dr Michael Dearnaley (2024, para. 18), who notes that new reefs have been identified in proximity to the Pātea Shoals. If these reefs fall within approximately 3 km of the mining operations, their potential exposure to effects would be more appropriately considered using near-field plume modelling, rather than the far-field approach adopted by NIWA.
- The calibration of the sediment plume model across different years and timeframes introduces potential uncertainty. The panel may need to weigh how this affects confidence in whether the model accurately reflects oceanic conditions.
- There remains a lack of clarity around the interaction of two sediment discharge sources, particularly the mechanism by which de-ored sand is expected to trap finer sediment. The panel may need to reflect on how this uncertainty affects the weight given to conclusions about sediment dispersal.
- The size and extent of the depositional area is not fully defined, limiting the ability to accurately assess the magnitude of sedimentation effects on the receiving environment.
- The absence of an updated assessment of localised impacts on reef habitats and associated species (e.g., Morrison 2022) creates uncertainty that the panel may wish to consider in its evaluation of ecological effects.
- The panel may therefore wish to consider how this uncertainty regarding reef locations and the modelling framework affects confidence in conclusions about potential impacts on reef ecosystems.

This will assist consideration against the following policies:

New Zealand Coastal Policy Statement (2010)

- Policy 11 – Indigenous biological diversity
- Policy 13 – Preservation of natural character
- Policy 15 – Natural features and natural landscapes
- Policy 22 – Sedimentation
- Policy 23 – Discharge of contaminants

Taranaki Regional Policy Statement (2010)

- CNC Policy 2 – The protection of natural character
- CNC Policy 4 – Protection of areas of importance to the region
- CWQ Policy 2 – Discharges from ships and other installations
- BIO Policy 2 – Adverse effects on indigenous biodiversity

- BIO Policy 5 – Ecosystems, habitats or areas with indigenous biodiversity values

Taranaki Regional Coastal Plan (2023)

- Policy 1(a) – Coastal management areas of outstanding value
- Policy 1(d) – Coastal management areas of the open coast for marine systems and habitats.
- Policy 3 – to adopt a precautionary approach where effects are uncertain, unknown or little understood but potentially significantly adverse.
- Policy 9 (a) – avoiding adverse effects of activities on the values of areas identified in Schedules 1 & 2.
- Policy 15 &16 – Indigenous biodiversity

5.0 Wider ecological effects (incl. benthic ecology)

5.1 The effects on seabirds

As part of the TTR application, Thompson (2013; updated 2015) investigated how artificial lighting from the vessels associated with the activity might affect fish, squid, and seabird species in the project area. MacDiarmid et al. (2015) explored the project's ecological impacts on seabirds, with an emphasis on species such as Gibson’s albatross, Westland petrel, sooty shearwater, red-billed gull, and little blue penguin. Thompson (2023) provided updated information on seabirds and the potential effects of mining activities, sediment plumes, and commercial fishing operations. Several joint statements in the field of “effects on seabirds” were convened and the most recent and relevant information is discussed below.

There has been general consensus that the STB is within the Cook Strait Important Bird and Biodiversity Area and is, therefore, of international significance for the conservation of seabirds, containing a number of ‘threatened’ and ‘at risk’ taxa (as defined by the New Zealand Threat Classification System), occurring within the STB (conservatively ten and 24 taxa, respectively) year-round or seasonally. Furthermore, the area from South Taranaki to Cook Strait is recognised as a ‘Significant Seabird Area’ under section 4B of the Taranaki Coastal Plan. Many of the species that utilise the South Taranaki Bight are also listed in section 4A as Threatened, At Risk, or Regionally Distinctive. Together, these schedules provide the basis for Policy 15, which seeks to protect significant indigenous biodiversity within the Taranaki coastal environment.

It was identified by the experts that no systematic surveys had been undertaken with regard to seabirds in the STB, and that relevant information (a 2014 list of seabirds from Dr Paul Schofield) had not been included in the 2017 evidence, and the unique characteristics of the STB as a key area for seabirds is now more widely recognised. The designation by the IUCN of the Cook Strait and Marlborough Sounds key biodiversity areas (KBAs; "the most important places in the world for species and their habitats") was not included in evidence presented to the DMC in 2017, despite the two species that trigger the KBA status, the grey faced petrel (*Pterodroma macroptera gouldi*) and the Bullers shearwater (*Puffinus bulleri*), also appearing in schedule 4A of the Taranaki Coastal Plan. These KBAs include all the waters of the STB, Cook Strait, and the inner waters of Marlborough Sounds.

Potential effects on seabirds, including the little penguin (*Eudyptula minor*) who travel to feed in the STB, and the relict fairy prions (*Pachyptila turtur*) were inconclusive, with experts unable to agree on the magnitude of effects. These effects were primarily considered to relate to displacement, the effect of the sediment plume on foraging, noise, lighting and potential oil/fuel spills.

The Integrated Mining Vessel (IMV) is large measuring >300 m length and will be a permanent feature in the STB over approximately 20 years. It is likely to become attractive for migratory and nearby seabirds (e.g., creating an artificial island attracting seabirds, specifically at night and during bad weather), which may lead to increased mortality.

However, it is expected that with appropriate mitigations for lighting (e.g., downward facing and specific tones) these potential effects may be able to be reduced. That said, the effect of the sediment plume on foraging activity remains an area of contention between experts.

Based on updated evidence provided by Dr David Thompson in May 2023, a total of 45 seabirds and 11 shorebirds are likely to occur in or adjacent to the South Taranaki Bight (STB). Of these, 11 seabirds and two shorebirds are classified as 'Threatened', and 24 seabirds and seven shorebirds as 'At Risk' (Robertson, et al., 2021). The list contains seven species classified as 'Endangered' and eight as 'Vulnerable' by the IUCN Red List[2] which fall in the IUCN 'Threatened categories'[3]. Adverse effects of activities on these species must be avoided in accordance with Policy 11 of the New Zealand Coastal Policy Statement (NZCPS) (2010).

5.1.1 Is the information provided sufficient to ascertain the effects of the activity?

Based on the information provided there does not appear to be sufficient information to fully and confidently assess the impacts of the mining activity on seabirds in the South Taranaki Bight (STB).

[2] https://www.iucnredlist.org/

[3] https://www.iucnredlist.org/about/faqs

The 2017 Decision-Making Committee (DMC) already noted "a lack of detailed knowledge about habitats and behaviour of seabirds in the STB". In response to this, TTR filed primary and rebuttal evidence of Dr David Thompson addressing the potential effects of the activity on seabirds, however no further information was obtained. This is despite Dr Thompsons earlier statement that "detailed, systematic and quantitative information on the at-sea distribution of virtually all species is currently lacking" (Thompson, 2015).

Site-specific data on seabird presence, distribution, foraging areas, and behavioural patterns remain limited, which makes it difficult to quantify potential population-level or long-term impacts, and there is little indication that these knowledge gaps have been substantially filled since the 2016 application.

How the proposed activity is able to 'avoid adverse effects of activities on indigenous taxa that are listed as threatened or at risk' under Policy 11a of the NZCPS (2010), should also be considered given that the experts agreed that "large numbers of seabirds may be present in the STB at night, including the proposed mining area, and that there is potential for significant mortality of seabirds attracted to mining vessel lights" in the Joint Statement of Effects in 2017 and 2024.

Summary - Seabirds:

- Based on the evidence, there does not appear to be sufficient information to fully and confidently assess the impacts of the mining activity on seabirds in the South Taranaki Bight (STB).
- The 2017 Decision-Making Committee (DMC) already noted "a lack of detailed knowledge about habitats and behaviour of seabirds in the STB," and there is little indication that these knowledge gaps have been substantially filled since the 2016 application.
- Site-specific data on seabird presence, distribution, foraging areas, and behavioural patterns remain limited, which makes it difficult to quantify potential population-level or long-term impacts.
- There are potential mitigations available to reduce the attractiveness of the IMV to birds.

The following policies are relevant when considering the impacts of the proposed activity on seabirds:

New Zealand Coastal Policy Statement (2010)

- Policy 11 – Indigenous biological diversity
- Policy 13 – Preservation of natural character
- Policy 23 – Discharge of contaminants

Taranaki Regional Policy Statement (2010)

- CWQ Policy 2 – Discharges from ships and other installations
- BIO Policy 2 – Adverse effects on indigenous biodiversity
- BIO Policy 5 – Ecosystems, habitats or areas with indigenous biodiversity values

Taranaki Regional Coastal Plan (2023)

- Policy 1(d) – Coastal management areas of the open coast for marine systems and habitats.
- Policy 3 – to adopt a precautionary approach where effects are uncertain, unknown or little understood but potentially significantly adverse.
- Policy 15 & 16 – Indigenous biodiversity

5.2 The effects on marine mammals

A range of scientific reports and evidence has been used to inform the assessment of potential effects on marine mammals associated with the proposed activity. The evaluation draws on systematic aerial surveys conducted over a two-year period (Martin Cawthron Associates, 2013), Department of Conservation (2023) marine observer records, published literature (MacDiarmid et al., 2013), habitat modelling studies (Torres et al., 2013; Derville et al., 2016), marine mammal distribution analyses (MacKenzie et al., 2016), and cetacean species distribution modelling (Stephens, 2020a; 2020b).

Joint statement of experts in the field of “effects on marine mammals” were convened in 2014 and 2017, with a third on 19 February 2024. The 2017 Joint Statement formed the starting point of the 2024 discussion. The main effects consideration related to the effects of noise, vessel strike, and the effects of the sediment plume on foraging and wider food web disturbance.

A total of 41 marine mammal species were recorded in the STB within the DoC sighting and stranding database (Childerhouse, 2023). This includes several ‘Threatened’ and ‘At Risk’ species including bottlenose dolphin, Hector’s dolphin, Maui dolphin, leopard seal, New Zealand sea lion, pygmy blue whale, killer whale (orca) and southern right whale, which are also listed in the Taranaki Regional Coastal Plan Schedule 4A. These species meet the criteria specified in Policy 11 (a) of the NZCPS (2010) and adverse effects on these species must be avoided. Childerhouse (2023) confirms that the STB region is an area of high marine mammal diversity, and some parts represent important habitat and foraging areas.

Of the species recorded via DoC sightings, only one record was within the proposed mining area, and six within a 5 km buffer and 6 within a 10 km buffer around the proposed mining area. The updated information still does not provide useful information about the marine mammals that occur with the proposed mining area and how they use it (Childerhouse, 2023).

It is also worth noting that since this application was submitted, a new sighting of two dolphins of the *Cephalorhynchus* genus (which could have been either Hector's or Maui dolphins) was recorded in the South Taranaki Bight near the Kaūpokonui Stream mouth in approximately 8 metres water depth (approximately 20 km northwest of Hāwera and 40 km northwest of Pātea). This sighting took place on 25 April 2025 and has since been verified and included DOC's Maui and Hector's dolphin database. The dolphins were travelling south along the coastline (Jesu Valdes, pers. comm.).

Additionally, the STB is an important habitat and foraging area for blue whales, of which Antarctic blue whales are 'Endangered' and pygmy blue whales are classed as 'Data deficient' by IUCN. It is also understood that that blue whales use STB for courting and mating in addition to foraging, and that calves have been observed in the STB.

Based on the information provided in the TTR application, the assessment of noise effects on marine mammals primarily relies on modelling of the Integrated Mining Vessel (IMV) and seabed crawler operations, rather than any in situ measurements. The proposed maximum operational noise threshold of 135 dB is used as a compliance benchmark, but there is limited empirical data to confirm how this threshold reflects actual conditions in the South Taranaki Bight. Consequently, there is some uncertainty about the potential effects of noise on marine mammal behaviour, distribution, and foraging, particularly for sensitive or endangered species such as blue whales, Hector's and Maui dolphins, and New Zealand sea lions.

There was general agreement between the experts in the 2024 caucusing that careful consideration is required when determining the magnitude and scale of effects of an activity on species, especially those that are close to extinction. Several agreements were also made about the uncertainty of the underpinning datasets for the marine mammal modelling, which were derived from incidental sightings.

5.2.1 Is the information provided sufficient to ascertain the effects of the activity?

Based on the information provided throughout the application, it is difficult to assess the potential for effects on marine mammals. This is also noted in the Supreme Court decision (para 129), which recognises that paucity in information about effects cannot be conditioned out due to the fact that given 'the uncertainty of the information, it was not possible to be confident that the conditions would remedy, mitigate or avoid the effects'.

Summary marine mammals:

- The panel may wish to consider whether the existing baseline data on marine mammal populations and behaviours are sufficient to evaluate the potential impacts of the proposed mining activities.
- The panel may wish to take into account that the described uncertainty could influence the ability to fully assess the magnitude and significance of potential noise-related impacts on marine mammals both directly and during foraging.

The following policies are relevant when considering the impacts of the proposed activity on marine mammals:

New Zealand Coastal Policy Statement (2010)

- Policy 11 – Indigenous biological diversity
- Policy 13 – Preservation of natural character
- Policy 23 – Discharge of contaminants

Taranaki Regional Policy Statement (2010)

- CWQ Policy 2 – Discharges from ships and other installations
- BIO Policy 2 – Adverse effects on indigenous biodiversity
- BIO Policy 5 – Ecosystems, habitats or areas with indigenous biodiversity values

Taranaki Regional Coastal Plan (2023)

- Policy 1(d) – Coastal management areas of the open coast for marine systems and habitats.
- Policy 3 – to adopt a precautionary approach where effects are uncertain, unknown or little understood but potentially significantly adverse.
- Policy 15 & 16 – Indigenous biodiversity

5.3 The ecological effects of a reduction in polychaete worms in the mining area

The proposed activity has generated considerable information on the subtidal ecology of the STB. Beaumont et al. (2013) conducted underwater video and still images at 144 locations to describe seabed habitats and macrobenthic communities, 331 surface sediment samples, including infaunal organisms, were collected from 103 sites. Additionally, benthic dredging at 116 sites yielded specimens of benthic macrofauna and macroflora. Anderson et al. (2013) conducted assessments of the benthic habitats, macrobenthos and surficial sediments at 36 nearshore and cross-shelf sites of the SBT. These and supplementary evidence (McClary, 2014; MacDiarmid, 2016) and 'Joint

Statement of Experts in the fields of: benthic ecology (2017), and sediment plume modelling and effects on benthic ecology (2024) were used to assess the potential effects of the proposed mining activities on polychaete worms ("wormfields") in the TTR application (2025).

Wormfields occurred at 20% (approx. 29 sites) of the 144 samples sites (Beaumont et al., 2013) (Figure 5-1). The dominant infaunal species, an undescribed sabellid tubeworm, referred to as *Euchone* sp. A, accounted for 34% of all polychaetes and 15% of total infauna. It was widespread across the central and northern mid-shelf in fine to medium sands, though it remains unclear whether sediment type influences its distribution or vice versa. Anderson et al. (2013) did not report the same abundance and dominance of polychaetes within the nearshore zone.

Previous studies related to the Kupe gas line to the north of the proposed mining site (Page et al., 1992) demonstrated a similar density of *Euchone* sp. A to that found within the current project site. However new taxa associated with the wormfields were identified in Beaumont et al. (2013), and it is outlined that it is unknown whether the new taxa are unique to the proposed mining area, or Pātea Shoals, as the shallow benthic environments along the west coast have to date been very poorly studied. This highlights both the sensitivity and the lack of knowledge around worm species of the STB area.

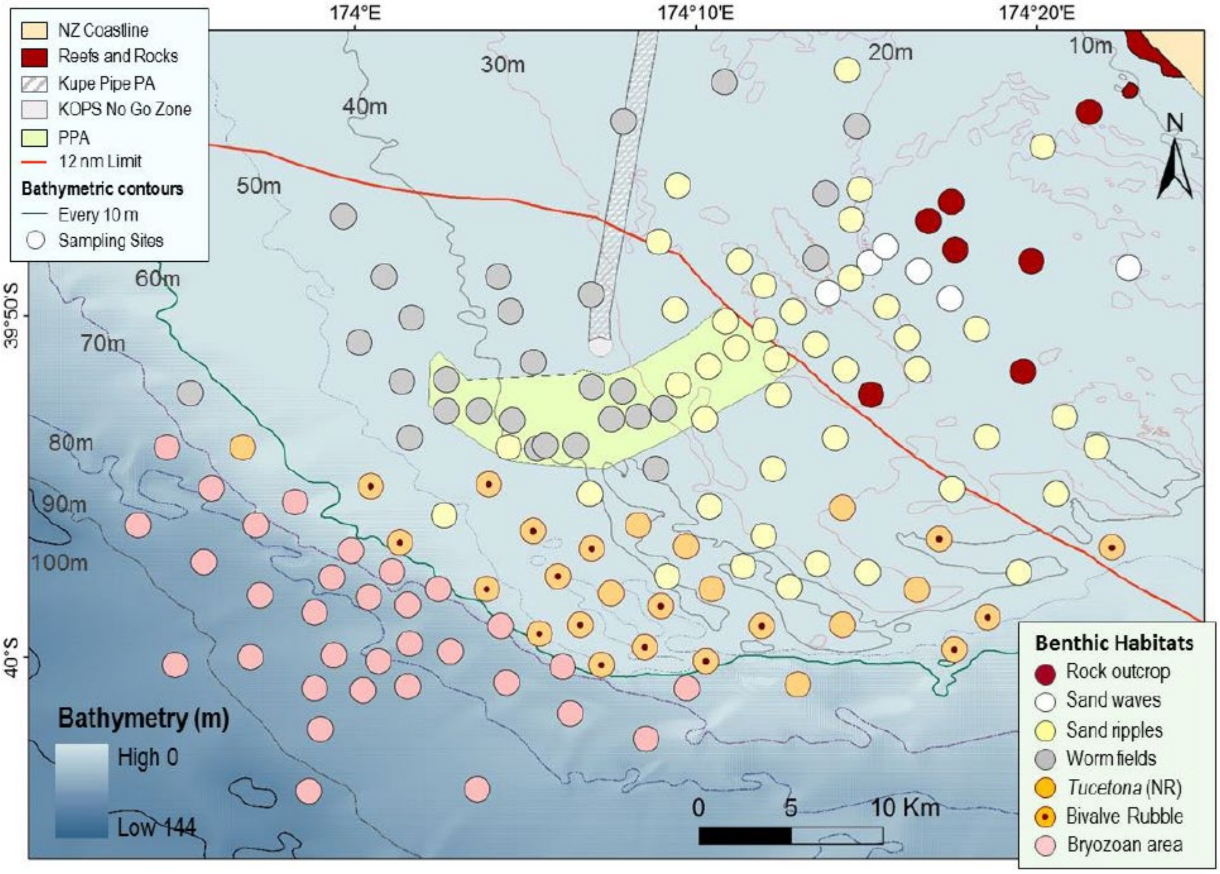

Figure 5-1: Seabed habitat types recorded at the 144 Beaumont et al. (2013) sampling sites.

Joint Statement of Experts in the fields of benthic ecology (2017); and sediment plume modelling and effects on benthic ecology (2024) were convened. However this was not specific to polychaetes, and therefore information with respect to the impacts of the proposed activity on polychaetes was taken more broadly from these discussions.

It is considered likely that given the small spatial footprint of the mining area at any one time (approximately 0.3% of the STB between 20 to 40 m depth), that recolonisation of seabed biota would occur, and flow on effects on food webs may be minimal. Timescales for this recovery have been estimated as 'months to a year' (MacDiarmid, 2023), although this is likely to vary significantly based on species generation times and how the mining operation is undertaken. For example, if large patches of the seafloor are mined in consecutive stages, recolonisation will be inhibited as adjacent areas will also be depauperate. Benthic fauna will need to have source populations within range to enable recolonisation.

Euchone and other opportunistic polychaete species identified in the area are considered early-stage colonisers and are relatively short-lived genera (MacDiarmid, 2016). Evidence provided by and McClary (2014) indicates that recolonisation of benthic communities, specifically polychaetes, in areas previously disturbed by dredging or similar (i.e., Hauraki Gulf & Lyttleton Harbour) was rapid (between 4 to 12 months). Therefore, recolonisation, provided sufficient source populations are present in sufficient density in proximity, is likely to be within the range described above.

5.3.1 Is the information provided sufficient to ascertain the effects of the activity?

There is a large amount of information provided on the benthic ecology of the proposed area, and in general the statements made are generally supported by the data. Despite this, there was broad agreement among experts that additional survey effort is necessary to identify sensitive benthic habitats within 2 km of the proposed mining area.

With regard specifically to polychaetes, given the small spatial footprint of the mining area at any one time (approximately 0.3% of the STB between 20 to 40 m depth), it is likely that recolonisation of seabed biota would occur, and flow on effects on food webs may be minimal.

Caveats to that statement include the presence of novel species where ecology is unknown, and that recolonisation potential relies on source populations within proximity to the area for recolonisation.

6.0 Conclusions

TTR has undertaken an extensive array of technical investigations and modelling to support previous applications for consent. The current application under the Fast-track Approvals Act (2024) has also benefited from further work requested by, and as responses to questions raised by the DMC.

There are, however, areas where further consideration and/or information may be required to accurately assess the impacts of the proposed activity, particularly on the sensitive benthic habitats that have recently been identified by TRC.

The review has identified several areas where further information is considered to not be of a sufficient resolution or scale for a determination on the magnitude of effects to be determined.

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Appendix 1: Optical Effects Tables

Table 1. Median euphotic zone depth for background levels versus modelled from Pinkerton (2017). Sites are listed by approximate proximity to Site A.

Site	Km from Site A	Background (m)	Mining at Site A (m)	Change when mining at Site A	Mining at Site B (m)	Change when Mining at Site B
The Crack 1	6	24.3	15.3	-36.90%	20.6	-14.90%
The Crack 2	9	24.9	14.2	-42.90%	20.2	-18.90%
Project Reef	17	20.2	14.7	-27.30%	18.1	-10.30%
Graham Bank	20	23.2	15.5	-33%	19.3	-17%
Rolling Grounds	20	27.9	26.7	-4.30%	24.8	-11.10%
Source A to North 20	20	16.8	15.9	-5.10%	16.5	-1.90%
Source A to Whanganui 20	20	23.1	15.4	-33.10%	19.5	-15.40%
North Traps	28	15	12.2	-19.20%	14	-6.90%

Table 2. Median days per year of >1% light at the seabed for background levels versus modelled from Pinkerton (2017). Sites are listed by approximate proximity to Site A.

Site	Km from Site A	Background (days)	Mining at Site A (days)	Change when mining at Site A (days)	Mining at Site B (days)	Change when Mining at Site B (days)
The Crack 1	6	142	47	-95	98	-44
The Crack 2	9	140	24	-117	87	-54
Project Reef	17	140	76	-64	111	-29
Graham Bank	20	205	81	-125	141	-64
Rolling Grounds	20	-1	-4	-4	-2	-1
Source A to North 20	20	132	114	-18	125	-8
Source A to Whanganui 20	20	200	84	-116	147	-53
North Traps	28	141	96	-45	124	-17

Table 3. Median good visibility days per year for background levels versus modelled from Pinkerton (2017). Sites are listed by approximate proximity to Site A.

Site	Km from Site A	Background (days)	Mining at Site A (days)	Change when mining at Site A (days)	Mining at Site B (days)	Change when Mining at Site B (days)
The Crack 1 - Midwater	6	229	108	-121	192	-37
The Crack 1 - Seabed	6	211	86	-124	171	-40
The Crack 2 - Midwater	9	220	87	-133	179	-41
The Crack 2 - Seabed	9	211	73	-138	166	-45
Project Reef - Midwater	17	189	119	-70	166	-22
Project Reef - Seabed	17	176	106	-70	155	-21
Graham Bank - Midwater	20	208	114	-94	171	-37
Graham Bank - Seabed	20	197	102	-95	160	-37
Rolling Grounds – Midwater	20	262	254	-8	239	-23
Rolling Grounds – Seabed	20	255	247	-8	223	-32
Source A to North 20 - Midwater	20	146	133	-13	138	-7
Source A to North 20 - Seabed	20	113	99	-14	104	-9

Table 3. Median good visibility days per year for background levels versus modelled from Pinkerton (2017). Sites are listed by approximate proximity to Site A.

Site	Km from Site A	Background (days)	Mining at Site A (days)	Change when mining at Site A (days)	Mining at Site B (days)	Change when Mining at Site B (days)
Source A to Whanganui 20 - Midwater	20	211	120	-92	180	-32
Source A to Whanganui 20 - Seabed	20	203	109	-94	169	-35
North Traps - Midwater	28	134	100	-34	122	-12
North Traps - Seabed	28	126	91	-35	112	-14

Table 4. Median horizontal visibility per year for background levels versus modelled from Pinkerton (2017). Sites are listed by approximate proximity to Site A.

Site	Km from Site A	Background (m)	Mining at Site A (m)	Change when mining at Site A	Mining at Site B (m)	Change when Mining at Site B
The Crack 1 - Midwater	6+B48:G63	6.9	3.2	-54.50%	5.3	-23.60%
The Crack 1 - Seabed	6	6.2	2.8	-54.40%	4.7	-24.60%
The Crack 2 - Midwater	9	6.7	2.9	-57.30%	4.9	-27.10%
The Crack 2 - Seabed	9	6.2	2.6	-57.90%	4.5	-27%
Project Reef - Midwater	17	5.2	3.4	-34.10%	4.4	-14.90%
Project Reef - Seabed	17	4.7	3.1	-34.20%	4	-15.70%
Graham Bank - Midwater	20	6.1	3.3	-45.20%	4.6	-23.30%
Graham Bank - Seabed	20	5.7	3.1	-46.10%	4.3	-24.50%
Rolling Grounds – Midwater	20	9.1	8.4	-7.30%	7	-22.70%
Rolling Grounds – Seabed	20	8.3	7.7	-7.30%	6.3	-24%
Source A to North 20 - Midwater	20	3.8	3.5	-6.70%	3.6	-4.30%
Source A to North 20 - Seabed	20	3.1	2.9	-5.90%	3	-3.20%

Table 4. Median horizontal visibility per year for background levels versus modelled from Pinkerton (2017). Sites are listed by approximate proximity to Site A.

Site	Km from Site A	Background (m)	Mining at Site A (m)	Change when mining at Site A	Mining at Site B (m)	Change when Mining at Site B
Source A to Whanganui 20 - Midwater	20	6.5	3.4	-47.10%	4.9	-24.60%
Source A to Whanganui 20 - Seabed	20	5.9	3.2	-45.30%	4.6	-22.60%
North Traps - Midwater	28	3.4	2.6	-24.80%	3.1	-7.90%
North Traps - Seabed	28	3.2	2.4	-23.70%	2.9	-9.70%