

**BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY
AT WELLINGTON**

IN THE MATTER of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (**EEZ Act**)

AND

IN THE MATTER of an application for marine consent under section 38 of the EEZ Act by Trans-Tasman Resources Limited to undertake iron ore and processing operations offshore in the South Taranaki Bight

BETWEEN **Trans-Tasman Resources Limited**
Applicant

AND **Environmental Protection Authority**
EPA

AND **Fisheries Inshore New Zealand Limited, New Zealand Federation of Commercial Fishermen Inc, Talley's Group Limited, Southern Inshore Fisheries Management Company Limited and Cloudy Bay Clams Limited**
Fisheries Submitters

**SUPPLEMENTARY STATEMENT OF EVIDENCE OF
GREGORY MATTHEW BARBARA FOR FISHERIES SUBMITTERS**

Dated: 19th May 2017

In response to DMC Minute 41

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INTRODUCTION

1. My name is Gregory Matthew Barbara.
2. I completed my primary statement of evidence for the Fisheries Submitters on 8 January 2017. My qualifications and experience are set out at paragraphs [3] to [9] of my primary evidence.
3. I participated in the first expert conference sessions on Sediment Plume Modelling 13 February 2017,¹ Effects of sediment plume on primary production 14 February 2017², Effects on (commercial) Fishing 14 February 2017³, Effects on Benthic Ecology 15 February 2017⁴, Effects on Fish 16 February 2017⁵, Effects on Marine Mammals 20 February 2017⁶ and the second expert conference on Sediment Plume Modelling – Setting Worst Case Parameters - on 23 February 2017.⁷
4. I prepared a supplementary statement of evidence on the “materiality” of the additional sediment plume modelling undertaken by Trans-Tasman Resources Limited (TTR) following the second conferencing session of Sediment Plume Modelling experts.⁸ I also addressed TTR’s plume information in my statement of evidence in reply to Dr Robertson.⁹ This is my fourth statement of evidence that I have prepared in relation to plume information presented by TTR during this hearing.

¹ Joint Statement of Experts in the Field of Sediment Plume Modelling, dated Monday, 13th February 2017.

² Joint Statement of Experts in the Field of Primary Production, dated Tuesday, 14th February 2017.

³ Joint Statement of Experts in the Field of (Commercial) Fishing, dated Tuesday, 14th February 2017.

⁴ Joint Statement of Experts in the Field of Benthic Ecology, dated Wednesday, 15th February 2017.

⁵ Joint Statement of Experts in the Field of Fish Ecology, dated Thursday, 16th February 2017.

⁶ Joint Statement of Experts in the Field of Marine Mammals, dated Monday, 20th February 2017.

⁷ Joint Statement of Experts in the Field of Sediment Plume Modelling – Setting Worst Case Parameters, dated Thursday, 23rd February 2017

⁸ Supplementary statement of Dr Gregory Matthew Barbara, dated 10th April 2017.

⁹ Supplementary evidence in reply of Dr Greg Barbara to the expert evidence of Dr Donald Robertson, dated 3 March 2017.

CODE OF CONDUCT

5. I have read the Environment Court Code of Conduct for expert witnesses and agree to comply with it.
6. I confirm that the topics and opinions addressed in this statement are within my area of expertise except where I state that I have relied on the evidence of other persons. I have not omitted to consider materials or facts known to me that might alter or detract from the opinions I have expressed.

PURPOSE AND SCOPE OF EVIDENCE

7. I have been retained by the Fisheries Submitters to prepare evidence for the assessment of TTR's proposed mining activities on fisheries and the supportive ecosystem within the South Taranaki Bight (**STB**).
8. This supplementary statement of evidence is prepared in response to:
 - (a) the three questions posed by the Decision Making Committee (**DMC**) in Minute 41 Appendix 2;
 - (b) the provision by TTR and my subsequent review of the Supplementary Evidence from Dr Alison Bronwyn MacDiarmid, Dr Lawrence B. Cahoon, Dr Mark Richard James 2 May 2017, and the Report on 'Optical effects of proposed iron-sand mining in the South Taranaki Bight region - worst case update' prepared by Pinkerton (2017); and
 - (c) Dr Mitchell's Supplementary Evidence in Response to Questions from the DMC, 2 May 2017, pertaining to the revised marine consent conditions.

QUESTION 1

When, where, and to what extent will elevated SSC levels cause environmentally significant changes (for benthos, primary production, fish) arising from light received. Decreased primary production is an example. What comprises a “significant” change should be specifically addressed.

9. As stated in my supplementary statement of evidence, dated 10 April 2017, several worst-case parameters for the model could not be determined due to lack of baseline data. As such a number of important parameters for a worst-case scenario, such as percentage of fines in plume, were not agreed upon for developing the model. Instead TTR proposed substituted “indicative” values in place of verified worst case values. This has resulted in the creation of an updated model that still does not represent a “worst-case scenario” but rather a “worse” case model.
10. A worst-case scenario is meant to include all of the most extreme events that could possibly happen, even the rare events. However, the current model has excluded unlikely events such as particle size distribution (**PSD**) concentrations beyond 2.25% being mined for greater than 21 days (as TTR proposed not to mine under those conditions), peak wave and extreme weather conditions. Therefore, the plume information that the DMC has asked the plume experts to review is not representative of a worst-case scenario.
11. What is shown in the revised suspended sediment concentration (**SSC**) model is that even with only a 21-day pulse of 2.25% fines the plume would extend into areas of sensitive benthic habitat and result in decreases of light reaching the benthos (Pinkerton, 2017). Pinkerton (2017) predicted from the revised model that there would be a 44% reduction in primary productivity and 30% decrease in light reaching the seabed from the original model due to the 2.25% pulse of fines. The actual decrease in primary productivity (etc.) is not clear from Pinkerton’s 2017 report, as the background levels used in the original and revised model are different. Background levels should be the same as there has been no additional environmental data collected since the

2015 Pinkerton and Gall optical effects report.¹⁰ If new background data has become available then an explanation as to why the present Pinkerton study has used lower background levels needs to be justified and the previous background recalibrated so that percentage changes in light/visibility and euphotic zone depth and >1% light at seabed can be interpreted fairly.

12. Dr. Cahoon states in his supplementary evidence¹¹ the reduction in light is not significant because the microalgae on unconsolidated sediments are motile and can move elsewhere, however this is not true for the macroalgae that grow attached to the clay banks in the STB. Areas of non-motile/sessile organisms will be subjected to increased sedimentation and reduction light. As the model is not a worst-case scenario, it is not possible to determine the extent of the elevated SSC levels. What we do know from the Optical Effects on Primary Production Report (Pinkerton 2017) is primary production within the 2.25% fines plume would be reduced by at least 40%.
13. Studies of dredge impacts (Schiel et al 2006¹²) have shown that macroalgal benthic primary productivity subjected to greater than 60 days of reduced light are impacted significantly. Therefore, if 2.25% mined fine dredge plumes persist for greater than a month at a time, it is likely benthic algae would be impacted, as the algae will not be adapted to a reduction in primary productivity for that duration.
14. Without knowing the full extent of a worst case scenario plume, it is not possible to address the question of what degree of impact may occur.
15. It is possible a worst case plume would extend into sensitive areas beyond what is currently modelled, and, as stated in paragraph [41] of my original evidence, this could result in significant impacts to macroalgal reefs.

¹⁰ Pinkerton, M.H.; M. Gall (2015). Optical effects of proposed iron-sand mining in the South Taranaki Bight region. NIWA client report WLG2015-26 rev 2 for Trans-Tasman Resources. Project TTR15301.

¹¹ Supplementary Evidence of Dr Lawrence Cahoon, dated 11 April 2017.

¹² Schiel, D.R.; Wood, S.A.; Dunmore, R.A.; Taylor, D.I. (2006). Sediment on rocky reefs: Effects on early post-settlement stages of habitat-forming seaweeds. *Journal of Experimental Marine Biology and Ecology*. 331:158-172

16. The inadequacy of information provided by TTR throughout the proceedings in regard to the PSD remains, and as agreed in the Sediment Plume modelling conferencing sessions, and as stated in paragraph [42] of my original evidence, a condition is required which restricts the mining of sediments which contain mud(s) above a certain percentage so to avoid the release of fine material into the marine environment.

QUESTION 2

When, where, and to what extent will elevated SSC levels cause environmentally significant changes (for benthos, primary production, fish) related to physical effects. Smothering of algae or filter feeders is an example. What comprises a “significant” change should be specifically addressed.

17. Pinkerton (2017) reports there are substantial reductions in midwater visibility due to mining close to the mining site (maximum changes of 83% mining at site A; 66% mining at site B). These reductions in visibility indicate that visual predators such as squid and tuna would have lower visibility within the areas affected by the proposed project area (**PPA**). While the visibility within the impact area will be akin to that already experienced along the shoreline, the PPA is in deeper water and the type of foragers that occupy that area are not the same as those found in the nearshore/surf zone. Therefore, it cannot be assumed that all the species within the PPA would be accustomed to this level of reduced visibility. Consequently, they are likely to be displaced from, or experience a decrease in prey abundance or availability in the areas affected by the plume.
18. TTR's experts' interpretation of the SSC impacts of the plume has been used to average out over the Sediment Model Domain (**SMD**) in order to put the impacts into context. However, the area of the SMD is often not defined, making it difficult to determine how large the area is, as was the case in the Pinkerton 2017 report. In any case the SMD is an arbitrary boundary. By averaging the SSC increase across a larger area, the concentration of SSC naturally decreases, this is a simple product of dilution. This mode of interpretation may work for boundaryless systems such as the open ocean, but it is not necessarily relevant for organisms that cannot relocate, or in the

case of commercial fisheries which have strict controls on where they are permitted to fish. Just because the impact of a mobile fish species is small (<1%) compared to the areas occupied by a fish species, does not mean the impact on the fishery that relies on catching that species in a specific area will be small. While fish can potentially move into new areas away from the plume, the fisheries are held within legal boundaries and cannot change their fishing boundaries as readily.

19. As indicated in the evidence provided by Captain Smith,¹³ the western half of the PPA is highly used as a trawled fishing ground. This evidence appears to be fundamental in determining the level of impacts on fisheries likely from TTR's proposed operations. From the subset of trawler tracks provided by Captain Smith, the level of fishing in this area appears to be higher than areas inshore and to the east, but lower than areas north and offshore of the PPA. The target species of these trawler tracks, or whether they are from multiple fisheries, is not presented in any of the TTR reports. This, together with the additional trawler tracks mentioned in Captain Smith's evidence, should have been reviewed by TTR's experts, and considered in regard to the level of impacts on fisheries from the mining operation. Without understanding the extent of current and historical use of the PPA by commercial fisheries, it is not possible to determine the extent of any impacts from the TTR operation and whether they would be significant.
20. Theoretically, significant impacts are impacts that cause a greater than 5% decrease in a receiver. Since fisheries are defined by a number of factors including commercial interests, as well as fish species, significant impacts on fisheries would need to account for commercial (financial and social) impacts as well as the ecology of fish, and any changes to fisheries areas or policy that may need to be implemented in order to account for these impacts.
21. The contention that the increases in SSC generated by the mining would fall into natural perturbations, as stated by Dr. Cahoon (refer supplementary evidence dated 11 April 2017), is not valid. It was agreed during both the SSC caucusing sessions that the river inputs are influenced by run-off from cleared agricultural lands representing an existing anthropogenic impact. Therefore

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Evidence of Captain Andy Smith in regards to Charts, dated 10 March 2017

the mine outputs would be a cumulative impact not a perturbation that falls within "natural limits".

22. It was acknowledged that benthic organisms within the STB are already under some stress having had to adapt to the increase in SSC from river outfalls. At this stage, however, it is not known whether benthic organisms living with the STB are at their physiological limits. It is not, therefore, possible to assume that effects of the mining proposal would not impose further strain on these organisms, particularly those in areas immediately east of the PPA that are not currently experiencing elevated SSC from rivers.
23. The revised model shows, even with only pulse increases in fines, that the SSC effects are significantly greater than the original model on visibility, light reaching the seabed and effects on primary productivity. The question of whether this would be a significant impact to organisms outside of the PPA impact area depends on how long these effects would last and how far the plume would extend in a worst-case scenario.

QUESTION 3

What issues of materiality, in terms of ecological effects, do you perceive between the original modelling and the HR Wallingford 17 March 2017 modelling?

24. The new model is only a "worse-case" scenario, which shows that the SSC plume increases and extends further eastwards 3 km of the proposed mining activity. This is predicted to result in a 44% decrease in primary productivity from the original model. Without knowing the full extent of a worst-case scenario plume, it is not possible to address the question.
25. As stated at paragraph [39] of my Primary Evidence, dated January 2017, there still remains a level uncertainty as to the potential extent of impacts from the mining operation due to the inadequacy of the information provided by TTR, specifically for the concentrations of PSD.

26. The risks are less likely to occur, assuming TTR is able to implement the revised conditions proposed in Dr Mitchell's supplementary evidence dated 2 May 2017. I refer in particular to proposed conditions 5 and 6. I have concerns as to whether TTR can operationally achieve the restrictions set out under those conditions given the paucity of operational information provided in support of the application.

REVISED MARINE CONSENT CONDITIONS

27. Dr Mitchell has provided supplementary evidence and supplied answers to questions raised by the DMC in regards to his primary evidence. Dr Mitchell has also supplied a memorandum on behalf of TTR which contains revised conditions that specify "end-of-pipe" discharge limits under proposed condition 5 (end-of-pipe limits). He also proposes receiving environment SSC limits under proposed condition 6 (receiving environment SSC limits), with limits for monitoring locations in Schedule 2 of his memorandum. However, he does not specify the units for these limits. I recommend that Schedule 2 be update to include the relevant units, i.e. mg/L.
28. Dr Mitchell revised conditions appear to be designed to address the deficiencies and data gaps highlighted during the Secondary Sediment Plume Modelling conferencing session,¹⁴ and adopt a number of those sessions recommendations. In particular, condition 5.c:
- i. 130 cubic metres per hour ("m³/hr"), averaged over any 48 hour period; and
 - ii. 83 m³/hr, averaged over any seven (7) day period; and
 - iii. 66 m³/hr, averaged over any three (3) month period.
29. Condition 5.c would restrict discharge of fines from the mining operation. In order to achieve this condition TTR will be required to select areas with low percentage fines based on the results of the geotechnical survey vessel. TTR would also require the mining operation to stop at times in order to remain within the limits and thresholds proposed in Dr Mitchell's memorandum. There

14 Joint Statement of Experts in the Field of Sediment Plume Modelling – Setting Worst Case Parameters, dated Thursday, 23rd February, 2017

are, however, a number of clarifications required in order to ensure that this condition would minimise SSC plume impacts.

30. In my opinion, a mass-based discharge rate would be more appropriate as opposed to a volumetric rate, as this rate can be determined more directly and compared to the target limits set for extraction and processing under proposed condition 5, which is expressed in tonnes/hr.
31. In order to achieve this TTR would need to develop a robust sampling plan for their 'end-of-pipe' monitoring, and to comply with environmental monitoring targets proposed in Condition 6. To date TTR have not provided a robust Environmental Management Plan (**EMP**) that details how samples will be collected and monitoring managed.
32. Proposed condition 5 also states "*for the purpose of (c) of this condition, the average value shall be derived from the analysis of one daily composite sample.*" No information on how the composite sample will be collected is provided, i.e. will it be randomly selected? Furthermore, one (composite) sample per day, to determine an averaged discharge limit, is not statistically robust. If the sample is a composite, this implies it is made up from a number of samples collected over a period of time throughout the day. Without specifying how samples should be collected, there is a distinct risk of introducing bias into the sample collection. The condition needs to be reworded to provide more certainty in how the composite sample is formed.
33. With regard to the seabed PSD sampling condition 5.d currently reads "*20 representative samples of the extracted seabed material*". This potentially means subsamples of extracted seabed material are tested for PSD, which may not include the whole sediment profile. The samples need to be representative of the seabed material extracted, and therefore whole samples representative of the extracted seabed material should be completed. I recommend the following rewording to condition 5.d:

20 whole samples representative of the extracted seabed material.

34. To date the operational information supplied by TTR in regard to the how proposed condition 5 and 6 will be implemented is very limited, and open to interpretation. As stated in paragraph [32] of this statement, no information has been provided as to where the samples will be taken to determine the discharge limit, nor what actions will be taken in the event of a measured exceedance of the limits. The lack of operational information and a draft EMP as to how the conditions will be implemented and managed during the mining project by TTR is a significant gap in information. As with the uncertainty around the PSD concentrations outlined in my original evidence and restated in paragraph [16] of this statement, this lack of information presents uncertainty and highlights risks around whether the environmental impacts of the proposed activity can be adequately managed.

CONCLUSIONS

35. The newly proposed conditions that set the sediment discharge limit for sediment less than 38 microns need to be reworded to provide more rigour and clarity as to what the limit covers (de-ored sediment and sediment from the hydro-cyclones) and how these limits will be measured to provide sound and statistically robust method for demonstrating compliance.
36. The proposed discharge limits set out in the revised proposed condition (5) potentially provides a mitigating measure to prevent the discharge of fines exceeding the rates modelled
37. If TTR are able to achieve this they would effectively restrict the discharge of SSC to be below the modelled outputs, in which case, as agreed in the caucusing sessions for Benthic Ecology and Optical Effects on Primary Productivity, the impacts from the SSC plume would be minor to the STB and restricted to the defined impact area of the PPA and 3 km plume extent.
38. However, there remains a significant information gap concerning whether TTR is able to achieve a robust and achievable monitoring and management plan for reducing fines extraction and generation. In my opinion, lack of detailed information concerning how TTR would implement the condition, and whether the condition is operationally achievable means that there remains a risk of significant adverse effects on marine ecology and fisheries.

Dated this 19th day of May 2017

A handwritten signature in black ink, appearing to read 'G. M. Barbara', written in a cursive style.

Gregory Matthew Barbara