BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY

AT WELLINGTON

IN THE MATTER	of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
AND	
IN THE MATTER	of a decision-making committee appointed to hear a marine consent application by Trans Tasman Resources to undertake iron ore extraction and processing operations offshore in the South Taranaki Bight

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EXPERT REBUTTAL EVIDENCE OF IAIN MACDONALD ON BEHALF OF TRANS TASMAN RESOURCES LIMITED

6 FEBRUARY 2017

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INTRODUCTION

1. My name is Iain Thomas MacDonald.

2. I prepared Expert Evidence dated 17 December 2016 (First Statement) with respect to these proceedings on behalf of Trans Tasman Resources Limited.

3. My qualifications and experience as a physical oceanographer are set out in paragraphs 13 to 15 of my First Statement.

4. I repeat the confirmation given at paragraph 16 of my First Statement that I have read the Code of Conduct for Expert Witnesses and agree to comply with it.

5. The purpose of this Rebuttal Evidence is to respond to matters raised in submitter evidence. It addresses the following matters:

   (a) Existing environment - Internal Solitary Waves (ISWs);

   (b) Seabed morphology – geo-stability; and

   (c) Seabed morphology – uncertainly in seabed disturbance time frames.

6. In preparing this evidence I have reviewed the following statements of evidence:

   (a) Maria Cecilia Cashmore for Te Rūnanga o Ngāti Ruanui Trust.

   (b) Natasha Sitarz for Royal Forest and Bird Protection Society of New Zealand Incorporated.

7. Various witnesses have suggested that there is insufficient information available to reliably assess the effects of the proposal and that there is an unacceptable level of uncertainty that can only be addressed by collecting additional data. I do not agree and insofar as it relates to the matters addressed in my evidence, I am satisfied that the existing environment is suitably defined and in sufficient detail for me to have confidence in the veracity of the assessments undertaken.

EXISTING ENVIRONMENT - INTERNAL SOLITARY WAVES

8. In her evidence Maria Cashmore (paragraphs 41 to 49) suggests that ISWs may play an important role in the resuspension of bed sediments. Field observations[1] of near-

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[1] MacDonald, I. T., R. Budd, D. Bremner, and S. Edhouse (2015), South Taranaki Bight Iron Sand Mining: Oceanographic measurements data report. NIWA Client Report No. HAM2012-147, 109 pp.

bed suspended sediment concentrations (SSC) measured in the South Taranaki Blight (STB) do not support this point of view. Measurements show that resuspension is driven by surface waves. At all measurement sites, periods of increased near-bed SSC coincided with periods of large (surface) waves. During calm periods, little sediment was found in suspension, highlighting the importance of surface waves in suspending sediment from the seabed. Furthermore, during these high energy events, increased mixing is likely to result in a well-mixed water column. A stratified fluid is required for the formation and propagation of ISWs.

SEABED MORPHOLOGY – GEO-STABILITY

9. In her evidence Maria Cashmore (paragraphs 88 to 103) raises concerns about the geo-stability of the region. My evidence addresses the natural reinstatement of the seabed morphology: I present predictions of the time that pits will take to infill and mounds will take to deflate under waves and currents in the STB. Pit infilling will occur over decades at the smallest water depth (20 m) and over centuries at the greatest water depth (45 m). Furthermore, I predict that mounds will deflate faster than pits will infill. Pit migration is estimated from published data to be around 10 m per year.

10. Maria Cashmore also suggests that a morphodynamic model could have been used. While such models can resolve small scale features (such as a better representation of the hydrodynamics) within the pit, it is not correct to assume that they will provide better predictions than those based on the sediment-trapping premise approach which I adopted. On this point, van Rijn[2] noted that the "modelling of morphodynamics is not very accurate due to the absence of accurate field data of sand transport processes. In the absence of such data the uncertainty margins are relatively large (up to factor 5)".

11. Under TTR's proposed monitoring and management framework, bathymetric surveys will be conducted quarterly. The results from repeat surveys should be used to assess the accuracy of the pit infilling and mound deflation predictions. The bathymetric measurements could also be used to establish morphodynamic change, such as rates of pit migration. I am not aware of any mitigation methods that have been tried and tested as increasing the speed of recovery of the seabed.

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[2] van Rijn, L. C., Soulsby, R. L., Hoekstra, P., & Davies, A. G. (2005). SANDPIT. Sand transport and morphology of offshore sand mining pits. Process knowledge and guidelines for coastal management. Retrieved from The Netherlands.

SEABED MORPHOLOGY – UNCERTAINLY IN SEABED DISTURBANCE TIME FRAMES

12. In her evidence Natasha Sitarz (paragraph 39) suggests that seabed disturbance time frames for recovery are uncertain. With regards to pit infilling and mound deflation, my predictions incorporate all relevant sediment-transport processes. Where possible, empirical coefficients in the sediment transport equations that I used were derived from measurements collected in the STB. I also accounted for the reduction in suspended-sediment trapping efficiency that occurs as pits infill.

13. Table 3 in my evidence provides a summary of infilling rates of existing extraction pits in the coastal waters of the USA, Japan, UK and the Netherlands. The summary shows filling timescale of about 100 years at water depths of 15 to 25 m, and for depths greater than 25 m, infilling is only "minor" according to van Rijn[2]. While useful in a broad time scale sense, a direct comparison of the rates in the table with the TTR project is not that helpful because, initial pit depths are not reported in the summary and, "filling" is not precisely defined. There is also no indication of the wave and current climate. My predictions show that, broadly, pit infilling will occur over decades at the smallest water depth (20 m) in the STB and over centuries at the greatest water depth (45 m), which is somewhat faster than the infilling rates reported in the summary.

CONCLUSIONS

14. The points raised by Maria Cashmore and by Natasha Sitarz do not affect the conclusions in my first statement.

Iain MacDonald

6 February 2017