Before the Taranaki VTM Expert Panel

under: the Fast-track Approvals Act 2024 and Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

in the matter of: an application by Trans-Tasman Resources Limited for marine consents to support a seabed mining operation in the South Taranaki Bight

Statement of evidence of **Regan James King** (Offshore Geotechnical) for Taranaki Offshore Partnership

Dated: 3 October 2025

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STATEMENT OF EVIDENCE OF REGAN JAMES KING FOR TARANAKI OFFSHORE PARTNERSHIP

INTRODUCTION

1 My name is Regan James King.

2 I am the sector lead for offshore wind and a senior geotechnical engineer at Tonkin & Taylor Ltd (T+T). I previously held geotechnical and design engineer roles at Gavin & Doherty Geosolutions (part of Venterra Group) (Scotland), Jacobs (NZ) and Engeo (NZ).

3 I hold a Bachelor of Natural Resources Engineering with Honours from the University of Canterbury and am a Chartered Engineer with the Institution of Civil Engineers (CEng, MICE). I have been working in the geotechnical sector across New Zealand, Ireland and the United Kingdom over the past 10 years.

4 I have been leading the development of T+T's offshore wind services over the past two years. This has involved building a knowledge of the New Zealand and Australian offshore wind sectors, understanding design requirements, building relationships with global technical specialists, and building capacity within the business.

5 I have been involved in geotechnical aspects of projects for various industries, including undertaking and advising on ground investigations, ground modelling, deep piling for onshore and near-shore projects, and was involved in the landing and onshore cabling assessment for Codling Windpark, an offshore wind project in Ireland. As part of my current role, I have been engaging with global offshore wind geotechnical experts in relation to the geotechnical aspects of offshore wind projects.

CODE OF CONDUCT

6 Although these proceedings are not before the Environment Court, I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note (2023), and I agree to comply with it as if these proceedings were before the Court. My qualifications as an expert are set out above. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

7 I have been engaged by Taranaki Offshore Partnership (*TOP*) to provide expert geotechnical evidence in relation to the application

lodged by Trans-Tasman Resources Limited (*TTRL*) for marine consents under the Fast-track Approvals Act 2024 (*FTAA*) and Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (*EEZ Act*).

8 TTRL seeks marine consents to extract 50 million tonnes of seabed material per year, over 20 years, mechanically recovering 5 million tonnes of heavy mineral sands concentrates containing iron ore, vanadium and titanium, and return the de-ored material to the seabed (*Proposal*).

9 In preparing this evidence I have reviewed:

9.1 From the TTRL application (*Application*):

(a) The parts of the Taranaki VTM application relating to the geotechnical aspects of the Proposal.

(b) The proposed marine consent conditions relating to the geotechnical aspects of the Proposal.

(c) OCEL Consultants NZ Limited (undated). Implications of loose tailings seabed material on future jack-up deployment in the South Taranaki Bight. Prepared for Trans-Tasman resources Limited. Job number 130101.

(d) OCEL Consultants NZ Limited (undated). SPT testing to assess dredge ability of the sand resource. Prepared for Trans-Tasman resources Limited. Job number 130101.

(e) NIWA, (2015). Geological Desktop Summary, Active Permit areas 50753 (55581), 54068 and 54272, South Taranaki Bight. Prepared for Trans-Tasman Resources Limited. Client Report No: WLG2013-44.

(f) Trans-Tasman Resources Ltd, (15 April 2025). Taranaki VTM Project, Fast-Track Act Application, Attachment 3a: Siecap Taranaki VTM Project Pre-Feasibility Study Offshore Iron Sands Project 25 March 2025 – Part 1.

(g) Trans-Tasman Resources Ltd, (15 April 2025). Taranaki VTM Project, Fast-Track Act Application, Attachment 3b: Siecap Taranaki VTM Project Pre-Feasibility Study Offshore Iron Sands Project 25 March 2025 – Part 2.

9.2 From previous TTRL hearing processes:

(a) Brown, M., (undated). General Manager Exploration, Trans-Tasman Resources Ltd, Geotechnical investigations, South Taranaki Bight Iron Sand.

(b) Carra, C., (24 January 2017). Expert evidence of Christopher John Carra for Origin Energy Resources

Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties.

(c) MacDonald, I., (17 December 2016). Expert evidence of Dr Iain MacDonald on behalf of Trans-Tasman Resources Limited.

(d) Overy, R., (24 January 2017). Expert evidence of Robert Francis Overy for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties.

(e) Overy, R., (March 2017). Environmental protection authority hearing, Trans-Tasman Resources Limited Marine Consent Application, Jack-ups, Seabed Slopes and Sub-sea Well Issues.

(f) Trans-Tasman Resources Ltd, (August 2016). South Taranaki Bight offshore iron sand extraction and processing project, Impact Assessment.

10 I have also reviewed the statements of evidence from Mr James Perry, Mr Peter McComb and Mr Fraser Colegrave.

11 My evidence will address:

11.1 For background context:

(a) Offshore wind farm (*OWF*) structures;

(b) Geology in the Proposal area;

11.2 The inadequacy of the baseline geotechnical information and geotechnical effects assessment provided in the Application;

11.3 Impacts of the Proposal from a geotechnical perspective on the feasibility of an offshore wind farm in the Proposal area and adjacent areas. The geotechnical effects I address are:

(a) ability to collect geotechnical data;

(b) effects on the seabed;

(c) geotechnical design properties and considerations;

(d) seabed morphology; and

(e) susceptibility to liquefaction and seismic hazards.

11.4 Impacts of the Proposal on the construction methodologies required to develop an OWF;

11.5 Impacts of the Proposal on the feasibility of OWF development adjacent to mining activities;

11.6 Comment on TTRL's proposed consent conditions; and

11.7 My conclusions.

SUMMARY OF EVIDENCE

12 TTRL's application includes limited site-specific geotechnical information. To fully understand the impacts of the Proposal on the seabed environment as it relates to the ability to develop other activities, and in particular an OWF, further information would be required related to:

12.1 the existing site conditions; and

12.2 the nature of the re-deposited material, including in particular:

(a) site specific stratigraphy,

(b) soil density,

(c) stabililty,

(d) strength characteristics, and

(e) liquefaction susceptibility.

13 However, even without the specific detail necessary to understand the Proposal's effects on those aspects of the site crucial to OWF development, it is evident that the Proposal will have an impact on the viability of developing an OWF in the same area, from a geotechnical perspective.

14 The Proposal is expected to:

14.1 result in a significantly reduced geotechnical strength and density of the re-deposited material in the upper 11 m of the seabed;

14.2 increase the settlement characteristics of the seabed in the mined area;

14.3 increase the risk of liquefaction and soil instability; and

14.4 make all existing surface mapping obsolete and remove the ability to map natural features and geo-hazards.

15 These impacts will have direct implications for offshore wind development. For example, mining of up to 11 m of the seabed is

likely to result in an impact on the size of the foundations required to support the wind turbine generators (*WTG*s). This will result in an increase in material and transportation requirements, and therefore additional cost to the development.

16 If the Proposal is undertaken adjacent to an offshore wind farm, the scale of the geotechnical effects is uncertain. The scale of the impacts will reduce over greater separation distances, however further information, for example regarding the migration of mounds and pits, would be needed to be understood to determine the scale of the residual impacts at different seperation distances.

OFFSHORE WIND FARM STRUCTURES

17 An OWF's WTGs can be built using a range of different structure and foundation types. The most common fixed bottom foundation options are illustrated in **Figure 1**, monopiles and jacket structures. Offshore WTGs in the South Taranaki Bight will likely be located on monopile foundations, as this is typically the most economic and efficient foundation type for water depths less than 60 m. WTGs are connected by inter-array electrical cables that feed to an offshore substation located within the WTG array. The offshore substation is then connected to the shore by an export electrical cable. Mr Perry's evidence expands further the typical components and infrastructure of an OWF.[1]

18 To support the design of the foundations, both geotechnical testing and geophysical surveys are undertaken. These help to provide an understanding of the local geology, including variations and features across the site, and an understanding of the behaviour of the soil. Geotechnical characteristics that are valuable to understand are the geological strata, soil density, friction angle, cohesion, shear strength, and stiffness. These inform the structures' response to forces and how large the piles need to be to resist them.

[1] Statement of evidence of James Philip Perry (Impacts on Offshore Wind Development) on behalf of Taranaki Offshore Partnership (*SOE Perry*) at [22-23].

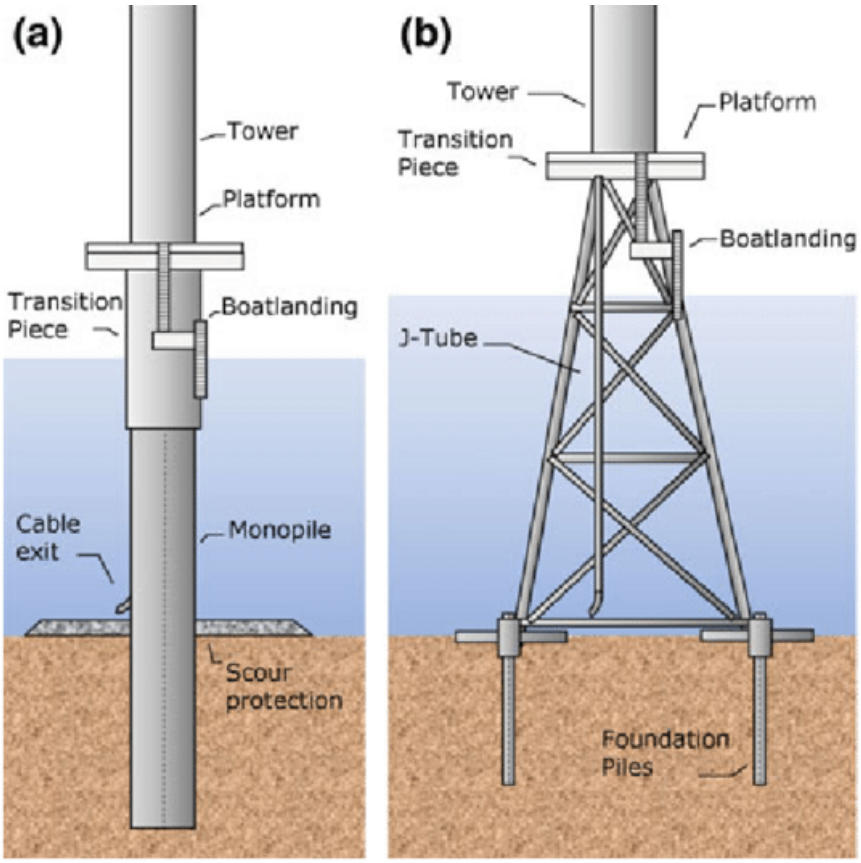

Figure 1: Offshore wind turbine foundation options (a) monopile and (b) jacket[2]

GEOLOGY IN THE PROPOSAL AREA

19 The Proposal area is approximately 65.76 square kilometres, located between 22 and 36 kilometres off the coastline of South Taranaki.

20 The Proposal site is identified in **Figure 2** below and comprises part of TTRL's wider Mining Permit MP55581. Figure 2 is taken from the Geological Desktop Summary provided with the Application[3] and illustrates the surficial geological units that have been identified in the Proposal area. The units include gravelly sand, sand-dunes and megaripples (dunes 3-12 m high), gravelly mud 1-3 m thick, gravelly mud over relict dunes, and various faults. It is unclear from the Geological Desktop Summary what the geological unit depths and thicknesses are.

[2] Klijnstra, Job & Zhang, Xiaolong & van der putten, Sjoerd & Röckmann, Christine. (2017). Technical Risks of Offshore Structures. 10.1007/978-3-319-51159-7_5.

[3] NIWA, (2015). Geological Desktop Summary, Active Permit areas 50753 (55581), 54068 and 54272, South Taranaki Bight. Prepared for Trans-Tasman Resources Limited. Client Report No: WLG2013-44.

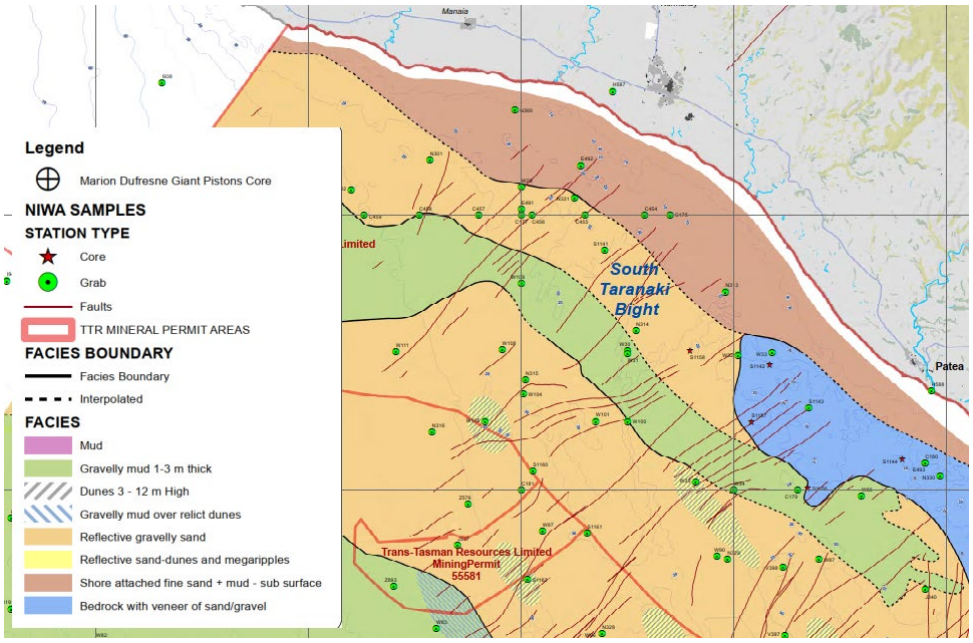

Figure 2: Surficial geological map of the Proposal area (NIWA, 2015).

INADEQUATE BASELINE AND GEOTECHNICAL EFFECTS ASSESSMENT

21 In my opinion, TTRL's application does not contain sufficiently detailed information on either:

21.1 the current/baseline geotechnical properties of the seabed in the Proposal area; or

21.2 the geotechnical properties of the re-deposited material;

to assess the geotechnical effects of the Proposal.

22 Geotechnical information in the Application is limited to:

22.1 In relation to the geotechnical properties of the in-situ soil, that presented by OCEL Consultants NZ Ltd (*OCEL*)[4]. That information is based on OCEL's one standard penetration test (SPT) to a maximum depth of 6.5m and adjacent grab sample undertaken in the Proposal area.

22.2 In relation to the geotechnical properties of the re-deposited material:

[4] OCEL Consultants NZ Limited (undated). SPT testing to assess dredge ability of the sand resource. Prepared for Trans-Tasman resources Limited. Job number 130101.

(a) information from Matthew Brown[5] of TTRL regarding the soil particle size distribution (*PSD*); and

(b) the assessment undertaken by OCEL[6] on the implications for jack-up foundations, and high-level commentary on liquefaction and fixed platform foundations.

23 The lack of geotechnical information necessary to assess geotechnical effects on the seabed resulting from the Proposal has also been identified by another independent expert, Christopher Carra,[7] in previous processes related to the Proposal.

24 As a minimum, to adequately understand the effects of the Proposal on the seabed environment, I would expect that TTRL would have undertaken a greater number of tests to provide a representative sample of the large area that is proposed to be disturbed. Tests should cover the various geological units identified, and to a depth below that which they are disturbing.

25 The Application states that the current seabed consists of dense to very dense fine sand. Following the mining process the material is indicated to be loose fine sand.

26 I understand that at the Kupe Wellhead Platform, located within the offshore wind area of interest and approximately 1.2 km northwest of the Proposal area, the upper 25 m is identified as very dense fine sand, underlaid by 21 m of medium dense silty fine sand[8]. Assuming the geology at the Kupe platform is similar to the area of the Proposal, the upper 25 m of very dense material is going to be reduced by approximately 50 percent once the upper 11 m is mined.

27 Even with this limited information only, I consider it is likely the Proposal will have a range of impacts on the future use of the seabed, and in particular the design of an OWF if one was to be built in the STB.

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5 Brown, M., (undated). General Manager Exploration, Trans-Tasman Resources Ltd, Geotechnical investigations, South Taranaki Bight Iron Sand.

6 OCEL Consultants NZ Limited (undated). Implications of loose tailings seabed material on future jack-up deployment in the South Taranaki Bight. Prepared for Trans-Tasman resources Limited. Job number 130101.

7 Carra, C., (24 January 2017). Expert evidence of Christopher John Carra for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties.

8 Overy, R., (24 January 2017). Expert evidence of Robert Francis Overy for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties.

IMPACTS ON FEASIBILITY OF OFFSHORE WIND DEVELOPMENT IN AREAS DIRECTLY IMPACTED BY MINING

Proposal's effect on ability to collect geotechnical data

28 Before designing and constructing an OWF, geotechnical and geophysical investigations need to be conducted to inform the design of the OWF. Given the Proposal's complete disturbance of up to 11 m of the upper seabed,[9] and the Application's lack of appropriate assessment of the geotechnical characteristics of the seabed post-mining, these campaigns will either need to be delayed until all mining works in the area are complete or be undertaken in two phases (pre and post mining). The purpose of undertaking two phases of investigations would be to enable initial design works to start under the phase one works, and then to be updated following the phase two works which will reflect the post mined conditions. Undertaking two phases of investigation would add substantial cost to the development of an OWF. The longer it takes for TTRL to commence and complete its activity the longer the period that an OWF developer will need to put-off necessary investigations and accommodate high levels of uncertainty of the geophysical and geotechnical environment in its initial OWF design.

29 The disturbance of the upper 11 m of seabed will make all existing geophysical data obsolete for this zone. This disturbance may also reduce the depth of competent seabed data that is able to be retrieved from particular survey methods i.e. what might have been 50 m of competent seabed data may now only be 39 m.

30 Mining of the seabed will mean the natural geomorphology and associated geological hazards, such as instabilities, erosion, slumping, and faulting, will no longer be able to be identified or mapped. Not understanding the geomorphology and not being able to fully understand the natural hazards at the site could have critical consequences for the design of the WTG structures. Missing critical information could result in the WTGs not being resilient enough for these natural hazards, resulting in damage or failure of part/all of the OWF during some future event.

Proposal's geotechnical effects on the seabed

Effect on geotechnical characteristics of the seabed

31 Based on the limited geotechnical information included in the Application, I understand the redeposited material will be placed as a loose slurry on the seabed.

32 The disturbance of the in-situ material and the proposed replacement methodology will significantly reduce the density of the soil. As a result, this will lead to the following geotechnical effects:

[9] Trans-Tasman Resources Ltd, (15 April 2025). Taranaki VTM Project, Fast-Track Act Application.

32.1 Reduced bearing capacity and strength characteristics. This is a reduction in the capacity of the mined seabed to support loads directly, and a reduction in its contribution to supporting deeper foundations both vertically and laterally.

32.2 Increased settlement characteristics. This is an increase of downward movement of the seabed (reduction in elevation) as a result of loose soil particles realigning. This happens under self-weight and can be exacerbated under external loads.

32.3 Reduced stability. This means soils are less able to hold their shape and resist forces from currents and earthquakes. This increases the risk of slope failure and ground movement.

32.4 Increased susceptibility to liquefaction (which I discuss later in my evidence). Liquefaction is a phenomenon where saturated, loose soils lose strength and stiffness during strong ground shaking, such as during an earthquake. This can lead to ground failure, settlement, and damage to structures due to loss of support.

Implications for OWF

33 The geotechnical properties of the seabed are an important design input for the development of an OWF.

34 The OCEL report[10] states "*The presence of the tailings will have no influence on the design of the foundations for any fixed platform structures. These structures would be expected to have pile foundations extending deep into the seabed, the nature of the seabed layer being close to insignificant*". This is not true for WTG foundations where monopile embedment depths are typically 30-60 m below seabed level. By replacing the upper 11 m of the seabed with loose soil, the Proposal is effectively removing 18-35% of the supporting soil. This will have a significant impact on the WTG foundation design.

35 The significantly reduced strength in the up to 11 m of redeposited material will have a direct impact on the vertical and lateral capacity of the WTG foundations. The wind turbine monopiles will need to be longer and potentially have a larger diameter and use thicker steel. This will significantly increase the materials required and the associated cost. In addition, it will create longer and heavier loads that will need to be considered in the transportation and installation assessment for the OWF.

[10] OCEL Consultants NZ Limited (undated). Implications of loose tailings seabed material on future jack-up deployment in the South Taranaki Bight. Prepared for Trans-Tasman resources Limited. Job number 130101.

36 The geotechnical parameters of the seabed impacted by the Proposal will also need to be understood further to inform settlement implications on the WTG foundations. Settlement of the soil around the piles can add additional downward forces to the foundations and can affect the pile response to lateral loading.

37 The placement of rock as part of scour protection for the WTG foundations may induce significant settlement that otherwise would not need to be accounted for if the soil was in an undisturbed state. For example, where rock is placed around a monopile to protect it from scour, the additional pressure from the rock can induce settlement of any loosely redeposited soil and as a result induce further loads onto the pile.

38 Total and differential settlement will need to be understood and considered in the OWF's inter array and export cable design. The settlement of the Proposals deposited materials will likely be non-uniform, resulting in potentially large differential settlements over potentially short distances. For example, differential settlement can lead to bending and stretching of the cable, resulting in cable damage and thus resulting in additional maintenance costs and potential disruptions to energy distribution. This will impose additional considerations, uncertainties, and constraints for cable design.

39 If any rock protection/anchoring is required around cables for scour or impact purposes, this additional weight will amplify the settlement effects that will need to be considered in the cable design.

Proposal's effect on the seabed morphology and hydrodynamics

Effect on seabed morphology, waves and current

40 The mining process will result in lanes of pits and mounds, in the order of 300 m wide, 300 m long and up to 11 m deep/high.[11]

41 Dr McComb's evidence[12] addresses the effects on seabed morphology, waves and currents resulting from that mining process. He concludes:

41.1 TTRL has underestimated the likely impact of the Proposal on seabed morphology (i.e. larger mounds could be anticipated).

41.2 TTRL's assessment of the migration of pits and mounds being in the order of up to 10 m per year is based on insufficient

[11] Trans-Tasman Resources Ltd, (15 April 2025). Taranaki VTM Project, Fast-Track Act Application.

[12] Statement of evidence of Peter John McComb (Seabed Morphology and Hydrodynamics) for Taranaki Offshore Partnership (*SOE McComb*).

information and no site-specific analysis. Therefore, the migration could be somewhat different to that presented.

41.3 Based on the assumed 10 m per year migration, the anticipated migration will mean the seabed effects of the Proposal will extend well beyond the proposed mining area and into other areas of the STB.

41.4 The Proposal could alter wave and current patterns and locally increase the ocean current speeds by 25-30%.

41.5 The infilling of pits and deflation of mounds will take at least 5 times longer than predicted by TTRL in shallow areas, and infilling and deflation is unlikely in deeper areas. Consequently, the effects of the Proposal are likely to remain material over timescales that will have implications for the future use of the Proposal site.

42 There is limited evidence on the likely slope of pits and mounds, and associated stability:

42.1 Mr Brown[13], on behalf of TTRL, has stated in previous application processes that the mining process will result in pits in the seabed typically having a 30-36 degree active cut slope angle.

42.2 In Mr Overy's[14] expert evidence on behalf of Kupe Joint Venture Parties, he identified that the effective friction angle for marine sand is typically 30 degrees, and that slopes of 30 degrees are not stable in an active marine environment such as the STB. He identified that the maximum angle of repose (angle the soil naturally sits at) for both pits and mounds is likely to be about 15 degrees. Based on his evidence it is interpreted that the slopes are unlikely to be static/stable until they reach this lower 15-degree angle.

Implications for OWF

43 The Proposal area is located in the middle of TOP's proposed OWF area. Consequently, the above effects will be directly relevant to the assessment of the feasibility and costs of an OWF in the Proposal area or the broader area (given the potential pit migration). In relation to OWF development, hydrodynamic and wave information will be critical to inform the impact on design parameters for WTG design loads.

44 An increase in the magnitude of wave forces will result in an increase in the wave design loads that need to be considered for the

[13] Brown, M., (undated). General Manager Exploration, Trans-Tasman Resources Ltd, Geotechnical investigations, South Taranaki Bight Iron Sand.

[14] Overy, R., (24 January 2017). Expert evidence of Robert Francis Overy for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties.

WTG design. As a result, this may have a direct impact on the requirements of the design, i.e. larger foundations or more robust steel sections.

45 Allowance will also need to be made for the migration of the pits and mounds and what influence this movement will have on the design loads over the design life of the structures.

46 When designing WTGs, an OWF developer makes allowance for natural variation in seabed elevation, e.g. sand waves crossing the site. The seabed elevation variation that will result following the Proposal's mining operations is expected to be significantly greater than the natural variations in the region.

47 Such high magnitude variations are likely to impact how the WTG foundations respond to design loadings, as both a decrease and increase in seabed elevation can impact the structural response of the WTG. Variation in seabed elevation can be designed for, as long as the variability is understood, but it will result in more geotechnical and structural capacity allowance needing to be built into the design. This too has a material implication in the construction and design cost of OWFs in the mining area and the surrounding area that will be affected by the Proposals mining activities.

48 The stability of the mounds and pit walls will need to be better understood to inform any OWF development that is located nearby. Instabilities could impact the stability or performance of WTG and vessel foundations (as discussed below), and cabling. If impacted, these could add significant time delays, costs and risks to OWF development.

49 Seabed variation and pit/mound migration will need to be well understood to optimise the foundation designs, otherwise this could result in the worst-case conditions needing to be considered across the entire OWF development area, resulting in significant development costs.

50 I consider the effect of the Proposal on seabed elevation variation will also be significant for the inter array and export cables.

51 The OWF cable design would need to include allowance for the variable seabed elevation over the design life of the cables. This includes differential performance as the cables run over mined and unmined areas, resulting in the potential for loss of support and the need for bridging, being buried deeper or being exposed.[15]

52 Due to the loose nature of the redeposited material, the implications of scour and sediment deposition will need to be better understood

[15] See also SOE Perry at [45-46].

and allowed for within both the WTG foundation and cable designs. Subject to how the WTG and cables are designed, the greater scour potential of the looser material present after mining will require more robust scour protection which will result in a greater cost to an OWF development.

Proposal's effect on the site's susceptibility to seismic hazards

Effect on liquefaction susceptibility

53 The Application contains no assessment of the liquefaction risk or seismic response of the deposited material. It also does not consider how the pits and mounds that will result from the mining process would behave under earthquake loading in regard to slope (in)stability and settlement.

54 TTRL's OCEL Report[16] does suggest there is potential for liquefaction under seismic events in the loose re-deposited material. In respect to jack-up vessel foundations, it concludes the loads imposed by the spudcans (footings) will make the soil less susceptible to any potential for seismically induced liquefaction, however, no analysis has been presented to validate this claim.

55 Evidence by Mr Carra assessed the discharged soil PSD against that typically considered susceptible to liquefaction. Mr Carra's evidence suggested that the PSD of the discharged seabed sediments were in the range that is typically susceptible to liquefaction. [17]

56 PSD results on their own only partially inform liquefaction susceptibility. Liquefaction susceptibility assessments typically consider other in-situ soil parameters such as the degree of compaction of the soil i.e. how loose or dense the soil is, and whether the soil behaves like a sand or a clay by measuring a property termed plasticity. However, as the Application only provides a limited assessment of the existing geotechnical properties of the seabed, it is not possible to know what the current liquefaction risk is.

57 Given the extent of disturbance and future impacts the Proposal will have on future activities in this area, I consider it would have been reasonable to have expected TTRL to undertake an assessment of current and predicted future seismic performance of the seabed. This would best be understood by undertaking Cone Penetrometer Testing (CPT) across the Proposal area.

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16 OCEL Consultants NZ Limited (undated). Implications of loose tailings seabed material on future jack-up deployment in the South Taranaki Bight. Prepared for Trans-Tasman resources Limited. Job number 130101.

17 Carra, C., (24 January 2017). Expert evidence of Christopher John Carra for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties. [paragraph 4.1.1.2]

58 Regardless of the current risk level, it is undoubtedly the case that replacement of existing ground with the disturbed hydraulically placed material will result in lower soil densities and as a result increase the soil's susceptibility to liquefaction as indicated by OCEL.[18] The scale of this increase in liquefaction risk has not been assessed in the Application and the Application does not contain sufficient information regarding the deposited material to enable a liquefaction susceptibility assessment to be undertaken.

Effect on other seismic hazards

59 No information has been provided in the Application on how the pits and mounds that are created by the seabed mining activity would behave under seismic loading.

60 Based on the loose nature of these features it would be expected that under seismic shaking they will be unstable, resulting in slope failure and settlement. Consequently, I expect the Proposal's effects on seabed stability to be compounded in cases of seismic activity.

Implications for OWF

61 An increased level of liquefaction susceptibility will result in additional costs for the WTG foundation design as it will require deeper and/or larger diameter piles to provide adequate stability.

62 An increased level of liquefaction susceptibility will add further risks to inter array and export cable designs, resulting in additional settlement during earthquake events and increasing the risk of damaged cables, associated maintenance costs and power disruptions.

63 During the 30-year design life of a WTG, the pits and mounds are estimated by TTRL to migrate by up to 300 m (10 m per year over 30 years). Evidence by Dr McComb[19] however suggests that a sufficient site-specific assessment has not been undertaken and that the migration could be somewhat different to that presented. If post-mining pits and mounds come to be located near, say within 50 m, from a WTG or cable, seismically induced settlement or instabilities could impact the WTG piles or cables resulting in damage.

EFFECTS OF THE PROPOSAL ON OWF CONSTRUCTION METHODOLOGIES

64 Jack-up vessels are vessels equipped with legs that can be lowered to the seabed, providing a stable platform for installation, maintenance and decommissioning activities. They are the most

[18] OCEL Consultants NZ Limited (undated). Implications of loose tailings seabed material on future jack-up deployment in the South Taranaki Bight. Prepared for Trans-Tasman resources Limited. Job number 130101.

[19] SOE McComb, at [29-30].

common vessels used for WTG installation activities. Other vessel options include anchoring and dynamic positioning, however jack-up vessels are generally the preferred option for the water depths and conditions as found in the project site area. Mr Perry's[20] evidence provides further details around OWF construction methodologies and considerations.

65 The proposed mining activities will add additional risks to the use of jack-up vessels in and around the mining area. This is due to there being significantly increased risks of:

65.1 looser soils with a reduced bearing capacity;

65.2 increased potential of punch through foundation failure if underlying soils are looser/softer;

65.3 unstable footings if spanning a mined/unmined area, i.e. potential for eccentric loadings;

65.4 increased potential for slippage on sloping and undulating ground; and

65.5 increase risk of backflow and infill around the footings resulting in difficulties extracting footings.

66 All of these factors will require in-depth consideration when planning what vessels are able to be used for OWF construction, maintenance and decommissioning activities, and the conditions they will be operating in. Even though some of these conditions can be designed for as indicated by OCEL,[21] the presence of looser material will add risk and uncertainty to the development, design, construction and operations of the OWF. This may also come at an increased cost to the developer.

67 In evidence on a previous application, Mr Overy[22] (for Kupe Joint Venture Parties) identified that the proposed operations would create buried slopes between loose and dense material. He noted that jack-up vessels do not handle uneven seabed well and how this has led to various past incidents. In a later piece of evidence Mr

[20] SOE Perry at [48-56].

[21] OCEL Consultants NZ Limited (undated). Implications of loose tailings seabed material on future jack-up deployment in the South Taranaki Bight. Prepared for Trans-Tasman resources Limited. Job number 130101.

[22] Overy, R., (24 January 2017). Expert evidence of Robert Francis Overy for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties.

Overy[23] presented an extract from ISO19905-01[24] that identifies that hard sloping strata can lead to eccentricities within the spudcan (jack-up leg foundation) loading and increase potential for slippage on sloping or undulating ground. Despite this issue being raised by Mr Overy in the previous application process, TTRL has not addressed it in this current application.

68 Buried slopes will need to be taken into account when planning jack-up vessel works and may require additional site investigations to inform the design of the foundations.

IMPACTS ON FEASIBILITY OF OFFSHORE WIND DEVELOPMENT ADJACENT TO ACTIVE MINING ACTIVITIES

69 This section explores the geotechnical implications of developing an OWF in an area adjacent to the proposed active mining activities in the remainder of TOP's area of interest.

70 Geotechnical impacts will be reduced where the Proposal and OWF operate in separate areas. The most significant geotechnical consideration will be understanding the migration of the pits and mounds (which is discussed above).

71 Other considerations that would need to be considered are the impacts the Proposal has on the scour and sediment deposition characteristics at varying distances from the Proposal. Significant changes in the seabed could affect the design considerations for an OWF. In order to properly understand any impacts, mining and OWF zones would need to be agreed upon to inform further site-specific analyses.

72 Mr Carra[25] identified potential impacts of the Proposal on the Kupe diver and remotely operated vehicle (*ROV*) operations due to increased water turbidity, and site-specific modelling was requested to further understand the impact. If the two activities are occurring at the same time, the Proposal will have the same implications for OWF investigation, monitoring, construction and operation activities where visibility by ROV is required.

COMMENT ON PROPOSED CONSENT CONDITIONS

73 Condition 92 proposed by TTRL requires the consent holder to prepare a geotechnical report on the geotechnical properties of the

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[23] Overy, R., (March 2017). Environmental protection authority hearing, Trans-Tasman Resources Limited Marine Consent Application, Jack-ups, Seabed Slopes and Sub-sea Well Issues.

[24] ISO 19905-1:2023. Oil and gas industries including lower carbon energy — Site - specific assessment of mobile offshore units. Part 1: Jack-ups: elevated at a site.

[25] Carra, C., (24 January 2017). Expert evidence of Christopher John Carra for Origin Energy Resources Kupe NZ Ltd on behalf of the Kupe Joint Venture Parties, Appendix B, p22-23.

backfilled mining lanes annually and where notice is received from the Kupe Operator. In my opinion, for the reasons set out in my evidence above, Condition 92 should be amended to require:

73.1 A baseline geotechnical report for the entire Proposal area and adjacent areas likely to be impacted by pit/mound migration to be completed prior to any mining commencing.

73.2 A minimum number of tests per depth of placed material e.g. at 0, 5, 10 meters below seabed level.

73.3 A minimum density of tests e.g. one per 300 m x 300 m block.

73.4 A minimum depth of cone penetrometer testing.

73.5 Requirements for when cone penetrometer vs shear strength data needs to be collected, and how the shear strength value is measured.

73.6 A bathymetry survey, along with a record of mound and pit migration over the most recent year and comparison to mound and pit movements to date.

73.7 Pit infilling rates and mound dispersion rates.

73.8 Annual testing including previously reported areas, not just the most recent year, and reporting on any further changes to geotechnical characteristics or bathymetry.

73.9 The geotechnical report should be provided and updated on request of any party with an exploration/mining permit or offshore renewable energy feasibility/commercial permit, not just the Kupe operator.

73.10 The geotechnical report and testing should be undertaken by a suitably qualified and experienced independent expert.

CONCLUSIONS

74 Even based on the limited information available in the Application, my view is that it is evident the Proposal will have a significant impact on seabed geotechnical charactertistics. The effects on seabed geotechnical characteristics will have implications for future development in the mined area, including OWF developments. The Proposal will result in the OWF development being signficantly more difficult and more expensive from a geotechnical perspective. Even if the Proposal's mining area and an OWF do not overlap, where they are located in close proximity to each other, there will likely be impacts on the OWF from a geotechnical perspective. The scale of those impacts will reduce over greater separation distances,

however, there is insufficient information to understand the scale of the residual impacts at different seperation distances.

Regan King
3 October 2025