**BEFORE THE TARANAKI REGIONAL COUNCIL AND NEW PLYMOUTH DISTRICT COUNCIL**

**MT MESSENGER BYPASS PROJECT**

| | |
|---|---|
| In the matter | of the Resource Management Act 1991 |
| and | |
| In the matter | of applications for resource consents, and a notice of requirement by the NZ Transport Agency for an alteration to the State Highway 3 designation in the New Plymouth District Plan, to carry out the Mt Messenger Bypass Project |

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# STATEMENT OF EVIDENCE OF GRAEME JOHN RIDLEY (CONSTRUCTION WATER MANAGEMENT) ON BEHALF OF THE NZ TRANSPORT AGENCY

25 May 2018

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BUDDLEFINDLAY
Barristers and Solicitors
Wellington

Solicitors Acting: **Paul Beverley** / **David Allen / Thaddeus Ryan**
Email: david.allen@buddlefindlay.com / thaddeus.ryan@buddlefindlay.com
Tel 64-4-499 4242 Fax 64-4-499 4141 PO Box 2694 DX SP20201 Wellington 6140

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## QUALIFICATIONS AND EXPERIENCE

1. My name is Graeme John Ridley.

2. I am a Director of Ridley Dunphy Environmental Limited ("**RDE**"), an environmental consultancy that specialises in environmental management of development sites and, in particular, erosion and sediment control.

3. I have the following qualifications and experience relevant to this evidence:

   (a) I have a Bachelor of Agricultural Science from Massey University, Palmerston North (1986).

   (b) I am a Certified Professional in Erosion and Sediment Control (CPESC Number 7629), a qualification that is achieved through the International Erosion Control Association.

   (c) Prior to forming RDE, I was employed as an environmental consultant with Environmental Management Services Limited. Prior to that I was employed by the former Auckland Regional Council ("**ARC**") in numerous roles including Manager of Consents and Compliance, Manager of the Land and Water Quality Team, and Manager of the Sediment and Stormwater Management Team.

   (d) A particular focus of my career has been in the field of erosion and sediment control. I have over 28 years' experience in this area. I have a broad range of experience in erosion and sediment control, including detailed involvement for councils and the development community. I am responsible for the design and monitoring of erosion and sediment controls on a number of development sites throughout New Zealand.

   (e) I have considerable experience in all aspects of earthworks, streamworks and stormwater activities. I have had intimate involvement with policy development and implementation, research, education and regulation covering all aspects of the development process.

   (f) I have specific on-site experience and consenting experience with a number of NZ Transport Agency ("**Transport Agency**") roading projects including, but not limited to, Transmission Gully, Puhoi to Warkworth and Auckland's Southern and Northern Corridor Improvements. Having been directly involved with all erosion and sediment control aspects of

these projects I am aware of the issues, opportunities and practicalities with planning and onsite implementation.

(g) I was the primary author of the ARC Technical Publication Number 90 "Erosion and Sediment Control Guidelines for Land Disturbing Activities" ("**TP90**"), which is a key guideline promoted and used by the former ARC, and now Auckland Council, for the management of erosion and sediment associated with development sites. I have advised on the implementation of TP90 on development sites and understand first-hand the various aspects of its application. I was also the primary author of the erosion and sediment control guidelines for the Bay of Plenty Region.

(h) I was one of the authors and peer reviewers of the New Zealand Transport Agency Erosion and Sediment Control Standard for State Highway Infrastructure (Draft), August 2010.

(i) I am a past director and vice president of the Australasian chapter of the International Erosion Control Association.

(j) I am an accredited hearing commissioner and have worked as a hearing commissioner for many council hearings around New Zealand, including acting as a hearing commissioner for projects such as Tauranga Eastern Link and Waikato Expressway Rangiriri Bypass.

4. I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

**EXECUTIVE SUMMARY**

5. The Project comprises a new section of two lane highway, approximately 6km in length, located to the east of the existing SH3 alignment. Earthworks fill volumes for the Project equate to approximately 890,000m3 over a total area of approximately 36ha including the early stages of works.

6. These areas of earthworks are 0.12% of the overall Tongaporutu Catchment and 0.09% of the Mimi Catchment area. On a sub catchment basis the Project earthworks equate to:

   (a) 7.4% of the total area immediately upstream of the Project in the Tongaporutu Catchment; and

   (b) 1.2% of the total area immediately upstream of the Project in the Mimi Catchment.

7. The existing environment and Project site conditions have been detailed with the works required for the Project to occur in both the Mangapepeke and Mimi catchments. The Mangapepeke Stream drains north-west to the Tongaporutu River with the Tongaporutu River subsequently discharging to the downstream coastal environment. The Mimi River flows south-west, discharging to the coast between Waiiti and Urenui.

8. Geology for the Project is dominated by papa mudstone within the steep sections, which also has a considerable influence on stream substrate, where the gravels are soft and a relatively high amount of fine sediment is present. The CWAR confirms the steep slopes (typically greater than 20%), which comprise a large portion of the Project alignment. Where the Project alignment follows the valley floor, slopes are typically less than 10%.

9. Baseline water quality data has been collected and is ongoing. This data shows the high sediment loadings that occur naturally in the Project waterways during rain events which is a reflection of the underlying geology.

10. To assist with understanding the nature and magnitude of Project construction risk, the existing topography has been assessed, from which a range of slope classifications have been identified within the Project footprint. It is also recognised that wetter periods of the year may pose a higher risk for sediment generation and discharges because higher rainfall generates such sediment.

11. Both erosion and sediment controls will be utilised to minimise, capture and treat sediment laden runoff that may enter the receiving environments. These approaches build on the traditional approach to erosion and sediment control on site and the methodology that applies. This includes a range of structural and non-structural measures which are all critical elements of reducing potential risk of sediment yields. Additionally, the duration and timing of works will be minimised as far as practical to minimise disturbed soils exposed to heavy rainfall.

12. Sediment yields from the Puhoi to Warkworth project were utilised for the Project for comparative sediment yield purposes. On a wider catchment basis, for both catchments, the Project is likely to result in an insignificant increase in potential sediment yields to the marine environment, equating to less than 1% on an annual basis. On a sub-catchment basis, this equates to less than 8% annual increase for the Mimi catchment, and a 46% annual increase for the Mangapepeke catchment.

13. Works in the Mangapepeke catchment are small overall (25ha of earthworks with an upstream catchment of 332ha) but involve earthworks directly within headwater stream systems and hence have a much greater percentage sediment yield increase when considered in this context.

14. A Construction Water Management Plan ("**CWMP**") has been developed and finalised to provide the overall approach and guidance for construction water management during construction of the Project. The CWMP will be a live document that will be reviewed and updated, if necessary, during the course of the Project to reflect material changes associated with construction techniques, communication, mitigation, or the natural environment.

15. A final CWMP is attached to the evidence of Mr Roan and forms part of the condition and management plan suite to be approved through the hearing.

16. In addition, for each area of work, prior to construction activity, detailed location and/or activity specific management plans (referred to as Specific Construction Water Management Plans - SCWMPs) are required. These SCWMPs include specific design detail and erosion and sediment control aspects for that area of work.

17. For all locations, the full suite of both structural and non-structural erosion and sediment controls will apply. For higher risk sites, there will be a more significant monitoring presence, ensuring progressive stabilisation continues to occur and working within more defined fine weather windows.

18. A detailed Construction Water Discharges Monitoring Programme ("**CWMDP**") is considered critical to the success of the Project and is included within the CWMP. This includes:

    (a) Receiving environment: on-site visual assessments;

    (b) Weather forecasting;

(c) On-site monitoring of water management devices;

(d) Flocculation monitoring;

(e) Quantitative sediment discharge monitoring;

(f) Pre and post-earthwork monitoring of freshwater habitats; and

(g) Triggered rainfall monitoring.

19. I assess overall that the construction water management and erosion and sediment controls to be employed:

(a) represent the best practice measures;

(b) will minimise discharges; and

(c) will enable ongoing monitoring and continuous improvement to occur.

20. I have responded to the submission points raised by DOC in particular and other submitters whom have raised similar issues. The majority of the submission points raised by DOC were the subject of discussion and have resulted in agreement in many areas. I have also responded to matters raised within the Taranaki Regional Council ("**TRC**") Section 42A Report.

**BACKGROUND AND ROLE**

21. The Transport Agency engaged me to advise it on its proposed Mt Messenger Bypass Project ("**Project**") to improve the section of State Highway 3 ("**SH3**") between Ahititi and Uruti, to the north of New Plymouth with a principal focus on the section of SH3 known as Mt Messenger.

22. Along with my colleague Sharon Parackal, I prepared the Construction Water Assessment Report ("**CWAR**") included as Technical Report 13, Volume 3 to the Assessment of Environmental Effects ("**AEE**") for the Project. This CWAR provides an assessment of the effects on the construction activities associated with the Project with a primary focus on earthwork activities. I was also part of the MCA process for the Project where specific construction water management issues formed part of the overall route selection options assessment.

23. Ms Parackal and I also prepared the CWMP and the Specific Construction Water Management Plans ("**SCWMPs**") for the Project.

24. I am familiar with the Project site and the existing SH3 alignment. As part of the CWAR development I have visited the site on three separate occasions: 19 July 2017; 23 November 2017; and 2 February 2018. These site visits involved walking the accessible parts of the Project alignment, to allow for an appreciation of the topography and overall site conditions while also allowing for an assessment of the ability and practicality of undertaking earthworks and the associated construction water management techniques that may apply.

25. Included in these site visits were staff and representatives of TRC (23 November 2017) and also the Department of Conservation ("**DOC**") (2 February 2018). This allowed for on-site discussions and understanding of issues and opportunities that both TRC and DOC identified.

26. In addition to site visits and other discussions, I have met with DOC on 27 March 2018 and 4 May 2018. These meetings were focused on the concerns raised by DOC through the submission process and have allowed for resolution of the majority of DOC's concerns. I also met with TRC representatives on 10 May 2018 where an overview of updated information was provided and discussed to ensure full understanding of the construction water management aspects of the Project. Further discussion with TRC representative, Mr Campbell Stewart, was held on 22 May 2018.

27. In addition, the development of the CWAR, CWMP and SCWMPs has included many discussions and internal workshops with other Project specialists to ensure all elements have been addressed appropriately.

**SCOPE OF EVIDENCE**

28. The purpose of my evidence is to outline the potential construction water related effects of the Project, and to then discuss the proposed management measures to address those effects, as set out in the CWMP and SCWMPs.

29. My evidence addresses:

    (a) the existing environment of the Project area as it relates to construction water management;

    (b) the baseline sedimentation risk associated with the Project, in light of the existing environment and the proposed construction method for the Project;

(c) an overview of construction water management and introduction to the CWMP and SCWMPs;

(d) an outline of the construction water management methods as set out in the CWMP and SCWMPs;

(e) the construction water discharges monitoring programme set out in Appendix C of the CWMP and further confirmed through the SCWMPs;

(f) an overall assessment of the construction water effects of the Project, with the CWMP and SCWMPs in place; and

(g) responses to submissions and the Section 42A Report.

30. My evidence should be read in conjunction with the AEE for the Project, particularly section 5 of the AEE (Construction).

**THE PROJECT AND THE EXISTING ENVIRONMENT**

31. The Project involves the construction of a new section of SH3, generally between Uruti and Ahititi, to the north of New Plymouth. This new section of SH3 will bypass the existing steep, narrow and winding section of the current highway at Mt Messenger. The Project is approximately 6km in length, with an earthworks volume of approximately 890,000m$^3$ over a total area of approximately 36ha including the early stages of works to establish construction yards, clear and create access to the earthwork areas, and establish areas to store/stockpile equipment for construction of the site. Importantly, this Project is not large from an earthworks area perspective and is representative of a small to medium earthworks project.

32. The existing environment and Project site conditions have been determined through site visits as outlined above, analysis of the existing information available, discussions with the various specialists, further research, and monitoring as necessary. The overall environment, from the perspective of the CWAR, is discussed below.

**Rainfall**

33. Annual rainfall for the Project location equates to approximately 2000mm with approximately 40% of this falling over the 4 month period from May to August. Lower rainfall is evident in the January to March period which indicates a drier period of the year.

34. The rainfall records were collected by a local landowner at the northern end of the Project alignment who has collected daily rainfall figures since 2012. These illustrate a reasonable spread of rainfall over a 12 month period. There appears to be no other historic rainfall records for the Project area.

35. **Figure 1** below outlines a summary of the five years of data collected from the local landowner.

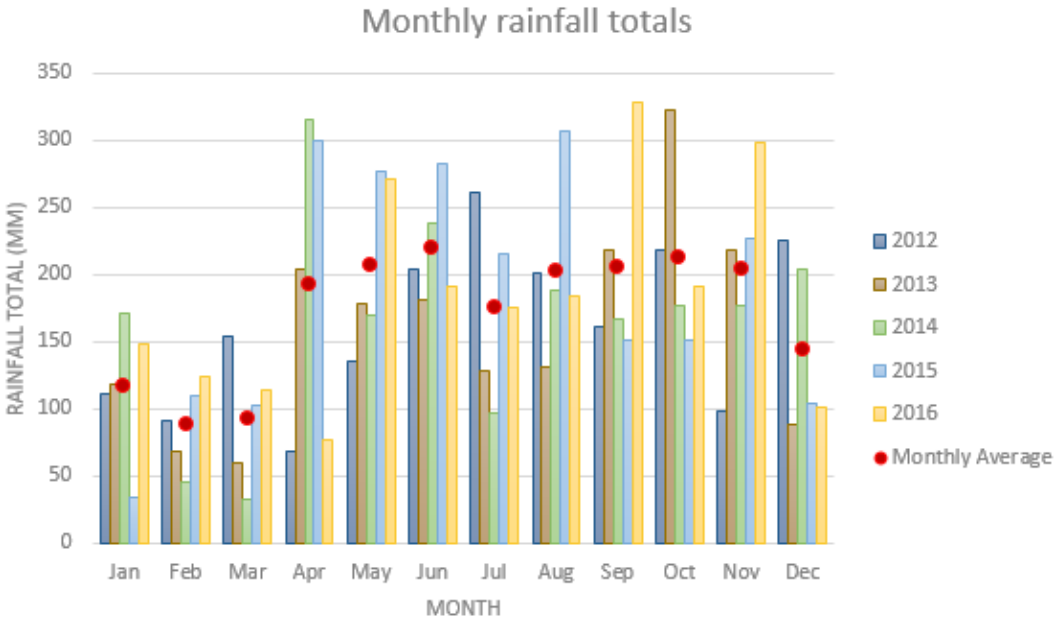


*Figure 1: Monthly Rainfall for Project Area*

36. The Project has recently installed a new rainfall site located close to the summit of Mt Messenger (refer to **Figure 2** below). This rainfall site has been operational since November 2017 and now provides specific Project site rain data. This data will assist with confirming accurate records up to the construction period and also during the construction period itself.

37. Overall it is assessed that while, based on rainfall data collected to date there is a drier and wetter period of the year, rainfall patterns for the Project are quite variable and high rainfall events can occur at any time of the year. Within the CWMP it is further recognised that the winter period is a colder period of the year with soil temperatures also lower. This can create soil moisture drying delays and also can limit the ability of traditional grass establishment methodologies to achieve vegetated cover over exposed areas.

## PROJECT LOCATION AND GEOLOGY

38. The Project will require works within both the Mangapepeke and Mimi catchments. The Mangapepeke Stream drains north-west to the Tongaporutu River with the Tongaporutu River subsequently discharging to the downstream

coastal environment. The Mimi River flows south-west, discharging to the coast between Waiiti and Urenui.

39. The Mangapepeke is a subcatchment of the Tongaporutu catchment immediately above the extent of works (Mangapepeke Stream) and comprises an area of 332ha. The total Tongaporutu catchment comprises a total area of 21,237ha.

40. The Mimi catchment comprises a total area of 13,235ha with the catchment extent immediately above the Project works comprising an area of 978ha.

41. These catchment areas confirm the very large catchments within which the Project is located.

42. The geology for the Project is dominated by papa mudstone within the steep sections, which also has a considerable influence on stream substrate, where the gravels are soft and a relatively high amount of fine sediment is present. Geotechnical investigations confirm that the valley floors, which the Project follows, contain significant depths of very soft to soft highly compressible alluvial deposits (soils washed down into the valley from the adjacent hillsides). These soils are predominant within the catchments as a whole and influence the baseline water quality as discussed in paragraphs 50 to 52 below.

**TOPOGRAPHY**

43. From the northern extent of the Project the alignment follows a valley floor which is an identified flood plain feature. From the valley floor the alignment progresses up a steep gully feature to the northern tunnel portal.

44. From the southern tunnel portal the alignment moves down a gully feature in the Mimi catchment to a wetland (referred to as the Mimi wetland) and progresses along the flats to the existing SH3.

45. The drawings which support the CWAR confirm the steep slopes (typically greater than 20%), which comprise a large portion of the Project alignment. Where the Project alignment follows the valley floor, slopes are typically less than 10%.

46. The transition between the valley floor and the steeper areas can be quite 'abrupt', however, generally the Project alignment is located within the lower slopes above the valley floor, to minimise works in the steeper locations and also the wet valley floor (flood plain) environment. Where the alignment

progresses up the gully features (both south and north of the proposed tunnel at chainage 2800 to 3900)[1] the topography is very steep and represents an area of higher risk from an erosion and sediment control perspective.

**WATER QUALITY**

47. Streams within the Project area are characterised by soft sediments where significant scour (bank and bed) has been observed. The streams have been subject to, and continue to be subject to, significant feral pig damage, and cattle access which has exacerbated further streambank slumping and high sediment loads.

48. Water quality was observed during site visits to the Project site on 19 July 2017, 28 August 2017, 23 November 2017 and 2 February 2018. The visits were during periods of fine weather and showed visual clarity of greater than 100mm. Deposited sediment was observed at the banks and base of the Mangapepeke Stream, and also in the Mimi wetland. While the upper catchment stream systems were clear during these visits, during the visit of the 2 February 2018 the downstream Tongaporutu River was observed and visually confirmed as having a very turbid appearance. This is illustrated in **Plate 1** below.

*Plate 1: Tongaporutu River Downstream 2 February 2018.*
*Photo supplied by DOC within Submission Information.*

[1] Alliance and DOC meeting of 27 March 2018 confirmed agreement that this location represented the highest risk for the Project earthworks.

49. While a specific comprehensive baseline monitoring programme is yet to be completed to an extent that allows for full analysis, it is assessed that during periods of rainfall, water quality declines within the upper stream catchments. This is likely due to increased suspended sediment loads from natural erosion of the stream beds and banks and some erosion of the surrounding soft papa mudstone including stock and pest induced erosion. More formal water quality baseline monitoring commenced in November 2017.

50. The primary purpose of the baseline monitoring is to understand natural, for example non-Project related, sediment loads to the immediate freshwater environment from rainfall and high stream flow conditions in the Mangapepeke and Mimi Stream catchments. Grab samples (using a stream level calibrated sampler) from the locations as identified in **Figure 2** below were collected from nine rainfall events to date. As confirmed in **Figure 2** the sampling sites are as follows:

    *Sites not affected by construction discharges (control sites):*

    - Mangapepeke Stream catchment: Site WQ1; and
    - Mimi Stream catchment: Site WQ4.

    *Sites downstream of construction discharges:*

    - Mangapepeke Stream catchment: Site WQ2; and
    - Mimi Stream catchment: Sites WQ3 and WQ5.

    *Sediment deposition at ecologically sensitive sites (if catchment relevant sediment retention pond management thresholds are exceeded):*

    - Site SD1 within the Mimi Swamp Forest.

51. Laboratory analysis for turbidity, pH, total suspended solids ("**TSS**") and settleable solids ("**SS**") was carried out with these results provided in Annexure 2 of the CWDMP.[2]

[2] The CWDMP is Appendix C of the CWMP.

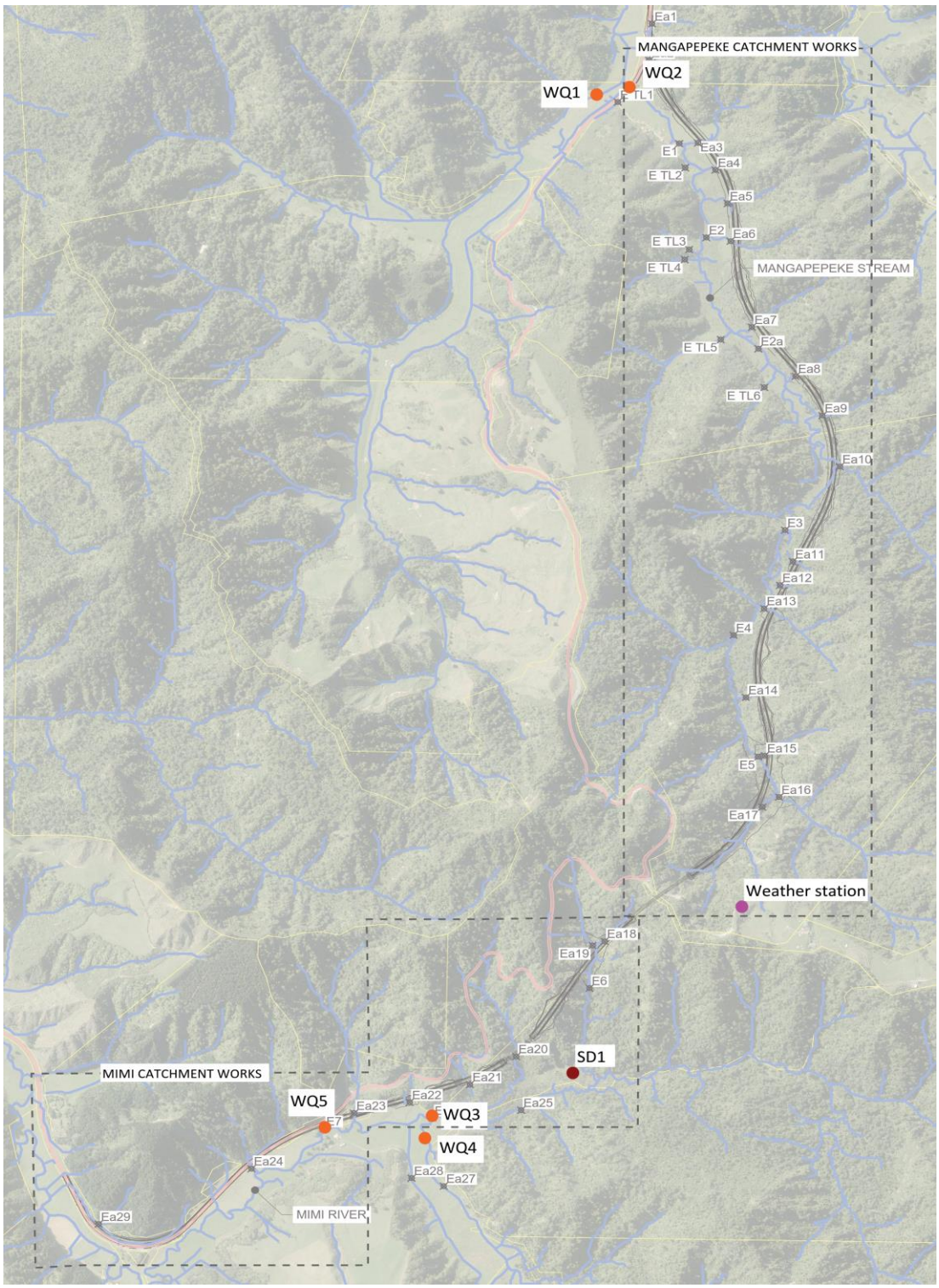


*Figure 2: Water Quality Sampling Sites and Rainfall Station Location*

52. In summary, the baseline monitoring results to date are:

    (a) The average pH at all sites (WQ1-WQ5) ranges from 6.8 - 7.1.

(b) At the control sites:

(i) WQ1: TSS concentrations typically range between 100 - 1000 mg/L, generally increasing with total rainfall and higher peak intensity;

(ii) WQ4: TSS concentrations typically stays above 1000 mg/L for most rainfall conditions; and

(iii) Turbidity levels are above 100 NTU at both locations.

(c) At monitoring site WQ3 downstream of the Mimi Wetland, TSS concentrations typically range between 100 - 1000 mg/L, with concentrations typically being higher for higher rainfall. Turbidity levels typically are above 150 NTU, increasing with higher rainfall.

(d) At the downstream sites:

(i) WQ5: TSS concentrations range from 138 - 8100 mg/L and turbidity levels are above 100 NTU;

(ii) WQ2: TSS concentrations range from 17 - 3200 mg/L. Similarly, a wide range of 30 -2800 NTU is observed for turbidity; and

(iii) The maximum concentrations at both these sites were measured following 81 mm total rainfall. TSS concentrations are notably higher at WQ5 compared to WQ2.

53. This baseline data collection is ongoing and at this early stage of collection it provides some trends and data of value. In particular it shows the high sediment loadings that occur naturally in these waterways during rain events which is a reflection of the underlying geology. The baseline data will continue to be collected up to Project commencement and will also form part of the ongoing CWDMP with more data allowing for a more robust analysis of baseline conditions.

54. In addition to the baseline sampling undertaken within the vicinity of the Project we have undertaken some water quality sampling of the downstream environments to allow for an understanding of the baseline conditions in the wider catchment context. **Figure 3** below confirms the location of these sample points.


*Figure 3: Downstream Water Quality Monitoring Locations*

55. The results from this sampling will be available for discussion at the hearing.

56. The Mangapepeke catchment is predominantly covered in indigenous forest. The valley floor, through which the stream meanders, is dominated by pasture and grazed wetland. Wetland vegetation is present at the valley floor where the ground is poorly drained.

57. Based on the freshwater assessment undertaken by Mr Hamill, Aquatic macroinvertebrate communities and Stream Ecological Valuation ("**SEV**") of the main stem of Mangapepeke Stream and representative tributaries indicate fair to good water quality in the lower reaches, improving to 'good' and 'excellent' water quality further upstream.

58. The Mimi River catchment is predominantly covered in indigenous forest but the valley through which the main stream meanders is predominated by pasture and grazed wetland. The Mimi wetland within this location is recognised in Mr Hamill's evidence as having high ecological value.

59. Based on the freshwater assessment undertaken by Mr Hamill, aquatic macroinvertebrate communities and SEV scores indicate high to very high water quality / condition along the main stem of Mimi River and forested

headwater streams. The small tributaries flowing through the pasture are heavily modified and impacted by stock and are of 'poor' ecological condition.

**RISK IDENTIFICATION**

60. With respect to the freshwater environment, locations of higher ecological value identified within the Project area include the Mimi wetland in the Mimi catchment, and all associated headwaters of the Mangapepeke and Mimi Streams outside of the Project footprint and currently not impacted by stock.

61. With respect to the marine environment, the marine assessment identified that there are significant coastal values downstream of the Project site, including:

    (a) Parininihi Marine Reserve - Pariokariwa Reef sponge garden;

    (b) Fisheries - snapper spawning, trevally, tarakihi and others;

    (c) Maui's dolphin;

    (d) Soft sediment benthic fauna; and

    (e) Seabirds.

62. The degree to which these coastal marine values may be adversely affected is dependent upon how much, and how far, suspended sediment would travel from the Project earthworks. It is noted that the Project is a significant distance from the coastal marine area (9.2km stream distance from the Tongaporutu River mouth and 21.5km stream distance from the Mimi Stream mouth).

63. I have further assessed the potential for construction related sediment concentrations downstream in both Mimi and Tongaporutu catchments by calculating the likely sediment yield from a sediment retention pond and placing this in the context of the Project earthworks and downstream flows. To do this, I obtained mean annual flow data of these environments from the NIWA Stream Explorer database. These are calculated as 64 $m^3$ per sec for the Mimi Catchment and 133 $m^3$ per sec for the Tongaporutu Catchment and represent river flows close to the coastal environment.

64. I have assessed the potential sediment yields per ha from measured data for an annual rain event (equating to approximately 20mm in a 1 hour period) from the outlets of 3 separate sediment retention ponds.[3] These measured

[3] Data obtained from Long Bay Auckland (2 sediment retention ponds) and Weiti Auckland (1 sediment retention pond) via automatic sampling devices for the equivalent of an annual rain event in February 2018.

yields equate to an average approximately 480 kg per ha of open earthworks for a 36 hour discharge period that resulted and was measured in those events.

65. Assuming similar treatment performance and effectiveness for this Project, and assuming the full potential earthworks area is open at any one time (note this is considered very unlikely to occur due to progressive stabilisation and sequencing of works, and therefore represents a very conservative scenario) the Project sediment yield for Tongaporutu catchment for such a rain event could be 11.8 tonnes.[4] For the Mimi Catchment this could be 5.5 tonnes.[5]

66. Back calculating this sediment yield with the flows and 36 hour duration (as per paragraph 63 above) for the Tongaporutu Catchment this equates to an average yield of 91 grams per second or an increase in sediment concentration of approximately 0.68 $g/m^3$ in the river flows at that point.

67. Back calculating this sediment yield with the flows and 36 hour duration (as per paragraph 63 above) for the Mimi Catchment, this equates to an average yield of 42 grams per second or an increase in sediment concentration of approximately 0.66 $g/m^3$ in the river flows at that point.

68. Both of these increases in sediment concentration are considered negligible and any resulting increase in total sediment concentration from expected background is unlikely and unable to be detected.

69. Of further importance with respect to the Project context, within the wider catchment the predominant land use is farming, which will also contribute to downstream sediment loads. The Project footprint is very small relative to the large size of the wider catchments.

70. Total earthworks for the Project equates to approximately 36ha, with 25ha (70%) in the Tongaporutu Catchment and 11ha (30%) in the Mimi Catchment. These areas of earthworks are respectively 0.12% and 0.09% of the catchment area as a whole.

71. On a catchment basis the Project earthworks equate to:

    (a) 7.4% of the total area immediately upstream of the Project in the Tongaporutu Catchment; and

[4] 24.6ha of earthworks @ 480 hg per ha yield.
[5] 11.4ha of earthworks @ 480kg per ha yield.

(b) 1.2% of the total area immediately upstream of the Project in the Mimi Catchment.

72. This is illustrated in **Figure 4** below.

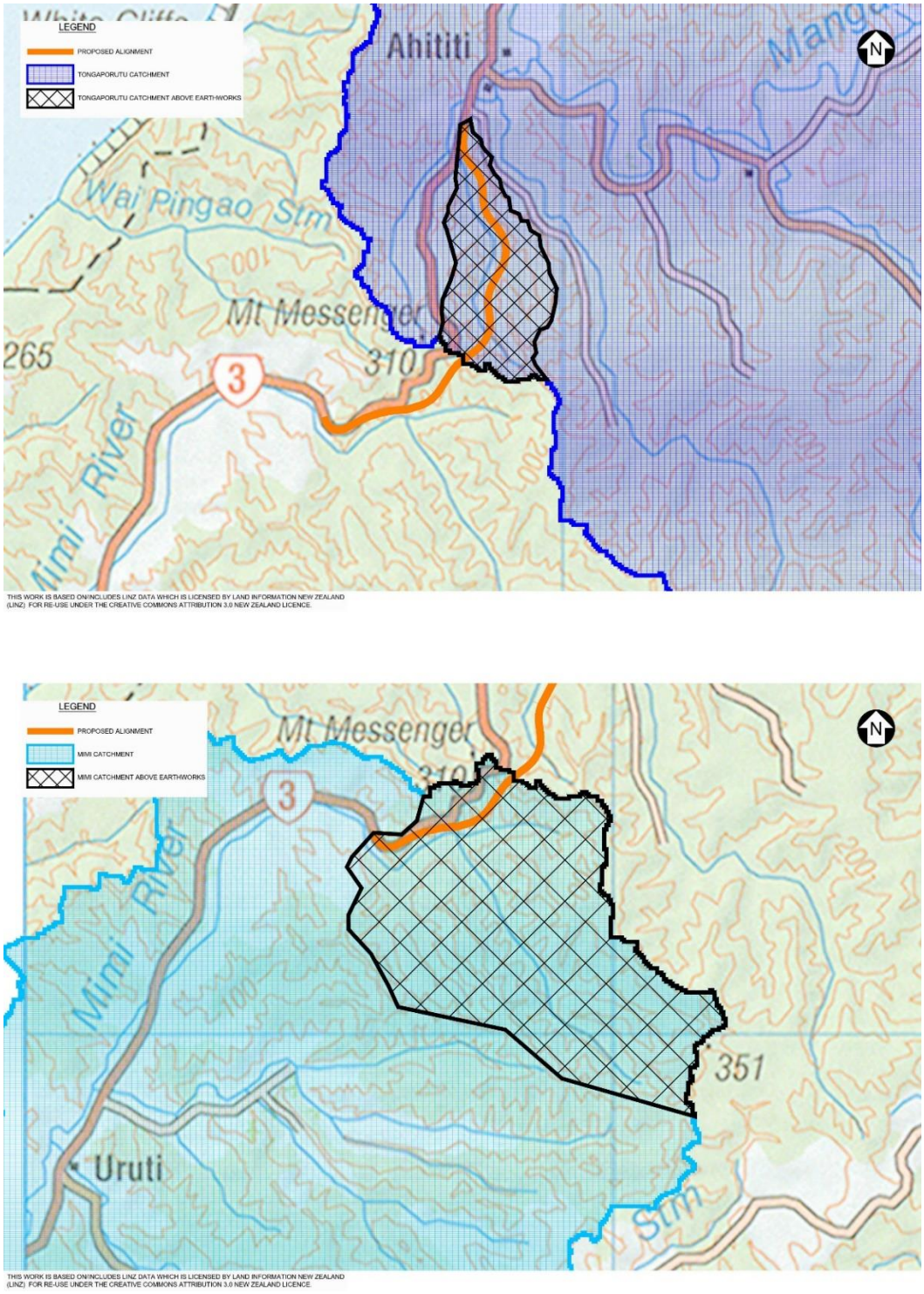


*Figure 4: Project Alignment and Catchment Areas immediately above Project. Top: Tongaporutu catchment. Bottom: Mimi catchment*

73. Construction related environmental risk for projects of this nature are typically the exposure of bare land from earthworks to rainfall (particularly within steep

topography), and works within or adjacent to watercourses including works within the flood plain.

74. The greatest area of potential sediment generation and yield for this Project relates to:

    (a) works within and adjacent to watercourses and wetlands, such as proposed fills, culvert placement and stream diversions; and

    (b) cut and fill operations on steep slope areas.

75. To assist with understanding the nature and magnitude of this risk, the existing topography has been assessed, from which a range of slope classifications have been identified within the Project footprint. The steep slopes are associated with a large portion of the Project alignment, with slopes typically greater than 20%. These represent a higher risk due to the increased potential (as compared to less steep slopes) for sediment generation.[6] Where the Project alignment follows the valley floor these slopes are, however, typically less than 10%.

76. It also recognised that wetter periods of the year may pose a higher risk for sediment generation and discharges because higher rainfall generates such sediment. This can apply to the winter period of 1 May to 30 September and construction activity within this period will need to reflect this higher risk. This risk will be managed through on site management and through the SCWMP process, whereby a risk assessment process is required to be undertaken including for works in the winter period. These works will require additional consideration of management procedures and specific measures, such as increased monitoring, progressive stabilisation and smaller exposed areas, which shall be described in the relevant SCWMP document.

77. Sediment yield risk is assessed for the proposed earthworks within the Project area, in the context of both event probability and associated consequence. This risk does, however, need to be placed in the context that the area of Project earthworks is considered very small at less than 40ha overall (including an indicative footprint for associated construction works) in the context of the overall catchment areas.

[6] A doubling of slope angle results in a three-fold increase in potential sediment generation.

**RISK MANAGEMENT**

78. Risk management for construction commences as part of the design process whereby avoidance of specific locations for construction or discharge points are key elements. For this Project, this has occurred early within the design whereby features such as the bridge across the tributary of the Mimi wetland will be established. This will avoid any construction within this location and avoid any direct effects from both an ecological and a construction sediment load perspective. Mr Boam's and Mr Milliken's evidence confirms this design process.

79. With consideration of non-earthwork, construction related discharges, these all represent a risk, however, as identified within the CWAR with a detailed management approach in place the effects of any such discharges are considered to be less than minor.

80. The earthworks themselves will be undertaken in various stages in a lineal fashion for the main alignment in addition to spoil stockpile locations. The risk from the earthworks themselves can be reduced by:

    (a) progressively stabilising as works proceed; and

    (b) by reducing slope length as much as practically possible through the provision of contour drains across cut slopes while earthworks are occurring.

81. With respect to progressive stabilisation, this is reflected within the requirement (as per draft Condition 38[7]) that exposed areas cannot be left exposed for more than 14 days if they are not being actively worked on, unless a different period is provided for in a SCWMP for that earthworks area. This is an effective method to encourage progressive stabilisation.

82. The CWMP:

    (a) Defines stabilised area[8] as an area inherently resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation or mulch, or as identified in the Construction Water Management Plan. Where vegetation is to be used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established.

[7] As lodged.
[8] CWMP, section 5.3.

(b) Provides the method of stabilisation is dependent upon site conditions and may include use of mulch and/or other woody organic matter, geotextile, the use of hard fill material and exposing rock.

(c) Defines actively worked[9] as actively subject to earthworks production with cut and fill, stockpiling or topsoil removal.

(d) Requires areas of earthworks to be monitored on a weekly basis with ongoing field checks and understanding of production locations. The Environmental Manager will have a responsibility for ensuring identification of areas not worked and ensuring these are stabilised within the 14 day period (or the period provided for in a SCWMP for that earthworks area).

(e) Requires that a 14 day period (or the period provided for in a SCWMP) will apply to all earthworks and will include parts of larger earthwork footprint locations. The overall intent is that if the Project is not working an area (or part of an area) then the stabilisation period provision applies.

83. With respect to slope length, the installation of contour drains as a best management practice will be required pre any rainfall event and this has the immediate effect of reducing sediment generation.[10]

84. It is recognised that the Project earthworks contains areas of risk as identified above. Within these areas, both erosion and sediment controls will be installed to minimise, capture and treat sediment laden runoff that may enter the receiving environments. Chemical treatment within Sediment Retention Ponds ("**SRPs**") and Decanting Earth Bunds ("**DEBs**") will allow for improved treatment efficiencies of these devices and is another critical element of reducing potential risk of sediment yields. Additionally, the duration and timing of works will be minimised as far as practical to minimise disturbed soils exposed to heavy rainfall.

85. In addition to the above, and to assist with understanding and minimising risk, as part of the SCWMP process, the exposure of works to heavy rainfall will be assessed and specific actions to manage this risk identified and implemented. This is discussed above.

[9] CWMP, section 5.3.
[10] Reduction of the slope length by 50% has the effect of reducing the sediment generation potential by 1.5 times

86. Rainfall is recognised as the key driver of sediment yield. Whilst extreme rainfall events with high return periods occur relatively infrequently, when a construction project extends over several years the probability of a high return period event occurring over the construction period increases.

87. During a four year construction period (as proposed for the Project), there is a 98% probability of a 1 year Average Recurrence Interval ("**ARI**") rainfall event occurring and a 55% probability of a 5 year ARI rainfall event occurring. For the 20 year, 50 year and 100 year ARI rainfall events the probability of occurrence are 18%, 8% and 4% respectively. Should the construction period extend beyond the four year proposed construction programme, then the probability of a higher return period rainfall event occurring also increases.

88. Given the anticipated Project duration, rainfall up to the five year ARI rainfall event is considered to present the highest risk to Project works. Design of erosion and sediment control measures accounts for this rainfall and with the associated CWDMP allows for ongoing assessment and improvements over time.

**SEDIMENT YIELDS**

89. When assessing potential sediment yields from the Project, there was considered to be minimal value in undertaking detailed sediment yield calculations for a construction programme that will include work on various fronts over a linear nature. It is, however, recognised that there is a direct relationship between sediment yield and soil types and slope classification for the Project.

90. The key purpose of undertaking sediment yield calculations is to assist with determination of risk and identification of the specific measures that will apply to address this identified risk. With risk identified as above, it was determined that for the purpose of assessing effects of sediment through a sediment yield comparative assessment, Project soil types (with a high clay content) and slopes were considered similar for this Project to the recently consented (and now subject to construction) Puhoi to Warkworth motorway project ("**P2WK**") which included a comprehensive sediment yield analysis.

91. P2WK included provision for a comprehensive erosion and sediment control implementation programme which includes chemically treated SRPs, DEBs, progressive stabilisation, training and a comprehensive monitoring programme. These same provisions apply to this Project and hence provide

some further comfort of the applicability of the sediment yield outcomes between the projects.

92. Utilising these existing sediment yield calculations enables a comparative assessment to occur within the Project and an indication of the potential likely sediment yields overall to also be determined. It is important that these yields are not considered in absolute terms and are instead utilised in a comparative manner to provide an indication of the potential quantum of sediment that may result.

93. **Table 1** below illustrates the resultant calculated sediment yields and compares these to potential background yields for the Project and catchment areas. This confirms the potential of 0.7% increase in sediment yield for the Tongaporutu catchment and a 0.5% increase in yield for the Mimi catchment.

**Table 1: Project Sediment Yield Estimates**

| Catchment | Project Earthworks (ha) | Potential Sediment Yield from Earthworks (tonnes/year) | Potential Background Sediment Yield from Full Catchment (tonnes/year) | Potential % increase in Sediment Yields from Project |
|---|---|---|---|---|
| **Tongaporutu Catchment** | 24.6 | 1207 | 167,770[11] | 0.7 |
| **Mimi Catchment** | 11.4 | 560 | 104,550[12] | 0.5 |

94. On a wider catchment basis, for both catchments, the Project is likely to result in an insignificant increase in potential sediment yields to the marine environment, equating to less than 1% on an annual basis. On a sub-catchment basis, this equates to less than 8% annual increase for the Mimi catchment, and a 46% annual increase for the Mangapepeke catchment.

95. Works in the Mangapepeke catchment are small overall and also in the context of the wider catchment. The works do however involve earthworks directly within headwater stream systems and hence have a much greater % sediment yield increase when considered in this context.

96. In addition it is assessed that sediment that discharges from sediment retention devices, including within the Mangapepeke catchment, will be of a

[11] 21237ha multiplied by 7.9 tonnes per ha
[12] 13235ha multiplied by 7.9 tonnes per ha

fine particle size and will likely remain in suspension for long periods of time with minimal settlement within the immediate environment. The potential effects of such discharges from the Project on the downstream receiving environment (i.e. short term effects) are discussed within the Aquatic and Marine Ecology Assessment Reports.

## MANAGEMENT PLANS AND SITE SPECIFIC DETAILS

### Introduction

97. The focus of construction water management for this Project is erosion and sediment control, and the associated principles and practices that apply.

98. The erosion and sediment control measures for the Project are designed to minimise the extent of soil erosion as a first principle and manage any resultant sediment yield. To minimise sediment generation, erosion control will be the highest priority in the design of Project erosion and sediment control measures. This is particularly important when considering the steep existing slopes associated with the Project.

99. To achieve the necessary environmental outcomes for this Project, the Alliance has adopted the Transport Agency guideline on erosion and sediment control,[13] which represents industry best practice ("**Transport Agency Guideline**").[14] In some circumstances, however, there will be specific practical reasons for not implementing controls in strict accordance with the Transport Agency Guideline. This does not in any way prevent the implementation of best practice but instead adapts the "standard" control measures to match site circumstances. As an example, with the slope categories on the Project there are constraints with respect to installing devices to full design standards and volume criteria. All construction works will be undertaken in accordance with the best methods and practice available at the time of construction to achieve the principles that apply. These will be detailed in SCWMPs as discussed below in paragraph 106.

100. The development of the erosion and sediment control measures for the Project is based on utilisation of industry best practice and applying a management approach which continually adapts and improves as the Project

[13] Transport Agency, Erosion and Sediment Control Guidelines for State Highway Infrastructure (September 2014).
[14] Alliance DOC meeting on 27 March 2018 confirmed acceptance of the Transport Agency Guideline as best practice.

progresses. The principles will form key considerations throughout the full construction period.

101. Importantly sediment control will be implemented for all sediment laden discharges, with SRPs considered the most viable and effective sediment control solution for the main construction works. SRPs will be rationalised within the Project area to ensure they are fully utilised, centralised and effective and do not create unnecessary earthworks in themselves. In some circumstances, where SRPs cannot initially be installed, container impoundment systems will be utilised.

**CWMP**

102. As set out above, the CWMP has been developed and finalised to provide the overall approach and guidance for construction water management during construction of the Project. The CWMP will be a live document that will be reviewed and updated, if necessary, during the course of the Project to reflect material changes associated with construction techniques, communication, mitigation, or the natural environment. The CWMP will primarily be based upon the erosion and sediment control principles as detailed and will reconfirm the methodologies and general construction sequence to be followed as the final design matures. The benefits of allowing this management plan approach to be established by the Project team prior to construction is to allow for contractor innovation and flexibility.

103. A draft CWMP was provided with the application documentation and a final CWMP has now been provided to TRC. This final CWMP is attached to the evidence of Mr Roan and forms part of the condition and management plan suite to be approved through the hearing.

104. This CWMP details the specific methodologies to be utilised and also provides details of the erosion and sediment control measures themselves. Maintenance of these measures is also specified.

105. The CWMP also provides an important link to ensuring Project personnel are appropriately trained and experienced in construction water management. All people working on-site, or with site responsibilities, will be required to undertake a formal site induction process with part of this process based on environmental management, including erosion and sediment control and the requirements under the CWMP. The CWMP includes details of the organisational structure for the Project. Further, all Project staff will undergo

general environmental awareness training, including ecology, vegetation and landscape matters. These aspects are considered important and are required through the CEMP and condition 21 of the draft consent conditions and condition 16 of the draft designation conditions.

106. For each area of work, prior to construction activity, detailed location and/or activity specific management plans (referred to as Specific Construction Water Management Plans - SCWMPs) are required. This process of plan development is illustrated in **Figure 5** below.

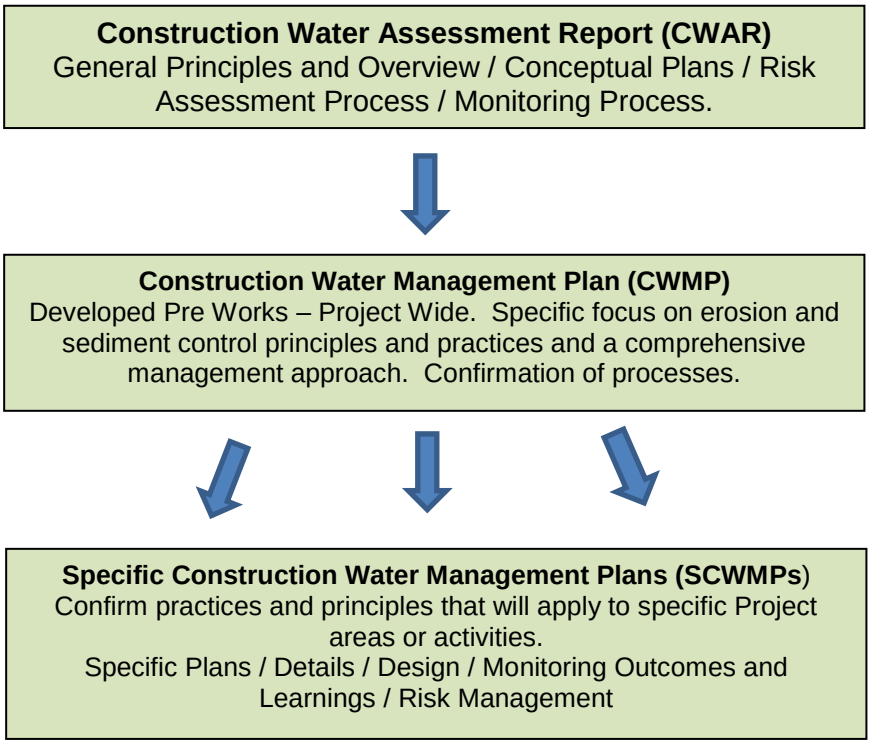


*Figure 5: CWAR, CWMP and SCWMP Framework*

107. While it is recognised that the development of SCWMP's will be ongoing throughout the Project, three SCWMPs have been prepared in accordance with the principles of both the CWAR and the CWMP including the SCWMP template that forms part of the CWMP (Appendix B of CWMP). These SCWMPs form part of the condition and management plan suite to be approved by the hearings commissioner, relate to:

(a) the staged formation of the Northern construction yard;

(b) Temporary Access Crossing at Ch 570; and

(c) establishment of fill disposal site 4.

108. SCWMPs not confirmed through the hearing process will be submitted to TRC for certification prior to the commencement of works within areas, or for specific activities, to which they apply. The SCWMPs will provide the detailed design, risk profile and management, specific erosion and sediment control measure location, staging and sequencing of works for that location and consider the best practicable option for managing construction water effects.

109. The SCWMPs will enable enhanced outcomes, adoption of learnings as the Project progresses and the opportunity for implementing innovative practices, particularly in sensitive locations. As above, the SCWMPs allow for the learning from the Project's monitoring programme to be applied for continuous improvement in response to monitoring outcomes as required.

110. The CWMP and SCWMPs development process above relies on having an experienced and involved team to ensure all relevant aspects of the Project are taken into consideration as part of planning and decision making. This will ensure adequate resources, commitment and expertise are provided to erosion and sediment controls from start to finish of the Project (design through to disestablishment).

111. In addition to the three SCWMPs produced, a methodology has been developed that will apply to both fill sites either side of the tunnel establishment.[15] These two locations were identified as higher risk locations with the specific methodologies uncertain at the time of consent lodgement. Two alternative methodologies have now been developed and discussed with DOC and TRC[16] to ensure there is certainty with respect to both constructability and environmental effects. These methodologies are based on the option of small incremental daily installation of diversion pipes, daily stabilisation, and progressive filling as works progress. The alternative option includes the installation of a pipe network for the full gully system allowing a shorter duration activity and effectively allowing filling and progressive stabilisation to then occur. It is assessed likely that a hybrid of both of these options will be implemented.

**OVERVIEW OF CONSTRUCTION WATER MANAGEMENT METHODS**

112. A proactive risk approach will be adopted for all works associated with the construction phase, whereby prior to construction works commencing, the site

[15] Evidence of Mr Hugh Milliken.
[16] Alliance discussion with DOC 4th May 2018 and TRC 10th May 2018 confirmed agreement of these methodologies and associated outcomes with details agreed to be provided within SCWMPs as necessary.

conditions and associated resources will be assessed for the exposure risk and the relevant SCWMP can be updated as required.

113. While for all locations, the full suite of both structural and non-structural erosion and sediment controls will apply, for higher risk sites, there will be a more significant monitoring presence, ensuring progressive stabilisation continues to occur and working within more defined fine weather windows. As detailed above this risk management approach will be confirmed with specific procedures detailed within the relevant SCWMPs.

114. In general, the erosion control measures to be applied to the Project are as follows.

    (a) Construction staging and sequencing:

        Bulk earthworks and construction activities will be staged and sequenced as part of the normal construction programme while also having the effect of limiting the area of exposed soil required to complete an element of the work. Open earthworks areas will be progressively stabilised to reduce the potential for erosion to occur. Where areas within the Project are not worked for more than a 14 day period (or a period as provided for within the SCWMP) they will be stabilised. This will ensure areas are not left exposed for long periods of time and will therefore reduce the potential for sediment generation (and subsequent yields). Stabilisation will be undertaken with three key purposes:

        (i) to achieve the progressive stabilisation as specified within consent conditions for the Project;

        (ii) to reduce the open area of higher risk locations to assist with a reduction in sediment generation; and

        (iii) to address any potential effects in response to the monitoring programme.

    (b) Clean and Dirty Water Diversions ("**CWD**" and "**DWD**"):

        (i) CWDs provide for the controlled conveyance of upslope runoff and will be used on the Project to minimise water from the catchment above the works from entering the Project construction area.

        (ii) DWDs will be utilised to safely allow the transfer of construction flows from disturbed areas to the sediment control devices.

(iii) There are some Project locations where CWDs will not be able to be installed to full capacity (generally on slopes greater than 30%). In such circumstances these will be detailed within the SCWMPs and alternatives will be assessed including:

(1) reducing the capacity of the CWD to an achievable design and reducing the duration and / or risk of the specific Project works;

(2) allowing the movement of clean water through the earthworks site in a controlled manner; and/or

(3) increasing the volume of the downstream sediment control device to allow for the extra upstream catchment, within the constraints of the device design catchment and capacity.

(c) Contour drains - Contour drains are temporary ridges or excavated channels or a combination of the two that are constructed to convey water across a slope at a minimum gradient. They reduce the slope length and therefore the velocity of water flowing down disturbed slopes and hence reduce the erosive power of construction runoff. These will be utilised within the Project on an as-required basis.

(d) Rock check dams - The purpose of a rock check dam is to reduce the velocity of flow within the channel and prevent scour of the channel surface. Check dams also allow for some settlement of suspended solids within the channel.

(e) Pipe drop structure / flume - Temporary pipe drop structures or flumes are constructed to convey construction runoff down a slope face without causing erosion of the slope and will be used to ensure no scour of these batters occurs.

(f) Stabilised construction entrance way - Stabilised construction entrance ways are stabilised pads of aggregate placed on a filter base located where construction traffic will exit or enter a construction site. They help to prevent site entry and exit points from becoming a source of sediment and also help to reduce dust generation and disturbance along public roads.[17] No vehicles will be allowed to leave the Project site unless

[17] Reference Construction Dust Management Plan, May 2018, CEMP Appendix.

tyres are clean, meaning vehicles will not contribute to sediment deposition on public road surfaces.

115. In general, the sediment control measures to be applied to the Project are as follows:

(a) SRPs will be designed in accordance with the volume criterion applied in relation to catchment size as per the Transport Agency Guideline.[18] This will include installation of a Super Silt Fence prior to establishment of any SRP, chemical treatment, forebays and the use of T Bar decants. Where sediment control devices are required within the 20 year ARI flood level, they will be designed to capture the minimum catchment area, have measures to protect the outer bund from scour and structural failure and will be subject to an increased inspection and maintenance regime. With the consideration of associated discharge levels (relative levels from discharge point to SRP invert levels) the establishment of a higher bund around the extent of the device will be established to minimise overtopping from flood waters.

(b) DEBs will be designed as per the Transport Agency Guidelines and will include chemical treatment and floating decants.

(c) Container impoundment systems ("**CIS**") will be used in locations where SRPs or DEBs cannot be located due to slope, space constraints or stability issues. These will be retrofitted with a decant system and subject to chemical flocculation. Such systems will be used primarily in the early stages of earthworks for small catchment areas prior to the ability to develop SRP structures. The CWMP provides a typical detail which illustrates a CIS (Reference Drawing Number MMA-DES-ESC-C0-DRG-4008 as per Appendix A of the CWMP).

(d) Super silt fence ("**SSF**") and Silt Fences and Filter Socks will be used throughout the Project with a focus on super silt fences in those areas of work adjacent to, or in the immediate vicinity of watercourses and also below SRP construction activities.

(e) Flocculation will be utilised within the Project. This is a chemical treatment method for increasing the retention of suspended solids from construction earthworks runoff in SRPs and DEBs. Testing undertaken

[18] Note that design calculations for the Transport Agency Guidelines have been undertaken and will be confirmed within the SCWMPs as required.

on Project soils to date (Appendix C of CWAR) demonstrates that chemically treating sediment laden water reduces turbidity at a much faster rate to untreated water. The samples tested with chemical flocculants achieved turbidity levels of less than 20 Nephelometric Turbidity Units ("**NTU**") within very short time periods. The chemical bench tests demonstrated two key elements:

(i) that there are chemical flocculants readily available on the market that are proven to be successful and will achieve the required flocculation of the suspended sediments from the soil types that will be encountered within the Project; and

(ii) that the level of treatment necessary, based on the tests undertaken, illustrate that low flocculation dosage rates are required.

116. For works within stream systems specific methodologies will be confirmed within the SCWMPs. However, as detailed within the CWMP (section 6.6), the principles for these works will be: reducing the duration and timing of works to avoid where practicable periods of high flow, wet weather and fish migration; and undertaking works in a 'dry' environment with the provision of diversions or pumping facilities.

117. All erosion and sediment control measures will remain in place until such a time as the catchment contributing to that device is stabilised. Once the contributing catchment is considered stabilised the erosion and sediment control measure will be decommissioned. The decision process and procedure for this will be outlined within the SCWMPs.

**CONSTRUCTION WATER MONITORING**

118. A detailed Construction Water Discharges Monitoring Programme is considered critical to the success of the Project and is appended to the CWMP (Appendix C). The focus of this monitoring programme is the management of sediment yield from the Project and to inform on site decisions about erosion and sediment control. Without such a monitoring programme, the ability to successfully implement effective erosion and sediment controls that respond to the Project constraints and improve the water management control measures and the overall management approach as required, will be greatly reduced.

119. The monitoring programme will involve ongoing site monitoring throughout the construction phase to check that construction water management measures have been installed correctly, and methodologies are being followed and are functioning effectively.

120. The Construction Water Discharges Monitoring Programme includes the following components:

    (a) Receiving environment: on-site visual assessments undertaken regularly throughout the work period including a photographic record.

    (b) Weather forecasting during Project implementation: weather forecast monitoring will form an important part of the Project implementation so that higher risk activities such as stream diversions and activities will only occur during a suitable fine weather window. The Project will utilise readily available forecast methodologies including metvuw.com and also metservice.com.

    (c) On-site monitoring of water management devices: monitoring of management devices (referred to as 'devices monitoring') will be utilised to demonstrate environmental compliance for the Project during the construction period. Environmental compliance will be achieved through appropriate installation, location, maintenance, and monitoring of these devices. It is important that within the context of monitoring, the devices are not restricted to physical structures but also include work practices and methodologies. During the construction period, the monitoring will be undertaken daily and more frequently during trigger rainfall events. Trigger rainfall will be measured within the on-site rain gauge. Checklists that confirm consistency with the Transport Agency Guideline will be utilised for this aspect of the monitoring programme.

    (d) Flocculation monitoring: a core part of flocculation management is monitoring to check that the systems are all working as anticipated and to provide information to facilitate management of the flocculation systems. This will include checking the treated detention device discharge and receiving environment pH levels at weekly intervals and during rain events of greater than 25mm within a 24 hour period or 15mm within a one hour period.

    (e) Quantitative sediment discharge monitoring: this will include manual monitoring of outflow turbidity and/or total suspended solids associated

with a selection of SRPs (to represent a minimum 50% of the SRPs utilised on site). This manual monitoring will occur at the times of the rainfall trigger as below and allows for comparative analysis between samples and also with any baseline data previously collected. In addition, monitoring of the receiving environment through manual sampling, both upstream and downstream of discharges, will occur where practicable.

(f) Pre and post-earthwork monitoring of freshwater habitats: prior to the start of earthworks water quality and habitat surveys will be undertaken in the freshwater habitats within and downstream of the Project in order to establish a robust pre earthworks baseline. These surveys should be repeated at regular intervals through the Project implementation, for example annually, and also following key construction activities. All annual surveys will be undertaken at a similar time of year to ensure comparative analysis can occur.

(g) Triggered monitoring. As an initial trigger rainfall greater than 25mm in a 24 hour period or 15mm in an hour will instigate a monitoring process, which includes:

(i) inspect all earthworks, all erosion and sediment controls and associated management procedures to identify any problems or activities likely to have contributed to increased sediment discharge to the receiving environment;

(ii) inspect freshwater receiving environment with a particular focus on sediment deposition locations;

(iii) collect manual samples from device discharges as necessary including:

(1) Stream Sampling;

(2) Manual Sampling; and

(3) Sediment Deposition Sampling; and

(iv) remedy any identified problems, and implement any further controls on activities that are likely to contribute to increased sediment discharge.

121. Monitoring results from the trigger event sampling will be used to identify potential long term risks to freshwater ecology based on pre-determined management thresholds. These thresholds were developed based on site knowledge and experience and are for sediment and other construction water discharges including: concrete, oil/fuel and chemical flocculants, with exceedance of these thresholds instigating a second level of investigation. These thresholds shall be referenced when Trigger Event monitoring occurs and any follow up monitoring that may be required.

122. Two levels of investigation occur as detailed below.

    (a) First level of investigation (Trigger Event exceeded):

        (i) When a Trigger Event is exceeded, a site audit inspection of the various construction water management measures shall be undertaken by site monitoring staff as soon as practicable (under safe conditions) following the trigger. The audit shall evaluate the performance of the project water management controls and identify any issues or opportunities that may exist, in conjunction with obtaining Stream Sampling and Manual Sampling water quality data.

    (b) Second level of investigation (Management Threshold exceeded):

        (i) Following an exceedance of a Management Thresholds a second level of investigation shall be undertaken, which includes:

            (1) The site monitoring staff re-notifying the Erosion and Sediment Control supervisor and the Project Environmental Manager.

            (2) The E&SC supervisor inspecting the specific site area where the threshold has exceeded, identifying specific continuous improvement opportunities (if any) and documenting it as per the reporting process set out below (refer section 6). This step will include:

                A. inspect the earthworks site, all water management including erosion and sediment controls and associated management procedures to identify any problems or activities likely to have contributed to the threshold exceedance;

B. collect further water quality samples from device discharges as necessary; and

C. remedy any identified problems and implement any further controls on activities that are likely to contribute to ongoing management threshold exceedances.

123. In the event of an exceedance of the Management Threshold for sediment (as a result of the Sediment Deposition Sampling) within the Mimi wetland, the ecological response and monitoring actions set out in the Freshwater Management Plan (Section 8.3.2 and 8.4) of the ELMP shall be undertaken.

124. During construction water management, measures and methodologies may be identified by the Alliance as requiring modification or improvement including those causing raised levels of sedimentation based on the management thresholds. The success and effectiveness of the monitoring programme is based on the overall comprehensive monitoring approach and ensuring that all aspects of the monitoring programme are implemented accordingly.

125. The CWDMP is illustrated within a flow chart in Annexure 1 of the CWDMP.[19]

**OVERALL EFFECTS ASSESSMENT**

126. Design and methodologies adopted for the Project are based on a best practicable option approach and reflect experience on many other Projects including Transport Agency roading projects and using technology and management approaches that are known to work. While developed and tested systems will be employed during construction to achieve the necessary outcomes, these systems must be backed up by a monitoring programme linked to identification for continuous improvement. This is a key element of ensuring success.

127. The knowledge of the baseline water quality assessed for the Project area, and the site visits undertaken, demonstrate that the water quality within the Project area is generally poor during rain events due to naturally occurring, and stock-induced high sediment yields. This water quality however is placed in the context of high ecological and the amenity values of the Project area and in particular the values of the Mimi wetland environment.

128. Construction water management measures outlined in the CWMP and SCWMPs will be implemented during construction of the Project to ensure the

[19] CWMP, Appendix C.

existing ecological, amenity and natural values of the receiving environment are maintained. All discharges will be treated to an industry best practice standard which will be exceeded in many circumstances and includes chemical treatment, non-structural control measures, comprehensive methodologies and stabilisation techniques.

129. All construction-related discharges from the Project area, including sediment, will be subject to relevant and proven measures and techniques that will have the direct effect of reducing the volume and toxicity of any such contaminant.

130. A continuous improvement monitoring programme will be implemented to measure the success and effectiveness, or otherwise of the treatment measures as a crucial element of successful and effective construction water management. This programme also allows for ongoing and continuous improvement throughout.

131. The Project is located in the headwaters of the Mangapepeke Stream and the Mimi catchment with a large area of the wider catchment areas below the extent of works. This, coupled with the significant stream distance to the coast, provides confidence that the relative increase in sediment yields at the coastal margin associated with construction of the Project will be insignificant.

132. It is recognised that the Project contains some higher risk locations due to topography and the ongoing development of SCWMPs will be a key tool to ensure risks are identified and managed accordingly. While some SCWMPs can be developed early in the Project many of these SCWMPs will be staged with the first stage including the removal of vegetation. Until such a time as the vegetation is cleared on many parts of the Project footprint the specific detail cannot be determined, due to the inability to know the specific nature of contour and ground conditions. The staged nature of the SCWMPs allow this process to occur and are assessed as the best available tool for addressing this situation.

133. The increase in sediment yields from current background sediment is assessed as low, and our assessment indicates there will be no cumulative effects on the downstream receiving environment as a result of the increase in sediment yield from the Project discharges during construction. The construction period is short and represents an effective and efficient process to achieve the necessary works in the shortest period possible, reducing risk throughout.

134. The potential increase in sediment yield during rain events may result in a change in water colour and clarity. Existing site and receiving environment conditions indicate that water clarity is currently low during rain events. Any sediment yield from the construction areas will be of fine clays and silts and may contribute to changes in colour. Conspicuous changes in colour and clarity in the freshwater systems within or downstream of the Project area will be temporary and occur during and post storm events. If higher levels of total suspended solids result, this will coincide largely with the natural change in colour and clarity that will occur during storm events while the sediment control devices discharge over this same period.

135. Comprehensive monitoring will take place which will confirm the ongoing effectiveness of the water management devices (including erosion and sediment controls) on the site, allow for effects assessment against receiving environment triggers and in turn allow for ongoing assessment and improvements of control measures as necessary.

136. The overall construction water management and erosion and sediment controls to be employed:

    (a) represent the best practice measures;

    (b) will minimise discharges; and

    (c) will enable ongoing monitoring and continuous improvement to occur.

137. The potential change in water quality is minimal and the increase in sediment (as shown in **Table 1**) is unlikely to be detectable. Accordingly, overall, my assessment is that, with the proposed control measures in place (and in particular the implementation of the CWDMP and the progressive stabilisation) as proposed, the effects of construction related water discharges will be negligible.

**RESPONSE TO SUBMISSIONS AND SECTION 42A REPORT**

138. I respond below to construction water issues raised in submissions on the Project and in the TRC Section 42A Report on the Project.

**Submissions**

*Director-General of DOC - Overall Effects*

139. The Director-General of the DOC raised some concerns with the Project's erosion and sediment control methods. I meet with DOC representatives on 27 March 2018 and have had ongoing discussions with Mr Duirs since that date, including a further meeting with him on 4 May 2018. Many of the items raised in DOC's submission have been resolved and/or are addressed in the final CWMP, now provided. I discuss the items raised in turn below.

140. Within its submission DOC considers that sediment loss to waterways during construction presents a major risk in terms of adverse ecological effects given the nature and scale of the site, the scale of works, the alignment design and the high value aquatic receiving environment. DOC requested that in addition to erosion and sediment control management measures proposed, the applicant should be required to identify and offset the residual effects that will occur within and immediately downstream of the site over the duration of the works.

141. As set out above, the scale of the Project is small with approximately 36ha of earthworks required. Specific risks have been identified with the steep topography, particularly within the fill sites immediately north and south of the tunnel, and also the flood plain location and environments such as the Mimi wetland. This risk will be managed through the SCWMP process in addition to progressive stabilisation, stabilising all areas not worked for more than 14 days, utilisation of best practice, and a comprehensive monitoring programme (the CWDMP - Appendix C of CWMP).

142. Earthworks within Tongaporutu Catchment are approximately 25 ha with a further 11ha in the Mimi Catchment representing 0.12% and 0.09% of the catchment area as a whole respectively. On a subcatchment basis the project earthworks equate to 7.4% of the total area immediately upstream of the Project in the Tongaporutu Catchment and equates to 1.2% of the total area immediately upstream of the Project in the Mimi Catchment.

143. My assessment of negligible effects remains, however, it is acknowledged that, if through the CWDMP, there are identified residual effects downstream, then part of the monitoring programme includes a determination about how these are addressed from an offset perspective. A deposition management threshold (area and depth of sediment within the Mimi wetland) has been

established and if this is exceeded than a series of actions, including an ecological response is required. This is set out in the CWDMP, appended to the CWMP as Appendix C.

144. DOC has received a copy of the CWDMP[20] and has confirmed acceptance of the CWDMP for monitoring construction related activities as fit for purpose. This matter has therefore been resolved.

*Fill Site Establishment*

145. DOC requested that more detail is required on the erosion and sediment control practices for the fill sites on both the northern and southern ends of the tunnel.

146. The Alliance has undertaken more assessment in these locations and has developed methodologies and a process to be applied in these locations. Two alternative methodologies have now been established and discussed with DOC to ensure there is certainty with respect to both constructability and environmental considerations. These methodologies are discussed above and within the evidence of Mr Hugh Milliken.

147. DOC[21] has accepted these methodologies but emphasised that the high risk profile of these locations remain. There is agreement that the fill sites in question are subject to SCWMPs and that the proposed staged approach enabled appropriate adaption of the methodologies. This matter has therefore been resolved.

*Compliance Monitoring*

148. DOC raised some concern regarding the implementation of effective erosion and sediment control measures over the duration of the works and how compliance monitoring will be achieved over the duration of the Project.

149. As detailed above the CWMP provides an important link to ensuring Project personnel are appropriately trained and experienced in construction water management. All people working on-site, or with site responsibilities, will be required to undertake a formal site induction process with part of this process based on environmental management, including erosion and sediment control and the requirements under the CWMP. The CWMP that supports the Project outlines the organisational structure of the Project. Further, all Project staff

[20] Formal copy sent 4th May 2018.
[21] Alliance DOC meeting 4th May 2018.

will undergo a general environmental awareness training to make all aware of their responsibilities, including to surrounding ecology, vegetation and landscape. These aspects are considered important and are required through the CEMP and draft condition 21 of the consents. In my experience this training and awareness process works very well and represents industry best practice for projects of this nature.

150. As set out above the CWDMP provides robust and appropriate monitoring provisions which from my experience have been shown to work on a national basis in informing SCWMPs (or equivalent) and enabling staged, adapted and continuous improvement processes.

151. TRC has an ongoing compliance monitoring role and will very much be part of the project implementation. While the Alliance has no direct influence over the TRC resourcing, ongoing discussions[22] in this regard have confirmed TRC involvement.

152. DOC has confirmed that its concerns on this matter have been resolved.

*SRP Sizing and Guidelines*

153. DOC raised concerns about SRP volume sizing as outlined within the conceptual plans provided as part of the CWAR.

154. It is acknowledged that the conceptual plans illustrated SRPs with a lesser volume than that required, based on the Transport Agency Guideline. DOC initially agreed that the Transport Agency Guideline represents best practice and should be utilised on the Project.[23] I therefore confirmed the SRP volume calculations to support the Transport Agency Guideline with DOC and have amended the plans attached to the CWMP accordingly. The Transport Agency Guideline will also apply to the volume requirement for DEBs.

155. Following the process outlined above, DOC considered that for SRP volume sizing greater volumes should be applied than the Transport Agency Guideline determines. It is unclear from discussions for the reasons behind this position except that DOC has noted that SRP design criteria have not previously been utilised on high risk projects. On further discussions with DOC[24] they have since confirmed their acceptance of the sizing criteria in the context that the

[22] Teleconference held between TRC, Alliance and DOC 26th April 2018.
[23] Alliance DOC Meeting 27 March 2018.
[24] Telephone discussion with DOC dated 17 May 2018.

sizing volumes will vary for the Project dependent upon location and associated conditions such as soil types, grade and rainfall.

156. Based on my experience working on high risk projects, my assessment remains that the Transport Agency Guideline is appropriate. The use of this design equates to some Project SRP volumes lesser than other regional guidelines and some volumes greater (with particular reference to Auckland Guidelines where a standard 2% and 3% volume criteria applies dependent upon slope and slope length). The SCWMPs will confirm this specific volume and this can be placed in the risk framework at that time. I consider that with the overall erosion and sediment management approach including progressive stabilisation and comprehensive monitoring the Transport Agency Guideline remains the appropriate design guideline to follow. Further, the use of one guideline document allows ease of implementation while also allowing flexibility for amendments throughout.

157. This matter therefore is now understood to be resolved with DOC.

158. DOC raised another concern that the application refers to both the Taranaki Regional Council Guidelines for Earthworks in the Taranaki Region (October 2006) and the NZTA Guidelines for State Highway Infrastructure - Construction Stormwater Management, 2014. The DOC submission considered the Transport Agency Guideline to be the most relevant and appropriate for the proposed activities as it represents a more up to date, detailed and conservative guideline document.

159. I confirm that, in addition to the ongoing discussions with DOC, I have discussed this directly with TRC officers and they have confirmed their acceptance of the Transport Agency Guideline as representing best practice erosion and sediment control.

160. The CWMP has been updated to reflect this reference more clearly and this matter has now been resolved.

*Winter Works*

161. DOC raised concerns that no winter works exclusion period is proposed for the Project. DOC notes its view that winter conditions within the Project site, including increased rainfall and reduced temperatures, present a greater risk for adverse sediment effects.

162. I have identified the SCWMPs as the tool for addressing this risk within the application documents. It is recognised that wetter periods of the year may pose a higher risk for sediment generation and discharges because of higher rainfall. This can particularly apply to the winter period of 1 May to 30 September and construction activity within this period will need to reflect this higher risk. This risk will be managed through the SCWMP process, whereby a risk assessment process is required to be undertaken including for works in the winter period. This is now detailed in full within the CWMP. These works will require additional consideration of management procedures and specific measures such as increased monitoring, progressive stabilisation and smaller exposed areas which will be described in the relevant SCWMP document.

163. In my opinion this approach will appropriately manage potential effects, apply best practice, and in my experience the erosion and sediment controls will work successfully. I consider that with the provisions detailed within the SCWMPs there is no need or requirement for further reporting or processes within consent conditions around winter works. Draft consent condition 34 has been amended to include specific reference to risk assessment for works within the winter period.

164. DOC has received a copy of the winter works provisions within the CWMP and it is understood that DOC remain concerned about this process with a preference for a traditional winter works application process. I remain of the view that the risk associated with winter works can be adequately addressed through the SCWMP process and there remains no need for further winter works application processes in this Project context.

*Progressive Stabilisation*

165. DOC raised some specific technical matters related to clarification of the 14 day stabilisation period, utilisation of sumps within dirty water diversion channels and utilisation of baffles within all SRPs and higher risk DEBs.

166. With respect to the 14 day stabilisation period this is now defined in more detail within the CWMP. This confirms that:

    (a) Stabilised Area is defined as an area inherently resistant to erosion such as rock, or rendered resistant by the application of aggregate, geotextile, vegetation or mulch, or as identified in the Construction Water Management Plan. Where vegetation is to be used on a surface that is

not otherwise resistant to erosion, the surface is considered stabilised once an 80% vegetation cover has been established.

(b) The method of stabilisation is dependent upon site conditions and may include use of mulch and/or other woody organic matter, geotextile, the use of hard fill material and exposing rock.

(c) Actively worked means actively subject to earthworks production with cut and fill, stockpiling or topsoil removal.

(d) Areas of earthworks will be monitored on a weekly basis with ongoing field checks and understanding of production locations. The Environmental Manager will have a responsibility for ensuring identification of areas not worked and ensuring these are stabilised within the 14 day period (or otherwise agreed).

(e) The 14 day period (or otherwise agreed) will apply to all earthworks and will include parts of larger earthwork footprint locations. The overall intent is that if the Project is not working an area (or part of an area) then the stabilisation period provision applies.

167. The other technical maters have also been clarified within the CWMP with both sumps and baffles identified as key design criteria that will apply.

168. DOC has received a copy of the progressive stabilisation provisions within the CWMP and has confirmed acceptance of this process. This matter has therefore been resolved.

**Submissions - Gordon and Joy Keighley, Evan John Lobb, Debbie Ann Pascoe**

169. The above submitters have expressed some generic concerns related to the overall Project construction activity and potential effects of sediment discharge that may result. I have assessed these submissions in the context of the overall approach to construction water management and in particular the details provided for within the CWMP and the CWDMP.

170. All construction works will need to comply with these plans and a focus will remain on progressive stabilisation, including the 14 day non earthwork period, and the detailed monitoring programme whereby sediment discharges will be qualitatively and quantitatively understood and managed to ensure continuous improvement can occur.

171. In addition, all construction earthworks will require a SCWMP to be in place and certified (via the hearing and TRC) prior to such works occurring. This provides the detailed design outcomes and the construction water management methodologies, both structural and non-structural, that will be implemented.

172. With respect to these submitters I also note the proposed draft resource consent condition # 5 and draft designation condition # 4 which requires the appointment of a Community Liaison Person for the duration of the construction phase of the Project to be the main and readily accessible point of contact for persons affected by Construction Works. This process allows a direct point of contact with the Project personnel for construction related activities including any resultant discharges.

**TRC Section 42A Report**

173. TRC has provided a Section 42A Report dated 18 May 2018 which I have reviewed and comment on below. I note that the ability to fully understand the technical rationale for some of the conclusions and the associated conditions is difficult in the absence of any equivalent technical memorandum, however, I respond as below to the key items identified. This response has been assisted by discussions with TRC representatives on 22 May 2018 where the rationale for some of the proposed conditions was explained in more detail. Condition references below are to the proposed conditions in the TRC Section 42A Report.

*Temporary and Permanent Culverts*

174. Condition 8 of both the temporary and permanent culvert consents states that:

> *Between 1 May and 31 October no work shall be undertaken on any part of the stream bed that is covered by water.*

175. It is unclear the key purpose of these conditions and if they are designed to address sedimentation issues or habitat and freshwater values. Either way these conditions may create some practical difficulties. The principle of undertaking any streamworks in the dry environment is a key element of the Project construction and will be achieved through the use of diversions and pumping activities. There may, however, be circumstances where it is identified that the best methodology, from a construction and health and safety perspective is to undertake streamworks (such as place a culvert, or rip rap material) directly into the stream bed. This will certainly not be a 'standard'

approach and will need to be detailed in SCWMPs where applicable. These are subject to TRC approval.

176. If such conditions are to remain, I recommend that they have flexibility within a SCWMP process to allow for such circumstances with TRC approval. TRC have confirmed on 22 May 2018 that they endorse this flexibility and that the conditions should reflect this.

*Diversion Channels*

177. Earthworks Condition 5b suggests that dirty water diversions and clean water diversions shall be designed for either a 100 year rain event or a 20 year rain event plus 300mm freeboard. It is unclear as to the reasoning for this except that this design standard is the approach utilised in most earthworks activities. I confirm that such a design is suitable and should be applied wherever it is practicable. As per the lodged documents, and the CWMP, there are situations likely where such design standards may not be able to be achieved. In those circumstances we provide alternatives and that this design will need to be approved within the SCWMP applicable to that activity or location.

178. I note that TRC has not previously raised this as an issue within previous meetings, or in a request for further information, and I remain of the view that the SCWMP is the tool within which such detail needs to be confirmed.

179. TRC have since confirmed on 22 May 2018 that they endorse this flexibility and that the conditions should reflect this.

*SRP and DEB Sizing*

180. Earthworks Condition 5e specifies that DEBs and SRPs shall be designed with a volume equivalent to a $3m^3$ per $100m^2$ of contributing catchment criteria. This is contrary to the volume calculations as per the Transport Agency Guidelines and will at times lead to a reduced volume and at others a greater volume. The rationale for this design criteria appears to be based on other national guidelines and TRC agreed earlier that utilising the Transport Agency Guidelines was appropriate hence the utilisation of these throughout.

181. Paragraphs 153 to 160 above provide further technical reasoning for the use of the Transport Agency Guideline and I remain of the view that these should continue to be utilised including for volume determination of DEBs and SRPs.

182. On discussion with TRC on 22 May 2018, it appears that they endorse this approach with the knowledge that each SCWMP will need to confirm such volume calculations for TRC approval. This matter therefore appears to be resolved and conditions need to reflect this position.

*Monitoring*

183. Earthworks Conditions 8 and 9 refers to the use of monitoring devices and auto turbidity meters. The condition requires turbidity continuous measurement in upstream and downstream locations (both the Mimi and the Mangapekeke Catchments). The conditions further recommend for 2 SRPs continuous recording of flow measurements. It is assumed that there is an error within these conditions and that TRC are seeking both flow and turbidity at upstream, downstream and SRP locations.

184. I have assessed the benefit of such further monitoring and my recommendation remains that the CWDMP should be the basis for ongoing determination of issues and management responses on site during construction. Based on discussions with TRC representatives, and in the absence of further technical information from TRC for such a requirement, it is assumed this response within the Section 42A report is primarily driven by the wish to obtain more detailed and real time monitoring data. I assess that the key purpose of the CWDMP is to assist with determination of undesirable environmental trends (pre any effects) and also to assist with determination of any on site improvement measures (such as structural and non-structural erosion and sediment controls. For this Project the CWDMP clearly achieves this through a qualitative and quantitative monitoring programme and does not require automated sampling devices to supplement such a programme.

185. The CWDMP is a fundamental part of the construction on site and has been established for this purpose. It also has been developed in recognition of the relatively small overall earthworks footprint for the Project. To assist TRC further the CWDMP now recommends that the content of the CWDMP be reviewed on a regular basis and if, at these review periods, there is a recognised benefit of further monitoring then such provisions can be incorporated at this time. It is recommended that this review period be three monthly for the first 12 months of construction followed by an annual review after that time.

186. The key catalyst for considering amendments to the CWDMP is if the existing CWDMP cannot:

(a) satisfactorily detect changes in ecological trends as a result of the Project, as determined by the Project Freshwater Ecologist; and / or

(b) satisfactorily identify and isolate Project areas when Second Level Investigations are required, as determined by the Project Erosion and Sediment Control specialist with resultant identification of continuous improvement opportunities.

187. This review will consider:

(a) if additional sampling / measuring points are appropriate; and

(b) if the use of continuous or automatic samplers to monitor water quality upstream and downstream of Project activity, and also at the SRP outlets is necessary to achieve the monitoring outcomes.

188. Discussion with TRC representatives on 22 May 2018 confirmed that they believe that the monitoring conditions within the Section 42A Report may contain typographical errors and that this monitoring should include both flow and turbidity provisions. I remain of the view that this is unnecessary to achieve the objectives as specified, particularly with the review of the CWDMP now a component of the monitoring provisions. TRC's position was unclear on the 22nd May 2018and this issue remains outstanding.

*Flocculation*

189. Earthworks Condition 15 specifies the need to submit a flocculation management plan prior to commissioning any flocculation system. We have provided some results of initial flocculation testing undertaken as part of the application lodgement and, in addition, we will be undertaking specific flocculation testing for each SCWMP developed. Until this time we cannot confirm with any certainty dose rates and specific design details.

190. I confirm that the use of the SCWMPs remains as the appropriate tool for this purpose and the Section 42A Report recommended condition be deleted. For related aspects such as spill contingencies and management of associated chemicals the CWMP is the framework within which I recommend these be addressed. I understand TRC are comfortable with this approach and this issue is now resolved.

*Winter Works*

191. Earthworks Conditions 17 to 19 require a specific winter works application to be made to TRC prior to that period. This is discussed in paragraphs 161 to 164 above.

192. My view remains in that the approach of utilisation of the SCWMPs, which include a specific section on risk management of winter activities. This will appropriately manage potential effects and will apply best practice. With such provisions detailed within the SCWMPs there is no need or requirement for further reporting or processes within consent conditions around winter works. I remain of the view that the risk associated with winter works can be adequately addressed through the SCWMP process and there remains no need for further winter works application processes in this Project context.

193. On 22 May 2018, TRC representatives confirmed that they have some remaining concerns about this approach and support a traditional winter works application process. This appears to be based solely on the assumption that TRC will not be able to approve any such winter works within the SCWMP process. I confirm, however, that the SCWMPs are subject to hearing approval, or after the hearing, TRC approval. The intent and framework, as per the application, allows for the review and approval of winter work activities.

**Graeme Ridley**

25 May 2018