Before a Board of Inquiry
Transmission Gully
Notices of Requirement and Consent Applications

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under: the Resource Management Act 1991

in the matter of: Notices of requirement for designations and resource consent applications by the NZ Transport Agency, Porirua City Council and Transpower New Zealand Limited for the Transmission Gully Proposal

between: **NZ Transport Agency**
Requiring Authority and Applicant

and: **Porirua City Council**
Local Authority and Applicant

and: **Transpower New Zealand Limited**
Applicant

Statement of evidence of Andrew Gough (Erosion and Sediment Control) for the NZ Transport Agency and Porirua City Council

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Dated: 18 November 2011

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STATEMENT OF EVIDENCE OF ANDREW GOUGH FOR THE NZ TRANSPORT AGENCY AND PORIRUA CITY COUNCIL

QUALIFICATIONS AND EXPERIENCE

1 My full name is Andrew Gough.

2 I am employed as a Senior Project Manager and Civil Engineer at Sinclair Knight Merz Limited New Zealand (*SKM*), and am the Leader of the Urban Infrastructure Team in SKM's Auckland office.

3 I began work in 1973 as a Graduate Engineer with the Auckland Regional Authority Drainage Department, and have since that time worked as a Senior Civil Engineer with the Solomon Islands Government Ministry of Works and Public Utilities, and as a Senior Civil Engineer at KRTA Limited in Auckland. I have worked for SKM (and one of its predecessors, Kingston Morrison Limited) since 1993, including periods of time working in the SKM offices in the Solomon Islands and Fiji. Between 1986 and 1992 I practiced as a Consulting Civil Engineer as a Sole Trader.

4 I have a Bachelor of Engineering in Engineering Science (with honours) and a Master of Engineering, also in Engineering Science, both from the University of Auckland. I am a Chartered Professional Engineer on the International Professional Engineers' Register, and am a member of the Institution of Professional Engineers of New Zealand.

5 I have particular expertise in site development for major infrastructure projects. Projects which I have recently worked on include:

5.1 East Taupo Arterial Bypass – I was the Design Leader responsible for developing hydraulic drop structure designs in erodible pumice soils, which required extensive erosion protection at the entry and outlet of each structure;

5.2 Tauhara Geothermal Development – I was responsible for preparing technical documents covering civil engineering matters as part of the submission of the Tauhara Geothermal Development Plan to the Board of Inquiry, including the Construction Management Plan, Erosion and Sediment Control Plan and Stormwater Management Plan;

5.3 I am the SKM Project Director for Transpower's North Island Grid Upgrade Project (the Brownhill to Pakuranga section of underground cable). I have specific responsibility for keeping an overview of civil engineering works.

6 On 15 August 2011 the NZ Transport Agency (*NZTA)*, Porirua City Council (*PCC)* and Transpower NZ Limited *(Transpower)* lodged

Notices of Requirement (*NoRs)* and applications for resource consent with the Environmental Protection Authority (*EPA)* in relation to the Transmission Gully Proposal (*the Proposal)*.

7 The Proposal comprises three individual projects, being:

7.1 The 'NZTA Project', which refers to the construction, operation and maintenance of the Main Alignment and the Kenepuru Link Road by the NZTA;

7.2 The 'PCC Project' which refers to the construction, operation and maintenance of the Porirua Link Roads by PCC[1]; and

7.3 The 'Transpower Project' which refers to the relocation of parts of the PKK-TKR A 110kV electricity transmission line between MacKays Crossing and Pauatahanui Substation by Transpower.

My evidence relates to the NZTA and PCC Projects (together the *TGP* or the *Project*). It does not relate to the Transpower Project.

8 I have received copies of reports prepared by Dr Les Basher and Brian Handyside for the Department of Conservation (*DOC*). While I have undertaken a high level review of these reports, I did not receive them in time to respond to them in this statement.

9 I have visited the area that the Project covers, including undertaking a drive-over of part of the Project route.

10 I helped develop the design philosophy for the TGP, and was the lead designer for the preliminary design of the erosion and sediment control plans, based on the performance criteria set out in Technical Report 15. Details of these designs are included in the Site Specific Environmental Management Plans (*SSEMPs*).

11 I have been assisted in my work on this Project by others within SKM. In particular, Nic Conland has assisted with matters relating to monitoring, performance criteria and Adaptive Management, given his knowledge of construction sites in the Wellington Region.

12 I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Consolidated Practice Note (2011), and I agree to comply with it as if this Inquiry were before the Environment Court. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

[1] The Porirua Link Roads are the Whitby Link Road and the Waitangirua Link Road.

SCOPE OF EVIDENCE

13 My evidence will:

13.1 Summarise the erosion and sediment control (*ESC*) implementation philosophy;

13.2 Describe the ESC practice measures used to achieve the performance criteria;

13.3 Provide an outline of the preparation of two SSEMPs;

13.4 Discuss performance of erosion and sediment control practice measures;

13.5 Respond to submissions; and

13.6 Provide brief conclusions.

14 My evidence discusses the relevant proposed conditions when discussing the issues to which they relate (rather than under a separate heading).

Links to other evidence

15 My evidence has links with that of **Mr Edwards**, particularly in the areas of construction programme and site management.

16 My evidence should be considered with **Ms Malcolm's** evidence regarding the water quality assessment of environmental effects. She has assessed the sediment yield and sediment transport in fresh water, and this has required consideration of the topography and geology of the area, and rainfall runoff. **Ms Malcolm's** evidence regarding water quality assumes runoff from construction sites is treated using the methods I describe.

17 My evidence also acknowledges the importance of sediment retention in the context of the associated assessment by **Ms Malcolm** of the effects associated with the release of sediment arising from the construction activities to bodies of water.

18 The ecological assessment of effects assumes that effective erosion and sediment controls are established and maintained during construction when considering the impacts of the Project on the ecology of the receiving streams and the coastal environments. The effects are addressed in **Dr Keesing's** and **Dr De Luca's** evidence.

19 During preparation of the indicative SSEMPs described in my evidence, I received feedback from other members of the design team, including **Mr Martell, Mr Brabhaharan and Mr Fuller**,

which was incorporated in the documents submitted in support of this Project.

SUMMARY OF EVIDENCE

20 On the basis of the work I have carried out, I believe that it is technically feasible to implement effective ESC plans, structures and methodologies described in Technical Report 15 for the proposed construction works.

21 The practices, structures and methodologies used in the preparation of ESC plans are based on the performance criteria and related recommendations (such as requirements for pond size and chemical dosing) set out in Technical Report 15.

22 Ongoing performance monitoring will be used to regularly assess the performance of the ESC measures against the criteria set out below. If any non-compliance is noted, the design and implementation of the particular measures giving rise to it shall be reviewed and amended to achieve the performance criteria. Any such amendment to the design shall then be considered for implementation on all parts of the site with similar conditions and construction activities.

23 Other methods which will enhance the effectiveness of the ESC include promoting ownership of ESC plans by the Contractor(s) and requiring the Contractor to undertake regular inspections, servicing and maintenance of all ESC controls, structures and methodologies, with additional checks before and after heavy rainfall events and maintaining the controls for the duration of the construction works. In my view the conditions proposed for this Project (as amended in the way discussed in this statement) will ensure ESC best practice is followed.

EROSION AND SEDIMENT CONTROL PHILOSOPHY

24 Sediment transport from catchments into streams and waterways is a natural phenomenon.[2] The extent of erosion will vary with vegetative cover, soil type, topography, land uses, rainfall (and in particular higher rainfall intensities), wind, and a range of other natural processes. Under existing conditions, sediment from the catchments traversed by the Project is being transported to streams and eventually into the marine environment.

25 During construction of the Project, areas of unvegetated earthworks will be created by earthworks cutting and filling, which will be significantly more prone to erosion than the existing (predominantly pastoral) land uses. During rainfall events, accelerated erosion from these areas will increase sediment runoff into the waterways and

[2] **Ms Malcolm's** evidence discusses sediment yield and transport.

eventually to the receiving marine environment. This has the potential to adversely impact the quality of the receiving waters and to result in substantially increased sediment deposition in stream beds and on the sea bed. The adverse impacts of this process would be significant if appropriate measures are not used to manage these potential effects.

26 The philosophy used to develop the ESC plans and practices for this Project is based on the following elements:

26.1 Minimise erosion;

26.2 Control and retain sediment generated by construction activities within the work site, for subsequent controlled removal and disposal;

26.3 Develop a "suite" of site specific practices for erosion control and sediment retention that meet the performance criteria for this particular Project;

26.4 Promote Contractor ownership of SSEMPs prepared for each stage of the work, integrating the plan with the construction program, to achieve effective implementation of best practice options;

26.5 Require the Contractor to prepare a facilities inspection and maintenance plan for each SSEMP; and

26.6 Establish practices and programs to identify and resolve any noncompliance with performance criteria and apply any lessons learnt from this process to the whole Project.

EROSION AND SEDIMENT CONTROL PRACTICE MEASURES

27 The designs for the ESC measures are based on the philosophy and approaches detailed in Technical Report 15[3], which adopt the following construction best practice measures for mitigation against sediment entering waterways:

27.1 **Minimise disturbance** – The extent of earthworks will be limited as much as possible while maintaining sufficient clearance for safe construction operations. In addition to the TGP road alignment and associated cut and fill areas, the extent includes identified access roads, the contractor's yards, stockpiled material and disposal sites and infrastructure works such as utilities relocation and protection. The total amount of "bare soils" exposed in construction areas at any

[3] Sinclair Knight Merz, 2011. *Transmission Gully Project: Assessment of Water Quality Effects, Technical Report 15* included in Volume 3 of the AEE.

one time shall be limited to 25% of the total area of the Project construction corridor.

27.2 **Preparatory environmental works** – Where specific works are required to establish environmental controls ahead of major works, these must be completed to the extent set out in the approved Construction Environmental Management Plan, Erosion and Control Sediment Plan, and relevant SSEMP, prior to commencement of the major works.

27.3 **Targeted erosion control** - Control and retention of disturbed soil at all earthworks sites will require the targeted selection of method(s) of stabilisation, determined after consideration of site specific parameters including soil type, slope and location. The selected method(s) will be used to stabilise the soil to minimise erosion while the vegetative cover is being re-established. **Table 1** below outlines a selection of techniques that will be used.

Table 1- Targeted erosion control measures include:

Erosion Control Measure	Specific Use During Transmission Gully Construction
Improve Soil Health	Use of stepped slopes, roughen soil and import topsoil/mulch
Provide Soil Cover and Improve Soil Health	Use of mulch or compost blankets
Provide Short Term Soil Cover	Use of sprayed and bound straw mulch or hydro seeding, granular aggregate
Provide Long Term Soil Cover	Use of rolled erosion control blankets or netting, granular aggregate
Steep Slope Conditions	Use of wire blankets or proprietary cellular confinement

27.4 **Construction staging -** This will take account of the requirements for effective erosion control using a planned approach to earthworks management during construction to ensure that non-stabilised earthworks are kept to a practical minimum and appropriate ESC measures are implemented at each stage of the work. The works required for any stage of construction are not complete until effective stabilisation of work areas is achieved, to a minimum of 75% cover of the subject area.

27.5 **Protect steep slopes** - The Project involves constructing a road across some very steep hillsides. The implications of

this for construction are that steep slopes have a much higher sediment-producing potential than flat slopes and require particular attention when designing ESC measures. The measures set out in the above table include erosion controls suited to steep slopes.

27.6 **Protect water bodies** - Construction of the road will require over 100 structures (culverts or bridges), as well as temporary and permanent stream diversions, which will require a significant investment in ESC measures in order to adequately protect waterways. Waterways potentially affected range from small ephemeral streams to larger and more significant waterways such as the Pauatahanui and Horokiri streams. The specific circumstances prevailing at each site will be considered in selecting the best practice option(s) required to mitigate the potentially adverse effects of sediment generation during construction.

27.7 **Stabilise exposed areas progressively** - The proposed alignment has numerous high and steep cut and fill slopes. In such areas of large cut or fill, involving benched earthwork slopes, the exposed face of each "lift" should be stabilised as soon as practicable after it is cut or filled to an interim or final profile. Where work is suspended on any part of the site for a period of more than a few days (or if bad weather threatens), it should be stabilised using a suitable interim measure.

27.8 **Install clean water perimeter controls** - Perimeter controls, such as diversion drains and earth bunds, should be used above the earthworks sites to intercept and divert clean runoff away from the working area. All channels will need base and side wall surface protection to avoid erosion from the high water velocities associated with heavy rainfall events and steep slopes.

27.9 **Collect internal surface water** - Channels are used within the work area to collect and direct sediment laden stormwater to areas of treatment. As noted above, channels will generally require base and side slope lining with careful design to avoid overtopping in storm events and to check the effects of changes of velocity at slope transitions. Rock riprap aprons on geotextile will generally be required at discharge points into detention bunds or ponds to prevent additional erosion.

27.10 **Chemically treated ponds** – The sediment pond and its smaller versions (Detention Bund and Container Sediment tank) are the primary form of sediment treatment used on earthworks construction sites. All sediment retention ponds and smaller settlement devices will include a rain gauge and

flow-activated chemical treatment to enhance settling performance. Chemical treatment is simply the addition of appropriate compounds in measured amounts to pond inflows during periods of rain. In its simplest form, a single compound is added to promote settlement of soil particles. Depending on soil type, there may be requirements for dual doses of chemicals, the first to correct high or low pH of the inflow and the second being the addition of a settling agent.

27.11 The design criteria for retention devices are to have an area of 3% of the catchment size with a minimum depth of 1m. The performance of individual devices could be increased by increasing area or other changes (e.g. in-pond baffles to stop short-circuiting) if in-service monitoring showed that the device was not achieving the required treatment criteria.

27.12 **Spillway design** - All ponds and bunds will have an emergency spillway to control flow designed to a minimum standard of the 50-year Annual Return Interval (*ARI*)[4] storm event (in accordance with GWRC, 2006), also referred to as the Q50 storm. Where a pond is in operation for an extended period (i.e. greater than 1 year) the pond spillway should be designed for a 100-year ARI storm event, referred to as the Q100. In the situation where there is a risk to human life should the pond fail, the spillway will be designed for the probable maximum flow (*PMF*).

27.13 **Other features**: There will be other minor erosion and control features associated with each work site, including stabilised entry/exits with a washdown facility to clean plant exiting the site. If any topsoil is stockpiled on site, it is likely to be surounded with a silt fence and, depending on the season, grassed to stabilise the surface. If any fuelling point or site lube area is required for the Contractor's plant, this will be a bunded area, with the Contractor providing a holding tank to capture stormwater runoff from the service area that may be contaminated with hydrocarbons. The Contractor is to empty the tank when it is full and discharge the contents at a Trade Waste disposal site.

27.14 **Performance monitoring** - As part of the development of the ESC philosophy for the Project, a set of performance criteria have been established. Ongoing monitoring is required for key parameters at each current work site, with results reviewed regularly and feedback given on the performance of sediment control features. In addition,

[4] ARI refers to the Annual Recurrence Interval for rainfall of a given magnitude, i.e. a 10-year ARI event is the size of a rainfall event expected to return once every 10 Years *on average*.

regular visual inspections will identify any developing problems associated with maintaining efficient conveyance systems for sediment laden water collection and clean water diversion on the site.

27.15 **Contractor requirements**: The Contractor will be responsible for the preparation of the SSEMPs and submitting these to GWRC for review prior to implementation. The SSEMPs will include an inspection and maintenance program to be undertaken on a regular basis as well as after all significant rain events to check the general condition and operation and follow up on any remedial work previously identified as being required. A typical format for this report is the SSEMP for Te Puka Stream, which is included in Volume 5 of the Assessment of Environmental Effects (*AEE)*.

28 An appropriate combination of the above practice measures, tailored to the specific conditions and construction activities for the different stages and sections of work, will effectively control the discharge of sediment from construction activites. With the proposed adoption and implementation of Adaptive Management practices and performance criteria to be set out in the ESCP, any sub-optimal performance that is identified will be corrected, and that correction noted for use in similar conditions elsewhere on the Project.

29 The ESC measures proposed for this Project are based on the GWRC's Erosion and Sediment Control Guidelines (2006). GWRC's Guidelines are not a statutory document, but are *"intended to assist all persons working in earthworks situations with implementing methods and devices for minimising erosion and sedimentation*[5]*"*. The Guidelines draw on material from the Auckland Regional Council (*ARC*) Technical Publication 90 (*TP90*) Erosion and Sediment Control Guidelines for Land Disturbing Activities (1999). The NZTA has prepared a draft document "Draft Erosion and Sediment Control Standard for State Highway Infrastructure" (August 2010) and plans to run workshops nationally in November and December 2011. It is suggested that the ESC measures proposed for this Project should be a combination of the most stringent requirements of the GWRC Guidelines and draft NZTA Standard.

Conditions relating to ESC measures

30 Condition E.3 contains the general objectives for ESC for the Project. These measures reflect the ESC practise measures described above. I support the intention and wording of condition E.3. However, I believe that key performance criteria need to be separated from general objectives and provided as a separate condition. I discuss this further below.

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5 GWRC's Erosion and Sediment Control Guidelines (2006).

31 It is my opinion that clause (b) of condition E.3 also needs changing to reflect the stated philosophy of applying the Best Practicable Option to the whole Project, rather than only in areas where highly erodible colluvium is found.

32 Proposed condition E.4 requires an Erosion and Sediment Control Plan (*ESCP*) to be submitted to GWRC for "certification" of the Manager. I understand the GWRC's preference is for ESCPs to be approved, rather than certified, and request the condition be so amended.

33 Condition E.5 sets out the matters to be included in ESCPs. I suggest the words "as far as practicable" can be deleted from the first line of proposed condition E.5, as there is no reason why the ESCPs should not be able to meet the objectives in E3.

34 As noted above, condition E.5 requires all ESC measures to be specified in a detailed ESCP. The ESCP will include design details such as the contributing catchment area, safety and access, and maintenance. I consider that provision of these details will enable the GWRC officers to be satisfied that the objectives in condition E.3 will be achieved.

35 As noted above, during my development of the ESC philosophy and methodology, draft SSEMPs were developed. These plans are detailed studies of important focus areas looking at effects on a sub-catchment basis. I believe they demonstrate that effective erosion and sediment control practice measures can be deployed, even in the steep catchments, to achieve the perfomance management requirements.

36 I support proposed condition E.20 which provides guidance and clear direction for the parties undertaking construction within each staged area to develop robust and consistent SSEMPs. I believe this is reinforced by the inclusion of a reference in condition E.20 to the 'NZTA's Draft Erosion and Sediment Control Standard for State Highway Infrastructure and Draft Field Guide for Contractors' in order to achieve best practice.

THE PREPARATION OF SSEMPS

37 The selection of the most appropriate ESC measures is based on field observations and experience with erosion control methodologies for slope stabilisation during active earthworks. Preliminary design work was undertaken as part of the process for preparing SSEMPs for Kenepuru Interchange and Te Puka Stream, to illustrate how effective sediment and erosion control could be achieved in practice.

38 My evidence covers erosion and sediment control practice measures which will be implemented during the construction phase of the Project. These are applied in the SSEMP focus areas, and have been developed to demonstrate the likely implementation of the ESC methods. The following sections of my evidence discuss the Kenepuru Interchange SSEMP and the Te Puka Stream SSEMP because these plans both explore erosion and sediment control in challenging terrain. The ESC measures which these plans provide for will also be used in other areas of the site.

Kenepuru Interchange SSEMP

39 The Kenepuru Interchange focus area SSEMP is an example of a typical staging process for implementing the ESC practice measures in a relatively complex construction sequence. It demonstrates that a logical sequence of works can be planned to maintain effective ESC works at each stage, so satisfying the primary sediment removal criteria for the Project.

40 The Plan provides for a number of smaller ponds to be established at appropriate locations around the periphery of the site, each fitted with an appropriate chemical dosing facility. One advantage of the use of smaller, multiple ponds in place of one large pond is that the potential adverse effects of a "blow-out" of a small pond on the environment is very much reduced, compared to a large pond installation.

41 The staging outline for the Kenepuru Interchange is described by drawings attached to the SSEMP.[6]

42 The construction methodology for the ESC aspects of the Kenepuru Interchange is as follows:

42.1 Stage 1:

(a) Construct 2 new culverts off-line;

(b) Divert watercourses to new culverts;

(c) Construct new entry to an existing culvert, using a coffer dam and over pumping during construction;

(d) Form a new permanent watercourse channel and divert to this;

(e) Provide clean water diversion bunds and fill redundant channels.

[6] See sheets SSEMP/F10 and SSEMP/F11 which are attached to SSEMP6 in volume 5 of the AEE.

42.2 Stage 2:

(a) Ongoing stream diversion and infilling of old watercourses;

(b) Construct sediment diversion bunds and clean water diversion bunds in preparation for bulk earthworks.

42.3 Stage 3:

(a) Construct new sediment ponds (minimum 3% criteria) and commission;

(b) Undertake bulk earthworks;

(c) Construct new cross-culvert over an existing gully as fill levels reach the correct height.

42.4 Stage 4:

(a) Divert flows through the new culvert and continue bulk earthworks to the north and east, relocating sediment ponds to suit new contours and changing construction catchments;

(b) Maintain sediment controls until all areas are stabilised.

Te Puka Stream SSEMP

43 Te Puka Stream focus area SSEMP is an example of using a staged construction process which allows implementation of appropriate and varied ESC practice measures for different stages, mindful of ecological issues raised by **Mr Fuller.** The construction is to be carried out in very steep and constrained terrain and includes the construction of high reinforced soil earth embankment (*RSE*) walls.

44 The methodology for constructing the ESC measures, which is described in some detail in the Te Puka SSEMP document, is summarised as follows:

44.1 *Stage 1:* The first stage is the diversion of the existing stream clear of the proposed embankment fill zone. This is done in a series of relatively short sections of work, each about 70 – 120 m long. Water is diverted from each section as necessary and a sediment pond constructed at the downstream end of the work section. Because the ponds are small, they can be fitted into the space available, while meeting all the criteria for chemical flocculation and flow discharge. Earthworks to form the new channel proceed until the section is completed, after which the Contractor moves to the next section downstream and the steps are repeated.

This is shown on drawings SSEMP/A6 and SSEMP/A7[7] which are attached to SSEMP1 in volume 5 of the AEE. This process is repeated progressively down the stream.

44.2 *Stage 2:* After the first 300 – 400 m of the stream diversion are completed, preparations for construction of the bulk fill will commence. Diversion channels are formed along the western side of the valley above the work area to divert clean water around the work site. A sediment pond with chemical treatment facilities will be constructed downstream of the area of work. When all erosion and sediment controls are in place, the existing material in the base of the western slope alignment will be excavated and replaced with good quality fill compacted to Engineering Standards. The surface of completed fill will be stabilised with granular aggregate cover, except for the area to be covered by the embankment. The eastern side of the base fill, adjacent to the realigned stream, will be used for vehicle access along the base of the fill embankment and also to form an overland diversion channel to direct sediment laden runoff to the sediment pond or to bypass clean water around the sediment pond.

44.3 *Stage 3:* Once construction of the base has progressed sufficiently for the use of bulk construction equipment, construction of the reinforced fill embankment will commence. The diversion channel/flume on the western side of the valley will be raised and small dams and overpumping used to divert any clean watercourse flows over or around the fill. This is shown on drawing SSEMP/A8[8]– which also includes details of culvert and cascade construction. As construction progresses and the fill height rises, it is intended to staple erosion matting over the completed surface, to stabilise it and limit erosion from the work site. Depending on the work program, season and planting schedules, this stabilisation may be temporary or permanent works.

PERFORMANCE OF EROSION AND SEDIMENT CONTROL PRACTICE MEASURES

Erosion control

45 As noted in paragraph 27.3 of this evidence, erosion control is achieved using a suite of measures that reduce the rate of erosion

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[7] I note that following my site visit I reviewed the details of the Te Puka SSEMP and consider that the size and nature of the indicative "Flume Channel" shown on section B of drawing SSEMP/A7 will need to be a larger and more robust structure than that shown on the drawing. A better option would be to use large prefabricated channel sections (such as lined shipping containers) set into the side of the slope. This amendment can be made when the SSEMPs are finalised as required by condition E.20.

[8] Appended to SSEMP1 in volume 5 of the AEE.

of soils. A target erosion control performance rate of 75% is proposed in section 9.6.1 of Technical Report 15 as appropriate and achievable and was used in modelling and assessing the environmental effects of the Project. This performance rate can be achieved by restricting the area of earthworks and unstabilised areas along the extent of the alignment to no more than 25% of the total area. As construction works are completed and fully stabilised, other areas of the alignment can then be opened up for construction works. In addition, the criteria for acceptance of achieving "stabilised" status shall be 75% coverage of the area under review.

46 Ongoing inspections of stabilised areas will continue and the Contractor required to maintain the areas until final planting and ground cover have matured sufficiently to give confidence that the stabilised area can be left for nature to maintain. **Mr Edwards** explains in his evidence how this will work in practice.

Sediment control

47 Sediment control measures are designed to capture sediment that is not retained by the erosion control measures.

48 For the Project, sediment control devices proposed include ponds, earth decanting bunds[9] and proprietary devices such as shipping container "ponds" or tanks where limited space demands innovative solutions for sediment control.

49 The performance of sediment control devices is determined by measuring the mass of sediment (as kg) captured during a rain event. The performance is the ratio of sediment received at the pond inlet to sediment released at the outlet.

50 This will require the contractor to install flow activated equipment to measure the concentration of sediment during rain events at the inlet and outlet of key ponds during the construction of each stage of the works. It will include measurement of rainfall and provide samples for analysis of soil type and particle size, to allow determination of the effectiveness of each pond.

51 In my opinion, the proposed average long term pond efficiency rate of 70% sediment removal[10] can be achieved. My view is based on the analysis in section 9.6.3 of Technical Report 15, which includes a discussion of the Moores and Pattison[11] study, and relies on the application of an Adaptive Management approach to the

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9 A temporary berm or ridge of compacted earth constructed to create impoundment areas where ponding of runoff can occur and suspended material can settle before runoff is discharged.

10 See condition E.3(g).

11 Moores, J & Pattison, P. (2008) *Performance of Sediment Retention Pond Receiving Chemical Treatment.* NIWA (for ARC), Auckland.

implementation of Erosion and Sediment Controls, including a rigorous monitoring programme across the Project.

52 Condition E.3(g) proposes that the criterion for acceptable pond efficiency is a minimum average of 70% over a 12-month period. Any individual results less than ARI-related performance levels which will be set out in the ESCP, or showing a decline of performance for a specific rain event, will trigger analysis of the particular event, the nature of work preceding the event, and the condition of the ESC practice measures, to verify that these meet best practice expectations. If necessary, improvements and changes will be made to the construction staging and practices on the site.

53 It is noted that the level of treatment efficiency can be enhanced by the installation and management of the on-site perimeter controls to provide early capture of sediment within the site prior to the sediment retention devices by the use of earth decanting bunds, grit traps, and silt fences/bio socks[12]. This is because the sediment ponds work most efficiently when they have less sediment to treat. This "treatment train" approach will form part of the ESC plans developed for the Project and is particularly useful for small, hard to access areas, and for localised areas of disturbed soil.

Conditions relating to ESC performance

54 The proposed conditions for the Project will provide the necessary performance management framework for the ESC practice measures in order to deliver the target ESC efficiencies.

55 Condition E.6 requires that erosion and sediment control measures shall be constructed and maintained in accordance with the NZTA's Draft Erosion and Sediment Control Standard for State Highway Infrastructure and Draft Field Guide for Contractors, or to a higher standard if that is detailed in an ESCP. Condition E.6 is important because it establishes particular performance criteria which are clear and enforceable. Indeed, I consider that some of the objectives in condition E.3 (such as the treatment efficiency in condition E.3(g)) could be moved to condition E.6, and other criteria added, in order to respond to concerns by submitters, such as DOC, that the conditions do not provide sufficiently enforceable standards.

56 The additional criteria which I suggest be added are:

56.1 A requirement that the area of unstabilised earthworks be no more than 25% of the total construction area, and that a minimum of 75% effective stabilisation is required before any

[12] A woven or non-woven water permeable material filled with a range of media including bark chips, compost, sands, flocculants and seed stocks. These are applied in a variety of engineering, stormwater management and erosion and sediment control applications.

given stage will be considered to be "Practically Complete"; and

56.2 A requirement for all sediment retention devices to be sized to at least 3% of their catchment area, with a minimum depth of 1m, where they form the final discharge point for a catchment.

57 My development of the design of erosion and sediment controls required that all sediment ponds are chemically treated and sized to be at least 3% of the contributing catchment. This is a higher standard than the default standard within either the NZTA or GWRC standard and is considered necessary because of:

57.1 The steep terrain;

57.2 The limited space available;

57.3 The length of time the works will be undertaken; and

57.4 The sensitive nature of the ultimate receiving environment.

58 The additional criteria suggested above reflect the modelling carried out for the Project.

59 Condition E.7 requires that the ESC measures be certified by an appropriately qualified and chartered professional engineer as having been constructed in accordance with the ESCP, prior to any earthworks commencing. I consider this to be best practise, and suggest the conditions could be improved by condition E.8 being amended to also require certification of the as-built drawings prepared by the contractor. This would increase the level of confidence in the accuracy of the as-built details (such as pond depth, pond area etc), which are required to direct the performance measures in the ESC philosophy to be followed.

60 Condition E.9 requires that each stage of earthworks has the appropriate perimeter controls in place at each stage of the open earthworks. These perimeter controls will ensure that sediment laden water is directed away from water bodies and to the appropriate treatment device. I recommend the following wording (or similar) be added to condition E.9, to recognise the role of perimeter controls in avoiding erosion:

"The diversion channels shall have surface lining or protection to avoid surface erosion."

61 Condition E.12 requires that surface water controls are in place to divert clean water away from the earthworks to prevent surface erosion. This would include the stabilisation of channels to avoid

scour and erosion. This condition reflects the ESC practise measure "install clean water perimeter controls" described in paragraph 27.8 above.

62 Condition E.18 requires that all sediment retention ponds and devices shall be chemically treated. This is consistent with the ESC philosophy and the modelling assumptions used to estimate the effects of sediment release to the environment.

63 Condition E.19 requires that prior to the commissioning of chemical treatments for sediment management, a Chemical Treatment Plan (*CTP*) will be developed for each stage of works.

64 The CTP will provide specific details on the catchment specific soil analysis and assumptions to provide the optimum dosage rates and controls. It will also provide details on the monitoring, maintenance and contingency planning.

65 As part of the CTP the consent holder will prepare a performance monitoring plan which will detail the ability of the sediment treatment ponds and devices to achieve the performance objectives. I recommend that condition E.19(f) is changed to include a reference to condition E.15, which requires monitoring of sediment retention devices during heavy rainfall events.

66 Conditions E.14 to E.16 require monitoring of ESC measures and specify minimum requirements for sediment device and erosion control device modelling, accepting that the monitoring requirements will also be specified in the ESCP. In addition to the matters listed in those conditions, I consider that the monitoring reports provided to satisfy the plan required by condition E.19(f) should also provide information about:

66.1 The date and start and finish times of the rainfall events monitored; and

66.2 The ARI of the rainfall events monitored.

67 This additional information will assist with determining the efficiency of ESC devices.

68 I recommend that the environmental management plan condition G13 is also updated to reflect the inclusion of the Performance Monitoring Plan requirement in condition E.19(f).

69 The information collected from this monitoring of erosion and sediment device performance is required for Adaptive Management of the Project ESC measures.

70 The Adaptive Management process includes observing the event based performance of the sediment ponds and measuring the treatment efficiency across a series of events. A reduction of treatment efficiency below 70% will provide the trigger for a review of the operation and efficiency of the chemical treatment system, and to make recommendations to improve the efficiency by means including: undertaking device maintenance or, reducing the open earthworks in that catchment by increasing the stabilised area or, rescheduling further cuts.

71 The performance of erosion control can be determined by careful observation, looking for signs including a loss of vegetative cover on a slope where targeted erosion controls have been applied, by observing rilling[13] on a slope, or by observing an increase in the particle sizes at the pond inlet as an indicator of inadequate erosion controls. These observations will provide the construction review team with the signal to review the targeted erosion practice measure.

RESPONSE TO ISSUES RAISED BY SUBMISSIONS

72 The submissions by Whitby Coastal Estates Ltd, Kapiti Coast District Council, and the Director-General of Conservation have raised a number of issues relevant to my evidence.

Whitby Coastal Estates Ltd

73 The submission from Whitby Coastal Estates Ltd (*WCEL*), EPA reference 60, recommends in part 3 on page 10 that " *it is prudent to design ESCP measures for a 20% AEP (5 year event), which requires sediment ponds to be sized at 370m^3 per hectare of catchment on slopes less than 10% and that flocculation is necessary*."

74 As stated above, the ESC measures have the ability to control the release of sediment during the Project and achieve the stated performance criteria. While the ESC design is at a concept stage, the criteria provide enough direction to develop in detail, as shown in the SSEMPs, the ESC requirements.

75 The performance management approach in the proposed conditions does not restrict the final design for the pond size; it only requires a minimum pond size of 3% of the area. The proposed monitoring of the pond performance will quickly identify whether the size is sufficient for the unique topography and geology of each catchment traversed by the Project.

[13] Rills are long narrow miniature channels, where anything from 10mm to 500mm of topsoil is removed by surface runoff concentrated into thick narrow threads.

Kapiti Coast District Council

76 The submission from Kapiti Coast District Council, EPA reference 23, states on page 5 that the conditions are inappropriately qualified "by statements such as 'as far reasonably practicable' and 'as far as practicable'". The submitter recommends that these phrases "need to be removed from the proposed conditions".

77 I have provided as much certainty in my assessment as possible for the concept stage and ESC philosophy. I have reviewed the conditions and recommended changes to remove uncertainty (such as the reference to "as far as reasonably practicable" in condition E.3 discussed above).

78 The ESC conditions provide for further certainty with the inclusion in conditions E.7 and E.8 of an certification of the ESCP and provision of 'As-Built' plans.

79 The proposed Adaptive Management approach provided by monitoring the ESC performance against the performance criteria to evaluate the ESC control practice measures in each stage adds a high degree of certainty to the ESC outcomes.

Director-General of Conservation

80 The submission from DOC, EPA reference 43, in paragraphs 13-17 discusses the assessment of sediment retention for the Project.

81 Paragraph 13 considers the details provided to describe the sediment retention measures selected and where they might be employed as 'insufficient'. Given the scale of the Project and the scope of the ESC design being at the concept stage, it is accepted that there is only enough detail to determine whether the ESC measures could be applied to avoid significant loss of sediment to the environment.

82 I believe that this is adequately accounted for in the assessment of the ESC performance and the introduction of the performance criteria in the consent conditions. This will serve to direct the contractor to achieve these criteria or adjust their ESC methodology in their ESCP or the earthworks staging.

83 Paragraph 15 considers the SSEMPs developed for specific areas of the Project. I have discussed these in my evidence and consider these provide an adequate description of the staging and site specific application of ESC for the current assessment of effects.

84 Paragraph 15 also considers the adequacy of the winter works management. Condition E5 for the ESCPs, at clause (l), requires the consent holder to have procedures for ensuring early warning of heavy rain events and management of such events. I believe that provided that systems are in place to:

84.1 Provide early warning of heavy rain events;

84.2 Require adequate contingency measures to be in place to quickly protect slopes and exposed earth;

84.3 Manage the scale and timing of each stage to soil types and site conditions; and

84.4 Maintain the Adaptive Management approach;

winter works will be able to be managed in compliance with the performance criteria stated above.

85 **Ms Malcolm's** evidence and Technical Report 15 address the application of the modelling to assess the event based yields for sediment during construction of the Project. The ESC philosophy and methods developed in Technical Report 15 have been routinely peer reviewed both internally (within SKM) and by Dr. Tim Fisher (Tonkin and Taylor). The report was also reviewed by Golders for the RATAG group.

86 The DOC submission also discusses (at paragraphs 33(a) to (q)) proposed conditions for the Project.

87 Paragraph 33(c) considers generally "conditions requiring construction to be managed to minimise sediment generation". I believe that the conditions proposed for the Project go beyond best practice by adopting an Adaptive Management approach. The Project has selected performance criteria which were used in the modelling of sediment yield and the contractor will be required by conditions to carry out monitoring to ensure that these criteria are achieved. Adaptive Management will be used to refine ESC measures and update the ESCP as required.

88 Paragraph 33(e) considers conditions which "establish standards to be achieved, rather than "objectives" to be set under management plans at a later date". I agree that the performance criteria could be more clearly stated within the conditions, and have suggested amendments to the conditions to achieve this.

89 Paragraph 33(l) considers conditions are necessary "requiring contingency plans to detail how wet weather periods will be addressed including shut down and limitations on construction works in the winter months". In my assessment I have recommended an Adaptive Management approach to the management of the earthworks for the Project. This will require the contractor to apply itself to allowing for and controlling the risks arising from wet weather events throughout the year. Paragraph 84 above refers to conditions for winter work.

90 There will always be the potential for rapid changes in weather, leading to unexpected rain events and subsequent erosion of exposed earthworks. The general condition G.16 provides the consent holder with a mechanism to undertake contingency measures after receiving a weather warning for a heavy rain event. The process for establishing early warnings for the weather is set out in the ESCP (condition E.5).

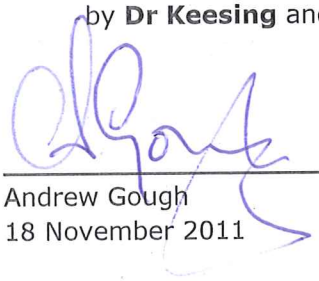
CONCLUSIONS

91 I believe that the ESC philosophy provides a suite of solutions to be implemented that enable the Project performance measures for ESCs to be achieved on site, including the steepest parts of the site.

92 The conditions as proposed with my recommended changes as described in this evidence provide sufficient direction to give me confidence that the Project's staging, ESC and chemical treatment will be controlled in a manner that is consistent with the assumptions in the assessment of effects on water quality.

93 Assuming the consent conditions are confirmed as proposed, and that the proposed management plan framework is implemented, it is my opinion that the adverse effects associated with ESC will be avoided, remedied or mitigated along the length of the alignment.

94 The effects caused by erosion and sediment on water quality are discussed in Technical Report 15 and in **Ms Malcolm's** evidence, and the ecological effects resulting from this are discussed in turn by **Dr Keesing** and **Dr De Luca**.



Andrew Gough
18 November 2011