Before a Board of Inquiry
MacKays to Peka Peka Expressway Proposal

under: the Resource Management Act 1991

in the matter of: Notice of requirement for designation and resource consent applications by the NZ Transport Agency for the MacKays to Peka Peka Expressway Proposal

applicant: **NZ Transport Agency**
Requiring Authority

Statement of rebuttal evidence of **Ann Williams** (Groundwater) for the NZ Transport Agency

Dated: 25 October 2012

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STATEMENT OF REBUTTAL EVIDENCE OF ANN WILLIAMS FOR THE NZ TRANSPORT AGENCY

1 My full name is Ann Louisa Williams.

2 I have the qualifications and experience set out at paragraphs 1 to 7 of my evidence in chief, dated 5 September 2012 (*EIC*).

3 I repeat the confirmation given in my EIC that I have read, and agree to comply with, the Code of Conduct for Expert Witnesses (Consolidated Practice Note 2011).

4 I confirm that I am authorised to give this evidence on behalf of the NZ Transport Agency (*NZTA)*.

5 In this statement of rebuttal evidence, I respond to the evidence of:

5.1 Mr Peter Callander and Mr Richard Percy on behalf of Greater Wellington Regional Council (*GWRC*) (submitter 684);

5.2 Mr Brydon Hughes and parts of the evidence of Mr Travis Wood, Ms Shona Myers and Ms Emily Thomson on behalf of the Kapiti Coast District Council (*KCDC*) (submitter 682);

5.3 Mr David Roil on behalf of Waikanae On One (*WOO*) (submitter 574);

5.4 Ms Helen Rutter for Christopher and Monica Dearden (submitter 261);

5.5 Dr Hugh Cherrill on behalf of Save Kapiti Inc (submitter 505);

5.6 Mary Campbell-Cree and Melanie Dixon on behalf of the Raumati South Residents Association Inc. (RSRA) (submitter 707)

5.7 Loretta Pomare (submitter 309);

5.8 Professor Martin Manning (submitter 687);and

5.9 Mr Gregory Olliver and Mr Pranil Wadan on behalf of St Heliers Capital Limited (submitter 644).

6 The fact that this rebuttal statement does not respond to every groundwater matter raised in the evidence of submitter witnesses within my area of expertise should not be taken as acceptance of the matters raised. Rather, I rely on my earlier technical report,[1] my EIC and this rebuttal statement to set out my opinion on what I consider to be the key hydrogeological (groundwater) matters for this hearing.

[1] Being Technical Report 21, Assessment of Groundwater Effects.

7 Consistent with my EIC, I have referred to the MacKays to Peka Peka Expressway Project as "the Project" in this rebuttal evidence.

EXECUTIVE SUMMARY

8 I have read the statements of evidence provided by submitters in relation to groundwater. That evidence has not caused me to depart from the opinions expressed in my EIC and I re-confirm the conclusions reached in my EIC.

9 The submitters' evidence has included some suggested additional resource consent conditions that I support, and these are set out in **Annexure A** to this rebuttal evidence.

10 The submitters' evidence has also suggested improvements to the Groundwater Management Plan (GMP) that I endorse. The key change is replacement of the proposed Action levels with a series of mitigative actions, agreed in advance with KCDC and GWRC, that can be selected or modified according to the actual situation that might occur.

EVIDENCE OF SUBMITTERS

Peter Callander for GWRC

Modelling issues

11 Mr Callander is in general agreement with the conceptual geological and groundwater models and the approach taken for the assessment of effects on groundwater. He notes however, that models are necessarily a simplification of the natural variability that occurs in the 'real world' and that it is important to keep this in mind when considering model outputs.[2] I agree with this.

12 Mr Callander describes the set-up of the 3D regional groundwater model in paragraphs 29 to 43 of his evidence. He discusses some areas where he is uncertain of how a parameter has been addressed in the model but concludes that overall these are unlikely to noticeably alter the assessment.

13 For clarification, I respond to various matters he has raised below:

13.1 The constant head cells along the foothills boundary of the 3D regional model indicated in Figure F1.[3] For clarification, constant heads were applied in order to simulate observed water levels in this area. As Mr Callander observes, whether or not such cells are used would not noticeably alter the findings of the groundwater assessment.

13.2 Mr Callander concurs that it is reasonable to model abstraction from the many domestic wells as

[2] Paragraphs 5 to 6, 26, 64, and 81 of Mr Callander's evidence.

[3] Paragraph 31 of Mr Callander's evidence.

evapotranspiration if the wells are distributed over the district and because individual abstractions are small. He suggests it would be helpful if a map showing the locations or likely locations was provided.[4] I attach a map showing the locations of these bores, which are indeed spread across the District (refer **Annexure B**).

13.3 Mr Callander notes that the pumping from the KCDC public water supply wells is not simulated in the regional model.[5] This is because the wells mostly abstract water from the deep Waimea aquifer, and have in the past been used only intermittently for short periods. (During the 2010-2011 period the wells were pumped for only 3 days for water supply, during 2009-2010 for only 12 days, and during 2008-2009 the KCDC wells were not used at all for water supply). We chose not to pump the wells in the model to allow us to better observe the differences between the pre-Expressway and post-Expressway condition which are small effects that might be masked by other effects such as the pumping of the KCDC wells. I therefore conclude that not pumping the KCDC public water supply wells in the models would not reduce the accuracy of the modelling but may improve it.

13.4 In response to Mr Callander's query,[6] I confirm that the conductances have indeed been taken from Jones & Gyopari (2005). Although applied to a cell of a particular size, conductance is calculated by considering the river length, width, bed thickness and bed hydraulic conductivity and is therefore the same regardless of cell size. I confirm that conductance has been applied appropriately in the modelling carried out by my team.

13.5 Mr Callander notes that the Layer 4 match of measured against modelled heads is "poor".[7] I attach an enlarged copy of the plot as well as a plot showing only layer 4 data points[8] as **Annexure C**. I note that many of the water levels for this layer were obtained from test pits, hand auger holes and private bores. The water levels recorded in them represent a single point in time, generally immediately following excavation or drilling and are therefore not necessarily representative of a particular soil layer or season. Water levels recorded in piezometers constructed and monitored as part of the Project commonly vary over a range of 0.5 m to 2 m. I therefore consider the calibration to be satisfactory.

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4 Paragraph 35 of Mr Callander's evidence.

5 Paragraph 36 of Mr Callander's evidence.

6 Paragraph 38 of Mr Callander's evidence.

7 Paragraph 41 of Mr Callander's evidence.

8 From Figure F4 of Technical Report 21.

13.6 Mr Callander was concerned that if dry layers occurred, these might preclude vertical groundwater flow and alter assessed effects.[9] I confirm that dry cells were limited to layers 1 to 3 and there are no sandwiched dry layers.

14 Mr Callander describes his observations of the smaller 'cut-out' 3D groundwater models in paragraphs 44 to 50 of his evidence. He notes that three of the four smaller models have a normalised RMS (Root Mean Square) error greater than 10 % and a wide scatter.[10] I do not consider this to be an issue. As described in Technical Report 21,[11] the smaller models (other than the Otaihanga model) could not be well calibrated because of the small number and less reliable source of data points (single point in time water levels recorded in hand auger holes or private wells) with no indication of whether it is a static water level or affected by local pumping. This means that the data-points available have an error associated with them and it is therefore difficult (and not necessarily appropriate) to achieve a good calibration to them. However, the smaller models are "cut outs" of the regional model which has been developed from the much wider data set and maintain the groundwater levels and flow directions determined from the regional context. This means the calibration of the cut out models should be considered in conjunction with that of the regional model.

15 In this regard, Mr Callander observes that the regional model "…*contour plots look reasonably good, with the overall pattern of flow comparing well to the observed groundwater contours. The location of the rivers losing and gaining reaches appears to match the conceptual model*."[12]

16 The normalised RMS data that resulted were reported for completeness and Mr Callander has recognised that "*The report notes the absence of reliable calibration points for these inset models, so these relatively large errors may simply be a product of the calibration data and do not necessarily indicate that the inset models are poorly calibrated or unsuitable for the task of assessing changes*".[13] Crucially, the smaller cut out models are used to determine the **difference** between the existing and post-construction situation, therefore the absolute values are less critical.

17 While Mr Callander has understood this, it does not appear to have been understood by some other parties[14] and I therefore refer to this matter again later in my evidence.

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9 Paragraph 43 of Mr Callander's evidence.

10 Paragraph 50 of Mr Callander's evidence.

11 Technical Report 21, Appendix F2.3.

12 Paragraph 39 of Mr Callander's evidence.

13 Paragraph 50 of Mr Callander's evidence.

14 For example Ms Rutter.

Effects on Surface Water

18 Mr Callander suggests[15] that it would be helpful if the particular surface waters affected by the reported peak reduction of 1.5 % in groundwater contribution be identified. In response I note that the reduction of up to 1.5 % reported is as a result of the short term construction water take. For the longer term, a reduction of 2 % is predicted over the whole Project area, however this relates wholly to groundwater diverted away from Wharemauku Stream and into offset storage areas 2, 3A and wetland 3. The model does not consider that the water will be discharged back to the Wharemauku Stream and therefore I conclude that the Project overall has a negligible effect on groundwater contribution to surface water.[16]

Effects on Existing Wells

19 Mr Callander observes that it is not clear what the drawdown effect indicated in 6 existing wells is due to.[17] The effects are described in Appendices F3 and F4 of Technical Report 21 and are due to the combined effect of the Expressway, stormwater devices and temporary construction water abstraction. The detailed assessment is attached in **Annexure D** to this rebuttal evidence.

20 I concur with Mr Callander that there may be other existing private wells (which do not have consents because they fall within the permitted take criteria) that could be affected by temporary construction water abstraction. I suggest that such effects, should they occur, be managed through the Complaints Register. As these effects would be temporary and during construction, I consider that they would be adequately addressed by the Complaints Register in its current form.

21 Mr Callander suggests that the Complaints process should extend into the post-construction monitoring period[18] as groundwater changes due to other aspects of the Project will be permanent and may not become clear until after construction is complete. While I do not anticipate that this will be the case, I agree that the Complaints process should remain in place through the post-construction monitoring period. This is discussed further in rebuttal the evidence of **Robert Schofield**.

Monitoring bores

22 Mr Callander suggests that, where not already proposed, consideration could be given to siting a monitoring bore close to the areas specifically identified by concerned residents.[19] Monitoring bores have been established between the works and the wells assessed as being potentially affected to provide warning of

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15 Paragraph 67 of Mr Callander's evidence.

16 Section F1.4 of Technical Report 21.

17 Paragraph 69 of Mr Callander's evidence.

18 Paragraph 102 – 103 of Mr Callander's evidence.

19 Paragraph 76 of Mr Callander's evidence.

drawdown effects. However, I do not consider it useful to install monitoring bores adjacent to every concerned landowner's well as there are a very large number of privately owned wells. I suggest, as Mr Callander has also, that any such effects that might eventuate in private wells be managed through the Complaints process.

23 With reference to Mr Callander's query about the location of monitoring bores,[20] I note that all of the proposed monitoring bores are now in place and that their locations were identified and agreed through discussion between the Project's stormwater hydrologists, ecologist, ground settlement expert and myself. The locations were selected with a view to providing coverage of the alignment, data in or adjacent to sensitive wetlands and in the vicinity of stormwater devices. I consider such a process and monitoring bore site selection to be appropriate.

24 I note Mr Callander's suggestion[21] that water levels could perhaps be monitored in selected shallow domestic wells. In my experience it is mostly not possible to record water levels where surface pumps are used and it requires regular access to private properties. My preference is therefore to monitor effects in the vicinity of the works which identify water level changes in advance of their propagation to private properties. That is provided for in this Project.

Alert and Action levels

25 Mr Callander suggests[22] reducing the Alert Levels proposed in the GMP for groundwater levels at or adjacent to sensitive wetlands[23] to 0.1 m. I do not agree. Considering the natural variation already recorded in monitoring wells that have been installed for a year or less is typically in the range of 0.5 to more than 2 m, and natural variability is most likely to exceed that of a single 12 month period of measurements, I consider setting a 0.1 m Alert level would trigger development of interventions that are not needed or desirable. Once the 12 months (minimum) pre-construction monitoring required is complete, it is possible that more specific Alert levels could be identified for different sets of piezometers located in different areas with reference to the natural variation in water level recorded in the pre-construction period for any given piezometer, and this might be a better method for setting Alert levels. I therefore suggest that the Alert levels for the sensitive wetlands be reconsidered once the pre-construction monitoring has been completed, as part of the GMP approval process.

26 Mr Callander suggests that rather than establish an Action level that triggers further monitoring or mitigation actions (as proposed in the GMP), for which selection of a meaningful value is difficult, it might

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[20] Paragraph 84 of Mr Callander's evidence.

[21] Paragraph 87 of Mr Callander's evidence.

[22] Paragraph 90 of Mr Callander's evidence.

[23] Alert levels proposed in Section 5.2 of the GMP (Appendix I of the CEMP).

be preferable to implement mitigation in response to demonstration of likely adverse effects as indicated by the more intensive assessments that would be triggered by the Alert level.[24] I am in agreement with this philosophy, in particular as parts of the alignment cross areas that are relatively more and less sensitive to water level change. This is now reflected in proposed Condition GD.2(d) attached in **Annexure A**.

Mitigation options

27 Mr Callander notes that more details of mitigation options could be provided in the GMP to facilitate more rapid implementation of them should the need arise.[25] I note that the GMP is a draft plan and will be developed in detail if the Project consents are granted. I agree that it would be appropriate to further develop the likely mitigation options set out in the GMP in conjunction with ecological, stormwater and geotechnical experts and that these concepts should be agreed in advance with KCDC and GWRC representatives and set out in the GMP. I propose an amendment to Condition GD.2 by way of the addition of sub-clause (d) (**set out in Annexure A**) that requires action measures set out in the GMP to be agreed with KCDC and GWRC (see **Annexure A**).

Existing Unconsented Private Wells

28 Mr Callander suggests that there may be existing privately owned shallow wells, the locations of which are unknown, that might be affected by the Project and that it might be prudent if a "door knocking" exercise were carried out to confirm the locations of all wells within 100 m of the Expressway.[26] As shown in **Annexure B** we are aware of the very large number of privately owned shallow wells and have considered these. As I noted in paragraph 20 above, I suggest that such effects, should they occur, be managed through the Complaints Register.

Risk register

29 I prepared the inputs to the environmental risk register for groundwater effects contained in Appendix D of the CEMP. I do not believe they give a different perspective to Technical Report 21, as suggested by Mr Callander.[27] It is important to clarify that the Technical Report considers the expected change to the groundwater regime; the risk register considers the significance of this expected change, as do the reports of the experts who address the effects of the water level change in their area (e.g. ecology).

Proposed consent conditions

30 Mr Callander provides comments on consent Conditions in paragraphs 102 to 115 of his evidence.

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[24] Paragraph 91 of Mr Callander's evidence.

[25] Paragraph 96 of Mr Callander's evidence.

[26] Paragraph 99 of Mr Callander's evidence.

[27] Paragraph 100 of Mr Callander's evidence.

31 As already described (in paragraph 21 above), Mr Callander suggests extending the complaints register process beyond the construction period. The Project team has given some thought to this and this is addressed in the rebuttal evidence of **Robert Schofield**.

32 As also described above, all of the proposed monitoring wells have now been installed and their locations were agreed by a team of experts on the Project. As a result, I do not see a need for the Condition which Mr Callander proposes at paragraph 105.1 of his evidence.

33 I concur with the intent of the suggested Condition at paragraph 105.2 of Mr Callander's evidence which requires a door knock check of all bores within 100 m of the Project. As I explain earlier, I have amended proposed Condition GD.2 to address this.

34 I disagree with the Condition proposed at paragraph 105.3 of Mr Callander's evidence which suggests monitoring of public water supply wells. As already agreed by Mr Callander and indicated by GWRC, these wells are most unlikely to be affected; they are monitored regularly by KCDC staff and I do not see the benefit of interference of the Project team in this. I am sure that KCDC will share its records with NZTA should any event of interest occur.

35 I support the proposed consent Condition relating to mitigation measures (set out in paragraph 106 of Mr Callander's evidence) which requires that the mitigation measures described in the GMP be implemented to ensure that **existing** groundwater users who cannot use their own supply as a result of the Project receive a replacement water supply. I have included this in a new Condition GD.6 included in **Annexure A**. This was the intention of NZTA as set out in the GMP and my evidence.

36 At paragraph 107 Mr Callander suggests the GMP be submitted 30 days (rather than the 15 days as proposed in Condition G.19) before commencement of works in order to allow 15 days for a GWRC audit. My understanding is that the 15 days proposed was for the GWRC review, and I therefore disagree with this proposed change.

37 Mr Callander suggests a further Condition[28] that requires an annual groundwater monitoring report, in addition to the quarterly reporting already proposed in Condition GD.3. While I am not opposed to this suggestion, I would have anticipated that the matters that he lists for inclusion in the annual report would be addressed in each quarterly report. Nevertheless I have included the requirement for an annual report in Condition GD.3 (**Annexure A**).

[28] Paragraph 108 of Mr Callander's evidence.

38 I agree with Mr Callander's suggestion[29] that the intended abstraction rates of up to 750 m^3/day from any single bore, and a maximum of 1990 m^3/day in total from any group of bores pumping at any one time, should be specified. I have amended Condition GT.2 in **Annexure A** accordingly.

39 Mr Callander points out that in addition to the stepped rate pumping test required by condition GT.4, a constant rate test should be carried out.[30] I agree with this and confirm that it was my intention that a constant rate pumping phase be carried out. I note that condition GT.5 requires sufficient information to be provided to GWRC to obtain approval to pump each well at the proposed rate including an assessment of effects. Each well will be in a different location and there will be different observation wells available for monitoring and the test might be carried out in different ways according to yield. I have updated Condition GT.4 accordingly in **Annexure A**.

40 I do not consider that the new Condition proposed in paragraph 113 of Mr Callander's evidence provides any additional benefits over Condition GT.5.

41 Finally, Mr Callander suggests that information on how it is proposed to use the water should be provided to GWRC.[31] The volume and timing of water usage has been carefully calculated by **Mr Andrew Goldie** and is attached to the rebuttal evidence of Mr Goldie. He is of course not able to predict in advance actual weather conditions during construction or the timing of all circumstances requiring water during construction, and so the water usage plan is a best estimate.

42 An updated set of the proposed groundwater Conditions containing the amendments discussed above and which I now propose, is attached as **Annexure A**.

Richard Percy for GWRC

43 Mr Percy states that overall it would be preferable that should mitigation works require resource consent, they be considered at this stage rather than as they arise (as this gives more certainty that mitigation can be delivered). However, he goes on to state that "where such mitigation related consents will be 'straight forward' and will not result in delays to implementation of mitigation, there is … scope to seek these at a later date."[32] He notes further[33] that it would be useful at this stage to have

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29 Paragraph 111 of Mr Callander's evidence.

30 Paragraph 112 of Mr Callander's evidence.

31 Paragraph 114 of Mr Callander's evidence.

32 Paragraph 45 of Mr Percy's evidence.

33 Paragraph 46 of Mr Percy's evidence.

information about the nature of wetland restoration and any other works that might trigger the need for resource consents.

44 In terms of groundwater, the mitigation options proposed are set out in section 6.2 of Technical Report 21 and in the GMP. Other than Option v. (Redirection of treated surface water to wetlands or surface water bodies) and Option vii. (Controlled recharge of groundwater to limit the amount of drawdown), I do not anticipate that resource consent would be required. I do not anticipate that either of these options would be used as immediate response measures and they would require careful consideration of the particular situation arising. I have however amended proposed Condition GD.2 such that it requires discussion of mitigation options described in the GMP with KCDC and GWRC, and amended proposed Condition G.29 to state that work with the potential to affect groundwater levels will not proceed until the GMP is certified. Therefore such mitigation options will have been considered prior to construction of the Project.

45 I have amended a number of the proposed Conditions relating to groundwater in response to the evidence of Mr Percy (and Mr Callander as described above) and include those changes in **Annexure A**. These are Conditions G.29, G.30, GD.2, GD.3, GD.4, GD.5, GD.6, GD.7 and GD.8.

46 I have not made all of the changes requested by GWRC, and set out those changes I have not made and the reasons below:

46.1 Condition G.29. More detail/ direction is sought for the GMP, that it include feedback loops and be amended to improve enforceability. I disagree. In my view the purpose of this Condition is to require development of a GMP that covers the listed areas in the timeframes sought, with the necessary certification; it should not begin to address these areas.

46.2 Condition GD.2. I agree that the justification for selected Alert levels could be submitted prior to submission of the GMP, however the Actions should be submitted as part of the GMP; they will already have been discussed with KCDC and GWRC.

46.3 Condition GD.3. By adding further context to Condition GD.2, much of Condition GD.3 becomes obsolete. However as I have noticed that there is no other requirement for reporting, I have strengthened this aspect of this Condition.

46.4 Condition GD.6. Various amendments and clarifications were sought in relation to this Condition. However, in the process of modifying Conditions GD.2 to GD.5 so that they include both a requirement and a consequence (where appropriate), GD.6 has since been made obsolete (and has been replaced with a new unrelated Condition).

46.5 Condition GD.7. I consider that the Condition as already drafted is clear that the criteria for the reduced monitoring period is one of those criteria listed, not all.[34]

Mr Brydon Hughes, Mr Travis Wood and Ms Shona Myers for KCDC

47 Evidence on groundwater for KCDC is principally provided by Brydon Hughes, but some aspects (water supply bores) are covered briefly in the evidence of Mr Wood and Ms Myers (interactions with wetlands).

Mr Brydon Hughes

48 Mr Hughes supports the GMP approach proposed[35] and agrees that changes to groundwater levels are likely to be small[36] and that Expressway construction is unlikely to have adverse effect on groundwater users.[37]

49 Mr Hughes identifies the magnitude of the standard error (normalised RMS) of the calibration for the "cut out" models as a contributor to uncertainties in the groundwater assessment.[38] I have responded to this matter above at paragraph 14 of my rebuttal evidence.

50 It is in my view particularly important to keep in mind that the models simulate the overall groundwater flow conditions and that they are used to then consider the potential effect of the Project, that is, the **difference** in groundwater levels that occur in the existing condition as compared with the post-construction condition. It is this difference that might result in an environmental effect.

51 Mr Hughes suggests that there is a degree of disconnection between the magnitude of changes in groundwater levels described in Technical Report 21 and the Ecological Assessment (Technical Report 26).[39] As noted in my EIC,[40] my assessment is of the effects of the various elements of the Project on groundwater levels and flow directions; my assessment is not of the effects of groundwater level changes on wetland ecology. My finding is that groundwater level changes will be small or negligible. The assessment of whether such changes are potentially harmful to the wetland ecology is made by **Mr Matiu Park** and addressed in his evidence.

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34 I do not address the request for additional Conditions for groundwater as it relates to contaminated groundwater management and is addressed by **Mr Kerry Laing** in his rebuttal evidence.

35 Paragraphs 3 to 5 and 6.8 of Mr Hughes' evidence.

36 Paragraph 9.1 of Mr Hughes' evidence.

37 Paragraph 6.10 of Mr Hughes' evidence.

38 Paragraph 6.4(a) of Mr Hughes' evidence.

39 Paragraph 6.4(b) of Mr Hughes' evidence.

40 My EIC, paragraph 114.

52 Mr Hughes suggests that NZTA should seek to improve its understanding of the individual wetlands, their water level changes and hydraulic connection in order to set thresholds for mitigation.[41] All of the submitters on groundwater have noted that the nature of the environment is such that the distribution of the sand, silt, gravel and peat in the area is discontinuous and variable. While I concur that over a period of many years monitoring of various aspects of the wetlands would provide a better understanding of them and their inter-connections, I do not believe all of the inter-connections and range of behaviours are able to be fully understood no matter how much monitoring is done.

53 Piezometers have been installed adjacent to many of the wetlands in the area and monitoring of water levels in them is underway to give some understanding of natural variations. The monitoring undertaken in the 12 months plus prior to commencement of construction is most unlikely to record the effects of an extreme rainfall or extreme drought event. In my view this means that Alert triggers will be set conservatively (as they are set as a level above or below the recorded seasonal variation).

54 I disagree with Mr Hughes' suggestion that the elevation of standing water in sensitive wetlands should also be recorded to enhance understanding of sensitivity wetlands in the long term.[42] **Mr Park** advises that the Wetland Condition Monitoring he has proposed[43] would provide very much more useful information on the wetlands as he describes in paragraph 74 of his rebuttal.

55 I favour the proposal of Mr Callander that triggering an Alert level triggers a more in-depth assessment of likely adverse effects in that location and, depending on the nature of such effects, actions that might include continuous water level checking or mitigation. This would avoid the need to pre-set Action levels that might not be appropriate. This change would be made to the approach set out in the GMP and does not require any changes to proposed consent Conditions.

56 Mr Hughes suggests monitoring be carried out for an "extended period following Expressway construction".[44] In Condition GD.7, I have proposed that monitoring be carried out for at least 12 months but up to 3 years after construction is complete. I have noted further that "*in cases where post-construction mitigation is implemented, monitoring specific to such mitigation may be continued for a longer period if the collected data do not indicate a return to pre-construction groundwater levels or establishment of a*

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41 Paragraphs 6.8(b) and 6.9 of Mr Hughes' evidence.

42 Paragraph 6.8(b) of Mr Hughes' evidence.

43 Section 11.7.8 of Technical Report 26.

44 Paragraph 6.8(c) of Mr Hughes' evidence.

new equilibrium."[45] I consider there is sufficient flexibility in Condition GD.7 and in the GMP to allow monitoring to continue for a longer period in areas where it is warranted.

57 I note that other submitters whose evidence I respond to below suggest a 5 year post-construction monitoring period. I consider that the current wording of proposed Condition GD.7 allows for an extended monitoring period if, as a result of monitoring carried out up until that time, GWRC considers that this is required.

58 Mr Hughes discusses the temporary and permanent realignment of the Waimeha Stream. He points out that initially "*until the streambed clogging layer re-accumulates*"[46] there may be some small effects on groundwater flow and suggests stream gauging.[47] I note that this situation is similar to the periodic clean-up of the streams that takes place in the district. I visited the Wharemauku stream shortly after such a clean-up and found that an excavator had been used to clear fines and vegetation from the base and sides of the stream (the cleared materials were stored at the top of the bank). I am therefore of the opinion that the minor (and for the most part temporary) stream realignments proposed are unlikely to have a long term effect on the overall groundwater regime.

59 In order for stream gaugings to be useful, a significant change in flow is needed for the gauging to distinguish from weather related variation. I understand from Mr Levy that measurement uncertainty can be or the order of +/- 10 %, even with a hydraulic control structure in the bed, so that even with concurrent upstream and downstream measurement to assess change over a reach, small changes may not be detectable with any level of confidence, or spurious differences may be recorded. I do not consider that gaugings on the Waimeha Stream will usefully detect the magnitude of flow change resulting from the proposed diversion.

60 Mr Hughes expresses concern[48] about the possibility of exacerbating transport of contaminants from the Otaihanga landfill in groundwater and suggests that Expressway construction might result in:

60.1 Reduced area of the wetland into which the leachate collection drain is periodically flushed and therefore a possible reduction in any treatment that might be occurring in the wetland; and/or

60.2 Changes in groundwater level beneath the landfill.

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[45] Appendix I of the CEMP, Groundwater Management Plan, section 5.1.4.

[46] Paragraph 7.5 of Mr Hughes' evidence.

[47] Stream gauging is the establishment of measuring device to record stream flows at a particular point on a stream or other waterway.

[48] Paragraphs 8.4 to 8.5 of Mr Hughes' evidence.

61 I have responded to the first issue in my EIC at paragraphs 135 to 138. I understand that data collected as part of the Project indicates very low levels of contaminants in the leachate drain and down-gradient piezometers. This matter is discussed further in the evidence rebuttal evidence of **Dr Kerry Laing**.

62 On the second issue, I confirm that my assessment is that groundwater levels beneath the landfill will not alter as a result of the Project.[49] This is supported by observations of aerial photographs[50] that demonstrate that land filling has occurred well above the level of the leachate drain upgradient of the Expressway.

Mr Travis Wood

63 Mr Wood lists existing public water supply bores that might be "compromised by the Expressway"[51] as K7, Kb12 and K10 and seeks that these bores, and access to them for reasonable maintenance and servicing, be protected. I confirmed at paragraph 144 of my EIC that all of these public water supply wells, and access to them to allow their proper operation and maintenance, will be preserved. Mr Wood notes at paragraph 6.1 that this matter has been resolved, but at paragraph 5.19(f) of his evidence seeks that this be formalised in a Condition. I am not opposed to this in principle, and I have included this requirement in Condition GD.6.

Ms Shona Myers

64 Ms Myers acknowledges that the review of monitoring data by both a hydrogeologist and an ecologist is required by Condition GD.5, but identifies that a strong link is needed between the EMP and GMP and the monitoring and triggers in these.[52] She also advocates for peer review of whether a wetland is adversely affected by the Project by representatives from independent authorities with expertise in wetland hydrology.[53] I agree that the EMP and GMP should be developed in parallel and that incorporation of the relevant parties in deciding the need for and agreeing suitable mitigation is desirable. I have amended Condition GD.2 to require discussion of actions with KCDC and GWRC in **Annexure A** of my evidence. I note also that Condition G.40 requires GWRC to be involved in adaptive management responses. Ms Myers suggested requirement for peer review of assessments as to whether an adverse effect has occurred as a result of the Project should be set out in the GMP. I consider that the requirement for discussion with KCDC and agreement of GWRC allows for those parties to consult with others as they see appropriate.

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49 Technical Report 21, Appendix labelled F1 Otaihanga landfill (Note this should have been F5) following Appendix F4.

50 Described in Technical Report 23.

51 Paragraph 5.17 of Mr Wood's evidence.

52 Paragraphs 6.27 and 7.3 of Ms Myers' evidence.

53 Paragraphs 6.25 to 6.27 and 7.3 of Shona Myers' evidence.

65 Ms Myers recommends extending the monitoring of groundwater levels for a period of 5 years following construction (instead of 3 years as currently proposed).[54] As I describe above and set out in paragraph 124 of my EIC, I concur that, given the potential sensitivity of the ecologically significant wetlands in close proximity to the Project, a longer post-construction monitoring period could be accepted for those wetlands outlined in the GMP. I note that I have already proposed an amendment to Condition GD.7 in Annexure B of my EIC with sufficient flexibility to allow this. (This is also included in **Annexure A** to this rebuttal statement).

Ms Emily Thomson for KCDC

66 Ms Thomson recommends changes to Condition G.29. She suggests addition of the requirement for base level monitoring. I have not included this in G.29 as it is already a requirement in the modified sub-clause (c) of proposed Condition GD.2 (**Annexure A**).

67 Ms Thomson suggests expanding the list of information to be addressed in the GMP (as set out in proposed Condition GD.29) to include the hydrological regime of each high value wetland and standing water levels of wetlands prior to construction commencing. As I have described earlier in my rebuttal evidence (paragraph 52), I consider that the hydrological regime cannot be fully understood, no matter how much monitoring is carried out. However, some understanding will be developed through the monitoring that is proposed as part of this consent. Therefore I have modified Ms Thomson's addition to: "*a summary of understanding of the hydrological regime in each high-value wetland at the time of preparation of the GMP*." The groundwater monitoring programme is set out in Condition GD.5 and I have not therefore included this in GD.29

68 I have not included Ms Thomson's request for monitoring of flows on the Waimeha Stream to be included in Condition G.29 because I understand from Mr Levy that the flow will be difficult to measure with sufficient accuracy to determine if there is an effect. Monitoring of the nearby piezometer 2010/BH07 is required already under proposed Conditions GD.2 – GD.4.

69 I have not included Ms Thomson's request for monitoring frequency to be set in proposed Condition G.29 as this is already covered in Condition GD.7. As I describe in paragraph 46.1 above, the purpose of Condition G.29 is to require development of a GMP that covers the listed areas in the timeframes sought, with the necessary certification. It is not intended to cover the specific details which are addressed in the GD series of Conditions.

Mr David Roil for WOO

70 Mr Roil sets out his research into the geology and hydrogeology of the area between the Waikanae River and the Waimeha Stream. I

[54] Paragraph 6.28 of Ms Myers' evidence.

am in agreement with many of his findings from this research, but I disagree with his conclusion that the NZTA Technical Reports do not adequately describe the materials or the behaviour of groundwater in the Waikanae River to Waimeha Stream area. This is incorrect. The high groundwater levels and presence of springs in the area are understood and described in both the Stormwater and Groundwater Technical Reports[55] and have dictated the proposed Wetland 9 design. I address this matter further in my response to Ms Rutter below.

71 I set out below some minor corrections to errors contained in Mr Roil's evidence and his interpretations below.

71.1 I am aware of and have considered the gravel aquifer in the Waikanae area.[56] It is described in Table 2 of Technical Report 21 and Table 1 of my EIC.

71.2 I do not consider the GWRC borehole records presented by Mr Roil to be contrary to the ground conditions anticipated.[57] They are driller's logs made from observation of cuttings recovered during well drilling, which, as described in the rebuttal evidence of **Mr Alexander**[58] in response to Mr Roil , are not precise but give an indication of ground conditions. I interpret these logs to show some organic silt and sand (broadly described as 'peat'), in the near-surface, overlying sands, silts and gravels.

71.3 Geological cross-sections have been plotted as part of the Project and are attached to the Geotechnical Interpretative Report;[59] they are not those taken from the WLR.[60]

71.4 Moreover, as described in the rebuttal evidence of **Mr Alexander**, there are now 8 machine boreholes, 2 cone penetration tests and 5 hand auger bores between Puriri Road and Te Moana Road, which addresses Mr Roil's concern about the lack of investigation sites in this area.[61]

72 I note that Mr Roil is not a hydrogeologist and has not practised as one. I disagree with Mr Roil's interpretation of the material he has presented, as set out in his conclusions.

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55 Technical Reports 22 and 21 referred to by Mr Roil I have a copy of, and have read, relevant portions of the Osborne (2006) thesis and it has been available to the NZTA team.

56 Paragraph 29 of Mr Roil's evidence.

57 Paragraph 30 of Mr Roil's evidence.

58 Paragraph 40 of Mr Alexander's rebuttal evidence.

59 Technical Report 36, Appendix 36.B, Sheet 7 of 11.

60 Paragraph 34 of Mr Roil's evidence.

61 Paragraph 35 of Mr Roil's evidence.

73 Should organic silts not exist beneath parts of the Expressway, then excavation of them will not be needed and conventional construction methods can be used.

74 Groundwater modelling carried out under my direction demonstrates that the Expressway will have only a small effect on the groundwater system. This is because much of the construction in this area is above the water table.

Ms Helen Rutter for the Deardens

75 Ms Rutter describes at great length her view of the shortfalls of the groundwater modelling, often mixing explanations and figures in Technical Report 21 that relate to one aspect with another (e.g. mixing descriptions of regional modelling with those of the cut-out 3D models or with the 2D models).[62]

76 I respond to Ms Rutter's evidence according to the sections set out in that evidence.

Conceptual Hydrogeological Model

77 Ms Rutter makes reference to an anomalous high in the water levels in well R26/6811"[63] at the property of 39 Puriri Rd. I confirm that my colleagues and I are aware of the very high water levels in this area. And while I understand that residents in the area might like to see some lowering of the groundwater level to avoid flooding of their properties in wet periods, Mr Levy has worked with myself to develop a stormwater device design that has very little influence on groundwater levels in order to avoid deleterious effects to the surrounding wetlands and potentially damaging consolidation settlement of homes in the vicinity. The stormwater device design is described in Technical Report 22.[64]

78 As Ms Rutter points out, there is an error in the labelling of the fill and greywacke in section CH5300 (Figure E1).[65] This is quite apparent but is corrected in **Annexure E** of this rebuttal evidence.[66]

79 Ms Rutter points out that in places river leakage contributes recharge.[67] This has been considered in modelling and is identified in Technical Report 21 (e.g. Appendix 21.D text and Figure D2).

80 At paragraph 17 of her evidence, Ms Rutter notes our reliance on parameters from Jones & Gyopari (2005), a modelling report that was focussed on shallow aquifer use. This is currently the best

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62 Paragraph 22 of Ms Rutter's evidence.

63 Paragraphs 7 and 12 of Ms Rutter's evidence.

64 Section 4.5.2 of Technical Report 22

65 Paragraph 14 of Ms Rutter's evidence. (Figure E1 is contained in Appendix E of Technical Report 21).

66 The original document is correct but transforms on saving in pdf format.

67 Paragraph 16 of Ms Rutter's evidence.

available data on the near surface aquifers.[68] I therefore consider it appropriate to use this data where it is in agreement with our observations. I also note that in other parts of her evidence, Ms Rutter suggests work should have been carried out in accordance with Jones & Gyopari (2005) - for example Ms Rutter's paragraph 33.

81 In response to paragraph 18 of Ms Rutter's evidence, I confirm that regional groundwater model parameters have been altered progressively to achieve calibration, rather than being applied from Jones & Gyopari (2005) without further consideration as Ms Rutter suggests.

Numerical modelling – calibration

82 Ms Rutter states that I did not highlight in my EIC that the calibration of the models was considered problematic.[69] This is because, as I describe in paragraph 15 above, I do not consider calibration of the 3D regional groundwater model to have been problematic. Rather, calibration of the smaller cut-out models proved problematic because there were insufficient reliable data points. However, because these smaller models are 'cut out' of the regional model, this has allowed these models to sit within the context of the regional model calibrated to a very large number of data points. I note that less reliable data points were not deleted and therefore contribute to the data "scatter" referred to by Ms Rutter.[70]

83 All calibration measures set out in paragraph 25 of Ms Rutter's evidence, except the absolute residual mean, were considered and are reported in Figure F4 of Technical Report 21.

84 In response to paragraph 26b of Ms Rutter's evidence, I note that any calibration will over- or under-predict an actual (observed) value and that the simulated water levels, for the most part, follow the pattern of the observed rather well.

85 Ms Rutter suggests that to state that the residual mean error is +/- 0.4 m in section F1.2 of Technical Report 21 is misleading.[71] The residual mean error for the regional steady state model is +/- 0.4 m as reported (attached in **Annexure C**). Irrespective of which mean is reported, this does not alter my findings.

86 Ms Rutter refers to variations between selected observed and simulated water levels in calibration (paragraphs 30 to 32).

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[68] I am aware that GWRC is in the process of developing a new regional groundwater model, but this work is not yet complete and I understand that it is unlikely to provide greater understanding of the groundwater / wetland interactions.

[69] Paragraph 22 of Ms Rutter's evidence.

[70] Paragraph 26a, 26c, 27 and 30 of Ms Rutter's evidence.

[71] Paragraph 29 of Ms Rutter's evidence.

However, it is important to keep in mind that the objective of the models is to assess the **difference** between the modelled existing condition and the modelled post-construction condition. I believe this is achieved in the modelling presented.

Numerical modelling – recharge

87 Ms Rutter criticises the approach to modelling recharge and in particular the assumption that a proportion of rainfall is available for recharge all year round.[72] Average annual rainfall recharge has been applied to the models throughout the year rather than varying the rainfall according to changes in seasonal rainfall patterns. Varying rainfall cannot be applied to a steady state model. The purpose of the modelling is to address the long term effect of the Project as compared with current conditions and therefore such averaging is appropriate.

88 Ms Rutter expresses disappointment that the models are run on a 2 week time step.[73] The purpose of the models is not to examine the peak rainfall event and current flooding issues, but rather to consider the long term effects of the Project. I consider this time step to be completely adequate for the intended purpose.

Numerical modelling – Site specific 3D model

89 Ms Rutter is concerned at the parameters selected for the alluvium in the cut-out model of Wetland 9.[74] However she notes that the proposed wetland is at around about the estimated boundary of the gravel and interbedded alluvials.[75] She also has observed that a number of springs occur in the area and anomalously high water levels.[76] In response I note that my colleagues initially modelled a high permeability alluvium (as described in Table 1 of Technical Report 21 and used in the regional 3D model) but found that a reasonable calibration was only achieved if the vertical hydraulic conductivity was lowered and in this way, greater anisotropy[77] introduced. This lower permeability and anisotropy is consistent with bedded deposits of quite differing hydraulic conductivity as we have here (gravels and silts) and development of springs and high groundwater levels. [78]

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72 With reference to paragraph 33 of Ms Rutter's evidence.

73 Paragraph 34 of Ms Rutter's evidence.

74 Paragraphs 2c, 2d and 36 of Ms Rutter's evidence.

75 Paragraph 12 of Ms Rutter's evidence.

76 Paragraph 12 of Ms Rutter's evidence.

77 Anisotropy is having properties that differ according to the direction of measurement. In this case where gravels and silts/clays occur in layers, the soil can be modelled as a single layer but with a high horizontal hydraulic conductivity (because water will flow more rapidly through the gravel), and a low vertical hydraulic conductivity (because water will flow more slowly through the silt/clay).

78 There is a typographical error in Section F4.2 of Technical Report 21: the horizontal hydraulic conductivity is reported as 1 x 10^{-6} m/s, but should read 1 x

90 In her summary[79] and in her later discussion (paragraphs 41), Ms Rutter suggests the existing pond (at the location of proposed Wetland 9) will be lined with an impermeable liner which will create an impermeable barrier. This is incorrect. The hydraulic conductivity of the lining proposed is 10^{-7} m/s[80] and will allow slow leakage. The proposal is to construct a low permeability bund, to line the existing pond (but not alter its depth) and to operate it at its current water level range. Only when flooding occurs will the water level rise above this water level range, and then it will slowly drain through a piped system.

91 Figure F8c of Technical Report 21 shows Wetland 9 and the effect of the excavate-and-replace construction methodology for the adjacent Expressway which results in the small amount of drawdown reported in Technical Report 21 (Table 2) and my EIC (Table 2, paragraph 97). Ms Rutter states that she does not understand how a lined pond would result in drawdown.[81] Drawdown occurs in response to the excavate-and-replacement construction methodology used for the Expressway adjacent to Wetland 9 at this location.

92 Ms Rutter is correct that drawdown is reported to be up to 0.4 m in Appendix F4 (Technical Report 21) but 0.3 m in the Tables.[82] This is because the predicted drawdown has been rounded up in the text and down in the summary tables. Because the storage area is lined and is largely above the ground surface, it does not cause noticeable groundwater mounding.

93 Ms Rutter has some concerns about Tables F12 (modelled water balance (transient) for the Wetland 9 area) and Table F13 (modelled water balance (steady state) for the Wetland 9 area).[83] I address these below:

93.1 Ms Rutter has misinterpreted the "in" and "out" columns in Table F13. The table shows, logically, that in winter, most water comes in from rainfall and not much from storage (there is a net gain to storage of about 580 m^3/day). In summer, more water comes from storage and rainfall recharge is much smaller.

93.2 The existing situation was modelled as a high water level rather than a pond, which is why there is no inflow or outflow.

10^{-4} m/s. However Ms Rutter's concern was with the vertical hydraulic conductivity which is reported correctly.

79 Paragraph 2e of Ms Rutter's evidence.

80 As described in Appendix F4, Technical Report 21.

81 Paragraphs 43 to 49 of Ms Rutter's evidence.

82 Paragraph 54 of Ms Rutter's evidence.

83 As contained in Technical Report 21. As contained in Technical Report 21. Paragraphs 43 to 48 of Ms Rutter's evidence.

This is because the existing pond behaves essentially as a water table in connection with the surrounding water table.

93.3 There is apparent groundwater flow toward the wetland because the model is of the effects of the Project at that location. This includes construction of the Expressway by excavate-and-replace methods, and shows that a small amount of drawdown will occur adjacent to the Expressway. A small amount of mounding occurs as a result of the wetland lining, which largely counters the drawdown on the southern side of the wetland.

93.4 The labels of the rows "Domestic Abstraction" and "General Heads" have been inadvertently inverted in Table F13. On further checking I find also that the Transient Conditions table has not been fully updated to reflect the final stormwater device model iteration. I therefore attach the correct Table F13 as **Annexure F** to my evidence. This omission has no effect on my findings because the correct model output has been incorporated in my assessment and is presented in Figure F8c of Technical Report 21.

94 Ms Rutter states that she does not understand the comment in section F4.4 of Technical Report 21 that "*because of the low permeability bund proposed around the wetland, drawdown of less than 0.1 m is predicted for properties on Puriri Road*."[84] In response, I can clarify that it means that the lower permeability bund (or lining) has a small mounding effect which compensates the drawdown anticipated from the excavate-and-replace construction of the Expressway.

95 Although I have addressed Ms Rutter's concerns, I concur that the vicinity of wetland 9 is an interesting area geologically and hydrogeologically and it would be prudent to consider specific mitigation concepts for this area[85] in the developed GMP. I have addressed this also in response to Mr Percy and Mr Callander's evidence in proposed Condition GD.2 (d).

Dr Hugh Cherrill, Loretta Pomare, Mary Campbell-Cree and Melanie Dixon

96 In terms of groundwater, these submitters all rely upon the evidence of Ms Rutter which I have responded to above. Unfortunately Ms Rutter has suggested that there is considerable uncertainty in the assessment of effects on groundwater to these submitters and their evidence has been prepared accordingly.

97 Conversely, Mr Callander has concluded that "the cause of groundwater changes arising from the Expressway and the general nature of those changes have been well described in Technical

[84] Paragraph 57 of Ms Rutter's evidence.

[85] Paragraphs 50 and 60 of Ms Rutter's evidence.

Report 21. The modelling approaches used to describe the potential groundwater effects appear reasonable".[86]

98 He also agrees "with the conclusion in Technical Report 21 and the evidence of Ann Williams that the groundwater level changes are likely to be of a generally small magnitude and extent".[87] He does caution that it is important to recognise the natural variability of the strata and the difficulty in characterising such variability. I concur with this.

99 Similarly Mr Hughes concludes in his evidence that while "Construction of the proposed Expressway has the potential to alter groundwater levels and flows in the unconfined aquifer on a local scale", "…the magnitude of these changes is likely to be relatively small…"[88] He cautions however that these small changes might nevertheless result in changes to high value wetlands and "While extensive investigation and modelling has been undertaken to quantify potential effects arising from Expressway construction, due to the heterogeneity of the hydrogeological environment an element of uncertainty remains regarding the absolute magnitude of effects likely to result."[89] I agree with that also.

100 Both Mr Callander and Mr Hughes conclude, as I have, that a GMP and monitoring approach is appropriate to manage such uncertainties.[90]

Dr Hugh Cherrill for SKI

101 As I describe above, Dr Cherrill has relied on Ms Rutter for his understanding of groundwater effects which he sets out in his evidence. **Mr Alexander's** rebuttal addresses various matters raised in Dr Cherrill's evidence.

Melanie Dixon for RSRA

102 Ms Melanie Dixon identifies at paragraph 53 of her (non-expert) evidence that she is in support of the proposal to monitor water levels for a period of 5 years following construction. This view is shared with other submitters (eg DOC and Ms Shona Myers) and I have responded to it in paragraph 65 above. In summary I have considered the submissions and evidence and consider that the opportunity for longer term monitoring in sensitive wetland areas is provided for in proposed Condition GD.7 included in **Annexure A**.

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86 Paragraph 116 of Mr Callander's evidence.

87 Paragraph 117 of Mr Callander's evidence.

88 Paragraph 9.1 of Mr Hughes' evidence.

89 Paragraph 3.4 of Mr Hughes' evidence.

90 Paragraph 118 of Mr Callander's evidence; Paragraph 3.5 of Mr Hughes' evidence.

Mary Campbell-Cree for RSRA

103 Ms Mary Campbell-Cree expresses concern in her (non-expert) evidence that development of a construction water supply well at Poplar Avenue might impact the wetlands and ecology.[91] I have addressed this matter in my EIC[92] and it has also been considered in the evidence of Mr Callander[93] on behalf of GWRC. Both Mr Callander and I conclude that the construction bore water supplies are most unlikely to have a deleterious effect on the overlying aquifers (and wetlands).

104 In particular I note that it is proposed to pump only a small volume (150 m^3/day) over a 10 month period from a bore in the Poplar Road vicinity. This means that the actual effects will be much less than those described in my EIC, which assessed effects based on pumping at 750 m^3/day, being the maximum proposed abstraction rate from any one bore.

Ms Loretta Pomare

105 Ms Pomare expresses concern in her (non-expert) evidence that changes to water levels in the vicinity of her property might exacerbate flooding.[94] Ms Pomare also makes reference to Ms Rutter's opinion.

106 No increase in groundwater level is expected to occur in the vicinity of Ms Pomare's property,[95] instead a very small lowering (0.1 m) might occur. Because of the sensitivity of the nearby wetlands, Project design has been aimed at causing almost no change in groundwater level in the area. This means existing elevated levels at house sites cannot be noticeably reduced.

Professor Martin Manning

107 Professor Manning indicates that sea level rise is likely to result in a groundwater level rise of 1 m or more.[96] While he does not state over what time period this might occur, he observes correctly that this change is significantly larger than the anticipated effects of the Project.

108 As I state in paragraph 150 of my EIC, climate change has not been considered in groundwater modelling because the purpose of the modelling is to assess the changes to the groundwater regime that might result from Expressway construction and, as far as possible, to avoid changes to that existing regime. The efficacy of the stormwater devices under elevated water level and rainfall events has been addressed in Technical Report 22 by Mr Levy.

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91 Paragraphs 5 to 7 of Ms Campbell-Cree's evidence.

92 Paragraphs 87 to 89 of my EIC.

93 Paragraph 110 of Mr Callander's evidence.

94 Paragraph 105 of Ms Pomare's evidence.

95 55 Puriri Road, Waikanae.

96 Paragraph 30 of Professor Manning's evidence.

Gregory Olliver and Pranil Wadan for St Heliers Capital

109 Mr Pranil Wadan has undertaken an alternative stormwater design for Wetland 4 at a new location in the southern part of the St Heliers Capital property between the Expressway alignment and the Wharemauku Stream.

110 A significant constraint on the design of offset storage area 2/3A and Wetland 3 (which is located opposite the St Heliers alternative pond 4 site, on the southern side of the Wharemauku Stream) was the extent of groundwater effects if the stormwater devices were of a depth that required removal of the full depth of underlying peat. This is because the sand aquifer beneath the peat is considered to be artesian. If the ponds were too deep, they would be in part filled with groundwater which modelling suggested would cause widespread drawdown of shallow groundwater (and potentially ground settlement at the surrounding house sites) and some local lowering of the underlying aquifer.

111 I understand that geotechnical and groundwater investigations have not been carried out by St Heliers Capital on the St Heliers alternative Wetland site and no boreholes have been drilled in the vicinity as part of the Project.

112 Site specific geotechnical and water level monitoring will be needed to confirm the optimal design and invert levels for the submitter's alternative design. I envisage a series of 3 boreholes drilled to depths of 6 to 8 m (depending on actual ground conditions), logged geologically, and completed with standpipe piezometers screened in the sand in the lower part of these boreholes. Three shallower 'partner' boreholes should be drilled beside each of these, and screened above a silt/ clay or peat layer (depending on actual ground conditions) and completed with shallow piezometers. In-situ hydraulic conductivity tests should be carried out in each piezometer and the water levels should be monitored for a period of at least 6 months to allow water levels to settle and give an indication of variations. I envisage that the physical investigations could be completed over a 2 to 3 week period. Should groundwater conditions be unfavourable, a larger shallower footprint may be required for the pond, or perhaps partial lining of the pond floor.

CONCLUSION

113 Overall, the experts for KCDC and GWRC agree that the groundwater level changes are likely to be of a generally small magnitude and extent.

114 However, we all recognise that the natural strata are variable, the hydrogeological environment heterogeneous, and characterising and modelling such variability presents challenges. For these reasons, the monitoring and adaptive GMP approach proposed is favoured.

115 I have suggested a number of amendments to proposed consent conditions to better define monitoring and response requirements of the GMP and the role of the Councils.

Ann Williams
25 October 2012

ANNEXURE A – PROPOSED CONDITIONS REFERRED TO IN THIS REBUTTAL STATEMENT

Further proposed changes to NZTA's groundwater Conditions referred to in my rebuttal evidence are shown by underlining additions and ~~strikethrough~~ deletions.

Proposed General Conditions

	Groundwater (Level) Management Plan
G.29	The consent holder shall finalise and submit ~~and implement through the CEMP,~~ the Groundwater (Level) Management Plan (GMP) ~~to be submitted~~ to the Manager for certification at least 15 working days prior to works commencing. The purpose of the management plan is to ~~address the minimum standards, outline~~ set out the best practicable options for groundwater monitoring and management and procedures to minimise~~the effects on~~ changes in groundwater levels. The GMP shall be finalised in consultation with Te Ati Awa ki Whakarongotai and Takamore Trust, The G~~W~~MP shall include information regarding: i. the schedule of groundwater monitoring bores identifying piezometer depth, screen length and geological unit; ii. the locations of groundwater monitoring bores shown on plans; iii. the locations of monitoring stations on the Wharemauku Stream and Drain 5; iv. a summary of understanding of the hydrological regime in each high-value wetland at the time of preparation of the GMP; v. monitoring frequency; vi. monitoring methods including the role of Te Ati Awa ki Whakarongotai and Takamore Trust; vii. reporting requirements; viii. alert and action programmes; ix. response management; and x. review procedures. Works shall not commence until the consent holder has received certification for the management plan(s).
G.30	At least 15 working days before submitting the GMP to ~~GWRC~~ the Manager for certification, the consent holder shall submit a copy of the draft GMP required by Condition G.29 to KCDC for comment. Any comments received shall be supplied to the Manager when the GMP is submitted, along with a clear explanation of where any comments have not been incorporated and the reasons why.

Proposed consent Conditions for borehole construction and groundwater take

	General Conditions – Borehole Construction
BC.1	The location, design, implementation and operation of the monitoring bore(s) shall be in general accordance with the resource consent application and the plans contained in the Groundwater Management Plan (CEMP, Appendix I).
BC.2	Within one month after completion of all monitoring bore installations, the consent holder shall submit to the Manager a copy of the borehole logs and details of the piezometer installations.
BC.3	Within one month after completion of each water supply well, the consent holder shall submit to the Manager a copy of the driller's bore log form as completed by the driller who constructed the bore(s) and details of the well installation.
BC.4	The bore(s) shall be constructed and maintained in accordance with the New Zealand Environmental Standard for Drilling of Soil and Rock (NZS 4411:2011).
BC.5	In the event of a bore(s) being decommissioned or abandoned, the bore will be backfilled in accordance with NZS 4411:2011.
BC.6	Is so requested by the Manager, the permit holder shall make their bore available for the monitoring of water levels and water quality.

	General Conditions – Groundwater Take
GT.1	The location, design, implementation and operation of the groundwater takes shall be in general accordance with the consent application and the plans contained in the Groundwater Management Plan (CEMP, Appendix I).
GT.2	The rate at which water is taken from each water supply bore shall not exceed 275,000 m^3/year at ~~800~~ 750 m^3/day and a maximum pumping rate of 35 litres/sec. The rate of pumping shall not exceed 1990 m^3/day in total from any group of bores pumping at any one time.
GT.3	The consent holder shall undertake the following: a) install and maintain a water meter on each water supply bore prior to the commencement of the take and for the duration of the abstraction from the point of take. The water meter shall measure both cumulative water abstraction and the instantaneous rate of take, and be capable of providing a pulse counter output; b) The water meter shall be calibrated to ensure that the error does not exceed +/- 5%. The water meter shall be

	General Conditions – Groundwater Take
	installed in accordance with manufacturer's specifications.
GT.4	A stepped rate pumping test shall be carried out in each new water supply bore to determine the volume of water that can be abstracted from the bore. The stepped rate test shall be followed by a constant rate pumping test of at least 8 hours duration at the desired pumping rate. Monitoring of water levels in at least one observation bore shall be carried out during the constant rate test.
GT.5	Within 3 months of the completion of each pumping test, the consent holder shall submit a report to the Manager, which contains but need not be limited to, the following information: a) Presentation of and analysis of the collected pumping test data b) Use results to simulate drawdown at any potentially affected neighbouring boreholes c) An assessment of the potential effect on nearby streams / wetlands; and d) An assessment on the risk of saline intrusion.
GT.6	If so requested by the Manager, the consent holder shall make its bores available for monitoring of water levels and water quality.

Proposed consent conditions for groundwater diversion

	Conditions – Groundwater Diversion
GD.1	The location, design, implementation and operation of the activity shall be in general accordance with the consent application and its associated plans.
GD.2	The consent holder shall: a) Install and maintain the groundwater monitoring boreholes shown in Appendix A of the Groundwater Management Plan (GMP) (CEMP, Appendix I) for the period of monitoring specified in this consent. b) Monitor groundwater levels in the groundwater monitoring boreholes shown in Appendix A of the GMP (CEMP, Appendix I) and keep records of the water level measurement and corresponding date in accordance with the GMP. These records shall be compiled and submitted to ~~GWRC~~ the Manager at three monthly intervals or upon request. c) Monitor groundwater levels monthly in existing boreholes and in newly installed monitoring boreholes shown in Appendix A of the GMP (CEMP, Appendix I) (required as

	Conditions – Groundwater Diversion
	part of this consent) for a period of at least 12 months (where practicable) before the commencement of construction that may affect groundwater levels in the area of monitoring. The consent holder will report the ~~variability in~~ groundwater levels recorded over this period, together with the monitoring trends obtained during the investigation and detailed design phases, ~~will be used~~ and use these to establish ~~seasonal~~ groundwater level ~~variability and establish~~ triggers~~level~~. The proposed alert triggers and supporting data shall be submitted to the Manager for certification 15 days prior to submission of the GMP. d) Develop actions for mitigation should alert levels (as determined in the GMP) be exceeded. These actions shall include provision for the accidental interception of artesian or spring flows in the area immediately adjacent to wetland 9 (located between the Waimeha Stream and Waikanae River).
GD.3	~~Prior to the commencement of the construction, and then~~ At 3 monthly intervals during construction, and for at least 12 months following completion of construction, the consent holder shall review and report the results of monitoring as compared with expected effects on groundwater levels assessed from groundwater modeling and the established range of groundwater levels determined from groundwater monitoring prior to the works. This review will consider the final construction methodology and progress at the time of the review. In addition, an annual report will be prepared and submitted to the Manager that describes: • The groundwater monitoring that has been undertaken since the outset of the Project • The actual and potential effects arising from the groundwater level changes • Any mitigative measures that have been implemented • Any changes to proposed mitigation measures; and • Any changes proposed for the future monitoring programme. Any changes to future monitoring and mitigation must be certified by the Manager before they can be implemented. The frequency of reporting may be extended to 6 monthly following completion of construction on receipt of written advice from the Manager. ~~The output of the first review shall be used to define the expected range of groundwater levels at each borehole and check the potential for damage to structures due to ground settlement. A factor for natural seasonal variability shall be allowed for in this review based on the monitoring completed under Condition GD.2.~~
GD.4	From the commencement of construction, the consent holder shall monitor groundwater levels in each borehole listed in Appendix A of the GMP at a minimum of monthly intervals and

	Conditions – Groundwater Diversion
	records shall be kept of each monitoring date and the corresponding water level in each borehole. In addition, all boreholes listed in Appendix A the GMP located within 200 metres of the advancing construction face shall be monitored twice weekly. These records shall be compiled and submitted to ~~GWRC~~ the Manager at 3 monthly intervals or upon request. In the event of an exceedance, the consent holder shall increase the frequency of monitoring to daily. If the exceedance continues for 3 consecutive days, the consent holder shall notify the Manager within 2 working days, advising of the exceedance, the risk of adverse effects on wetlands or ground settlement that might cause damage to structures, details of the actions undertaken and initiate the Actions set out in the GMP.
GD.5	Monitoring bores installed in or adjacent to wetlands and water level monitoring posts installed in wetlands shall be reviewed on a monthly basis to determine if there is any ~~effect of the works on water levels within them~~ change in water levels. The results shall be jointly reviewed by a suitably qualified hydrogeologist and a suitably qualified fresh water ecologist and included in the 3 monthly groundwater monitoring reports provided to GWRC. In the event that water level changes occur that exceed Alert levels for a wetland, the consent holder shall notify the Manager and initiate the Actions set out in the GMP.
GD.6	~~Monitoring data obtained pursuant to Condition GD.4 shall be compared to the expected groundwater levels for each borehole. Where groundwater level triggers are exceeded the appropriate actions as set out in the GMP shall be undertaken and the GWRC notified advising of the exceedance, the risk of adverse effects on wetlands or ground settlement that might cause damage to structures, and details of the actions undertaken.~~ The consent holder shall implement mitigation measures described in the GMP to ensure that existing groundwater users (consented users or those identified in Condition GD.2e) who cannot use their own water supply as a result of the Project receive a replacement water supply. The consent holder shall avoid adversely affecting KCDC's public water supply bores shall ensure access to the bores for maintenance and servicing is maintained throughout the Project.
GD.7	The consent holder shall continue to monitor groundwater levels in each borehole listed in Appendix A of the GMP at monthly intervals for a period for up to 12 months following completion of Expressway construction, ~~then~~ and 3 monthly thereafter for a further 24 months, or a lesser period (except in the case of piezometers in or adjacent to high value wetlands in

	Conditions – Groundwater Diversion
	proximity to the Project which shall continue to be monitored for 48 months following the initial 12 month period), if groundwater levels in any particular borehole show either: a) Recovery of the groundwater level to within 0.3 m of the pre-construction groundwater level as recorded in accordance within Condition GD.3 b) A trend of increasing groundwater level in at least 3 consecutive monthly measurements; or c) An equilibrium in the groundwater level, allowing for the seasonal variation, has been reached In which case monitoring at that borehole may cease, subject to written approval of ~~GWRC~~ the Manager.
GD.8	The consent holder shall, within 10 working days of completion of the Project construction, advise the ~~GWRC~~ Manager in writing, of the date of completion.

ANNEXURE B – MAP SHOWING BORE LOCATIONS INCLUDING THOSE OF DOMESTIC WELLS

GIS@beca.com

Rauoterangi Channel (Otaheke Strait)

Waikanae River

KAPITI ROAD

MAZENGARB ROAD

PEKA PEKA ROAD

NGARARA ROAD

POPLAR AVENUE

Legend

- Proposed M2PP Construction Water Supply Bore
- Existing KCDC Water Supply Bore
- KCDC Bore >= 20m Depth*
- KCDC Bore < 20m Depth*
- Private Bore >= 20m Depth*
- Private Bore < 20m Depth*
- Existing KCDC Borefield Pipeline
- Proposed M2PP Expressway Alignment
- State Highway 1
- Parcel Boundary
- Watercourse
- Road Network

Scale 1:40,000 at A3

0 0.5 1 2

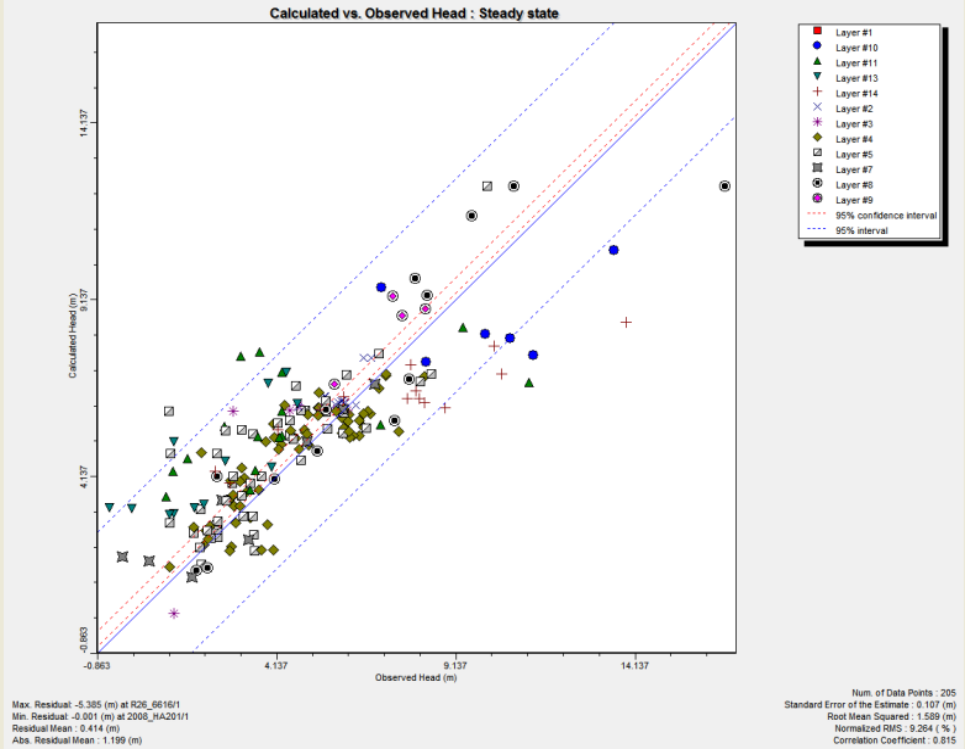
Kilometres

N

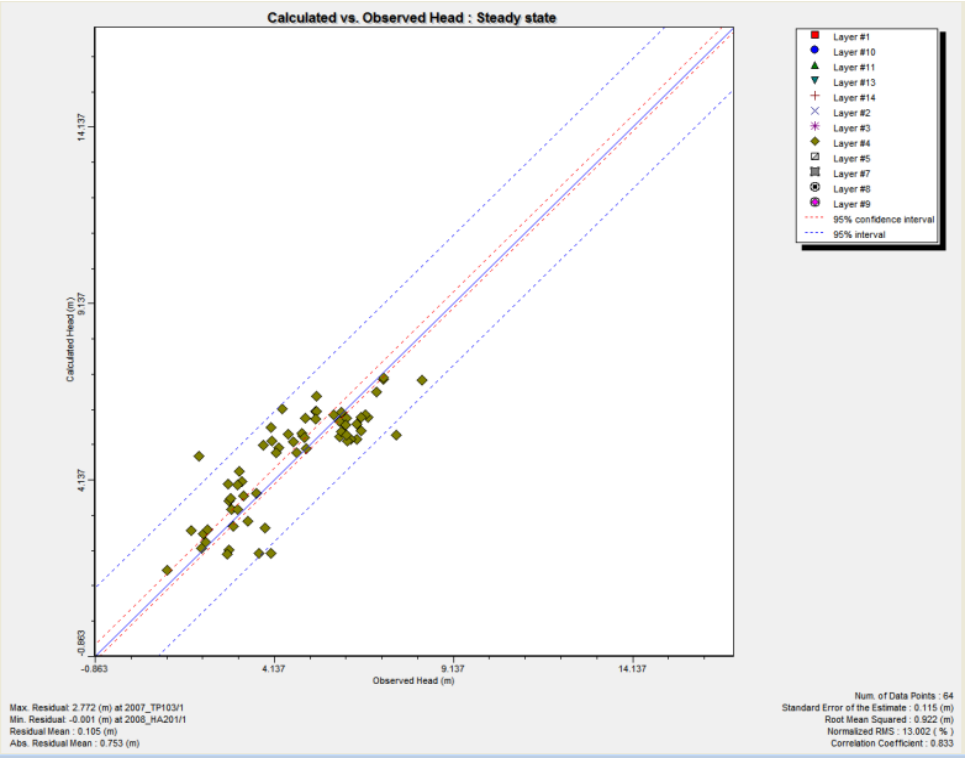
* From Greater Wellington Regional Council (GWRC) Bore Database

P:\65\16515959\TGI\55_Workspaces\01_mxd\GIS-65159959-42_KWSPExisting_Bores_From_GWRC_Database_Rev2.mxd

ANNEXURE C – ENLARGED PLOT OF REGIONAL MODEL CALIBRATION (FROM FIGURE F4, TECHNICAL REPORT 21)



Regional 3D Model Calibration Figure F4 Enlarged



Regional 3D Model Calibration Layer 4 (extracted from the above figure)

ANNEXURE D – ASSESSMENT OF EXISTING BORES AFFECTED BY TEMPORARY CONSTRUCTION WATER ABSTRACTION

Well	World x	World y	Screen Elevation (mRL)	Reported SWL (mRL)	Decrease in Maximum water level (m)	Change in Range (m)
R26_6641/	1775558	5476850	-39.34	7.37	0.65	-0.51
R26_6992/	1773140	5475374	-0.87	2.7	0.44	0.35
R26_7202/	1767538	5468618	-1.53	-	0.43	0.24
R26_5118/	1767838	5468169	-1.50	-	0.43	0.08
R26_5120/	1767831	5468162	-1.52	-	0.42	0.08
R26_5555/	1767935	5468246	-4.33	-	0.42	0.05
R26_5432/	1767440	5468536	-5.21	-	0.41	0.16
R26_5176/	1767516	5468224	-3.76	-	0.41	0.09
R26_5664/	1767490	5468611	-4.46	-	0.40	0.18
R26_6750/	1775346	5476829	-24.33	7.63	0.38	-0.27
R26_5624/	1767370	5468499	-2.41	-	0.35	0.07
R26_6740/	1775682	5476785	-39.64	7.06	0.35	-0.25
R26_5821/	1768042	5468158	-4.44	-	0.34	-0.06
R26_5823/	1768094	5468162	-2.76	-	0.33	-0.09
R26_5152/	1768105	5468186	-1.94	-	0.32	-0.09
R26_5923/	1768140	5468213	-3.93	-	0.32	-0.10
R26_6746/	1775982	5477385	-24.20	11.74	0.27	-0.15
R26_5195/	1767869	5467639	-2.83	-	0.27	0.00
R26_6521/	1767208	5468481	-35.58	2.46	0.26	-0.12
R26_5476/	1768006	5467632	-2.18	-	0.25	-0.05
R26_7163/	1767667	5468762	-5.00	-	0.24	0.16
R26_5408/	1767411	5468742	-4.35	-	0.24	0.02
R26_6516/	1768382	5467985	0.00	3.17	0.24	-0.10
R26_6346/	1767253	5468613	0.00	-	0.23	-0.02
R26_5241/	1767794	5467485	-2.70	-	0.23	0.10
R26_5899/	1767521	5467632	5.08	-	0.22	0.02
R26_5990/	1767242	5468782	-6.72	-	0.20	-0.07
R26_6238/	1767462	5467181	-16.02	-	0.18	-0.06
R26_5640/	1767259	5467622	-3.03	-	0.17	-0.02
R26_6751/	1775282	5477385	-40.21	5.5	0.17	-0.09
R26_5255/	1767451	5467281	-1.26	-	0.16	0.00
R26_6772/	1767389	5467329	0.00	-	0.16	-0.01
R26_6524/	1768782	5468585	-39.50	4.71	0.16	-0.07
R26_6747/	1775247	5477235	-54.70	3.65	0.16	-0.09
R26_5253/	1767348	5467305	-4.04	-	0.15	-0.02
R26_6327/	1767407	5467240	0.00	-	0.15	-0.02
R26_6372/	1767290	5467311	0.00	-	0.15	-0.03

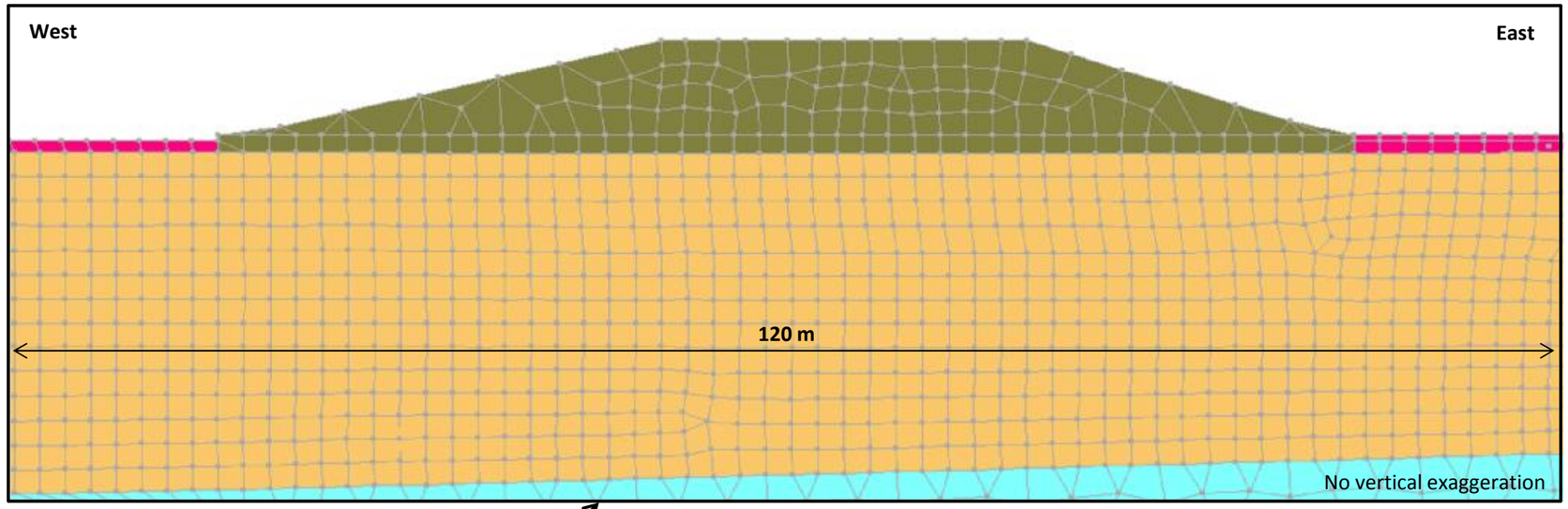
Well	World x	World y	Screen Elevation (mRL)	Reported SWL (mRL)	Decrease in Maximum water level (m)	Change in Range (m)
R26_6348/	1767302	5467275	0.00	-	0.14	-0.03
R26_6241/	1767415	5467171	0.00	-	0.14	-0.02
R26_6526/	1766802	5469021	-47.10	-0.52	0.14	-0.07
R26_7167/	1767292	5467231	0.79	-	0.14	-0.04
R26_6565/	1767982	5469585	-47.78	2.7	0.13	-0.07
R26_6412/	1766944	5467864	0.00	2.92	0.13	-0.02
R26_6831/	1768770	5469188	1.69	5.79	0.12	-0.01
R26_7035/	1767738	5466704	1.26	-	0.11	-0.05
R26_6525/	1769082	5468585	-35.21	13.99	0.11	-0.04
R26_5109/	1766472	5466220	-53.33	2.83	0.11	-0.06
R26_6215/	1767758	5469112	2.37	-	0.10	-0.01
R26_6244/	1767764	5469088	1.79	-	0.10	0.00
R26_6564/	1769150	5469091	-38.24	3.91	0.10	-0.03
R26_6512/	1766846	5467540	0.00	3.17	0.09	-0.01
R26_6555/	1768577	5469972	-48.55	1.27	0.08	-0.03
R26_5121/	1766745	5469046	-24.03	6.93	0.08	-0.04
R26_6643/	1774814	5477172	-38.61	5.75	0.07	-0.03
R26_6532/	1767791	5470328	-39.94	7.26	0.06	-0.03
R26_7118/	1768129	5467229	0.56	-	0.05	-0.02
R26_6222/	1767642	5469089	0.93	-	0.05	-0.01
R26_6811/	1771630	5473401	-5.70	-	0.05	-0.05
R26_6563/	1768796	5470693	-57.66	1.66	0.04	0.00
R26_6886/	1771939	5474425	-1.50	3.7	0.03	-0.03
R26_6533/	1769782	5469985	-45.90	4.29	0.03	0.00
R26_6098/	1771792	5473312	-3.01	-	0.03	-0.04
R26_6550/	1767582	5470785	-38.22	17.25	0.03	-0.02
R26_7166/	1767793	5468851	-2.21	-	0.03	0.02
R26_6072/	1771527	5473324	-4.45	-	0.03	-0.03
R26_7141/	1766337	5465971	-21.41	1.99	0.03	0.00
R26_7025/	1772141	5473628	-1.50	4.99	0.03	-0.04
R26_6558/	1768982	5470935	0.00	1.17	0.02	0.01
R26_6269/	1771709	5473220	-0.33	-	0.02	-0.02
R26_5201/	1771292	5473346	-1.77	-	0.02	0.01
R26_7055/	1771320	5473255	-1.29	-	0.01	0.00
R26_7169/	1771634	5473168	-0.11	-	0.01	-0.01
R26_6604/	1772191	5472464	-44.44	8.26	0.01	-0.02
R26_6541/	1767322	5471462	-45.06	2.2	0.01	0.00
R26_5147/	1771399	5473218	-4.92	-	0.01	-0.01
R26_5755/	1771396	5473187	-4.49	-	0.01	0.00
R26_7056/	1771056	5473231	-4.16	-	0.01	0.05

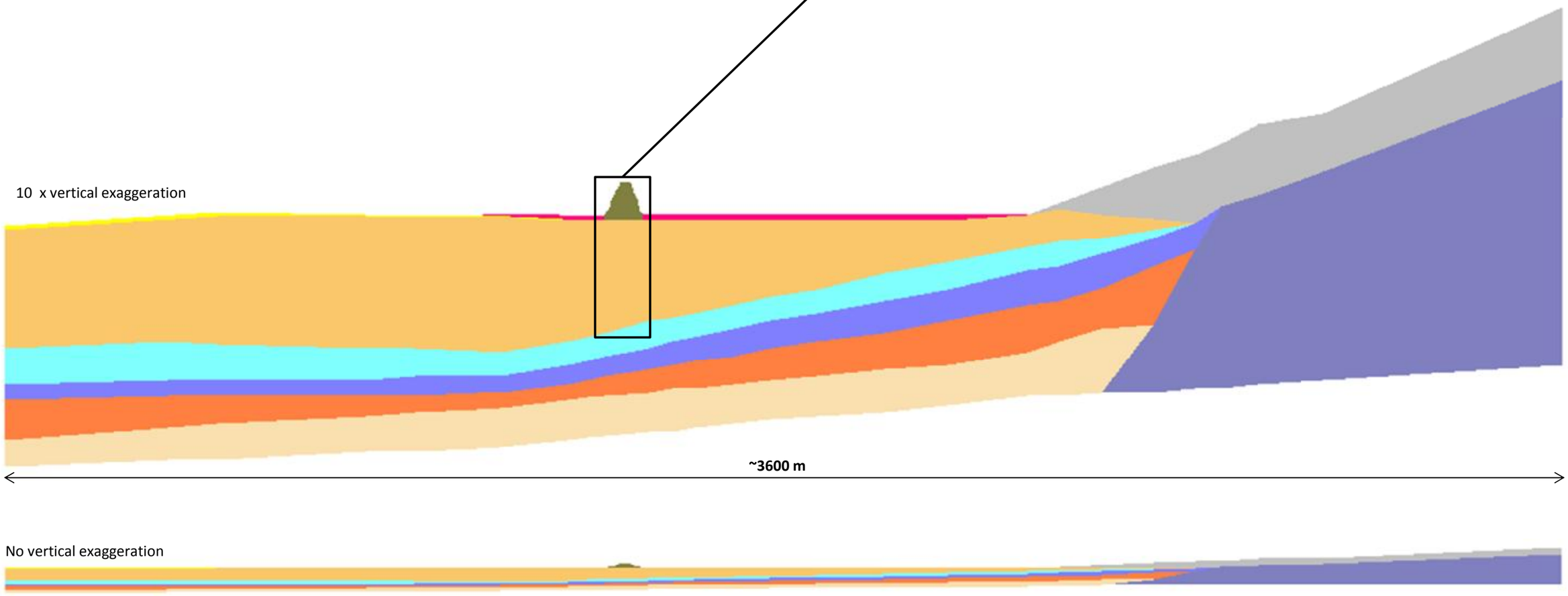
Well	World x	World y	Screen Elevation (mRL)	Reported SWL (mRL)	Decrease in Maximum water level (m)	Change in Range (m)
R26_6664/	1770120	5472786	-72.82	1.14	0.01	0.00
R26_6284/	1772736	5473167	8.00	8.9	0.01	-0.02
R26_7109/	1770699	5473704	-29.93	3.34	0.00	-0.01
R26_6991/	1773517	5474443	4.94	8.44	0.00	-0.06
R26_6916/	1770722	5473136	-1.00	2.2	0.00	0.00
R26_6549/	1768002	5472377	-39.76	1.89	0.00	0.01
R26_6287/	1770587	5474307	-1.01	2.04	0.00	-0.01
R26_6673/	1770439	5474422	-30.64	1.76	0.00	-0.01
R26_6833/	1766872	5471508	-1.45	1.27	0.00	0.00
R26_6569/	1770929	5470578	-10.66	8.3	0.00	0.01
R26_6571/	1770782	5470885	-49.18	11.17	0.00	0.01
R26_6770/	1767341	5466908	6.81	-	0.00	0.00
R26_6566/	1769407	5473310	-1.50	2.13	0.00	0.00
R26_6559/	1769742	5472369	-77.45	1.84	0.00	0.01
R26_6556/	1769721	5472427	-79.42	1.27	0.00	0.01
R26_5645/	1768822	5472768	-5.15	-	0.00	0.01
R26_6657/	1773623	5473917	-49.67	7.87	0.00	-0.03
R26_6737/	1775382	5475785	-23.30	13.54	0.00	0.00
R26_6616/	1774127	5472834	-10.77	13.88	-0.01	-0.02
R26_6503/	1766253	5462295	-0.64	10.96	-0.01	0.04
R26_6667/	1773132	5475385	-60.44	4.21	-0.01	0.00
R26_6734/	1775482	5475285	-28.79	10.74	-0.02	0.00

ANNEXURE E – CORRECTED FIGURES E1 (TECHNICAL REPORT 21)

HYDROGEOLOGICAL UNIT

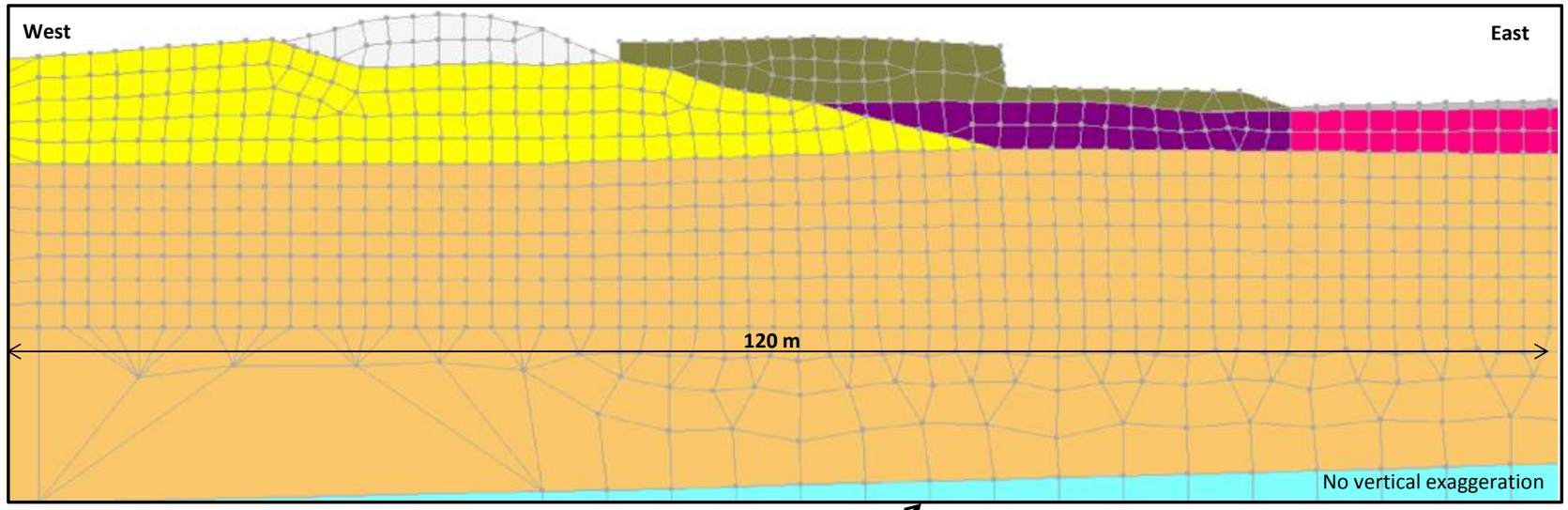
- Fill / Colluvium
- Holocene Peat
- Holocene Sand
- Upper Marine Sands
- Parata Gravel Aquifer
- Regression Alluvium
- Lower Marine Sands
- Waimeha Aquifer
- Greywacke
- Fill Embankment (sand)

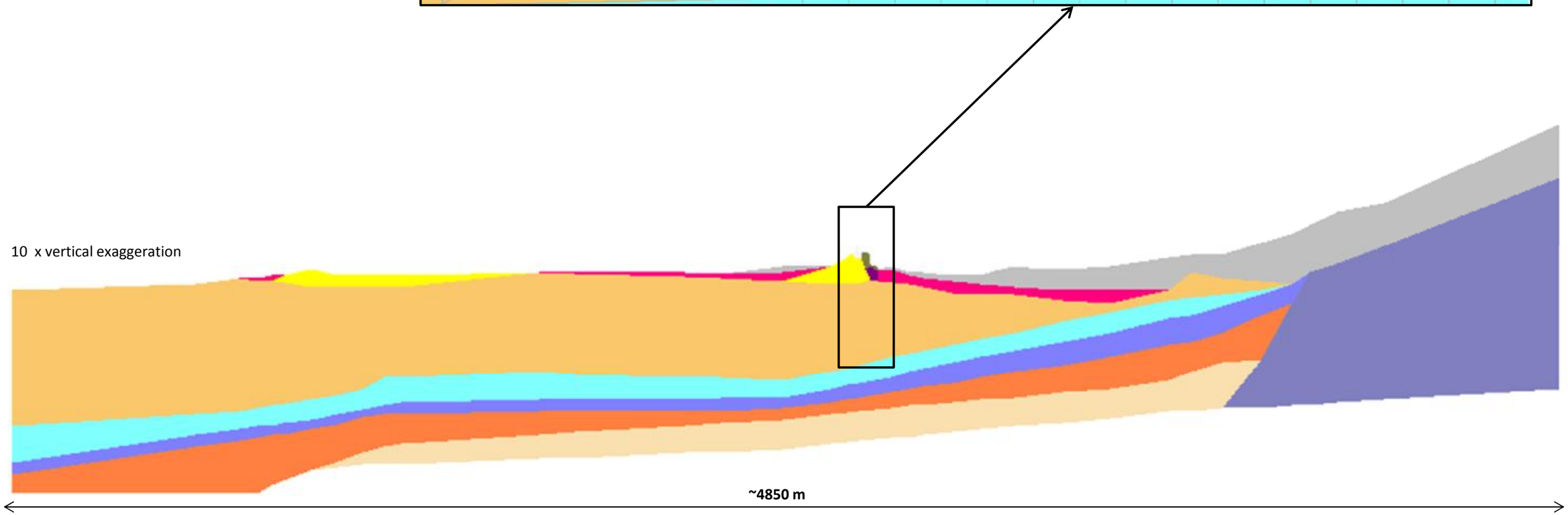




HYDROGEOLOGICAL UNIT

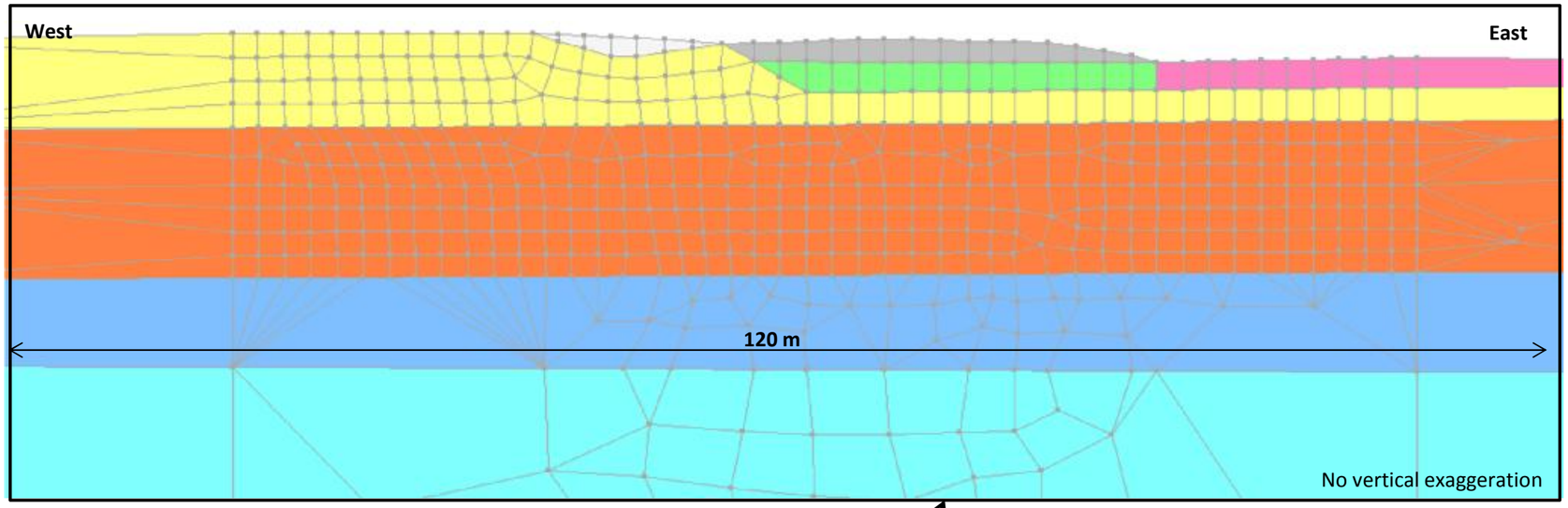
- Fill / Colluvium
- Holocene Peat
- Holocene Sand
- Upper Marine Sands
- Parata Gravel Aquifer
- Regression Alluvium
- Lower Marine Sands
- Waimeha Aquifer
- Greywacke
- Fill Embankment (sand)
- Surcharged Peat

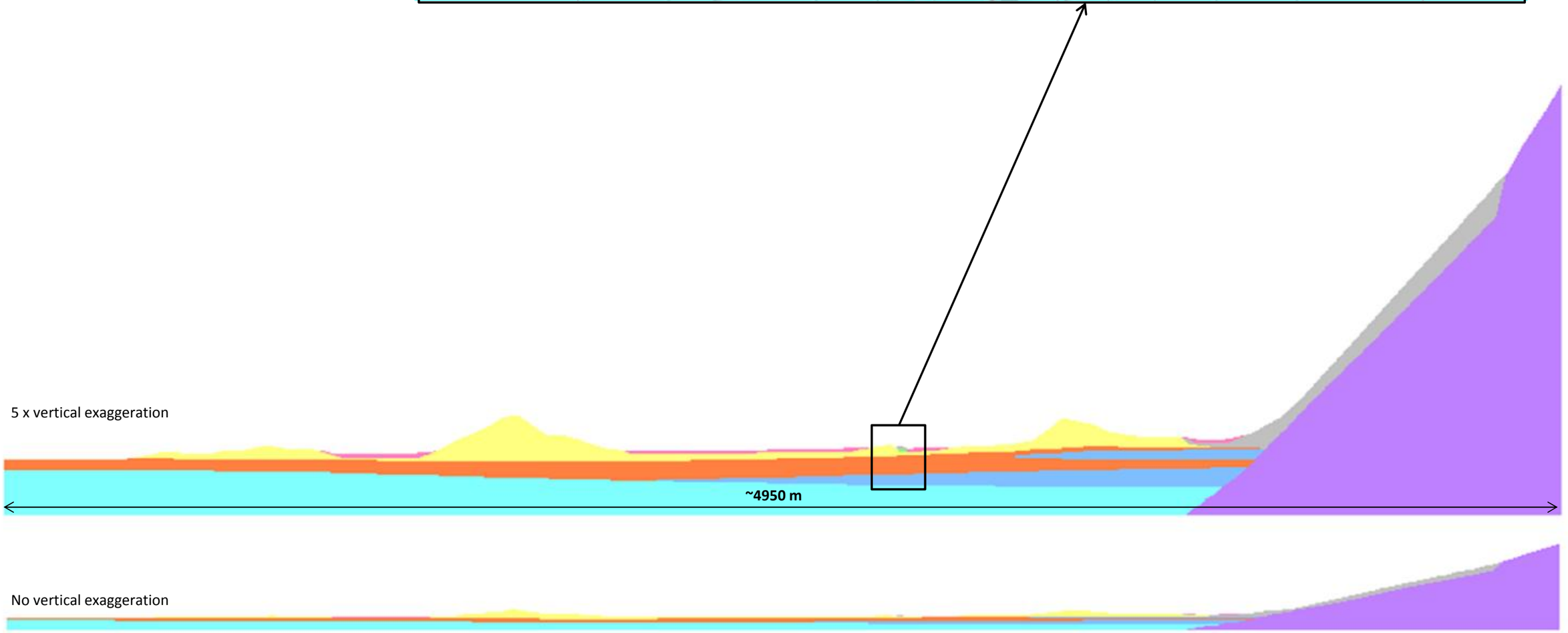




HYDROGEOLOGICAL UNIT

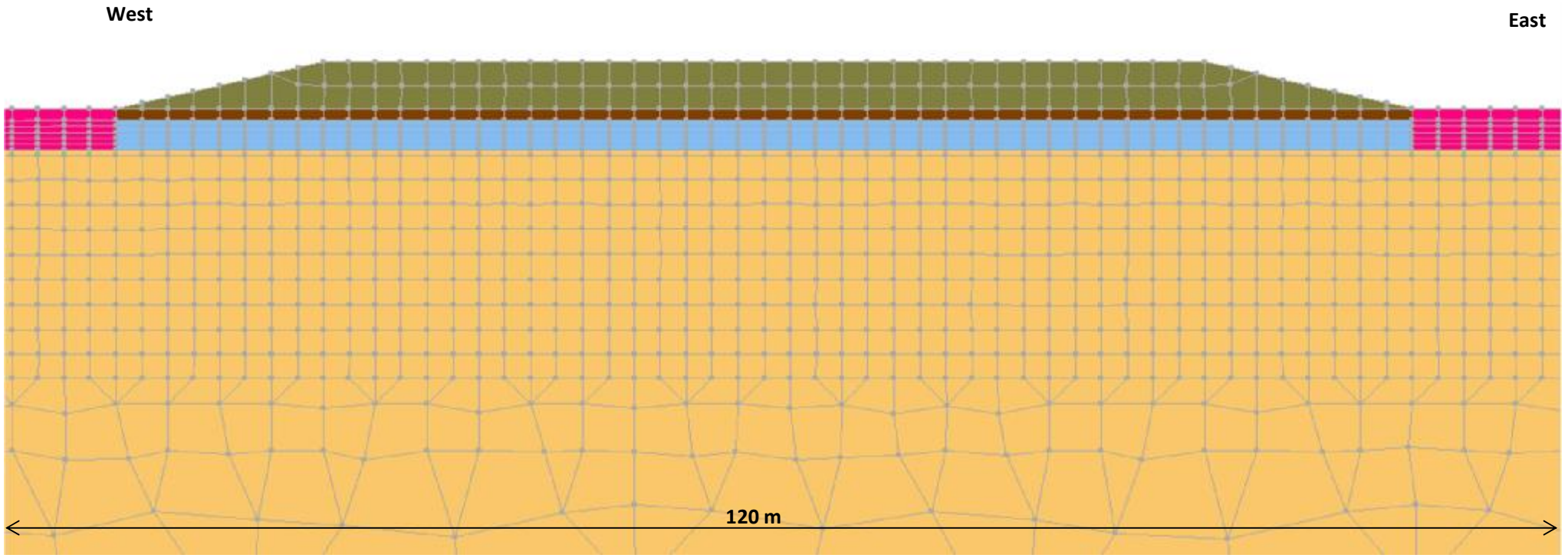
- Fill / Colluvium / Alluvium
- Holocene Peat
- Holocene Sand
- Upper Marine Sands
- Parata Gravel Aquifer
- Regression Alluvium
- Lower Marine Sands
- Waimeha Aquifer
- Greywacke
- Surcharged Peat





HYDROGEOLOGICAL UNIT

- Fill Embankment
- Holocene Peat
- Surcharged Peat
- Drainage Layer
- Marine Sands



Generic Model

Figure E1

ANNEXURE F – CORRECTED TABLE F13 (TECHNICAL REPORT 21)

Corrected Table F13: Wetland 9 – Modelled Water Balance (Transient)

Source / Sink	Transient Winter Conditions				Transient Summer Conditions			
	Natural		Constructed		Natural		Constructed	
	In (m^3/d)	Out (m^3/d)	In (m^3/d)	Out (m^3/d)	In (m^3/d)	Out (m^3/d)	In (m^3/d)	Out (m^3/d)
Storage	276	857.7	238.5	547.3	2392.9	207.6	2337	7.3
Constant Head	0	0	0	0	0	0	0	0
Rainfall Recharge	3143.2	0	2909	0	177.9	0	164.5	0
River Leakage	374.7	3113.3	374.6	3146.4	374.5	3116.2	374.6	3116.5
Drains	0	0	0	0	0	0	0	0
Wetland Ponds	0	0	1.5	1.04	0	0	1.5	1.00
General Heads	544	299.6	539.2	318	540.2	301.7	540.37	316.35
Domestic Abstraction	0	57.6	0	55.2	0	56	0	52.14
TOTAL	4337.9	4328.2	4062.8	4068	3485.5	3681.5	3418.00	3493.3
Discrepancy (Outflow – Inflow)	–9.7 m^3/d		5.2 m^3/d		196 m^3/d		75.3 m^3/d	
	–0.2 %		0.1 %		5.3 %		2.1 %	