

Before the Board of Inquiry  
Waterview Connection Project

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*in the matter of:* the Resource Management Act 1991

*and*

*in the matter of:* a Board of Inquiry appointed under s 149J of the Resource Management Act 1991 to decide notices of requirement and resource consent applications by the NZ Transport Agency for the Waterview Connection Project

Rebuttal evidence of **Tim Fisher (Stormwater and Streamworks)** on behalf of the **NZ Transport Agency**

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## **REBUTTAL EVIDENCE OF TIM FISHER ON BEHALF OF THE NZ TRANSPORT AGENCY**

### **INTRODUCTION**

- 1 My full name is Dr Timothy Simon Richmond Fisher. I refer the Board of Inquiry to the statement of my qualifications and experience set out in my evidence in chief (*EIC*) (dated 12 November 2010).
- 2 I repeat the confirmation given in that statement that I have read and agree to comply with the Code of Conduct for Expert Witnesses in the Environment Court.

### **PURPOSE OF EVIDENCE**

- 3 The purpose of this rebuttal evidence is to respond to certain aspects of the evidence lodged by submitters. Specifically, my evidence will respond to the evidence of:
  - 3.1 Haydon Easton/Auckland Council;
  - 3.2 Bronwyn Rhynd/Living Communities & Friends of Oakley Creek;
  - 3.3 Wendy John/Friends of Oakley Creek;
  - 3.4 Shona Myers/Living Communities & Friends of Oakley Creek;<sup>1</sup>
  - 3.5 Andrea Julian/Auckland Council;
  - 3.6 Neil Buchanen/KiwiRail;
  - 3.7 Mark Bellingham/Royal Forest & Bird Society;
  - 3.8 George Richardson;
  - 3.9 Pita Turei/Te Kawarau a Maki;
  - 3.10 Dr Allan Woolf.
- 4 In addition, I will comment on relevant aspects of the Section 42A Report prepared by Environmental Management Services (*EMS*) dated 7 December 2010 and Addendum dated 20 December 2010.
- 5 My rebuttal evidence addresses stormwater and streamworks issues **in the submitter's evidence only to the extent that those issues have**

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<sup>1</sup> My response to Ms Myers' evidence is incorporated into my responses to other witnesses who raise the same points (principally Ms John).

not already been addressed in Technical Report G.15 Assessment of Stormwater & Streamworks Effects, or in my EIC.

- 6 Given the degree of overlap between streamworks, freshwater ecology and (to the extent it relates to riparian planting) vegetation, my rebuttal evidence refers at various points to the caucusing statements of:
- 6.1 Stormwater expert witnesses,<sup>2</sup> which I attended and signed;
  - 6.2 Freshwater ecology expert witnesses,<sup>3</sup> which I attended and signed;
  - 6.3 Vegetation expert witnesses,<sup>4</sup> which I did not attend.
- 7 My rebuttal evidence also addresses questions from the Board of Inquiry in its *Minute from the Board to the Parties Concerning Important Matters that NZTA Should Respond To*.<sup>5</sup>

#### **HAYDEN EASTON/AUCKLAND COUNCIL<sup>6</sup>**

- 8 The evidence of Hayden Easton for Auckland Council (*Council*) is generally supportive of the stormwater management proposed for the Project. He recommends<sup>7</sup> three further consent conditions regarding the management of stormwater contaminants generated from the Project that have regard to:
- 8.1 The submission of wetland final design plans to the Council for approval;
  - 8.2 An inspection of all proposed wetlands two years after construction to determine the wetlands health; and
  - 8.3 The post construction monitoring of Polycyclic Aromatic Hydrocarbons (*PAHs*) for the discharges of stormwater from the Project to the Oakley Creek, Pixie Stream and Meola Creek for a period of three years followed by a review by the Council.

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<sup>2</sup> Statement of Agreement Reached in Caucusing by Timothy Simon Richmond Fisher, Bronwyn Patricia Rhynd and Hayden Russell Easton, 2 February 2011 (*Stormwater & Streamworks Joint Caucusing Statement*).

<sup>3</sup> Expert Caucusing Joint Report to the Board of Inquiry – Freshwater Ecology, 27 January 2011 (*Freshwater Joint Caucusing Statement*).

<sup>4</sup> Expert Caucusing Joint Report to the Board of Inquiry – Vegetation, 28 January 2011 (*Vegetation Joint Caucusing Statement*).

<sup>5</sup> Dated 28 January 2011.

<sup>6</sup> Hayden Easton (Evidence No.111-6).

<sup>7</sup> Easton Evidence, paragraph 3.2.

- 9 Mr Easton also notes<sup>8</sup> that the proposed stormwater condition SW6 requiring amendments to the Temporary Stormwater Management Plan (*TSMP*) to be approved by Auckland Council was included in my evidence in chief, but was struck out (deleted) in the compiled proposed conditions.<sup>9</sup> This condition has been deleted from the compiled conditions because the intention of SW6 to allow for a process for making amendments to the TSMP is already provided for in proposed conditions CEMP.12 and CEMP.13. These conditions provide for the CEMP and all sub plans including the TSMP. All parties in the stormwater expert caucusing agreed<sup>10</sup> that the proposed conditions that the proposed conditions CEMP.12 and CEMP.13 adequately address this issue.

### **Final design plans to the Council for approval**

- 10 I support **Mr Easton's suggestion that wetland final design plans be submitted to Council for approval.** I consider, however, that this is generally provided for in proposed stormwater condition SW12<sup>11</sup> that requires the detailed design and plans for all wetlands, as well as other treatment devices, structures, outfalls, and bypass devices be submitted to Council prior to construction.
- 11 **Mr Easton's** specific concern is that the best selection of wetland plants is made to reduce plant mortality during periods of drought. To address this specific concern (and to avoid doubt) the requirement for planting plans for stormwater treatment devices to be submitted for Council review and approval has been added to SW12.<sup>12</sup> All parties in the stormwater expert caucusing agreed<sup>13</sup> that the amended condition adequately addresses this issue.
- 12 A copy of the proposed stormwater conditions incorporating suggested amendments outlined in this rebuttal evidence is attached as **Annexure A.**

### **Inspection of wetlands two years after construction**

- 13 I support **Mr Easton's suggestion** that the proposed wetlands be inspected two years after construction to determine the health of the wetland. Regular monitoring and maintenance are planned and are described in the Operational Stormwater Management Plan.<sup>14</sup> **However, I understand Council's desire to have more confidence**

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<sup>8</sup> Easton Evidence, paragraph 3.3.

<sup>9</sup> Refer to 3<sup>rd</sup> Statement of Evidence in chief of Amelia Linzey, Annexure B, page 67.

<sup>10</sup> Stormwater & Streamworks Joint Caucusing Statement, refer to paragraph regarding Review Condition for TSMP.

<sup>11</sup> Refer to Annexure A.

<sup>12</sup> Refer to Annexure A.

<sup>13</sup> Stormwater & Streamworks Joint Caucusing Statement, refer to paragraphs regarding Final Design Plans to the Council for Approval.

<sup>14</sup> Refer to Appendix D in Technical Report G.15 Assessment of Stormwater and Streamworks.

that the proposed efficiencies for removal of stormwater contaminants using wetland treatment can be achieved on a longterm basis. I support this suggestion because it has been my experience that, there is mortality of plants over the first couple of years and that the performance of wetland may take several years to reach the design level as it takes this time for plants to mature and the organic content in sediments to accumulate. The consent condition suggested by Mr Easton<sup>15</sup> has been adopted with some clarifications and is included as SW21.<sup>16</sup> All parties in the stormwater expert caucusing agreed<sup>17</sup> that the amended condition adequately addresses this issue.

### **Monitoring of PAHs**

- 14 **I disagree with Mr Easton's suggestion** for post construction monitoring of PAHs with a limit of 15 mg/L for the discharges of stormwater from the Project. I do not believe there to be a need for PAH monitoring because PAH currently does not/nor is it expected to have, an adverse effect on the environment, and the stormwater treatment measures will remove the majority of total hydrocarbons and PAH. Further, the limit concentration suggested by Mr Easton is much higher than expected concentrations so there is little value in testing for it. These points are detailed below.
- 15 Dr De Luca<sup>18</sup> in her evidence comments on the low concentrations of observed PAHs in surface marine sediment samples throughout the CMA adjacent to the Project, where all but two samples revealed concentrations within the ERC-green range, i.e. unlikely to affect biota. These low concentrations have arisen under a regime where the existing run-off discharges untreated to the CMA, whereas stormwater treatment areas proposed for Sectors 1-5 of the Project will assist with ensuring that PAHs remain below effect threshold concentrations.
- 16 Reid and Timperley (2004)<sup>19</sup> undertook event-based sampling in Oakley Creek at Richardson Road and found 90% of samples had less than 0.2mg/L, which was the lowest of 5 streams compared. The Project initiated a water and sediment quality sampling programme for Oakley Creek, which started in November 2009. After three rounds of monthly frequency sampling of PAH and TPH in the water none had been detected<sup>20</sup> and sampling for these

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<sup>15</sup> Easton Evidence, paragraph 5.1(b).

<sup>16</sup> Refer to Annexure A.

<sup>17</sup> Stormwater & Streamworks Joint Caucusing Statement, refer to paragraph regarding Inspection of Wetlands Two Years After Construction.

<sup>18</sup> Refer to Evidence in Chief of Dr De Luca, at paragraph 69.

<sup>19</sup> Reid, J. and M. Timperly (2004) Stream flow and stormflow water quality monitoring: Oakley Creek and Whau River. Prepared for Metrowater and Auckland City Council by NIWA.

<sup>20</sup> Detection limits for PAH between 0.0003 and 0.0005 mg/L. Detection limits for TPH 0.7 mg/L.

parameters was stopped. PAH in sediments has been detected in two of nine samples.

- 17 Mr Easton suggests a consent condition<sup>21</sup> for monitoring of PAH with a limit of 15 mg/L. It appears this limit is derived from the MfE (1998) *Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand* which are referenced<sup>22</sup> in Mr Easton's evidence. The Proposed Auckland Regional Plan: Air Land and Water (*PARP:ALW*) does not set any standards for PAH. Nor does ARC Technical Publication No. 10 Stormwater Management Devices: Design Guidelines Manual (TP10) (despite this standard **also being referenced in Mr Easton's evidence**<sup>23</sup>). The MfE (1998) limit was established as the maximum level of contaminants allowable in stormwater systems which discharge into the environment. MfE (1998) is a guidance document for owners and managers of petroleum industry sites (e.g. service stations, truck stops, terminals and depots and manufacturing plants). I would expect to have much lower concentrations of PAH/TPH in runoff from the motorway as I explain in paragraph 20 below.
- 18 Furthermore, MfE (1998) specifies a limit of 15 mg/L for total petroleum hydrocarbon (TPH) with no limit specified for PAH. PAH is a subgroup of TPH and occurs at much lower concentrations than TPH. Therefore the numerical value for TPH is not appropriate to be used as limit value for PAH and should not be used for a consent condition
- 19 The ANZECC (2000)<sup>24</sup> guidelines are widely adopted for water quality and would be a reasonable basis for water quality standards if they were applied to this Project. However the ANZECC guidelines do not include values for PAH<sup>25</sup> indicating there is insufficient data for a reliable trigger value.
- 20 Recent research has been undertaken by Moores et al (2010)<sup>26</sup> into the quality of stormwater from the State highway network and the effectiveness of stormwater treatment devices. Sampling sites were SH18 at Westgate, SH1 Northern Motorway at Northcote, SH16 at Huapai and SH1 Northern Motorway at Redvale. The non-detection of TPHs in the stormwater runoff was a feature of the results. TPHs

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<sup>21</sup> Easton Evidence, paragraph 5.1(c).

<sup>22</sup> Easton Evidence, paragraph 4.7.

<sup>23</sup> Ibid.

<sup>24</sup> ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

<sup>25</sup> ANZECC (2000) does not include a limit for total PAH. It does include limits for Naphthalene at 0.0025 to 0.12 mg/L. It lists Anthralene, Phenanthrene, Fluoranthene and Benzo(a)pyrene but notes that there is insufficient data for a reliable trigger value.

<sup>26</sup> Moores, J, P. Pattenson and C. Hyde (2010). Enhancing the control of **contaminants from New Zealand's roads: results of a road runoff sampling programme**. NIWA for New Zealand Transport Agency, Report 395.

were measured above the detection limit of 0.7 mg/L in 3 of 6 rainfall events at Westgate and 1 of 7 events at Huapai, but not for any rainfall events at SH1 Northcote (7 events) or SH1 Redvale (8 events). **O'Riley et al (2002) undertook water quality sampling of stormwater at a urban roundabout at River Road and Wairere Drive, Hamilton.** They found PAH<sup>27</sup> in concentrations of up to 0.0025 mg/L. Williamson (1991) suggested an event mean concentration<sup>28</sup> of 1-5 mg/L for TPH and 0.007 mg/L for PAH for general urban landuse. It can be seen from the observed values from Auckland state highways and motorways, supported by other New Zealand data, that TPH and PAH occur at much lower concentrations in road runoff than the proposed limit of 15 mg/L. Therefore, for the Project, where stormwater treatment will be provided and is likely to remove the majority of TPH and PAH, there is no need for monitoring of these contaminants.

- 21 Finally, I note that a comprehensive water monitoring programme being undertaken by NZTA for Oakley Creek covering water quality, flow and ecology.<sup>29</sup> The water quality aspects of this programme have not been made clear in the application to date. Mr Leersnyder in his rebuttal provides additional detail on the water quality monitoring programme. It includes for hydrocarbons in sediment and hydrocarbons in the water for event based sampling.<sup>30</sup> I also note that PAH is being monitored as part of the marine ecological monitoring described by Sharon De Luca.<sup>31</sup>
- 22 The issue of post construction monitoring of hydrocarbons was discussed in the stormwater expert caucusing. Through this process Mr Easton and I have concurred that the request for manual grab sampling of Polycyclic Aromatic Hydrocarbons (PAH) post construction is not warranted. This agreement has been achieved through discussion of literature and findings from Moores et al. (2009),<sup>32</sup> presented by me during the caucusing session. Agreement was reached by all the stormwater experts that PAH concentrations within the stormwater discharge from the proposed stormwater

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<sup>27</sup> PAH sum of pyrene, phenanthrene and fluoranthene, other PAHs not sampled. Pyrene contributed 60% of the PAHs.

<sup>28</sup> Event mean concentration is a flow-weighted mean concentration calculated by **dividing the storm (the "event") mass by the storm volume.**

<sup>29</sup> Summarised in the Technical Report G.21, Construction Environmental Management Plan (*CEMP*), Appendix P.

<sup>30</sup> Refer to Rebuttal evidence of Hugh Leersnyder, paragraphs related to water quality monitoring.

<sup>31</sup> Refer to the Evidence in Chief of Sharon De Luca, Annexure D, Condition M.4 (c), which states "Sampling of the sediment surface (top 2 cm) for sediment quality (analysis of the concentration of copper, lead, zinc and polycyclic aromatic hydrocarbons)".

<sup>32</sup> Moores J, P Pattinson and C Hyde (2009) Enhancing the control of contaminants **from New Zealand's roads: results of a road runoff sampling programme.** New Zealand Transport Agency research report 395. 161pp.



treatment devices are anticipated to have no more than a minor environmental effect.<sup>33</sup>

### **BRONWYN RHYND/FRIENDS OF OAKLEY CREEK AND LIVING COMMUNITIES<sup>34</sup>**

- 23 The evidence of Bronwyn Rhynd for Friends of Oakley Creek and Living Communities is generally supportive of the stormwater management measures proposed for the Project. Ms Rhynd notes<sup>35</sup> a number of issues that require greater certainty through consent conditions. **Ms Rhynd's** recommendations are listed below with my responses to follow:
- 23.1 Conditions of consent to include the level of treatment to be 75% suspended solid removal (in Sectors 7 to 9) on a long **term average basis with reference to ARC TP10's latest** technical reviews.
  - 23.2 Conditions of consent to reflect the need to design the outfall structures for the critical storm event. It is noted, but not recommended for consent condition, that the aesthetic design of the outfall structures also need to be considered.
  - 23.3 The offset mitigation for the loss of Oakley Creek stream bed is to be undertaken both upstream and downstream of the re-alignment works.
  - 23.4 That wastewater mains and overflows to the Oakley Creek need to be maintained during and post construction.
  - 23.5 That the Urban Design and Landscape Plan include a rehabilitation plan for sub soil strata within construction yards.

### **Condition of consent to reference level of treatment and ARC TP10's latest technical reviews**

- 24 Ms Rhynd<sup>36</sup> recommended that the conditions of consent should require the level of treatment in Sectors 7 to 9 to be 75% suspended solid removal on a long term average basis, with **reference to ARC TP10's latest technical reviews**. While this was partially covered in proposed conditions SW.10, to avoid doubt it was agreed by the stormwater experts<sup>37</sup> to add a summary table to

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<sup>33</sup> Stormwater & Streamworks Joint Caucusing Statement, refer to paragraph related to Post Construction Monitoring of Hydrocarbons.

<sup>34</sup> Bronwyn Rhynd (Evidence No. 167 & 179-1).

<sup>35</sup> Rhynd Evidence, paragraphs 10.2-10.10.

<sup>36</sup> Rhynd Evidence, paragraphs 4 and 10.1-10.2.

<sup>37</sup> Stormwater & Streamworks Joint Caucusing Statement, refer paragraph regarding Clarity of Conditions for Level of Stormwater Treatment.

the conditions, with levels of stormwater treatment and areas for each Sector of the Project.

- 25 It was also agreed that reference to ARC TP10 (2003) or subsequent revisions was not necessary because the level of treatment was the important issue, and how it was achieved did not need to be written into the consent condition.
- 26 Finally, it was agreed by all parties that proposed condition SW.12 provided adequate controls over the details of the design. The revised SW10 is included in Annexure A.

**Design outfall structures for the critical storm event**

- 27 Ms Rhynd recommended<sup>38</sup> that the design of energy dissipation and erosion protection be assessed for various rainfall events to ensure that the critical storm event is considered by the design. This has not been done at this stage as we are only at the consent level of design, but it would be my expectation that this would be done at the detailed and construction stages of design. To provide more confidence to the submitter on this issue I propose modifying condition SW.19 to explicitly include this requirement.
- 28 I have also modified SW.19 to allow for energy dissipation as well as erosion protection, as in my opinion energy dissipation prior to discharge is preferable to discharge of higher velocity stormwater that would necessitate erosion protection measures.
- 29 The proposed changes to condition SW.19 have been agreed<sup>39</sup> by the stormwater experts in caucusing.
- 30 The concern expressed by Ms Rhynd regarding the aesthetic aspects of stormwater outfalls discharging to Oakley Creek has been addressed by strengthening condition STW.1 to include a reference to the Oakley Creek Re-alignment and Rehabilitation Guidelines.<sup>40</sup> This will benefit the design of the streamworks generally by linking it to the vision for the design expressed in the guidelines. The proposed change<sup>41</sup> to condition STW.1 have been agreed<sup>41</sup> by the stormwater expert caucus group.
- 31 A copy of the proposed streamworks conditions incorporating suggested amendments outlined in this rebuttal evidence is attached as **Annexure B**.

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<sup>38</sup> Rhynd Evidence, paragraph 5.

<sup>39</sup> Stormwater & Streamworks Joint Caucusing Statement, refer paragraphs regarding Design Outfall Structure for the Critical Storm Event.

<sup>40</sup> Appendix C to Technical Report G.6 Assessment of Freshwater Ecological Effects.

<sup>41</sup> Stormwater & Streamworks Joint Caucusing Statement, refer paragraphs regarding Design Outfall Structure for the Critical Storm Event.

### **Offset Mitigation for Stream Realignment**

- 32 Ms Rhynd<sup>42</sup> is concerned about the location and extent of offset mitigation works. The detailed response to this concern is set out in the rebuttal evidence of Mr Eddie Sides, the Projects Freshwater Ecologist. However, I note that the issue was discussed in the freshwater ecology expert caucusing, resulting in agreement<sup>43</sup> to include a new condition STW.20A. This revised condition is included in Annexure B to this statement.

### **Wastewater Mains Requiring Relocation in Sector 9**

Ms Rhynd<sup>44</sup> noted that wastewater mains and overflows to the Oakley Creek need to be maintained during and post construction. In stormwater caucusing<sup>45</sup> the issue of service relocations was discussed and it was agreed that the issue was a wider issue than just the wastewater services in Sector 9. It was agreed by all parties that the relocation of wastewater mains and other services is outside the scope of the experts in the stormwater caucusing.

### **Rehabilitation Plan for Sub Soil Strata**

- 33 Ms Rhynd<sup>46</sup> is concerned that the reinstatement of construction yards, once they have been decommissioned, may have compacted sub-soils that reduce the infiltration of rainfall and increase the runoff volume. This is valid concern and has the potential to cause a minor effect from the increase in runoff volume. The likely solution is the tilling of subsoils and the reinstatement of topsoils as part of the site rehabilitation.
- 34 I support Ms Rhynds suggestion of a condition of consent requiring rehabilitation of the sub soil strata. While the effect is hydrological, the best place to include this condition is in the conditions associated with landscape issues, and for the work to be included in the proposed Urban Design and Landscape Plans. I proposed the following condition LV.9 to the stormwater experts in caucusing who agreed with it. The additional condition is noted in the rebuttal evidence of Ms Lynne Hancock.

*The NZTA shall ensure that open space areas affected by construction activities have sub-soil rehabilitated and top-soil replaced so that the hydrological response including the volume of stormwater runoff generated is as close as practicable to the predevelopment situation. The methodologies to achieve this shall be documented in the UDLP.*

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<sup>42</sup> Rhynd Evidence, paragraphs 6, 9.6-9.7 and 10.5 and 10.6.

<sup>43</sup> Freshwater Joint Caucusing Statement, paragraph 11.

<sup>44</sup> Rhynd Evidence, paragraphs 7 and 10.7-10.8.

<sup>45</sup> Stormwater & Streamworks Joint Caucusing Statement, refer paragraphs regarding Wastewater Mains Requiring Relocation.

<sup>46</sup> Rhynd Evidence, paragraphs 8,9.8-9.9 and 10.9-10.10.

## **WENDY JOHN/FRIENDS OF OAKLEY CREEK<sup>47</sup>**

### **Cumulative hydrological effects from Project in addition to Mt Roskill section SH20 and Maioro Street project**

- 35 In her evidence on behalf of the Friends of Oakley Creek (*FOOC*), Ms John<sup>48</sup> is concerned about the cumulative loss of floodplain and increase in impervious surface areas from the Project in addition to the Mt Roskill and Maioro interchange sections of SH20.
- 36 I note the Maioro interchange is partially covered by Mt Roskill consents and partially covered by stormwater management proposed for the Project. The Mt Roskill section of SH20 has standalone resource consents<sup>49</sup> that require a similar level of stormwater mitigation<sup>50</sup> as proposed for the Project.
- 37 There will be a cumulative effect from the increase in runoff volume due to SH20. In my opinion however, adverse effects will be adequately mitigated, by the stormwater treatment devices for Mt Roskill section (SH20) and in Sector 9 of the Project that attenuate peak flows to pre-development levels for events up to the 100 year Average Recurrence Interval (ARI) event.
- 38 The effects on the Oakley floodplain from the Mt Roskill section were negligible because the motorway was designed to be outside the stopbanks of Oakley Creek<sup>51</sup> therefore the Mt Roskill motorway did not alter the floodplain or flood risk in anyway. The effects on the floodplain due to the Maioro interchange project were assessed as part of the current Project. There is no cumulative effect from changes to the floodplain from Mt Roskill, Maioro and the Project parts of SH20.
- 39 As an aside, I also note that the proposed tunnel will significantly reduce potential stormwater generation as it will result in less impermeable surface area in the catchment, compared with a surface motorway.

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<sup>47</sup> Wendy John (Evidence No. 179-1).

<sup>48</sup> John Evidence, paragraph 4.4.

<sup>49</sup> SH20 Mt Roskill and Royal Oak catchment consents: Auckland Regional Council Resource Consent Permit No. 31073, 31075, 31077.

<sup>50</sup> Personal communications with Ben Chester (URS), Civil/Stormwater designer for SH20 Mt Roskill project. SH20 Mt Roskill resource consents and AEE require attenuation of runoff from new impervious surfaces for the 2, 10 and 100 year ARI storm to the predevelopment levels, with stormwater treatment in accordance with TP10.

<sup>51</sup> Personal communications with Ben Chester (URS), Civil/Stormwater designer for SH20 Mt Roskill project.

### **Stormwater standards**

- 40 Ms John<sup>52</sup> seeks a higher standard of stormwater treatment for Sectors 6-9. The proposed standard of 75% total suspended solids (TSS) removal on a long term average basis is consistent with the requirements of the PARP:ALW ARC TP10. Further, the effects of the additional stormwater on Oakley Creek has been assessed by Mr Sides as *"unlikely to have significant adverse ecological effects"*<sup>53</sup> meaning further treatment is not required.
- 41 Ms John,<sup>54</sup> on the issue of treatment devices to achieve 80% TSS removal, paraphrases me as saying that **"larger treatment wetlands would result in an unacceptable loss of open space"**. This misrepresents the point I was making. **What I actually said was "An increase in treatment device size would leave less space available for other Project mitigation including open space replacement"**.<sup>55</sup>
- 42 For example, in the case of the Valonia Street (Goldstar) area, Ms John suggests this area should accommodate larger wetlands and floodplain storage rather than the proposed sports fields. However, the Valonia area is required not just for sports fields but also for flood storage (that is, in extreme flood events, the sports fields will provide additional flood storage). Stormwater treatment wetlands are necessarily separate from (and raised above) general floodplains so an increase in the size of the stormwater wetland to enable 80% TSS removal could potentially result in reduced flood storage, not more as Ms John appears to believe.
- 43 Larger wetlands with higher levels of TSS removal are possible. However, in summary, **I don't believe larger wetlands** are necessary in Sector 9 for the following reasons:
- 43.1 As noted in my EIC<sup>56</sup> the optimal sizing is for 75% TSS removal.
- 43.2 Larger wetlands take up more space in an area where open space mitigation and flood storage is already a key issue.
- 43.3 The level of treatment meets the PARP:ALW and TP10 guidelines.
- 43.4 As per the evidence of Mr Sides, the percentage increase in impermeable surface area in this urbanised catchment at just 0.78% of the Oakley catchment is small and has treatment unlike most other impervious surfaces.

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<sup>52</sup> John Evidence, paragraph 5.3.

<sup>53</sup> Refer to Evidence in Chief of Eddie Sides, paragraph 55.

<sup>54</sup> John Evidence, paragraph 5.4.

<sup>55</sup> Refer to my evidence in chief, paragraph 123.

<sup>56</sup> Refer to my EIC, paragraph 123.

43.5 Mr Sides, the **NZTA's** expert freshwater ecologist, does not believe the stormwater discharges to have significant adverse ecological effects, so further treatment is not warranted.

44 I would also like to reiterate here that other stormwater experts, Mr Easton of Auckland City and **the Friends of Oakley Creek's own** expert Ms Rhynd, support the level of stormwater treatment that is proposed for the Project. Mr Easton notes the 75% removal of TSS removal as meeting **PARP:ALW requirements**, with 80% TSS removal proposed for Sectors 1-5 exceeding it. He acknowledges the applicant's commitment made to address the effects of stormwater contaminants in a highly sensitive receiving environment.<sup>57</sup> Ms Rhynd wants to strengthen the consent conditions to reflect the design principle of 75% TSS removal on a long term average basis, which has been addressed previously in this statement.

45 The level of stormwater treatment was discussed by the stormwater experts in caucusing and it was agreed<sup>58</sup> that the level of stormwater treatment (quality and quantity) that has been proposed for the Project is appropriate.

#### **Increasing the area of wetland restoration in Sector 9**

46 As noted above, Ms John<sup>59</sup> requests that the wetland at 25 Valonia St (Goldstar) site be increased in area to reinstate the wetland that historically occurred at this site. Ms Myers<sup>60</sup> in her evidence on behalf of FOOC makes a similar point. Mr McKay<sup>61</sup> also suggests that this area be allowed to revert to its natural wetland state. This point was previously addressed in my EIC<sup>62</sup> and that of Mr Little<sup>63</sup> in which the change of use of the Goldstar property (25 Valonia Street) from a (consented) proposed housing development (which would have significantly reduced flood storage), to open space is central to the open space strategy.

47 Ms John<sup>64</sup> says that if the NZTA intends to divest the property<sup>65</sup> that it holds bordering Bollard Avenue, Oakley Creek and the proposed motorway, then this area should be added to calculations for stormwater treatment capacity. I disagree as the Project does not

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<sup>57</sup> Easton Evidence, paragraph 4.1.

<sup>58</sup> Stormwater & Streamworks Joint Caucusing Statement, **refer to the "General Statement" section.**

<sup>59</sup> John Evidence, paragraph 5.6 to 5.8.

<sup>60</sup> Shona Myers (Evidence No. 167 & 179-2) paragraph 5.25.

<sup>61</sup> Bill McKay (Evidence No. 185-1) paragraphs 6.8.4 and 8.8.

<sup>62</sup> Refer to my EIC, paragraph 92, 131-136.

<sup>63</sup> Refer to Evidence in Chief of David Little, paragraphs 20, 53.

<sup>64</sup> John Evidence, paragraph 6.11.

<sup>65</sup> Refer to F.16 Urban Design and Landscaping Plans, Drawing 20.1.11-3-D-L-810-222, Rev B, where the area is depicted with a notation "M3".

propose any change of landuse for the land, so there is no effect to mitigate. Furthermore, I consider that it would be better to develop site specific stormwater treatment that is integrated with the final landuse, especially the intended impervious cover, should the landuse change. Without knowing what the final landuse will be it is not sensible to design or provide for stormwater treatment. Furthermore, the distance from the far end of the site (north-east corner) to the Valonia wetland (TD9B) is likely to preclude the use of this wetland to treat the property. Should a development occur in the future, then the *PARP:ALW* requires that stormwater treatment be considered, so it can and should be assessed at that time.

### **Re-creation of cascade in Stoddard Road Tributary to Oakley Creek**

- 48 Ms John<sup>66</sup> seeks re-creation of the natural cascade currently at the junction of Oakley Creek and its tributary, which is a section of stream proposed for realignment.<sup>67</sup> Ms Myers<sup>68</sup> also notes this “small natural basalt rock waterfall at the confluence with Oakley Creek”, and requests consideration of options for this realignment to be avoided.
- 49 I note that the Stoddard Road tributary at this location is straight and likely to be manmade as part of drainage works to drain the historical wetland in this area. Oakley Creek is also in a manmade channel at this location. Therefore the cascade that connects this manmade Stoddard Road tributary to the manmade Oakley Creek, is also likely to be manmade, although formed in natural rock.
- 50 There is a Watercare sewer upstream of the cascade that is at a shallow level. The top of the pipe is estimated to be 100-200 mm under the stream bed of the Stoddard Road tributary. Therefore, the realignment of this section of the Stoddard Road Tributary will need to have a similar vertical alignment, including a **drop “cascade”** between the sewer crossing and the confluence. For this reason the cascade will be re-created in the realigned Stoddard Road tributary.
- 51 The requirement for the recreation of the cascade was discussed with the freshwater ecology experts during caucusing. It was agreed<sup>69</sup> to specify this requirement with an additional sentence in STW.20(c) (refer **Annexure B**). This change is also noted on drawing 20.1.11-3-D-D-300-118 Rev D,<sup>70</sup> which is attached to this evidence as **Annexure C**.

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<sup>66</sup> John Evidence, paragraphs 11.3 to 11.4.

<sup>67</sup> Refer to my report, Technical Report G15, Appendix A, Drawing 20.1.11-3-D-D-300-118.

<sup>68</sup> Myers Evidence, paragraph 5.24.

<sup>69</sup> Freshwater Joint Caucusing Statement, paragraph 9.

<sup>70</sup> Refer to Annexure D.

### **Basalt columns in Oakley Creek**

- 52 Ms John<sup>71</sup> also seeks re-creation of the basalt columns downstream of the tributary on the basis of their heritage value. She notes that **these resulted from creation of the channel in the 1930's by** blasting. The location of basalt columns have been mapped, and a copy of that map is attached as **Annexure D**. There are a number of locations where broken columnar basalt outcrops occur in the channel bank and two locations where the basalt columns are better formed. NZTA heritage expert Mr Clough<sup>72</sup> does not consider them to be historic heritage features. The NZTA geology expert Ms Williams<sup>73</sup> does not consider them to have geological value.
- 53 Despite the basalt columns having low heritage and geological value, they are nonetheless a feature, so should be retained if possible. **Columnar basalt "A" is at a location where stream** rehabilitation is proposed. At this location the columnar basalt will be retained with details developed at the detailed design stage. **However, columnar basalt "B" is at a location where Oakley Creek is** proposed to be realigned to accommodate the proposed sportfields. Without the stream realignment at this location there is insufficient room for the sports fields. Therefore, at this location the columnar basalt will not be retained. NZTA urban design expert Lynne Hancock<sup>74</sup> describes the landscape treatment of the retained **Columnar basalt "A"** in her rebuttal evidence.

### **Stream realignment to be natural**

- 54 Ms John<sup>75</sup> also requests that stream realignments, if necessary, have soft-streambeds of a muddy-bottom type stream, and that natural plant-based material should be used to slow the water and provide habitat. Ms Myers<sup>76</sup> makes a similar point that materials used for stream realignments reflect the geology and soft-bottom nature of the stream. I believe this concern is addressed by strengthening of condition STW.1 to include a reference to the principles of the Oakley Creek Re-alignment and Rehabilitation Guidelines. This approach was suggested by Ms Myers.<sup>77</sup> This approach was agreed<sup>78</sup> by the freshwater ecology expert caucusing group. It was agreed at the same time that Ms Myers request<sup>79</sup> for the stream rehabilitation to be supervised by a fresh water ecologist was already adequately covered by STW.1.

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<sup>71</sup> John Evidence, paragraphs 11.10-11.11.

<sup>72</sup> Clough rebuttal evidence, refer paragraphs 21 to 22.

<sup>73</sup> Williams rebuttal evidence, refer paragraphs 24 to 26.

<sup>74</sup> Hancock rebuttal evidence, refer paragraphs 17.

<sup>75</sup> John Evidence, paragraph 11.12.

<sup>76</sup> Myers Evidence, paragraph 5.19.

<sup>77</sup> Myers Evidence, page 21.

<sup>78</sup> Freshwater Joint Caucusing Statement, paragraph 8.

<sup>79</sup> Myers Evidence, page 21.



- 55 Ms Myers<sup>80</sup> usefully suggests that practical experience with stream restoration in other urban streams in Auckland should be used to guide this Project. It would be my expectation that any design team would be sufficiently experienced and/or use local experience in stream restoration. The Streamworks conditions provide adequate controls over the quality of stream diversion:
- 55.1 STW1 (now) refers to the proposed design and Oakley Creek Re-alignment and Rehabilitation Guidelines.
  - 55.2 STW2 refers to procedures for approval of amendments by Auckland Council.
  - 55.3 STW4 requires pre-construction meetings with Auckland Council, NZTA and primary contractor.
  - 55.4 STW5 requires Auckland Council approval of construction design details.
  - 55.5 STW15 requires monitoring of the streamworks construction by the design engineer and Project ecologist to monitor construction. Also it requires that an appropriately qualified and experienced engineer and ecologist certify that the streamworks have been constructed in accordance with the approved design.

#### **ANDREA JULIAN/AUCKLAND COUNCIL**<sup>81</sup>

##### **Riparian Planting of Oakley Creek**

- 56 The issue of riparian planting was raised by Dr Julian<sup>82</sup> with related concerns from Ms Myers.<sup>83</sup> I note the outcomes from the vegetation expert caucusing<sup>84</sup> where agreement was reached on the issue of 70% shading of Oakley Creek because this resulted in an amendment to STW.20(d). The revised condition is included in Annexure B.

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<sup>80</sup> Myers Evidence, paragraph 5.19.

<sup>81</sup> Andrea Julian (Evidence No. 111-12).

<sup>82</sup> Julian, paragraph 9.1.

<sup>83</sup> Myers Evidence, paragraph 5.23.

<sup>84</sup> Vegetation Joint Caucusing Statement.

**NEIL BUCHANAN/KIWIRAIL GROUP<sup>85</sup>**

57 Mr Buchanan submits<sup>86</sup> that if the Avondale / Southdown rail line is constructed it will need to utilise the same stormwater network as provided for the Project. He requests that appropriate conditions be imposed so that stormwater has regard for the potential Avondale / Southdown line.

58 In response, I note that that stormwater design already has provision for stormwater drainage across the railway corridor in Section 9. The Hendon Avenue Swale<sup>87</sup> located along the edge of the railway designation has been designed to intercept overland flow from the Hendon Avenue area. This swale discharges into two culverts, which also connect to local stormwater pipes. These culverts are aligned under the railway corridor and motorway and discharge to Oakley Creek. Condition SW.8 requires that overland flow paths are not blocked the by the Project. Stormwater treatment is not provided for the future railway land use, as the railway line is not part of the Project.

**MARK BELLINGHAM/ROYAL FOREST & BIRD SOCIETY<sup>88</sup>****Contaminant Loads**

59 Dr Bellingham<sup>89</sup> raises the issue of contaminant loads and whether the proposed stormwater treatment provides a net improvement with increase of traffic. This point was addressed in my EIC<sup>90</sup> which summarised work by NIWA<sup>91</sup> and evidence of Jonathon Moores.<sup>92</sup> The contaminant load modelling demonstrates that total suspended solids, Zinc and Copper loads estimated for 2016 and 2026 (using traffic volumes at those times) are 20%-40% lower for the SH16 sections of the Project with its stormwater improvements compared to the those predicted for the existing motorway in those years.

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<sup>85</sup> Neil Buchanan (Evidence No. 164-1).

<sup>86</sup> Buchanan, paragraph 3.5(d).

<sup>87</sup> Refer to Technical Report G.15, Appendix A, Drawings 20.1.11-3-D-D-300-117 and 118.

<sup>88</sup> Dr Mark Bellingham (Evidence No. 217-2).

<sup>89</sup> Bellingham Evidence, paragraphs 18d-e.

<sup>90</sup> Refer to my EIC, paragraphs 34, 35 and 112.

<sup>91</sup> Technical Report G.30 – Assessment of Associated Sediment and Contaminant Loads.

<sup>92</sup> Refer to EIC of Jonathon Moores, paragraph 21 and 29.

### **GEORGE RICHARDSON**

- 60 Mr Richardson in his evidence on behalf of Townscape Securities Auckland Ltd, raises<sup>93</sup> a concern about the effect of the tunnel construction on the stormwater treatment systems of 1510 Great North Road. Stormwater services that are affected by construction of the tunnel will be repaired to their pre-construction state or better.

### **PITA TUREI/TE KAWARAU A MAKI**

- 61 Pita Turei<sup>94</sup> requests opportunity to review and enhance stormwater management to provide for biodiversity, cultural practice and mauri associated with waterways. No concerns regarding the proposed **stormwater and streamworks are noted**. NZTA's planning expert Amelia Linzey addresses community involvement during the Project.<sup>95</sup>

### **ALLAN WOOLF**

- 62 Dr Woolf<sup>96</sup> brings the Boards attention to the grill that was previously installed at the entrance to the Bollard overflow culvert. He notes that this lead to significant blockages, that held back water and bent the grill. He seeks assurances that the grill will not be re-installed. NZTA do not have any control over the culvert as this is an Auckland Council asset.
- 63 Dr Woolf also raises a concern<sup>97</sup> that the motorway and possible reinstatement of the culvert grill will cause the probability of flooding of his house at 34B Bollard Avenue to be high. The flooding assessment and mitigation of stormwater effects has been extensively covered in my EIC and Technical Report G.15.
- 64 In terms of the specifics of the house at 34B Bollard Avenue, Dr Woolf says that the house was built 1.4m above the 100 year ARI flood level of 37.8 mRL (his memory based on the previous Beca report), which would make the floor level of 34B Bollard Avenue to be 39.2 mRL. Actually the Beca (1998)<sup>98</sup> Report concluded that the flood level at this location is 38.4 mRL, which would make the floor level of 34B Bollard Avenue to be 39.8 mRL. The water level for the 100 year ARI event at this location from the Catchment Model increases slightly as a result of the Project, from 37.49 mRL to

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<sup>93</sup> George Richardson (Evidence No. 101-1), page 3.

<sup>94</sup> Pita Turei (Evidence No. 241-1) item 8d.

<sup>95</sup> Refer to planning rebuttal evidence of Amelia Linzey.

<sup>96</sup> Allan Woolf (Evidence No. 234-1) section 3.

<sup>97</sup> Ibid.

<sup>98</sup> Beca (1998) Stormwater Management Plan, Report No. 5, Oakley Stormwater Comprehensive Management Plan, Appendix A 1% AEP Flood Plain, Drawing 20213/082.

37.57 mRL, an increase of 0.08m. This effect has been noted previously.<sup>99</sup> The floor levels of 34B Bollard Avenue, based on either Dr Woolf's recollection or the actual Beca (1998) flood level plus the 1.4 m height from Dr Woolf, appear to be well above the 100 year ARI flood level, which includes allowances for maximum probable development and climate change.

### **COMMENT OF SECTION 42A REPORT(S)**

- 65 The Section 42A<sup>100</sup> report notes that the stormwater treatment is in accordance with TP10 and recognises the improvement in overall treatment level to be a positive outcome for the Project.
- 66 The Section 42A reports notes that Oakley Creek habitat will be materially improved.<sup>101</sup>
- 67 The Section 42A report notes a submitter concern regarding the effects from flooding on a septic tank at 7 Bollard Avenue.<sup>102</sup> This point is highlighted for consideration in the Section 42A Addendum report.<sup>103</sup> This issue was addressed in my EIC.<sup>104</sup> My investigations concluded that changes in peak flows and water level in Oakley Creek at this location from the Project are negligible. Therefore the effect of the Project on this property in terms of water levels, flows, erosion and the performance of the septic tanks will be no more than minor. The effect from tunnel settlement on the performance of the septic tank is addressed in the rebuttal evidence of Gavin Alexander.<sup>105</sup>
- 68 Dr Gregory Ryder<sup>106</sup> recommends that the minimum stormwater treatment device efficiency be specified in the consent conditions. This has been addressed in the changes to SW.10, which have been previously addressed in paragraph 24.

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<sup>99</sup> Technical Report G.15, page 166, paragraph 3 and Table 8.7.

<sup>100</sup> Section 42A report by Environmental Management Services, 7 December 2010, paragraphs 10.2.28 (Sector 1), 10.3.13 (Sector 2), 10.4.12 (Sector 3), 10.5.15 (Sector 4), 10.6.27 (Sector 5), 10.7.14 (Sector 6), 10.8.71 (Sector 7), 10.10.102 (Sector 9).

<sup>101</sup> Section 42A report by Environmental Management Services, 7 December 2010, paragraphs 10.10.102.

<sup>102</sup> Section 42A report by Environmental Management Services, 7 December 2010, paragraphs 10.10.103.

<sup>103</sup> Section 42A Addendum Report, Environmental Management Service, 20 December 2010, Section 3.7.

<sup>104</sup> My EIC, paragraphs 151-152.

<sup>105</sup> Alexander rebuttal, in his response to Section 42A reports.

<sup>106</sup> Section 42A report by Environmental Management Services, 7 December 2010, Appendix B – Waterview Connection Project: Freshwater Ecology Review, Ryder Consulting, November 10, 2010.

## QUESTIONS FROM THE BOARD

- 69 The Board<sup>107</sup> has asked for clarification on a number of stormwater issues and I respond to these in the paragraphs that follow.

### Design Life

- 70 The Board asks what the design life is; whether is it for 100 years or until 2090. The design life for the stormwater infrastructure is 100 years. This is put into practice by the selection of materials that have estimated durability of 100 years e.g. concrete pipes. It is also put into practice by the design of stormwater systems e.g. size of pipe for the rainfall than can be expected in 100 years time based on the design criteria for that element of the stormwater system e.g. 10 year ARI, 100 year ARI, 2500 year ARI.

### Climate Change – 2090 Period

- 71 The Board notes that the climate change scenario has been limited to 2090 not 100 years and asks whether the base data can be extrapolated for the full 100 year design life. The Board is correct, that to date for the consent design the climate change predictions for 2090 have been used based on MfE (2008) guidelines.<sup>108</sup> The MfE guidelines do not provide guidance on extrapolating rainfall beyond 2090 for a 100 year design life that might end in 2116 (motorway completion plus 100 years), unlike sea level rise where a number of mm/year is often used to extrapolate prediction. However, as a precautionary approach I recommend that at the detailed design stage the climate change predictions are extrapolated to estimate the rainfall in 2116 for the design events (10 year ARI, 100 year ARI and 2500 year ARI). These rainfall estimates should be used for design or for the planning of adaptive approaches, whichever is more appropriate to the stormwater element being considered for design.

### Climate Change – Percentage Rainfall Increase

- 72 The Board notes that the increase in rainfall has been based on a mean predicted temperature increase and asks what effect does the maximum estimate of the predicted temperature make.
- 73 The MfE guidelines infer that annual mean temperatures are to be used, with screening calculations for low and high temperature change scenarios.<sup>109</sup> For the 100 year ARI rainfall the guidelines recommend a factor<sup>110</sup> for percentage adjustments of 8 that is multiplied by the projected climate temperature change to calculate the percentage change in rainfall. I used the mid-range estimate of

<sup>107</sup> *Minute from the Board to the Parties Concerning Important Matters that NZTA Should Respond To* (28 January 2011), Issue Z.

<sup>108</sup> MfE (2008) *Preparing for Climate Change – A Guide for Local Government in New Zealand (MfE (2008) Guidelines)*.

<sup>109</sup> *MfE (2008) Guidelines*, page 34, paragraphs 1 and 2.

<sup>110</sup> *MfE (2008) Guidelines*, Table 7.

the annual temperature change at 2090 which was 2.1°C,<sup>111</sup> to get a percentage change in rainfall due to climate change at 2090 of 16.8%.

74 There is a lot of uncertainty with this estimate because the scientific **communities' predictions for climate change and its effect on rainfall** are still developing. The MfE guideline is full of caveats, but the approaches set out in this document are still considered to be the best practice for engineers designing infrastructure in New Zealand. Some of the uncertainties come from:

74.1 The rainfall estimates that have been used for the consent design are based on the HIRDS database and verified against local gauges.<sup>112</sup> However, these are statistical estimates of stochastic processes that are based on rainfall records, which have spatial and temporal limitations. Therefore, there are error bars associated with the estimation of extreme rainfall.

74.2 The factors<sup>113</sup> for percentage adjustments have major limitations and MfE guidelines state that, in some areas, increases substantially higher than the upper limit of 8 per cent given are possible, but no guidance is given on this.

74.3 An annual climate temperature change was used, however, there is variation between seasons. For Auckland the mid-range estimates for summer is 2.3 °C, autumn is 2.1 °C, winter is 2.0 °C and spring is 1.9 °C. Using the maximum and minimum values of the mid-range seasonal climate temperature changes, the percentage change in rainfall due to climate change at 2090 are 15.2% and 18.4%, respectively, compared to the mean I used of 16.8 degrees C.

74.4 The mid-range estimate for climate temperature change is the average of the changes estimated by several computer models and for a variety of possible emissions scenarios. However, the minimum and maximum values across these models and scenarios for the annual climate temperature change at 2090 are 0.6 and 5.8 °C, respectively. Using the maximum and minimum values and the factor of 8, the lower and upper bounds on the percentage change in rainfall due to climate change at 2090 are 4.8% and 46.4% respectively, compared to the mean I used of 16.8 °C.

75 Given these uncertainties, consideration should be given to testing the design for the upper estimates of the percentage change in rainfall during detailed design. Flooding is the most critical aspect of the stormwater and streamworks infrastructure in terms of

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<sup>111</sup> *MfE (2008) Guidelines*, Table 2.

<sup>112</sup> Technical Report G.15, Section 3.2.

<sup>113</sup> *MfE (2008) Guidelines*, Table 7.

hazard. Freeboard depths between 0.5m and 1m have been assumed for aspects of the design such as the SH1 crossing of Oakley Creek and for flood protection of the tunnel southern portal. I recommend that sensitivity testing of flood levels be undertaken at the detailed design stage to ensure that the hydrological uncertainties (with other provisions for freeboard) are appropriately accounted for in the freeboard allowances.

### **Observed extreme events**

- 76 The Board asks if any records that indicated the 100 year ARI rainfall has been exceeded in the area to date. Based on my review of catchment management reports and rainfall data, no events of this size have occurred in the recorded history of the catchment. Smedley and Captain (2009)<sup>114</sup> reports large flooding events in 1979 and 1981 that were attributed to the development of higher land increasing storm runoff and the draining of the two large swamps eliminating the original storage. Beca (1998)<sup>115</sup> notes particular storms causing flooding in July 1979 and May 1985. The highest rainfall depth recorded at the Owairaka gauge is 165mm on the 22<sup>nd</sup> May 1985, which is similar to the 50 year ARI rainfall depth used in the consent design. More recently, the calibration and verification of the Oakley Catchment model by Metrowater and AECOM was based on more recent flood events in that were in the 1 to 5 year ARI range.

### **Flood Levels in Oakley Inlet**

- 77 The Board seeks clarification on the determination of flood level in Oakley Inlet for the design of the motorway. I confirm that Technical Report G.27 to the AEE is correct and that the determination of flood levels will be for the combination of Oakley Creek flow and sea levels, with both to include climate change effects. I believe the proposal for flood levels to be based on the higher of the 100 year ARI rainfall event plus the 20 year ARI sea level, and the 20 year ARI rainfall event and plus the 100 year ARI sea level, is appropriate.

### **Wetland Crest Level**

- 78 The Board asks if the level of the pond crest at 3.25mRL can be higher than the causeway revetment crest level of 3 mRL. I presume that the question relates to the Jack Colvin wetland as this is the only wetland on the coastal edge. The crest of the wetland is at 3.6mRL,<sup>116</sup> which is determined by the stormwater treatment and storage requirements of the wetland. The revetment height on the seaward side of the embankment is based on the protection

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<sup>114</sup> R. Smedley and X. Captain. (2010). Managing the Oakley Catchment Model Build and other Client-Side Frustrations – Auckland, New Zealand. Water NZ Stormwater Conference, 13-14 May 2010.

<sup>115</sup> Beca (1998) Stormwater Management Plan, Report No. 5, Oakley Stormwater Comprehensive Management Plan, Section 2.5.

<sup>116</sup> Refer to Technical Report G.15, Appendix A, Drawings 20.1.11-3-D-D-341-202.

requirements for the coastal hazard at this location and will be at a lower level. In this case the upper slope of the seaward side of the pond embankment, above the rock revetment, will be stabilised with vegetation. The minimum crest level for the actual causeway revetment is to be confirmed and will be discussed by NZTA expert Dr Rob Bell in rebuttal evidence.

#### **OTHER AMENDMENTS TO CONDITIONS**

- 79 NZTA propose minor changes to the stormwater and streamworks conditions for consistency and to apply specific durations for processes. These are set out in the amended Stormwater and Streamworks Conditions attached as Annexures A and B respectively. Amendments are proposed to clarify timeframes and to ensure sufficient time to finalise and supply information. I note that condition SW.20 has been amended to require water treatment rather than stormwater treatment, because the Concrete Batching and Crushing Plants are now to be covered. I have also taken the opportunity to correct minor typographical errors.
- 80 The attached conditions also incorporate the caucusing amendments. I am advised that the NZTA accepts the amended conditions.



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**Tim Fisher**  
**February 2011**



## ANNEXURE A: PROPOSED STORMWATER CONDITIONS

Changes made at evidence in chief stage are in red. Changes made in rebuttal evidence stage are blue bold.

### PROPOSED STORMWATER CONDITIONS

	Construction
SW.1	Stormwater management during construction shall be undertaken in accordance with the plans and information submitted with this application and the information contained within Technical Report G.15 <i>Assessment of Stormwater and Streamworks Effects</i> . In particular this requires the construction and completion of stormwater management works to the treatment standards detailed in Table 7.1 for the catchment areas detailed in Tables 7:20 and 7:21 of Technical Report G.15 <i>Assessment of Stormwater and Streamworks Effects</i> .
SW.2	The NZTA shall inform the Auckland Council in writing at least 10 working days prior to the start date of the works authorised by this consent.
SW.3	<p>The NZTA shall submit the final design of the construction stormwater system to the Auckland Council prior to the commencement of construction works. This shall include, but not be limited to:</p> <p>(a) Design calculations for the following:</p> <ul style="list-style-type: none"> <li>i) flow attenuation devices,</li> <li>ii) stormwater treatment device sizing,</li> <li>iii) bypass device design,</li> <li>iv) stormwater treatment device efficiency;</li> </ul> <p>(b) Design drawings, including all structures, outfalls, treatment devices, bypass devices, wetlands and ponds;</p> <p>(c) Catchment plans detailing the area draining to each device; and</p> <p>(d) Outfall locations.</p> <p>Any amendments to these designs shall be <u>submitted for</u> approved in writing by the <u>Auckland Council</u> <u>at least 20 working days</u> prior to implementation.</p>
SW.4	<del>That the</del> NZTA shall arrange and conduct pre-construction site meetings between the <u>Auckland Council City</u> and all relevant parties, including the site stormwater engineer, with regard to the temporary stormwater management works, prior to construction of these works. Any resulting amendments may be reviewed at that time and shall be approved in accordance with Condition SW.3.

## PROPOSED STORMWATER CONDITIONS

SW.5	The NZTA shall finalise and implement the Temporary Stormwater Management Plan (TSMP) submitted with this application, <u>as part of the CEMP</u> . The purpose of the TSMP is to ensure appropriate controls are in place to manage stormwater during construction.
<del>SW.6</del>	<del>Any amendments to the TSMP shall be approved by the [Auckland Council] in writing.</del>
SW.6	The NZTA shall undertake regular inspections of all stormwater treatment devices installed during construction to ensure they are operating successfully.
SW.7	The NZTA shall arrange and conduct a post construction site meeting within 30 days of completion of installation of the stormwater management works between Auckland Council and all relevant parties, including the site stormwater engineer.
SW.8	<p>The NZTA shall ensure that, for stormwater flows in excess of the capacity of the primary systems, major overland flow paths shall be provided and maintained to allow surplus stormwater from critical storms, up to the 100-year <u>average recurrence interval (ARI)</u> event, to discharge with the minimum of nuisance and damage.</p> <p>Advice note: for the purposes of this Consent, "major overland flow paths" are those that accompany a primary drainage system of a nominal 600 mm diameter pipe or larger or with peak overland flow exceeding 0.5 m<sup>3</sup>/s in the 100-year ARI event.</p>
SW.9	Any stormwater outfalls authorised by this Consent shall incorporate erosion protection measures to minimise the occurrence of bed scour and bank erosion.
	<b>Operation</b>
SW.10	The permanent stormwater measures shall be installed and operated in accordance with the plans and information submitted with this application and the information contained within Technical Report G.15 <i>Assessment of Stormwater and Streamworks Effects</i> . In particular this requires the construction and completion of stormwater management works to the treatment standards <u>detailed in Table 6-1</u> for the catchment areas detailed in <u>Table 1 Tables 6:24 of Technical Report G.15 Assessment of Stormwater and Streamworks Effects</u> . <u>Stormwater treatment should also be provided for adjunct activities associated with the Project including access roads and carparks for the tunnel ventilation buildings.</u>

## PROPOSED STORMWATER CONDITIONS

**Table 1: Catchment areas and treatment standards for Waterview Connection Project by Sector.**

<u>Sector</u>	<u>Existing Impervious</u>		<u>Additional Impervious</u>		<u>Total</u>		<u>Treatment</u>		
	<u>Area (ha)</u>	<u>Percentage proposed treatment (%)</u>	<u>Area (ha)</u>	<u>Percentage proposed treatment (%)</u>	<u>Area (ha)</u>	<u>Percentage proposed treatment (%)</u>	<u>TSS removal *1 (%)</u>	<u>Flood attenuation *2</u>	<u>Erosion protection require*3</u>
<b>1</b>	<b>8.05</b>	<b>100</b>	<b>3.67</b>	<b>100</b>	<b>11.72</b>	<b>100</b>	<b>80</b>	<b>No</b>	<b>No</b>
<b>2</b>	<b>1.45</b>	<b>100</b>	<b>0.72</b>	<b>100</b>	<b>2.17</b>	<b>100</b>	<b>80</b>	<b>No</b>	<b>No</b>
<b>3</b>	<b>3.88</b>	<b>100</b>	<b>1.47</b>	<b>100</b>	<b>5.35</b>	<b>100</b>	<b>80</b>	<b>No</b>	<b>No</b>
<b>4</b>	<b>8.37</b>	<b>100</b>	<b>3.40</b>	<b>100</b>	<b>11.77</b>	<b>100</b>	<b>80</b>	<b>No</b>	<b>No</b>
<b>5</b>	<b>6.62</b>	<b>92.1</b>	<b>3.43</b>	<b>100</b>	<b>10.05</b>	<b>94.8</b>	<b>80</b>	<b>No</b>	<b>No</b>
<b>6</b>	<b>4.08</b>	<b>68.7</b>	<b>1.06</b>	<b>100</b>	<b>5.14</b>	<b>75.2</b>	<b>75</b>	<b>No</b>	<b>Yes</b>
<b>7</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>
<b>8</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>
<b>9</b>	<b>1.04</b>	<b>100</b>	<b>8.49</b>	<b>100</b>	<b>9.53</b>	<b>100</b>	<b>75</b>	<b>Yes</b>	<b>Yes</b>
<b>Total</b>	<b>33.49</b>	<b>94.5</b>	<b>22.25</b>	<b>100</b>	<b>55.74</b>	<b>96.8</b>			

**\*1 TSS removal is on a long term average basis.**

**\*2 Attenuation of the peak post-development runoff to the peak pre-development runoff for the 2, 10 and 100 year ARI rainfall events**

**\*3 Extended detention of the 34.5mm rainfall event for 24 hours in accordance with ARC TP10 (2003) guidelines.**

SW.11 The NZTA shall inform the Auckland Council in writing at least 10 working days prior to the start date of the works authorised by this resource consent.

SW.12 The NZTA shall submit the final design of the operational stormwater system to the Auckland Council prior to the commencement of construction works on the permanent stormwater system. This shall include, but not be limited to:

(a) Design calculations for the following:

- v) flow attenuation devices,
- vi) stormwater treatment device sizing,

## PROPOSED STORMWATER CONDITIONS

	<p>vii) bypass device design,</p> <p>viii) stormwater treatment device efficiency;</p> <p>(b) Design drawings, including all structures, outfalls, treatment devices, bypass devices, wetlands and ponds;</p> <p><b>(c) <u>Planting plans and schedules for all stormwater treatment devices;</u></b></p> <p>(d) Catchment plans detailing the area draining to each device; and</p> <p>(e) Outfall locations.</p> <p>Any amendments to these designs shall be <u>submitted for approval</u> in writing by the Auckland Council <u>at least 20 working days</u> prior to implementation.</p>
SW.13	<p>The NZTA shall arrange and conduct pre-construction site meetings between the <del>Auckland</del> <u>City Council</u> and all relevant parties, including the site stormwater engineer, with regard to the operational stormwater management works, prior to construction of the permanent stormwater devices. Any resulting amendments may be reviewed at that time and shall be approved in accordance with Condition SW.<del>13</del><u>12</u>.</p>
SW.14	<p>Within <del>90 days</del> <u>three months</u> of the practical completion of the stormwater management system, "As Built" plans and documentation of the stormwater system which are certified as a true record of the stormwater management system by a suitably qualified Chartered Professional Engineer shall be supplied to the Auckland Council</p>
SW.15	<p>The NZTA shall submit to the Auckland Council within <del>90 days</del> <u>three months</u> of the completion of installation of the stormwater management system an updated and final version of the Operational Stormwater Management Plan (OSMP) submitted with the application, <del>to certify confirm</del> <u>it meets the performance standards specified in Technical Report G.15</u>. The purpose of the OSMP is to set out operation and maintenance requirements for the long term operation of stormwater systems implemented as part of the Project.</p> <p><u>The OSMP shall include a monitoring programme for tunnel water quality to be agreed with the Auckland Council. The monitoring programme shall have a duration of two years. The water quality report shall be submitted to the Auckland Council at the end of each year. The OSMP shall be updated at the end of the monitoring programme to revise procedures for the treatment and disposal of tunnel water.</u></p> <p>The OSMP shall include, but not be limited to:</p> <p>(a) A programme for regular maintenance and inspection of works;</p> <p>(b) A programme for the collection and disposal of debris and sediment collected by the stormwater management devices or</p>

## PROPOSED STORMWATER CONDITIONS

	<p>practices;</p> <p>(c) A programme for inspection and maintenance of outfall erosion;</p> <p>(d) A programme for post-storm maintenance;</p> <p>(e) General inspection checklists for all aspects of the stormwater management system;</p> <p>(f) Details of the person or bodies whom will hold responsibility for long-term maintenance of the stormwater management system and the organisational structure which will support this process.</p>
SW.16	<p>Any amendments to the OSMP shall be <u>submitted for approval in writing</u> by the Auckland Council <u>in-writing within at least 20 working days prior to implementation</u>.</p>
SW.17	<p>The NZTA shall arrange and conduct a post construction site meeting within 30 days of completion of installation of the stormwater management works between the Auckland Council and all relevant parties, including the site stormwater engineer.</p>
SW.18	<p>The NZTA shall ensure that, for major overland flow paths in excess of the capacity of the primary systems, secondary flow paths shall be provided and maintained to allow surplus stormwater from critical storms, up to the 100-year ARI event, to discharge with the minimum of nuisance and damage.</p> <p>Advice note: for the purposes of this consent "major overland flow paths" are those that accompany a primary drainage system of a nominal 600 mm diameter pipe or larger, or with peak overland flow exceeding 0.5 m<sup>3</sup>/s in the 100-year ARI event.</p>
SW.19	<p>Any stormwater outfalls authorised by this Consent shall incorporate <u>energy dissipation and/or</u> erosion protection measures to minimise the occurrence of bed scour and bank erosion. <u>The design of stormwater outfalls shall assess various rainfall events and tailwater levels (stream and sea levels) to ensure the critical storm event is considered in the design.</u></p>
SW.20	<p>The NZTA shall finalise and implement through the CEMP, the Concrete Batching and Crushing Management Plan (CBCMP) submitted with the application. <del>The NZTA shall provide the CBCMP to the [Auckland Council] prior to the commencement of any site works. The CBCMP shall be revised to accurately reflect the conditions of this consent and changes to the details of construction processes prior to construction commencing.</del> The CBCMP shall include, but not be limited to, details of:</p> <p>(a) Design of <del>the</del> stormwater treatment device(s)</p> <p>(b) Monitoring requirements</p> <p>(c) Procedures to be undertaken in the event of unexpected discharges</p>

**PROPOSED STORMWATER CONDITIONS**

	(d) Complaints, investigation, monitoring and reporting.
SW.21	<u>In the second year of operation of stormwater treatment wetlands, during the months of December to February, the NZTA shall arrange and conduct a site meeting between the Auckland Council and NZTA, including the design stormwater engineer, in order to assess plant health of the stormwater treatment wetlands. Any resulting amendments to the wetland design may be reviewed at that time and shall be approved by the Auckland Council.</u>

## ANNEXURE B: PROPOSED STREAMWORKS CONDITIONS

Changes made at evidence in chief stage are in red. Changes made in rebuttal evidence are blue bold.

### PROPOSED STREAMWORKS CONDITIONS

STW.1.	<p><b>General conditions</b></p> <p>The streamworks <u>and associated works (such as stormwater outfalls)</u> shall be undertaken in accordance with the plans and information contained within Technical Report G.15 <i>Assessment of Stormwater and Streamworks Effects</i> and Technical Report G.22 <i>Erosion and Sediment Control Plan</i>, submitted with this application. <u>The design of streamworks and associated works shall follow the approach expressed in the Oakley Creek Re-alignment and Rehabilitation Guidelines, Appendix C of Technical Report G.6 Assessment of Freshwater Ecology Effects.</u></p>
STW.2.	<p>Any future amendments that may affect the performance of the streamworks shall be approved by the Auckland Council in writing, prior to construction. Any amendments to the design should be in accordance with the Western Ring Route: Oakley Creek Re-alignment and Rehabilitation Guidelines (Boffa Miskell, 2010).</p>
STW.3.	<p>The NZTA shall inform the Auckland Council in writing at least 10 working days prior to any streamworks commencing, and again 10 working days before any environmental protection measures are removed.</p>
STW.4.	<p>Prior to streamworks commencing on site the NZTA shall arrange and conduct a pre-construction site meeting between Auckland Council, NZTA and the primary contractor, <u>prior to any works commencing on the site.</u></p>
STW.5.	<p><u>At least 20 working days</u> prior to commencement of streamworks associated with the realignments of Oakley Creek and the Stoddard Road tributary, the construction design details associated with these works shall be submitted to the Auckland Council for approval. The details shall include but not be limited to:</p> <ul style="list-style-type: none"> <li>(a) Detailed design of the proposed streamworks including long sections, cross sections and details of the design including any freshwater habitat improvement and riparian planting;</li> <li>(b) Construction erosion and sediment control plans (ESCP).</li> </ul>

### PROPOSED STREAMWORKS CONDITIONS

STW.6.	<p>The NZTA shall forward a detailed construction programme and methodology to the Auckland Council <a href="#">at least 10 working days</a> prior to the commencement of works, and shall provide monthly updates during the streamworks. These shall include details of:</p> <p>(a) The commencement date and expected duration of the streamworks;</p> <p>(b) The location of any works and structures in relation to the streamworks; and</p> <p>(c) Dates for the implementation of erosion and sediment controls.</p>
STW.7.	<p>No streamworks shall be undertaken between 1 May and 30 September unless written approval has been obtained from the Auckland Council. Any such approval shall be sought at least 10 working days prior to the proposed commencement of the works.</p>
STW.8.	<p>All erosion and sediment controls associated with the streamworks shall be constructed and installed in accordance with Technical Report G.22 <i>Erosion and Sediment Control Plan</i> submitted with this application.</p>
STW.9.	<p>The site shall be stabilised against erosion as soon as practicable and in a progressive manner as streamworks are finished.</p>
STW.10.	<p>All uncompacted material shall be kept clear of the channel during and after streamworks.</p>
STW.11.	<p>The NZTA shall ensure that any temporary dam structure built within the stream shall be constructed from non-erodible material (such as sandbags or sheet piles).</p>
STW.12.	<p>The NZTA shall ensure that when dewatering the in-stream works area, no sediment-laden water shall be discharged directly into a watercourse. Any sediment-laden water must be treated in an appropriate sediment treatment device <a href="#">in accordance with TP90</a>.</p>
STW.13.	<p>All machinery shall be maintained and operated in a way which ensures that spillages of fuel, oil and similar contaminants are prevented, particularly during refuelling and machinery servicing.</p>



## PROPOSED STREAMWORKS CONDITIONS

STW.14.	<p>The NZTA shall ensure that:</p> <p>(a) Any excavated sediment that requires temporary stockpiling shall not be placed within the 100 year ARI flood plain, and</p> <p>(b) Erosion and sediment control measures around the stockpile perimeter shall be constructed in accordance with TP90.</p>
STW.15.	<p>The design engineer and Project ecologist shall monitor the construction of the streamworks. The NZTA shall submit <a href="#">to Auckland Council</a> a certificate signed by an appropriately qualified and experienced engineer and ecologist to certify that the streamworks have been undertaken in accordance with the drawings supplied with this application, or as otherwise amended under Condition STW.2, within <del>60 working days</del> <a href="#">three months</a> of completion of the streamworks.</p>
STW.16.	<p>The NZTA shall obtain approval of the <a href="#">constructed</a> stream realignment works from the Auckland Council <a href="#">at least 20 working days</a> prior to diversion of Oakley Creek into the new channel.</p>
STW.17.	<p><b>Bridge Structure</b></p> <p>The NZTA shall submit a certificate signed by an appropriately qualified and experienced engineer to certify that the Oakley Creek <a href="#">SH20 motorway</a> bridge (<del>SH20</del>) has been constructed in accordance with the drawings supplied with this application, within <a href="#">3 months</a> <del>60 working days</del> of completion of the structure.</p>
STW.18.	<p>Any erosion occurring as a result of construction of the Oakley Creek bridge (SH20) shall be remedied as soon as possible and to the satisfaction of the Auckland Council.</p>
STW.19.	<p>The area of Oakley Creek beneath the Oakley Creek bridge (SH20) shall be maintained free of debris to ensure stream flows are not restricted.</p>

## PROPOSED STREAMWORKS CONDITIONS

STW.20.	<p><b>Streamworks Environmental Management Plan (SWEMP)</b></p> <p>The NZTA shall submit for <del>approval</del> <u>review</u> to the Auckland Council a Streamworks Environmental Management Plan (SWEMP) which shall include details of the final freshwater mitigation and environmental enhancement works associated with the Project <u>to confirm it is consistent with the design set out in Technical Report G.15 and principles of the “Western Ring Route – Maioro Street Interchange and Waterview Connection – Oakley Creek Realignment and Rehabilitation Guidelines” described in STW.21.</u> This SWEMP shall cover the mitigation for the loss of an area of Pixie Stream, Oakley Creek and the Stoddard Road tributary. It shall be submitted to the Auckland Council at least 40 <u>20</u> working days prior to the proposed enhancement works being commenced under this consent and shall include, but not be limited to, the following:</p> <ul style="list-style-type: none"> <li>(a) The nature of works to be undertaken;</li> <li>(b) The location of works;</li> <li>(c) Detailed design and plans of all enhancements to the stream bed and/or stream channel, including any structures or other engineering works. <u>This includes replication of the existing waterfall located on the Stoddard Road tributary near the confluence with Oakley Creek in a similar position within the new realignment;</u></li> <li>(d) Riparian planting programmes, including detailed planting plans and specifications relating to species mix, location, density, size and maintenance, <u>to achieve an overall average of 70% shading of stream at maturity within those reaches where realignments of the SEV off-setting mitigation associated with the Project are proposed;</u></li> </ul> <p><u>(Advice Note: The intent is to include the SEV off-setting mitigation associated with the Maioro Project within Hendon Park and Alan Wood Reserve, and to the same shading standard as specified in Condition STW.20(d).)</u></p> <p>and</p> <ul style="list-style-type: none"> <li>(e) Timing of implementation; <u>and</u></li> <li>(f) <u>The outcomes of consultation with Iwi (Ngati Whatua o Orakei and Te Kawerau Tribal Authority) and Friends of Oakley Creek.</u></li> </ul>
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## PROPOSED STREAMWORKS CONDITIONS

STW.20A	<p><u>The realignments necessary for highway construction will be rehabilitated separately to the Project's SEV off-set mitigation requirement of 343 metres. The Project's SEV off-set mitigation requirements will be undertaken within the areas demarcated as "Oakley Creek Rehabilitation A – D" as shown on Drawing 20.1.11-3-D-D-330-211 Rev A.</u></p> <p><u>Advice Note : The SEV off-set mitigation associated with the Maioro Interchange Project is intended to be undertaken upstream and downstream of those areas shown for Realignment and Rehabilitation on Drawing 20.1.11-3-D-D-330-211 Rev A, for the purposes of creating a coherent ecological corridor in this area.</u></p>
STW.21.	<p>The SWEMP shall be prepared in general accordance with the "Western Ring Route – Maioro Street Interchange and Waterview Connection – Oakley Creek Realignment and Rehabilitation Guidelines" (Boffa Miskell, 2010) appended to <i>Technical Report G.6 Assessment of Freshwater Ecological Effects</i>.</p>
STW.22.	<p>The NZTA shall implement the mitigation and environmental enhancement works contained in the approved SWEMP within 12 months of practical completion of the Project.</p>
STW.23.	<p>The NZTA shall supply to the Auckland Council within <del>30 working days</del> <u>three months</u> of the completion of the riparian planting works written confirmation from an appropriately qualified landscape architect or ecologist that the riparian plantings have been implemented in accordance with the SWEMP approved under Condition SW.20.</p>
STW.24.	<p>Any material amendments to the SWEMP shall be submitted for approval by the Auckland Council <u>at least 20 working days</u> prior to any amendment being implemented.</p>
STW.25.	<p><b>Fish Passage</b></p> <p>All proposed stream bed and/or stream channel structures shall not impede the passage of fish both upstream and downstream.</p>

## PROPOSED STREAMWORKS CONDITIONS

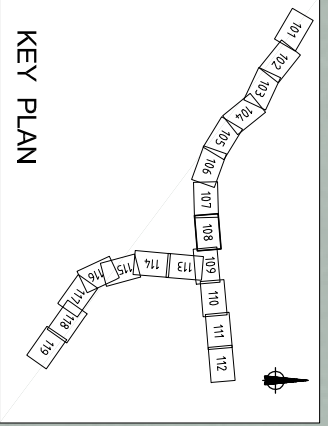
STW.26.	<p><b>Flooding</b></p> <p>Works in the floodplain (including motorway embankments, ancillary earthworks and streamworks) shall be undertaken in accordance with the plans and information submitted with this application including, but not limited:</p> <p>(a) Waterview Connection Project. Assessment of Environmental Effects Report (Dated August 2010).</p> <p>I. Plan F.2 Operation Scheme Plans</p> <p>II. Plan F.14 Streamworks and Stormwater Discharges</p> <p>(b) Technical Report G.15 <i>Assessment of Stormwater and Streamworks Effects</i>.</p>
STW.27.	<p>Within <del>60 working days</del> <u>three months</u> of completion of the works, the NZTA shall submit to the Auckland Council “as built” plans certified by a qualified and experienced engineer to confirm that the works have been carried out in accordance with Condition SW.26.</p>
STW.28.	<p>Any amendments to works by the NZTA in the floodplain that may increase the flooding effects shall be submitted to the Auckland Council for approval in writing <u>at least 20 working days</u> prior to construction. These proposed amendments shall include updated drawings and hydraulic modelling using the Oakley Creek Catchment Model to assess the effects of the change.</p>
STW.29.	<p>The NZTA shall submit to the Auckland Council a certificate signed by an appropriately qualified and experienced engineer to certify that the flood protection works for the tunnels have been constructed in accordance with the drawings, approach and standards supplied with this application, prior to the opening of the Project.</p>
STW.30.	<p><u>Design of flood defences for the southern portal shall <del>take into account</del> be in accordance with the catchment management option preferred by Auckland Council with allowances for climate change and maximum probable development.</u></p>

**ANNEXURE C: UPDATED DRAWINGS****Drawing 20.1.11-3-D-D-300-118 Rev C**

Updated note requiring cascade in Stoddard Road Tributary at confluence and clarifying timing of realignment

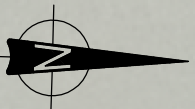
**Drawing 20.1.11-3-D-D-300-118 Rev D**

Corrections to information added for Fisher evidence

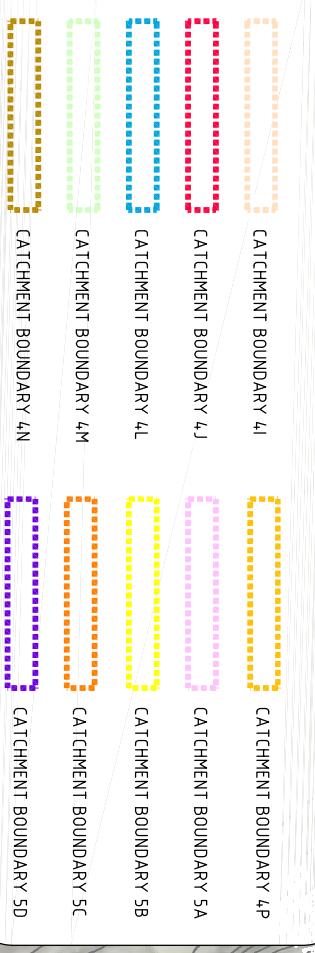


NOTE:  
REFER TO DRAWING 20.111-3-D-D-300-100 FOR LEGEND

WAIATEMATA HARBOUR



TREATMENT CATCHMENT LEGEND



TD4I - CAUSEWAY BRIDGE TO TRAHERNE  
CATCHMENT AREA: 4.19ha  
WIDTH: 7m  
REFER TO DWG: 20.111-3-D-D-340-304

TD4N - CAUSEWAY BRIDGE EASTBOUND  
CARTRIDGE FILTER  
CATCHMENT AREA: 0.177ha  
VAULT DIMENSIONS:  $\phi$ 1.8m  
690mm CARTRIDGE UNITS: 5 No  
REFER TO DWG: 20.111-3-D-D-340-306  
FOR TYPICAL DETAIL

TD4L - GREAT NORTH ROAD TO CAUSEWAY BRIDGE EASTBOUND  
CATCHMENT AREA: 0.94ha  
WIDTH: 7m  
REFER TO DWG: 20.111-3-D-D-340-304

TD5A - CAUSEWAY EAST END  
EASTBOUND BIO FILTER STRIP  
CATCHMENT AREA: 0.46ha  
WIDTH: 7m  
REFER TO DWG: 20.111-3-D-D-340-304  
FOR TYPICAL SECTION

TD4J - CAUSEWAY BRIDGE TO TRAHERNE  
WESTBOUND FILTER STRIP  
CATCHMENT AREA: 3.836ha  
WIDTH: 7m  
REFER TO DWG: 20.111-3-D-D-340-304

TD4P - CAUSEWAY BRIDGE WEST BOUND  
CARTRIDGE FILTER  
CATCHMENT AREA: 0.177ha  
VAULT DIMENSIONS:  $\phi$ 1.8m  
690mm CARTRIDGE UNITS: 5 No  
REFER TO DWG: 20.111-3-D-D-340-306  
FOR TYPICAL DETAIL

TD5B - CAUSEWAY EAST END  
WESTBOUND BIO FILTER STRIP  
CATCHMENT AREA: 0.96ha  
WIDTH: 7m  
REFER TO DWG: 20.111-3-D-D-340-304  
FOR TYPICAL SECTION

TD4M - GREAT NORTH ROAD TO CAUSEWAY BRIDGE  
WESTBOUND BIO FILTER STRIP  
CATCHMENT AREA: 0.92ha  
WIDTH: 7m  
REFER TO DWG: 20.111-3-D-D-340-304

TD5E - WATERVIEW INTERCHANGE SWALE  
CATCHMENT AREA: 0.58ha  
BASE WIDTH: 1.8m  
LONGITUDINAL SLOPE: 3%  
REFER TO DWG: 20.111-3-D-D-340-304  
GENERIC SECTION

WATERVIEW ESTUARY INLET

WATERVIEW ESTUARY INLET

WATERVIEW ESTUARY INLET

HEMINGTOWN

OAKLEY INLET



No.	Revision	By	CHK	App'd	Date
A	FOR REVIEW	JB	JB	JH	30.03.10
B	CONSULT ISSUE	TM	JB	JH	27.07.10
C	PRELIMINARY DESIGN	JC	JB	JH	06.10.10
D	ADD TREATMENT TO CAUSEWAY BRIDGES	EHF	TSRF	TSRF	24.01.11
E	CORRECTIONS				

Drawing Originator:  
**aurecon**  
Aurecon New Zealand Limited  
139 Collins Drive Road PO Box 97921 Newmarket  
Auckland New Zealand  
Telephone: +64 9 524 9119  
Facsimile: +64 9 524 9118  
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Original Scale (A1)	Design Engineer	Original Scale (A3)	Design Engineer
1:800	JB	1:2000	JB
Reduced Scale (A3)	Drafting Checked	Consultant Approval	JH
	Received by Beca		

**NZ TRANSPORT AGENCY**  
WAKA KOTAHU

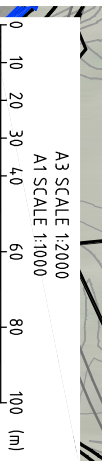
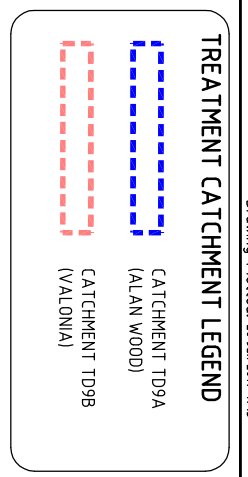
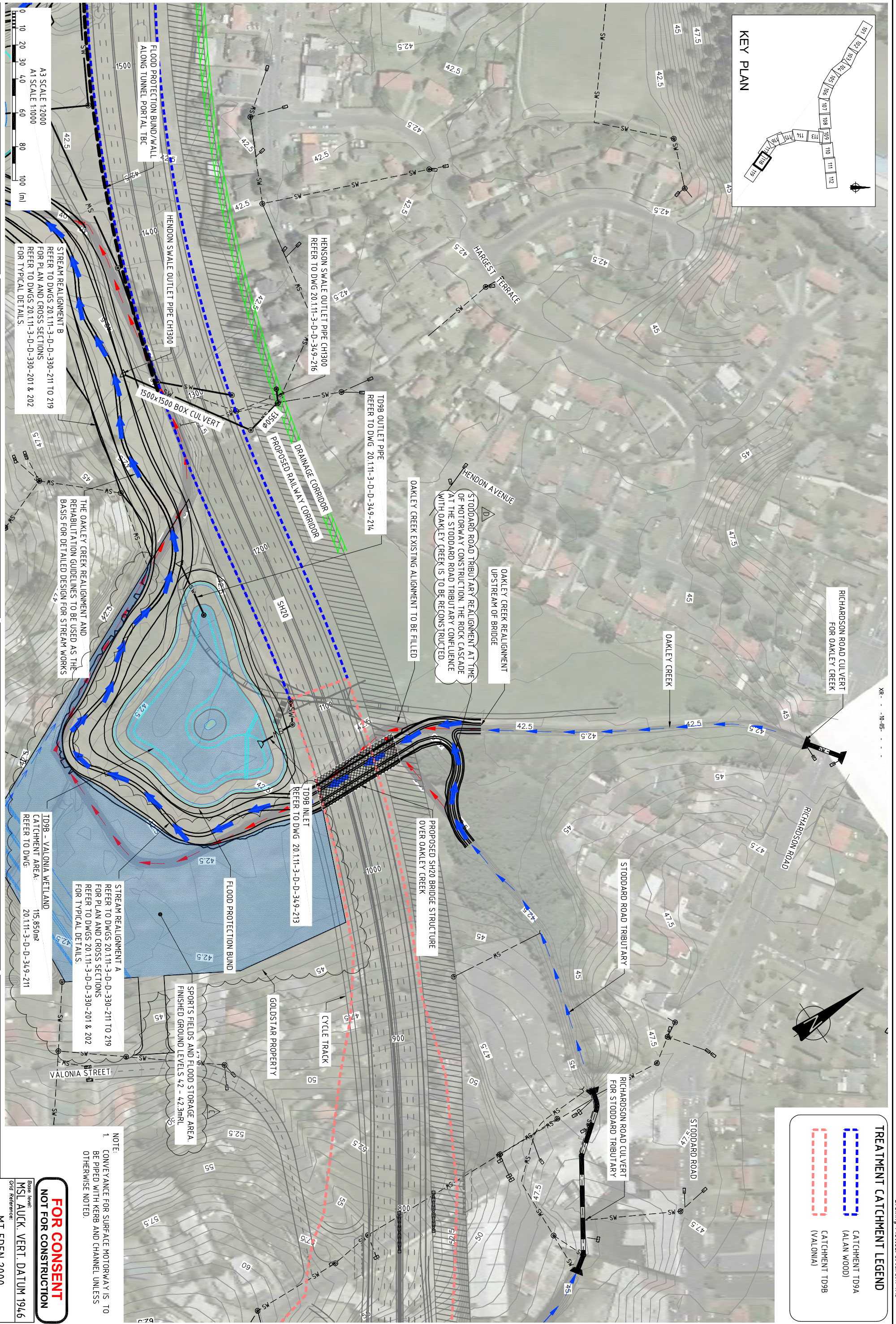
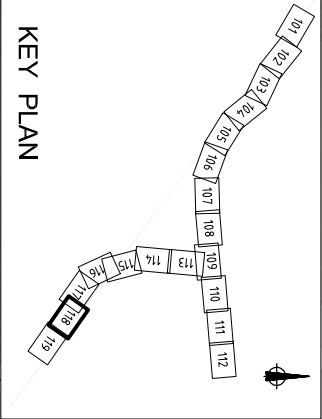
Project: WATERVIEW CONNECTION  
PROJECT SH16 / SH20

Title: STORMWATER & STREAMWORKS  
OPERATIONAL PHASE  
SHEET 8

Project No. 20.111-3-D-D-300-108  
Originator No. MT EDEN 2000  
Base Level: NZL AUCK. VERT. DATUM 1946  
Grid Reference:  
**FOR CONSENT NOT FOR CONSTRUCTION**

DO NOT SCALE

IF IN DOUBT ASK



**STREAM REALIGNMENT B**  
REFER TO DWGS 20.111-3-D-D-330-211 TO 219 FOR PLAN AND CROSS SECTIONS  
REFER TO DWGS 20.111-3-D-D-330-201 & 202 FOR TYPICAL DETAILS

**TD98 OUTLET PIPE**  
REFER TO DWG 20.111-3-D-D-349-214

**TD99 INLET**  
REFER TO DWG 20.111-3-D-D-349-213

**TD9B OUTLET PIPE**  
REFER TO DWG 20.111-3-D-D-349-216

**HENDON SWALE OUTLET PIPE CH1300**

**1500x1500 BOX CULVERT**

**PROPOSED RAILWAY CORRIDOR**

**DRAINAGE CORRIDOR**

**OAKLEY CREEK EXISTING ALIGNMENT TO BE FILLED**

**OAKLEY CREEK REALIGNMENT UPSTREAM OF BRIDGE**

**STODDARD ROAD TRIBUTARY REALIGNMENT AT THE OF MOTORWAY CONSTRUCTION. THE ROCK CASCADE AT THE STODDARD ROAD TRIBUTARY CONFLUENCE WITH OAKLEY CREEK IS TO BE RECONSTRUCTED.**

**PROPOSED SH20 BRIDGE STRUCTURE OVER OAKLEY CREEK**

**STODDARD ROAD TRIBUTARY**

**RICHARDSON ROAD CULVERT FOR STODDARD TRIBUTARY**

**RICHARDSON ROAD CULVERT FOR OAKLEY CREEK**

**FLOOD PROTECTION BUND/WALL ALONG TUNNEL PORTAL TBC**

**HENDON AVENUE**

**HARGEST FERRACE**

**VALONIA STREET**

**GOLDSTAR PROPERTY**

**CYCLE TRACK**

**SPORTS FIELDS AND FLOOD STORAGE AREA FINISHED GROUND LEVELS 4.2 - 4.23mRL**

**THE OAKLEY CREEK REALIGNMENT AND REHABILITATION GUIDELINES TO BE USED AS THE BASIS FOR DETAILED DESIGN FOR STREAM WORKS**

**STREAM REALIGNMENT A**  
REFER TO DWGS 20.111-3-D-D-330-211 TO 219 FOR PLAN AND CROSS SECTIONS  
REFER TO DWGS 20.111-3-D-D-330-201 & 202 FOR TYPICAL DETAILS

**TD9B - VALONIA WETLAND CATCHMENT AREA:**  
115,850m<sup>2</sup>  
20.111-3-D-D-349-211

**NOTE:**  
1. CONVEYANCE FOR SURFACE MOTORWAYS IS TO BE PIPED WITH KERB AND CHANNEL UNLESS OTHERWISE NOTED

**FOR CONSENT NOT FOR CONSTRUCTION**

NO.	REVISION	DATE
A	FOR REVIEW	
B	CONSENT ISSUE	
C	ADD FLOOD STORAGE AREA	
D	MODIFIED NOTE	

Author	JATG	TSRF	TSRF	25.01.11
Check	JATG	TSRF	TSRF	09.10.11
Design	JATG	KAMH	KID	30.07.10
Drawn	JATG	KAMH	KID	30.03.10
By	CHK	Appl	Date	

Original Scale (A1)	1:1000
Reduced Scale (A3)	1:2000

Design Engineer	SHR/KAMH
Review Engineer	TSRF
Consultant Approval	TSRF
Received by Desc	RH

Project	WATERVIEW CONNECTION PROJECT SH16 / SH20
Title	STORMWATER & STREAMWORKS OPERATIONAL PHASE SHEET 18

Formal Issue	MCL/AUCK VERT. DATUM 1946
Grid Reference	MT EDEN 2000
Project No.	20.111-3-D-D-300-118
Rev.	C



**ANNEXURE D: DRAWING SHOWING LOCATION OF BASALT COLUMNS**

**Boffa Miskell Drawing, Oakley Creek Columnar Basalt,  
Date: 21 January 2011, Revision: 0**



