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 **Graeme Ridley** (Erosion and Sediment Control) for the NZ Transport Agency

Dated: 25 October 2012

REFERENCE: John Hassan (john.hassan@chapmantripp.com)
Suzanne Janissen (suzanne.janissen@chapmantripp.com)

Chapman Tripp
T: +64 4 499 5999
F: +64 4 472 7111

10 Customhouse Quay
PO Box 993, Wellington 6140
New Zealand

www.chapmantripp.com
Auckland, Wellington,
Christchurch

TABLE OF CONTENTS

STATEMENT OF REBUTTAL EVIDENCE OF GRAEME RIDLEY FOR THE NZ TRANSPORT AGENCY

1 My full name is Graeme John Ridley.

2 I have the qualifications and experience set out at paragraphs 1 to 5 of my evidence in chief, dated 3 September (*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 In this statement of rebuttal evidence, I respond to the evidence of:

4.1 Robert van Bentum on behalf of Kāpiti Coast District Council (*KCDC*) (submission no. 682);

4.2 Shona Myers on behalf of KCDC;

4.3 Dr Death on behalf of KCDC;

4.4 Emily Thomson on behalf of KCDC;

4.5 Alton Perrie on behalf of Greater Wellington Regional Council (*GWRC*) (submission no. 684);

4.6 Brian Handyside on behalf of GWRC; and

4.7 Richard Percy on behalf of GWRC.

5 The fact that this rebuttal statement does not respond to every 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 report, Appendix H of the Construction Environmental Management Plan (*ESCP*), my EIC and this rebuttal statement to set out my opinion on what I consider to be the key erosion and sediment control matters for this hearing.

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

EXECUTIVE SUMMARY

7 I have read all of the relevant parts of statements of evidence lodged by submitters. This has not caused me to depart from the opinions expressed in my EIC, and I re-confirm the conclusions reached.

8 I respond below to the key erosion and sediment control issues raised through the submitters' evidence; I have not responded to minor issues raised.

Robert van Bentum (KCDC)

9 In his evidence, Mr van Bentum states that the Project will generate significant erosion and sediment volumes but notes that he supports the general management approach outlined within the Erosion and Sediment Control Plan (*ESCP*).[1] He states:

> "I also support the requirement for site specific sediment and control strategies to be developed ahead of each phase and stage of the work. However I recommend a number of changes to the plan and the addition of consent conditions to provide additional protection." [2]

10 With reference to the ESCP, Mr van Bentum states:

> "I support its general approach, and in particular the special attention and protection provided to sensitive environments including the Waikanae River, Te Harakeke/Kawakahia Wetland and its tributaries, the Waimeha Estuary and Wharemauku Stream Estuary." [3]

11 He confirms that there are a number of other wetlands which also require attention in respect of sediment control. He goes on to identify a number of other wetland environments where he believes enhanced erosion and sediment control measures should be implemented.

12 Mr van Bentum recommends the ESCP be amended to require hydro seeding and mulching on large cut sand slopes to minimise erosion and sediment loss.[4]

13 Mr van Bentum notes that he believes the 95% efficiency for all sediment retention measures is overstated and states that he supports the use of chemical treatment in combination with sediment ponds to ensure consistently high removal of sediment and particularly the clay fraction which contributes to colour. He recommends a modification to the consent conditions that requires all Construction Erosion and Sediment Control Plans (*CESCPs*) include chemical treatment.[5]

Response

14 Mr van Bentum does not reference the Universal Soil Loss Equation (*USLE*) provided within my ESCP and EIC. The basis for his statement that the Project will generate significant volumes of sediment is unclear, particularly when considered in the context of the general support within Mr van Bentum's evidence for the proposed approach to erosion and sediment control.

---

1 Paragraph 3.6 of Mr van Bentum's evidence.

2 Paragraph 3.7 of Mr van Bentum's evidence.

3 Paragraph 6.1 of Mr van Bentum's evidence.

4 Paragraph 6.4 of Mr van Bentum's evidence.

5 Paragraph 6.7 of Mr van Bentum's evidence.

15 I agree with Mr van Bentum's statement that particular attention needs to be provided to all sensitive environments,[6] however, I also note that the ESCP does not imply in any way that those environments that are not considered "special" or "sensitive" can receive a lesser degree of attention with respect to erosion and sediment control. The ESCP contains a number of key principles[7] and practices which must be applied to all erosion and sediment control measures and methodologies. In addition, the methodologies specified within the ESCP are robust and provide, as a minimum, industry best practice with respect to design, implementation and maintenance.

16 The CESCPs to be developed are required for each area of works prior to those works commencing and in this regard further specific erosion and sediment control plans will be developed and submitted to GWRC.[8] As a minimum these CESCPs will meet the requirements of the ESCP. I note that any specific receiving environment values will need to be further addressed within these CESCPs with a full opportunity to "enhance" the erosion and sediment controls if necessary at that time.

17 While I acknowledge that enhancements and amendments will likely result to the erosion and sediment control measures through the CESCPs to be developed, I remain of the view that the ESCP represents industry best practice and is comprehensive and complete and will ensure protection of the receiving environments in all cases. I am unclear what specific enhanced erosion and sediment control measures Mr van Bentum refers to or expects (as outlined within paragraph 6.3 of his evidence).

18 As for mulch and hydro-seeding, I refer to erosion control principle number 11,[9] and the specific use of mulch to achieve a stabilised surface in particular for stockpiles and batter establishment. Preload activities will also be subject to this principle. I confirm that I remain of the view that this will provide for both short term erosion protection and dust management. I also note that hydroseeding (as outlined within paragraph 6.4 of Mr van Bentum's evidence) is not considered as a stabilisation measure in itself and simply advances the establishment of a vegetative cover.

19 Mr van Bentum questions the efficiency of the proposed sediment control measures, and yet appears to state that he is comfortable with the assessment of sediment yields provided chemical treatment is utilised throughout the Project. As detailed within my EIC, I note that emphasis is placed on erosion control and prevention of

---

6 I note this reflects the evidence of Ms Shona Myers (at paragraph 6.30) on behalf of KCDC which states that there is a need for a higher level of sediment control for the Te Harakeke/Kawakahia wetland areas.

7 ESCP pages 6 to 11.

8 Proposed Conditions G.28 and E.3.

9 ESCP page 9.

sediment generation as a first step.[10] I reiterate the comments I made in my EIC, that the peat replacement trial and chemical treatment investigations both demonstrate the very effective nature of the control measures and provide a large degree of confidence that high sediment removal efficiencies can be obtained.[11] I also reconfirm the very high natural infiltration rates that will occur within the sand environments.

20 In my opinion, there remains minimal value in chemically treating all discharges from the site as many of these discharges, in particular those within the sand environments, will either not occur or will be of a suitable water quality. The vehicle of the CESCP remains as the best option for determining the necessity or otherwise of chemical treatment. This is determined prior to works occurring within specific locations and is also certified by GWRC prior to works commencing.

Dr Death (KCDC)

21 Dr Death notes that trout can be especially sensitive to increased sediment and act as an indicator of effects on declining water quality that in turn can be detrimental to indigenous species.[12] In this context he expresses concern that *"The proposed expressway will potentially increase the sediment levels of the Waikanae River"*.

22 He also notes a series of specific monitoring parameters related to sedimentation downstream from the Project which he believes are necessary and discusses the need to avoid the migration period of freshwater fish species.[13]

23 With respect to stream diversion activities, Dr Death notes concerns about "sediment slugs" when such diversions are activated.[14] In particular, he notes that measures will need to be put in place to ensure that large sediment slugs do not end up in larger receiving waterbodies as these can have more detrimental effects than the constant slow release over a long time period of the same volume of sediment.[15]

24 Dr Death also highlights what he perceives as a risk of dramatically increased sediment levels in the Waikanae River and in relation to the associated diversion of the Muaupoko Stream which he considers could lead to a decline in ecological condition.[16]

---

10 My EIC, paragraph 108.

11 ESCP Appendix H.N and ESCP Section 7.12.

12 Paragraph 3.10 of Dr Death's evidence.

13 Paragraph 5.14 of Dr Death's evidence.

14 Paragraph 6.1 of Dr Death's evidence.

15 Paragraph 6.1 of Dr Death's evidence.

16 Paragraph 6.7 of Dr Death's evidence.

Response

25 In response to Dr Death's suggestion that there be a condition that requires there be no greater than 20% change in visual clarity to any receiving waterbody,[17] I note that in his rebuttal evidence **Dr Keesing** does not agree that clarity monitoring is required in addition to monitoring for turbidity.[18] He goes on to note that:

> "...a number of the streams within the Project footprint are never clear. The Kakariki and Paetawa Streams and Drain 7 for example are tannin enriched and typically dark. Furthermore, in rain events most of the streams run murky. "

26 Further, I note that section 5.3 of the ESCP identifies specific onsite monitoring which will occur with respect to erosion and sediment control measures. Baseline surveys will define the antecedent conditions in the Project area and monitoring during construction will be undertaken to a pre determined schedule.[19] Devices monitoring[20] will include the monitoring of onsite construction activities and structures. Triggered response monitoring will be based on a series of triggers as identified within the ESCP[21] and then a series of actions followed which are also identified within the ESCP.[22]

27 I remain of the opinion that this monitoring "package" is robust and satisfactory to ensure that adaptive management can occur and that any effects of sediment can be minimised accordingly. I consider that if any triggers are breached, or potential issues identified, that appropriate actions will be implemented to mitigate effects as per the ESCP. This is further supported through the Condition G.40 which requires a full adaptive management approach to the Project in accordance with the Ecological Management Plan (*EMP*).[23]

28 The methodologies for the proposed stream diversions are outlined in Section 7.7 of the ESCP. With reference to the "sediment slugs" as referred to by Dr Death, the key methodology items to be considered are that the diversion itself is required to be fully stabilised (geotextile and rip rap suggested) prior to accepting any stream flows. In addition the downstream dam structure is designed to prevent backflow into the channel, and therefore at all times the potential for sediment release from these areas is significantly minimised. I have assisted with the design and implementation of these types of diversions on other projects with success and with minimal sediment release. I have not experienced

---

17 Paragraph 5.14 (b) of Dr Death's evidence.

18 Paragraphs 97-98 of Dr Keesing's rebuttal evidence.

19 ESCP Section 5.3.2.

20 ESCP Section 5.3.2.

21 ESCP page 23.

22 ESCP page 23.

23 The EMP itself is required under proposed condition G.34.

any "sediment slugs" as suggested by Dr Death and if this circumstance did ever occur I would suggest this is a direct result of poor practice and implementation. I remain of the view that the methodologies and controls in the ESCP will ensure that such an effect will not occur on this Project.

29 In response to Dr Death's concern that works in the Waikanae River and the diversion of Muaupoko Stream could generate significant adverse ecological effects, I note that for the Waikanae River works a set of specific plans have been provided,[24] further supported by a staged methodology within Section 7.10 of the ESCP. These detail the specific methodologies and sequence of works and will ensure an environmentally robust programme occurs. The proposed Muaupoko Streamworks form part of these details.

30 The Muaupoko Stream will be subject to a temporary diversion followed by excavation of a new channel in a "dry" environment. Within the Project there are a number of stream diversions required and in all of these (including the Muaupoko Stream), prior to introducing flows into the new diversion, full stabilisation is required to occur. Further I note that the Muaupoko Stream diversion occurs early in the sequence of works and once operational, will be protected fully from surrounding works with a super silt fence structure.

31 My original assessment of the suitability of this methodology remains and I assess the potential for any "sediment slug" to be very low. I also note paragraph 30 of Mr Brian Handyside's evidence (representing GWRC) where he indicates support for this construction methodology approach while confirming the need to address these activities through CESCP's.

Emily Thomson (KCDC)

32 Ms Thomson recommends changes to proposed condition G.27 related to the submission of a final ESCP for the Project.[25] She suggests:

32.1 A 20% change in visual clarity and deposited sediment be included within the condition as a standard to achieve;[26]

32.2 Specific wetland environments be identified as higher risk affording more detailed erosion and sediment control;[27] and

32.3 Hydroseeding and mulching be incorporated as a specific erosion control measure required for larger sand cut slopes.[28]

---

[24] Drawings CV CM 500 to 508 within Appendix H.R Management Plan Appendices, Appendix H of CEMP.

[25] Paragraph 10.5 of Ms Thomson's evidence.

[26] On the basis of Dr Death's evidence, paragraph 6.15(f).

[27] On the basis of Mr van Bentum's evidence, paragraph 6.2.

Response

33 I have addressed the issue of monitoring in my response to Dr Death but I reiterate that with respect to erosion and sediment control, the ESCP and my EIC outline the specific monitoring requirements for onsite measures and methodologies and I remain comfortable that these are appropriate and sufficient. They represent a monitoring programme whereby adaptive management and ongoing improvements can occur as necessary over the duration of the Project.

34 Ms Thomson refers to a visual clarity and deposited sediment percentage change of 20% to any receiving environment as a suitable sediment threshold. I am unsure of the background to this 20% value for this Project, which was suggested in the evidence of Dr Death, and consider that there are no effects or erosion and sediment control rationale to support this. While measuring clarity may assist with monitoring sediment discharge effects, as Dr Keesing confirms, triggers for responses will be difficult unless a good baseline data set is available. While clarity measurement may be undertaken within the Project, I remain of the view that these would need to be targeted to specific environments only. Overall I confirm that the current approach adopted within the ESCP will adequately ensure that sediment is monitored and discharges are minimised throughout.

35 Ms Thomson suggests including the specific names of a number of wetland features that require particular emphasis within the proposed consent condition G.27 requiring submission of a new ESCP. I consider that including reference to specific wetland features is appropriate and I accept, from an erosion and sediment control perspective, that this would be helpful for the Project implementation in ensuring these environments afford particular attention. I have included Ms Thomson's suggested amendments, with some changes to receiving environments reference names, to proposed condition G.27(d) in **Annexure A** of this evidence.

36 Ms Thomson also suggests an addition to proposed consent condition G.27 where the ESCP must provide for mulch and hydroseeding to be used on larger cut sand slopes. I do not agree with such an inclusion:

36.1 Firstly, as outlined in my response to Mr van Bentum above, hydroseeding in itself is not an erosion control measure, and while it would assist with more rapid vegetative growth, it would not be effective in immediately managing erosion of the sand cut areas.

36.2 Secondly, flexibility must remain with the erosion control techniques and there may be more effective measures, other than mulch, which can be applied as an erosion control

[28] On the basis of Mr van Bentum's evidence, paragraph 6.4.

measure on these slopes. The CESCP's will ensure that such provisions apply.

Alton Perrie (GWRC)

37 Mr Perrie states that *"Large increases in sediment inputs are predicted to occur to some rivers and streams in the project area."* He notes the predicted increase within the Waimeha Catchment of 25% and refers to this as a significant increase.[29]

38 Mr Perrie states that *"There appears to be no provision made for water quality monitoring during construction in the draft monitoring plan"* and suggests that it would be appropriate to monitor parameters such as total suspended solids and or turbidity upstream and downstream of significant areas of instream works or earthworks.[30]

Response

39 Mr Perrie is correct in that the USLE calculations show a comparative increase in sediment yields to the Waimeha Catchment of 25%. I emphasise that the USLE is a comparative assessment tool only and it provides a measure of the risk of sediment generation and yields, and assists in identifying controls required for managing this risk to the environment from sediment discharges. As detailed in my EIC, GWRC has also confirmed that the USLE should be used as a risk assessment process rather than a specific sediment yield estimation tool for the purposes of determination of specific effects.[31]

40 I also consider that further caution needs to be applied when considering the 25% figure in isolation. The 25% represents a comparative increase from the larger catchment area, from 2.37 tonnes to 2.97 tonnes overall. Effectively the actual estimated tonnage of sediment yield remains low.

41 In relation to Mr Perrie's concern about monitoring, I disagree that no provision is being made for water quality monitoring during construction. Monitoring of the specific erosion and sediment control measures is detailed within the ESCP and my EIC.[32] This includes ongoing site monitoring by the Project team to ensure that the proposed erosion and sediment control measures have been installed correctly, and that required methodologies are being followed and are functioning effectively throughout the duration of the works.

42 Baseline surveys will define the antecedent conditions within the Project area by measuring preconstruction environmental (including ecological) variables. Scheduled monitoring will be undertaken

---

29 Paragraph 16 of Mr Perrie's evidence.

30 Paragraph 19 of Mr Perrie's evidence.

31 Paragraph 41 of my EIC.

32 ESCP Section 5.3 and my EIC paragraphs 86 to 95.

during the construction period and triggered monitoring will occur when pre-determined thresholds are exceeded.

43 'Devices' monitoring comprises the monitoring of on-site construction activities, but more particularly the monitoring of on-site structures and devices designed to control the potential adverse effects of those site activities (in particular erosion and subsequent sedimentation). The key purpose of this monitoring is to ensure that all practices, control measures and devices are constructed, operated and maintained so they remain fully effective at all times. The 'Devices' monitoring will act as a trigger for more detailed monitoring or remedial action should this be required. During the undertaking of activities considered higher risk, the monitoring of devices will be undertaken on a daily basis and more frequently during heavy rainfall. This will be undertaken with the checklists provided.

44 In the event that adverse impacts on the receiving environments are detected by the ecological monitoring programme, a possible (cause-effect) association with the Project will be investigated and erosion and sediment control measures and methodologies fully investigated and amended as necessary.

Brian Handyside (GWRC)

45 Mr Handyside states that he is in:

> general agreement with the [Project's] erosion and sediment control approach" and considers "the proposed methodology and measures should generally be appropriate.[33]

46 He also notes that:

> There is a significant level of detail in the application documents and this allows a good appreciation of how the sediment related effects are to be avoided, remedied and mitigated. This approach is supported. I also support the proposal that detailed Construction Erosion and Sediment Control Plans (CESCPs) would subsequently be prepared for individual work areas because this allows focussed methodologies and control measures to be developed and tailored for specific sites and activities. There is depth to the application documents and these have been very helpful when assessing the potential sediment related implications of the project.[34]

47 I also note Mr Handyside's general support for the ESCP when he states:

> Appropriately constructed and maintained ponds are generally considered to be the most effective sediment retention measure on earthwork sites. I understand that the project proposes to use rock check dams on sand with the aim of encouraging infiltration to ground; and that decanting earth bunds are proposed where there is underlying peat (and a high water table). Although ponds are the usual mainstay for sediment retention on most earthwork sites, I consider that the proposed rock dams and decanting earth bunds should work satisfactorily on this project

[33] Paragraph 3 of Mr Handyside's evidence.

[34] Paragraph 15 of Mr Handyside's evidence.

> because of the free draining nature of the underlying sand and the expected rapid deposition of the sand sized particles. In doing so I assume that the free draining sand soil characteristics are not compromised by clogging e.g. with the fine textured sand material.[35]

48 Mr Handyside notes the potential for impeded drainage of the sand soil profile due to the fine sand that may be encountered within the Project. While he states that this could have sediment discharge implications, he goes on to say that it is a maintenance and monitoring issue.[36]

49 With respect to the CESCPs, Mr Handyside suggests that while this approach is supported it is important that all land disturbing activities be addressed by CESCPs.[37] He further comments on the use of "Turkey Nests" which are proposed within the Project and notes their unsuitability.[38] Turkey Nests are temporary small impoundments which are lined with geotextile material. Water flows through these with sediment retained by the geotextile. It is proposed within the ESCP to utilise these Turkey Nests as part of pumping and the peat replacement methodologies. Mr Handyside's opinion of Turkey's Nests appears to be due to such a control measure not being included within the GWRC Erosion and Sediment Control Guideline.

50 Mr Handyside has included an attachment to his evidence within which he addresses some concerns related to overall efficiency of sediment control measures and also provides commentary on the USLE calculations undertaken. Mr Handyside considers an efficiency of 86% is a more accurate sediment control efficiency percentage figure for sediment control measures.[39]

51 USLE outcomes provided by Mr Handyside result in a sediment yield of 40 tonnes which essentially represents a threefold increase from that calculated within the ESCP. No specific calculations to support this outcome were provided. He also comments on the level of uncertainty within the USLE calculations and states a figure of ± 25%. Mr Handyside notes that he assesses the overall comparative assessment process to not be representative of actual yields on a catchment wide scale and therefore considered that the USLE is not appropriate in this regard.[40]

---

35 Paragraph 26 of Mr Handyside's evidence. Mr Handyside offers further support for the ESCP approach at paragraph 45 of his evidence.

36 Paragraph 20 of Mr Handyside's evidence.

37 Paragraphs 24 and 52.1 of Mr Handyside's evidence.

38 Paragraph 27 of Mr Handyside's evidence.

39 Attachment A to Mr Handyside's evidence, page 4.

40 Paragraphs 47 and 50 of Mr Handyside's evidence.

52 As a result of the USLE outcomes provided, Mr Handyside questions the conclusions reached by both Dr Keesing and Dr De Luca on behalf of NZTA.[41]

53 Mr Handyside places some emphasis on the proposed monitoring programme. He notes that no water quality discharge standards are proposed and suggests a rapid feedback clarity orientated condition could be appropriate for site monitoring purposes.[42] He notes Section 5.3 of the ESCP where it records that any noticeable change in water clarity from that prior to the rainfall event, or upstream of the site works, as a result of the earthworks activity will result in a review of the erosion and sediment control measures implemented and changes made as necessary.

54 Finally, Mr Handyside outlines a number of amendments to the proposed consent conditions.

Response

55 Mr Handyside shows general support for the ESCP and the principles and practices within it. He supports the control measures and methodologies including the chemical treatment proposed.[43] The five areas of concern as outlined above, appear to be:

55.1 Impeded drainage of sand soil profile and therefore impact on sediment control devices;

55.2 The use of Turkey Nests as an appropriate sediment retention measure;

55.3 The use of 95% as an efficiency figure that will be obtained with respect to sediment retention within sediment control devices;

55.4 USLE assumptions and resultant sediment yields; and

55.5 Proposed environmental monitoring.

Sand Soil Profile

56 The sand-dominant soils within the Project are subject to significant infiltration and can erode relatively easily if surface runoff occurs, but will settle very quickly within a water column. Permeability rates of sand are well recognised as significantly higher than those of clay based soils and within the Project many of these areas are expected to experience minimal runoff at all times. Mr Handyside has expressed concern that this infiltration may be impeded over time. While some compaction may result over time, I assess that the high rates of infiltration can continue to be monitored over time

41 Paragraphs 49 to 51 of Mr Handyside's evidence.

42 Paragraph 48 of Mr Handyside's evidence.

43 ESCP Section 7.12.

and if such a problem eventuates (as Mr Handyside suggests) then maintenance, in the form of removal, or rakings, of the top 20 to 50mm layer of sand, can occur to reintroduce the original drainage pattern. The CESCPs required within proposed Condition E.3 will address this maintenance requirement.

57 I note Mr Handyside refers to the control measures in these sand environments as rock check dams.[44] It is important that these are not confused with the rock check dams within the GWRC Erosion and Sediment Control Guideline which form a different function. Within this Project and the associated ESCP, the control measures are referred to as Rock Filters with the associated design drawings also provided.

58 Importantly the Rock Filters are also located within the Project on places of low gradient and this in itself results in large areas within the associated swales where ponding can occur. Therefore if infiltration does become reduced over time in certain locations, significant ponding areas will provide a further "buffer" with infiltration continuing along its length.

Turkey Nests

59 With respect to the use of "Turkey Nests" as an erosion and sediment control measure this is a specific measure which, like all erosion and sediment control measures, has an appropriate place within the Project. Mr Handyside seems to suggest that because such a measure is not included within the GWRC Erosion and Sediment Control Guidelines, that it is not appropriate.[45] Such measures are used on a national basis for pumping activities and can be very effective in managing sediment discharges from a site. As detailed within Section 7.2 of the ESCP, pumping forms a key component of the peat replacement process and in this regard Turkey Nests are proposed. Section 7.9 of the ESCP further details this proposed pumping which includes some 'pre treatment' prior to the discharge. I consider that Turkey Nests should remain as a key control measure within this methodology and while it is expected they will only be used for pumping, should not be limited to this alone. Again the CESCPs will allow for such flexibility (and certification by GWRC) to occur to ensure appropriateness of this as a measure.

60 It is unclear why Mr Handyside suggests that Turkey Nests should be supplemented with other control measures such as a sediment retention pond. Given the methodologies provided and the results of the peat replacement trial, I consider this is unnecessary.[46]

---

44 Paragraphs 26 and 29 of Mr Handyside's evidence.

45 Paragraph 27 of Mr Handyside's evidence.

46 ESCP Section 7.2 and 7.3.

95% efficiency

61 As noted above, Mr Handyside has provided some calculations to demonstrate the 95% sediment control measure efficiency is too high.[47] He appears to make assumptions about the proposed efficiency of control measures within peat soils, gravels and sand. I am unsure where these assumptions have derived from but they do not appear to take account of the nature of the specific control measure to be used and the use of chemical treatment to be determined through the CESCP's.

62 As detailed within my EIC,[48] the ESCP outlines the emphasis which is placed on erosion control and prevention of sediment generation as a first step. The peat replacement trial and chemical treatment investigations both demonstrate the very effective nature of the control measures and provide a large degree of confidence that high sediment removal efficiencies can be obtained.[49] I also note the very high natural infiltration rates that will occur within the sand environments and, in this regard, my experience confirms that runoff in un-compacted sand locations will be minimal.

63 I note that with respect to sediment control efficiencies, Mr Handyside refers to the Transmission Gully project.[50] Again I reiterate the completely different nature of that project and its environment from this Project. Mr Handyside acknowledges the different soil types, but importantly other site conditions including slope length and slope angles in particular are also different and there is no sensible comparison that can be made. For example, site grade alone will significantly reduce (or increase) erosion potential with the knowledge that as we double a slope angle, we triple sediment generation from this slope.

64 I remain of the view that 95% is an appropriate efficiency figure that can be achieved overall throughout the Project implementation.

USLE assumptions and sediment yields

65 While USLE calculations have not been provided by Mr Handyside, he has detailed his assumptions and conclusions within his evidence.[51]

66 While he agrees with the use of the USLE model as a comparative tool for the Project footprint, from a whole of catchment perspective Mr Handyside suggests that a much higher sediment yield would apply and therefore to undertake a comparative assessment is inaccurate.[52] It remains a little unclear, but it appears that Mr

---

47 Attachment A to Mr Handyside's evidence.

48 My EIC, paragraph 108.

49 Appendix H.L of ESCP.

50 Paragraph 28 of Mr Handyside's evidence.

51 Annexure A to Mr Handyside's evidence.

52 Paragraph 46 and 47 of Mr Handyside's evidence.

Handyside essentially endorses the USLE as a sediment yield estimation tool and in particular from a pre construction to during earthworks comparison perspective for the Project alone. However, Mr Handyside appears to not support such a comparative approach using USLE on a catchment wide scale.

67 For explanation purposes, I confirm that in undertaking the USLE I have used the specific slope classes from within the Project footprint and have simply extrapolated this out to the wider catchment on a pro-rata basis. I have not attempted to assess the wider catchment differences or sediment loads from stream bank and bed erosion. I remain of the view, however, that for comparative purposes only, the USLE remains as a sensible risk assessment tool to allow some appreciation of the percentage increase in sediment yields, on a catchment wide basis, from the Project.

68 To undertake an accurate catchment wide sediment yield assessment would require water quality and flow monitoring at the base of the catchment to be undertaken over a long period of time or (as an alternative) a full detailed catchment wide study of land use, slope, soil type and sediment generation and yield modelling. However, for the purposes of comparative assessment only this is not considered necessary.

69 Mr Handyside does not appear to provide an alternative comparative assessment tool but instead makes some broad assumptions as to percentage of different land class within the wider catchment and relies on other Project sediment yield information. This includes some detail from the Transmission Gully project.[53]

70 Mr Handyside considers, as an example, that the Wharemauku Catchment sediment yield is 3 times the USLE calculated figure.[54] If Mr Handyside's assessment is taken as appropriate, this has the effect of reducing the Project footprint sediment yields as a proportion of that overall catchment yield to a percentage increase of less than 2%. While the other catchment areas have not been assessed further, if a similar approach to that suggested by Mr Handyside was taken for these catchments, then the percentage increase of sediment yield from the Project footprint would **reduce** significantly from what is currently calculated and shown within the ESCP.[55]

71 Mr Handyside appears comfortable with the pre construction sediment yields and through his own calculations arrives at a similar conclusion. This indicates general support for the USLE calculations provided in my ESCP.[56]

---

53 Appendix A Mr Handyside's evidence.

54 Section 3.1 Appendix A Mr Handyside's evidence.

55 Page 14 ESCP.

56 Paragraph 38, Section 3.2, Appendix A of Mr Handyside's evidence.

72 During the construction phase Mr Handyside also appears comfortable with the factors used within the USLE representing rainfall, length slope factor, cover factor and sediment delivery ratio.[57] Mr Handyside questions, however, the soil erodibility factor (K factor), erosion control practice factor (P factor), duration of works and sediment control efficiencies. I have discussed the efficiency of the sediment control measures above in my earlier rebuttal evidence.

73 The Soil Erodibility Factor, or the K Factor, is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. This is predominantly driven by soil texture however structure, organic matter and permeability also contribute and are taken into account. The preferred method of calculating this factor is the nomograph method whereby the percentage of clay, silts and sands is utilised. Within the ESCP I have calculated the K factor using the soil size faction analysis undertaken for the Project.

74 Mr Handyside has included a percentage of very fine sand (particle size between 0.05 and 0.1mm diameter) within his USLE assumptions (taken from the Project's Technical Report 36) and as a result has adjusted the K factor accordingly. I have been unable to check his calculations as they have not been provided. However, I agree that I have not incorporated this very fine sand component within the K factor used and as a result I have recalculated the sediment yield with adjusted K factors.

75 Importantly, Mr Handyside in incorporating this fine sand fraction appears to have made an error and accordingly the K factor should be assessed as 0.3, rather than the 0.41 as he has indicated[58]. The overall implication of this and my revised calculations are discussed in paragraph 80-81 below.

76 With respect to the Length Slope (LS) factor,[59] while Mr Handyside accepts the LS factors utilised, he casts some doubt over the benefits of the use of contour drains as an erosion control factor. I note that the use of contour drains is an accepted practice on all earthworks sites and is a recognised temporary erosion control measure within the GWRC Erosion and Sediment Control Guidelines. This erosion control measure will be utilised on the site and will be a key, pre rain measure installed prior to forecast rain events. Where these are installed a corresponding decrease in erosion of the soil profile will occur.

77 The erosion control practice factor, or P Factor, is defined within paragraph 48.5 of my EIC. I have assessed this factor as 0.9 which is representative of a rough irregular surface for the Project

---

[57] Section 3.3 Appendix A Mr Handyside's evidence.

[58] Section 3.2 Appendix A Mr Handyside's evidence.

[59] Defined in paragraph 48.3 of my EIC.

earthworks footprint. Mr Handyside has assessed the factor as 1.0. The full rational for his choice of 1.0 is unclear. I remain of the view that 0.9 will represent the soil surface during a rain event and also is reflective of the high infiltration rates of sand that will be encountered.

78 Mr Handyside has assessed that the area open at any one time would be a 4 month window. This appears to be based on the overall area of the Project footprint and the overall expected Project duration. It does not appear to take into account the methodologies and in particular the progressive stabilisation that will occur within the Project.

79 With respect to the duration of earthworks, I have detailed this within my EIC.[60] For the purpose of the USLE I have assumed a 2 month window as the expected timeframe prior to stabilisation of that specific area of works. Again I emphasise the use of USLE as a comparative analysis tool only. While the 2 month window is the expected duration of exposed surfaces, there will be times where such periods are reduced or exceeded dependent upon site conditions at that time. If the duration of earthworks exceeds that as assumed within the USLE, there is the ability to manage this through the provision of more progressive stabilisation techniques and the implementation of further measures (such as contour drains) to further reduce slope lengths and reduce sediment yields accordingly. Such details will be provided within the CESCPs to be developed under proposed Condition G.28.

80 I have included within **Annexure B** of this rebuttal evidence revised USLE calculation spreadsheets which take account of the revised K factor (for very fine sand) as noted above. I have also reduced slope lengths to 50 metres for the Project which is considered more representative of what can be expected to be implemented within the Project. In doing so, the total sediment yields for the Project footprint are actually <u>further reduced</u> than originally calculated. This is illustrated in **Table 1** below.

81 I conclude therefore that the USLE figures provided by Mr Handyside are not representative of the site, and that through good project management and implementation of erosion and sediment control measures, the USLE calculations provided within this rebuttal are more representative of the site. While these calculations are primarily for comparative analysis purposes, I note a small reduction in sediment yields from what was originally calculated within my ESCP.

[60] Paragraph 52 of my EIC.

Sediment Yield (tonnes) Over a 2 Month Period	Project Footprint Pre Earthworks	Whole Catchment Pre Earthworks	Project Footprint During Earthworks	Whole Catchment Less Project Footprint Pre Earthworks	Whole Catchment Including Earthworks Area	% Increase – Pre Earthworks to Earthworks Whole Catchment
Whareroa	0.11	18.17	0.42	18.06	18.48	1.7
Wharemauku	0.87	38.02	3.38	37.15	40.53	6.6
Waikanae	1.16	644.72	2.99	643.57	646.56	0.3
Waimeha	0.16	2.37	0.60	2.20	2.80	18.1
Ngarara	1.90	50.56	5.19	48.66	53.85	6.5
Totals	**4.21**	**753.84**	**12.58**	**749.63**	**762.22**	**1.1**

Table 1 – Updated USLE Calculations[61]

82 **Dr Keesing** and **Dr De Luca** further assess these sediment yields from an effects perspective in their rebuttal evidence.

Proposed Environmental Monitoring

83 With respect to monitoring of the erosion and sediment control measures, Mr Handyside suggests a consent condition requiring water clarity measurements associated with the erosion and sediment control measures and as a result ensuring instant feedback during site monitoring.[62] With respect to erosion and sediment control, the ESCP and my EIC outline the specific monitoring requirements for onsite measures and methodologies and I remain comfortable that these are appropriate. They represent a monitoring programme whereby adaptive management and ongoing improvements can occur as necessary over the duration of the Project. I also refer to paragraphs 25 above of this rebuttal evidence.

Proposed conditions

84 Mr Handyside suggests a number of amendments to the proposed consent conditions, and I will discuss these next. I attach an amended set of conditions, incorporating those of Mr Handyside's suggestions which I support (see **Annexure A** of this rebuttal evidence).

85 Condition G.28. I agree with the proposed changes.[63] The CESCPs are designed to cover this wide range of activities. I note that for a specific activity, such as peat replacement, which is repeated throughout the Project, one CESCP that covers the general activity may be sufficient. I recommend that a sentence be added to the Advice Note to confirm this scenario. I also accept that removal of the word "stage" is appropriate in the context of the CESCPs.[64]

---

61 Table 1 should be considered in comparison to the sediment yield tables on page 14 of my EIC. The key difference between these tables is the reduction within Table 1 of the sediment yields from the Project footprint as a result of the revised USLE calculations. This has a consequential reduction in the whole of catchment sediment yields (including the earthworks footprint), and a reduction in the % increase in sediment yield from pre earthworks to during the construction period.

62 Paragraph 52.4 Mr Handyside's evidence.

63 Paragraph 52.1 of Mr Handyside's evidence.

64 Paragraph 52.12 of Mr Handyside's evidence.

86 Condition E.8(d). I agree with the proposed changes[65] which reflect a proactive and ongoing maintenance programme.

87 New Condition – Turkeys Nest.[66] For the reasons as detailed earlier, I consider that this condition is not necessary.

88 New Condition – Monitoring regarding water clarity.[67] While it is unclear if Mr Handyside is actually suggesting a new condition, for the reasons detailed earlier, I consider that such a condition is not necessary.

89 New Condition – CESCP.[68] I agree with the proposed changes which provide specific reference to determining if chemical treatment is required as part of the CESCP preparation process. I have proposed an amendment to Condition E.3(c) to support this. This also supports the existing wording of Condition E.11.

90 New Condition – Open Areas.[69] Based on the USLE calculations provided which demonstrate a comparatively low sediment yield and overall percentage increase in sediment yields, and the associated effects assessment of Dr Keesing and Dr De Luca, I consider such a condition is not necessary. This is further supported by the necessity to undertake progressive stabilisation on the Project as detailed in condition E.3(h).

91 New condition – Stabilisation.[70] This is not considered necessary as it is adequately addressed through the CESCPs (Condition E.3), which includes provision for managing non stabilised areas of earthworks, including through progressive stabilisation.

92 New Condition – Stabilisation definition.[71] A definition is considered useful for the term stabilisation. However, for the purposes of defining if a surface is stabilised, in my opinion there is no need to have approval or an inspection by the "Manager" as suggested by Mr Handyside. Stabilised is a well understood term and can be assessed as per the definition by any party (including contractors) on the Project. I have proposed wording to be incorporated into an Advice Note associated with Condition E.3.

93 New Condition – Storm Monitoring.[72] This is not considered necessary as it is addressed through Condition E.8.

---

65 Paragraph 52.2 of Mr Handyside's evidence.

66 Paragraph 52.3 of Mr Handyside's evidence.

67 Paragraph 52.4 of Mr Handyside's evidence

68 Paragraph 52.5 of Mr Handyside's evidence

69 Paragraph 52.6 of Mr Handyside's evidence.

70 Paragraph 52.7 of Mr Handyside's evidence.

71 Paragraph 52.8 of Mr Handyside's evidence.

72 Paragraph 52.9 of Mr Handyside's evidence.

94 Condition G.11. I agree with the importance of the proposed training and the need to ensure that this is focused and addresses key issues. While the wording suggested by Mr Handyside[73] is generally accepted, I recommend some further amendments to his proposed wording as detailed within G.11 of Annexure A.

95 Condition G.27 (f).[74] This is not considered necessary as it is adequately addressed through the existing provisions of Condition G.27. In particular, that condition already requires the compliance with the existing ESCP provisions including progressive stabilisation.

96 Condition G.28.[75] I agree with the removal of the term "stage" from this condition for the reason outlined by Mr Handyside.

97 Condition E.1. Mr Handyside suggests a number of amendments to ensure the ESCP is appropriate for the Project.[76] I consider these changes are unnecessary as the same ESCP is required through Condition G.27 and within that condition the requirements are clearly documented. In particular Condition G.27 includes the need to follow the principles and practices within the current ESCP document. I do however endorse some minor amendments to Condition E.1 for clarity purposes as per Annexure A.

98 Condition E.3. I consider that the staging requirements and detailed schedule of construction activities as suggested by Mr Handyside are not necessary.[77] The existing provisions of Condition E.3 are considered robust enough to ensure that adequate transfer of information and detail is provided to the necessary parties. I do however acknowledge that there needs to be an ability to make amendments to the CESCP's, and this needs to be a clear process whereby the ESCP principles still continue to be achieved. I agree with Mr Handyside's recommendation in this regard but with the proviso that such amendments need to be more than a minor change. (For example, if a silt fence is proposed to be moved a few meters with the same function then no additional certification should be required. However if a sediment retention pond is to be removed and replaced with a decanting earth bund, then further certification will be required from the Manager). I propose a change to Condition E.2 to accommodate this recommendation, with no consequential change to Condition E.3 required.

99 Condition E.7. I agree with Mr Handyside[78] that the reference should be to all "erosion and sediment control measures".

---

73 Paragraph 52.10 of Mr Handyside's evidence.

74 Paragraph 52.11 of Mr Handyside's evidence.

75 Paragraph 52.12 of Mr Handyside's evidence.

76 Paragraphs 52.13 and 52.14 of Mr Handyside's evidence.

77 Paragraph 52.15 of Mr Handyside's evidence.

78 Paragraph 52.16 of Mr Handyside's evidence.

100 Condition E.8. I do not consider it the role of the Consent Holder to report any non compliance and while these circumstances (if they occur) will be recorded and addressed within the Project documentation, I do not consider it necessary or appropriate to include such an amendment to this condition as suggested.[79] The conditions clearly outline the requirements for the consent holder and should those requirements not be met, then it is a non-compliance issue and will be considered as such by Council through its compliance monitoring programme.

Richard Percy (GWRC)

101 Mr Percy refers to Mr Handyside's evidence and in particular references the need to address the effects on the freshwater and marine receiving environment.[80] This is in particular reference to the USLE calculations as provided by Mr Handyside. Mr Percy also makes reference to the efficiency of the sediment control devices referred to within the ESCP.[81]

Response

102 I have responded to the above matters in my response to Mr Handyside's evidence.

103 Mr Percy suggests a number of amendments to the proposed consent conditions. As not all of the suggested amendments are clear, I respond below to key amendments. I also set out my suggested amendments to the proposed conditions in **Annexure A** to this rebuttal evidence.

104 Condition G.27. Mr Percy suggests a number of formatting and grammatical changes to the condition.[82] I agree with these changes as they have no fundamental bearing on the intent of the condition.[83] I do not however consider it necessary to expand on the technical information to be provided within the ESCP or to detail the guideline documents to be followed as Mr Percy suggests. There is already a linkage between this condition and Condition E.1 which requires submission and implementation of an ESCP. This contains a lot of detail and also reference to the guidance documents as appropriate. In addition, the existing draft ESCP contains a significant amount of information and design details which will likely be repeated within the ESCP.

105 I do not agree with a 20 working day timeframe for submission of the ESCP. 15 working days is considered appropriate for GWRC to engage expertise if necessary and to review and provide any comments associated with the ESCP. This again is in recognition

79 Paragraph 52.17 of Mr Handyside's evidence.

80 Paragraphs 83-84 of Mr Percy's evidence.

81 Paragraph 92 of Mr Percy's evidence.

82 Page 26 of Mr Percy's evidence.

83 Refer Annexure A for suggested amendments.

that a significant amount of design and detail exists within the ESCP already submitted which has already been reviewed in detail by GWRC.

106 I disagree with Mr Percy that reference to the NZTA Environmental Plan be deleted from Condition G.27. This is an overarching document which provides the basis for the overall environmental approach and principles of NZTA to erosion and sediment control and as such provides an important guidance document.[84]

107 Condition G.28. Mr Percy suggests a number of formatting and grammatical changes to the condition.[85] I agree with these changes as they have no fundamental bearing on the intent of the condition and assist with the clarification and overall understanding. I am unsure why Mr Percy requests removal of the Advice Note. I consider this should remain as it provides a key linkage back to the current ESCP document.

108 Conditions E.1 and E.2. Mr Percy suggests deletion of these conditions and advice notes.[86] Mr Percy notes that the content is already covered within Condition G.27 and G.28. However, I consider that the conditions are important as standalone conditions to ensure the earthworks provisions are clear. I am comfortable that, provided consistency remains between these conditions (E.1/E.2 and G.27/G.28), they are appropriate. I consider that the other documents that Mr Percy references are already detailed within condition E.1 (and I have commented on the suggested deletion of the NZTA's Environmental Plan in relation to G.27 above). I also endorse some minor amendments to Condition E.1 and E.2 for clarity purposes as per Annexure A.

109 Condition E.3.[87] As I explained earlier at paragraph 98, I consider that the staging requirements and detailed schedule of construction activities are not necessary.

110 Condition E.4. Mr Percy suggests a number of changes to this condition.[88] I accept these changes as appropriate.

111 Condition E.7. I agree with Mr Percy's suggested change[89] related to the reference to all control measures. However I disagree with the suggestion that 10 working days notice is required and that approval of the Manager is required. The time period in the condition is the specified timeframe for informing GWRC of removal of erosion and sediment control measures. 2 working days is

84 Refer to Appendix H.O of ESCP.

85 Page 26 of Mr Percy's evidence.

86 Pages 30 and 31 of Mr Percy's evidence.

87 Page 31 of Mr Percy's evidence.

88 Page 31 of Mr Percy's evidence.

89 Page 31 of Mr Percy's evidence.

considered appropriate to allow GWRC to act accordingly on the notification of such intent to remove any erosion and sediment control measures. As the condition specifies, if the stage or subcatchment area is not stabilised or is not in accordance with the CESCP,[90] then control measure removal cannot occur as per the condition. No formal decision or approval from GWRC is therefore required and 2 days notice is considered adequate.

112 Condition E.8. I agree with the minor amendments suggested.[91] However, I consider there is no need to include performance standards, conditions detailing the adaptive management regime or reporting of non compliance. These aspects are already addressed within the CESCPs and the ecological monitoring and reporting required by other conditions of consent.[92]

113 Condition E.9. Mr Percy suggests a number of amendments that provide specific items to be addressed in the event of a discharge covered by proposed condition E.9.[93] I consider these additions unnecessary. The response to any such discharge is totally dependent upon the nature of the storm event and the associated discharge itself. It is not considered practical to try and predetermine these aspects.

114 Condition E.10. Mr Percy suggests all aspects of the site should be subject to at least weekly monitoring and inspection.[94] I agree with this as a general best practice and that the inspections will not be limited to haul roads. With ongoing activities on the site, such a frequency of monitoring will occur by default. I propose a change of condition wording to reflect that all working stages of the site will be subject to weekly inspections as a minimum.

115 Condition E.11. While the general amendments suggested are considered appropriate, I consider that the need to state when chemical treatment will be implemented is not necessary.[95] The CESCPs are designed to specifically identify if chemical treatment is required and, if so, how such a process will occur. It is not until these CESCPs are developed that there will be the opportunity to determine if such chemical treatment is required. I agree with Mr Percy that the condition needs to state that any amendments to the CTP shall be submitted (not approved) a number of days before implementation. However I disagree with the 10 day duration suggested. I propose a 5 day duration as this is considered adequate time to allow Manager consideration. It will also ensure

---

90 Refer to Condition E.3 (m) re CESCP.

91 Page 31 of Mr Percy's evidence.

92 For example Condition E.3 (j), E.8, E.9 and G.34 to G.40.

93 Page 32 of Mr Percy's evidence.

94 Page 32 of Mr Percy's evidence.

95 Page 32 of Mr Percy's evidence.

consistency with Condition G.28 as outlined earlier in this rebuttal evidence.

116 General New Conditions. Finally, I note that Mr Percy identifies a number of areas where further conditions may be required.[96] I have not provided any further comment on these except to note that many of the items identified are already addressed within existing conditions and within existing proposed amendments. I have taken this position due to the lack of detail provided to enable assessment of what is actually proposed by Mr Percy.

117 I note however that the discharge of treated cement contaminated water as raised by Mr Percy, was addressed through the ESCP and my EIC. With respect to cement contamination from concrete works, it is important to recognise that there is no intention within the Project to discharge such a contaminant directly into the receiving environment. Treatment of cement runoff is specifically outlined and includes the use of housekeeping practices, discharging through appropriate filter facilities or direct removal from the site via sucker truck. Dedicated concrete wash facilities will be established on site as required. Further to this and, if necessary, any discharges on site will be discharged only after treatment through treatment tanks and bark filled filter socks with pH checked prior to discharge to the stream environment. I note the while this detail will again be included within the ESCP, there were no specific conditions related to this discharge. I have therefore recommended an addition to Condition E.3 which provides specific reference to this discharge and requires the submission of the details of the treatment of any contaminated discharge, other than sediment, and in particular that associated with cement. **Annexure A** now contains this recommended condition.

CONCLUSION

118 In my opinion, the submitters' evidence has not raised any valid concerns regarding the assessment of effects related to erosion and sediment control, nor the overall management approach provided in the ESCP to address these effects. Where issues such as the USLE have been discussed within submitters' evidence,[97] I remain of the view that I have assessed the erosion and sediment control aspects correctly and appropriately for the Project to enable effects to be assessed.

119 As detailed above, I have accepted a number of amendments to the proposed conditions suggested by submitters. The further amendments to conditions which I agree with and now propose are shown in **Annexure A.**

---

[96] Page 33 of Mr Percy's evidence.

[97] Evidence of Mr Handyside.

120 I note the evidence of Mr Handyside and the further issues he has raised. All of these items are considered to have been addressed and adequately considered within the ESCP, my EIC and this rebuttal evidence.

Graeme Ridley
25 October 2012

ANNEXURE A – PROPOSED CONDITIONS REFERRED TO IN THIS REBUTTAL STATEMENT

Further changes I am proposing to conditions are shown in underline for additions and ~~strikethrough~~ for deletions.

	Staff Training
G.11	The consent holder shall ensure that ~~earthworks contractors~~ personnel responsible for supervising earthworks site staff i.e. foremen, supervisors and managers shall undergo environmental awareness training, required by the CEMP. This training shall occur prior to the commencement of any earthworks or earthworks stage and shall be given by a suitably qualified and experienced person certified by the Manager to deliver ~~a~~ practical on-site training ~~session~~. Specifically, ~~contractors shall be briefed as follows~~ training shall include but not be limited to: a) ~~Contractors likely to be involved in the construction and maintenance of erosion and sediment control devices shall receive training on the performance standards~~ Design details for the erosion and sediment control devices and associated methodologies; ~~and~~ b) ~~Contractors likely to be involved in the construction~~ Details of any stream diversions or other in-stream works or wetlands, ~~shall be briefed~~ briefing on the values of the streams and wetlands, the objectives ~~of~~ for stream and culvert design and construction erosion and sediment control measures, the requirements of native fish for fish passage, and the sensitivity of the receiving environment to sediment discharges; c) ~~Contractors~~ For supervisory and management personnel likely to be involved in any works involving vegetation clearance, ~~shall be briefed~~ briefing on the values of any significant areas of vegetation that are to be retained, and the methods that shall be used to identify and protect them during construction; and d) ~~All contractors shall be briefed~~ Briefing on the requirements of Te Ati Awa ki Whakarongotai and Takamore Trust for cultural ceremonies to occur before the commencement of works. The environmental awareness training shall include a process and programme for training of new staff members joining the project team, and for any staff moving to a new CESCP area within the project. This environmental awareness training shall continue for the duration of the project earthworks.
	Erosion and Sediment Control Management Plan
G.27	The consent holder shall ~~finalise~~, submit ~~and implement through the CEMP,~~ an Erosion and Sediment Control Management Plan (ESCP) to ~~be submitted to~~ the Manager for certification at least 15 working days prior to works commencing in accordance with Condition E.1.

	The purpose of the ESCP is to describe the methods and practices to be implemented to minimise, avoid, remedy or mitigate the effects of sediment generation and yield on the aquatic receiving environments associated with the Project. In addition, the ESCP shall: a) Outline the principles that the ESCP shall ~~seek to~~ adhere to; b) Be developed in accordance with the objectives outlined in NZTA's Environmental Plan~~, including;~~ c) ~~Ensuring~~ Ensure construction and maintenance activities avoid, remedy or mitigate effects of soil erosion, sediment run-off and sediment deposition; d) Identify areas susceptible to erosion and sediment deposition and implement erosion and sediment control measures appropriate to each situation with particular emphasis on high-risk areas, including El Rancho Wetland (Weggery), Raumati Manuka Wetland (between Poplar Avenue and Raumati Road), Southern Otaihanga Wetland and the Northern Otaihanga Wetland (adjacent to Otaihanga Landfill); and e) Use bio-engineering and low-impact design practices where practicable. Works shall not commence until the consent holder has received the Manager's written certification for the ESCP. ***Advice Note:*** *This ESCP shall follow the principles and practices ~~as outlined within~~ and be consistent with the ESCP, Appendix H of the CEMP.*
G.28	The consent holder shall ~~prepare,~~ submit ~~and implement through the CEMP,~~ site specific Construction ~~[stage]~~ Erosion and Sediment Control Plans (CESCP), for all land disturbing activities including streamworks, to ~~be submitted to~~ the Manager for certification at least ~~5~~ 10 days prior to work commencing in that site. The purpose of the CESCP is to allow the consent holder ~~and GWRC~~ to further develop methodologies to be implemented throughout the duration of the project to address the specific characteristics of various sites along the route. In addition, the CESCP shall: a) ~~The CESCP will~~ Be consistent with the CEMP as required for G.20 and the ESCP as required for G.27 and E.1. b) Ensure that any more than minor changes to the CESCP shall be ~~approved~~ certified by the Manager prior to the amendment being implemented in accordance with Condition E.2. The CESCP will be consistent and in accordance with the CEMP as required for G.20 and the ESCP as required for G.27 above. Reference shall also be made to Condition E.3 for CESCP details. Works shall not commence until the consent holder has received the Manager's written certification for the CESCP.

	Advice Note: *These CESCPs will be developed within the context of the principles and practices of the ESCP and will allow for innovation, flexibility and practicality of approach to erosion and sediment control. The CESCPs will also ensure ongoing adaption to changing conditions throughout the project lifetime.* *Where activities may be repeated throughout the site, such as peat replacement, then one CESCP may be developed which will cover the ongoing implementation of such activities and without the need to develop ongoing and repeat CESCPs for certification.*

	Erosion and Sediment Control
E.1	The consent holder shall ~~finalise,~~ submit ~~and implement through the CEMP,~~ an Erosion and Sediment Control Management Plan (ESCP) to ~~be submitted to~~ the Manager for certification at least 15 working days prior to works commencing. ***Advice Note:*** *Erosion and sediment control measures shall be constructed and maintained in accordance with the NZTA's Draft Erosion and Sediment Control Standard for State Highway Infrastructure and Draft Field Guide for Contractors (and any subsequent amendments to that document that occur after this consent is granted and prior to the commencement of construction), except where a higher standard is detailed in the ESCP referred to in Condition 0 and E.1, in which case the higher standard shall apply.*
E.2	The consent holder shall ~~prepare,~~ submit ~~and implement through the CEMP,~~ site specific Construction ~~[stage]~~ Erosion and Sediment Control Plans (CESCPs) ~~to be submitted~~ to the Manager for certification at least ~~10~~ 5 days prior to work commencing in that site. The CESCPs shall be prepared in consultation with Te Ati Awa ki Whakarongotai and Takamore Trust. Where a more than minor change to the CESCP is required, the consent holder may request amendments to any CESCP by submitting the amendments in writing for the certification of the Manager. Any amendments to a given CESCP shall ensure that the plan will continue to meet the purpose and objectives as outlined in G.28 to the satisfaction of the Manager. Works shall not commence until the consent holder has received the Manager's written certification for the CESCP.

E.3	The CESCPs shall meet the purpose in Condition G.28 and include, but need not be limited to: a) Contour information at suitable intervals; b) Erosion and sediment control measures including specific pond design (including calculations supporting pond sizing); c) Determination of the requirement for chemical ~~Chemical~~ treatment and if required the associated design and details; d) Catchment boundaries for the erosion and sediment control measures; e) Location of the Work, and cut and fill operations; f) Details of construction methods to be employed, including timing and duration; g) Design details including: i. Contributing catchment area; ii. Retention volume of structure (dead storage and live storage measured to the top of the primary spillway); iii. Shape of structure (dimensions of structure); iv. Location of flood waters v. Safety and access vi. Position of inlets/outlets vii. Stabilisation of the structure; and viii. Maintenance. h) A programme for managing non-stabilised areas of earthworks, including progressive stabilisation considerations; i) The identification of appropriately qualified and experienced staff to manage the environmental issues onsite; j) The identification of staff who have clearly defined roles and responsibilities to monitor compliance with the Consent Conditions and the ESCP; k) The role of Te Ati Awa ki Whakarongotai and the Takamore Trust in monitoring; l) Provision of details of a chain of responsibility for managing environmental issues and details of responsible personnel; and m) Methods and procedures to be undertaken for decommissioning of erosion and sediment control measures including chemical treatment devices. n) Methods, design details and procedures for managing the discharge of contaminants with a particular focus on that associated with cement contamination. *Advice Note: For the purpose of this condition stabilisation shall mean making an area resistant to erosion. This may be achieved by using indurated rock or through the application of basecourse, grassing, or mulch. Where seeding or grassing is used on a surface that is not otherwise resistant to erosion, the surface is considered stabilised once 80% vegetative ground cover has been established over the entire area. "Non stabilised" areas are those which do not meet the definition of "stabilised".*

E.4	Prior to any earthworks commencing within ~~a site~~ each area of works (other than those required to establish erosion and sediment control measures), a certificate signed by an appropriately qualified and experienced sediment control practitioner shall be submitted to ~~GWRC~~ the Manager to certify that the erosion and sediment control measures (including clean and dirty water diversion channels, silt fences, decanting earth bunds, sediment retention ponds, rock filters and chemical treatment systems) for that ~~site~~ area of works have been constructed in accordance with the relevant CESCP. The certificate is to be provided to the Manager 2 working days prior to the commencement of construction in that area of works.
E.5	A copy of the "as-built(s)" and the certified CESCPs shall be kept on site, and all erosion and sediment control measures (including staging boundaries and particularly the extent of exposed areas) shall be updated as soon as practicable as changes are made. As-built plans shall be prepared by a suitably qualified person and shall be accompanied by text detailing the relevant earthworks methodology, constraints and likely progressions, and shall be revised as required to enable clear interpretation as to the day-to-day operation and management of erosion and sediment control measures, provided that such revisions are in general accordance with the CESCPs.
E.6	All necessary perimeter controls for a site or stage shall be operational before earthworks (or relevant stage of earthworks) within the site or stage commence.
E.7	No ~~sediment retention ponds, chemical treatment systems or perimeter controls~~ erosion and sediment control measures shall be removed or decommissioned from a site, or stage before the entire area is stabilised, unless such removal and decommissioning is in accordance with the CEMP or a CESCP, and the Manager has been informed not less than 2 working days prior.
	Erosion and Sediment Control Monitoring
E.8	The Consent Holder shall carry out monitoring in accordance with the ESCP and the certified CESCP and ~~which will seek to~~ shall ensure that: a) The proposed erosion and sediment control measures have been installed ~~properly~~in accordance with the certified CESCP; b) Methodologies are carried out properly; ~~and~~ c) Erosion and sediment control measures are functioning ~~properly~~in accordance with the certified CESCP ~~effectively~~ throughout the duration of the project.; and d) The sediment discharge implications of any impeded drainage to ground, such as by deposition of fine sand, should be a particular focus of site control monitoring, with appropriate remedial action taken as required.

E.9	In the event of either a failure of erosion and sediment control devices or where a storm event exceeds the design volume of the device, and where the discharge is to a perennial or intermittent freshwater body, wetland or estuarine/marine environment, a suitably qualified ecologist(s) shall be notified within 24 hours, who shall then inspect the relevant area to determine whether significant adverse effects on the affected area's ecological values have occurred. The Project's Environmental Manager shall, in consultation with Te Ati Awa ki Whakarongotai and the Takamore Trust, prepare a report on the effects of the failure and any recommended measures that may be required to remedy the effects; the report shall be submitted to the Manager for approval within 5 working days of the event. The remedial measures shall be implemented within 10 working days of the approval of the Manager.
E.10	The consent holder shall carry out ~~weekly~~ inspections at a minimum frequency of weekly, of all ~~site haul roads~~ working areas of the site in order to ensure they are well maintained and that erosion and sediment control devices remain effective.
	Chemical Treatment (Flocculation)
E.11	a) Prior to the commissioning of chemical treatments for sediment management purposes, the Consent Holder shall provide ~~GWRC~~ the Manager with a Chemical Treatment Plan (CTP) for each site, or stage of the works, or in association with an CESCP, at least ~~10~~ 5 working days before the commencement of flocculation works. b) The CTP shall be submitted to the Manager for certification that the proposed use of chemical flocculation will assist in achieving appropriate sediment removal efficiencies in accordance with the principles of the ESCP. c) Each CTP shall include, but need not be limited to: i) Specific design details of the chemical treatment system; ii) Monitoring, maintenance (including post-storm) and contingency programme (including a Record Sheet); iii) Details of optimum dosage (including catchment specific soil analysis and assumptions); iv) Procedures for carrying out an initial treatment trial; v) A spill contingency plan; vi) A performance monitoring plan; and vii) Details of the person or bodies that will hold responsibility for the maintenance of the chemical treatment system and the organisational structure which will support the system. d) Any amendments to a CTP shall be ~~approved by~~ submitted to the Manager at least ~~10~~ 5 working days prior to implementation. Works shall not commence until the consent holder has received the Manager's written certification for the CTP.

	Advice Note: The CTP will demonstrate the nature of soils within which the works are to occur and, through the necessary bench testing and settleability analysis, will determine the need for chemical treatment or not. This will be reflected within the CESCPs submitted for certification to the Manager.

ANNEXURE B – REVISED USLE CALCULATION SPREADSHEETS

USLE Calculation M2PP During Earthworks - Project Footprint - October 2012 - Rebuttal

Catchment 1	Whareroa	1600
Catchment 2	Wharemauku	1380
Catchment 3	Waikanae	14200
Catchment 4	Waimeha	120
Catchment 5	Ngarara	1690
		Total Catchment Area (ha)

Assumptions

R factor based on NIWA HIRDS data
K Factor based on soil samples and soils /gravels to be utilised - sand fine fraction also taken into account
LS Factor based on different slopes with a uniform 100m slope length with a contour drain installed to break the slope length (flow path) to a maximum of 50m
C and P Factors based on a bare site which has a rough and irregular surface
Duration - for purposes of risk assessment has been based on 2 months total for each stage however staging and progressive stabilisation will occur.
Sediment Deilivery Ratio - based on a high infiltration rate and irregular surface capturing flow and sediment - 0.25 assumed figure
Efficiency - based on 95% due to control measures exceeding guidelines and chemical treatment - all measures considered of equal efficiency

CATCHMENT #		Footprint hectares	r	k	ls	c	p	time	sdr	sed eff.	Yield	Overall Footprint Yield	Area	Project Footprint Area	Pro Rata Total Catchment Area	Slope % Total Catchment	Total Catchment Less Project Footprint	Pro Rata Total Catchment Area
1	**Area 1**																	
	Slope 0-5%	6.66	71	0.396	0.2808282	1	0.9	0.16	0.25	0.95	0.094654443				1095.034528	0.74	1088.374528	
	Slope 5-10%	1.44	71	0.396	1.1610704	1	0.9	0.16	0.25	0.95	0.084614948				236.7642223	0.16	235.3242223	
	Slope 10-20%	0.54	71	0.396	3.2801914	1	0.9	0.16	0.25	0.95	0.089643538				88.78658336	0.06	88.24658336	
	Slope >20%	0.36	71	0.396	5.2269822	1	0.9	0.16	0.25	0.95	0.095231267		9		59.19105557	0.04	58.83105557	1479.776389
	Area 2																	
	Slope 0-5%	0.5122	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.009220802				84.21571851	0.700492341	83.70351851	
	Slope 5-10%	0.0592	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.004406245				9.73364025	0.080962801	9.67444025	
	Slope 10-20%	0.0596	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.012532388				9.799408089	0.081509847	9.739808089	
	Slope >20%	0.1002	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.033574312	**0.423877943**	0.7312	**9.7312**	16.4748438	0.137035011	16.3746438	120.2236107
2	**Area 1**																	
	Slope 0-5%	4.426	71	0.396	0.2808282	1	0.9	0.16	0.25	0.95	0.062903988				192.9147369	0.471121708	188.4887369	
	Slope 5-10%	0.689	71	0.396	1.1610704	1	0.9	0.16	0.25	0.95	0.040485902				30.03123673	0.073340004	29.34223673	
	Slope 10-20%	1.5453	71	0.396	3.2801914	1	0.9	0.16	0.25	0.95	0.256529926				67.35452847	0.16448811	65.80922847	
	Slope >20%	2.7361	71	0.396	5.2269822	1	0.9	0.16	0.25	0.95	0.723784085		9.3964		119.2575716	0.291241777	116.5214716	409.4796176
	Area 2																	
	Slope 0-5%	0.5863	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.006388417				25.54998721	0.188387636	24.96368721	
	Slope 5-10%	0.2276	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.010253295				9.918432695	0.073131547	9.690832695	
	Slope 10-20%	0.4838	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.061574044				21.08320623	0.155452734	20.59940623	
	Slope >20%	1.8145	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.367993898		3.1122		79.07291795	0.583028083	77.25841795	135.6245441
	Area 3																	
	Slope 0-5%	2.8566	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.031125962				124.4859176	0.90338699	121.6293176	
	Slope 5-10%	0.0312	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.001405548				1.359644552	0.009866861	1.328444552	
	Slope 10-20%	0.1189	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.015132604				5.181465938	0.037601594	5.062565938	
	Slope >20%	0.1554	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.031516259		3.1621		6.772075751	0.049144556	6.616675751	137.7991038
	Area 4																	
	Slope 0-5%	0.3701	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.004032668				16.12834772	0.547890452	15.75824772	
	Slope 5-10%	0.0062	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.000279308				0.270185776	0.009178386	0.263985776	
	Slope 10-20%	0.0343	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.004365419				1.49473744	0.050777202	1.46043744	
	Slope >20%	0.2649	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.053723661		0.6755		11.54390519	0.39215396	11.27900519	29.43717612
	Area 5																	
	Slope 0-5%	0.0402	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.000438026				1.751849712	0.128025478	1.711649712	
	Slope 5-10%	0.0066	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.000297328				0.287617117	0.021019108	0.281017117	
	Slope 10-20%	0.0646	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.008221751				2.815161477	0.205732484	2.750561477	
	Slope >20%	0.2026	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.041088765		0.314		8.828973919	0.64522293	8.626373919	13.68360222
	Area 6																	
	Slope 0-5%	0.1491	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.001624617				6.497532139	0.203105844	6.348432139	
	Slope 5-10%	0.323	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.014551029				14.07580738	0.439994551	13.75280738	
	Slope 10-20%	0.1127	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.01434352				4.911280161	0.153521319	4.798580161	
	Slope >20%	0.1493	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.030279134		0.7341		6.506247809	0.203378286	6.356947809	31.99086749
	Area 7																	
	Slope 0-5%	0.2967	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.00323289				12.92969675	0.296967271	12.63299675	
	Slope 5-10%	0.0719	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.003239068				3.133283439	0.071964768	3.061383439	

	Slope 10-20%	0.2426	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.030876112			10.57210796	0.242818537	10.32950796	
	Slope >20%	0.3879	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.078668963	0.9991		16.90404237	0.388249424	16.51614237	43.53913052
	Area 8																
	Slope 0-5%	1.119	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.0121928			48.76417481	0.451902108	47.64517481	
	Slope 5-10%	0.3714	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.016731431			16.18499957	0.149987885	15.81359957	
	Slope 10-20%	0.5687	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.07237941			24.78300823	0.229666424	24.21430823	
	Slope >20%	0.4171	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.084590937	2.4762		18.17653022	0.168443583	17.75943022	107.9087128
	Area 9																
	Slope 0-5%	0.6771	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.007377788			29.50690148	0.425073765	28.82980148	
	Slope 5-10%	0.1415	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.006374522			6.166336671	0.088831691	6.024836671	
	Slope 10-20%	0.3093	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.039365134			13.47878397	0.194174148	13.16948397	
	Slope >20%	0.465	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.094305408	1.5929		20.26393323	0.291920397	19.79893323	69.41595536
	Area 10																
	Slope 0-5%	0.7131	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.00777005			31.07572212	0.655905077	30.36262212	
	Slope 5-10%	0.0585	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.002635403			2.549333535	0.053807947	2.490833535	
	Slope 10-20%	0.1527	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.019434387			6.654414203	0.140452539	6.501714203	
	Slope >20%	0.1629	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.033037314	1.0872		7.098913383	0.149834437	6.936013383	47.37838324
	Area 11																
	Slope 0-5%	0.5134	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.009242405			22.37312542	0.51453197	21.85972542	
	Slope 5-10%	0.0728	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.005418491			3.172503955	0.072960513	3.099703955	
	Slope 10-20%	0.2617	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.055028959			11.40445447	0.262277009	11.14275447	
	Slope >20%	0.1499	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.050227439	0.9978		6.53239482	0.150230507	6.38249482	43.48247866
	Area 12																
	Slope 0-5%	0.8128	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.008856396			35.42048372	0.315112042	34.60768372	
	Slope 5-10%	0.346	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.01558717			15.07810946	0.134139722	14.73210946	
	Slope 10-20%	0.3469	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.044150549			15.11732997	0.134488641	14.77042997	
	Slope >20%	1.0737	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.217754229	2.5794		46.7900755	0.416259595	45.7163755	112.4059987
	Area 13																
	Slope 0-5%	0.3989	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.007181136			17.38340423	0.526392188	16.98450423	
	Slope 5-10%	0.1825	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.013583441			7.953049064	0.240828715	7.770549064	
	Slope 10-20%	0.0805	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.016927135			3.508057258	0.106228556	3.427557258	
	Slope >20%	0.0959	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.032133499	0.7578		4.179163864	0.126550541	4.083263864	33.02367441
	Area 14																
	Slope 0-5%	0.2864	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.003120659			12.48083974	0.08604735	12.19443974	
	Slope 5-10%	0.0959	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.004320259			4.179163864	0.028812643	4.083263864	
	Slope 10-20%	0.3364	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.042814197			14.65975729	0.101069583	14.32335729	
	Slope >20%	2.6097	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.529266286	3.3284		113.7264227	0.784070424	111.1167227	145.0461836
	Area 15																
	Slope 0-5%	0.3664	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.00659606			15.96710782	0.807048458	15.60070782	
	Slope 5-10%	0	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0			0	0	0	
	Slope 10-20%	0.012	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.0025233			0.522940212	0.026431718	0.510940212	
	Slope >20%	0.0756	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.025331517	**3.384613894**	0.454	31.6671	3.294523338	0.166519824	3.218923338	19.78457137
3	**Area 1**																
	Slope 0-5%	1.6884	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.030395162				939.2199571	0.455204767	937.5315571	
	Slope 5-10%	0.3154	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.023475164				175.4501152	0.085034105	175.1347152	
	Slope 10-20%	0.5939	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.124882303				330.3735682	0.160119706	329.7796682	
	Slope >20%	1.1114	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.372400108	3.7091			618.2474889	0.299641422	617.1360889	2063.291129
	Area 2																
	Slope 0-5%	0.2064	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.002248967				114.8158014	0.223739837	114.6094014	
	Slope 5-10%	0.0606	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.002730007				33.71045333	0.065691057	33.64985333	
	Slope 10-20%	0.1931	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.024576163				107.4173026	0.209322493	107.2242026	
	Slope >20%	0.4624	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.093778109	0.9225			257.222997	0.501246612	256.760597	513.1665544
	Area 3																
	Slope 0-5%	0.1254	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.001366378				69.75727471	0.198104265	69.63187471	
	Slope 5-10%	0.03	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.001351489				16.68834323	0.047393365	16.65834323	
	Slope 10-20%	0.1213	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.015438056				67.47653447	0.191627172	67.35523447	
	Slope >20%	0.3563	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.072260251	0.633			198.2018898	0.562875197	197.8455898	352.1240422
	Area 4																
	Slope 0-5%	0.0226	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.000246253				12.57188523	0.150466045	12.54928523	
	Slope 5-10%	0	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0				0	0	0	
	Slope 10-20%	0.0194	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.002469071				10.79179529	0.129161119	10.77239529	
	Slope >20%	0.1082	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.021943753	0.1502			60.18929125	0.720372836	60.08109125	83.55297178
	Area 5																
	Slope 0-5%	0.3833	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.004176497				213.2213987	0.401109251	212.8380987	
	Slope 5-10%	0.1459	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.00657274				81.16097592	0.152678945	81.01507592	
	Slope 10-20%	0.188	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.023927078				104.5802843	0.196735036	104.3922843	
	Slope >20%	0.2384	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.048349267	0.9556			132.6167009	0.249476769	132.3783009	531.5793597
	Area 6																
	Slope 0-5%	0.1175	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.001280298				65.36267766	0.142182962	65.24517766	
	Slope 5-10%	0.0185	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.000833418				10.29114499	0.022386254	10.27264499	
	Slope 10-20%	0.2	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.025454338				111.2556215	0.242013553	111.0556215	
	Slope >20%	0.4904	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.099456714	0.8264			272.798784	0.593417231	272.308384	459.7082282
	Area 7																
	Slope 0-5%	0.1358	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.001479698				75.54256703	0.422001243	75.40676703	

	Slope 5-10%	0.0038	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.000171189			2.113856809	0.011808577	2.110056809	
	Slope 10-20%	0.0372	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.004734507			20.69354561	0.115599751	20.65634561	
	Slope >20%	0.145	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.029407063	0.3218		80.66032562	0.450590429	80.51532562	179.0102951
	Area 8																
	Slope 0-5%	1.5033	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.016380193			836.2528793	0.507169124	834.7495793	
	Slope 5-10%	0.3173	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.014294246			176.5070436	0.10704767	176.1897436	
	Slope 10-20%	0.5455	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.069426707			303.4497078	0.184035626	302.9042078	
	Slope >20%	0.598	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.121278783	2.9641		332.6543084	0.201747579	332.0563084	1648.863939
	Area 9																
	Slope 0-5%	0.0392	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.000427129			21.80610182	0.098989899	21.76690182	
	Slope 5-10%	0.0001	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	4.50496E-06			0.055627811	0.000252525	0.055527811	
	Slope 10-20%	0.0968	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.0123199			53.84772083	0.244444444	53.75092083	
	Slope >20%	0.2599	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.052709625	0.396		144.5766802	0.656313131	144.3167802	220.2861307
	Area 10																
	Slope 0-5%	0.7927	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.008637384			440.961656	0.503877447	440.168956	
	Slope 5-10%	0.0943	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.00424818			52.45702556	0.05994152	52.36272556	
	Slope 10-20%	0.2878	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.036628792			160.0968394	0.182939232	159.8090394	
	Slope >20%	0.3984	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.08079844	1.5732		221.6211981	0.2532418	221.2227981	875.1367191
	Area 11																
	Slope 0-5%	0.1365	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.00245732			75.9319617	0.441747573	75.7954617	
	Slope 5-10%	0.0069	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.000513566			3.838318943	0.022330097	3.831418943	
	Slope 10-20%	0.062	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.013037048			34.48924268	0.200647249	34.42724268	
	Slope >20%	0.1036	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.034713561	0.309		57.63041196	0.335275081	57.52681196	171.8899353
	Area 12																
	Slope 0-5%	0.3648	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.003974918			202.9302537	0.192374624	202.5654537	
	Slope 5-10%	0.1759	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.007924229			97.84931915	0.092759584	97.67341915	
	Slope 10-20%	0.517	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.065799464			287.5957817	0.272636186	287.0787817	
	Slope >20%	0.8386	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.170074226	1.8963		466.4948211	0.442229605	465.6562211	1054.870176
	Area 13																
	Slope 0-5%	0.0408	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.000734496			22.69614679	0.10151779	22.65534679	
	Slope 5-10%	0.0348	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.002590158			19.35847815	0.086588704	19.32367815	
	Slope 10-20%	0.1562	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.03284495			86.89064042	0.388653894	86.73444042	
	Slope >20%	0.1701	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.056995914	0.4019		94.62290612	0.423239612	94.45280612	223.5681715
	Area 14																
	Slope 0-5%	0.8678	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.015622436			482.7381419	0.513916854	481.8703419	
	Slope 5-10%	0.1449	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.01078488			80.60469781	0.085810731	80.45979781	
	Slope 10-20%	0.1855	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.039006006			103.189589	0.109854317	103.004089	
	Slope >20%	0.4904	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.164319788	1.6886		272.798784	0.290418098	272.308384	939.3312127
	Area 15																
	Slope 0-5%	0.9862	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.01074579			548.6014698	0.258716126	547.6152698	
	Slope 5-10%	0.0835	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.003761644			46.44922199	0.021905087	46.36572199	
	Slope 10-20%	0.3967	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.05048868			220.6755253	0.104068837	220.2788253	
	Slope >20%	2.3455	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.475684589	3.8119		1304.750302	0.61530995	1302.404802	2120.476519
	Area 16																
	Slope 0-5%	0.5971	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.010749201			332.1536581	0.58821791	331.5565581	
	Slope 5-10%	0.1606	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.011953428			89.3382641	0.158211014	89.1776641	
	Slope 10-20%	0.1583	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.033286527			88.05882445	0.155945227	87.90052445	
	Slope >20%	0.0991	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.033205732	1.0151		55.12716047	0.09762585	55.02806047	564.6779071
	Area 17																
	Slope 0-5%	0.6855	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.007469316			381.3286428	0.519436236	380.6431428	
	Slope 5-10%	0.0629	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.002833621			34.98989298	0.047662348	34.92699298	
	Slope 10-20%	0.1984	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.025250703			110.3655766	0.150337198	110.1671766	
	Slope >20%	0.3729	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.075626853	1.3197		207.4361064	0.282564219	207.0632064	734.1202188
	Area 18																
	Slope 0-5%	0.4202	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.004578565			233.7480609	0.48337743	233.3278609	
	Slope 5-10%	0.2141	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.009645125			119.0991429	0.246290118	118.8850429	
	Slope 10-20%	0.182	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.023163448			101.2426156	0.209363856	101.0606156	
	Slope >20%	0.053	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.010748788	0.8693		29.48273971	0.060968595	29.42973971	483.572559
	Area 19																
	Slope 0-5%	0.9161	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.01649195			509.6063745	0.748325437	508.6902745	
	Slope 5-10%	0.0531	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.003952223			29.53836752	0.043375265	29.48526752	
	Slope 10-20%	0.1488	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.031288915			82.77418243	0.121548767	82.62538243	
	Slope >20%	0.1062	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.03558475	1.2242		59.07673504	0.086750531	58.97053504	680.9956595
	Area 20																
	Slope 0-5%	0.1055	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.001149545			58.68734036	0.761732852	58.58184036	
	Slope 5-10%	0.0207	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.000932527			11.51495683	0.149458484	11.49425683	
	Slope 10-20%	0.0083	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.001056355			4.617108294	0.059927798	4.608808294	
	Slope >20%	0.004	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.000811229	0.1385		2.225112431	0.028880866	2.221112431	77.04451792
	Area 21																
	Slope 0-5%	0.2541	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.004574396			141.3502672	0.634615385	141.0961672	
	Slope 5-10%	0.0598	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.004450903			33.26543084	0.149350649	33.20563084	
	Slope 10-20%	0.054	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.011354848			30.03901782	0.134865135	29.98501782	
	Slope >20%	0.0325	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.010889872	**2.985680406**	0.4004	25.5268	18.0790385	0.081168831	18.0465385	222.7337543
4	**Area 1**																

	Slope 0-5%	1.188	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.012944635				17.06651343	0.403450384	15.87851343	
	Slope 5-10%	0.1683	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.007581852				2.41775607	0.057155471	2.24945607	
	Slope 10-20%	0.3024	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.038486959				4.344203419	0.102696461	4.041803419	
	Slope >20%	1.2859	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.260789944		2.9446		18.47292056	0.436697684	17.18702056	42.30139348
	Area 2																	
	Slope 0-5%	2.5951	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.046717889				37.28056314	0.949473145	34.68546314	
	Slope 5-10%	0.1266	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.009422815				1.818704209	0.046319333	1.692104209	
	Slope 10-20%	0.0087	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.001829392				0.124982043	0.003183082	0.116282043	
	Slope >20%	0.0028	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.000938204		2.7332		0.040224106	0.00102444	0.037424106	39.2644735
	Area 3																	
	Slope 0-5%	1.3112	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.014287041				18.83637408	0.490094939	17.52517408	
	Slope 5-10%	0.2511	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.011311961				3.607240339	0.093855124	3.356140339	
	Slope 10-20%	0.4336	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.055185005				6.228990088	0.162069223	5.795390088	
	Slope >20%	0.6795	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.13780758	**0.597303277**	2.6754	8.3532	9.761528516	0.253980713	9.082028516	38.43413303
5	**Area 4**																	
	Slope 0-5%	1.2918	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.023255431				34.3694722	0.893360996	33.0776722	
	Slope 5-10%	0.1114	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.008291481				2.963894723	0.077040111	2.852494723	
	Slope 10-20%	0.0235	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.004941462				0.625238115	0.016251729	0.601738115	
	Slope >20%	0.0193	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.006466908		1.446		0.51349343	0.013347165	0.49419343	38.47209846
	Area 5																	
	Slope 0-5%	2.2292	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.024289713				59.3098215	0.256716762	57.0806215	
	Slope 5-10%	0.1105	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.004977984				2.939949433	0.012725284	2.829449433	
	Slope 10-20%	1.1824	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.150486047				31.45878923	0.136166292	30.27638923	
	Slope >20%	5.1614	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	1.046769746		8.6835		137.3235747	0.594391662	132.1621747	231.0321349
	Area 6																	
	Slope 0-5%	0.0314	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.000565274				0.835424545	0.09570253	0.804024545	
	Slope 5-10%	0.0319	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.002374311				0.848727483	0.097226455	0.816827483	
	Slope 10-20%	0.1634	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.03435893				4.347400338	0.498018897	4.184000338	
	Slope >20%	0.1014	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.0339764		0.3281		2.69783595	0.309052118	2.59643595	8.729388317
	Area 7																	
	Slope 0-5%	0.1224	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.002203487				3.256559372	0.250562948	3.134159372	
	Slope 5-10%	0.019	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.001414166				0.505511667	0.038894575	0.486511667	
	Slope 10-20%	0.0647	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.01360479				1.721400256	0.132446264	1.656700256	
	Slope >20%	0.2824	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.094624609		0.4885		7.513499728	0.578096213	7.231099728	12.99697102
	Area 8																	
	Slope 0-5%	0.3886	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.006995712				10.33904389	0.331485115	9.950443889	
	Slope 5-10%	0.0211	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.001570469				0.561384009	0.017998806	0.540284009	
	Slope 10-20%	0.1842	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.038732649				4.900802584	0.157127015	4.716602584	
	Slope >20%	0.5784	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.19380621		1.1723		15.38883939	0.493389064	14.81043939	31.19006987
	Area 9																	
	Slope 0-5%	2.7681	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.030161652				73.64772874	0.234945128	70.87962874	
	Slope 5-10%	0.8022	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.036138809				21.34323471	0.06808749	20.54103471	
	Slope 10-20%	2.5318	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.322226466				67.36075995	0.21488894	64.82895995	
	Slope >20%	5.6798	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	1.151905066		11.7819		151.1160614	0.482078442	145.4362614	313.4677848
	Area 10																	
	Slope 0-5%	1.1832	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.021300376				31.48007393	0.65136251	30.29687393	
	Slope 5-10%	0.3828	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.028491733				10.1847298	0.21073493	9.801929801	
	Slope 10-20%	0.1868	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.039279364				4.969977865	0.102835122	4.783177865	
	Slope >20%	0.0637	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.021344149		1.8165		1.694794379	0.035067437	1.631094379	48.32957597
	Area 11																	
	Slope 0-5%	0.3045	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.00331788				8.101489614	0.39048474	7.796989614	
	Slope 5-10%	0.1425	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.006419572				3.791337504	0.182739164	3.648837504	
	Slope 10-20%	0.2114	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.026905235				5.624482445	0.271095153	5.413082445	
	Slope >20%	0.1214	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.02462081		0.7798		3.229953495	0.155680944	3.108553495	20.74726306
	Area 12																	
	Slope 0-5%	0.4734	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.008522311				12.59522228	0.634669527	12.12182228	
	Slope 5-10%	0.0994	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.007398324				2.644624196	0.133261831	2.545224196	
	Slope 10-20%	0.0965	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.020291534				2.567467152	0.129373911	2.470967152	
	Slope >20%	0.0766	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.02566659		0.7459		2.038010195	0.102694731	1.961410195	19.84532382
	Area 13																	
	Slope 0-5%	0.6494	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.007075964				17.27785667	0.453396635	16.62845667	
	Slope 5-10%	0.1365	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.006149274				3.631702241	0.095301264	3.495202241	
	Slope 10-20%	0.4554	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.057959528				12.11631649	0.31795015	11.66091649	
	Slope >20%	0.191	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.0387362		1.4323		5.08172255	0.133351951	4.89072255	38.10759795
	Area 14																	
	Slope 0-5%	0.0219	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.000394251				0.582668711	0.184343434	0.560768711	
	Slope 5-10%	0.0733	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.005455705				1.9502108	0.617003367	1.8769108	
	Slope 10-20%	0.0173	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.003637757				0.460281676	0.145622896	0.442981676	
	Slope >20%	0.0063	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.00211096		0.1188		0.167617027	0.053030303	0.161317027	3.160778214
	Area 15																	
	Slope 0-5%	0.8079	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.014544096				21.49488821	0.659941186	20.68698821	
	Slope 5-10%	0.112	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.008336139				2.979858249	0.091488319	2.867858249	
	Slope 10-20%	0.1693	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.035599552				4.504375014	0.138294396	4.335075014	
	Slope >20%	0.135	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.045234852		1.2242		3.591793425	0.110276099	3.456793425	32.5709149

Area 16																	
Slope 0-5%	0.6664	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.007261199				17.73015658	0.597079115	17.06375658	
Slope 5-10%	0.1529	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.006888088				4.068038627	0.136994893	3.915138627	
Slope 10-20%	0.2198	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.027974318				5.847971814	0.196935758	5.628171814	
Slope >20%	0.077	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.015616164		1.1161		2.048652546	0.068990234	1.971652546	29.69481957
Area 17																	
Slope 0-5%	11.1025	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.120974584				295.3917519	0.784523633	284.2892519	
Slope 5-10%	1.2694	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.057185994				33.77350055	0.089698203	32.50410055	
Slope 10-20%	1.1628	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.147991522				30.93731403	0.082165646	29.77451403	
Slope >20%	0.6172	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.125172683		14.1519		16.42114742	0.043612518	15.80394742	376.5237139
Area 18																	
Slope 0-5%	5.4906	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.098843683				146.0822295	0.788550748	140.5916295	
Slope 5-10%	0.4638	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.034520548				12.33980586	0.066610177	11.87600586	
Slope 10-20%	0.4787	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.100658627				12.73623343	0.06875009	12.25753343	
Slope >20%	0.5298	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.177521664		6.9629		14.09579375	0.076088986	13.56599375	185.2540625
Area 19																	
Slope 0-5%	6.3419	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.114169081				168.7318128	0.903005795	162.3899128	
Slope 5-10%	0.3299	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.024554396				8.777278896	0.046973559	8.447378896	
Slope 10-20%	0.2865	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.060243778				7.622583824	0.040793951	7.336083824	
Slope >20%	0.0648	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.021712729		7.0231		1.724060844	0.009226695	1.659260844	186.8557363
Area 20																	
Slope 0-5%	0.6919	71	0.3036	0.2808282	1	0.9	0.16	0.25	0.95	0.007539051				18.40860645	0.664840972	17.71670645	
Slope 5-10%	0.235	71	0.3036	1.1610704	1	0.9	0.16	0.25	0.95	0.010586662				6.252381147	0.225809551	6.017381147	
Slope 10-20%	0.0904	71	0.3036	3.2801914	1	0.9	0.16	0.25	0.95	0.011505361				2.405171301	0.08686461	2.314771301	
Slope >20%	0.0234	71	0.3036	5.2269822	1	0.9	0.16	0.25	0.95	0.004745691		1.0407		0.622577527	0.022484866	0.599177527	27.68873643
Area 21																	
Slope 0-5%	1.6663	71	0.5016	0.2808282	1	0.9	0.16	0.25	0.95	0.02999731				44.33337322	0.519533564	42.66707322	
Slope 5-10%	0.5562	71	0.5016	1.1610704	1	0.9	0.16	0.25	0.95	0.041397863				14.79818891	0.173416893	14.24198891	
Slope 10-20%	0.6075	71	0.5016	3.2801914	1	0.9	0.16	0.25	0.95	0.127742042				16.16307041	0.189411655	15.55557041	
Slope >20%	0.3773	71	0.5016	5.2269822	1	0.9	0.16	0.25	0.95	0.126423035	**5.194156**	3.2073	63.5198	10.03839748	0.117637889	9.661097476	85.33303002

TOTAL 12.5856 tonnes

138.7981 Total Area (ha)

Sitename: M2PP Paraparaumu
Coordinate system: NZMG
Easting: 2679016
Northing: 6030188

Rainfall depths (mm)

		Duration									
ARI (y)	**aep**	**10m**	**20m**	**30m**	**60m**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**
1.58	0.633	7	9.9	12.2	17.5	24.2	40.6	56.3	78	90.9	99.4
2	0.5	7.5	10.7	13.2	18.9	26.1	43.5	60	82.8	96.5	105.6
5	0.2	9.6	13.7	16.8	24	32.8	53.6	73.1	99.6	116.1	127
10	0.1	11.2	16	19.7	28.2	38.1	61.5	83.2	112.6	131.2	143.6
20	0.05	13	18.6	23	32.8	44.1	70.3	94.3	126.6	147.6	161.5
30	0.033	14.2	20.4	25.1	35.8	47.9	75.8	101.3	135.4	157.9	172.7
40	0.025	15.1	21.6	26.7	38.1	50.8	80	106.6	142	165.6	181.2
50	0.02	15.9	22.7	28	40	53.2	83.4	110.9	147.4	171.8	187.9
60	0.017	16.5	23.6	29.1	41.6	55.2	86.3	114.5	151.8	177	193.7
80	0.012	17.6	25.1	30.9	44.2	58.5	91	120.4	159.2	185.6	203
100	0.01	18.4	26.3	32.4	46.4	61.2	94.9	125.2	165.1	192.5	210.6

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	**aep**	**10m**	**20m**	**30m**	**60m**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**
1.58	0.633	8.1	11.4	14	19.8	27.2	44.9	61.7	84.7	97.8	106.4
2	0.5	8.7	12.3	15.1	21.4	29.3	48.1	65.8	89.9	103.8	113
5	0.2	11.1	15.8	19.3	27.4	37.2	60.1	81.6	110.4	127.7	139.2
10	0.1	13	18.5	22.7	32.4	43.6	69.9	94	126.8	147.2	160.5
20	0.05	15.1	21.6	26.6	37.9	50.8	80.7	108.1	144.8	168.6	184.1
30	0.033	16.5	23.7	29.1	41.5	55.6	87.9	117.5	157.1	182.5	199.3
40	0.025	17.5	25.1	31	44.2	58.9	92.8	123.7	164.7	191.8	209.6
50	0.02	18.4	26.3	32.5	46.4	61.7	96.7	128.6	171	199.3	218
60	0.017	19.1	27.4	33.8	48.3	64	100.1	132.8	176.1	205.3	224.7
80	0.012	20.4	29.1	35.8	51.3	67.9	105.6	139.7	184.7	215.3	235.5
100	0.01	21.3	30.5	37.6	53.8	71	110.1	145.2	191.5	223.3	244.3

Sitename: M2PP PekaPeka
Coordinate system: NZMG
Easting: 2685968
Northing: 6038488

Rainfall depths (mm)

		Duration									
ARI (y)	**aep**	**10m**	**20m**	**30m**	**60m**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**
1.58	0.633	7.7	10.7	13	18.3	24.7	39.9	54	73.2	88	98
2	0.5	8.3	11.6	14.1	19.7	26.5	42.7	57.6	77.7	93.5	104.1
5	0.2	10.4	14.5	17.7	24.8	33.1	52.4	70.1	93.7	112.6	125.4
10	0.1	12.1	16.9	20.6	28.8	38.3	60.1	79.8	106	127.4	141.9
20	0.05	14	19.6	23.9	33.4	44.1	68.4	90.4	119.3	143.4	159.8
30	0.033	15.3	21.3	26	36.3	47.8	73.8	97.1	127.7	153.5	171
40	0.025	16.2	22.6	27.6	38.5	50.6	77.8	102.1	134	161.1	179.4
50	0.02	16.9	23.7	28.8	40.3	52.8	81.1	106.2	139	167.2	186.2
60	0.017	17.6	24.6	29.9	41.9	54.8	83.8	109.6	143.3	172.3	192
80	0.012	18.7	26.1	31.8	44.4	58	88.3	115.2	150.3	180.7	201.3
100	0.01	19.5	27.3	33.2	46.5	60.5	92	119.8	156	187.5	208.9

Extreme rainfall assessment with climate change

Projected temperature change: 2.0 ° C
Rainfall depths (mm)

		Duration									
ARI (y)	**aep**	**10m**	**20m**	**30m**	**60m**	**2h**	**6h**	**12h**	**24h**	**48h**	**72h**
1.58	0.633	8.9	12.3	14.9	20.8	27.8	44.1	59.2	79.5	94.7	104.9
2	0.5	9.6	13.4	16.1	22.3	29.8	47.2	63.1	84.4	100.6	111.4
5	0.2	12.1	16.7	20.3	28.3	37.5	58.8	78.2	103.8	123.9	137.4
10	0.1	14	19.5	23.7	33.1	43.8	68.3	90.2	119.4	142.9	158.6
20	0.05	16.2	22.7	27.6	38.5	50.8	78.5	103.6	136.5	163.8	182.2
30	0.033	17.7	24.7	30.2	42.1	55.4	85.6	112.6	148.1	177.4	197.3
40	0.025	18.8	26.2	32	44.7	58.7	90.2	118.4	155.4	186.6	207.6
50	0.02	19.6	27.5	33.4	46.7	61.2	94.1	123.2	161.2	194	216
60	0.017	20.4	28.5	34.7	48.6	63.6	97.2	127.1	166.2	199.9	222.7
80	0.012	21.7	30.3	36.9	51.5	67.3	102.4	133.6	174.3	209.6	233.5
100	0.01	22.6	31.7	38.5	53.9	70.2	106.7	139	181	217.5	242.3

Rainfall Erosion Index (J/ha) - Based on NIWA HIRDS Data

R = 0.00828p2.2*1.7

48.1 **p = 6 hour duration 2 year storm**

R Factor	**71**

K Factor

Peat	Clay	Silt	Sand	Nomograph Value	Correction Factor Peat (4% Organic) Sand/Gravels (0% Organic)	Value	Metric Convert K Factor
Sample 1	16	71	13				
Sample 2	15	66	19				
Average	**15.5**	**68.5**	**16**	0.52	-0.14	0.38	0.5016
Sand Soils							
Sample 1	1	6	93				
Sample 2	2	8	90				
Average	**1.5**	**7**	**91.5**	0.17	0.06	0.23	0.3036
Adjusted Fine Sand	**1.5**	**12**	**86.5**				
Gravels	10	20	70	0.2	0.1	0.3	0.396

LS Equation

m	0.2 for slopes < 1% 0.3 for slopes 1 to 3% 0.4 for slopes 3.5 to 4.5% 0.5 for slopes > 5%

Slope (Av/Mid Slope)	Area	S2	S2+10000		L (m)	Weight L	*m*	LS
Area 1								
2.5	6.6	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	1.44	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.54	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.36	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 2								
2.5	0.5122	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0592	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0596	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1002	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 1								
2.5	4.426	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.689	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	1.5453	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	2.7361	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 2								
2.5	0.5863	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.2276	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.4838	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	1.8145	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 3								
2.5	2.8566	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0312	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1189	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1554	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 4								
2.5	0.3701	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0062	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0343	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.2649	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 5								
2.5	0.0402	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0066	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0646	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.2026	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 6								
2.5	0.1491	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.323	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1127	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1493	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 7								
2.5	0.2967	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0719	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2426	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.3879	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 8								
2.5	1.119	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.3714	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.5687	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.4171	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 9								
2.5	0.6771	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211

7.5	0.1415	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.3093	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.465	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 10								
2.5	0.7131	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0585	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1527	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1629	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 11								
2.5	0.5134	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0728	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2617	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1499	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 12								
2.5	0.8128	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.346	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.3469	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	1.0737	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 13								
2.5	0.3989	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1825	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0805	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0959	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 14								
2.5	0.2864	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0959	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.3364	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	2.6097	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 15								
2.5	0.3664	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.012	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0756	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 1								
2.5	1.6884	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.3154	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.5939	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	1.1114	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 2								
2.5	0.2064	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0606	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1931	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.4624	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 3								
2.5	0.1254	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.03	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1213	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.3563	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 4								
2.5	0.0226	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0194	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1082	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 5								
2.5	0.3833	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1459	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.188	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.2384	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 6								
2.5	0.1175	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0185	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.4904	400	10400	101.9803903	50	15.24	0.5	5.226982231

Area 7								
2.5	0.1358	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0038	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0372	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.145	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 8								
2.5	1.5033	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.3173	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.5455	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.598	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 9								
2.5	0.0392	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0001	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0968	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.2599	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 10								
2.5	0.7927	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0943	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2878	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.3984	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 11								
2.5	0.1365	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0069	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.062	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1036	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 12								
2.5	0.3648	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1759	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.517	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.8386	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 13								
2.5	0.0408	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0348	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1562	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1701	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 14								
2.5	0.8678	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1449	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1855	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.4904	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 15								
2.5	0.9862	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0835	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.3967	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	2.3455	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 16								
2.5	0.5971	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1606	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1583	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0991	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 17								
2.5	0.6855	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0629	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1984	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.3729	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 18								
2.5	0.4202	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.2141	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.182	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.053	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 19								
2.5	0.9161	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0531	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412

15	0.1488	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1062	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 20								
2.5	0.1055	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0207	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0083	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.004	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 21								
2.5	0.2541	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0598	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.054	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0325	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 1								
2.5	1.188	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1683	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.3024	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	1.2859	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 2								
2.5	2.5951	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1266	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0087	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0028	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 3								
2.5	1.3112	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.2511	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.4336	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.6795	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 4								
2.5	1.2918	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1114	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0235	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0193	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 5								
2.5	2.2292	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1105	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	1.1824	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	5.1614	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 6								
2.5	0.0314	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0319	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1634	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1014	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 7								
2.5	0.1224	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.019	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0647	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.2824	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 8								
2.5	0.3886	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0211	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1842	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.5784	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 9								
2.5	2.7681	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.8022	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	2.5318	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	5.6798	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 10								
2.5	1.1832	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.3828	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1868	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0637	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 11								

2.5	0.3045	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1425	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2114	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.1214	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 12								
2.5	0.4734	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0994	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0965	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0766	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 13								
2.5	0.6494	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1365	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.4554	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.191	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 14								
2.5	0.0219	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.0733	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0173	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0063	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 15								
2.5	0.8079	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.112	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.1693	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.135	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 16								
2.5	0.6664	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.1529	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2198	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.077	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 17								
2.5	11.1025	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	1.2694	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	1.1628	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.6172	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 18								
2.5	5.4906	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.4638	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.4787	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.5298	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 19								
2.5	6.3419	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.3299	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.2865	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0648	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 20								
2.5	0.6919	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.235	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.0904	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.0234	400	10400	101.9803903	50	15.24	0.5	5.226982231
Area 21								
2.5	1.6663	6.25	10006.25	100.0312451	50	15.24	0.3	0.280828211
7.5	0.5562	56.25	10056.25	100.2808556	50	15.24	0.5	1.161070412
15	0.6075	225	10225	101.1187421	50	15.24	0.5	3.280191442
20	0.3773	400	10400	101.9803903	50	15.24	0.5	5.226982231