

To: RCL Group

Attention: Dan Wells

Project Name Homestead Bay

Project/File: 310104425

From: Stantec New Zealand
Dunedin

Date: 5 September 2025

Reference: Homestead Bay Fast Track Consent**Revision Schedule**

Revision No.	Date	Description	Prepared by	Quality Reviewer	Independent Reviewer	Project Manager Final Approval
1	5 Sept 2025	Final	PW	MB	NK	PW

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The conclusions in the report are Stantec's professional opinion, as of the time of the report, and concerning the scope described in the report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The report relates solely to the specific project for which Stantec was retained and the stated purpose for which the report was prepared. The report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Introduction

This Report provides responses and further information to the peer reviews obtained by Otago Regional Council (ORC) from SLR Consulting New Zealand Ltd (SLR) of the Fast Track Consent Application (including subsequent attachments) submitted to the Environmental Protection Authority (EPA) by RCL Homestead Bay Ltd for the development of a residential subdivision in Queenstown.

This Report covers requested matters in the following SLR reports:

- RM24.355 / FTA063 – RCL Homestead Bay Ltd, Defence Against Water Technical Peer Review (31 July 2025)
- RM24.355 / FTA063 – RCL Homestead Bay Ltd, Stormwater Discharges Technical Peer Review (7 August 2025)
- RM24.355 / FTA063 – RCL Homestead Bay Ltd, Wastewater Discharge (Effects on Groundwater) Technical Peer Review (13 August 2025)
- RM24.355 / FTA063 – RCL Homestead Bay Ltd, Earthworks Technical Peer Review (1 August 2025)

2 Responses to Defence Against Water Technical Peer Review

The scope of this review focused on the natural hazard posed by flooding.

The responses requested are for the following:

- Details of how flood volumes have been calculated, including whether the detention basins are sized appropriately. This relates to comments from the peer reviewer that the Stantec report on infrastructure feasibility lacked detail on key components of the flood hazard. It was also noted that the Geosolve assessment noted that discharges at the site boundary have the potential to impact on downstream flooding, and that this will be mitigated during Stantec's design, but it was unclear to the reviewer whether Stantec have resized the diversion channel and bund as required. The peer reviewer also noted that comments suggest this is yet to happen.
- Additional information on the effect of runoff on the gullies - The peer review considered that there has been no assessment of whether peak velocities may cause erosion of stream banks, particularly in the Southern Creek. The peer reviewer also noted that there is a dwelling near the edge of the bank on the southern side of this gully which may be at risk if erosion of the toe of the bank were to occur.

Reference: 310104425

- Clarification on the design of the diversion channels - The peer review questioned whether maximum water was contained in the diversion channels as proposed, and that State Highway 6 may become inundated as the proposed finished ground level of the bund is higher than the ground level of the highway.

A meeting was held with the peer reviewer on 29 August 2025, discussing the information in the following sections 2.1-2.3.

2.1 Calculation of Flood Volumes and Drainage

The calculation of flood volumes and of the design of the diversion channels was done jointly by Geosolve and Stantec. This was separately reported by each company, in the Stantec “Engineering Feasibility Assessment” submitted in Appendix B of the Fast Track Consent Application and in the Geosolve “Natural Hazards Assessment of Homestead Bay” included as an Appendix E to that Stantec report.

The process followed for this work was:

1. Geosolve Assessment of runoff

- Geosolve modelled the external Remarkables catchment flows to 1%AEP, with a combination of HEC-HMS to define catchments and HEC-RAS to complete 2D hydraulic modelling, for a range of fan formation scenarios to give likely critical combinations of movement in the fan dominant runoff channels. Peak runoffs were also calculated up to a 250 year event.
- Bulk-up flows with debris entrainment factors were assessed resulting in an increase above rainfall runoff (detailed in Geosolve report)
- There are 3 dominant Fan flows that can move across a defined spread. The spreads can overlap to give combined flows from 2 fans.
- Existing State Highway 6 culverts were not included in the Remarkables modelling in favour of the dominant pathway overtopping the road (see Section 2.3). They consist of one DN1200 into Southern Creek and three DN600 culverts passing Northern Creek.
- An envelope of worst-case fan overlapping flows was agreed by Geosolve and Stantec
- Modelled 1%AEP flows plus snowmelt were taken as the Design Flows for the diversion channels, conveyed with 500mm freeboard
- Modelled 1%AEP runoff with debris flow and the feasible worst-case combinations of stream alignments, conveyed with 0mm minimum freeboard in the open channel cross section to critical levels, were taken as the “over-design” case for additional diversion earth bunding (positioned between the open channel top of bank and the property lots) to provide additional flood protection in extreme events. The bunding has additional roles by being the visual buffer to State Highway 6, and the final height is generally set by these screening outcomes.
- These flow cases are shown in Geosolve’s Table 4.5 and Stantec Figures 4-9 and 4-8.

2. Stantec Diversion bund design

- Stantec then designed uniform open channel cross sections (combined channels and bunds) with the available gradient, for the worst case Geosolve 1%AEP design events as above, using FlowMaster hydraulic software and modelled cross sections from Civil3D geometric design.
- The Diversion channel/bund alongside State Highway 6 (within the subject site) serves to divert Remarkables flow into two flowpaths past the development: Northern channel to Māori Jack Stream and Southern Creek to Lake Wakatipu.

Reference: 310104425

- Open channel flows were assessed in FlowMaster steady state Mannings calculator using the worst-case flow scenario for fan flows in each channel:
 - Northern channel from the proposed SH6 roundabout to Homestead Bay Rd
 - Southern channel from the proposed SH6 roundabout to top end of Southern Creek
 - Southern Creek is naturally large and assessed to manage Remarkables flows with excess capacity. The Remarkables flows already drain to this channel.
 - The Southwestern Creek is effectively isolated from Remarkables flows.
 - There was then a feedback loop to Geosolve:
 - The proposed Northern channel diversion channel was captured in a Civil3D digital surface and provided to Geosolve for model assessment in a post-development scenario to see the effects on flows, water levels and velocity at the downstream area at Homestead Bay Rd.
 - Development flow hydrographs from the two attenuation ponds were also entered into the Geosolve post-development model.
 - Assessment focused on 1) the 1% AEP with snow melt to ensure there was 500mm freeboard to urban areas and 2) the overdesign event with debris flow and fan breakout to ensure that there was enough capacity in the channels and no overtopping occurring.
 - The difference in hydraulic character at Homestead Bay Rd due to the diversion and Northern Channel was judged to be “less than minor” compared to the pre-development scenario.
 - Therefore, the Northern Channel form and pond attenuations were validated.
3. Internal development catchments were assessed by Stantec based on the proposed post-development ground contours.
- Two main earthworks iterations occurred. The driver was for a balance of earthworks cut and fill volumes, while achieving secondary overland flowpaths along streets and away from property
 - The piped reticulation was modelled in PC-SWMM pipe network software to the 5%AEP (plus RCP8.5 2081-2100 climate change allowance) event using a nested rainfall hyetograph.
 - The attenuation ponds were modelled dynamically in the basin model of PC SWMM. The required pond volumes were cut into the ground model. The pond volumes provide a neutral peak catchment runoff (post development = pre development) into the Northern channel
 - The southern catchments drain to the Southwestern and Southern Creeks, both of which are large and are much larger than required to pass flows. The Southwestern Creek sees no direct Remarkables flows but a large proportion of post development subdivision flows. The Southern Creek sees Remarkables flows plus some post-development subdivision flows.
 - Piped flows will be managed to the Creek floors via pipe and energy dissipator, then flow to the Lake. There is no flooding risk here but scour countermeasures are required.

The Stantec work has been covered in Sections 4.4 and 4.5 of the Engineering Feasibility Assessment. This includes the detention basins discussed in Section 4.5.2. The Geosolve Natural Hazard Assessment report predates the Stantec report and makes only general references to the work being completed by Stantec.

An additional report by Stantec “Homestead Bay Stormwater Model – Basis of Design” is attached. This covers the analysis of the internal stormwater network for the proposed development, including the analysis of the proposed detention areas. This report is an update to a previous report that was not included in the Fast Track Consent application and follows some additional design work after the

Reference: 310104425

lodgement. As a result, some numbers differ from those in the Engineering Feasibility Assessment but the differences are not significant.

Geosolve also updated their hydraulic model in May 2025 for the stormwater within the development site. This update is covered in the attached letter from Geosolve, dated 21 May 2025. This letter notes that the modelling incorporates the current proposed earthworks elevation model provided by Stantec on the 13th of May 2025.

2.2 Effect of Runoff on the Creeks

2.2.1 Changes resulting from Proposed Development

The rate of discharge into the Creeks from piped infrastructure will be controlled with impact energy dissipator outlets on the Creek floor. Flows will then disperse in the Creek floors where scour countermeasures will be provided in conjunction with the landscaping works.

Additional information on expected flow depths in the Southern Creek and Southwestern Creek is in the attached cross-sections. Actual depths are likely to be lower because of soakage into the permeable soils in the Creeks. While the large channels can readily accommodate the increased flow area, there are two main changes that need to be considered to avoid erosion impacts:

1. Increase in flow velocity and frequency that would potentially increase erosive effects.
2. Wider flow area extending into surfaces that would not have been subject to regular flows.

The Southern Creek is approximately 1100m long with an average gradient of approximately 6.2%, from State Highway 6 to where it terminates at the lakeshore terrace. The Southeastern Creek is approximately 500m after the proposed filling of the top section, with an average gradient of 8.4%.

Without any modifications to the channel alignment, roughness and grade (i.e. without any mitigation to limit velocities) peak flow velocities in the Southern Creek are approximately 0.9-1.15 m/s for the 1% AEP pre-development flows (without climate change) and increase to 1–1.3 m/s for the 1% AEP post-development flows (with RCP8.5 2081-2100 climate change allowance). Similarly, in the Southwestern Creek, peak flow velocities are approximately 1.3-1.4 m/s for the 1% AEP pre-development flows (without climate change) and increase to 2.1-2.2 m/s for the 1% AEP pre-development flows (with RCP8.5 2081-2100 climate change allowance).

For comparison with river and bridge scour applications, engineers will begin to consider rock riprap as a countermeasure when design velocity exceeds 2m/s in a 1 in 25 year (4% AEP) flood magnitude. Grass lining that is well rooted can pass short duration flows in the order of 30 minutes for up to 2m/s. Reinforced turf, along with well-rooted grass, can pass flows up to 5m/s for short durations (less than 1 hour). Therefore, velocities are at the lower end of the design spectrum to need rock interventions.

Potential long-term erosion of the bed of the Southern and Southwestern creeks will then be controlled by:

- reducing flow velocities to be similar to current peak velocities, by a combination of methods along the gully floors to suit the location and anticipated flow, and
- protection of erodible areas to avoid erosion at the resulting peak velocities.

2.2.2 Erosion Mitigation Methods

The following mitigation methods will be used to spread flood flows across the gully floor width, reduce the effective channel gradient and thereby reduce peak velocities, increase the gully roughness in shallow-depth flows to reduce velocity, and line the gully floors with well rooted vegetation and rock placements to provide protection against water scour and erosion.

1. Reduce the effective channel gradient by:

- Reducing effective gradient and therefore flow velocities using introducing low rock weir/drop structures approximately 0.5-1m high to cause short lengths of backwater ponding and short lengths of controlled fall through the rock formations (steps). To reduce the gradient in the Southwestern Creek to achieve similar post-development flow velocities to predevelopment figures is estimated to require drop structures 0.75m high every 20 metres between chainages 100 and 500 (refer drawing 310104425-00-000-C0278). To reduce the gradient in the Southern Creek to achieve similar post-development flow velocities to predevelopment figures is estimated require drop structures 0.5m high every 40metres between chainages 500 and 1100 (refer drawing 310104425-00-000-C0278). The final layout may change with completion of the final design of the stormwater reticulation network, and the roughness achieved by the landscape planting.
- Placing regular small sections of heavy rock placements across the low-flow channel flowpath to break up flow lines and form a longer meandering low-flow channel

2. Increase channel roughness by:

- Improving vegetation including grasses, shrubs and riparian species as part of the gully floor cross section landscaping to increase bed friction, choosing species that develop deep roots and can survive intermittent and irregular short term flooding episodes. Turf-reinforcement (for example enkamat) may be used as needed to establish new grass coverage or areas where low vegetation is removed and replanted.
- Large rock placement sporadically placed along the channel to blend with landscaping and generally increase the overall roughness of the gully floor and reduce velocity through turbulence.

3. Improve planting and armouring to protect surfaces likely to be subject to peak flows by:

- Retaining any well-developed trees and shrubs with good roots that contribute to the landscape plans, and existing grass vegetation in riparian parts of the cross sections
- Ensuring the selected vegetation extends beyond the limit of the peak design flow
- Developing enhanced rock lining around the centreline (low flow channel)
- Retaining any existing rock formations or grade changes in the gully profiles
- Shaping the lower extent of the Creeks to make flows spread out (fan out) across a wider front with a part-buried rock formation lining the low flow channel.

Examples of the use of rock drops and stream planting are shown in photos below:



2.2.3 Channel Bank Protection

Protection of the toe of some batter slopes may be needed in addition to the bed protection. At this time only the base of the bank on the southern side the Southern Creek has been identified where this is likely to be necessary to stabilise the toe of the debris slope there. This would take the form of placement of revetments using large rocks, gabions or reinforced soil and vegetation, as suited to the landscape works there.

Reference: 310104425

2.3 Diversion Channels

Attached are updated issues of drawings 310104425-00-000-C0274 and 310104425-00-000-C0275. These have been amended to show extended versions of the lines indicating the level of the 1% AEP flow and the level of 500mm freeboard above that.

Key points to note:

- The 1%AEP water levels have a freeboard of greater than the required 500mm to the top of the bunds, protecting the development from inundation.
- The 1%AEP water levels do not reach Stage Highway 6 notwithstanding that there is no requirement to avoid inundation of the road for this flow. There is also no freeboard requirement for the State Highway
- Surface runoff currently would overtop State Highway 6 rather than be contained in culverts. This will continue to be the case following development but the flow over the State Highway will then be contained in the diversion channels and bunds.
- It is therefore acceptable for the bund to be higher than the State Highway, allowing even greater protection to the urban areas.

3 Responses to Stormwater Discharges Technical Peer Review

The scope of this peer review included the effects of stormwater discharge quality from the proposed activities on the receiving environment. Comments of the peer reviewer are covered in responses by others.

4 Responses to Wastewater Discharge (Effects on Groundwater) Technical Peer Review

The peer reviewer commented as follows in regard to the Lakeside Estate bore F42/0103:

"The results from the CRT were used to conclude the following (which I agree with):

The well has a long-term sustainable yield of ~44 L/s

Drawdown effects on neighbouring bores at Lakeside estate would be ~ 2m, greater than the 1m threshold in Schedule 5B of the Otago Regional Plan: Water, and is therefore considered to be affected. Affected party sign-off should be sought."

This is covered in Section 6.1 of the Komanawa report, including the following:

Being considered 'affected' according to Schedule 5B is not the same as the bores being minimally, significantly, or even adversely affected. The status set out in Schedule 5B and the associated policy (Policy 6.4.10B) triggers the need to assess the conservatively estimated effect using existing information on bore construction, geohydrological conditions and calculations. After such assessment, consultation or notification may be used to work with the potentially affected party or parties to resolve the drawdown effect. Written approval by potentially affected parties may be used to indicate the drawdown effect would not be considered in the strict case of the signatory's bore(s) or well(s).

....and in Section 7 of the same report:

Reference: 310104425

7. While the RCL Group 95 meter deep bore and the Lakeside Estate supply bore are arguably screened in different water-bearing layers, calculation of drawdown effect of the RCL Group bore pumping at 40 litres per second for up to 365 days equates to 2 meters of drawdown effect at the closest neighbouring bore, which is more than the drawdown considered to indicate 'effect' in terms of Regional Plan: Water, Schedule 5. It is also arguably screened in a different water-bearing layer from the more recently drilled RCL Group bore, as such the RCL bore would not have a drawdown effect on the Lakeside Estate supply bore.

The Lakeside estates well head is significantly higher and the bore significantly shallower than the RCL well, as the following Table 1 shows:

Table 1 - Lakeside Estate and Homestead Bay Bore

Site	Well Number	Bore Head Ground Level (m AMSL)	Bottom of Screen Depth (m below ground level)	Bottom of Screen Depth (m AMSL)	Top of Screen Depth (m below ground level)	Top of Screen Depth (m AMSL)
Lakeside Estate WS Bore	F42/0103	351.36	50.48	300.88	47.88	
RCL Homestead Bay WS Bore	CC11/0151	319.3	94.88		86.33	233

The base of the Lakeside well screen is thus 67.9m higher than the top of the RCL well screen.

In the RCL bore CC11/0151 the water supply aquifer was found after 75 metres of drilling. This thickness was filled with clay and silt that was effectively impermeable. The water-bearing layer of the Lakeside well was an unconfined water table aquifer, while the RCL well taps a confined aquifer. This indicates that the water-bearing layers of each well are different aquifers and unconnected.

The ORC's plan does not make any distinction between bore intakes separated by vertical and hydrogeological separations. Other parts of the Regional Plan: Water include explanatory information to the policies and rules relating to surface water - groundwater interaction that indicate that the presence of significant vertical separations and low permeability intervening material does have a material effect (Policy 6.4.1A). These modes of separation between aquifers and surface water also apply between different aquifers. This supports the presumption in regional water policy that the calculated drawdown effect need not be applied to adjoining but separate aquifers as if they were the same aquifer.

Thus, it is concluded that the RCL bore has no drawdown effect on the Lakeside Estate bore F42/0103.

Reference: 310104425

5 Responses to Earthworks Technical Peer Review

The matters raised in the peer review require further information on the following:

- Areas for each of the proposed stages of earthworks (see section 4 Figure 2 of the CMP).
- Update the CMP to address the cleanfill site and how it will be managed (see section 6.4 of the CMP).
- Provide a draft of the EMP for the first four stages and including an Adaptive Management Plan as a section in the EMP (see Appendices C and D of the CMP).
- Consideration of erosion and sediment control measures to avoid the wetland drying out (see section 6.6 of the CMP)
- Erosion and sediment control measures for the gullies and northern channel works (see section 6.5 of the CMP)
- Provide justification of 100 times mixing for TSS.

These are covered in the attached updated CMP with additional appendices.

6 References

The following additional documents are attached:

- Homestead Bay Stormwater Model – Basis of Design, Stantec August 2025
- Flood Diversion Assessment Homestead Bay, Queenstown, Geosolve, 21 May 2025
- Stantec drawings 310104425-00-000-C0274 and 310104425-00-000-C0275, Rev 0A
- CMP
- Sections of Southern Creek and Southwestern Creek (Stantec drawings 310104425-00-000-C0277 to C0278.

Homestead Bay Development Construction Management Plan

Prepared for: RCL Homestead Bay Ltd



Revision Schedule

Revision No.	Date	Description	Prepared by	Quality Reviewer	Independent Reviewer	Project Manager Final Approval
1	March 2025	Draft for Consent Application	Iain Banks	Patrick Leslie	Peter White	Peter White
2	August 2025	Updates following ORC Peer Review (shown in red)	Iain Banks	Patrick Leslie	Peter White	Peter White

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Figure 2 Homestead Bay Staging Plan

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Figure 4 A Summary of the HAIL activities identified in the PSI Report

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Appendix A Master Plan ESCP

Appendix B Template EMP

Appendix C EMP/ESCP Stages 1-4

Appendix D Adaptive Management Plan



1 General

The purpose of the Construction Management Plan (CMP) is to provide guidance on the construction activities and considerations involved in the delivery of the Homestead Bay Development. The CMP has been prepared in draft to support the resource consent application process and will be finalised by the Consent Holder and certified by local authorities prior to construction commencing.

The key objectives of the CMP are as follows:

- To inform the draft construction management processes considered as part of Project delivery including project management plans, methodologies or intended sequencing which may apply to the Project.
- Identify the key environmental, health and safety, security and traffic management considerations and the potential effects of the construction work.
- Establish communication processes with potentially affected parties including local authorities, community groups, Iwi, commercial businesses, and adjacent residents



2 Scope of Works

The scope of work covers large scale civil construction of all infrastructure required to service the new development including:

- Set up of Environmental Controls
- Bulk Earthworks
- Bulk Infrastructure
 - o Water Bores and Mains Supply Pipelines
 - o Water Treatment Plant
 - o Water Reservoirs
 - o Wastewater pump station and Rising Mains
 - o Waste Water Treatment Plant
 - o Land Disposal of Treated Wastewater
- Roding Access off State Highway 6
- Upgrades to existing State Highway Infrastructure
- Stormwater Diversion Channels
- Internal Civil Infrastructure
 - o 3 Waters piped networks
 - o Utility services (Power, Telecom)
 - o Roding network
 - o Pedestrian/cycling network
 - o Lighting
- Landscaping including Parks and Playground Facilities



3 Project Personnel

The overall contract procurement strategy for the project has yet to be confirmed, however, the key parties involved in the development are:

RCL Homestead Bay Ltd – Principal

Stantec New Zealand – Engineering Design Consultant and Engineer to Contract/Engineer's Representative

Patersons – Principals Surveyor

Remarkable Planning – Planning Consultant

Blakely Wallace Associates – Landscape Architects

Contractors – TBC for Earthworks and Civil Construction



4 Construction Methodology

The methodology for construction will generally be as per the following sequence for each stage of the development:



Figure 1 Works Sequence for each stage of Construction

An initial staging plan has been prepared for the full development and, whilst subject to change, provides the overall likely sequencing of how the land will be developed.

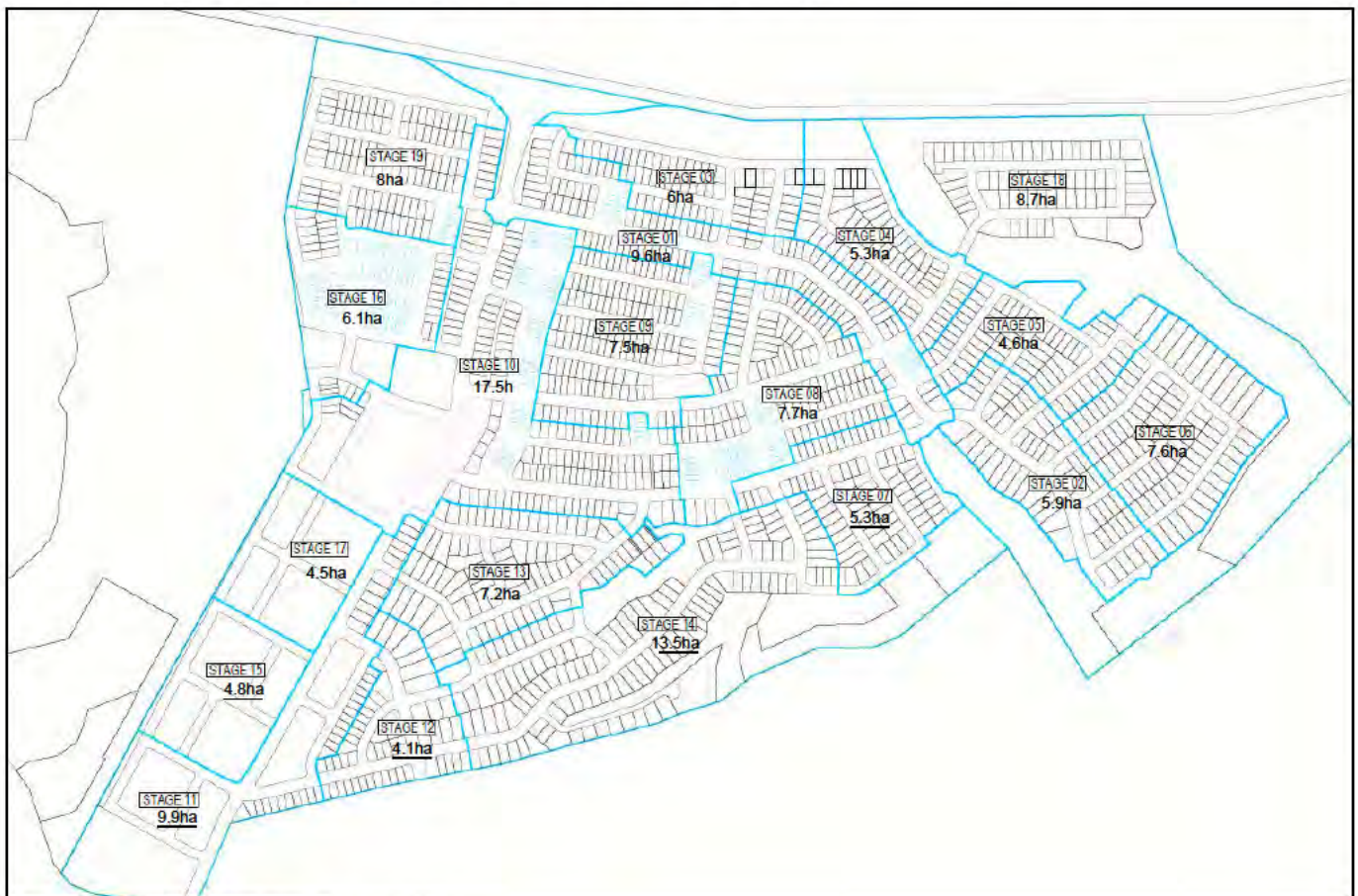


Figure 2 Homestead Bay Staging Plan

The likely order and scope of work is as follows:

Phase 1 - Initial Development Required to release titles in Stage 1

- Earthworks in Stages 1-6 combined (potentially 1-4 initially)
- State Highway Intersection Construction
- Highway Bund/Diversion Channel from Intersection South to Existing Southern Gully
- Pumps and Bulk Rising Main from Water Bore to Treatment Plant



Homestead Bay Development

4 Construction Methodology

- Wastewater Pump Station B and bulk rising main to Treatment Plant
- Water/Wastewater Treatment Plant
- Water Reservoirs and bulk Rising/Falling Mains
- Water Booster Pump Station for pumped zone areas
- Stage 1 Land Disposal Fields (Area 1)
- Civil Construction Stage 1 including stormwater outlet to existing gully

Phase 2 – Progressive Construction of Medium Term Stages

- Civil Construction Stage 2, 3, 4
- Civil Construction Stage 5
- Civil Construction Stage 6
- Earthworks Stage 7, 8, 9
- Civil Construction Stage 7 including wastewater pump station C
- Civil Construction Stage 8
- **Upgrade of Jack Hanley Intersection to Roundabout (Approximately 600 Lots/units Developed)**
- Civil Construction Stage 9
- Stage 2 Land Disposal Fields (Remainder Area 1 and Part Area 2)

Phase 3 - Medium to Long Term Stages

- Earthworks Stage 10, 11 Combined
- Detention Pond and outlet within Stage 11
- Highway Bund/Diversion Channel from Intersection North to Existing Northern Channel
- Northern Channel Upgrade
- Wastewater Pump Station A and bulk rising main to Treatment Plant
- Stage 10 Civil Construction
- Stage 11 Civil Construction
- **Connect internal network to Homestead Bay Rd (approximately 1200 units Developed)**
- Earthworks Stage 12, 13, 14 Combined
- Stage 12 Civil Construction
- Stage 13 Civil Construction
- **Upgrade Māori Jack Road Intersection to Roundabout (approximately 1400 Lots Developed)**
- Stage 14 Civil Construction
- Stage 3 Land Disposal Fields (part Area 2 plus part Area 3)

Phase 4 – Long Term Stages

- Earthworks Stage 15, 16, 17, 18, 19 Combined
- Detention Pond and outlet within Stage 16
- Stage 15 Civil Construction
- Stage 16 Civil Construction
- Stage 17 Civil Construction



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- Highway Bund/Diversion Channel from Existing Southern Gully to Southern Boundary
- Box Culvert Access to Stage 18
- Stage 18 Civil Construction
- Stage 19 Civil Construction
- Stage 4, 5, 6 Land Disposal Fields (Part Area 3 plus Area 4)



5 Project Timeline

The draft project timeline is subject to change and will be dependent on a number of factors including demand for sections but is provisionally as follows:

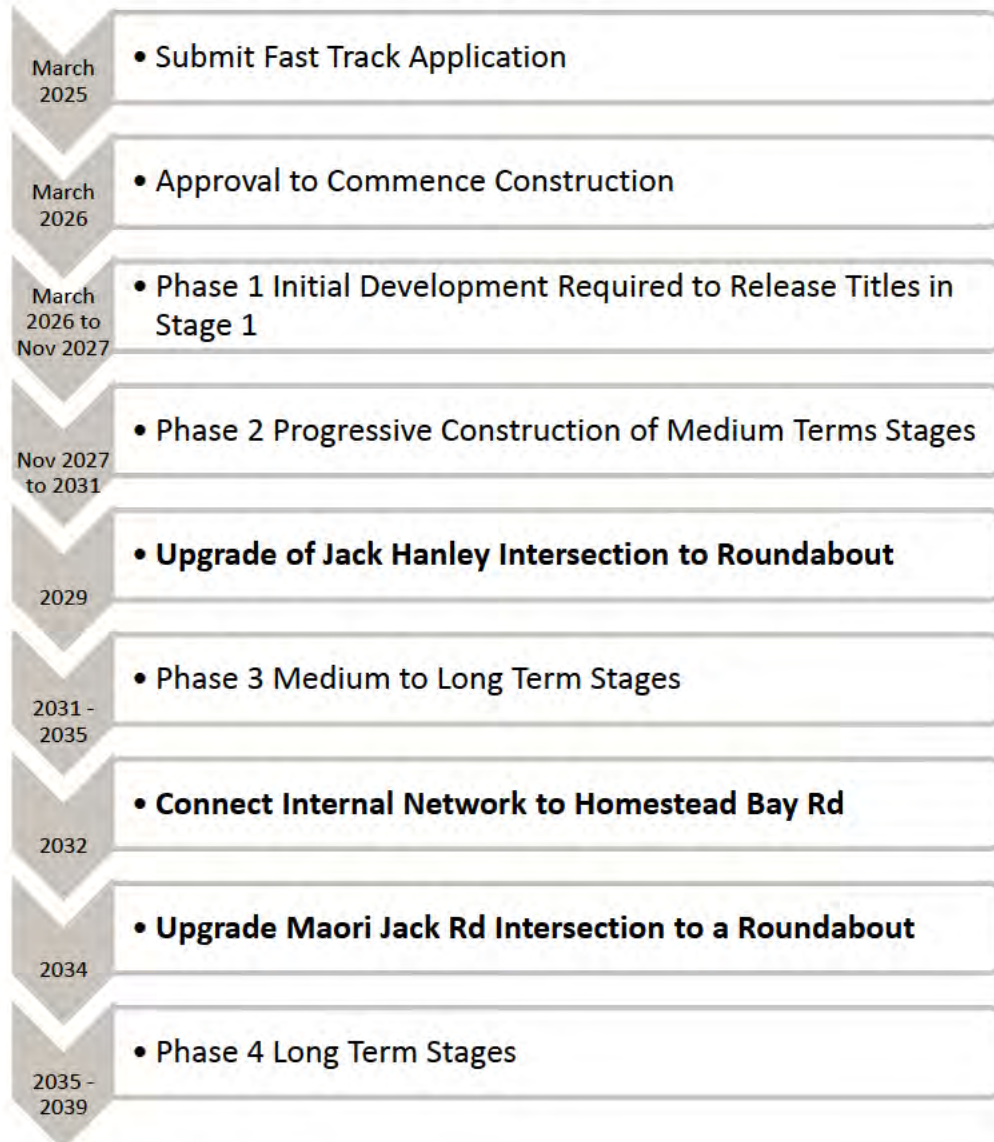


Figure 3 Draft Project Timeline



6 Environmental Management

6.1 Environmental Management Plans

Given the scale of the site and extent of earthworks planned, good environmental management is a key component of the development works. A high level Erosion and Sediment Control Plan (ESCP) of the likely controls is presented in Appendix A and a detailed Environmental Management Plan (EMP) and ESCP will be prepared and submitted to the relevant authorities prior to each stage of the development. These documents will be prepared by a Suitably Qualified and Experienced Person (SQEP) and be in general accordance with the QLDC Guidelines for Environmental Management Plans, Auckland Council's Erosion and Sediment Control Guide for Land Disturbing Activities (GD05) where applicable and the Otago Regional Council Residential Earthworks in Otago A Guide for developers, landowners contractors and service providers.

The content of the EMP will generally be as per the following format and an example template is attached in Appendix B:

a) Administrative Requirements

- i. Daily inspections of specific erosion and sediment control measures as required by GD05 (such as sediment retention ponds)
- ii. Weekly site inspections
- iii. Monthly environmental reporting
- iv. Pre and post rainfall inspection as required by GD05
- v. Independent audit by a SQEP
- vi. Notification and management of environmental incidents
- vii. Records and registers
- viii. Environmental roles and responsibilities of personnel (including nomination of Principal Contractor)
- ix. Site induction

b) Operational Requirements

- i. Erosion and sedimentation, including an ESCP to be prepared by a SQEP
- ii. Water quality monitoring including sampling locations
- iii. Dust management
- iv. Chemical and fuel management

c) Sufficient detail to address the following matters:

- i. Assessment of soil characteristics within earthworks catchments and the necessity for additional erosion and sediment control practices
- ii. Location of specific sensitive environmental area
- iii. Specific erosion and sediment control works (locations, dimensions, capacity etc.)
- iv. Supporting calculations and design drawings
- v. Catchment boundaries and contour information
- vi. Details of construction methods
- vii. Timing and duration of construction and operation of control works
- viii. Processes in place if unexpected contaminated land is encountered



- ix. Contingency measures for snow and/ or frost events (in relation to chemical treatment)
- x. Measures to avoid silt and/or sediment tracking onto roads and then to water for the duration of the earthworks, such as:
 - Providing stabilised entry and exit point(s) for vehicles
 - Providing wheel wash facilities; and
 - Cleaning road surfaces using street-sweepers immediately where sediment has been tracked onto the road.
- xi. Details relating to the management of exposed areas.
- xii. Monitoring and maintenance requirements; and
- xiii. Details relating to the management of long-term stockpiling (over 28 days).

Based on recent peer review commentary and current status of the project a draft detailed EMP/ESCP has now been prepared for earthworks within Stages 1-4 and is attached in Appendix C. This will be updated as necessary as further extent of work within phase 1 is confirmed i.e. extent of civil works and final extent of works for bulk water and wastewater infrastructure. In addition, given the scale of proposed works, an Adaptive Management Plan has been prepared and is to be read and actioned in conjunction with the EMP/ESCP for each stage of works, see Appendix D.

6.2 Site Management and Preparation

The overall strategy for site management is to split the site into stages related to how the development will be progressed from a servicing and sales perspective and where practical earthworks areas should be combined to make cut and fill operations as efficient as possible. Where possible site controls will be set up in a way that they can remain in place for multiple phases, including during house building, and then can be remediated at the end into final planned features e.g. enhanced reserve areas and/or longer term retention features for stormwater management. This will not be possible for all areas of the site and shorter term management will be necessary during earthworks and civil construction operations.

Following the requirements of the Environmental Management Plans the key components of Site Management will be:

- The extent of areas stripped at any one time shall be kept to manageable sizes to prevent excess risk of dust or dirty water runoff.
- Topsoil stripping and subsequent earthworks be undertaken only when a suitable interval of fair weather is expected.
- Uncontrolled fill and buried topsoil should be removed and replaced with a fill certified in accordance with NZS4431, or otherwise clearly demarcated for future use.
- Stockpiles will be kept in designated areas and managed to suitable sizes with safe batter slopes and sealed off or topsoiled and seeded if planned to remain in place for extended periods of time to prevent risk of dust.
- Since historic farmland activity was carried out within Homestead Bay low-volume uncontrolled fills are expected and have been identified in the Geotechnical investigations to date, so all uncontrolled fill material will need to be removed during bulk earthworks with supervision from a qualified geotechnical practitioner.
- Contaminated land has also been identified as being present and will be managed as discussed in section 6.7 below.



6.3 Management of Surface Water Runoff

Stormwater runoff during construction will ultimately discharge into Lake Wakatipu as clean diverted runoff or treated site runoff. This will be either via one of the existing large gullies in the southern portion of the site or the northern creek via the Jacks Point stream that outlets from Lake Tewa to Lake Wakatipu.

Due to the medium erodible nature of some of the soils present across the site the EMP and site control will be set out in a manner to manage site runoff to meet local authority discharge requirements and consents. The EMP will include a provision for management, control, and testing of all site runoff.

The following measures to manage stormwater runoff will be included in the EMP to be employed on site during construction:

- Positive grading to subgrade will be done to minimize ponding.
- Bunding around areas to minimize the amount of runoff generated on exposed surfaces.
- Channelling of sediment laden runoff to collection points for treatment.
- Sediment retention ponds with treatment facilities and testing locations will be installed to collect and treat all sediment laden runoff.
- Silt fences or other similar controls to act as filters, stabilizers and erosion prevention measures will be in place until sufficient vegetation is reached.
- Watering of exposed earth surfaces will be undertaken during dry conditions to prevent dust nuisance. Care will be taken to avoid excess watering that may promote erosion.

The location and type of control measures adopted will be outlined in the EMP's and installed when required during the construction progress of the site.

6.4 Management of Clean Fill Sites and Stockpiles

A specific clean fill site is noted as being completed within Lot 9027 (stage 14) and additional clean fill will be placed in areas of the state highway stormwater diversion channel/bund. The Southern component of the diversion channel/bund between the new state highway roundabout and the southern gully will be completed in phase 1 and planned environmental controls for this are included in the draft EMP for stages 1-4 attached in Appendix C.

The clean fill site within Lot 9027 is unlikely to be utilised until phase 2 or more likely phase 3. Details of the specific control measure will be included in the EMP/ESCP for earthworks in those stages but are likely to include a combination of clean water diversions to minimise runoff into the clean fill site, drop out pits and silt fences to control dirty runoff within the clean fill site and, if necessary, a specific SRP for that area to ensure no dirty water is able to leave site. Specific measures to reduce the risk of dust from temporary filling within the clean fill will include wetting and capping of layers prior to dry and windy weather and/or use of temporary dust suppression sprays (based on analysis of soil characteristics and what products are available that will provide effective dust suppression). In addition, minimising or stopping works during periods of weather where dust is more likely to occur. Management of haul roads to and from the clean fill site will also be part of the specific controls for this area.

Similar measures are to be employed for ongoing management of temporary stockpiles throughout construction i.e. watering and capping, dust suppression sprays, minimising or stopping work when conditions are not appropriate as well as including measures to manage any dirty runoff if not within the extent of works being completed within that phase or stage of works.



6.5 Specific Methodology within Gullies and Northern Channel

The expected stormwater construction within the Southern and Southwestern Creeks will involve cutting of trenches and installation of stormwater pipes down the steep slopes of the gullies, and subsequent backfill. Concrete outlet structures will then be constructed at the bottom of the slopes (but not directly in the base of the gullies other than likely rip rap rock installation).

A likely typical detail for the outlet structures is shown in drawing C0266 and an example is shown here:



Construction will be done in dry conditions and will be timed to ensure minimal risk of work occurring during flows in the gullies. However, construction timeframes are likely to be in the order of 3 to 4 weeks to complete each outlet. Therefore, the areas of construction will be bunded off during the works to divert any flows from upstream. This will ensure no dirty water runoff occurs if flow in the base of the gullies is present.

Installation of the culvert in Southern Creek

This will be very similar to the works in the Northern channel at Hanley's Farm and the previous works for the installation of the box culverts in Hanley's Farm DP7B.

Disturbance of the bed itself is likely to be around 1-2 weeks, with the box culvert units being dropped in over a matter of days. However, the whole scope of work in the vicinity is likely to be 4-6 weeks to allow for all earthworks, headwalls, rock protection works and works on top of the culvert itself once it is in place.

Bunding and temporary piping of any flows in the bed of the creek as a clean water diversion will be put in place while the works are in progress, to divert any rainfall flows reaching the Creek. The bigger risk will be around much larger flows from The Remarkables. Therefore, the work will be timed to pick a window of anticipated dry weather.



The likely extent of works is shown in Drawing C0230. The extent of the embankment construction and culvert along the creek bed is approximately 50metres.

Bridge crossing over the Northern Channel

This crossing is for a pedestrian/cycle trail and is expected to be like the bridge constructed at Hanley's Farm. The channel is separately proposed to be modified as part of the general earthworks and drainage and this should be completed during dry months when the creek is not flowing.

The works for the bridge within the newly formed channel are likely to be limited to foundations on each bank of the new channel. The main bridge structure will then be craned into place and completed. No diversion of flow in the channel will be required for the bridge construction and no disturbance of the bed of the creek will be necessary.

The duration of the bridge construction is expected to be approximately 6 weeks.

Pipes under the Northern Channel

Pipes will be constructed in open cut trenches below the channel base at the eastern end of the channel to connect these services between the subdivision and the water/wastewater treatment plants. The alignment would be perpendicular to, and span over the width of, the channel. Trenching and pipeline installation can potentially be done over a day but allow 2-3 days. Based on this, a window could be chosen when there is no flow to prevent the need to divert existing flows, although if it were needed then temporary PVC pipes would be used to divert clean water flows over the trenches.

6.6 Management adjacent to Wetland Area 3

No earthworks are proposed within the Wetland 3 area and the intention is to fully protect this area and ensure it is not disturbed.

The closest that works will potentially be is in the order of 20-30m with the construction of a temporary Sediment Retention Pond (SRP) as part of the onsite temporary environmental controls where earthworks is progressing within stages 7-9. This would be built in a way to fully protect the wetland area with the emergency spillway directed to the large gully to ensure no dirty water gets into the wetland. The closest infrastructure will be within Road 72 and 73, being standard roading and underground services, along with the potential pump station at the end of Road 72. The wetland would be fully protected from these works via the environmental controls.

In order to prevent the risk of the drying out of wetland 3 during construction, controlled discharge from the sediment retention pond will occur. The quantum and timing of this discharge is to be finalised in conjunction with the wetland management plan being prepared by Wildlands but is likely to be in the order of 5% of total runoff being contained in the ponds. Inflows to the pond will be monitored in order to determine the required outflow into the wetland and will either be manually or automatically syphoned off from the main discharge to the gully, when flows are meeting the minimum requirements for water quality.

Longer term management of flows into the wetland to prevent it drying out once existing overland flow is cut off by roads and other infrastructure is to be determined in conjunction with the ongoing monitoring planned under the wetland management plan. It is possible that specific irrigation will need to be included in the design of infrastructure in this area to ensure pre development flows into the wetland are maintained at specific times of the year.



6.7 Lizard Management Plan

A specific Lizard Management Plan has been prepared by Wildland Consulting, dated April 2025. Key aspects for construction in terms of the Lizard Management Plan are as follows:

- Work will be programmed to ideally remove existing vegetation during warmer months (October to March)
- Maintain existing areas of grazing for as long as possible whilst work is ongoing in other areas to reduce the risk of lizards moving into areas they are not currently in
- A process has been outlined to salvage lizards in each stage prior to work starting, this is to be managed by the herpetologist. Earthworks then need to start within 2 weeks of salvage (this will be included in the construction programme for each stage)
- Trapping to salvage lizards occurs for around 7-10 days or until no more lizards are caught (there is some risk here around programme and starting earthworks if catches continue for a longer period)
- The initial release area is in a 4Ha area of the lower section of the Southeastern Creek so this area needs to be kept clear of any disturbances.
- Another area would be identified for release if a larger than expected number of lizards are captured.
- A further incident discovery protocol is in place and staff on site will be made aware of it.

6.8 Noise

It is expected that conventional earthmoving equipment, such as excavators, trucks, rollers, plate compactors will be required during earthworks construction. Rock breakers are not expected to be required. The contractor will ensure that all works are undertaken in accordance with the noise limits set in any relevant conditions of consent, national standard or in the absence of a consented limit must comply with the district plan noise limits. The EMP will include provisions that for works exceeding 20 weeks the noise limits will be limited to 70dB with a max of 85dB. The EMP will include provisions to mitigate noise generation.

6.9 Dust

Soil materials at this site have the potential to generate dust. The earthworks contractor will take appropriate measures to control dust in accordance with QLDC requirements. Construction methodology, staging of works and limited works during forecasted wind events are all commonly used controls by the contractor to minimize the generation of dust. To manage conditions when dust is generated, regular damping will be undertaken. The EMP will include provisions for dust control during dry conditions.

6.10 Vibration

The site largely comprises a rural setting. Jacks Point residential buildings are located approximately 300 m from the northern boundary of the development, separated by Lot12 which is not proposed to have any major earthworks completed on it. Some residential buildings are also located to the south west of the development and the Lakeside Development is located south of Homestead Bay but is largely separated by the existing deep stormwater gully.



The residential buildings are separated by earth mounding and vegetated landscaping area, all items that will minimize any vibration disturbance from construction activities. Overall, the risk of vibration to neighboring properties is considered low. The EMP will include provisions to mitigate vibration during construction works.

6.11 Contaminated Land

A Preliminary Site Investigation (PSI) has been completed by WSP to assess the potential risk to human health from contaminants in the soil associated with historical site uses (786 Kingston Road, Queenstown, Preliminary Site Investigation, dated 3 February 2025).

The PSI has found that:

- Historical and current Hazardous Activities and Industrial List (HAIL) activities have taken place on the site.
- As a result, the *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NESCS)* apply
- Identified HAIL activities and the risk to human health and the environment are assessed as either moderate or high risk. These are summarised below and in Figure 1:
 - o HAIL sites with Moderate Risk to Human Health and Environment
 - Fuel storage, workshops, washdown areas, and fire practice areas at the skydiving facilities (F1)
 - Chemical, fuel, or liquid waste storage tanks at the skydiving facilities (A17)
 - Possible landfilling north of the skydiving facilities (G3)
 - Fertiliser manufacture or bulk storage northeast of Lot 8 (A6)
 - Wastewater treatment and disposal field (G6)
 - o HAIL sites with High Risk to Human Health and Environment
 - Livestock dip or spray operations (A8)
 - Wastewater treatment and disposal field (G6). Note environmental risk assessed as moderate.
- Due to the assessed risk of HAIL sites, the proposed land use change from rural to urban is assessed to be a **discretionary activity**.
- **Since development is considered a discretionary activity, a Detailed Site Investigation (DSI) is required**

The recommendations from the PSI include:

- Submit the PSI report to the Consenting Authority (QLDC)
- Submit the PSI report to the Regional Authority (ORC) to enable an update of their HAIL database
- Complete a Detailed Site Investigation (DSI) to outline risks to human health and the environment along with required remediation works.
- Engage a suitably qualified and experienced practitioner (SQEP) if additional contaminated ground is encountered

It is expected that the outcome of the DSI will be that a Remediation Action Plan, that will form part of the overall EMP for each stage, will need to be prepared prior to earthworks commencing. This will detail the course of action to suitably manage and dispose of the contaminated waste in a safe and controlled manner.





Figure 4 A Summary of the HAIL activities identified in the PSI Report

7 Health and Safety

The Contractor(s) will prepare a comprehensive Site Specific Health and Safety Plan which:

- Incorporates the relevant requirements of the key client and stakeholder Health and Safety (H&S) Plans
- Incorporates the Contractor's own H&S system, and applies to any subcontractors working on the Project; and
- Is tailored to suit the specific conditions and risks appropriate to the Project.

The objective is to have only one Project specific H&S Plan that applies to the Project and is administered and managed by the Contractor who is in control of the site.

The overall objective of the H&S Plan is to enable a safe working environment and avoid harm for all parties involved in the Project, and the public

The H&S Plan will be prepared – and will be maintained and managed – in accordance with the Health and Safety at Work Act 2015, and all other relevant health and safety legislation and regulations. The Health and Safety at Work Act 2015 requires the employer and employees to do all that is reasonably practicable to ensure the safety of staff whilst at work. This includes ensuring that:

- All persons are appropriately trained, skilled and/or supervised for their tasks
- All hazards are identified, notified, and managed to accepted industry and H&S standards
- Safety barriers and signage are provided as appropriate, and hazard registers and noticeboards are kept up to date and discussed at regular site toolbox meetings
- Appropriate personal protective equipment is worn at all times; and
- All visitors to the site are safe at all times.

RCL Homestead Bay Ltd will be responsible for ensuring that the site complies with the Health and Safety at Work Act 2015 and any relevant Health and Safety regulations. The H&S Plan will specify appropriate H&S management procedures including audits, incident reporting and actioning, and any corrective action as necessary to ensure the safety of all throughout the duration of the Project.

The information below is a list of typical project hazards which are anticipated to apply to the Project site. Any other hazards identified during the Project will be incorporated into the CMP as identified.

- Construction plant
- Open excavations
- Demolition
- Heavy trucks and other road-going vehicles including cars, trailers and campervans
- Underground and overhead services
- Earthworks
- Contamination
- Hazardous materials
- Explosive or flammable materials
- Noise and vibration
- Dust and fumes
- Craneage
- Trips, slips and falls



Homestead Bay Development

7 Health and Safety

- Working at heights
- Working over water
- Confined spaces; and
- Foreign tourists and other unfamiliar public driving through site



8 Traffic Management

Management of Construction traffic can generally be split into three parts:

- access into and out of site,
- within site during earthworks and civil construction prior to any internal roading being accessed to the public
- within the development whilst parts of the roading network are accessible to the public.

The main access into and out of site will be from SH6, initially through the existing access to the NZone Skydive facility or the existing access to Lot 12. No large scale movement of earthworks materials into or out of site is expected and therefore access off the state highway will generally be limited to light vehicles, delivery trucks and road pavement material trucks. It is proposed that a new roundabout on the State Highway to access the development will be constructed in the early stages in order to provide a safe and efficient means of accessing the site. The alignment of this roundabout means that it can be built largely offline with two way flow maintained on the State Highway. Short term lane closures will likely be necessary for completion of the tie ins to the existing alignment but otherwise disruption to the State Highway will be minimal. Temporary site access and access to the Skydive facility will also need to be maintained during the construction of the roundabout. Fully detailed traffic management plans will be developed for this phase of works and submitted to the RCA for approval prior to works commencing,

Within site itself for phase 1 Earthworks all large scale plant will be brought to site and will work within specified areas with temporary haul roads constructed where necessary. This work can be completed with minimal traffic management other than clearly defining routes through the site for construction traffic, no public access will be allowed. The areas for movement of construction will change as the earthworks move between each stage of the development.

As the stages progress and roading construction advances from the roundabout south, basic traffic management will be necessary in order to ensure it is clear where public access is allowed and where entrances to site for construction traffic are. Standard traffic management plans will be prepared for these scenarios and submitted to the RCA for approval prior to works commencing. As the development fills up with houses and traffic increases more detailed traffic management may be necessary but in generally each stage will be clearly delineated and ideally fenced off to minimise the interaction with the travelling public. It is not expected that the construction traffic will need to access the site through Jacks Point and Homestead Bay Road but once the link to this road is created then general traffic and particularly builders construction traffic may access via this route.

Construction traffic for the treatment plant area and water reservoirs will be via the existing access to Lot 12 from the State Highway. This access was previously upgraded and considered suitable in its current condition to deal with the expected construction traffic for this phase of the project.



9 Site Security

Areas of the site will be securely fenced generally as per the proposed staging plan with deer fencing and access gates. Additional fencing is likely to be required in the early stages around the north western area of the development to limit the chances of public access to the site. A site compound will be established in a central location and will also be securely fenced and CCTV cameras installed. The site compound is likely to move as the development progresses.



10 Quality Control

Quality Management Plans will be prepared by each Contractor detailing how works will be constructed, monitored, tested, inspected and approved in accordance with the drawings, specifications, manufacturer's requirements and any specific consent conditions.

Independent on site inspections and construction monitoring will be completed by Stantec Representatives on behalf of RCL to ensure the works are completed to the required quality standards and in accordance with local authority requirements and national standards.



11 Communication

Communication will generally be internal between the main parties engaged by RCL. Any external communication shall be directed through the RCL Project Manager and no parties shall engage directly with the media or public without prior agreement from RLC.



12 Risks

A full risk assessment will be completed for each stage of the project as it progresses, however, at this early stage the key risks that have been identified include:

- Timing of approval through the Fast Track process
- Engagement with stakeholders during the Fast Track process and potential for negative feedback which delays the consenting process
- Resourcing to complete all inputs through both design and construction
- Cost of material and construction affecting the financial viability of the project
- Demand for sales affecting the progress of future stages

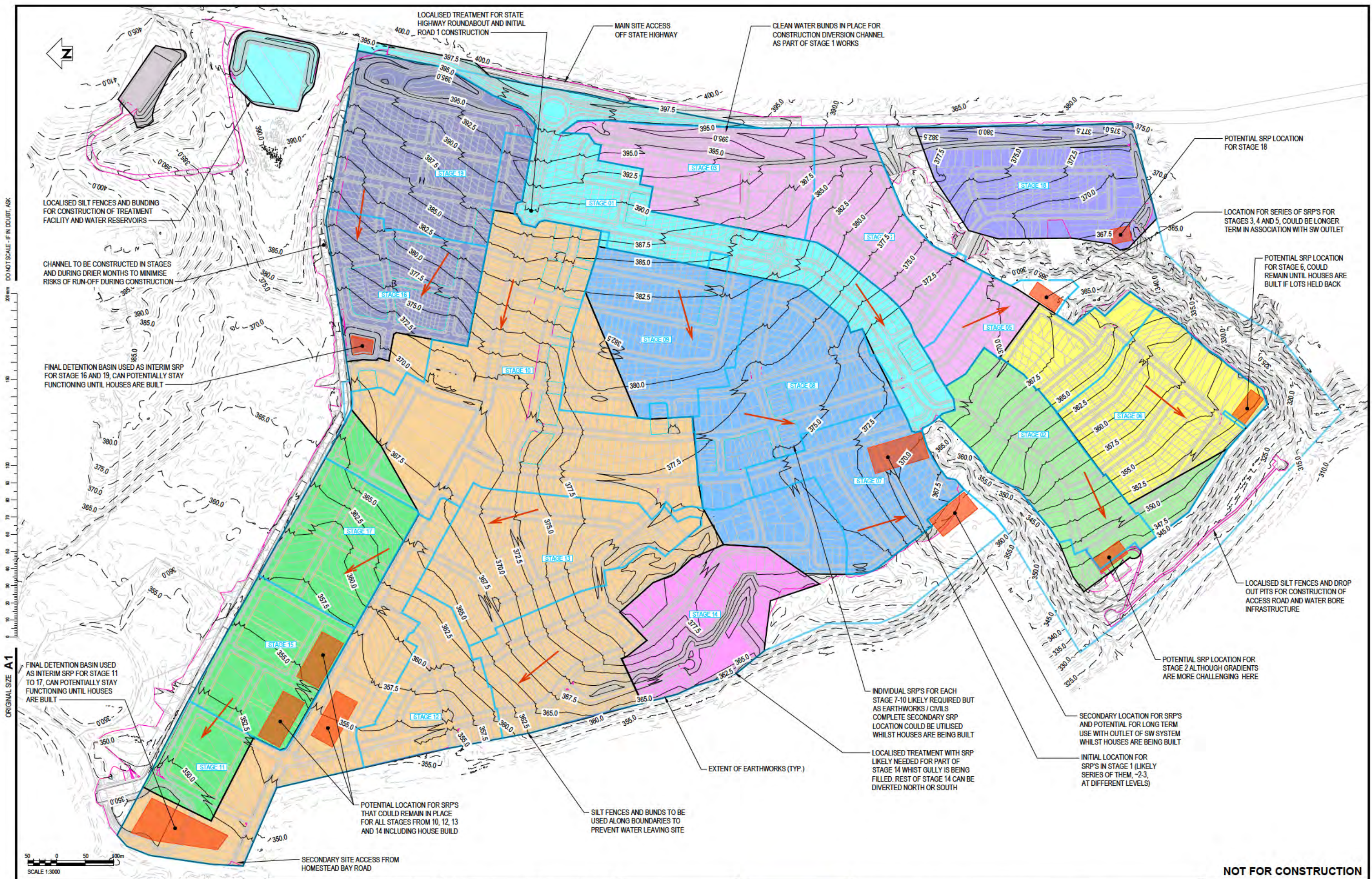


Appendices



Appendix A Master Plan ESCP





NOTED: 16/04/2025 11:25 AM <table><tr><td>0</td><td>ISSUED FOR CONSENT</td><td>BG</td><td>PAT</td><td>PSW</td><td>11.04.25</td></tr><tr><td>REV</td><td></td><td>DRN</td><td>CHK</td><td>APP</td><td>DATE</td></tr></table>										0	ISSUED FOR CONSENT	BG	PAT	PSW	11.04.25	REV		DRN	CHK	APP	DATE	SURVEYED DESIGNED DRAWN CAD REVIEW DESIGN CHECK DESIGN REVIEW APPROVED PROF REGISTRATION: <table><tr><td>Patersons</td><td>08.24</td></tr><tr><td>Iain Banks</td><td>02.25</td></tr><tr><td>Brent Grey</td><td>02.25</td></tr><tr><td>Peter Thomson</td><td>11.04.25</td></tr><tr><td>Peter Thomson</td><td>11.04.25</td></tr><tr><td>Peter White</td><td>11.04.25</td></tr><tr><td>Peter White</td><td>11.04.25</td></tr></table>			Patersons	08.24	Iain Banks	02.25	Brent Grey	02.25	Peter Thomson	11.04.25	Peter Thomson	11.04.25	Peter White	11.04.25	Peter White	11.04.25	Client Stantec rclgroup		Client Homestead Bay Subdivision, Queenstown Master Planning Draft Erosion and Sediment Control Plan Masterplan Layout on Finished Ground Contours		Status Stamp FOR CONSENT Date Stamp 11.04.2025 Scales 1:3000 Drawing No. 310104425-00-000-D2011 Rev. 0	
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DO NOT SCALE - IF IN DOUBT, ASK

200 mm
180
160
140
120
100
80
60
40
20
0

ORIGINAL SIZE A1

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11.04.25
DATE
PROF REGISTRATION:

WIDTH OF TOP EMBANKMENT SHOULD BE WIDE ENOUGH TO ENSURE MACHINERY ACCESS FOR DE-SLUDGING OF POND, IF THERE ARE NO OTHER ACCESS POINTS AVAILABLE

SPILLWAY COMPACTED AND SMOOTHED TO ELIMINATE ALL VOIDS PRIOR TO LAYING AND PINNING APPROPRIATE GEOTEXTILE/CONCRETE

EXISTING GROUND LEVEL

0.30m MINIMUM FREEBOARD

MOUND

DP8 SW MANHOLE

ANTI-SEEP COLLARS AT 10m SPACINGS

DN300 PIPE

LOWEST INLET PIPE TO RISER IS ANGLED UPWARD AT 15° TO EASE TENSION ON FLEXIBLE JOINT.

TEE BAR CONCRETE MH RISER, MAY REQUIRE WEIGHTING OR ANCHORING TO PREVENT FLOATING.

DECANT.

WARATAH STAKES REQUIRED FOR ALL DECANTS.

UPPER DECANT OPERATES OVER 1/3 OF LIVE STORAGE ONLY
MIDDLE DECANT OPERATES OVER 2/3 OF LIVE STORAGE ONLY

LOWER DECANT EXTENT OF TRAVEL IS OVER 100% OF THE LIVE STORAGE DEPTH - VARIABLE UP TO 1600mm

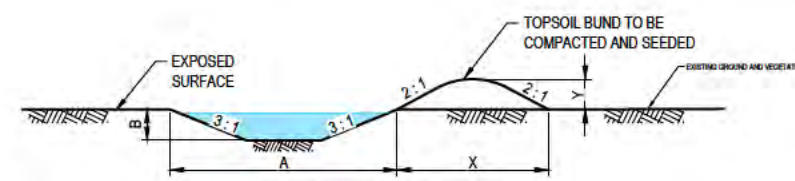
DEAD STORAGE = 30% POND VOLUME

POND OUTLET DETAIL

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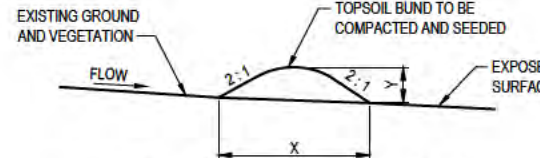
NOTES:

1. REFER TO THE EMP REPORT FOR ALL LETTERED DIMENSIONS SHOWN ON THIS SHEET.



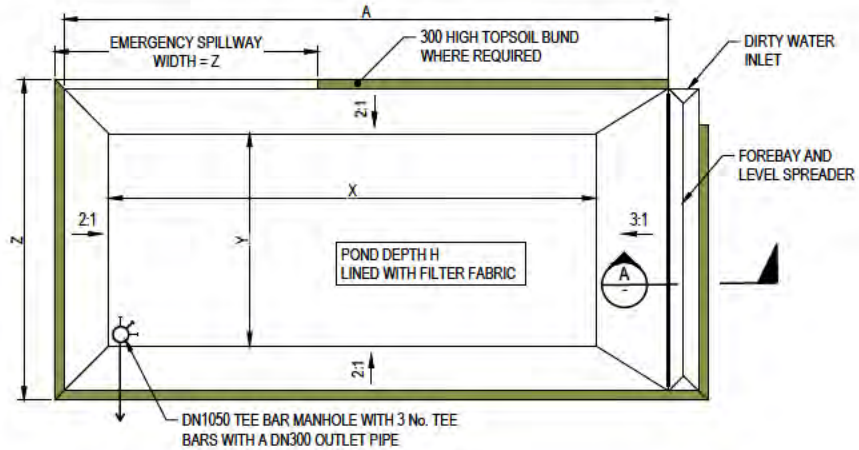
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SCALE 1 : 50



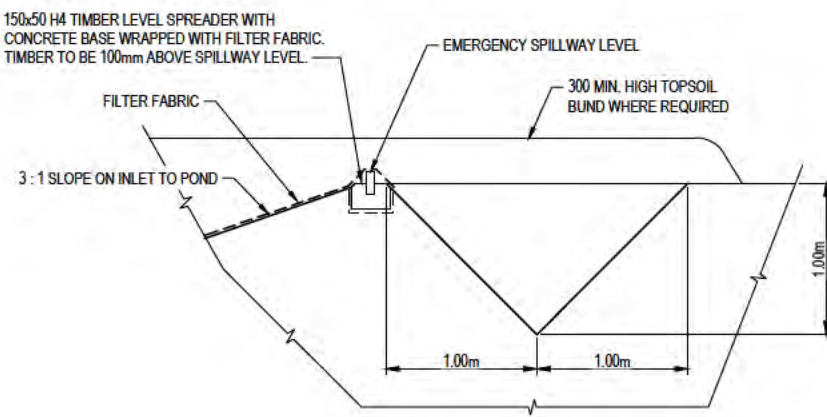
CLEAN WATER / PERIMETER BUND

SCALE 1 : 50



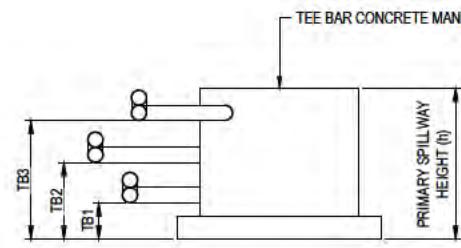
POND - TYPICAL PLAN

SCALE 1 : 250



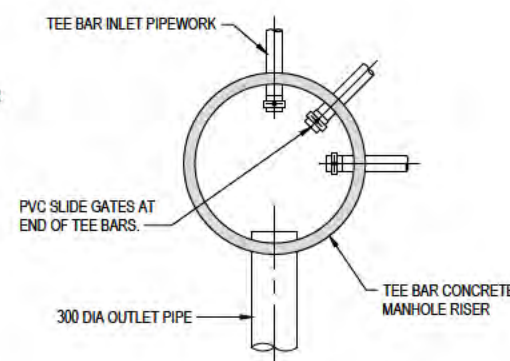
SECTION A-A

SCALE 1 : 25



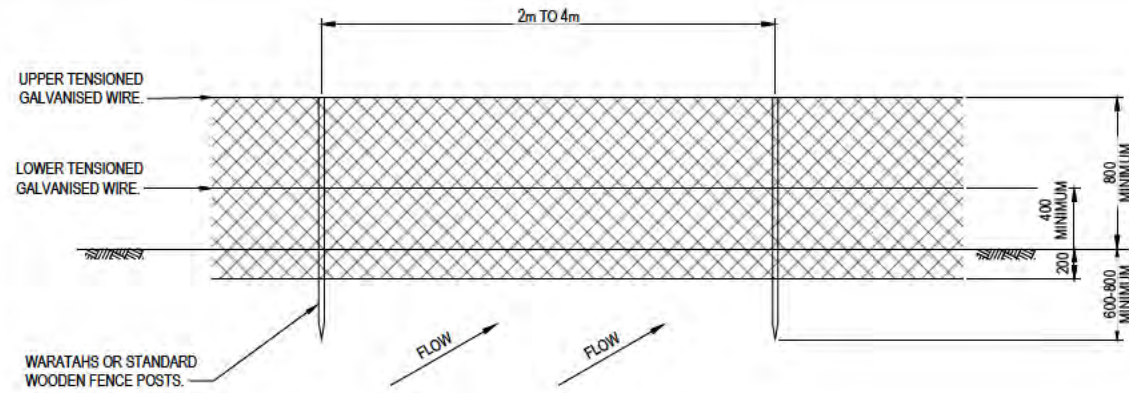
POND TEE BAR HEIGHTS

SCALE 1 : 25



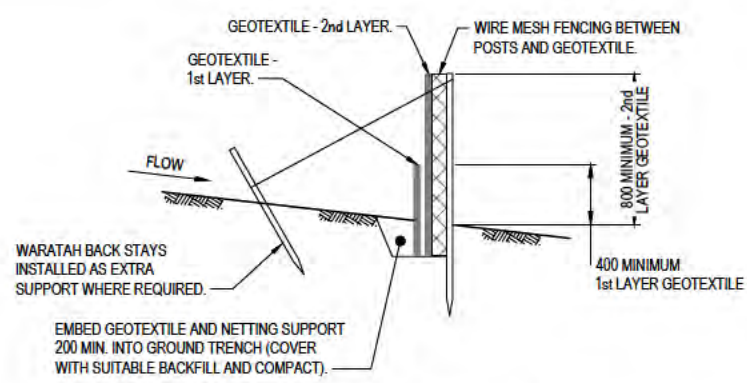
TEE BAR MANHOLE - PLAN

SCALE 1 : 25



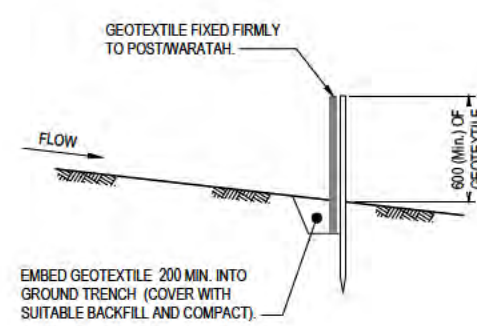
SUPER SILT FENCE - ELEVATION

SCALE 1 : 25



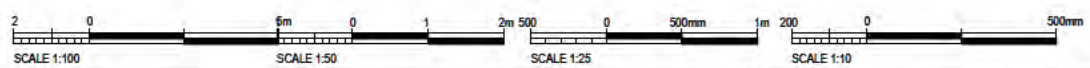
SUPER SILT FENCE - SECTION

SCALE 1 : 25



STANDARD SILT FENCE - SECTION

SCALE 1 : 25



NOT FOR CONSTRUCTION

SURVEYED	Patersons	08.24
DESIGNED	Patrick Leslie	02.25
DRAWN	Brent Grey	03.25
CAD REVIEW	Peter Thomson	11.04.25
DESIGN CHECK	Iain Banks	11.04.25
DESIGN REVIEW	Peter White	11.04.25
APPROVED	Peter White	11.04.25
PROF REGISTRATION:		



HOMESTEAD BAY SUBDIVISION, QUEENSTOWN
MASTER PLANNING
DRAFT EROSION AND SEDIMENT CONTROL PLAN
TYPICAL CONSTRUCTION DETAILS

Status Stamp	FOR CONSENT
Date Stamp	11.04.2025
Scales	AS SHOWN
Drawing No.	310104425-00-000-D2012
Rev.	0

Appendix B Template EMP





ENVIRONMENTAL MANAGEMENT PLAN

Homestead Bay Development

Stage XX

PREPARED FOR RCL HOMESTEAD BAY LTD | Date XX

Revision Schedule

Rev No	Date	Description	Signature of Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1						
2						
3						

Quality Statement

The conclusions in the report are Stantec's professional opinion, as of the time of the report, and concerning the scope described in the report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The report relates solely to the specific project for which Stantec was retained and the stated purpose for which the report was prepared. The report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorised use or reliance is at the recipient's own risk.

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Abbreviations

Enter Abbreviation	Enter Full Name
SRP	Sediment retention pond
QLDC	Queenstown Lakes District Council
EMP	Environmental Management Plan
ESCP	Erosion and sediment Control Plan
ORC	Otago Region Council
GD05	Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region
SQEP	Suitably Qualified and Experienced Person
TSS	Total Suspended Solids
NTU	Nephelometric Turbidity
ARI	Annual Reoccurrence Interval

1 Introduction

This Environmental Management Plan (EMP) outlines the administrative/operational procedures and practices that are to be implemented to manage, remedy, and mitigate potential environmental effects, ensure the health and wellbeing of all employees on site, and adhere to all statutory requirements whilst undertaking earthworks and civil works associated with the construction of stage XX of Homestead Bay Development.

The contents of this EMP outlines Queenstown Lakes District Council (QLDC) and Otago Regional Council (ORC) requirements for the earthworks activities and will be discussed in the site inductions/toolbox meetings to ensure all parties are aware of the requirements. This will ensure that QLDC and ORC's environmental views are appropriately protected, and the resource consents adhered to.

This EMP report is to be read in conjunction with the Erosion and Sediment Control Plan (ESCP) and together both sections shall be referred to as 'the EMP'.

2 Level of Risk

The works associated with stage XX can be categorized as high-risk based on QLDC's Guideline for Environmental Management Plans. The extent of the works is approximately XX ha of area. The work area is divided into localized areas, XX as follows..... By dividing it up this will ensure runoff can be collected and treated separately and effectively.

3 Site and Work Description

3.1 Location

Describe location of Stage

Insert Location Plan

Figure 3-1: Extents and extents of work covered by previous EMP

3.2 Existing Features

3.2.1 Stage XX – Existing Stormwater Overland Flow Paths

Describe existing overland flow paths

Insert Plan of flow paths

Figure 3-2: Existing flow paths – orientated north.

3.2.2 Ground Condition

Describe ground conditions

4 Administrative Requirements

4.1 Environmental Roles

The environmental roles are outlined in Table 4-1 below.

Table 4-1: Environmental Roles

Contactor's Site Manager	Earthworks stage - XX
--------------------------	-----------------------

Environmental Representative	P: XX	
	Civils stage – XX	
	P: XX	
	Earthworks stage - XX	
Environmental Advisors and Engineers	P: XX	E:
	Civils stage – XX	
	P: XX	E:
	Iain Banks SQEP – Stantec	
Clients Representative	P: [REDACTED]	E: [REDACTED]
	Patrick Leslie – Stantec	
	P: [REDACTED]	E: [REDACTED]
	Dan Wells	
Queenstown Lake District Council (QLDC)	P: [REDACTED]	E: [REDACTED]
	Monitoring Department	
Otago Regional Council (ORC)	P: 03 441 0499	E: RCMonitoring@qldc.govt.nz
	Compliance hotline	
	P: 0800 474 082	E: compliance@orc.govt.nz
	P: 03 474 0827	
	Pollution Hotline	
	P: 0800 800 033	E: pollution@orc.govt.nz

The Client's Engineers are responsible for ensuring the Contractors and Environmental Representative are upholding the requirements of this document. Compliance inspections will be undertaken monthly or as required to ensure all measures are in working order. As part of the inspection an overall assessment will be completed to assess if environmental measures can be improved and to ensure the site is being managed effectively to prevent the risk of an environmental incident during work.

For the position of a Suitably Qualified and Experienced Person (SQEP), Iain Banks of Stantec is a Chartered Professional Engineer with a background in civil construction and transportation projects. For the last 8 years Iain has been responsible for overseeing construction and site monitoring of the Hanley's Farm Development including overseeing works in streams and land disturbance activities of the previous stages. Based on this, Iain meets the definition of a SQEP for a high-risk site as defined in the QLDC Guideline for Environmental Management Plans. Assisting with tasks onsite will be another employee of Stantec, Patrick Leslie, who has been working under the guidance of Iain for the last 6 years.

The Clients Representative role in environmental management is to ensure the clients best interests are heard and adhered to while ensuring the progress is to the clients liking. They will be involved with all large changes that require approval from the client while providing feedback to the client about the site and any environmental issues.

The Contractor's Site Manager is responsible for ensuring the site operates in a safe and effective manner while ensuring all Contractor obligations outlined in the document are upheld. This includes items like implementation of the Environmental Management Plan while ensuring work is undertaken in a timely manner and in accordance with the specification of the project. They are also responsible for assisting the Site Representative with the management of any accidental discovery/environmental incident in accordance with this EMP and the relevant sections below.

The Environmental Representative is responsible for implementation of environmental controls and administrative activities.

They will:

- Ensure installation of environmental controls as per the EMP.
- Undertake environmental site inspections of the project.
- Oversee the maintenance and improvement of defective environmental controls.
- Undertake environmental incident reporting.
- Undertake environmental monitoring.
- Keep project leadership informed of environmental performance of the project.
- Inform staff of procedures and constraints applicable to managing specific environmental issues
- Providing environmental inductions to all staff and sub-contractors
- Attending to environmental incidents and complaints.

The Environmental Representative should be familiar with:

- Environmental aspects of the project
- Environmental Management Plan
- Best practice erosion and sediment control from:
 - Guidance Document 2016/005: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05); and/or
 - Erosion and Sediment Control Toolbox for Canterbury on Environment Canterbury website; and/or
 - Best Practice Erosion and Sediment Control, International Erosion Control Association Best Practice Guidelines.
 - QLDC Guidelines for Environmental Management Plans
 - Otago Regional Council Residential Earthworks in Otago A Guide for developers, landowners contractors and service providers

4.2 Hours of Operations

Hours of operating for works will be in accordance with the applicable QLDC resource consent hours of operation and limited to the following:

- Monday to Saturday (inclusive): 7.30 am to 6:00 pm.
- Sunday and public holiday: No Activity

In addition, no heavy vehicles are to enter or exit the site and no machinery will start operating earlier than 7.30am. All activity on the site is to cease by 6:00pm.

4.3 Site Inductions

The Contractor will deliver a project specific site induction to all persons upon entering the site, a separate document has been prepared for this purpose. The environmental site induction includes a summary of all items included in this EMP and ESCP and specifically covers:

- The basic roles and responsibilities for environmental management and each person's responsibility while onsite.
- Specific locations within the site of environmental significance or risks, including exclusion zones and sensitive environmental receptors.
- An outline and discussion covering the conditions of resource consents.
- The limit of clearing and earthworks for each stage of works (as indicated on the ESCP).
- Environmental management measures required and how they should look.
- Procedures of notifying of potential environmental incidents.
- Procedures for managing environmental management measures during wind and rain events.

The Contractor is responsible for maintaining a register signed by those inducted. The register shall have, but not be limited to, the name of the inductee, date inducted, and the name of the induction facilitator. An example of an environmental site induction registers is included in Appendix C.

The Contractor's Health and Safety Advisor will conduct a weekly site health and safety meeting with the employees on site, minutes of these meetings will be kept on site and will also be available to view if requested. Weekly client meetings will discuss relevant health and safety issues that have been highlighted in the weekly toolboxes and other observations from site works.

4.4 Monitoring

4.4.1 Ongoing Monitoring

The Contractor's Environmental Representative and staff will monitor ongoing site activities to ensure compliance and that there are no adverse effects on sensitive environment receptors like the neighboring residential development of Jacks Point is experienced.

Noise levels will be measured if a valid complaint is received. This will ensure compliance with the standard and levels referenced. It should be noted that a valid complaint means a complaint the administering authority considers is not frivolous, nor vexatious nor based on mistaken belief.

Vibration's monitoring will be measured if a valid complaint is received. This will ensure compliance with the standards outlined below.

Wind condition will be monitored during the works, especially if there is large area of exposed land in direct contact with the wind. During periods of high wind, the Environmental Representative is to advise the Site Manager of the conditions and suggest changes to the work program to minimize dust generation or ensure additional dust prevention measures are implemented.

Weather conditions during works will be monitored. Severe changes in the weather may require action to be taken. Any person onsite who notices signs of uncontrolled sediment runoff because of rain shall notify the Environmental Representative or Site Manager immediately. The Environmental Representative, and if required Stantec, shall rectify the situation and update the EMP.

4.4.2 Weekly, Pre and Post Rainfall Events

The Contractor's Environmental Representative and, if requested, Stantec shall undertake and document weekly inspections of the environmental management controls of the site for the purpose of monitoring the following:

- Verifying that the management measures are present, functional, and adequate.
- Observing the site for actual or potential adverse environmental effects.
- Identify maintenance requirements for implemented management measures.
- Verifying preparedness for adverse weather conditions where rain and/or wind is forecast.
- Observing any visual evidence of dust travelling beyond the boundaries of the site and evidence of dust fallout from the works on adjacent vegetation or buildings.

The Contractor's Environmental Representative is responsible for monitoring the weather forecasts and prior to any significant forecast rain (such as a 20mm over a 12hr period) and post rainfall events when there is flow of water being discharged from site, they shall undertake a site inspection of the environment management controls. If maintenance or alteration is required, this will be undertaken prior to the forecasted rain fall event. They shall document the inspection using the form in Appendix F

The Contractor shall undertake corrective actions to rectify issues identified by the site inspections. Each weekly inspection shall be recorded including date, observations, and any corrective actions. Appendix G has a template for the weekly site inspection form.

Between the weekly and post-rain event inspections, the site personnel shall also undertake a daily pre-start inspection to ensure that no new environmental issues have arisen, or mitigation measures have been compromised from the previous day's work. Observations should be recorded in a works diary.

4.4.3 Monthly

Stantec shall monitor the site monthly to ensure that the site is complying with its EMP, identify any new environmental risks arising that could cause an environmental effect and suggest alternative solutions that will result in more effective and efficient management. The outcome of these inspections will be reported and included in the monthly environmental report referred to below. Appendix I has an example of a monthly inspection form to be completed at the specified date and for inclusion in the monthly environmental report.

The Contractor shall complete and submit a monthly environmental report to QLDC and ORC. The monthly environmental report will be submitted to QLDC's Regulatory Department and ORC compliance within five working days of the end of each month. It will include exception reporting and statements actively addressing but not limited to the following that occurred during the reporting month:

- Updates to the EMP and the Erosion and Sediment Control Plan (if required).
- Weekly Site Inspections – number of inspections completed, and summary of corrective actions undertaken if any. Any area where replacement or rework of control features occurred will be noted.
- Monitoring reporting – summary of monitoring and whether non-conforming results were obtained.
- Positive environmental outcomes achieved, and opportunities identified by the Contractor.
- Stantec inspection report.

4.5 Incidence Reporting and Management

The Contractor will report to QLDC, ORC and Stantec within 12 hours via email of any environmental incident where an EMP has failed leading to an environmental nuisance or harm offsite. Once the immediate risk from the environmental incident is alleviated, the Contractor and Stantec will investigate the cause of the breach and/or adverse environmental effects. After which, identification and implementation of corrective actions will be undertaken.

The Contractor will provide any incident report to the Stantec, ORC and QLDC within 10 working days. Appendix D has a reporting template that is to be used when completing an environmental incident report.

Definition of environmental nuisance or harm off site can be found in the QLDC Guideline for Environmental Management Plans, June 2019.

Any environmental issues reported to the site manager, such as noise and vibration issues will result in works stopping until appropriate response measures have been agreed upon between the Stantec and the Site Manager and recorded in the Contractors incident register.

After any identification of incident or failure, the source/cause is to be immediately located and the following measures implemented:

- Build-up of sediment off the site – the material will be collected and disposed of in a manner that will not cause ongoing environmental nuisance or harm; then on-site EMP measures amended (if required), to reduce the risk of further sedimentation.
- Excessive sediment build-up on the site – collect and dispose of material, then amend up-slope drainage and/or erosion control measures as appropriate to reduce further occurrence.
- Severe or excessive erosion – investigate cause, control up-slope water movement, re-profile surface, cover dispersive soils with a minimum 100mm layer of non-dispersive soil, and stabilise with erosion control blankets and vegetation as necessary.
- Off-stream erosion – fill eroded areas, vegetate, and install velocity control measures.
- In-stream erosion – consult Stantec.
- Poor vegetation growth or soil coverage – plant new vegetation. Newly planted and previously planted areas may require supplementary watering and replanting. Additionally, erosion protection matting can be used to help ensure slope stability until growth is achieved.
- Sediment fence failure – replace and monitor more frequently. Regular failures may mean that the sediment fence location, alignment, or installation may need to be amended.
- Source of incidents is not a part of works – notify Stantec, ORC and QLDC of the source location.

4.6 Records and Registers

The Contractor is responsible for keeping all onsite records up to date. Environmental records will be made available upon request, immediately if the request is made by a QLDC or ORC Officer onsite and within 24 hours if requested by a QLDC or ORC Officer offsite.

Records and registers to be managed onsite shall include the following:

- Environmental induction attendance register (Appendix C).
- Environmental incident reports and associated corrective actions undertaken (Appendix D).
- Complaints register and associated corrective actions undertaken (Appendix E).
- Daily diary entries (including pre-start inspection observations).
- Post-rain event inspection observations and corrective actions (Appendix F).
- Weekly site inspection checklists (Appendix G).
- Monitoring results (e.g. water quality) (Appendix J).
- EMP non-conformance register (based on weekly inspection results or otherwise identified) and associated corrective actions taken (Appendix H).

4.7 Complaints Process

While it is hoped the environmental measures outlined in this document will prevent complaints from surrounding residents and the wider community, complaints or concerns can be reported via two channels:

- Via QLDC – <https://www.qldc.govt.nz/do-it-online/make-a-complaint/>
- Via ORC – <https://www.orc.govt.nz/managing-our-environment/waste-and-hazardous-substances/pollution/report-pollution> or the ORC hotline which is managed 24 hours a day 0800 800 033.

If the complaint is related to project management reference should be made to Section 4.1 of this EMP for contact details.

Once a valid complaint is received the Contractor's Environmental Representative or Site Manager will investigate the cause of the complaint, speak with the complainant (if available), consult with Stantec and work on a solution to prevent future complaints of the same nature. All valid complaints shall be registered on the complaints register as shown in Appendix F .

5 Operational Controls

5.1 Dust Minimization and Control

5.1.1 Performance Requirements

The Contractor shall always take reasonable and practicable management measures to avoid dust moving beyond the boundaries of the site.

5.1.2 Sensitive Receivers

Based on site visits and investigation it was concluded that the following dust sensitive receivers are present on and off site:

- Residences of Jacks Point.
- Vehicles using SH6
- Residences to the south
- Workers on site.

5.1.3 Dust Sources and Controls

Works could create adverse environmental effects in relation to dust including earthworks operations like excavation, transporting, compacting, and seeding soil during the course of works.

Based on prior knowledge the prevailing wind direction is from the south to southwest coming off the lake. It is a light to moderate wind most of the time but has been known to have some strength to it as long as it is not obstructed by objects. The measures below will be used to help prevent dust generation.

If visible dust clouds are seen approaching the site boundaries or deemed to have potential to cause a nuisance, water carts will be actioned to minimize dust generation, haul roads will be doused, and earthworks will cease if required. The Contractor will provide a standby operator available to control dust outside of working hours or if forecasted winds are expected.

Measures to be utilized onsite to prevent dust generation or manage the dust generated include:

- Suspension of works during high winds: During periods of high wind, vehicle movements and construction activities may need to be reduced or suspended to minimize potential dust nuisance.
- Water supply: confirm water supply location (likely from bores on site). Alternatively, the sediment retention pond (s) may have water available for use (refer to Appendix A).
- Avoid steep cut faces: Steep cut faces disrupt the wind and cause swirling effects, which generate more dust than off a flat surface. The earthworks will be excavated down in layers rather than deeper cut faces where appropriate.
- Topsoil shall be pre-wetted prior to stripping if ground conditions are particularly dry, this reduces the amount of dust generated by excessively dry ground conditions.
- Application of hydro seed: Depending on the type of hydro seed employed various binding materials can be added to the hydro seed mix to more effectively bind the topsoil surface to create a crust which is able to stay in place over a prolonged period if required.
- Application of dust suppressant: Depending on the area of application a dust suppressant can be applied to exposed surfaces to help reduce the creation of dust.
- Scale back operations to an area that can be controlled for dust when conditions are windy: Depending on wind conditions some operations might be scaled back or shifted to a different part of the site to avoid generation of dust.
- Re-topsoil finished areas as soon as possible and re-grass: Following completion of bulk earthworks topsoil is to be placed and dampened down to form a crust with immediate grass seeding. As new ground is opened for cut to fill operation the stripped topsoil will be placed over completed areas so that there is a progression of completed areas and open areas being worked on.

The Contractor will rectify any instance where dust from site is found to be off site and causing an issue. It could be sweeping the dust off the road to prevent the situation getting worse.

5.2 Noise

5.2.1 Performance Criteria

The Contractor shall always take reasonable and practicable management measures to avoid and mitigate effects from noise associated with construction works.

The Contractor shall ensure that all works are undertaken in accordance with the noise limits set in any relevant conditions of consent or in the absence of a consented limit must comply with the noise limits. For clarification with works exceeding 20 weeks, the noise limits are limited to 70dB with a max of 85dB.

For all sites the contractor shall review the EMP, update and implement additional management measures:

- In response to a justifiable complaint caused by construction works
- When changes in the equipment/work method, intensity, location.

5.2.2 Noise Management

Noise generation activities include vehicle movement throughout site and excavation on site from equipment like water carts, excavators and haul trucks. All equipment used on site shall be regularly maintained and must only output acceptable construction noise. Construction noise is inevitable as part of the construction. However, construction noise will only be generated during the hours of operation permitted in the resource consent.

All practical steps shall be taken to minimize noise particularly when working adjacent to an existing residential area. It is noted that the proposed works are fairly separated from any such areas except for vehicle movements past existing houses within Jacks Point.

If a suitable complaint is received the Environmental Representative should monitor from the site compound and site boundary. A suitably qualified person should be engaged with an appropriate noise monitoring device to test the noise levels. Measurements will be taken at a height of 1.2 to 1.5 metre and 1 metre from any wall to align with the standards.. If levels are above the noted requirements, then additional investigation should be taken.

5.3 Vibration

The Earthworks may create severe vibration as operations such as rock installment is required for the works on site.

The Environmental Representative can monitor vibration levels using a suitable accelerometer typically found in today's smart phones or a vibration monitoring app like "Vibration Meter". If a justified complaint is received a qualified vibration monitor and expert will be engaged to measure and report what vibration levels are onsite.

5.3.1 Performance Criteria

Stantec undertook an inspection of the site, and it was identified that the nearest vibration sensitive receptor is the residence at Jacks Point. The vibration is deemed to be low risk with suitable distance form machines, bunds, and channels in place to disrupt the vibration. The construction staff will be informing the homeowner of every step of work to ensure clear communication is continued as in previous stages.

5.3.2 Vibration Management

To avoid exceeding the guidelines of British Standard – Code of Practice for noise and Vibration Control on Construction and Open Sites (BS5228.2:2009), vibration monitoring at the site boundary will undertake to ensure the vibration levels do not exceed 10 mm/s. Given the distance to the vibration sensitive receptor from the works site and the ongoing residential construction within the area any vibration levels closer to the residences could be caused by an outside source not associated with these works.

Table 5-1: Guidance on Effects of Vibration Levels (from British Standards BS5228.2:2009)

Vibration Level	Effect
0.14 (mm/s)	Vibration might be just perceptible in the most sensitive situations for vibration frequencies associated with construction and maintenance. At lower frequencies, people are less sensitive to vibration
0.3(mm/s)	Vibration might be just perceptible in residential environments but unlikely to be felt by a person
1.0(mm/s)	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10(mm/s)	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

5.3.3 Effects on Structures

For the purpose of this EMP, a structure includes infrastructure and utilities like pump stations, electrical and telecommunications facilities and utilities such as water mains and sewers.

The vibration will be monitored and DIN 4150-3:1999 Structural vibration – Part 3: Effects of vibration on structures will provide a comparative benchmark for preventing damage that could adversely affect the structures serviceability and give the Contractor a level to measure against if required. This standard has been adapted by New Zealand providing guideline vibration levels for assessing building damage risk.

The DIN 4150-3 (1999) guideline values for evaluating short-term and long-term vibration on structures are given in Table 5-2.

Table 5-2: Summary of Building Damage Criteria in DIN 4150.3:1999 (Source Deutsch Institut für Normung, 1999)

Type of structure	Short term vibration			Long term vibration	
	PPV at the foundation at a frequency of:			PPV at horizontal plane of the highest floor (mm/s)	PPV at horizontal plane of the highest floor (mm/s)
	1 – 10 Hz (mm/s)	1 – 50 Hz (mm/s)	50 – 100 Hz (mm/s)		
Commercial/industrial	20	20-40	40-50	40	10
Residential/school	5	5-15	15-20	15	5
Historical/Sensitive	3	3-8	8-10	8	2.5

For the works associated with the Conveyance Channel, it would be classed as long-term vibration according to the definition given in the standard. Works similar to rock breaking can be categorized as short-term vibration in the respected vibration frequencies of the equipment.

To avoid exceeding the guidelines of DIN 4150.3:1999, vibration monitoring at the site boundary will be undertaken to ensure the vibration levels do not exceed 10 mm/s. Given the distance to the vibration sensitive receptor are from the earthworks site and the ongoing residential construction within the area, any vibration levels closer to the residential area could be caused by outside sources not associated with the works.

If a valid vibration complaint relating to structure damage from Conveyance Channel work is received, the Environmental Representative will undertake vibration measurements at the location of the damage and compare to the levels above. Previous monitoring on the nearby Hanley's Farm Development have only shown levels of 1.5mm/s at the site boundary. These observations were observed when heavy compaction rollers were operating within 10m of the boundary so not every complaint will be considered as valid.

A valid complaint will be considered if one of the following minor damages is evident. In DIN 4150.3:1999, These effects are deemed 'minor damage':

- Cracks form in plastered surfaces of walls not due to house construction work.
- Existing cracks in the building become enlarged with proof of the change in crack sizes. Proof of existing cracks prior and post damage is required.
- Partitions become detached from load bearing walls or floors.

The Contractor will undertake the following action if required:

- The Contractor shall be responsible for identifying any additional sensitive environmental receptors and critical facilities, infrastructure and utilities likely to be impacted by construction vibration. This may include things like residential housing or critical infrastructure susceptible to failure with excessive vibration.
- The earthworks shall cease if at any time a justifiable complaint is received regarding effects from vibration associated with earthworks activities within the work area.
- The issue will be investigated and if required alternative measures and/or operational changes will be made to resolve, mitigate, and avoid another complaint of vibration.
- If these concerns cannot be resolved between the parties, a suitably qualified professional shall be engaged to assess vibration associated with the earthworks and determine any adverse effect on land and buildings beyond this site. This assessment shall outline whether the works comply with BS5228.2:2009 or DIN 4150-3:1999 or a similar internationally accepted standard and if there is a non-compliance identified include recommendations on what changes to construction methodology are required to comply.

5.4 Contaminated Soil on Site

Contaminated Soil **has/has not** been identified within this stage of the works. Removal and management of soil within the areas identified is to be managed in accordance with the Remediation Action Plan.

If any further contaminated soil is discovered works shall immediately cease and the Site Supervisor and Environmental Representative shall be informed, who shall then notify ORC. The process outlined in the National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health are then to be reviewed and applied. A SQEP in contaminated land would be brought on site to assist and determine the best solution to deal with unexpected, contaminated soil. At minimum, the soil shall be dug out placed in a road truck, covered, and carted off site for disposal at an appropriate facility.

5.5 Chemicals and Fuels

During the works associated with the development, the Contractor will have diesel brought onsite for the purpose of fueling equipment during works. Trailer mounted tanks will be used to refuel equipment. Bulk fuel storage will be at the works compound as shown in the ESCP. If fuel storage is relocated to another area the EMP will be updated to reflect this.

Because of the potential environmental risk having these substances on site, the Contractor will have spill kits onsite. These are kits specially for diesel spill as this is the critical chemical stored onsite during day works. These kits can be found in the utility vehicles (30L mobile general-purpose spill kit) and the site office (240L oil and hydrocarbon spill kit).

Fuel storage is more than 30m from any watercourse at the site office, this is to prevent a spill affecting the water quality in the surrounding watercourses.

To contain any spill that may occur during refueling the machinery will be stationary on a disposable material base that can be removed after the earthworks containing any spill that may have occurred.

To prevent storage failure, no storage container is to be used on site if it leaks or has a fault resulting in leaking of fuel. Containment vessels are typically doubled skinned to prevent leaks and the contractor can use such vessels as that are rated for fuel storage.

In the rare event fuel is leaked on site, the Contractor will use appropriate measures to contain, remove, and dispose of the spill.

Where any incident of fuel is found leaking from site, the Environmental Representative shall investigate and complete an environmental incident report (refer to Appendix D).

5.6 Waste

5.6.1 Performance Criteria

The Contractor shall ensure the following criteria is always met:

- All waste is removed from site.
- No waste shall be burnt onsite.
- Bins are provided in common areas at all times. Bins shall be fitted with lids and serviced prior to being filled.
- The site should be free of litter and no litter should leave the boundary of the site nor can enter any waterway within the site.

5.6.2 Management

Waste containment locations can be found at the site compound with adequate rubbish facilities so that the site remains litter free at all times. Waste is to be removed from site on a regular basis. Where possible recyclable materials shall be separated and disposed of at the Frankton Transfer Station.

5.7 Water Quality

5.7.1 Performance Criteria

Stage XX currently sheet flows to XX (refer to Figure 3-2). The construction of stage XX will direct stormwater secondary flows like what is occurring now (refer to Figure 5-1). The ESCP will protect the receiving environment during construction (refer to the supporting plans in the ESCP).

Insert snapshot of secondary flow paths

Figure 5-1: Proposed finished ground secondary flow paths (orientated north).

The following water quality parameters shall be met:

- Total Suspended Solids (TSS) – no more than 50 mg/L TSS
- pH – within 5.5 – 8.5.
- Hydrocarbons, tannins, and paint – no visible trace.
- Waste – no visible litter or waste from site.
- Turbidity reading of no more than 100 NTU.

5.7.2 Testing

5.7.2.1 Suspended Solids

Rather than measuring TSS through the filtration testing method which causes delays in getting information back to site, turbidity, or Nephelometric Turbidity (NTU) will be measured onsite using nephelometer. With this said samples shall be taken at the same time as the nephelometer reading and the Contractor shall undertake lab testing to determine the correlation for the NTU from the total suspended solids.

5.7.2.2 PH Testing

PH testing will be undertaken with litmus paper when suspended solids samples are taken. If inadequate water is available for testing no testing shall be undertaken until a forecasted storm events occurs.

5.7.2.3 Timing of Testing

A visual inspection of the discharge from the stormwater devices will be completed as part of the weekly inspection and post rainfall events to ensure compliance. If water is discharging from the sediment pond outlet(s) water will be tested. If no water is discharging, then the next sample is taken during the time water is discharging from the ponds and noted. Results will be included in the monthly report.

5.7.3 Non-conformant

If water is found to not meet the requirements outlined in section 5.7.1 or the consent, a new sample is to be retested to confirm it is in accordance. The additional sample must be taken within 5 working days of the original sampling. Where one or more of the limits set out in section 5.7.1 are exceeded on two consecutive sampling occasions and these results are confirmed, an incident report is to be prepared. This will include the water quality parameter that exceeded the criteria above and level that was recorded noting the sample location. The table in Appendix J shall be used to detail this information. If any sediment or erosion control devices has failed, this information will need to be included along with the

incident report to identify what failed and what was done to rectify the failure. If a rain event had occurred which contributed to the non-conformance, the depth of rain recorded at the nearest meteorological station should be obtained. This information should then be used to determine the Annual Recurrence Interval (ARI) of the rain event (i.e. 2-year, 5-year or 20-year). This information along with the cause and implement corrective actions to prevent re-occurrence of monitoring non-conformances should be included as part of the non-conformance reported to QLDC and ORC.

5.8 Indigenous Vegetation and Protected Trees

Within the site there is no indigenous vegetation or trees requiring protecting as the previous land use was originally farmland or farm sheds. Any existing vegetation that is removed will be replaced with new trees, plants and grass as part of the development.

5.9 Cultural Heritage

If the Contractor discovers iwi tangata (human skeletal remains), waahi taoka (resources of importance), waahi tapu (places or features of special significance) or other Maori artefact material, the consent holder shall without delay:

- Notify QLDC, ORC, Tangata whenua and Heritage New Zealand Pouhere Taonga and in the case of skeletal remains, the New Zealand Police
- Stop work within the immediate vicinity of the discovery to allow a site inspection by the Heritage New Zealand Pouhere Taonga and the appropriate runanga and their advisors, who shall determine whether the discovery is likely to be extensive, if a thorough site investigation is required, and whether an Archaeological Authority is required.

Any tangata discovered shall be handled and removed by tribal elders responsible for the tikanga (custom) appropriate to its removal or preservation. Site work shall only recommence following consultation with QLDC, ORC, Heritage New Zealand Pouhere Taonga, Tangata whenua, and in the case of skeletal remains, the New Zealand Police, provided that any relevant statutory permissions have been obtained.

If the Contractor discovers any feature or archaeological material that predates 1900, or heritage material, or disturbs a previously unidentified archaeological or heritage site, the Contractor shall follow the Accidental Discovery Protocol found in Appendix K

All persons working on the site will be made aware of the above-mentioned protocols, this will be covered off during site inductions.

5.9.1 Contact Detail

Heritage New Zealand Regional Archaeologist:

Rebecca Benham
Regional Archaeologist Otago/Southland
Heritage New Zealand
PO Box 5467, Dunedin

Ph: [REDACTED], M: [REDACTED]

E: [REDACTED]

5.10 Temporary Fire Control

Fire extinguishers are located in all marked vehicles and machinery. There will also be additional fire extinguishers in the site office. A number of the Contractor's staff on site are fire fighters with the New Zealand Volunteer Fire Service and are trained to handle an incident that could arise. A water cart will be present on site that can assist if required.

Fire and emergency procedures will be outlined in the site health and safety policy. The site emergency procedure will be displayed on the wall of site office. All persons inducted to site will be made aware of the first aiders on site and the means of fire control.

5.11 Site Security

The main access to site will have signs which will clearly mark the safe vehicle route for parking within the site.

All machinery will be parked and secured at the end of each day.

Deliveries will be made to the site office and the Site Manager will liaise with the delivery company to ensure appropriate drop off times. Documents of sensitive nature in regard to the project will be kept in the contractor office or the site office if required by the consent.

Temporary orange net fencing will be installed, along with appropriate signage, for boundaries between public areas and the construction site where it is deemed to be a risk of public entry.

6 Erosion and Sediment Control Plan

6.1 Erosion and Sediment Control Principles

The following erosion and sediment control plan has been prepared based on designing, installing, maintaining, and decommissioning in accordance with the following principles:

- Erosion and sediment controls are integrated with construction planning and operation.
- Effective and flexible erosion and sediment control plans are developed based on soil, site slope, weather, construction conditions and the receiving environment.
- The extent and duration of soil exposure is minimised.
- Water movement through the site is controlled – in particular clean water is diverted around the site and 'dirty' and 'clean' water is kept separated as far as is practicably possible.
- Soil erosion is minimised as far as reasonable and practical (to the satisfaction of QLDC and ORC)
- Disturbed areas are promptly stabilised.
- Sediment retention on site is maximised (i.e. must meet the discharge criteria for suspended sediment)
- Controls are always maintained in proper working order.
- The site is monitored, and erosion and sediment practices adjusted to maintain the required performance standard.
- Avoidance of discharges, especially sediment off site.

The site must perform in a way that any releases from site must not cause scour at the area of discharge. Water must only be released at the discharge point nominated within the ESCP and as deemed acceptable by ORC. Any modification to discharge point must be accepted by ORC.

The erosion and sediment controls shall be sufficient to achieve the water quality criteria for discharge in accordance with section 5.7.1 water quality performance criteria, provided resource consent has been obtained for the earthwork's activity. Otherwise, the performance criteria shall be in accordance with the currently active Operative and Proposed District Plan.

The contractor shall remove temporary controls when permanent measures are in place and/or site stabilization (defined as at least 80% revegetation cover) has occurred.

6.2 Details of Works

Earthworks will be conducted first which involves excavation, shaping and forming the finish shape. The proposed lots will be topsoiled and grassed. After the general earthworks are complete the drainage and services will be installed. When all underground services are done the road construction will begin to seal off the exposed services and topsoiling of berms will finish off the works.

6.3 Reference Documents

- Guidance Document 2016/005: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05),
- Erosion and Sediment Control Toolbox for Canterbury - <https://www.esccanterbury.co.nz/>
- Best Practice Erosion and Sediment Control, International Erosion Control Association Best Practice Guidelines.
- Otago Regional Council Residential Earthworks in Otago A Guide for developers,

6.4 Erosion Controls

6.4.1 Non-Structural Control Measures

6.4.1.1 Staged Construction

To ensure the site can be managed the areas to be opened will progress in a staged manner to effectively manage the stormwater in and around the area of works.

Update with details of order of works within the stage

6.4.1.2 Minimizing Disturbance

To reduce the amount of water that requires treatment, catchment sizes have been limited to a manageable size for the intended operation, draining to local low points that are existing. The area of stage XX has been split into XX

catchments. Operations during earthworks will focus on stripping areas, cutting/filling, then soiling back over to grass it and move to another area. This way the amount of exposed subgrade is limited, manageable and able to be sealed off quickly if required.

6.4.2 Water Management

6.4.2.1 Clean Water Management

Homestead Bay has a sloped terrain on the east side of the site, therefore stormwater from uphill needs to be diverted around the site where possible. Clean water perimeter bunds will be used to divert water around areas of work to natural flows paths away from site.

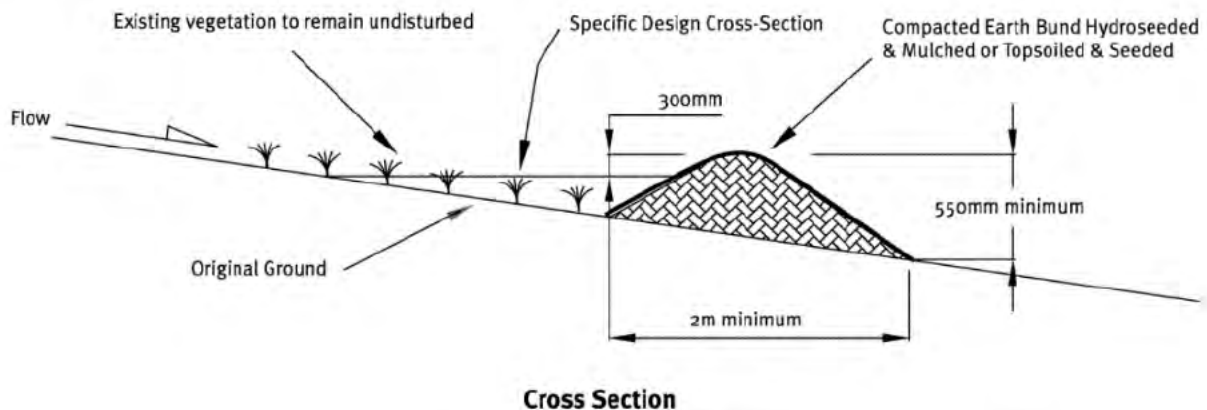


Figure 6-1: Clean water perimeter bund (Source: Auckland Council Guideline Document 2016/005, October 2018)

6.4.2.2 Dirty Water Management

During works, dirty water channels will be used to convey dirty water to ponds and contain dirty water runoff within the site. Other areas of site where water requires diverting are as shown on the plans attached in Appendix A

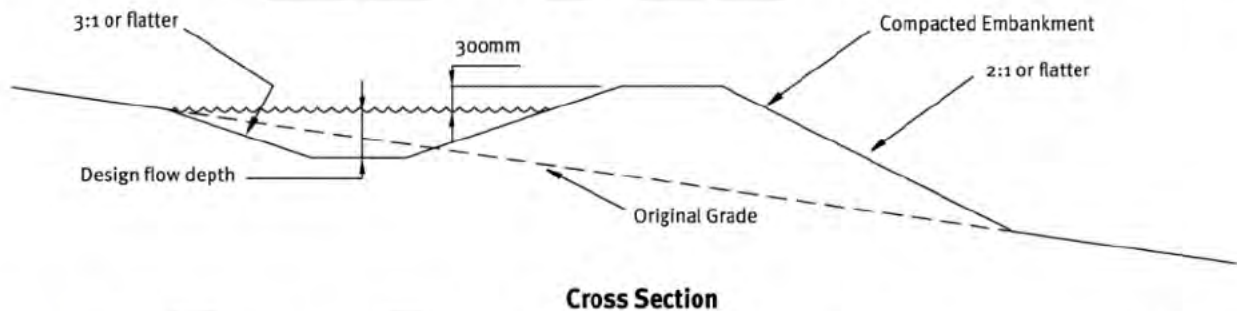


Figure 6-2: Dirty water diversion channel (Source: Auckland Council Guideline Document 2016/005, October 2018)

6.4.2.3 Stockpiles

Any stockpiles onsite are to be located within the catchment areas therefore any runoff from them will be collected and treated onsite.

6.4.3 Vehicle Access

Access to stage XX will be via XX. To prevent sediment getting tracked onto the road network, sedimentation mats will be set up. Examples of the mats are shown below (Figure 6-3).



Figure 6-3: Example of sedimentation mats

6.4.4 Soils and Surface Stabilization

6.4.4.1 Topsoil and Seed

As earthworks progress exposed areas where work is no longer required will be covered with a layer of topsoil from the available stockpile, spread and seeded.

Any area where heavy rain has caused topsoil or grass to erode will require respreads and reapplication, to prevent further erosion.

6.5 Sediment Control

6.5.1 Sedimentation Retention Ponds

XX sedimentation and retention ponds will be constructed for stage XX. The purpose of the first pond is.... The second pond will be established for

insert plan of sediment pond locations

Figure 6-4: Sediment pond locations

6.5.1.1 Ponds

To align with GD05 the stormwater ponds need to be 300m³ of storage per ha for a maximum of 5 ha of contributing catchment. Appendix B has all the required calculation for the pond sizing.

The pond will require a forebay of 2 metres wide 1 metre deep installed across the front with a level spreader to distribute the flows into the pond. A bund of 0.5m height will allow the dirty water channels to run alongside the pond where needed. This will also allow the emergency spillway to be in line with the minimum requirements of GD05.

6.5.1.2 Decanting Tee Bar System

For the most effective discharge of water from a sediment retention pond a decanting tee bar system has been selected. Figure 6-5 shows an example of the tee bar system which is a suitable dewatering device and has been used in previous stages. Figure 6-5 is an off the shelf system from Cirtex for a 110m tee-bar decant system.

To maintain 30% dead storage in the pond the lowest tee bar is placed at a height appropriate to achieve this this requirement.

The tee bars can be installed on a pully system to prevent water from discharging from the pond if there is a requirement to use the top clean water for dust suppression. If pulleys are used it allows the lower decanter to be raised as sediment is deposited.



Figure 6-5: Sediment Retention Pond outlet example

6.5.1.3 Primary Spill Way

The **northern pond** has a catchment area of between 3 - 5 ha therefore a 1050 mm concrete manhole riser will be used as a primary spillway with a 300mm outlet. The **southern pond** as a catchment area of less than 1.5ha therefore the minimum requirement is a 150mm upstand as per GD05 details for a sediment retention pond less than 1.5ha.

6.5.1.4 Emergency Spill Way

The emergency spill way for both ponds have been designed to be located at a height of 300mm above the primary spillway. As the topography around the ponds is not perfectly flat the emergency outlets have been designed to be the full width of the pond increasing the amount of water the emergency spillway can discharge with effecting the surrounding area.

A schematic of the pond spillways can be found in Appendix A plans.

6.5.1.5 Use of Flocculent

Flocculant is to be used in the ponds given the range of soil found onsite. Testing, handling, and storage of flocculate will be in accordance with the site-specific Chemical Treatment and Management Plan.

For cold temperatures where ice and snow will form onsite the ponds are to be isolated from discharging freely overnight and check to ensure the water quality is achieved, ponds are in good condition and able to operate efficiently.

6.5.2 Silt Fences

Super silt fences will be able to control the sediment runoff from some areas while maintaining a sheet flow like current overland flow. Therefore, super silt fences will be installed in areas where there is a suitable grass buffer and adequate space to install a suitable super silt fence. This will help reduce the amount of sheet flows that are concentrated for treatment.

The current ESCP only proposes to have 2 super silt fences where directing the water to the pond is unable to be achieved.

6.5.3 Stockpile Management

Stockpile locations shall be within the catchment areas so any runoff for them can be treated before discharging from site. Long term piles will have vegetation cover to prevent dust generation.

6.6 Installation Sequence for Stage XX

To ensure best practices are upheld and the control of any sediment or erosion is contained the order in which control measures are installed is critical. The following is the likely installation sequence to achieve the best outcomes:

- Build access into site.
- Build ponds.
- Build bunds and cut off drains.
- stage 1 works, excavation and truck offsite waste. Backfilling holes with fill material.
- Stage 2 Cut to fill, soil and seed areas.
- Stage 3 Cut to fill, soil and seed areas
- Stage 4 is infrastructure and roading where drainage, water, power and chorus are installed.
- Build roads.
- Hydro seed completed berms.
- Removal of ponds
- Removal other controls and silt fences.

6.7 Managing Significant Rain Events

In line with the monitoring requirements daily checks of weather forecasts must be undertaken. Where significant rain events (20mm over 12h hours) are forecasted specific checks of the site are to be completed to ensure all control measures are in place and working adequately. Where necessary works shall stop in advance of the event and all areas of the site shall be made secure including stabilizing cut and fill areas, stockpiles etc. Additional measures such as localized bunding of trenches shall be formed to further protect critical assets within the site. The site foreman shall ensure the site is safe and adequately protected prior to leaving for the day in advance of any forecast rain event.

6.8 Post Construction Controls and Decommissioning

Upon final completion and once at least 80% of the site is stabilized and covered with vegetation the environmental controls shall be removed. This will include infilling of the ponds with suitable engineered fill and shaping to the final surface level.

7 Updates

The EMP will be updated when the work program progress and an update is required, or when an issue is identified and needs to be rectified. With weekly and monthly inspections of the site measures, significant issues will be updated in the EMP immediately and minor issues will be covered with the monthly environmental report to be submitted to Council.

Additional updates of the EMP will happen if directed by ORC or QLDC's Monitoring Department.

All updates shall be represented in the revision panel at the beginning of the report.

All staff and sub-contractors will be notified of any change to the EMP and the new responsibilities and requirements.

Appendices

We design with community in mind



Appendix A Erosion and Sediment Control Plans

Appendix B Calculations

B.1 Pond Sizing

Stage XX North Pond

- Catchment area = 4.5 ha
- Slope length = 300m
- Slope grade = approximately 4.5 degrees sloping to the west at the steepest point
- Best practice requires 300m³ per hectare.

Stage XX South Pond

- Catchment area = 1.1 ha
- Slope length = 50m
- Slope grade = approximately 1 degree
- Best practice requires 300m³ per hectare.

Insert plan of pond location

Figure 7-1: Pond location (approximate),

Pond Volume:

Pond Stage XX North: 4.5ha * 300m³ = 1350m³

Pond Stage XX South: 1.1ha * 300m³ = 330m³

Pond Shape:

Size of pond is required to be 3-5 times as long as wide with a max depth of 2 meters.

The size of the pond is an inverted truncated pyramid with a side slope of 2:1 to 3:1 to fit with the natural shape of the ground.

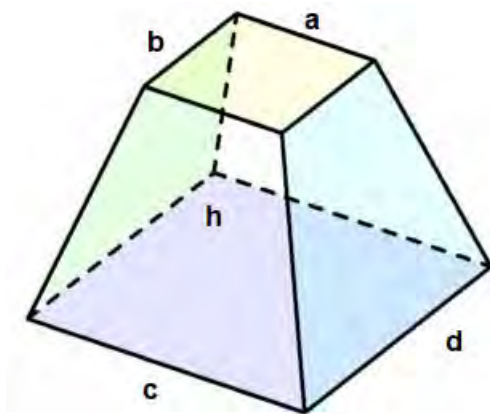


Figure 7-2: Truncated Pyramid

Example calculation for North Pond with a length to width ration of 4 and targeted depth of 1.5m

$$V = \frac{1}{6} * h * (a * b) + (a + c) * (b + d) * (c * d)$$

$$5a = b, \quad c = a + (h * 2 + h * 2), \quad d = 5a + (h * 3 + h * 2)$$

$$1350 = \frac{1}{6} * 1.5 * (a * 5a) + (2a + 6) * (5a + 5a + 7.5) * ((a + 6) * (5a + 7.5))$$

$$a = 9$$

Table 7-1: Pond sizing

	Base Width (y)	Base Length (x)	Top Width (Z)	Top Length (A)	Depth (h)	Volume
North Pond	9m	63m	18m	72m	1.5m	1377m ³
South Pond	4m	44m	10m	50m	1m	332m ³

B.2 Tee Bar Spacing

Pond 1: 30% Dead storage = $0.3 \times 1377\text{m}^3 = 413.1\text{m}^3$

Pond 2: 30% Dead storage = $0.3 \times 332\text{m}^3 = 99.6\text{m}^3$

Table 7-2: Tee bar spacing

	Bottom Tee bar (m) TB1	Mid Tee bar (m) TB2	Top Tee bar (m) TB3
North Pond	0.6m	0.94m	1.24m
South Pond	0.42		

* Measurement is from the base of the pond to the tee bar

B.3 Dirty Water Bund

Runoff

Catchment area (A_c) = 4.5 ha

20-year AEP (i) = 21.9mm/h

Coefficient (C) = 0.7 Bare impermeable clay with no interception channels or run-off control (worse case)

$$Q = \frac{CiA_c}{360}$$

$$Q = \frac{4.5 * 0.7 * 21.9}{360}$$

$$Q = 0.191\text{ m}^3/\text{s}$$

Dirty Bund Sizing

Width of channel (a) = 2.5m.

Depth of channel (b) = 0.1m.

Shape of channel = trapezoid 3:1 batters.

Longitudinal slope of bund = 0.5%.

Slope of banks 33.3% (1 in 3).

Freeboard = 0.3.

Figure 7-3 shows the channel sizing. The channel with no freeboard and has the capacity to convey 191 l/s. Figure 7-4 shows the sizing of the channel with 300mm freeboard, this will be the size of the channel that will be constructed.

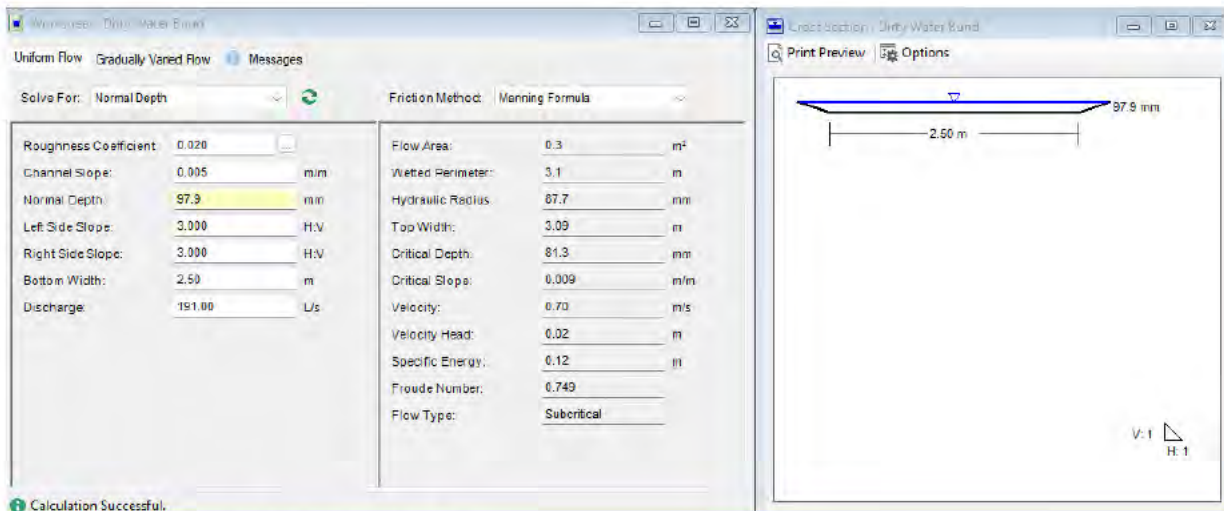


Figure 7-3: Channel sizing no freeboard.

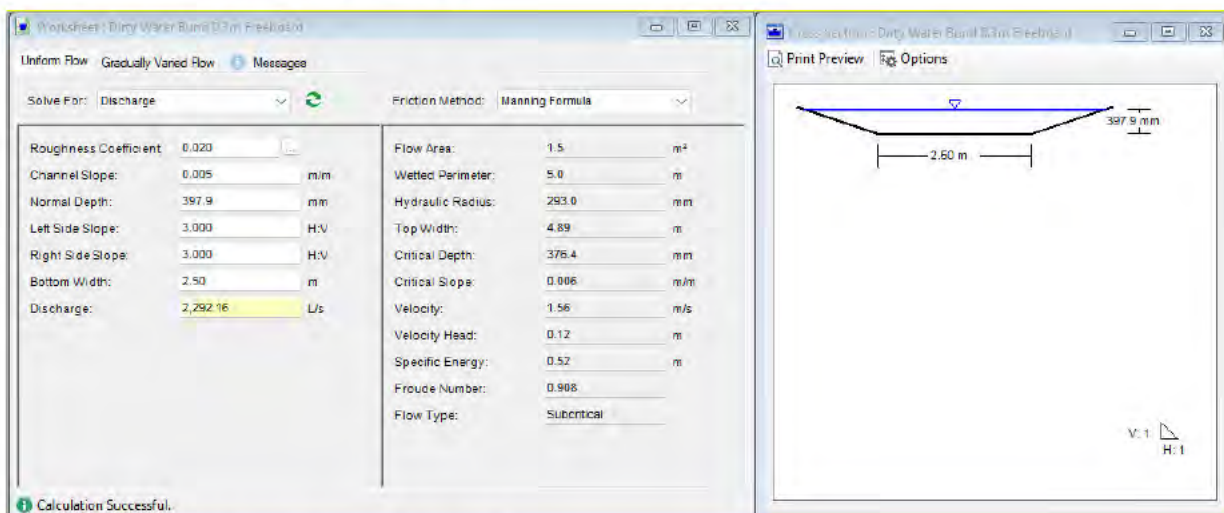


Figure 7-4: Channel sizing 300mm freeboard.

Stage XX culvert size

Catchment = 1.1ha

$$Q = \frac{CiA_c}{360}$$

$$Q = \frac{1.1 * 0.7 * 21.9}{360}$$

$$Q = 0.047 \text{ m}^3/\text{s}$$

For 47l/s to flow through the pipe the minimum pipe size needed is 225mm. as shown below in Figure 7-5

				Results			
				Flow depth, y	211.5000	mm ▾	X
				Flow area, a	0.0388	m^2 ▾	X
				Pipe area, a0	0.0398	m^2 ▾	X
				Relative area, a/a0	0.9755	fraction ▾	X
Inputs				Wetted perimeter, P _w	0.5955	m ▾	X
Pipe diameter, d ₀	0.225	m ▾	X	Hydraulic radius, R _h	0.0651	m ▾	X
Manning roughness, n	0.011		X	Top width, T	0.1069	m ▾	X
Pressure slope (possibly ? equal to pipe slope), S ₀	1	% rise/run ▾	X	Velocity, v	1.4717	m/s ▾	X
Relative flow depth, y/d ₀	94	% ▾	X	Velocity head, h _v	0.1104	m H2O ▾	X
				Froude number, F	0.78		X
				Average shear stress (tractive force), tau	6.3870	N/m^2 ▾	X
				Flow, Q (See notes)	57.0812	l/s ▾	X
				Full flow, Q0	53.0653	l/s ▾	X
				Ratio to full flow, Q/Q0	1.0757	fraction ▾	X

Figure 7-5: Stage XX south culvert sizing

Stage XX clean water culvert

Catchment = 1.5ha

$$Q = \frac{CiA_c}{360}$$

$$Q = \frac{1.1 * 0.7 * 21.9}{360}$$

$$Q = 0.064 \text{ m}^3/\text{s}$$

To achieve adequate flow through the culvert the next size up from the DN225 will be needed. This is a DN300mm PVC pipe which has the capacity for 122L/s, more than the required 64l/s

				Results			
				Flow depth, y	282.0000	mm ▾	X
				Flow area, a	0.0690	m^2 ▾	X
				Pipe area, a0	0.0707	m^2 ▾	X
				Relative area, a/a0	0.9755	fraction ▾	X
Inputs				Wetted perimeter, P _w	0.7940	m ▾	X
Pipe diameter, d ₀	0.30	m ▾	X	Hydraulic radius, R _h	0.0868	m ▾	X
Manning roughness, n	0.011		X	Top width, T	0.1425	m ▾	X
Pressure slope (possibly ? equal to pipe slope), S ₀	1	% rise/run ▾	X	Velocity, v	1.7828	m/s ▾	X
Relative flow depth, y/d ₀	94	% ▾	X	Velocity head, h _v	0.1621	m H2O ▾	X
				Froude number, F	0.82		X
				Average shear stress (tractive force), tau	8.5160	N/m^2 ▾	X
				Flow, Q (See notes)	122.9316	l/s ▾	X
				Full flow, Q0	114.2827	l/s ▾	X
				Ratio to full flow, Q/Q0	1.0757	fraction ▾	X

Figure 7-6: Stage XX north culvert sizing

Appendix C Environmental Induction Register

[illegible]

Appendix D Environmental Incidence Report Form

Project Address:	QLDC/ORC Consent Number (if applicable):
	RM BC
Project Description:	

Instructions

Complete this form for all environmental incident that cause contaminants (including sediment) or environmental nuisance to leave the site. Be succinct, stick to known facts and do not make assumptions. Once completed submit to the personnel outlining section 4.1

Incident details

Date and Time	Date:	Time:	AM	PM
Description Provide a brief and factual description of what happened during the incident, include relevant details such as: - The estimated distance to the nearest waterway (include storm water and dry courses) - The estimated distance to the nearest sensitive rec - The activity being undertaken when the incident occurred Sketches/diagrams/photos may be reference and attached to this report to aid in the description of the incident				
Exact location of the incident Include address, landmarks, features, nearest intersection etc. Maps and plans can be attached to the incident report if appropriate				
Quantity or volume of material escaped or causing incidence				
Who identified the incident				

What immediate actions/control measures were taken to rectify or contain the incident?

What initial corrective action will be taken to prevent similar incidents recurring in the near future?

Has the Otago Regional Council been notified? Yes / No / N/A

Approvals:

Environmental Representative/Person making report

Name..... Signature.....

Organisation..... Date.....

Mobile phone number.....

Site Supervisor

Name..... Signature.....

Organisation..... Date.....

Mobile phone number.....

Appendix E Complaints Register

Complainant	Contact details	Date	Issue	Area of concern	Action required	EMP change required

Appendix F Post Forecasted Rain Event Inspection Form

LOCATION _____

INSPECTOR(S) _____

DATE: _____

Legend:

✓ - OK

✗ - Not OK/ potential problem

N/A - Not applicable

Item	Consideration	Assessment
1	Existing road sumps have filter clothes in working order and are not blocked with sediment.	
2	Entry/exit measures clear of excessive sediment deposition.	
3	Up-slope "clean" water is being appropriately diverted around the site without causing erosion.	
4	Drainage paths are free of soil scour and sediment deposition.	
5	Sediment fences are free from damage, secure and in working order.	
6	Sediment-laden stormwater is not able to get around the silt fences or other sediment devices.	
7	All sediment devices have no sediment build up reducing the effectiveness of the device	
8	The sediment pond has sedimental settling out prior to discharge such water.	
9	All reasonable and practicable measures are being taken to control sediment runoff from the site.	
10	All Erosion and Sediment Control measures are in proper working order.	

Remedial action taken:

Location

Reason:

Appendix G Weekly Site Inspection Checklists

LOCATION

INSPECTOR(S)

DATE:

Legend:

✓ - OK

× - Not OK/ potential problem

N/A - Not applicable

Item	Consideration	Assessment
1	Public roads clear of sediment from this works. (Note and photograph if other works is causing issues)	
2	Entry/exit measures clear of excessive sediment deposition.	
3	Entry/exit rock have adequate space to trap sediment.	
4	Existing road sumps have filter clothes, are not blocked with sediment and in adequate working order.	
5	The site is clear of litter and unconfined rubbish.	
6	Rubbish bins are not over-following or require emptying	
7	Adequate stockpiles of emergency sediment and erosion control materials are onsite.	
8	Site dust is being adequately controlled.	
9	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	
10	Up-slope "clean" water is being appropriately diverted around/through the site without causing erosion.	
11	Drainage paths are free of soil scour and sediment deposition.	
12	No areas of exposed soil need erosion control.	
13	Earth batters are free of erosion.	
14	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	
15	Sediment fences are free from damage.	
16	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	
17	All sediment traps are free of excessive sediment deposition.	
18	The settled sediment layer within a sediment retention pond is clearly visible through the water prior to discharge of such water.	
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	
20	No new areas of uncontrol site runoff in need of control measures	
21	Stabilised surfaces have topsoil and grass seed	
22	The site is adequately prepared for forecasted storms.	
23	All Erosion and Sediment Control measures are in proper working order.	

Rain fall record:

RAINFALL (mm)	DATE:

Remedial action taken:	Location
Reason:	
Remedial action taken:	Location
Reason:	

Appendix H EMP Non-Conformance Register

Date	Non conformance	Reason	Resolution	EMP require update

Appendix I Monthly Checklist

LOCATION _____

INSPECTOR(S) _____

DATE: _____

Legend:

✓ - OK

× - Not OK/ potential problem

N/A - Not applicable

Item	Consideration	Assessment
1	Appropriate Contactor site inspections of EMP controls carried out such that all control measures are being maintained adequately and checked weekly.	
2	Site inspections and monitoring are being carried out at appropriate times and intervals. (i.e. weekly, pre and post rain events)	
3	Are environmental sensitive receptors outline in the approved EMP are being adequately protected	
4	Are all conditions of consent related to environmental management being satisfied?	
5	Was the full perimeter of the work site inspected?	
6	Are all reasonable and practicable measures being taken to minimize environmental harm?	
7	Adequate drainage and sediment controls exist at site entry/exit points.	
8	Adequate drainage, erosion and sediment controls have been placed around the site compound.	
9	Site compound area and car park gravel/stabilized where necessary to control erosion and sediment.	
10	Appropriate drainage and sediment controls are installed prior to new areas being cleared or disturbed.	
11	Site personnel appear to be aware of ESC requirements and have ready access to the Erosion and Sediment Control Plan. (Check induction registers as well)	
12	Haul roads are stabilized.	
13	Sediment deposition is <u>not</u> observed on external roads by operations associated with this works. (Note if other works is causing this issue)	
14	Fuel appropriately stored on site.	
15	Spill kits available on-site where appropriate.	
16	Adequate litter and waste receptors exist on-site.	
Topsoil and Stockpiles		
17	Topsoil stripped and stockpiled prior to major earthworks.	
18	Stockpiles located at least 5m away from top of watercourse banks.	
19	Long-term soil stockpiles adequately protected against wind and rain.	
20	Adequate sediment controls placed down-slope of stockpiles.	
21	Stockpile sediment control is appropriate for the soil type and site conditions.	
22	Adequate drainage controls placed up-slope of stockpiles. (i.e. diversion channels)	
23	Topsoil is being replaced at an adequate depth.	
Drainage		
24	Drainage Control measures are consistent with the EMP.	
25	Drainage Control measures are being adequately always maintained in proper working order.	
26	Up-slope "clean" water is being appropriately diverted around/through the site in a non-erosive manner.	
27	Stormwater runoff diverted away from unstable slopes.	

28	Flow diversion channels/banks stabilized against erosion.	
29	Dirty Water Drains: → Adequate depth/width. → Adequate flow capacity is being maintained. → Stabilised against soil scour.	
30	Channel Linings (mats/cloth): → Lining is well anchored. → Mats/cloth overlap in direction of flow. → Lining is appropriate for flow conditions. → No damage to the mat/cloth by lateral inflows.	
Erosion		
31	Erosion control standard is consistent with the EMP and QLDC requirements.	
32	Soil erosion is being controlled to a standard consistent with the level of environmental risk.	
33	Disturbance to existing ground cover is being minimized as much as possible	
34	Earth batters are free of erosion.	
35	Dust problems are being adequately controlled.	
36	Erosion Control measures are being adequately always maintained in proper working order.	
37	All disturbed areas are adequately stabilised given: → Erosion hazard risk. → Degree of downstream sediment control. → Days since earthworks were finalised.	
Sediment controls		
38	Sediment is being controlled to a standard consistent with QLDC / ORC requirements	
39	Sediment Control is consistent with the approved EMP	
40	Sediment Control is appropriate for the soil type.	
41	Sediment Control measures are being adequately always maintained in proper working order.	
42	Collected sediment is being disposed of in an appropriate manner.	
43	Entry/Exit Points: → Control measures are appropriate for the site conditions. → Control measures are constructed appropriately → Excessive sediment removed from sediment traps. → Excessive sedimentation is <u>not</u> evident on roadway. → Stormwater drainage is controlled such that sediment is not being washed onto the adjacent roadway drainage network	
44	Sediment Fences: → Choice of fabric is appropriate. → Bottom of fabric is securely buried. → Fabric is appropriately overlapped at joints. → Fabric is appropriately attached to posts. → Support posts are at correct spacing → Sediment Fence does <u>not</u> cause flow diversion/bypass. → Sediment Fence has regular returns. → Lower ends of fence are returned up the slope. → Sediment Fences are free of damage. → All fences are free of excessive sediment deposition. → Fences are adequately spaced from toe of fill banks.	
45	Sediment Retention Ponds. → Pond geometry and layout match design details. → As built plans have been prepared. → The pond does <u>not</u> represent a safety risk.	

	→ De-watering is conducted in accordance with best practice.	
	→ Excessive sediment removed from pond.	
	→ Primary outlet structure is free from sediment blockage.	
	→ Emergency spillway has adequate scour control and/or grass length	
	→ Soil erosion is adequately controlled at inlet points.	
	→ The sediment settles prior to discharge such water.	
46	Site stabilization/revegetation is occurring in accordance with the EMP and work program.	
47	Exposed areas are adequately stabilized given the site conditions, environmental risk, and construction schedule.	
48	No newly seeded areas require reseeding.	
49	Grass seed is <u>not</u> being placed directly on compacted soil.	
50	Water application is appropriate for the site conditions.	
51	Revegetation is controlling soil erosion as required.	

Action summary		
Item	Consideration	Yes or No
	Answer "Yes" if further action is required on site	
1	Do any existing control measures require modification?	
2	Are additional EMP measures required on the site?	
3	Are alternative EMP measures required on the site?	
4	Is a revised EMP required for the site?	
5	Is further water quality monitoring required?	
6	Do any EMP measures need repairs or de-silting?	
7	Is additional erosion control required?	
8	Will the underlying cause of any non-compliance need further investigation?	
9	Has any complaint been raised that need to be resolved?	
10	Have any non-conformance issue happened?	
	Date of next inspection	

Notes:

Appendix J Water Quality Reporting

Pond 1					
Date	Time	NTU	pH	Acceptable	Discharging

Appendix K Accidental Discovery Protocol

CREATING COMMUNITIES

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of belonging. That's why at Stantec, we always **design with community in mind**.

We care about the communities we serve—because they're our communities too. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

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Appendix C EMP/ESCP Stages 1-4





ENVIRONMENTAL MANAGEMENT PLAN

Homestead Bay Development

Stages 1-4

PREPARED FOR RCL HOMESTEAD BAY LTD | Date 1/9/2025

Revision Schedule

Rev No	Date	Description	Signature of Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1	1/9/2025	Draft Detailed EMP Stage 1-4	PL	IB	PW	PW
2						
3						

Quality Statement

The conclusions in the report are Stantec's professional opinion, as of the time of the report, and concerning the scope described in the report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The report relates solely to the specific project for which Stantec was retained and the stated purpose for which the report was prepared. The report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorised use or reliance is at the recipient's own risk.

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PROJECT MANAGER	PROJECT TECHNICAL LEAD

PREPARED BY

Patrick Leslie



1/9/2025

CHECKED BY

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STATUS Final | Project No 310101105

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Abbreviations

Enter Abbreviation	Enter Full Name
CMP	Construction management plan
AMP	Adaptive management plan
DSI	Detail site investigation
SRP	Sediment retention pond
QLDC	Queenstown Lakes District Council
EMP	Environmental Management Plan
ESCP	Erosion and sediment Control Plan
ORC	Otago Region Council
GD05	Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region
SQEP	Suitably Qualified and Experienced Person
TSS	Total Suspended Solids
NTU	Nephelometric Turbidity
ARI	Annual Reoccurrence Interval

1 Introduction

This Environmental Management Plan (EMP) outlines the administrative/operational procedures and practices that are to be implemented to manage, remedy, and mitigate potential environmental effects, ensure the health and wellbeing of all employees on site, and adhere to all statutory requirements whilst undertaking earthworks and civil works associated with the construction of earthworks stages 1-4 within Phase 1 of Homestead Bay Development.

The contents of this EMP outlines Queenstown Lakes District Council (QLDC) and Otago Regional Council (ORC) requirements for the earthworks activities and will be discussed in the site inductions/toolbox meetings to ensure all parties are aware of the requirements. This will ensure that QLDC and ORC's environmental views are appropriately protected, and the resource consents adhered to.

This EMP report is to be read in conjunction with the Erosion and Sediment Control Plan (ESCP) and together both sections shall be referred to as 'the EMP'.

2 Level of Risk

The works associated with Stages 1-4 can be categorized as high-risk based on QLDC's Guideline for Environmental Management Plans. The extent of the works is approximately 32.1 ha of area. The work area is divided into localized areas, ranging from 2.46 to 5ha. By dividing it up this will ensure runoff can be collected and treated separately and effectively, while the cut to fill operation can progress across Phase 1 in a methodical manner.

3 Site and Work Description

3.1 Location

Stage 1-4 is the eastern side of the Homestead Bay development next to the southern Creek and extends down to the southwestern creek. It includes the earthworks for formation of a large roundabout on the state highway to gain access into the development. Current access to the land is via State Highway 6 where there is a narrow-formed road to the skydiving airport. The area of work extends to the southern boundary of Homestead Bay where stage 2 is located overlooking Lake Wakatipu.

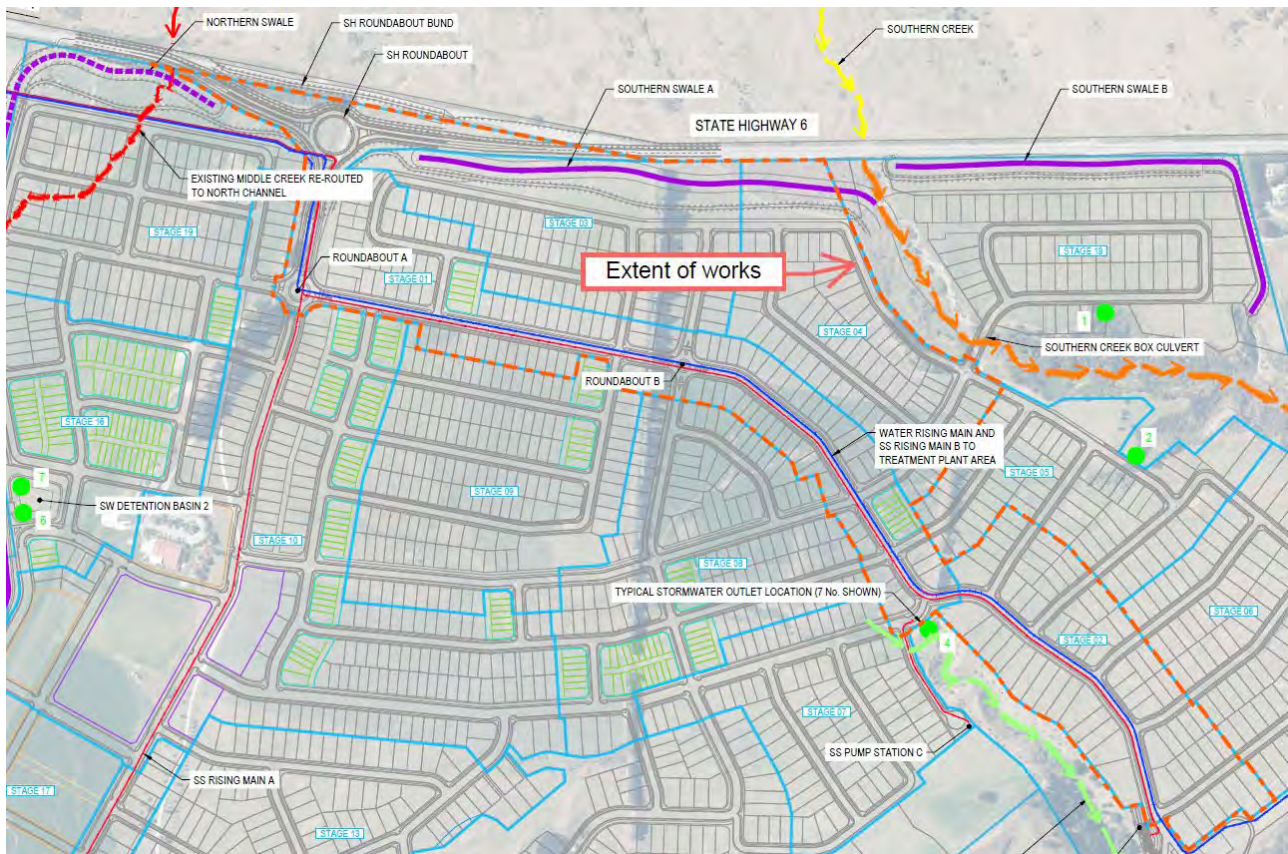


Figure 3-1: Extent of stage 1-4 of Homestead Bay development

3.2 Existing Features

3.2.1 Stages 1-4– Existing Stormwater Overland Flow Paths

Currently most of the stormwater from the stage 1-4 discharges as sheet flow in a southwestern direction through Homestead Bay and to either the Southwestern creek or sheet flows over the southern boundary and down to Lake Wakatipu. To the east of Phase 1 is the southern creek, this conveys flows from across State highway 6 to the lake. A smaller portion of Stages 1-4 flows into this channel.



Figure 3-2: Existing flow paths – orientated north.

3.2.2 Ground Condition

As covered by the Geosolve Geotechnical Assessment for Resource Consent Report dated January 2025 the site stratigraphy typically comprises alluvial fan deposits, beach deposits, lake sediments, some uncontrolled fill, loess, glacial pond sediments, glacial till and outwash deposits. The regional ground water was observed in the piezometers installed in the boreholes at depth below the site. Perched groundwater was encountered at shallow depths along the elevate eastern site boundary.

4 Administrative Requirements

4.1 Environmental Roles

The environmental roles are outlined in Table 4-1 below.

Table 4-1: Environmental Roles

Contactor's Site Manager	Earthworks stage - XX	
	P: XX	
Environmental Representative	Civils stage – XX	
	P: XX	
	Earthworks stage - XX	
	P: XX	E:
	Civils stage – XX	
	P: XX	E:

Environmental Advisors and Engineers	Iain Banks SQEP – Stantec	
	P: [REDACTED]	E: [REDACTED]
Clients Representative	Patrick Leslie – Stantec	
	P: [REDACTED]	E: [REDACTED]
Queenstown Lake District Council (QLDC)	Dan Wells	
	P: [REDACTED]	E: [REDACTED]
Otago Regional Council (ORC)	Monitoring Department	
	P: 03 441 0499	E: RCMonitoring@qldc.govt.nz
	Compliance hotline	
	P: 0800 474 082 P: 03 474 0827	E: compliance@orc.govt.nz
	Pollution Hotline	
	P: 0800 800 033	E: pollution@orc.govt.nz

The Client's Engineers are responsible for ensuring the Contractors and Environmental Representative are upholding the requirements of this document. Compliance inspections will be undertaken monthly or as required to ensure all measures are in working order. As part of the inspection an overall assessment will be completed to assess if environmental measures can be improved and to ensure the site is being managed effectively to prevent the risk of an environmental incident during work.

For the position of a Suitably Qualified and Experienced Person (SQEP), Iain Banks of Stantec is a Chartered Professional Engineer with a background in civil construction and transportation projects. For the last 9 years Iain has been responsible for overseeing construction and site monitoring of the Hanley's Farm Development including overseeing works in streams and land disturbance activities of the previous stages. Based on this, Iain meets the definition of a SQEP for a high-risk site as defined in the QLDC Guideline for Environmental Management Plans. Assisting with tasks onsite will be another employee of Stantec, Patrick Leslie, who has been working under the guidance of Iain for the last 7 years.

The Clients Representative role in environmental management is to ensure the clients best interests are heard and adhered to while ensuring the progress is to the clients liking. They will be involved with all large changes that require approval from the client while providing feedback to the client about the site and any environmental issues.

The Contractor's Site Manager is responsible for ensuring the site operates in a safe and effective manner while ensuring all Contractor obligations outlined in the document are upheld. This includes items like implementation of the Environmental Management Plan while ensuring work is undertaken in a timely manner and in accordance with the specification of the project. They are also responsible for assisting the Site Representative with the management of any accidental discovery/environmental incident in accordance with this EMP and the relevant sections below.

The Environmental Representative is responsible for implementation of environmental controls and administrative activities.

They will:

- Ensure installation of environmental controls as per the EMP.
- Undertake environmental site inspections of the project.
- Oversee the maintenance and improvement of defective environmental controls.
- Undertake environmental incident reporting.
- Undertake environmental monitoring.
- Keep project leadership informed of environmental performance of the project.
- Inform staff of procedures and constraints applicable to managing specific environmental issues
- Providing environmental inductions to all staff and sub-contractors
- Attending to environmental incidents and complaints.

The Environmental Representative should be familiar with:

- Environmental aspects of the project
- Environmental Management Plan
- Best practice erosion and sediment control from:
 - Guidance Document 2016/005: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05); and/or
 - Erosion and Sediment Control Toolbox for Canterbury on Environment Canterbury website; and/or
 - Best Practice Erosion and Sediment Control, International Erosion Control Association Best Practice Guidelines.
 - QLDC Guidelines for Environmental Management Plans
 - Otago Regional Council Residential Earthworks in Otago A Guide for developers, landowners contractors and service providers

4.2 Hours of Operations

Hours of operating for works will be in accordance with the applicable QLDC resource consent hours of operation and limited to the following:

- Monday to Saturday (inclusive): 7.30 am to 6:00 pm.
- Sunday and public holiday: No Activity

In addition, no heavy vehicles are to enter or exit the site and no machinery will start operating earlier than 7.30am. All activity on the site is to cease by 6:00pm.

4.3 Site Inductions

The Contractor will deliver a project specific site induction to all persons upon entering the site, a separate document has been prepared for this purpose. The environmental site induction includes a summary of all items included in this EMP and ESCP and specifically covers:

- The basic roles and responsibilities for environmental management and each person's responsibility while onsite.
- Specific locations within the site of environmental significance or risks, including exclusion zones and sensitive environmental receptors.
- An outline and discussion covering the conditions of resource consents.
- The limit of clearing and earthworks for each stage of works (as indicated on the ESCP).
- Environmental management measures required and how they should look.
- Procedures of notifying of potential environmental incidents.
- Procedures for managing environmental management measures during wind and rain events.

The Contractor is responsible for maintaining a register signed by those inducted. The register shall have, but not be limited to, the name of the inductee, date inducted, and the name of the induction facilitator. An example of an environmental site induction registers is included in Appendix C.

The Contractor's Health and Safety Advisor will conduct a weekly site health and safety meeting with the employees on site, minutes of these meetings will be kept on site and will also be available to view if requested. Weekly client meetings will discuss relevant health and safety issues that have been highlighted in the weekly toolboxes and other observations from site works.

4.4 Monitoring

4.4.1 Ongoing Monitoring

The Contractor's Environmental Representative and staff will monitor ongoing site activities, sediment retentions ponds and decanting earth bunds daily to ensure compliance and that there are no adverse effects on sensitive environment receptors like the neighboring residential development of Jacks Point is experienced.

Noise levels will be measured if a valid complaint is received. This will ensure compliance with the standard and levels referenced. It should be noted that a valid complaint means a complaint the administering authority considers is not frivolous, nor vexatious nor based on mistaken belief.

Vibration's monitoring will be measured if a valid complaint is received. This will ensure compliance with the standards outlined below.

Wind condition will be monitored during the works, especially if there is large area of exposed land in direct contact with the wind. During periods of high wind, the Environmental Representative is to advise the Site Manager of the conditions and suggest changes to the work program to minimize dust generation or ensure additional dust prevention measures are implemented.

Weather conditions during works will be monitored. Severe changes in the weather may require action to be taken. Any person onsite who notices signs of uncontrolled sediment runoff because of rain shall notify the Environmental Representative or Site Manager immediately. The Environmental Representative, and if required Stantec, shall rectify the situation and update the EMP.

4.4.2 Weekly, Pre and Post Rainfall Events

The Contractor's Environmental Representative and, if requested, Stantec shall undertake and document weekly inspections of the environmental management controls of the site for the purpose of monitoring the following:

- Verifying that the management measures are present, functional, and adequate.
- Observing the site for actual or potential adverse environmental effects.
- Identify maintenance requirements for implemented management measures.
- Verifying preparedness for adverse weather conditions where rain and/or wind is forecast.
- Observing any visual evidence of dust travelling beyond the boundaries of the site and evidence of dust fallout from the works on adjacent vegetation or buildings.

The Contractor's Environmental Representative is responsible for monitoring the weather forecasts and prior to any significant forecast rain (such as a 20mm over a 12hr period) and post rainfall events when there is flow of water being discharged from site, they shall undertake a site inspection of the environment management controls. If maintenance or alteration is required, this will be undertaken prior to the forecasted rain fall event. They shall document the inspection using the form in Appendix F

The Contractor shall undertake corrective actions to rectify issues identified by the site inspections. Each weekly inspection shall be recorded including date, observations, and any corrective actions. Appendix G has a template for the weekly site inspection form.

Between the weekly and post-rain event inspections, the site personnel shall also undertake a daily pre-start inspection to ensure that no new environmental issues have arisen, or mitigation measures have been compromised from the previous day's work. Observations should be recorded in a works diary.

4.4.3 Monthly

Stantec shall monitor the site monthly to ensure that the site is complying with its EMP, identify any new environmental risks arising that could cause an environmental effect and suggest alternative solutions that will result in more effective and efficient management. The outcome of these inspections will be reported and included in the monthly environmental report referred to below. Appendix I has an example of a monthly inspection form to be completed at the specified date and for inclusion in the monthly environmental report.

The Contractor shall complete and submit a monthly environmental report to QLDC and ORC. The monthly environmental report will be submitted to QLDC's Regulatory Department and ORC compliance within five working days of the end of each month. It will include exception reporting and statements actively addressing but not limited to the following that occurred during the reporting month:

- Updates to the EMP and the Erosion and Sediment Control Plan (if required).
- Weekly Site Inspections – number of inspections completed, and summary of corrective actions undertaken if any. Any area where replacement or rework of control features occurred will be noted.
- Monitoring reporting – summary of monitoring and whether non-conforming results were obtained.
- Positive environmental outcomes achieved, and opportunities identified by the Contractor.
- Stantec inspection report.

4.5 Incidence Reporting and Management

The Contractor will report to QLDC, ORC and Stantec within 12 hours via email of any environmental incident where an EMP has failed leading to an environmental nuisance or harm offsite. Once the immediate risk from the environmental incident is alleviated, the Contractor and Stantec will investigate the cause of the breach and/or adverse environmental effects. After which, identification and implementation of corrective actions will be undertaken.

The Contractor will provide any incident report to the Stantec, ORC and QLDC within 10 working days. Appendix D has a reporting template that is to be used when completing an environmental incident report.

Definition of environmental nuisance or harm off site can be found in the QLDC Guideline for Environmental Management Plans, June 2019.

Any environmental issues reported to the site manager, such as noise and vibration issues will result in works stopping until appropriate response measures have been agreed upon between the Stantec and the Site Manager and recorded in the Contractors incident register.

After any identification of incident or failure, the source/cause is to be immediately located and the following measures implemented:

- Build-up of sediment off the site – the material will be collected and disposed of in a manner that will not cause ongoing environmental nuisance or harm; then on-site EMP measures amended (if required), to reduce the risk of further sedimentation.
- Excessive sediment build-up on the site – collect and dispose of material, then amend up-slope drainage and/or erosion control measures as appropriate to reduce further occurrence.
- Severe or excessive erosion – investigate cause, control up-slope water movement, re-profile surface, cover dispersive soils with a minimum 100mm layer of non-dispersive soil, and stabilise with erosion control blankets and vegetation as necessary.
- Off-stream erosion – fill eroded areas, vegetate, and install velocity control measures.
- In-stream erosion – consult Stantec.
- Poor vegetation growth or soil coverage – plant new vegetation. Newly planted and previously planted areas may require supplementary watering and replanting. Additionally, erosion protection matting can be used to help ensure slope stability until growth is achieved.
- Sediment fence failure – replace and monitor more frequently. Regular failures may mean that the sediment fence location, alignment, or installation may need to be amended.
- Source of incidents is not a part of works – notify Stantec, ORC and QLDC of the source location.

4.6 Records and Registers

The Contractor is responsible for keeping all onsite records up to date. Environmental records will be made available upon request, immediately if the request is made by a QLDC or ORC Officer onsite and within 24 hours if requested by a QLDC or ORC Officer offsite.

Records and registers to be managed onsite shall include the following:

- Environmental induction attendance register (Appendix C).
- Environmental incident reports and associated corrective actions undertaken (Appendix D).
- Complaints register and associated corrective actions undertaken (Appendix E).
- Daily diary entries (including pre-start inspection observations).
- Post-rain event inspection observations and corrective actions (Appendix F).
- Weekly site inspection checklists (Appendix G).
- Monitoring results (e.g. water quality) (Appendix J).
- EMP non-conformance register (based on weekly inspection results or otherwise identified) and associated corrective actions taken (Appendix H).

4.7 Complaints Process

While it is hoped the environmental measures outlined in this document will prevent complaints from surrounding residents and the wider community, complaints or concerns can be reported via two channels:

- Via QLDC – <https://www.qldc.govt.nz/do-it-online/make-a-complaint/>
- Via ORC - <https://www.orc.govt.nz/managing-our-environment/waste-and-hazardous-substances/pollution/report-pollution> or the ORC hotline which is managed 24 hours a day 0800 800 033.

If the complaint is related to project management reference should be made to Section 4.1 of this EMP for contact details.

Once a valid complaint is received the Contractor's Environmental Representative or Site Manager will investigate the cause of the complaint, speak with the complainant (if available), consult with Stantec and work on a solution to prevent future complaints of the same nature. All valid complaints shall be registered on the complaints register as shown in Appendix F .

5 Operational Controls

5.1 Dust Minimization and Control

5.1.1 Performance Requirements

The Contractor shall always take reasonable and practicable management measures to avoid dust moving beyond the boundaries of the site.

5.1.2 Sensitive Receivers

Based on site visits and investigation it was concluded that the following dust sensitive receivers are present on and off site:

- Residences of Jacks Point.
- Vehicles using SH6
- Residences to the south
- Workers on site.

5.1.3 Dust Sources and Controls

Works could create adverse environmental effects in relation to dust including earthworks operations like excavation, transporting, compacting, and seeding soil during the course of works.

Based on prior knowledge the prevailing wind direction is from the south to southwest coming off the lake. It is a light to moderate wind most of the time but has been known to have some strength to it as long as it is not obstructed by objects. The measures below will be used to help prevent dust generation.

If visible dust clouds are seen approaching the site boundaries or deemed to have potential to cause a nuisance, water carts will be actioned to minimize dust generation, haul roads will be doused, and earthworks will cease if required. The Contractor will provide a standby operator available to control dust outside of working hours or if forecasted winds are expected.

Measures to be utilized onsite to prevent dust generation or manage the dust generated include:

- Suspension of works during high winds: During periods of high wind, vehicle movements and construction activities may need to be reduced or suspended to minimize potential dust nuisance.
- Water supply: From the site bores and water tanks. Alternatively, the sediment retention pond (s) may have water available for use (refer to Appendix A).
- Avoid steep cut faces: Steep cut faces disrupt the wind and cause swirling effects, which generate more dust than off a flat surface. The earthworks will be excavated down in layers rather than deeper cut faces where appropriate.
- Topsoil shall be pre-wetted prior to stripping if ground conditions are particularly dry, this reduces the amount of dust generated by excessively dry ground conditions.
- Application of hydro seed: Depending on the type of hydro seed employed various binding materials can be added to the hydro seed mix to more effectively bind the topsoil surface to create a crust which is able to stay in place over a prolonged period if required.
- Application of dust suppressant: Depending on the area of application a dust suppressant can be applied to exposed surfaces to help reduce the creation of dust.
- Scale back operations to an area that can be controlled for dust when conditions are windy: Depending on wind conditions some operations might be scaled back or shifted to a different part of the site to avoid generation of dust.
- Re-topsoil finished areas as soon as possible and re-grass: Following completion of bulk earthworks topsoil is to be placed and dampened down to form a crust with immediate grass seeding. As new ground is opened for cut to fill operation the stripped topsoil will be placed over completed areas so that there is a progression of completed areas and open areas being worked on.
- Erosion control matting applied to stockpiles in wind affected areas.

The Contractor will rectify any instance where dust from site is found to be off site and causing an issue. It could be sweeping the dust off the road to prevent the situation getting worse.

5.2 Noise

5.2.1 Performance Criteria

The Contractor shall always take reasonable and practicable management measures to avoid and mitigate effects from noise associated with construction works.

The Contractor shall ensure that all works are undertaken in accordance with the noise limits set in any relevant conditions of consent or in the absence of a consented limit must comply with the noise limits. For clarification with works exceeding 20 weeks, the noise limits are limited to 70dB with a max of 85dB.

For all sites the contractor shall review the EMP, update and implement additional management measures:

- In response to a justifiable complaint caused by construction works
- When changes in the equipment/work method, intensity, location.

5.2.2 Noise Management

Noise generation activities include vehicle movement throughout site and excavation on site from equipment like water carts, excavators and haul trucks. All equipment used on site shall be regularly maintained and must only output acceptable construction noise. Construction noise is inevitable as part of the construction. However, construction noise will only be generated during the hours of operation permitted in the resource consent.

All practical steps shall be taken to minimize noise particularly when working adjacent to an existing residential area. It is noted that the proposed works are fairly separated from any such areas except for vehicle movements past existing houses within Jacks Point.

If a suitable complaint is received the Environmental Representative should monitor from the site compound and site boundary. A suitably qualified person should be engaged with an appropriate noise monitoring device to test the noise levels. Measurements will be taken at a height of 1.2 to 1.5 metre and 1 metre from any wall to align with the standards.. If levels are above the noted requirements, then additional investigation should be taken.

5.3 Vibration

The Earthworks may create severe vibration as operations such as rock installment is required for the works on site.

The Environmental Representative can monitor vibration levels using a suitable accelerometer typically found in today's smart phones or a vibration monitoring app like "Vibration Meter". If a justified complaint is received a qualified vibration monitor and expert will be engaged to measure and report what vibration levels are onsite.

5.3.1 Performance Criteria

Stantec undertook an inspection of the site, and it was identified that the nearest vibration sensitive receptor is the residence at Jacks Point. The vibration is deemed to be low risk with suitable distance from machines, bunds, and channels in place to disrupt the vibration.

5.3.2 Vibration Management

To avoid exceeding the guidelines of British Standard – Code of Practice for noise and Vibration Control on Construction and Open Sites (BS5228.2:2009), vibration monitoring at the site boundary will undertake to ensure the vibration levels do not exceed 10 mm/s. Given the distance to the vibration sensitive receptor from the works site and the ongoing residential construction within the area any vibration levels closer to the residences could be caused by an outside source not associated with these works.

Table 5-1: Guidance on Effects of Vibration Levels (from British Standards BS5228.2:2009)

Vibration Level	Effect
0.14 (mm/s)	Vibration might be just perceptible in the most sensitive situations for vibration frequencies associated with construction and maintenance. At lower frequencies, people are less sensitive to vibration
0.3(mm/s)	Vibration might be just perceptible in residential environments but unlikely to be felt by a person
1.0(mm/s)	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10(mm/s)	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

5.3.3 Effects on Structures

For the purpose of this EMP, a structure includes infrastructure and utilities like pump stations, electrical and telecommunications facilities and utilities such as water mains and sewers.

The vibration will be monitored and DIN 4150-3:1999 Structural vibration – Part 3: Effects of vibration on structures will provide a comparative benchmark for preventing damage that could adversely affect the structures serviceability and give the Contractor a level to measure against if required. This standard has been adapted by New Zealand providing guideline vibration levels for assessing building damage risk.

The DIN 4150-3 (1999) guideline values for evaluating short-term and long-term vibration on structures are given in Table 5-2.

Table 5-2: Summary of Building Damage Criteria in DIN 4150.3:1999 (Source Deutsch Institut für Normung, 1999)

Type of structure	Short term vibration			Long term vibration	
	PPV at the foundation at a frequency of:			PPV at horizontal plane of the highest floor (mm/s)	PPV at horizontal plane of the highest floor (mm/s)
	1 – 10 Hz (mm/s)	1 – 50 Hz (mm/s)	50 – 100 Hz (mm/s)		
Commercial/industrial	20	20-40	40-50	40	10
Residential/school	5	5-15	15-20	15	5
Historical/Sensitive	3	3-8	8-10	8	2.5

For the works associated with the Conveyance Channel, it would be classed as long-term vibration according to the definition given in the standard. Works similar to rock breaking can be categorized as short-term vibration in the respected vibration frequencies of the equipment.

To avoid exceeding the guidelines of DIN 4150.3:1999, vibration monitoring at the site boundary will be undertaken to ensure the vibration levels do not exceed 10 mm/s. Given the distance to the vibration sensitive receptor are from the earthworks site and the ongoing residential construction within the area, any vibration levels closer to the residential area could be caused by outside sources not associated with the works.

If a valid vibration complaint relating to structure damage from Conveyance Channel work is received, the Environmental Representative will undertake vibration measurements at the location of the damage and compare to the levels above. Previous monitoring on the nearby Hanley's Farm Development have only shown levels of 1.5mm/s at the site boundary. These observations were observed when heavy compaction rollers were operating within 10m of the boundary so not every complaint will be considered as valid.

A valid complaint will be considered if one of the following minor damages is evident. In DIN 4150.3:1999, These effects are deemed 'minor damage':

- Cracks form in plastered surfaces of walls not due to house construction work.
- Existing cracks in the building become enlarged with proof of the change in crack sizes. Proof of existing cracks prior and post damage is required.
- Partitions become detached from load bearing walls or floors.

The Contractor will undertake the following action if required:

- The Contractor shall be responsible for identifying any additional sensitive environmental receptors and critical facilities, infrastructure and utilities likely to be impacted by construction vibration. This may include things like residential housing or critical infrastructure susceptible to failure with excessive vibration.
- The earthworks shall cease if at any time a justifiable complaint is received regarding effects from vibration associated with earthworks activities within the work area.
- The issue will be investigated and if required alternative measures and/or operational changes will be made to resolve, mitigate, and avoid another complaint of vibration.
- If these concerns cannot be resolved between the parties, a suitably qualified professional shall be engaged to assess vibration associated with the earthworks and determine any adverse effect on land and buildings beyond this site. This assessment shall outline whether the works comply with BS5228.2:2009 or DIN 4150-3:1999 or a similar internationally accepted standard and if there is a non-compliance identified include recommendations on what changes to construction methodology are required to comply.

5.4 Contaminated Soil on Site

Contaminated Soil has been identified within the stage 4 area of the works where a sheep dip once was located. This is referred to as HAIL A8 site in the PSI. Removal and management of soil within the areas identified is to be managed in accordance with the Remediation Action Plan.

If any further contaminated soil is discovered works shall immediately cease and the Site Supervisor and Environmental Representative shall be informed, who shall then notify ORC. The process outlined in the National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health are then to be reviewed and applied. A SQEP in contaminated land would be brought on site to assist and determine the best solution to deal with unexpected, contaminated soil. At minimum, the soil shall be dug out placed in a road truck, covered, and carted off site for disposal at an appropriate facility.

5.5 Chemicals and Fuels

During the works associated with the development, the Contractor will have diesel brought onsite for the purpose of fueling equipment during works. Trailer mounted tanks will be used to refuel equipment. Bulk fuel storage will be at the works compound. If fuel storage is relocated to another area the EMP will be updated to reflect this.

Because of the potential environmental risk having these substances on site, the Contractor will have spill kits onsite. These are kits specially for diesel spill as this is the critical chemical stored onsite during day works. These kits can be found in the utility vehicles (30L mobile general-purpose spill kit) and the site office (240L oil and hydrocarbon spill kit).

Fuel storage is more than 30m from any watercourse at the site office, this is to prevent a spill effecting the water quality in the surrounding watercourses.

To contain any spill that may occur during refueling the machinery will be stationary on a disposable material base that can be removed after the earthworks containing any spill that may have occurred.

To prevent storage failure, no storage container is to be used on site if it leaks or has a fault resulting in leaking of fuel. Containment vessels are typically doubled skinned to prevent leaks and the contractor can use such vessels as that are rated for fuel storage.

In the rare event fuel is leaked on site, the Contractor will use appropriate measures to contain, remove, and dispose of the spill.

Where any incident of fuel is found leaking from site, the Environmental Representative shall investigate and complete an environmental incident report (refer to Appendix D).

5.6 Waste

5.6.1 Performance Criteria

The Contractor shall ensure the following criteria is always met:

- All waste is removed from site.
- No waste shall be burnt onsite.
- Bins are provided in common areas at all times. Bins shall be fitted with lids and serviced prior to being filled.
- The site should be free of litter and no litter should leave the boundary of the site nor can enter any waterway within the site.

5.6.2 Management

Waste containment locations can be found at the site compound with adequate rubbish facilities so that the site remains litter free at all times. Waste is to be removed from site on a regular basis. Where possible recyclable materials shall be separated and disposed of at the Frankton Transfer Station.

5.7 Water Quality

5.7.1 Performance Criteria

Stages 1-4 currently sheet flows in a south western direction towards the south western creek(refer to Figure 3-2). The ESCP will protect the receiving environment during construction (refer to the supporting plans in the ESCP).

The following water quality parameters shall be met:

- Total Suspended Solids (TSS) – no more than 50 mg/L TSS
- pH – within 5.5 – 8.5.
- Hydrocarbons, tannins, and paint – no visible trace.
- Waste – no visible litter or waste from site.
- Turbidity reading of no more than 100 NTU.

5.7.2 Testing

5.7.2.1 Suspended Solids

Rather than measuring TSS which causes delays in getting information back to site, turbidity, or Nephelometric Turbidity (NTU) will be measured onsite using nephelometer. With this said samples shall be taken and the Contractor shall undertake lab testing to determine the correlation for the NTU from the total suspended solids. Example of a handheld nephelometer that are commonly used onsite for NTU readings is shown below.



Figure 5-1: Hand held nephelometer

5.7.2.2 PH Testing

PH testing will be undertaken with hand held pH readers when suspended solids samples are taken. If inadequate water is available for testing no testing shall be undertaken until a forecasted storm events occurs. Example of handheld pH is in the figure below.



Figure 5-2: Hand held pH reader

5.7.2.3 Timing of Testing

A visual inspection of the discharge from the stormwater devices will be completed as part of the weekly inspection and post rainfall events to ensure compliance. If water is discharging from the sediment pond outlet(s) water will be tested. If no water is discharging, then the next sample is taken during the time water is discharging from the ponds and noted. Results will be included in the monthly report.

5.7.3 Non-conformant

If water is found to not meet the requirements outlined in section 5.7.1 or the consent, a new sample is to be retested to confirm it is in accordance. The additional sample must be taken within 5 working days of the original sampling. Where one or more of the limits set out in section 5.7.1 are exceeded on two consecutive sampling occasions and these results are confirmed, an incident report is to be prepared. This will include the water quality parameter that exceeded the criteria above and level that was recorded noting the sample location. The table in Appendix J shall be used to detail this information. If any sediment or erosion control devices has failed, this information will need to be included along with the incident report to identify what failed and what was done to rectify the failure. If a rain event had occurred which contributed to the non-conformance, the depth of rain recorded at the nearest meteorological station should be obtained. This information should then be used to determine the Annual Recurrence Interval (ARI) of the rain event (i.e. 2-year, 5-year or 20-year). This information along with the cause and implement corrective actions to prevent re-occurrence of monitoring non-conformances should be included as part of the non-conformance reported to QLDC and ORC.

In addition to the above further sampling shall be completed in the Gullies upstream of the discharge points and at a point 5m from the shoreline of Lake Wakatipu near the south eastern gully entry to the lake and testing shall be completed for:

- Conductivity
- Total nitrogen
- Nitrate-nitrogen
- Total ammoniacal-nitrogen
- Total phosphorus
- Dissolved reactive phosphorus; and
- Dissolved metals (copper, lead, zinc)

If the test results exceed the following parameters in just the downstream location then a report shall be prepared for the consenting authority noting the exceedance values and confirming what remediation measures will be put in place to rectify the issues:

- i. Nitrate nitrogen - 0.075 milligrams per litre;
- ii. Ammoniacal nitrogen – 0.01 milligrams per litre; and
- iii. total phosphorus 0.1392 milligrams per litre*see note below;
- iv. total nitrogen 0.636 milligrams per litre*see note below; ✗
- v. Dissolved copper - 0.00047 milligrams per litre (ANZG DGV 95%);
- vi. Dissolved lead - 0.0034 milligrams per litre (ANZG DGV 95%); or
- vii. Dissolved zinc - 0.0041 milligrams per litre (ANZG DGV 95%).

5.8 Indigenous Vegetation and Protected Trees

Within the site there is no indigenous vegetation or trees requiring protecting as the previous land use was originally farmland or farm sheds. Any existing vegetation that is removed will be replaced with new trees, plants and grass as part of the development.

5.9 Cultural Heritage

If the Contractor discovers iwi tangata (human skeletal remains), waahi taoka (resources of importance), waahi tapu (places or features of special significance) or other Maori artefact material, the consent holder shall without delay:

- Notify QLDC, ORC, Tangata whenua and Heritage New Zealand Pouhere Taonga and in the case of skeletal remains, the New Zealand Police
- Stop work within the immediate vicinity of the discovery to allow a site inspection by the Heritage New Zealand Pouhere Taonga and the appropriate runanga and their advisors, who shall determine whether the discovery is likely to be extensive, if a thorough site investigation is required, and whether an Archaeological Authority is required.

Any tangata discovered shall be handled and removed by tribal elders responsible for the tikanga (custom) appropriate to its removal or preservation. Site work shall only recommence following consultation with QLDC, ORC, Heritage New Zealand Pouhere Taonga, Tangata whenua, and in the case of skeletal remains, the New Zealand Police, provided that any relevant statutory permissions have been obtained.

If the Contractor discovers any feature or archaeological material that predates 1900, or heritage material, or disturbs a previously unidentified archaeological or heritage site, the Contractor shall follow the Accidental Discovery Protocol found in Appendix K

All persons working on the site will be made aware of the above-mentioned protocols, this will be covered off during site inductions.

5.9.1 Contact Detail

Heritage New Zealand Regional Archaeologist:

Rebecca Benham
Regional Archaeologist Otago/Southland
Heritage New Zealand
PO Box 5467, Dunedin
Ph: [REDACTED], M: [REDACTED]
E: [REDACTED]

5.10 Temporary Fire Control

Fire extinguishers are located in all marked vehicles and machinery. There will also be additional fire extinguishers in the site office. A number of the Contractor's staff on site are fire fighters with the New Zealand Volunteer Fire Service and are trained to handle an incident that could arise. A water cart will be present on site that can assist if required.

Fire and emergency procedures will be outlined in the site health and safety policy. The site emergency procedure will be displayed on the wall of site office. All persons inducted to site will be made aware of the first aiders on site and the means of fire control.

5.11 Site Security

The main access to site will have signs which will clearly mark the safe vehicle route for parking within the site.

All machinery will be parked and secured at the end of each day.

Deliveries will be made to the site office and the Site Manager will liaise with the delivery company to ensure appropriate drop off times. Documents of sensitive nature in regard to the project will be kept in the contractor office or the site office if required by the consent.

Site fencing will be installed, along with appropriate signage, for boundaries between public areas and the construction site where it is deemed to be a risk of public entry.

6 Erosion and Sediment Control Plan

6.1 Erosion and Sediment Control Principles

The following erosion and sediment control plan has been prepared based on designing, installing, maintaining, and decommissioning in accordance with the following principles:

- Erosion and sediment controls are integrated with construction planning and operation.
- Effective and flexible erosion and sediment control plans are developed based on soil, site slope, weather, construction conditions and the receiving environment.
- The extent and duration of soil exposure is minimised.
- Water movement through the site is controlled – in particular clean water is diverted around the site and 'dirty' and 'clean' water is kept separated as far as is practicably possible.
- Soil erosion is minimised as far as reasonable and practical (to the satisfaction of QLDC and ORC)
- Disturbed areas are promptly stabilised.
- Sediment retention on site is maximised (i.e. must meet the discharge criteria for suspended sediment)
- Controls are always maintained in proper working order.
- The site is monitored, and erosion and sediment practices adjusted to maintain the required performance standard.
- Avoidance of discharges, especially sediment off site.

The site must perform in a way that any releases from site must not cause scour at the area of discharge. Water must only be released at the discharge point nominated within the ESCP and as deemed acceptable by ORC. Any modification to discharge point must be accepted by ORC.

The erosion and sediment controls shall be sufficient to achieve the water quality criteria for discharge in accordance with section 5.7.1 water quality performance criteria, provided resource consent has been obtained for the earthwork's activity. Otherwise, the performance criteria shall be in accordance with the currently active Operative and Proposed District Plan.

The contractor shall remove temporary controls when permanent measures are in place and/or site stabilization (defined as at least 80% revegetation cover) has occurred.

6.2 Details of Works

In accordance with the CMP, earthworks will be conducted first which involves vegetation clearance, excavation, shaping and forming the finish shape before soil and seeding of finished area. Then construction moves onto the next step with the civil works installing drainage, services and roading. This is followed by the landscaping works finishing the berms and streetscape off before the completed stage is handed over to lot owners and local authority.

6.3 Reference Documents

- Guidance Document 2016/005: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05),
- Erosion and Sediment Control Toolbox for Canterbury - <https://www.esccanterbury.co.nz/>
- Best Practice Erosion and Sediment Control, International Erosion Control Association Best Practice Guidelines.
- Otago Regional Council Residential Earthworks in Otago A Guide for developers,

6.4 Erosion Controls

6.4.1 Non-Structural Control Measures

6.4.1.1 Staged Construction

To ensure the site can be managed the areas to be opened will progress in a staged manner to effectively manage the stormwater in and around the area of works.

The basic staged approach to stage 1-4 earthworks is outlined in the following steps:

1. Set up clean water diversion bunds, clean water level spreader and silt fences
2. Set up site compound, entrance way and site fencing.
3. Construct RAB & 1C ponds to allow cut to fill operations at the RAB area to begin.

4. Start earthworks in RAB catchment and 1C catchment forming dirty water cutoffs as works progress.
5. Set up Pond 1B, 1A, 2, 4 and Highway area.
6. Progress earthworks across the site closing completed areas with topsoiling and seeding
7. Finish up all earthworks and begin civils.

6.4.1.2 Minimizing Disturbance

To reduce the amount of water that requires treatment, catchment sizes have been limited to a manageable size for the intended operation, draining to local low points that are existing. The area of stage 1&3 has been split into 5ha catchments, with the Roundabout and highway areas their own smaller catchments at 2.46 and 3ha . Operations during earthworks will focus on stripping areas, cutting/filling in localized area, then soiling back over to grass it and move to another area. This way the amount of exposed subgrade is limited, manageable and able to be sealed off quickly if required. It also allows the cutting and filling operations to be in close proximity to each other and reduce the amount of truck movement across the full extent of works.

6.4.2 Water Management

6.4.2.1 Clean Water Management

Homestead Bay has a sloped terrain on the east side of the site, therefore stormwater from uphill needs to be diverted around the site where possible. Clean water diversion bunds will be used to divert water around areas of work to natural flows paths away from site.

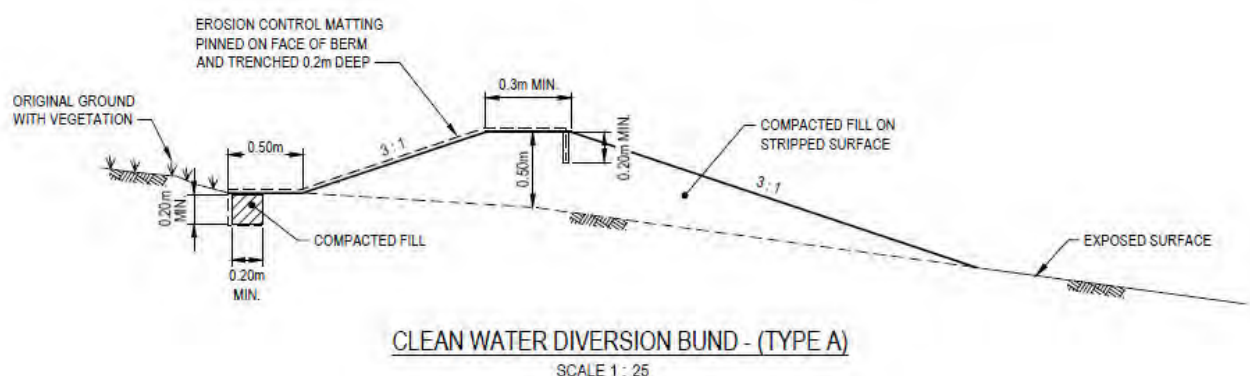


Figure 6-1: Clean water division bund

6.4.2.2 Dirty Water Management

During works, dirty water channels will be used to convey dirty water to ponds and contain dirty water runoff within the site. Other areas of site where water requires diverting are as shown on the plans attached in Appendix A

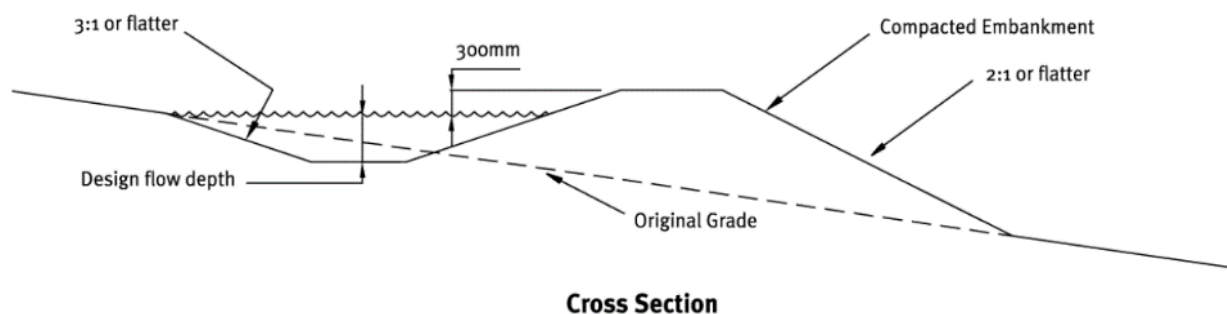


Figure 6-2: Dirty water diversion channel (Source: Auckland Council Guideline Document 2016/005, October 2018)

6.4.3 Vehicle Access

Access to stages 1-4 will be via site access located at the west of Road 1 internal roundabout, to prevent sediment getting tracked onto the road network, sedimentation mats will be set up. Examples of the mats are shown below (Figure 6-3).



Figure 6-3: Example of sedimentation mats

6.4.4 Soils and Surface Stabilization

6.4.4.1 Topsoil and Seed

As earthworks progress exposed areas where work is no longer required will be covered with a layer of topsoil from the available stockpile, spread and seeded.

Two types of seed application will be used across the area of works.

Drill seeding – drill seeding will be used on large flat areas where machine access is available. Drill seeding strike success is achievable in spring to autumn months with appropriate water application.

Hydroseeding- hydro seeding application of seed will be used in steeper batters at risk of erosion before strike, however effectiveness of hydroseeding is limited to Autumn and spring months. Summer months the seed burns off too quick and grass strike is difficult to achieve.

For winter months the ground is either oversaturated or frozen and seed strike difficult to achieve, as such soiling of earth is typically held off until late winter to have it ready for spring. Previous success in ground stabilization has been achieved with soil stabilizing polymers applied over the winter with seeding done in the spring. This will be completed in stage 1-4 should winter soiling occur and need stabilizing.

Any area where heavy rain has caused topsoil or grass to erode will require respreads and reapplication, to prevent further erosion.

6.5 Sediment Control

6.5.1 Sedimentation Retention Ponds

7 sedimentation and retention ponds will be constructed for stage 1-4. Each pond has its own unique catchment that allows cutting and filling operation to be progress across one or 2 catchments, meaning the site can progress in a efficient manner without the need to have all catchments opened at once to gain material to filling elsewhere.

Pond locations and catchments are all shown in the ESCP.

6.5.1.1 Ponds

To align with GD05 the stormwater ponds need to be 300m³ of storage per ha for a maximum of 5 ha of contributing catchment. Appendix B has all the required calculations for the pond sizing.

Each pond will require a forebay 1 metre deep, full width of the pond, installed across the front with a level spreader to distribute the flows into the pond. A bund of 0.5m height will allow the dirty water channels to run alongside the pond where needed. This will also allow the emergency spillway to be in line with the minimum requirements of GD05. Forebays are all sized to be 10% of the size of the pond to allow sufficient space for sediment to be disposed before full.

6.5.1.2 Decanting Tee Bar System

For the most effective discharge of water from a sediment retention pond a decanting tee bar system has been selected. Figure 6-5 shows an example of the tee bar system which is a suitable dewatering device and has been used in

previous stages. Figure 6-5 is an off-the-shelf system from Cirtex for a 110m tee-bar decant system that can discharge at a rate of 4.5l/s.

To maintain 30% dead storage in the pond the lowest tee bar is placed at a height appropriate to achieve this requirement.

The tee bars can be installed on a pully system to prevent water from discharging from the pond if there is a requirement to use the top clean water for dust suppression. If pulleys are used it allows the lower decanter to be raised as sediment is deposited. Additional to ensure tee bars can prevent discharge each tee bar will have a slide gate installed at the manhole to close of each tee bar individually.



Figure 6-4: Sediment Retention Pond outlet example

6.5.1.3 Primary Spill Way

5 ponds have a catchment area of 5ha therefore a 1050 mm concrete manhole riser will be used as a primary spillway with a 300mm outlet. The Highway pond and RAB pond have catchment area of 1.5 to 3ha therefore the minimum requirement is a 150mm upstand with a minimum 150mm outlet pipe as per GD05.

6.5.1.4 Emergency Spill Way

The emergency spill way for all ponds have been designed to be located at a height of 300mm above the primary spillway. As the topography around the ponds is not perfectly flat the emergency outlets have been designed to be the full width of the pond increasing the amount of water the emergency spillway can discharge with effecting the surrounding area.

A schematic of the pond spillways can be found in Appendix A ESCP plans.

6.5.1.5 Use of Flocculent

Flocculant is to be used in the ponds given the range of soil found onsite. Testing, handling, and storage of flocculate will be in accordance with the site-specific Chemical Treatment and Management Plan.

For cold temperatures where ice and snow will form onsite the ponds are to be isolated from discharging freely overnight and check to ensure the water quality is achieved, ponds are in good condition and able to operate efficiently.

Floc storage onsite will be in UV protected container to prevent the floc from degrading over time and still remains effective.

6.5.2 Silt Fences

Silt fences will be able to control the sediment runoff from some areas while maintaining a sheet flow like current overland flow. Therefore, silt fences will be installed in areas where there is a suitable grass buffer and adequate space to install a suitable silt fence. This will help reduce the amount of sheet flows that are concentrated for treatment

Super silt fences have been incorporated into the ESCP plans in Appendix A, these are to be installed in the SRP to reduce the amount of water effected by wind and causing the top layer of water to stir up and become dirty, additional these silt fences help drop out the sediment and floc quicker at the inlet of the pond before reaching the outlet.

6.5.3 Stockpile Management

Stockpile locations shall be within the catchment areas so any runoff for them can be treated before discharging from site. Stockpile likely to be left for a duration of 1 month or longer will be covered in soil and seeded, or an erosion protection matting like a Hession or geotextile fabric covering will be pinned to the compacted stockpile.

6.6 Installation Sequence for Stages 1-4

To ensure best practices are upheld and the control of any sediment or erosion is contained the order in which control measures are installed is critical. The following is the likely installation sequence to achieve the best outcomes:

- Build access into site.
- Build ponds for RAB, Highway and 1C catchments
- Build bunds and cut off drains.
- Fence off site and set up site entrance controls
- First operation of cutting and filling from catchment 1C to the RAB, with the mound and channel shaped in the highway catchment.
- Soiling & seeding completed areas of the highway, 1C and RAB Catchments
- Set up ponds from Catchment 1B, 1A, 2 and 4
- Stage 2 Cut to fill, soil and seed areas, with excess fill used in Stage 1A and 4.
- Stage 1B, 1A and 4 Cut to fill, soil and seed areas
- Updated EMP as works moves into Civil.
- Install drainage networks
- Install services networks
- Build roads.
- Hydro seed completed berms.
- Removal of ponds
- Removal other controls and silt fences.

6.7 Managing Significant Rain Events

In line with the monitoring requirements daily checks of weather forecasts must be undertaken. Where significant rain events (20mm over 12h hours) are forecasted specific checks of the site are to be completed to ensure all control measures are in place and working adequately. Where necessary works shall stop in advance of the event and all areas of the site shall be made secure including stabilizing cut and fill areas, stockpiles etc. Additional measures such as localized bunding of trenches shall be formed to further protect critical assets within the site. The site foreman shall ensure the site is safe and adequately protected prior to leaving for the day in advance of any forecast rain event.

6.8 Post Construction Controls and Decommissioning

Upon final completion and once at least 80% of the site is stabilized and covered with vegetation the environmental controls shall be removed. This will include infilling of the ponds with suitable engineered fill and shaping to the final surface level.

7 Updates

The EMP will be updated when the work program progress and an update is required, or when an issue is identified and needs to be rectified. With weekly and monthly inspections of the site measures, significant issues will be updated in the EMP immediately and minor issues will be covered with the monthly environmental report to be submitted to Council.

Additional updates of the EMP will happen if directed by ORC or QLDC's Monitoring Department.

All updates shall be represented in the revision panel at the beginning of the report.

All staff and sub-contractors will be notified of any change to the EMP and the new responsibilities and requirements.

Appendices

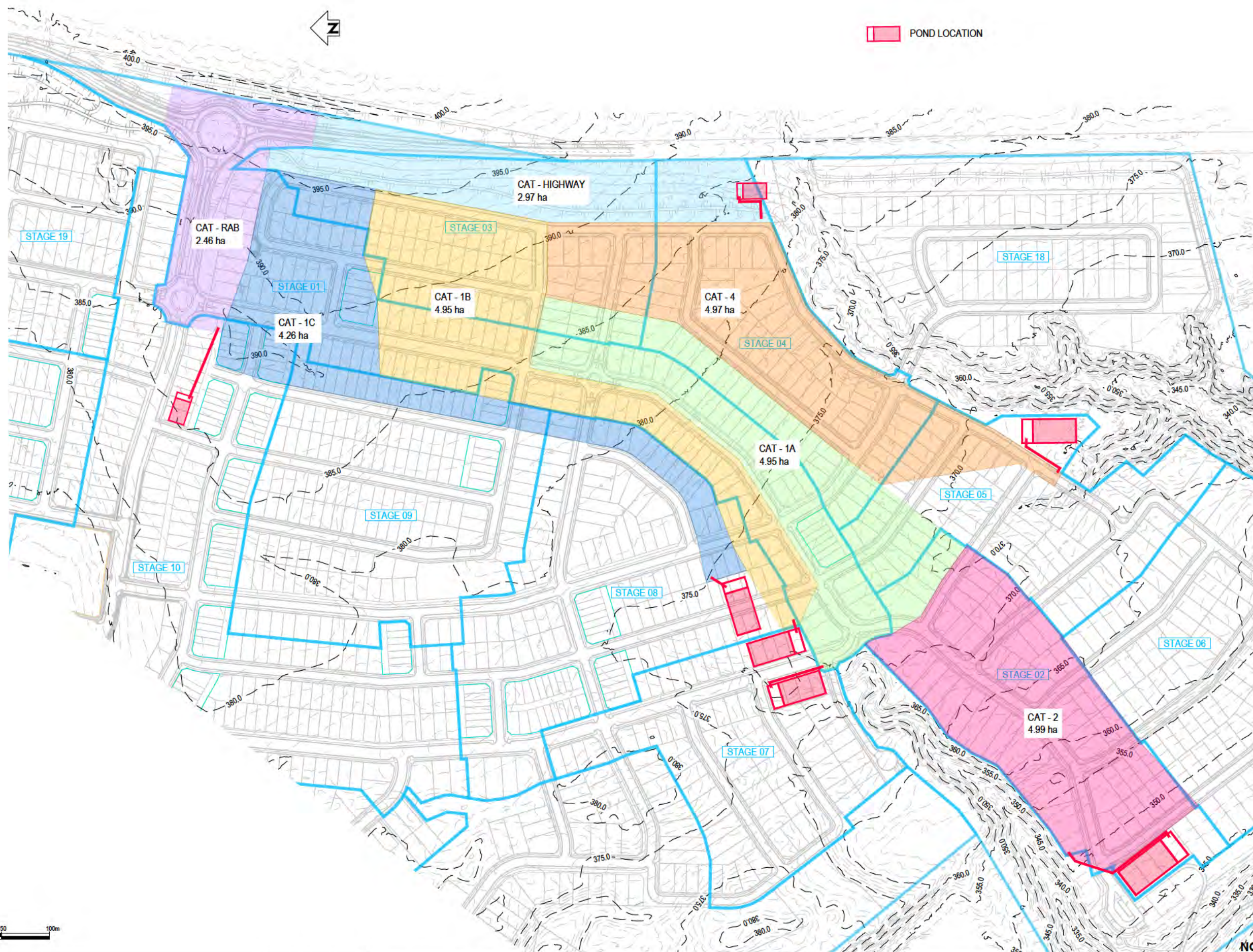
We design with community in mind



Appendix A Erosion and Sediment Control Plans



POND LOCATION



NOT FOR CONSTRUCTION

SCALE 1:2000

REV	ISSUED FOR CONSENT	PAT	PL	PSW	DATE	REVISIONS
0	ISSUED FOR CONSENT	DRN	CHK	APP	03.09.25	

SURVEYED	Patersons	08.24
DESIGNED	Iain Banks	02.25
DRAWN	Brent Grey	02.25
CAD REVIEW	Peter Thomson	11.04.25
DESIGN CHECK	Peter Thomson	11.04.25
DESIGN REVIEW	Peter White	11.04.25
APPROVED	Peter White	11.04.25
PROF REGISTRATION:		



HOMESTEAD BAY SUBDIVISION, QUEENSTOWN
MASTER PLANNING

DRAFT EROSION AND SEDIMENT CONTROL PLAN - STAGES 1 - 4
POND CATCHMENTS

Status Stamp	FOR CONSENT
Date Stamp	03.09.2025
Scales	1:3000
Drawing No.	310104425-00-000-D2013
Rev.	0

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

PLOTTED: 2025/03/03 10:19 AM

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DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

PLotted: 2024/03/10 09:45pm



LEGEND

- EXISTING FLOW PATH
- EXISTING EPHEMERAL STREAMS
- POND AND OUTLET
- SEDIMENT TRACK OUT MATS AT SITE EXIT
- SITE FENCE AND GATES
- TIE INTO EXISTING FENCE
- SILT FENCE
- CUT-OFF DRAIN
- DIRTY WATER BUND
- DIRTY WATER FLOWS
- CLEAN WATER BUND TYPE A
- CLEAN WATER BUND TYPE B
- CLEAN WATER FLOWS

NOTE:
FOR POND DIMENSIONS, REFER TO EMP DOCUMENT



SCALE 1:2000

SURVEYED	Patersons	08.24
DESIGNED	Iain Banks	02.25
DRAWN	Brent Grey	02.25
CAD REVIEW	Peter Thomson	11.04.25
DESIGN CHECK	Peter Thomson	11.04.25
DESIGN REVIEW	Peter White	11.04.25
APPROVED	Peter White	11.04.25
PROF REGISTRATION:		



HOMESTEAD BAY SUBDIVISION, QUEENSTOWN
MASTER PLANNING

DRAFT EROSION AND SEDIMENT CONTROL PLAN STAGES 1 - 4
ESCP DURING EARTHWORKS

NOT FOR CONSTRUCTION

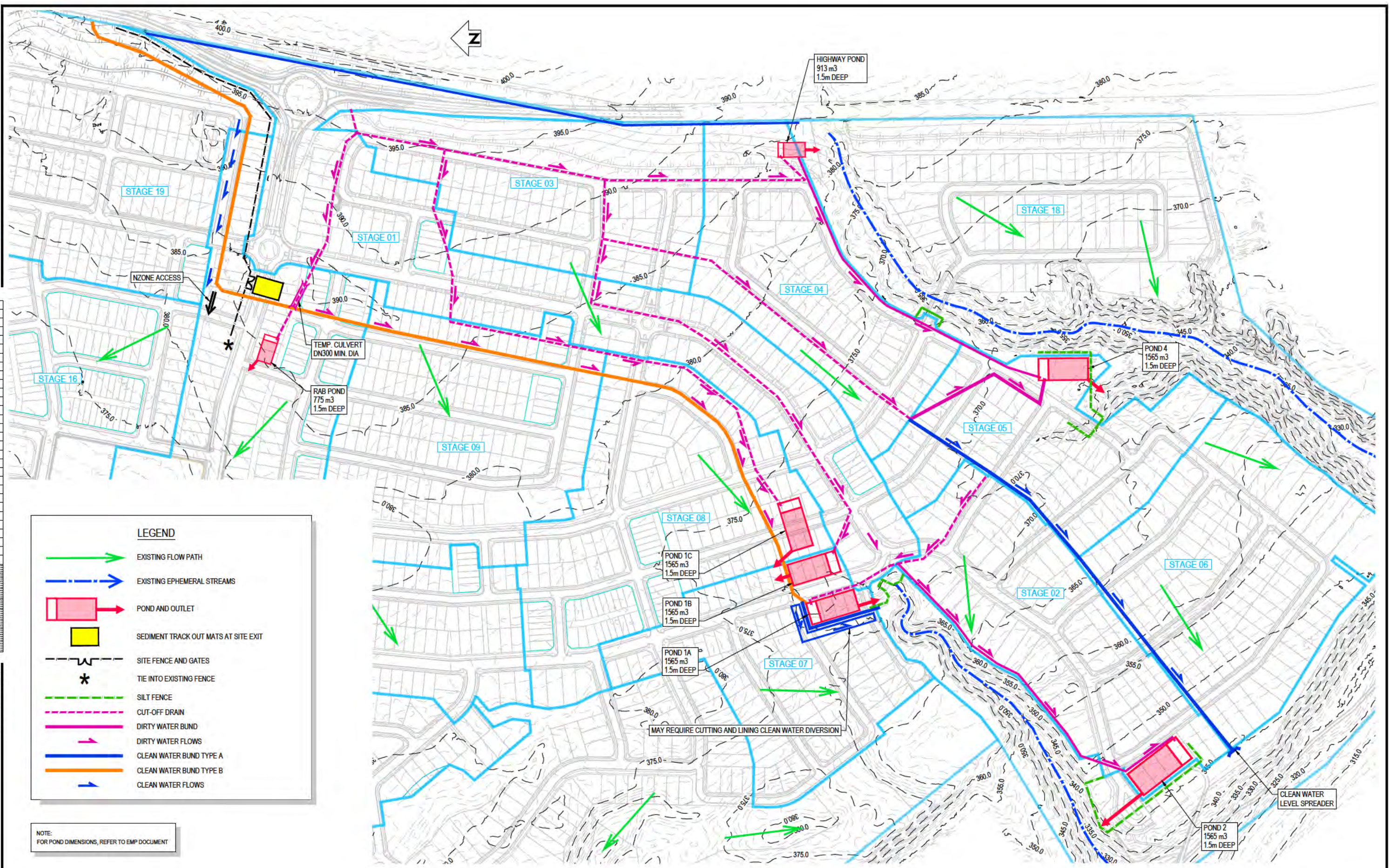
FOR CONSENT

Date Stamp: **03.09.2025**

Scales: 1:2000

Drawing No: 310104425-00-000-D2014

Rev: 0



DO NOT SCALE - IF IN DOUBT, ASK

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ORIGINAL SIZE A1

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SCALE 1 : 25

SCALE 1 : 25

SCALE 1 : 25

FOR USE ONCE LOTS ARE TOPSOILED

0	ISSUED FOR CONSENT				
REV	REVISIONS	PAT DRN	PW CHK	PSW APR	03.09.25 DATE

SURVEYED	Patterson	08.24
DESIGNED	Patrick Leslie	02.25
DRAWN	Brent Grey	03.25
CAD REVIEW	Peter Thomson	11.04.25
DESIGN CHECK	Iain Banks	11.04.25
DESIGN REVIEW	Peter White	11.04.25
APPROVED	Peter White	11.04.25
PROF REGISTRATION:		



DRAFT EROSION AND SEDIMENT CONTROL PLAN
TYPICAL BUND CONSTRUCTION DETAILS

Drawing No.
310104425-00-000-D2015

Rev.

Appendix B Calculations

B.1 Pond Sizing

Catchment 1a

- Catchment area = 4.95 ha, for simplicity it has been rounded to 5ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Catchment 1b

- Catchment area = 4.95 ha, for simplicity it has been rounded to 5ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Catchment 1c

- Catchment area = 4.26ha, to account for haul road runoff pond catchment has been rounded to 5 ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Stage 2

- Catchment area = 4.99 ha, for simplicity it has been rounded to 5ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Stage 4

- Catchment area = 4.97 ha, for simplicity it has been rounded to 5ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Roundabout (RAB) catchment

- Catchment area = 2.46 ha, for simplicity it has been rounded to 2.5ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Highway area catchment

- Catchment area = 2.97 ha, for simplicity it has been rounded to 3ha.
- Slope length = 300m
- Best practice requires 300m³ per hectare.

Refer to ESCP for pond locations

Pond Volume:

Pond 1a	1500m ³
Pond 1b	1500m ³
Pond 1c	1500m ³
Pond 2	1500m ³

Pond 4	1500m ³
RAB pond	750m ³
Highway Pond	900m ³

Pond Shape:

Size of pond is required to be 3-5 times as long as wide with a max depth of 2 meters.

The size of the pond is an inverted truncated pyramid with a side slope of 3:1 to fit with the natural shape of the ground.

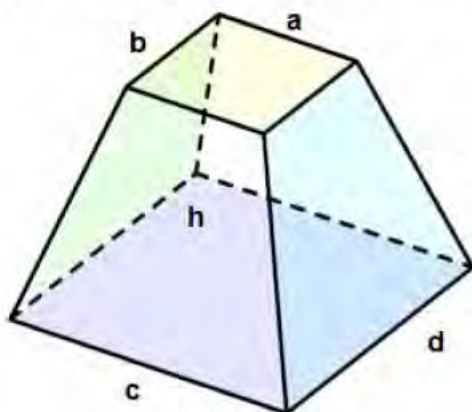


Figure 7-1: Truncated Pyramid

Example calculation for Pond 1a with a length to width ration of 4 and targeted depth of 1.5m

$$V = \frac{1}{6} * h * (a * b) + (a + c) * (b + d) * (c * d)$$

$$5a = b, \quad c = a + (h * 2 + h * 2), \quad d = 5a + (h * 3 + h * 2)$$

$$1500 = \frac{1}{6} * 1.5 * (a * 5a) + (2a + 6) * (5a + 5a + 7.5) * ((a + 6) * (5a + 7.5))$$

$$a = 9.66$$

Table 7-1: Pond sizing

	Base Width (y)	Base Length (x)	Top Width (Z)	Top Length (A)	Depth (h)	Volume
Pond 1a	10m	67m	19m	76m	1.5m	1565.25m ³
Pond 1b	10m	67m	19m	76m	1.5m	1565.25m ³
Pond 1c	10m	67m	19m	76m	1.5m	1565.25m ³
Pond 2	10m	67m	19m	76m	1.5m	1565.25m ³
Pond 4	10m	67m	19m	76m	1.5m	1565.25m ³
RAB pond	5.25m	48m	14.25m	57m	1.5m	777.9m ³
Highway Pond	6.2m	51.8m	15.2m	60.8m	1.5m	913.74m ³

B.2 Tee Bar

B.2.1 Dead storage volumes

Ponds are required to have 30% dead storage in the base of the pond and depending on the catchment size 1-3 tee bars.

Ponds 1a, 1b,1c, 2 & 4 – dead storage = $1565.25 \times 0.3 = 469.58\text{m}^3$

RAB pond – dead storage = $777.9 \times 0.3 = 233.38\text{m}^3$

Highway pond – dead storage = $913.74 \times 0.3 = 274.12\text{m}^3$

To ensure the required dead storage is achieved the following is a summary of the tee bar heights

Table 7-2: Tee bar spacing

	Bottom Tee bar (m) TB1	Mid Tee bar (m) TB2	Top Tee bar (m) TB3
Pond 1a	0.6	0.94	1.24
Pond 1b	0.6	0.94	1.24
Pond 1c	0.6	0.94	1.24
Pond 2	0.6	0.94	1.24
Pond 4	0.6	0.94	1.24
RAB pond	0.66	N/A	1.13
Highway Pond	0.63	N/A	1.125

* Measurement is from the base of the pond to the tee bar

B.2.2 Discharge rates

To comply with GD05 the recommended discharge rate per pond is 3l/s/ha. For the ponds with a 5ha catchment this means they need to discharge at a maximum of 15l/s./ the highway ponds is 3ha of catchment so 9l/s and the RAB pond is 2.5Ha of catchment so 7.5l/s.

As each pond has a different number of tee bars so the discharge rates are different for each pond based on the number of tee bars. Each tee bar has up to 200 holes to obtain a discharge rate of 4.5l/s. To ensure the correct disagree rate is achieved the number of holes can be reduced by using an adhesive tape to cover the correct number of holes. Below is a summary of the number of tee bars and number of holes each tee bar needs to achieve the correct discharge rate.

Table 7-3: Number of tee bars and required number of holes.

	Number of Tee bars	Number of holes per tee bar
Pond 1a	3	200
Pond 1b	3	200
Pond 1c	3	200
Pond 2	3	200
Pond 4	3	200
RAB pond	2	167
Highway pond	2	200

B.3 Forebay sizing

Each pond is to have a forebay the full width of the pond. However, each forebay is 10% the size of the pond and as such different sizes. Below is the summary of forebay lengths and volumes.

Table 7-4: Pond forebay sizes

	Forebay length (m)	Volume (m3)
Pond 1a	8.2	156.5
Pond 1b	8.2	156.5
Pond 1c	8.2	156.5

Pond 2	8.2	156.5
Pond 4	8.2	156.5
RAB pond	5.5	77.79
Highway Pond	6.0	91.37

B.4 Dirty Water Bund

Runoff

Catchment area (A_c) = 5ha

20-year AEP (i) = 20.3mm/h

Coefficient (C) = 0.7 Bare impermeable clay with no interception channels or run-off control (worse case)

$$Q = \frac{CiA_c}{360}$$

$$Q = \frac{5 * 0.7 * 20.3}{360}$$

$$Q = 0.197 \text{ m}^3/\text{s}$$

Cut off bund sizing

Width of channel (a) = 2.0m.

Depth of channel (b) = 0.42m

Shape of channel = trapezoid 3:1 batters.

Longitudinal slope of bund = 0.5%.

Slope of banks 33.3% (1 in 3).

Freeboard = 0.3.

Figure 7-2 shows the channel sizing. The channel with no freeboard and has the capacity to convey 0.2039m³/s. The sizing of the channel with 300mm freeboard will be 0.42m deep, this will be the size of the channel that will be constructed.

Bottom width, b	2	m	X
Side slope 1 (horiz./vert.)	3		X
Side slope 2 (horiz./vert.)	3		X
Manning roughness, n ? ☐ Strickler ☐ B/B (See notes)	0.02		X
Channel slope, S	0.5	% rise/run	X
Flow depth, y	0.115	m	X
Rock specific gravity (2.65)	2.65		X

Results			
Flow area, a	0.2697	m ²	X
Wetted perimeter, P _w	2.7273	m	X
Hydraulic radius, R _h	0.0989	m	X
Velocity, v	0.7560	m/s	X
Flow, Q	0.2039	m ³ /s	X

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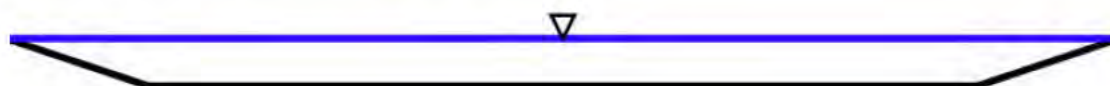


Figure 7-2 Channel sizing no freeboard.

RAB pond culvert size

Catchment = 2.5Ha

$$Q = \frac{CiA_c}{360}$$

$$Q = \frac{2.5 * 0.7 * 20.3}{360}$$

$$Q = 0.098 \text{ m}^3/\text{s}$$

For 98l/s to flow through the pipe the minimum pipe size needs is 300mm at 0.65% slope as shown below in Figure 7-5

Inputs				Results			
Pipe diameter, d ₀	0.3	m	X	Flow depth, y	0.2820	m	X
Manning roughness, n	0.011		X	Flow area, a	0.0690	m ²	X
Pressure slope (possibly ? equal to pipe slope), S ₀	0.65	% rise/run	X	Pipe area, a ₀	0.0707	m ²	X
Relative flow depth, y/d ₀	94	%	X	Relative area, a/a ₀	0.9755	fraction	X
				Wetted perimeter, P _w	0.7940	m	X
				Hydraulic radius, R _h	0.0868	m	X
				Top width, T	0.1425	m	X
				Velocity, v	1.4373	m/s	X
				Velocity head, h _v	0.1053	m H ₂ O	X
				Froude number, F	0.66		X
				Average shear stress (tractive force), tau	5.5354	N/m ²	X
				Flow, Q (See notes)	0.0991	m ³ /s	X

Figure 7-3: RAB pond culvert.

Appendix C Environmental Induction Register

	Homestead Bay Environmental induction.		Contractor:	
			Date:	
			Consent Number:	
			Construction stage:	
Attendees	Company	Attendees	Company	
Topics to discuss				Check if completed
Resource consent conditions	Who has a copy			
	Is there are copy located onsite			
	Are all conditions clear and understood for relevant activities			
	Are any conditions specific to this site or task only			
	Erosion and sediment control plan approved			
Communication	Key individuals and contact details available and recorded in the EMP.			
	Line of responsibility of each person clear			
	Reporting of issues identified outlined clearly			
Erosion and sediment control plan	Everyone is clear on the plan			
	Identified any highlighted critical areas where extra care must be taken			
	Discuss any needed field modifications/alteration to the plan			
	Discuss project phasing/staging/order of operations			
	Discuss the need for 'As Built' certification per local requirements			
Maintenance of erosion and sediment controls	Daily inspection items covered off			
	Weekly inspection items covered off			
	Pre rainfall inspection items covered off			
	Post rainfall inspection items covered off			
	Trigger events covered off			
	Discuss the periodic need for maintenance and material replacement.			
Site stabilisation	Discuss project time frames and any staging of activities			
	Discuss project phasing and when stabilisation must be done			
Decommissioning	Discuss what degree of stabilisation is required for sediment control practices to be removed and what it looks like			
Preconstruction meeting minutes	Ensure that all parties are provided with any notes made at the meeting.			

Appendix D Environmental Incidence Report Form

Project Address:	QLDC/ORC Consent Number (if applicable):
	RM BC
Project Description:	

Instructions

Complete this form for all environmental incident that cause contaminants (including sediment) or environmental nuisance to leave the site. Be succinct, stick to known facts and do not make assumptions. Once completed submit to the personnel outlining section 4.1

Incident details

Date and Time	Date:	Time:	AM	PM
Description Provide a brief and factual description of what happened during the incident, include relevant details such as: - The estimated distance to the nearest waterway (include storm water and dry courses) - The estimated distance to the nearest sensitive rec - The activity being undertaken when the incident occurred Sketches/diagrams/photos may be reference and attached to this report to aid in the description of the incident				
Exact location of the incident Include address, landmarks, features, nearest intersection etc. Maps and plans can be attached to the incident report if appropriate				
Quantity or volume of material escaped or causing incidence				
Who identified the incident				

What immediate actions/control measures were taken to rectify or contain the incident?

What initial corrective action will be taken to prevent similar incidents recurring in the near future?

Has the Otago Regional Council been notified? Yes / No / N/A

Approvals:

Environmental Representative/Person making report

Name..... Signature.....

Organisation..... Date.....

Mobile phone number.....

Site Supervisor

Name..... Signature.....

Organisation..... Date.....

Mobile phone number.....

Appendix E Complaints Register

Complainant	Contact details	Date	Issue	Area of concern	Action required	EMP change required

Appendix F Post Forecasted Rain Event Inspection Form

LOCATION _____

INSPECTOR(S) _____

DATE: _____

Legend:

✓ - OK

✗ - Not OK/ potential problem

N/A - Not applicable

Item	Consideration	Assessment
1	Existing road sumps have filter clothes in working order and are not blocked with sediment.	
2	Entry/exit measures clear of excessive sediment deposition.	
3	Up-slope "clean" water is being appropriately diverted around the site without causing erosion.	
4	Drainage paths are free of soil scour and sediment deposition.	
5	Sediment fences are free from damage, secure and in working order.	
6	Sediment-laden stormwater is not able to get around the silt fences or other sediment devices.	
7	All sediment devices have no sediment build up reducing the effectiveness of the device	
8	The sediment pond has sedimental settling out prior to discharge such water.	
9	All reasonable and practicable measures are being taken to control sediment runoff from the site.	
10	All Erosion and Sediment Control measures are in proper working order.	

Remedial action taken:

Location

Reason:

Appendix G Weekly Site Inspection Checklists

LOCATION

INSPECTOR(S)

DATE:

Legend:

✓ - OK

× - Not OK/ potential problem

N/A - Not applicable

Item	Consideration	Assessment
1	Public roads clear of sediment from this works. (Note and photograph if other works is causing issues)	
2	Entry/exit measures clear of excessive sediment deposition.	
3	Entry/exit rock have adequate space to trap sediment.	
4	Existing road sumps have filter clothes, are not blocked with sediment and in adequate working order.	
5	The site is clear of litter and unconfined rubbish.	
6	Rubbish bins are not over-following or require emptying	
7	Adequate stockpiles of emergency sediment and erosion control materials are onsite.	
8	Site dust is being adequately controlled.	
9	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	
10	Up-slope "clean" water is being appropriately diverted around/through the site without causing erosion.	
11	Drainage paths are free of soil scour and sediment deposition.	
12	No areas of exposed soil need erosion control.	
13	Earth batters are free of erosion.	
14	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	
15	Sediment fences are free from damage.	
16	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	
17	All sediment traps are free of excessive sediment deposition.	
18	The settled sediment layer within a sediment retention pond is clearly visible through the water prior to discharge of such water.	
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	
20	No new areas of uncontrol site runoff in need of control measures	
21	Stabilised surfaces have topsoil and grass seed	
22	The site is adequately prepared for forecasted storms.	
23	All Erosion and Sediment Control measures are in proper working order.	

Rain fall record:

RAINFALL (mm)	DATE:

Remedial action taken:	Location
Reason:	
Remedial action taken:	Location
Reason:	

Appendix H EMP Non-Conformance Register

Date	Non conformance	Reason	Resolution	EMP require update

Appendix I Monthly Checklist

LOCATION

INSPECTOR(S)

DATE:

Legend:

✓ - OK

✗ - Not OK/ potential problem

N/A - Not applicable

Item	Consideration	Assessment
1	Appropriate Contactor site inspections of EMP controls carried out such that all control measures are being maintained adequately and checked weekly.	
2	Site inspections and monitoring are being carried out at appropriate times and intervals. (i.e. weekly, pre and post rain events)	
3	Are environmental sensitive receptors outline in the approved EMP are being adequately protected	
4	Are all conditions of consent related to environmental management being satisfied?	
5	Was the full perimeter of the work site inspected?	
6	Are all reasonable and practicable measures being taken to minimize environmental harm?	
7	Adequate drainage and sediment controls exist at site entry/exit points.	
8	Adequate drainage, erosion and sediment controls have been placed around the site compound.	
9	Site compound area and car park gravel/stabilized where necessary to control erosion and sediment.	
10	Appropriate drainage and sediment controls are installed prior to new areas being cleared or disturbed.	
11	Site personnel appear to be aware of ESC requirements and have ready access to the Erosion and Sediment Control Plan. (Check induction registers as well)	
12	Haul roads are stabilized.	
13	Sediment deposition is <u>not</u> observed on external roads by operations associated with this works. (Note if other works is causing this issue)	
14	Fuel appropriately stored on site.	
15	Spill kits available on-site where appropriate.	
16	Adequate litter and waste receptors exist on-site.	
Topsoil and Stockpiles		
17	Topsoil stripped and stockpiled prior to major earthworks.	
18	Stockpiles located at least 5m away from top of watercourse banks.	
19	Long-term soil stockpiles adequately protected against wind and rain.	
20	Adequate sediment controls placed down-slope of stockpiles.	
21	Stockpile sediment control is appropriate for the soil type and site conditions.	
22	Adequate drainage controls placed up-slope of stockpiles. (i.e. diversion channels)	
23	Topsoil is being replaced at an adequate depth.	
Drainage		
24	Drainage Control measures are consistent with the EMP.	
25	Drainage Control measures are being adequately always maintained in proper working order.	
26	Up-slope "clean" water is being appropriately diverted around/through the site in a non-erosive manner.	
27	Stormwater runoff diverted away from unstable slopes.	

28	Flow diversion channels/banks stabilized against erosion.	
29	Dirty Water Drains: → Adequate depth/width. → Adequate flow capacity is being maintained. → Stabilised against soil scour.	
30	Channel Linings (mats/cloth): → Lining is well anchored. → Mats/cloth overlap in direction of flow. → Lining is appropriate for flow conditions. → No damage to the mat/cloth by lateral inflows.	
Erosion		
31	Erosion control standard is consistent with the EMP and QLDC requirements.	
32	Soil erosion is being controlled to a standard consistent with the level of environmental risk.	
33	Disturbance to existing ground cover is being minimized as much as possible	
34	Earth batters are free of erosion.	
35	Dust problems are being adequately controlled.	
36	Erosion Control measures are being adequately always maintained in proper working order.	
37	All disturbed areas are adequately stabilised given: → Erosion hazard risk. → Degree of downstream sediment control. → Days since earthworks were finalised.	
Sediment controls		
38	Sediment is being controlled to a standard consistent with QLDC / ORC requirements	
39	Sediment Control is consistent with the approved EMP	
40	Sediment Control is appropriate for the soil type.	
41	Sediment Control measures are being adequately always maintained in proper working order.	
42	Collected sediment is being disposed of in an appropriate manner.	
43	Entry/Exit Points: → Control measures are appropriate for the site conditions. → Control measures are constructed appropriately → Excessive sediment removed from sediment traps. → Excessive sedimentation is <u>not</u> evident on roadway. → Stormwater drainage is controlled such that sediment is not being washed onto the adjacent roadway drainage network	
44	Sediment Fences: → Choice of fabric is appropriate. → Bottom of fabric is securely buried. → Fabric is appropriately overlapped at joints. → Fabric is appropriately attached to posts. → Support posts are at correct spacing → Sediment Fence does <u>not</u> cause flow diversion/bypass. → Sediment Fence has regular returns. → Lower ends of fence are returned up the slope. → Sediment Fences are free of damage. → All fences are free of excessive sediment deposition. → Fences are adequately spaced from toe of fill banks.	
45	Sediment Retention Ponds. → Pond geometry and layout match design details. → As built plans have been prepared. → The pond does <u>not</u> represent a safety risk.	

	→ De-watering is conducted in accordance with best practice.	
	→ Excessive sediment removed from pond.	
	→ Primary outlet structure is free from sediment blockage.	
	→ Emergency spillway has adequate scour control and/or grass length	
	→ Soil erosion is adequately controlled at inlet points.	
	→ The sediment settles prior to discharge such water.	
46	Site stabilization/revegetation is occurring in accordance with the EMP and work program.	
47	Exposed areas are adequately stabilized given the site conditions, environmental risk, and construction schedule.	
48	No newly seeded areas require reseeding.	
49	Grass seed is <u>not</u> being placed directly on compacted soil.	
50	Water application is appropriate for the site conditions.	
51	Revegetation is controlling soil erosion as required.	

Action summary		
Item	Consideration	Yes or No
	Answer "Yes" if further action is required on site	
1	Do any existing control measures require modification?	
2	Are additional EMP measures required on the site?	
3	Are alternative EMP measures required on the site?	
4	Is a revised EMP required for the site?	
5	Is further water quality monitoring required?	
6	Do any EMP measures need repairs or de-silting?	
7	Is additional erosion control required?	
8	Will the underlying cause of any non-compliance need further investigation?	
9	Has any complaint been raised that need to be resolved?	
10	Have any non-conformance issue happened?	
	Date of next inspection	

Notes:

Appendix J Water Quality Reporting

Pond 1					
Date	Time	NTU	pH	Acceptable	Discharging

Appendix K Accidental Discovery Protocol

CREATING COMMUNITIES

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of belonging. That's why at Stantec, we always **design with community in mind**.

We care about the communities we serve—because they're our communities too. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

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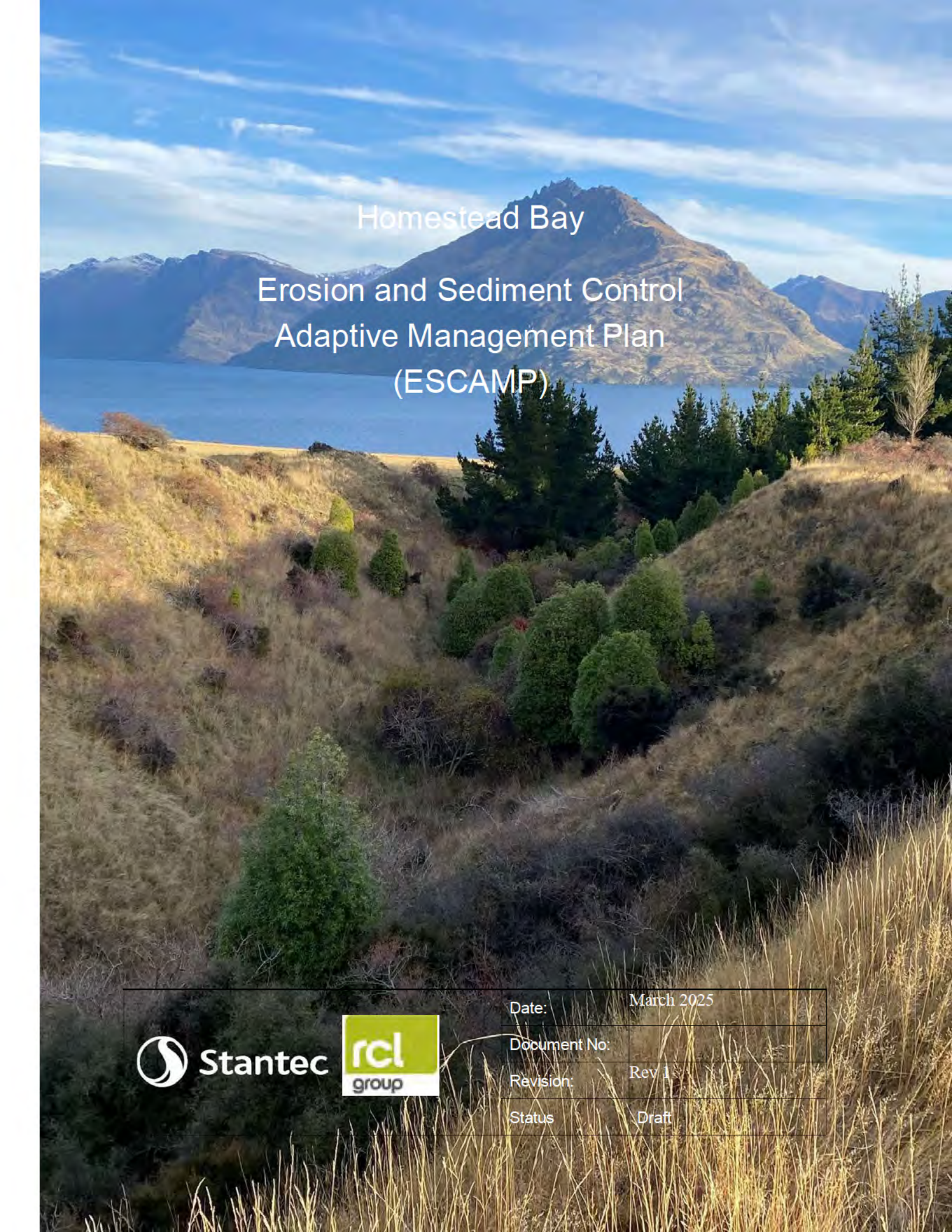
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Appendix D Adaptive Management Plan





Homestead Bay

Erosion and Sediment Control Adaptive Management Plan (ESCAMP)



Date:	March 2025
Document No:	
Revision:	Rev 1
Status	Draft

Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
01	August 2025	Iain Banks	Patrick Leslie	Peter White	Draft

Revision Details

Revision	Details
01	Initial document for Fast Track Application

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1. Introduction

The Erosion and Sediment Control Adaptive Management Plan (ESCAMP) is a management and monitoring system that will be implemented for the duration of the earthworks period of the Homestead Bay Development (the Project) that will assist the management of sediment related effects where those effects could be greater than those anticipated through the consenting of the Project.

The purpose of this ESCAMP is supplementary to the erosion and sediment control plan (ESCP) prepared for an earthworks site. The ESCAMP does not replace day-to-day Erosion and Sediment Control (ESC) management which is required on all sites in accordance with Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region* (GD05) or better if that is required by consent conditions. Nor does it apply to compliance with consented ESC methodologies. It addresses the management of sediment-related effects that may still occur when full compliance with the consent is maintained in order to avoid or minimise adverse effects on the receiving environment.

The ESCAMP includes details of processes and procedures that will be followed and confirms how the ESC management, monitoring and reporting will be undertaken. It also includes the methods that will be used during construction to ensure that performances are managed appropriately, that all conditions of consent [insert consent number] are complied with and that adverse environmental effects remain within the range anticipated by the consent. It will provide rapid and real time information and control to the project team to create a continuous feedback loop of the performance of the project ESC site and device management.

Any changes to this document will be agreed upon by all parties involved (including but not limited to QLDC/ORC ESC technical specialist and compliance monitoring officer as well as the consent holder's technical specialist and project manager, see Section 2 for further details). Any changes to the ESCAMP will remain consistent with the intent of the relevant conditions and achieve the required environmental outcomes.

The ESCAMP covers:

- Site management structures, practices and procedures.
- Baseline Monitoring
- Weather Monitoring
 - Prior to commencement of construction works an automated weather station will be installed onsite.
- ESC Monitoring
 - Scheduled site visits, pre, during and post rain event monitoring and water sampling.
 - Automated turbidity recording on one selected Sediment Retention Pond and rainfall event triggered manual turbidity monitoring.
 - Chemical treatment will be monitored in accordance with the Project's Chemical Treatment Management Plan
- Reporting
 - Rainfall trigger event reporting following a rainfall trigger event (as defined in Section 3.1).
 - Recommendations of changes that need to be implemented onsite and modifications to any ESC will also be included.

- Annual Reporting
 - A Monitoring and Maintenance annual report will be completed and issued to Council by the end of June. This report will contain all the monitoring results and interpretation of the fluctuations and observations recorded over the previous year, as well as any changes or modifications that are proposed to the ESCMP.

2. Erosion and Sediment Control Plan Implementation

The construction of all erosion and sediment controls will be managed as follows:

- The ESC Technical Specialist will prepare a Site Specific ESC Plan (SSESCP) in conjunction with the environmental representative or nominated person for each phase of work (which can include multiple stages of the site).
- The ESCP will be approved by the SQEP or nominated person and then submitted to Council for certification against GD05 / consent conditions.
- Once certified, the SQEP or nominated person will issue an approved ESCP to the earthworks Project staff responsible for the implementation.
- A pre-construction meeting will be held with Council where the sediment controls to be built will be discussed and specific direction given on construction.
- The location of the controls and requirements of the relevant ESCP will be confirmed on site with the construction team.
- The construction of the controls will be overseen by the SQEP or nominated person.
- Hold points for construction will be established for each control whereby the SQEP or nominated person will inspect the work completed, for example the installation of anti-seep collars or the installation of primary outlet.
- Each control will be 'as built' certified by the SQEP to confirm compliance with the ESCP prior to bulk earthworks commencing in the catchment of the device(s).
- Copies of the "as-built" certifications will be submitted to Council.

2.1 Erosion and Sediment Control Inspections

The Environmental Representative or nominated person will conduct routine (minimum weekly) inspections of the site. These inspections will take place with adequate time allocated and will be thorough and systematic (see section 5.1).

Communication is critical to the successful implementation of ESCPs. Internal inspections will cover all areas of the Project, even those that may have been dormant for some time, to ensure that the controls are still operating properly. These internal inspections will be captured in writing and will include actions and timeframes for close out if the controls are found not to be operating correctly.

3. Receiving Environment Monitoring

3.1 Baseline Monitoring

3.1.1 Freshwater

Upstream / Downstream

Where the site discharges to a stream or to land adjacent to a stream, instream turbidity monitoring will be undertaken immediately upstream and downstream of the site to determine the extent that the site works are influencing the stream. If feasible, instream monitoring will be undertaken using instream continuous monitoring equipment that will record turbidity (at minimum during a rainfall trigger event). Data will be recorded and sent via remote telemetry (live data - data automatically uploaded to a database). If this is not possible due to the ephemeral nature of the streams and gullies then manual testing will be undertaken during rain events as follows.

At a minimum, stream monitoring will be undertaken during rainfall trigger events and be repeated 24 and 48 hours after that exceedance (if flows are still present). Instream monitoring responses will be based on the following two triggers:

- a gross exceedance trigger of >50% increase in turbidity at the downstream monitoring station when compared to the upstream site; and
- an elevated exceedance trigger of >20% increase in turbidity at the downstream site when compared to the upstream site.

Downstream

Where there is no upstream extent but the site discharges to a freshwater environment, monitoring is based on visual inspections in response to trigger events, as detailed in Section 7.

4. Weather Monitoring

4.1 Rain Forecast

Rain forecasts relevant to the site will be checked daily using MetService / MetVuw online forecasting system. Close monitoring of the rain forecast will be necessary to ensure the appropriate site works can be implemented prior to rainfall trigger events.

The daily weather forecast checks will be forwarded to relevant Project staff every morning and will be recorded in the daily prestart job sheets.

If the forecasts show more than 30mm of rainfall over a 24-hour period, then this will trigger the pre-rain event environmental team inspections as outlined in section 5.1 (pre-rain event with forecast >30mm over 24 hours). This is in addition to the routine pre -rain event detailed in section 5.1 below. Note the pre-rain forecast trigger of >30mm over 24 hours is less than the rainfall trigger monitoring (referred to in section 5.1 below) to provide a buffer and to ensure no actual rain event of greater than 40mm is “missed” by the construction team.

4.2 Rain Gauges (Weather Stations)

A telemetered rainfall monitoring station will be installed on site to provide real-time continuous rainfall intensity and volume data which will be able to be observed online by Project personnel. Email and/or text notifications will be programmed to ensure relevant staff, including the Environmental Representative or nominated person, are alerted when rainfall trigger events occur onsite.

5. Erosion and Sediment Control Device Monitoring

5.1 Site inspections

Routine inspections are undertaken during and post construction of ESC devices. During construction certain stages are identified for inspection, such as during the installation of anti-seep collars, level spreaders, and T-bars.

Post construction monitoring is undertaken once a Sediment Retention Pond (SRP) or Decanting Earth Bund (DEB) is operational and the rainfall activated chemical treatment system is operational for the first time. Monitoring will take place as soon as practicable

following the first rainfall event that generates a discharge. This is to assess the performance of the device and chemical treatment system and the resulting quality of treated water being discharged from the site.

The site will be inspected weekly as a minimum by the Environmental Representative or nominated person during the course of the works. These inspections will ensure that all ESC devices are installed correctly and then operate effectively throughout the duration of the works. This inspection programme will provide certainty to all parties that appropriate measures are being undertaken to ensure compliance with conditions of consent and the ESCPs. The inspection regime will keep ESC management at the forefront of works on site. Any potential problems will be identified immediately, and remedial works will be promptly carried out.

The inspection programme shall consist of:

Weekly site walkovers involving the environmental team to inspect all ESC measures, identify any maintenance or corrective actions necessary, assign timeframes for completion, and identify any devices that are not performing as anticipated through the ESCP.

Pre-rain event: Prior to all forecast rainfall events, additional inspections will be made of ESC devices, including chemical treatment systems and automated monitoring devices, to ensure that they are fully functioning in preparation for the forecast event. These will be undertaken by the Environmental Representative or nominated person.

Pre-rain event with forecast > [e.g. 30mm over 24 hours]: Prior to forecast rainfall “trigger” events the site will be inspected by the Environmental Representative or nominated person. The aim of the inspection will be targeted at any additional ESC measures that are required to be installed to ensure that the sites ESC management system performs effectively during an expected larger event.

Rainfall Trigger Inspections: In addition to the general post rainfall event monitoring, during or immediately after rainfall trigger events additional actions will be undertaken in accordance with Section 7.1 below. The purpose of this response is to confirm the performance of devices under the stress of heavy rainfall, obtain a spot check efficiency of the device and to compare the field results with the results gained from the automated turbidity monitoring stations.

The key rainfall event triggers driving specific device monitoring are as follows:

- >40mm rainfall over any 24-hour period; and
- >15mm over any 1-hour period.

Post-rain event: Following all rainfall events including rainfall trigger events, inspections will be made of all ESC measures to ensure that all controls have performed as expected and to identify any maintenance requirements. Any remedial works will be documented during these monitoring inspections and immediately addressed.

When rainfall triggers are exceeded the following will occur:

- Within 24hrs of a rainfall trigger, carry out and record in writing a full audit of the condition of all ESCs;

- Remedy any causes on site that may have contributed to a device not achieving 90% efficiency as soon as practicable, and record what remedial measures were undertaken;

5.2 Sediment Retention Pond Monitoring

5.2.1 Turbidity Monitoring

Automated Monitoring

If feasible, continuous turbidity monitoring will be undertaken at the inlet and outlet of one SRP to observe live real time data and formulate decisions based on data obtained throughout the entire rain event. The location of this SRP will be determined in consultation with Council. The purpose of this automated monitoring is to provide real time and entire event performance indicator of the treatment efficiency of the device for all rainfall events that result in a discharge. This information will inform the overall likely performance of the devices across the site, when used in conjunction with manual turbidity monitoring undertaken during rainfall trigger events.

The inlet sensor will be located upstream of the SRP forebay and chemical application point.

The outlet sensor will be located within the discharge manhole or an alternative location at the discharge point of the SRP.

This data will be accessible online in real-time.

Manual

Manual turbidity monitoring of the inlet and outlet flows of all SRPs will be undertaken during rainfall trigger event site walkovers to provide a snapshot of the ESC performance. Manual turbidity monitoring will be undertaken using a handheld water quality field instrument used to measure both inflow and outflow turbidity of discharging SRPs.

5.2.2 Turbidity Triggers

A treatment efficiency benchmark for the SRPs will be set at an average 90% efficiency (2-year 1hr duration – 9.97^{mm}).

5.3 pH Monitoring

pH will be recorded at each device receiving chemical treatment, using the following procedure:

1. Ensure that the pH meter has been calibrated and that the calibration has not expired.
2. Use the pond water (or water that is to be discharged) to rinse out a small container then half fill with water from the same source.
3. Immerse the pH meter in the water and leave for up to 1 minute or until the reading stabilises and doesn't change. Place the container in a shaded place (out of direct sunlight) while it stabilises.
4. Record the pH reading given on the meter along with the date, time, and source of the water.

6. Data Interpretation

All data will be compiled to allow for the analysis of device efficiency in relation to rainfall, earthworks area and overall ESC management. This will also inform potential for modification of site ESC practices to better retain sediment within the site, if that is deemed necessary.

7. Management Responses

Management responses / actions will be identified when a trigger event occurs. These responses should not be mistaken for general site management and maintenance that will be ongoing.

In some instances, responses will be discussed and agreed with Council to ensure the most appropriate outcomes are achieved. General actions to be undertaken during trigger events are as follows:

Investigate whether the thresholds have been exceeded as a result of a natural process.

Investigate whether there have been any significant events or failures that could have caused the discharge.

Ensure all site controls are operating in accordance with approved plans and best practice

Determine if the discharge is an isolated case or is likely to be repeated.

Investigate and implement modifications, including:

- Investigate ESC measures to determine whether there has been a discharge from the devices;
- Make alterations to ESC measures and methodologies; (check that a further approval is not required from Council)
- Consider additional ESC;
- Refinement of chemical treatment systems;
- Progressive stabilisation in sub-catchments;
- Increase maintenance of controls;

- Amendments to methodologies and sequencing of works and refinement of controls necessary. (check that a further approval is not required from Council) and
- Reduction of open area limits of earthworks.

7.1 Rainfall Trigger Event Responses

Whenever a rainfall trigger event occurs ($\geq 40\text{mm}$ rainfall over any 24-hour period or $\geq 15\text{mm}$ over any 1-hour period) the actions listed in Sections 5.2, 5.3 and 5.4 will be undertaken (subject to health and safety restrictions):

Within 24hrs of a rainfall trigger, carry out and record in writing a full audit of the condition of all ESC within the earthworks. All SRPs and DEBs and their catchments will be inspected in accordance with Section 5;

Manual turbidity readings will be recorded at inlet and outlet flows of SRPs and DEBs;

pH will be recorded at the inlet and outlet flows of all chemically treated devices;

Remedy any causes on site that may have contributed to a threshold exceedance as soon as practicable, and record what remedial measures were undertaken;

Notify Council by email within 1 working day if any threshold exceedance;

Undertake stream monitoring as per Section 7.3

Record an assessment of the success of each remedial work in reducing ongoing sediment discharge; and

Prepare and provide to the Council an Adaptive Management Response Report, within 10 working days.

7.2 Sediment Efficiency Trigger Responses

If an exceedance of the 90% threshold (2-year 1-hour event) is identified through automated rainfall and turbidity monitoring, then the following will occur:

- Within 24hrs of a threshold exceedance, carry out and record in writing a full audit of the condition of all ESC within the earthworks;
- Remedy any causes on site that may have contributed to a threshold exceedance as soon as practicable, and record what remedial measures were undertaken;
- Notify the Council by email within 1 working day of a threshold exceedance;
- Undertake receiving environment monitoring as per Section 7 (as applicable);
- Record an assessment of the success of each remedial work in reducing ongoing sediment discharge; and

- Prepare and provide to the Council an Adaptive Management Response Report within 10 working days.

The treatment efficiency trigger will also be used to identify catchments that are deemed higher risk. If efficiency triggers are breached, then that SRP will be deemed to be 'high risk' for the next rainfall trigger event.

High risk SRPs will be subjected to additional scrutiny during pre-forecast inspections (forecasts of >40mm/24 hrs) to ensure that repeat breaches do not occur.

7.3 Stream Trigger Responses

If the gross exceedance trigger referred to in section 3.1.1 is exceeded in any monitoring, or if the elevated level trigger referred to in section 3.1.1 is exceeded at the 48-hour monitoring then the following will occur:

- Within 24hrs of a threshold breach, an ESC Specialist is to carry out and record in writing a full audit of the condition of all ESCs within the earthworks area discharging to the monitored waterway;
- Remedy any causes on site that may have contributed to a threshold breach as soon as practicable, and record what remedial measures were undertaken;
- Notify the Council by email within one working day of a threshold breach, including providing details of the percentage change in turbidity and any remedial measures taken;
- If the turbidity remains generally elevated above either exceedance trigger for more than 48hrs, then an ecologist is to undertake visual quantitative survey of the downstream environment / baseline monitoring sites to determine what effects have occurred (if any);
- Consult with the Otago Regional Council Compliance Monitoring Officer, detail what mitigation measures are proposed and the timeframes for implementing these, subject to approval by the Council;
- Implement the mitigation measures approved by Council;
- Prepare and provide to Council a Rainfall Trigger Event Report or Trigger Level Exceedance Report within 10 working days.

8. Reporting

8.1 Site Auditing

Daily inspections will be undertaken by the Environmental Representative or nominated person.

An internal audit will be undertaken by the Environmental Representative or nominated person at least weekly. Any maintenance actions will be undertaken that day, or at least acknowledged to the Council Compliance Monitoring Officer during their audit.

Actions will be loaded into the Environmental Management system and Work Instructions with details and timeframes will be issued by the SQEP or nominated person, with specific actions and closeout timeframes.

For programmed Council inspections, the Environmental Representative and SQEP or nominated person will accompany the Council Monitoring Officer in all audits. Usually a member of the construction team will also be present.

As for internal audits, all ESC maintenance actions identified by the Council Monitoring Officer will be recorded into the Project ESC recording management system. Instructions with details and timeframes will be issued to the Environmental Representative or nominated person, based on the Council's instruction. The Environmental Representative or nominated person will report back the completion of those actions to the Project Manager and the works will be inspected and confirmed by the SQEP or nominated person. Confirmation will be emailed to the Council.

8.2 Rainfall Trigger Event Report

Following a rainfall trigger event, a report will be produced that will provide to Council [and key stakeholders if required by consent conditions] a summary of the performance of SRPs, DEBs and overall ESC system observed during the rainfall event. The report will include:

- A summary of the rainfall (total and intensity)
- A summary of the data acquired from the automated turbidity monitors from the one SRP.
- A summary of the manual monitoring undertaken and comparison of manual monitoring results with automated results.
- Identification if a threshold exceedance occurred. This will outline what exceedance occurred, the extent of the exceedance, any actions taken to mitigate the effects of the event and a proposed management response if required.
- A record of any other matters which may have compromised the overall ESC performance during the rain event and the identified mitigation, maintenance and management response.

The rainfall trigger event report will be provided to Council and key stakeholders within 10 days of the rainfall trigger event.

8.3 Annual Report

An annual report containing monitoring results and an assessment of discharge compliance will be provided to Council [and key stakeholders if required by consent conditions] by June 30 of each year. This report will contain the following details.

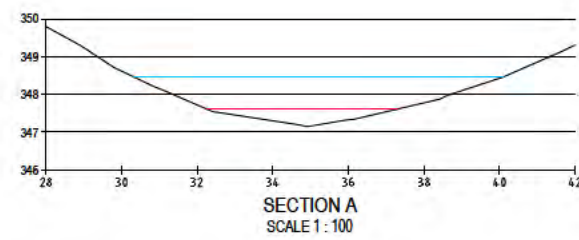
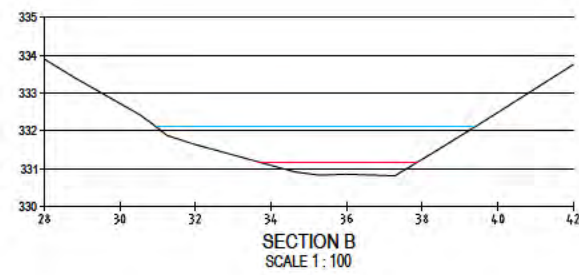
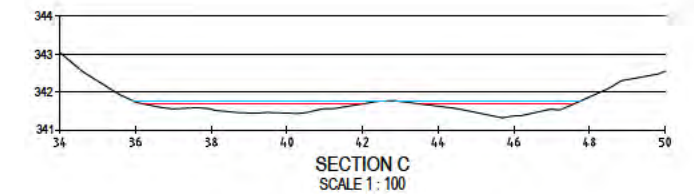
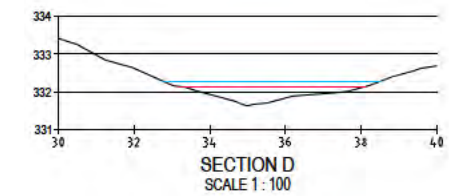
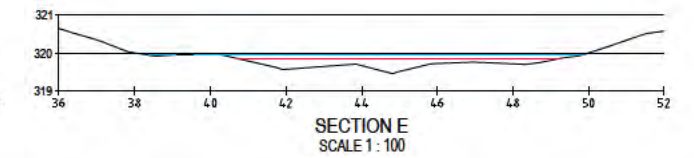
- A summary of the results of all monitoring within that period.
- A summary of any threshold exceedances that occurred and the response actioned.
- Any proposed changes or updates to the ESCMP to be submitted to the Council for certification [in accordance with consent conditions]. Certification from Council must be provided prior to any changes to the ESCAMP being implemented.



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SOUTHERN CREEK - CROSS-SECTIONS

WATER LEVELS LEGEND		
	PRE-DEVELOPMENT (HISTORICAL RAINFALL)	POST-DEVELOPMENT (RCP 8.5 2080 - 2100 RAINFALL)
20% AEP FLOW LEVEL		



NOT FOR CONSTRUCTION

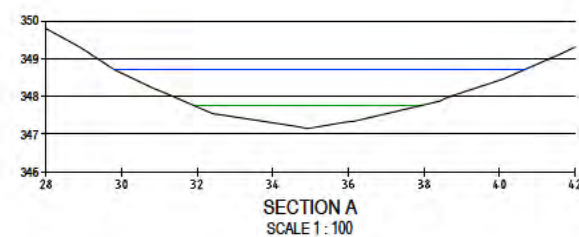
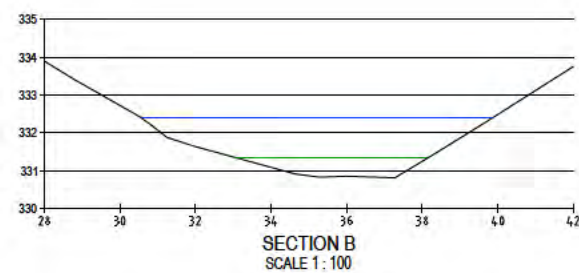
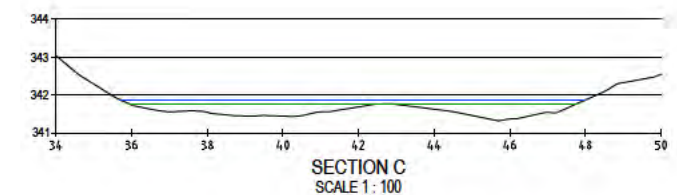
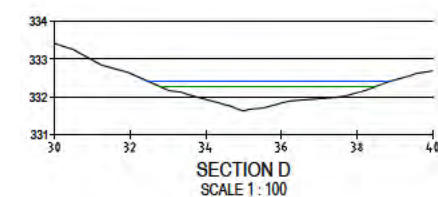
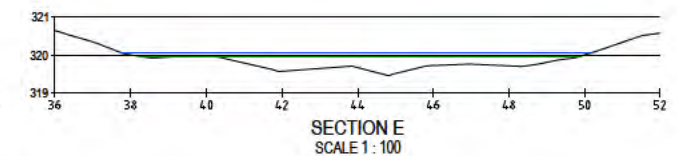
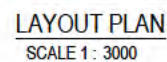
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					DESIGNED	Jack Boyd	09.25
					DRAWN	Peter Thomson	09.25
					CAD REVIEW	Jack Boyd	09.24
					DESIGN CHECK	Jack Boyd	09.24
					DESIGN REVIEW	Peter White	09.24
0	FOR CONSENT				APPROVED	Peter White	04.09.2024
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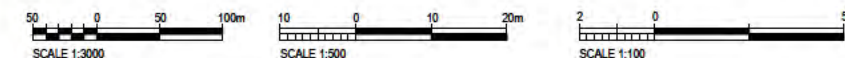
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MASTER PLANNING

STORMWATER - EROSION ASSESSMENT (EXISTING CREEKS)
CROSS-SECTIONS SHOWING 20% AEP FLOWS PRE AND POST DEVELOPMENT

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WATER LEVELS LEGEND		
	PRE-DEVELOPMENT (HISTORICAL RAINFALL)	POST-DEVELOPMENT (RCP 8.5 2080 - 2100 RAINFALL)
1% AEP FLOW LEVEL		



FOR CONSENT

04.09.204

Scales AS SHOWN

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310104425-00-000-C0278

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SURVEYED	PATERSONS	05.24
DESIGNED	Jack Boyd	09.25
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DESIGN CHECK	Jack Boyd	09.24
DESIGN REVIEW	Peter White	09.24
APPROVED	Peter White	04.09.2024



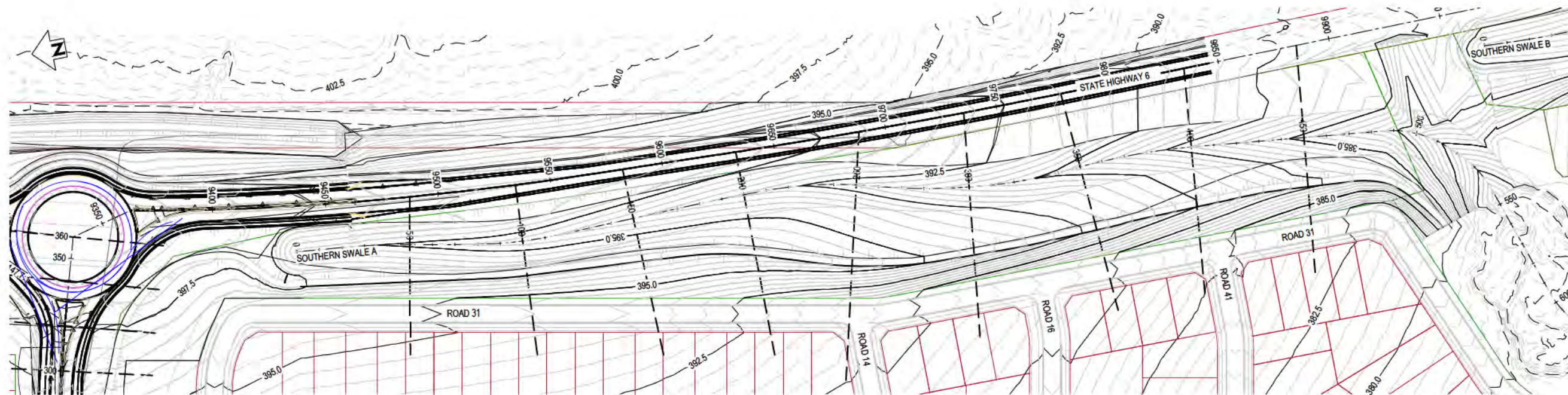
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STORMWATER - EROSION ASSESSMENT (EXISTING CREEKS)
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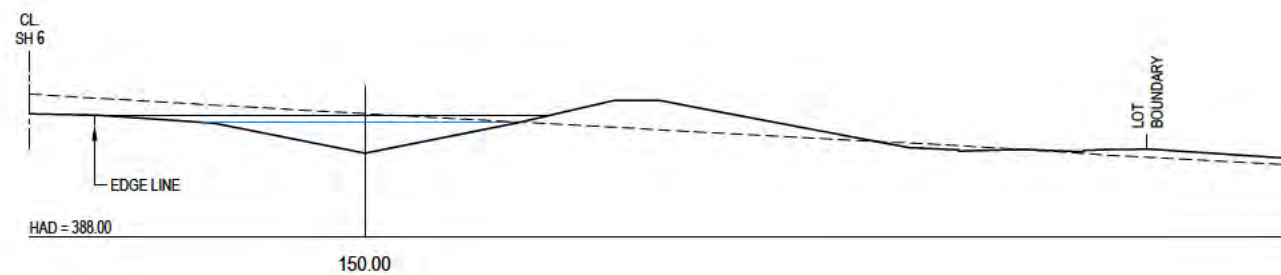
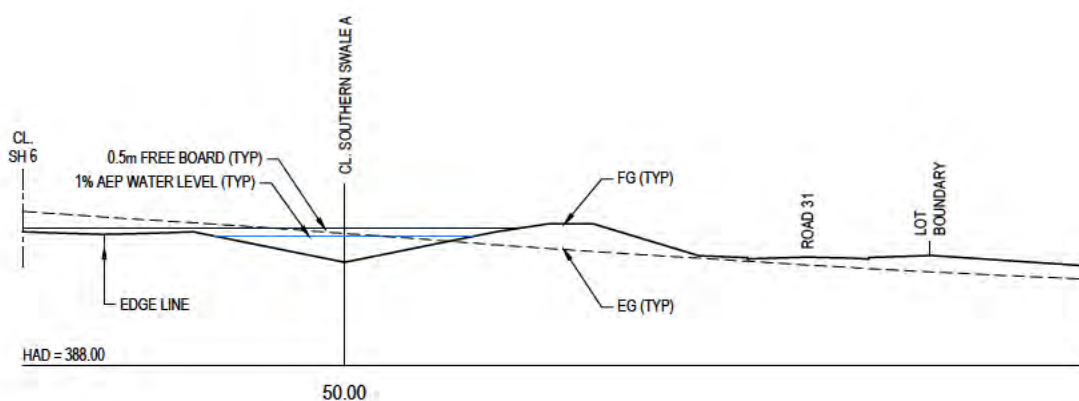
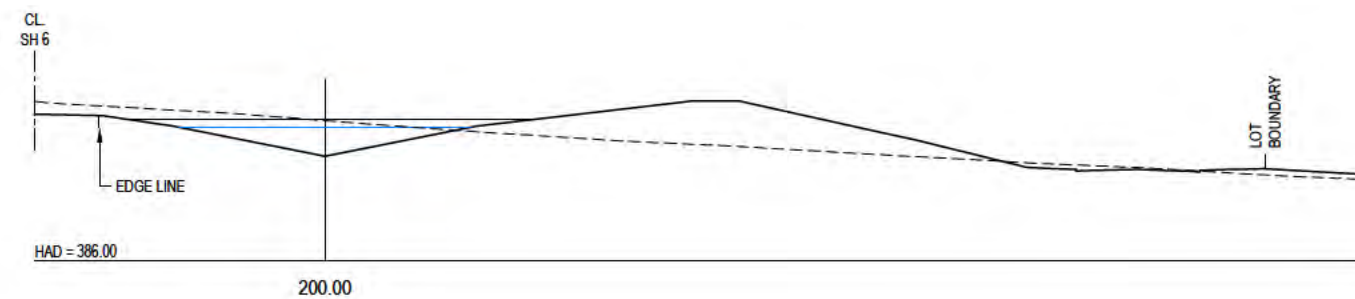
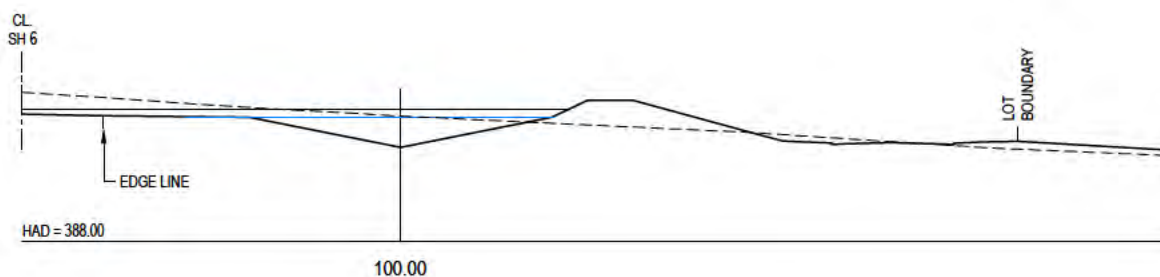
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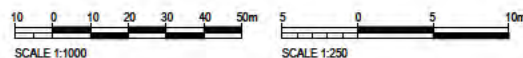
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LAYOUT PLAN
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CROSS-SECTIONS
SCALE 1 : 250



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STORMWATER
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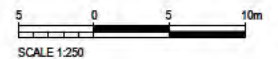
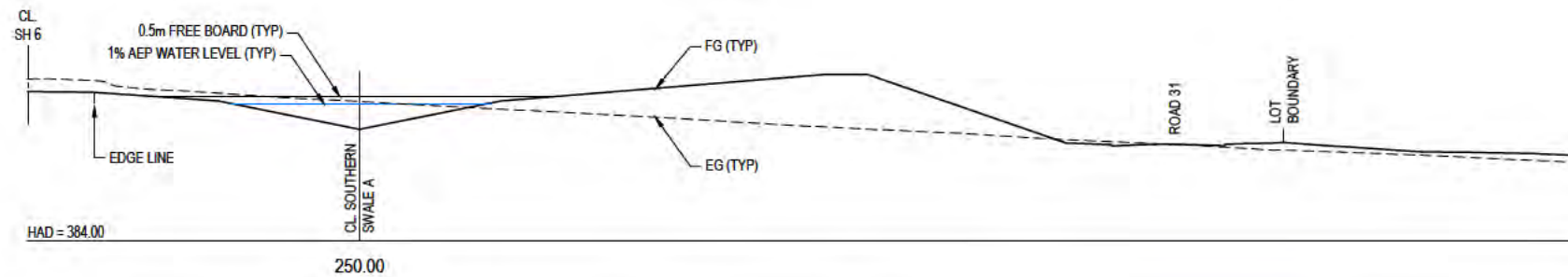
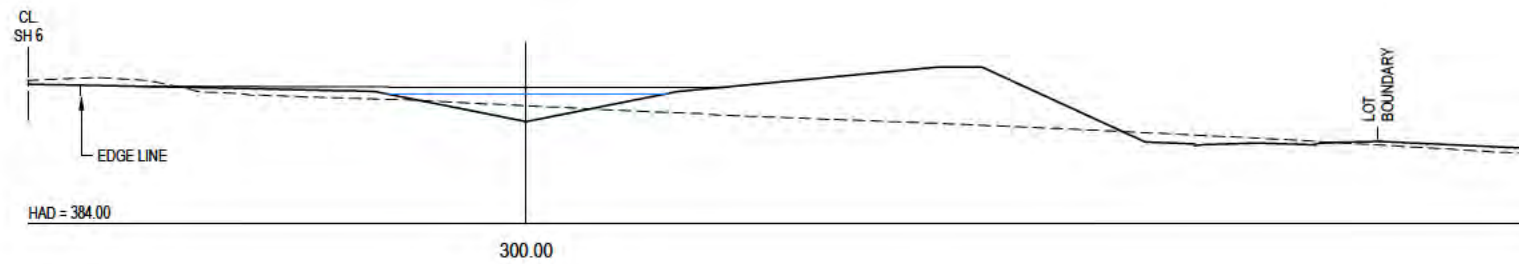
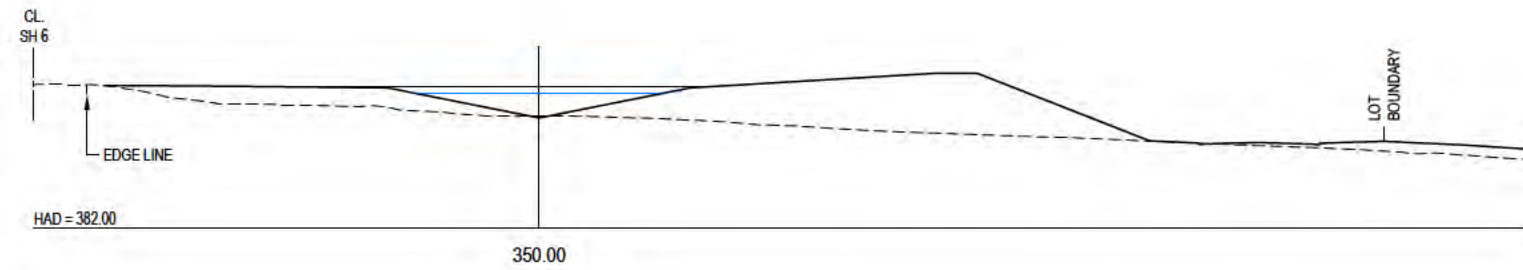
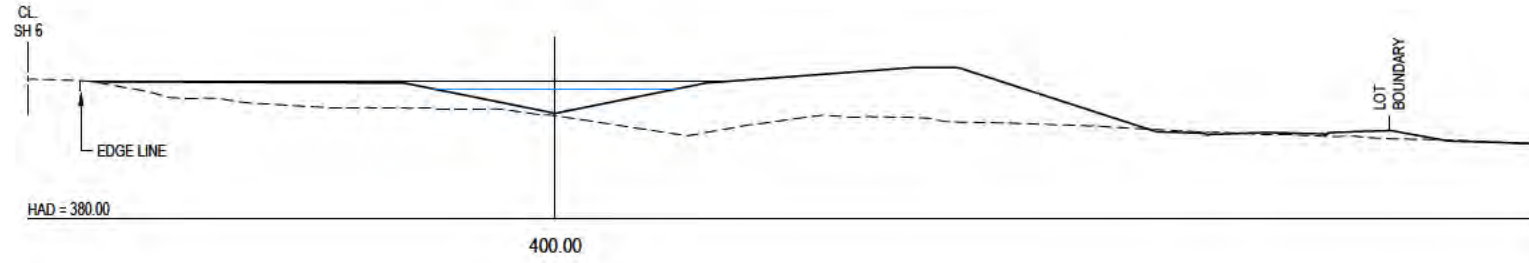
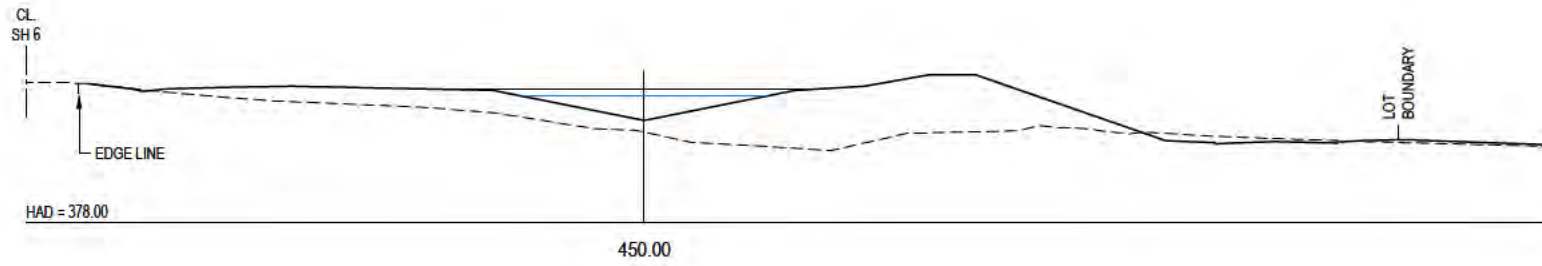
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ORIGINAL SIZE A1



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0	ISSUED FOR CONSENT	11.04.25	GH	BJ	PSW
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SURVEYED	Patersons	08.24
DESIGNED	Ferdie Zimmerman	03.25
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DESIGN REVIEW	Peter White	11.04.25
APPROVED	Peter White	11.04.25
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MASTER PLANNING

STORMWATER
SOUTHERN SWALE A - PLAN AND CROSS SECTIONS SHT 2 OF 2

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Rev.	0A

Homestead Bay Stormwater Model - Basis of Design

This report documents the basis of design for the Homestead Bay stormwater model.

The stormwater model has been used to hydraulically size the primary stormwater network and size stormwater attenuation ponds.

Prepared for:
RCL Group

26 August 2025

Prepared by:
Jack Boyd

Project/File:
310104425



Revision Schedule

Revision No.	Date	Description	Prepared by	Quality Reviewer	Independent Reviewer	Project Manager Final Approval
1	26 Aug 2025	Final	JB	MB	PW	PW

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1 Introduction

Stantec has been engaged by RCL Group (RCL) to provide engineering advice for a proposed subdivision located near Homestead Bay, Queenstown (refer to Figure 1).

This report documents the hydrology and hydraulic assumptions and inputs into the Homestead Bay subdivision development stormwater model (the Model).

The Model has been built to calculate changes in catchment runoff due to development, size a primary stormwater network throughout the proposed development, size stormwater attenuation volumes to mitigate increased surface impermeability due to development, and to identify secondary overland flowpaths.



Figure 1. Homestead Bay Development location



2 Basis of Design

2.1 Hydrology

2.1.1 Method

The Model has been developed using the PCSWMM Professional 2D software package developed by Computational Hydraulics Inc. (CHI).

PCSWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of PCSWMM operates on a collection of sub catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of PCSWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. PCSWMM tracks the quantity and quality of runoff generated within each sub catchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps¹.

PCSWMM allows a study area to be subdivided into any number of irregularly shaped sub catchment areas to best capture the effect that spatial variability in topography, drainage pathways, land cover, and soil characteristics have on runoff generation. Stormwater runoff is therefore computed on a sub catchment by sub catchment basin¹.

PCSWMM conceptualizes a sub catchment as a rectangular surface that has a uniform slope and a width that drains to a single outlet channel¹.

The sub catchment experiences inflow from precipitation (rainfall and snowmelt) and losses from evaporation and infiltration. The net excess basins atop the sub catchment surface to a calculated depth. Pondered water above the depression storage depth will become runoff outflow. Depression storage accounts for initial rainfall abstractions such as surface ponding, interception by flat roofs and vegetation, and surface wetting¹.

The Model assumes that flow across the sub catchment surface behaves as if it were uniform flow within a rectangular channel with a given width, height, and slope. The Manning equation is used to express the runoff's volumetric flow rate¹.

2.1.2 Model Inputs

2.1.2.1 Rainfall

The Model inputs rainfall inputs which have been sourced from National Institute of Water and Atmospheric Research (NIWA) High Intensity Rainfall (HIRD's) Design System v4. Four separate 24-hour rainfall events have been assessed for predevelopment and post development scenarios:

- 5% Annual Exceedance Probability (AEP) Historic rainfall data
- 1% AEP Historic rainfall data

¹ Stormwater Management Model Reference Manual, Volume 1 – Hydrology (Revised), EPA United States Environmental Protection Agency



Stormwater Modelling Basis of Design

2 Basis of Design

- 5% AEP Relative Concentration Pathway (RCP) 8.5 2081-2100 rainfall data (future climate with worst case climate change allowance)
- 1% AEP RCP 8.5 2081-2100 rainfall data (future climate with worst case climate change allowance)

Each of the rainfall events is modelled as a nested storm, which allows shorter storm duration events, with higher rainfall intensities, to be embedded inside a 24-hour storm duration.

The peak of the nested storm is at hour 12, with the rainfall distributed evenly on either side of the storm peak. This complies with Queenstown Lakes District Council Code of 2025 (QLDC CoP) Clause 4.3.5.1.4.

A hyetograph for each of the four rainfall events is provided in Appendix A.

2.1.2.2 Existing Ground Surface

The model utilizes an existing ground surface which has been developed using a combination of both Light Detection and Ranging (LiDAR) data and conventional survey data.

Patersons have supplied an existing ground surface using a combination of both LiDAR data and conventional survey data. The surface is in terms of New Zealand Geodetic Datum 2000 (Mount Nicholas Circuit) and New Zealand Vertical Datum 2016.

The LiDAR data was observed in March 2021 for Queenstown Lakes District Council. Copyright in the underlying dataset from which this work has been derived is owned by Queenstown Lakes District Council.

Conventional survey data was observed in 2024 and includes some spot heights captured at key locations within the development.

2.1.2.3 Design Surface

The model utilizes a design surface which has been developed for the proposed subdivision lot layout dated 5 March 2025 (Rev O5). The proposed subdivision lot layout is provided in Appendix B.

The design surface was built using the Stantec roading design. The roading design sets the level of the design surface within the road corridor. The design surface has been built by linear interpolation between road corridors.

2.1.2.4 Catchment Areas – Pre and post development

The predevelopment catchment areas within the site boundary have been developed using the PCSWMM built in catchment delineation tool. This tool automates catchment delineation using a Digital Elevation Model (DEM) surface of the existing ground (refer to Section 2.1.2.2).

A catchment plan showing the combined predevelopment catchment areas is provided in Appendix C.

The post development catchment areas have been developed using the proposed lot layout dated 5 March 2025 (Rev O5). The proposed subdivision lot layout is provided in Appendix B. A catchment plan showing the combined post development catchment areas is provided in Appendix D.



Stormwater Modelling Basis of Design

2 Basis of Design

Predevelopment and post development catchment areas have been summarised in Appendix G and Table 1 below.

Table 1. Predevelopment and post development catchment area draining to each model outlet

PRE DEVELOPMENT			POST DEVELOPMENT		
Catchment	Area (Ha)	Outlet Node	Catchment	Area (Ha)	Outlet
1	21.96	1	1	21.96	1
Total	21.96	1	Total	21.96	1
2	49.97	2&3	2B	12.33	4
3	47.11	2&3	2A	36.87	2&3
Total	97.08	OF2&3	3	52.13	2&3
4	8.78	5	Total	101.33	2&3
Total	8.78	5	4	1.26	5
5	4.85	6	Total	1.26	5
6	1.88	6	5	0.60	6
7	9.07	6	6	1.25	6
Total	15.8	6	7	3.99	6
8	1.26	7	Total	5.84	6
Total	1.26	7	8	1.26	7
9	33.56	Southwestern Creek	Total	1.26	7
Total	33.56	Southwestern Creek	9C	44.2	8
14	36.85	Southern Creek	9B	2.09	9
Total	36.85	Southern Creek	9D	15.89	10
10	16.22	14	9A	5.86	Southwestern Creek
Total	16.22	14	Total	68.04	Southwestern Creek
			11A	19.28	Southern Creek
			11B	3.12	11
			11C	5.27	12+13
			Total	27.67	Southern Creek
			10	4.09	14
			Total	4.09	14

2.1.2.5 Catchment Flow length

The catchment flow lengths for predevelopment catchment areas are defined using the built in PCSWMM catchment delineation tool. These catchment areas were verified using ground surface contours.

The catchment flow length for post development catchment areas are manually defined by drawing flow paths within each of the post development catchment areas, which converge at a catchment outlet. The Model calculates the average flow length for each catchment using these defined flow paths.

2.1.2.6 Catchment Slope

The catchment slope for individual predevelopment catchment areas is calculated by PCSWMM using the existing ground surface. The calculated catchment slope was verified manually using distance measurements and existing ground surface contours.



The catchment slope for individual post development catchment areas is calculated by PCSWMM using the design ground surface. The calculated catchment slope was verified manually using distance measurements and the design ground surface contours.

2.1.2.7 Infiltration

Infiltration losses for predevelopment and post development surfaces have been calculated in the Model using the Soil Conservation Service (SCS) curve number method. Curve numbers have been sourced from the Urban Hydrology for Small Watersheds Technical Release 55 (TR55).

The different soil types over the development have been determined using S-Maps. Five different soil types have been identified across the development site:

- Wakapitu_1a.1 (hydrological soil group D)
- Eelyz_6a.1 (hydrological soil group A)
- Barrhill_42a.1 (hydrological soil group B)
- Pigburn_1a.1 (hydrological soil group B)
- Tucker_2a.1 (hydrological soil group A)

Each soil type has been assigned a curve number for both the predevelopment and post development land use. A summary of each soil type, corresponding hydrological soil group classification, and the curve numbers assigned for various land use types is provided in Appendix E.

In addition to curve number, the Model allows a percentage of catchment area to be set as impervious (zero infiltration). This has been done to represent roofed/ fully sealed areas within catchments instead of assigning a curve number because it is more conservative (all rainfall is converted to runoff). The percentage of impervious catchment area has also been defined for each of the proposed developed catchment land uses:

- Low density residential housing
- Medium density residential housing
- Medium density super lots
- High density super lots
- Commercial
- Proposed school

The percent of impervious area which has been assigned to each development land use type is provided in Table 2 and in Appendix F.



Table 2. Impervious percentage assigned to each land use type

	Percent Pervious	Percent Impervious
High density super lots	10%	90%
Medium density super lots	15%	85%
Medium density	20%	80%
Low Density	25%	75%
School	50%	50%

The impervious area for low density development lots has been determined by measuring the pervious and impervious area of five lots within the neighboring Hanley's Farm development. This assessment determined that the average proportion of impervious area over the five measured lots is 75%. Therefore, an impervious area percentage of 75% has been set for all low density lots.

The impervious area for high density super lots has been determined using runoff coefficients defined in the New Zealand Building Code (NZBC). The NZBC gives a runoff coefficient of 0.90 for fully roofed and/or sealed developments. Therefore, an impervious area percentage of 90% has been set for all high density super lots.

The impervious area for both medium density lots and medium density super lots is anticipated to lie between the impervious area set for low density lots and high density super lots. A impervious area of 80% was assigned for medium density lots and an impervious area of 85% was assigned for medium density super lots.

The Model conservatively assumes zero storage depth for both impervious and pervious catchment areas, meaning that rainfall is converted to runoff without delay.

2.1.3 Stormwater Runoff

PCSWMM uses a non-linear reservoir model to estimate runoff produced by rainfall over a sub catchment. The model was first published by Chen and Shubinski (1971) and included in the original release of SWMM (Metcalf and Eddy et al., 1971a)².

Stormwater runoff has been calculated for both the predevelopment site and the post development site for each of the four rainfall scenarios (refer to Section 2.1.2.1).

The stormwater discharge hydrograph for each scenario has been calculated at each of the drainage outlets which have been identified by the Model, using the predevelopment surface and the post development DEM surfaces. This allows the effects of the development to be compared at locations where flows are modelled to leave the site. A summary of the predevelopment stormwater flows, and post development stormwater flows is provided in Table 3 and Appendix G.

² Stormwater Management Model Reference Manual, Volume 1 – Hydrology (Revised), EPA United States Environmental Protection Agency



Stormwater Modelling Basis of Design

2 Basis of Design

There is an increase in stormwater discharge to several drainage outlets. Mitigations for increases in stormwater discharge are discussed in Section 2.2.3.



Stormwater Modelling Basis of Design

2 Basis of Design

Table 3. Predevelopment and post development stormwater flow

Outlet Node	Pre development				Outlet Node	Post development			
	Historic		RCP8.5 2080-2100			Historic		RCP8.5 2080-2100	
	5% AEP (m³/s)	1% AEP (m³/s)	5% AEP (m³/s)	1% AEP (m³/s)		5% AEP (m³/s)	1% AEP (m³/s)	5% AEP (m³/s)	1% AEP (m³/s)
1	0.771	1.600	1.261	2.555	1	0.771	1.601	1.261	2.555
Outlet 1	0.771	1.600	1.261	2.555	Outlet 1	0.771	1.601	1.261	2.555
2	1.508	3.021	2.431	4.861	2	0.996	2.067	1.649	3.399
3	1.579	3.091	2.526	4.874	3	5.405	8.664	7.399	11.593
4	0.000	0.000	0.000	0.000	4	1.223	1.967	1.671	2.694
Northern Outlets	3.087	6.112	4.957	9.735	Northern Outlets	7.624	12.698	10.719	17.686
5	0.542	1.024	0.834	1.535	5	0.072	0.138	0.112	0.209
6	0.315	0.589	0.480	0.875	6	0.044	0.079	0.065	0.115
6	0.135	0.246	0.202	0.359	6	0.092	0.165	0.136	0.239
6	0.611	1.131	0.923	1.668	6	0.292	0.527	0.432	0.765
7	0.087	0.161	0.131	0.236	7	0.087	0.161	0.131	0.236
Western Outlets	1.690	3.151	2.570	4.673	Western Outlets	0.587	1.070	0.876	1.564
8	0.000	0.000	0.000	0.000	8	4.041	6.683	5.64	9.268
9	0.000	0.000	0.000	0.000	9	0.201	0.331	0.279	0.459
10	0.000	0.000	0.000	0.000	10	1.465	2.393	2.025	3.302
Southwestern Creek	1.325	2.592	2.100	4.023	Southwestern Creek	0.076	0.175	0.134	0.306
Southwestern Creek	1.325	2.592	2.100	4.023	Southwestern Creek	5.783	9.582	8.078	13.335
11	0.000	0.000	0.000	0.000	11	0.312	0.517	0.436	0.721
12+13	0.000	0.000	0.000	0.000	12+13	0.479	0.784	0.662	1.084
Southern Creek	1.135	2.282	1.826	3.672	Southern Creek	0.406	0.884	0.688	1.472
Southern Creek	1.135	2.282	1.826	3.672	Southern Creek	1.197	2.185	1.786	3.277
14	0.529	1.049	0.840	1.640	14	0.075	0.161	0.125	0.267
Minor Lakeside Outlets	0.529	1.049	0.840	1.640	Minor Lakeside Outlets	0.075	0.161	0.125	0.267



2.2 Hydraulics

2.2.1 Primary System

2.2.1.1 Pipes

The primary stormwater network has been sized to convey the RCP8.5 2080-2100 5% AEP storm event without surcharging above pipe soffit. This complies with QLDC CoP Clause 4.3.5.1.2.

Key Model inputs that have been applied to hydraulically size the stormwater network are provided below:

- Pipes have been sized using Mannings equation
- Conservatively, a Mannings roughness of 0.012 (concrete pipes) has been applied to all stormwater pipes. This complies with QLDC CoP clause 4.3.5.3.
- Local losses and minimum internal fall through manholes have been set using a combination of QLDC CoP Clause 4.3.5.3 and QLDC CoP 5.3.8.4.4:
 - o 0 – 30 degrees deflection angle = 30mm (QLDC CoP Clause 5.3.8.4.4). Pipe connections that meet these criteria have been assigned a local loss (k) of 0.25 as per QLDC CoP Clause 4.3.5.3.
 - o >30 degrees to 60 degrees deflection angle = 50mm (QLDC CoP Clause 5.3.8.4.4). Pipe connections that meet these criteria have been assigned a local loss (k) of 0.60 as per QLDC CoP Clause 4.3.5.3.
 - o >60 degrees to 120 degrees deflection angle = 80 mm (QLDC CoP Clause 5.3.8.4.4). Pipe connections that meet these criteria have been assigned a local loss (k) of 0.90 as per QLDC CoP Clause 4.3.5.3.

2.2.1.2 Catchpits

Stormwater catchpits have not been modelled. Catchpit sizing, spacing and design will be completed during the next phase of the project.

The Model conservatively adds stormwater flow from adjacent catchment areas into the stormwater manhole node at the upstream end of the pipe link.

2.2.1.3 Outlets

The stormwater discharge hydrograph for each scenario has been calculated at each of the drainage outlets which have been identified by the Model, using predevelopment and post development surfaces. This allows the effects of the development to be compared at locations where flows are modelled to leave the site.

Stormwater outlets have been defined in the Model and used to assess predevelopment and post development stormwater flow. A summary of the predevelopment and post development stormwater catchment area and peak flow at each outlet is provided in Table 1, Table 3, and Appendix G.



Stormwater Modelling Basis of Design

2 Basis of Design

The proposed development increases stormwater catchment area and peak flow to two of the existing outlets defined in the predevelopment catchment assessment (refer to Section 2.2.1.3):

- Northern Outlets (2, 3, 4). Flows from these outlets have been assumed to drain to the same downstream stormwater network at the northwest corner of the development. Two attenuation basins have been proposed to maintain predevelopment stormwater flows (refer to section 2.2.3).
- Southwestern Channel (8, 9, 10, Southwestern Creek). Flows discharge to the Southwestern Gully. Attenuation of flows is not required due to the proximity of the outlet to Lake Wakatipu.

The post development peak stormwater flow is equal or less than the predevelopment peak stormwater flow at all other outlets.

2.2.2 Secondary System

The secondary system has not been modelled in detail. Secondary system design will be added to the PCSWMM model as connected road carriageways above the piped system during the next phase of the project.

However, the Model included a scenario with 'upsized pipes', to route flows from a 1% AEP storm to each stormwater outlet. This allowed both historical and future 1% AEP stormwater flows to be calculated and attenuation basins to be sized. This model can be refined during future design phases to include secondary overland flowpaths, i.e., the roading network, to provide a more accurate representation of a 1% AEP storm event.

2.2.3 Peak Discharge Attenuation

The post development design includes two peak runoff attenuation basins:

- Attenuation Basin 1 (Northwest corner of the proposed development, near the proposed school)
- Attenuation Basin 2 (Along the northern boundary of the proposed development, north of the commercial area)

The locations of Attenuation Basin 1 and Attenuation Basin 2 are shown in Figure 2 below.



Stormwater Modelling Basis of Design

2 Basis of Design



Figure 2. Attenuation basin location plan

As per the QLDC CoP Clause 4.3.5.1.2, the Model has been used to assess the critical attenuation volume for two scenarios:

- Post development has been compared to the pre-development using historical design rainfall intensity
- Post-development has been compared to the predevelopment using future climate change adjusted design rainfall intensity

The two attenuation basins have been sized to attenuate stormwater outflows to maintain the 5% AEP and 1% AEP post development peak stormwater discharge to the 5% AEP and 1% AEP predevelopment peak flow with future climate change (RCP8.5 2080-2100).

The critical rainfall runoff event for designing the size of attenuation basins 1 and 2 was a post-development, 1% AEP, flood event with future climate change (RCP8.5 2080-2100) rainfall intensity.

The minimum attenuation volume demand for attenuation basin 1 is approximately 13,000 m³.

The minimum attenuation volume demand for attenuation basin 2 is approximately 1,800 m³.

A summary of the critical peak outflow and attenuation volume demand for each attenuation basin for each storm event is provided in Appendix H.



2.3 Model Exclusions

The Model will be refined and developed during future design phases, and excludes the following:

- Stormwater catchpits and catchpits leads.
- Attenuation basin configurations including intake energy dissipation, emergency spillways, primary and secondary outlet levels, throttle pipes and outlets.
- Steep pipelines and energy dissipation measures, gully flows to the Lake outlets.
- Optimized secondary stormwater system throughout the finalised street layout.
- Catchment runoff flows from The Remarkables which will be managed by diversion channels around the development. Tailwater levels from diversion channel flows have been estimated from first principles without assessing temporal dynamics.



Appendices



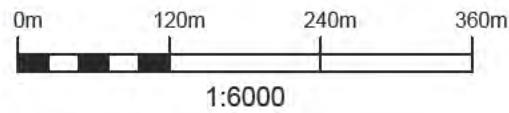
Appendix A Rainfall Hyetograph



Appendix B Proposed Subdivision Layout (Rev O, 5/3/25)

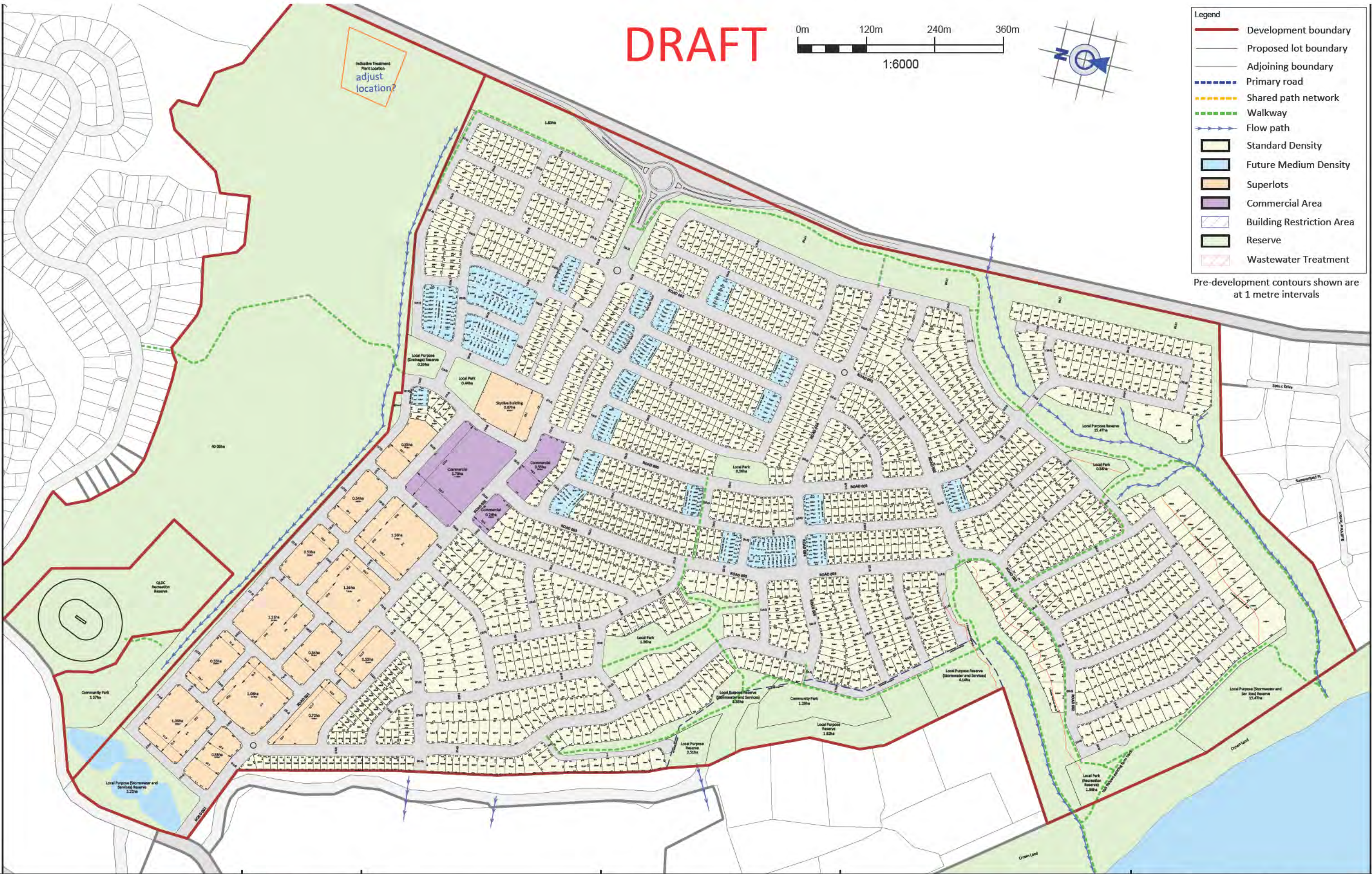


DRAFT



- Legend
- Development boundary
 - Proposed lot boundary
 - Adjoining boundary
 - Primary road
 - Shared path network
 - Walkway
 - Flow path
 - Standard Density
 - Future Medium Density
 - Superlots
 - Commercial Area
 - Building Restriction Area
 - Reserve
 - Wastewater Treatment

Pre-development contours shown are at 1 metre intervals



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E queenstown@patersons.co.nz

Client & Location:
RCL Henley Downs Limited
Queenstown

Purpose & Drawing Title:
Preliminary Subdivision Plan
with areas and dimensions

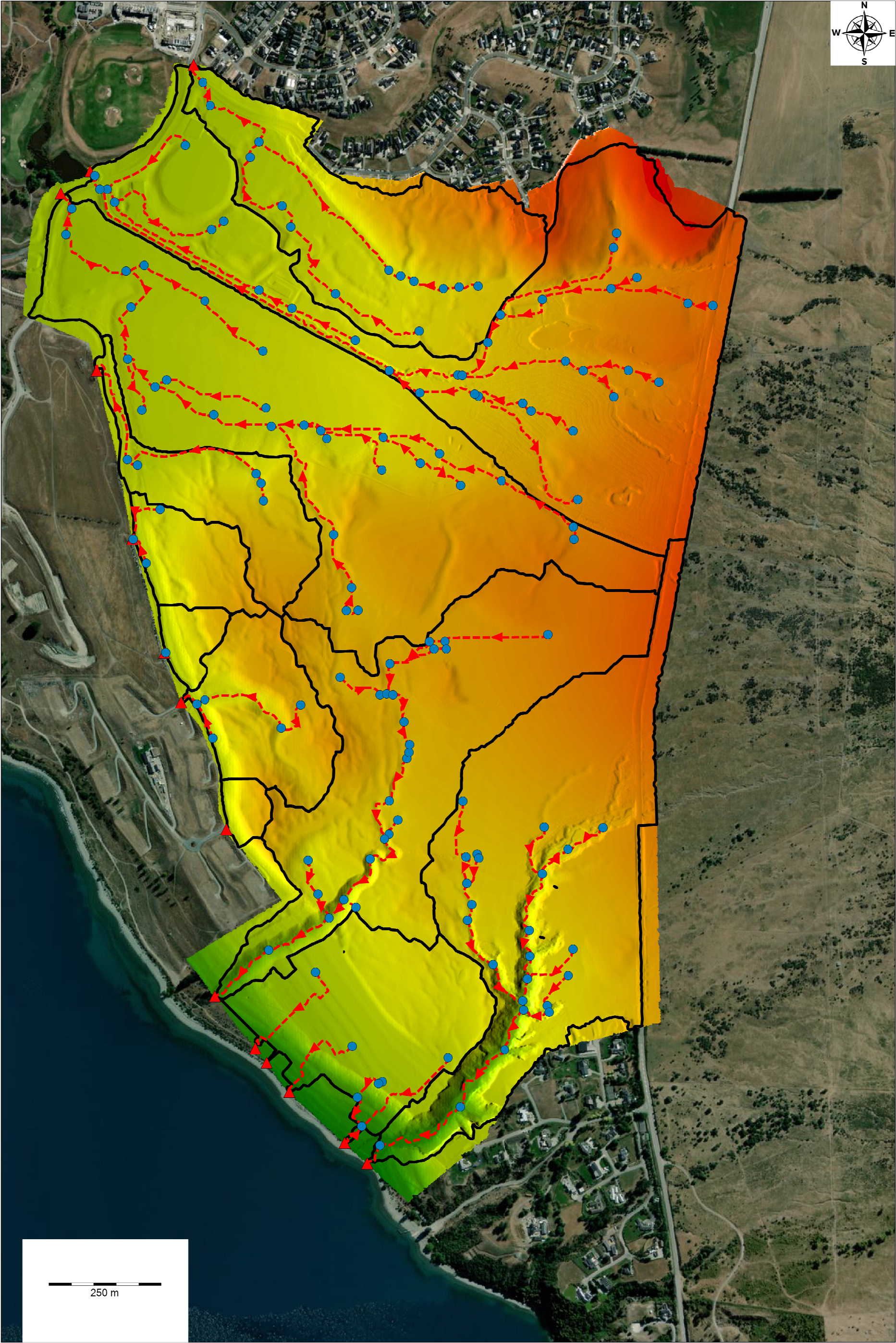
FOR DISCUSSION

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Surveyed by:	PPG, RCL	Original Size:	Scale:
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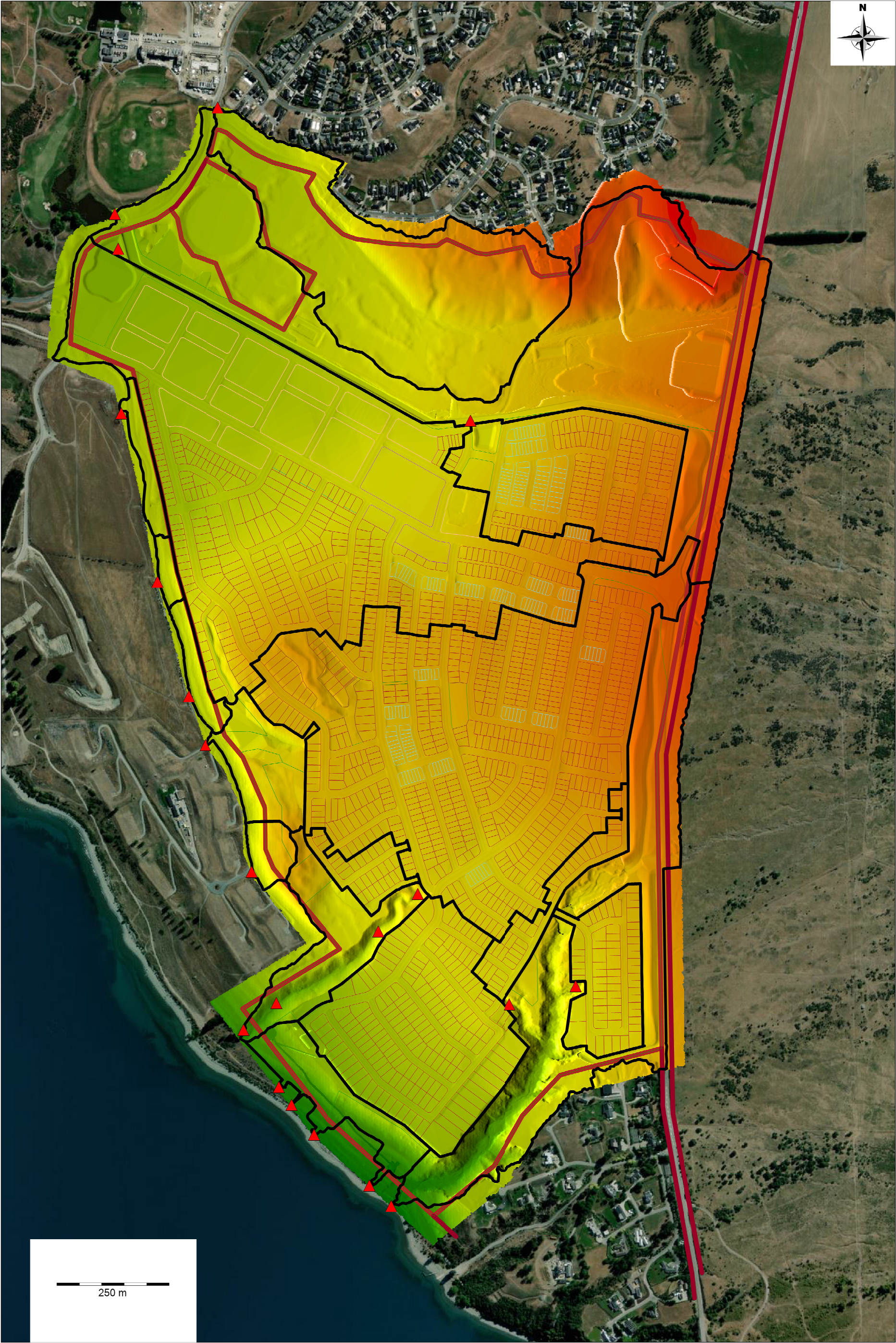
Appendix C Predevelopment Catchment Plan





Appendix D Post Development Catchment Plan





Appendix E SCS Curve Numbers



Curve Number Inputs						
Soil	Hydrological Soil Group	Predevelopment	Reserve Areas	Road Reserve	Commercial	Residential
Wakapitu_1a.1	D	80	84	98	95	80
Eelyz_6a.1	A	39	49	98	89	39
Barrhill_42a.1	B	61	69	98	92	61
Pigburn_1a.1	B	61	69	98	92	61
Tucker_2a.1	A	39	NA	NA	NA	NA

Table 2-2a Runoff curve numbers for urban areas ^{1/}

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area ^{2/}	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ^{3/} :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ^{4/}		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas					
(pervious areas only, no vegetation) ^{5/}		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

¹ Average runoff condition, and $I_a = 0.2S$.² The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.³ CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.⁴ Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.⁵ Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands ^{1/}

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment ^{2/}	Hydrologic condition ^{3/}	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded or broadcast legumes or rotation meadow	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

¹ Average runoff condition, and $I_a=0.2S$ ² Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.³ Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good $\geq 20\%$), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands ^{1/}

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. ^{2/}	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. ^{3/}	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 ^{4/}	48	65	73
Woods—grass combination (orchard or tree farm). ^{5/}	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. ^{6/}	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 ^{4/}	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

¹ Average runoff condition, and $I_a = 0.2S$.² *Poor:* <50% ground cover or heavily grazed with no mulch.*Fair:* 50 to 75% ground cover and not heavily grazed.*Good:* > 75% ground cover and lightly or only occasionally grazed.³ *Poor:* <50% ground cover.*Fair:* 50 to 75% ground cover.*Good:* >75% ground cover.⁴ Actual curve number is less than 30; use CN = 30 for runoff computations.⁵ CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.⁶ *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.*Fair:* Woods are grazed but not burned, and some forest litter covers the soil.*Good:* Woods are protected from grazing, and litter and brush adequately cover the soil.

Wakapitu_1a.1Report generated: 6-Nov-2024 from <https://smap.landcareresearch.co.nz>

Wakat_1a.1 (100% of the mapunit at location (1265202, 4998044), Confidence: Low)

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Capture of the base soil information in this region was funded by Otago Regional Council, Fertiliser Association, Dunedin Rural Development and MWLR.

Soil Classification**Soil Classification:****Typic Immature Pallic Soils (PIT)****Family Name:****Wakapitu (Wakat)****Sibling Name:****Wakapitu_1a.1 (Wakat_1a.1)****Soil profile material**

Rounded stony soil

Profile texture

loam

Parent Material**Stones/rocks**

schist rock

Depth class (diggability)

Shallow (20 - 45 cm)

Soil material

schist rock

Origin

Loess on Glacial Till

Soil Sibling Concept

This soil belongs to the Pallic soil order of the New Zealand soil classification. Pallic Soils have pale coloured subsoils, due to low contents of iron oxides, have weak soil structure and high density in subsurface horizons. Pallic Soils tend to be dry in summer and wet in winter. It is formed in a blanket deposit of silt sized windblown materials overlying poorly stratified poorly sorted gravel sand and mud deposited from glacial ice or meltwater, from schist parent material.

The topsoil typically has loam texture and is stoneless. The subsoil has dominantly loam textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth is 20 - 45 (cm), due to densely packed gravels that mechanically impedes root growth.

Generally the soil is well drained with moderate vulnerability of water logging in non-irrigated conditions, and has moderate to low soil water holding capacity. Inherently these soils have a high structural vulnerability and a high N leaching potential, which should be accounted for when making land management decisions.

Allan Hewitt ©

**Immature
Pallic****About this publication**

- This information sheet describes the *typical average properties* of the specified soil.
- For further information on individual soils, contact Landcare Research New Zealand Ltd: www.landcareresearch.co.nz
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- The information has been derived from numerous sources. It may not be complete, correct or up to date.
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Wakapitu_1a.1

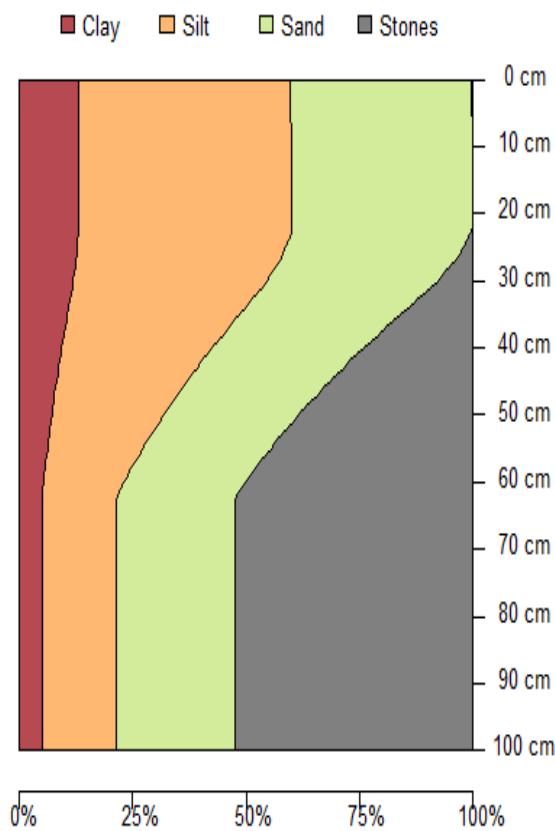
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

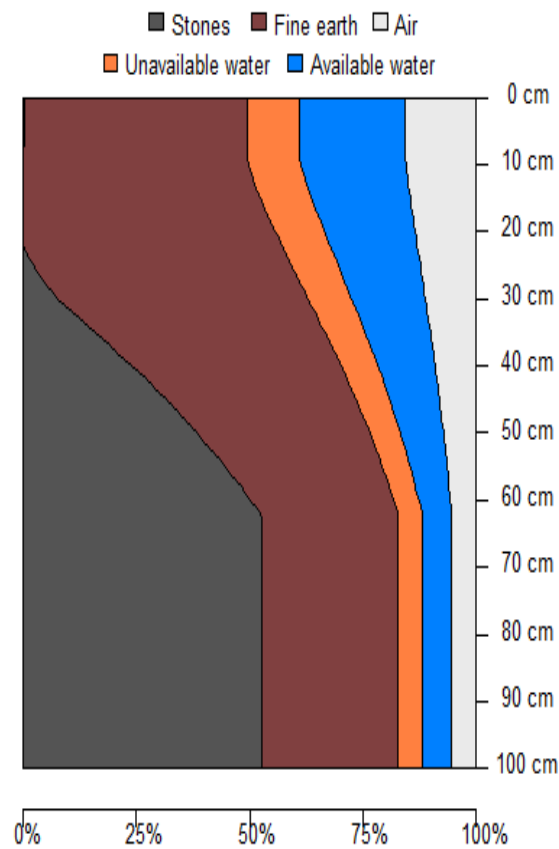
Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Loamy Weak	10 - 20 cm	0 %	8 - 18 %	20 - 60 %	rapid
Loamy Weak	10 - 25 cm	0 - 5 %	8 - 18 %	20 - 60 %	moderate
Very Stony Loamy Dense	55 - 80 cm	35 - 70 %	6 - 15 %	40 - 70 %	slow

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Texture



Water Retention



The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Wakapitu_1a.1

Soil physical properties

Depth class (diggability)

Shallow (20 - 45 cm)

Potential rooting depth

20 - 45 (cm)

Rooting barrier

Densely packed gravels

Depth to hard rock

No hard rock within 1 m

Depth to soft rock

No soft rock within 1 m

Depth to stony layer class

Shallow

Texture profile

Loam

Topsoil stoniness

Stoneless

Topsoil clay range

8 - 18 %

Drainage class

Well drained

Permeability profile

Moderate over slow

Depth to slowly permeable horizon

20 - 45 (cm)

Permeability of slowest horizon

Slow (< 4 mm/h)

Aeration in root zone

Moderately limited

Profile available water

(0 - 30cm or root barrier)

High (63 mm)

(0 - 60cm or root barrier)

Moderate (67 mm)

(0 - 100cm or root barrier)

Moderate to low (67 mm)

Dry bulk density

topsoil

1.25 g/cm³

subsoil

1.50 g/cm³

Soil chemical properties

Topsoil P retention

Low (23%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability

High (0.64)

Pugging vulnerability

not available yet

Septic tank installation category

A1 if slope > 15 deg otherwise B2

Contaminant management

N leaching vulnerability

High

P leaching vulnerability

not available yet

Dairy effluent (FDE) risk category

C

Water management

Water logging vulnerability

Moderate

Drought vulnerability - if not irrigated

Moderate

Bypass flow

High

Hydrological soil group

D

Relative Runoff Potential

Slope	0-3°	4-7°	8-15°	16-25°	>25°
Risk	L	M	H	VH	VH

SINDI - Soil quality Indicators

SINDI - Soil Quality Indicators

A suite of soil quality indicators is available from <http://sindi.landcareresearch.co.nz/>

- Compare your soil with information from our soils databases.
- Assess the intrinsic resources and biological, chemical and physical quality of your soil
- See how your soil measures up against current understanding of optimal values.
- Learn about the effect each indicator has on soil quality and some general management practices that could be implemented to improve soil quality.

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Wakat_1a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.
- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.
- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.
- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates supplied by the S-map web service have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER.

Eelyz_6a.1

Report generated: 6-Nov-2024 from <https://smap.landcareresearch.co.nz>

Eeltz_6a.1 (100% of the mapunit at location (1264928, 4997855), Confidence: Low)

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Capture of the base soil information in this region was funded by Otago Regional Council, Fertiliser Association, Dunedin Rural Development and MWLR.

Soil Classification

Soil Classification:

Typic Orthic Brown Soils (BOT)

Family Name:

Eelyz (Eeltz)

Sibling Name:

Eelyz_6a.1 (Eeltz_6a.1)

Soil profile material

Rounded stony soil

Profile texture

loam

Parent Material

Stones/rocks

schist rock

Depth class (diggability)

Shallow (20 - 45 cm)

Soil material

schist rock

Origin

Alluvium

Soil Sibling Concept

This soil belongs to the Brown soil order of the New Zealand soil classification. Brown Soils have a brown or yellow-brown subsoil below a dark grey-brown topsoil. The brown colour is caused by thin coatings of iron oxides weathered from the parent material. It is formed in alluvial sand silt or gravel deposited by running water, from soft sandstone parent material.

The topsoil typically has loam texture and is moderately stony. The subsoil has dominantly loam textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth extends beyond 1m.

Generally the soil is well drained with very low vulnerability of water logging in non-irrigated conditions, and has moderate soil water holding capacity. Inherently these soils have a moderate structural vulnerability and a moderate N leaching potential, which should be accounted for when making land management decisions.

Allan Hewitt ©



Orthic
Brown

About this publication

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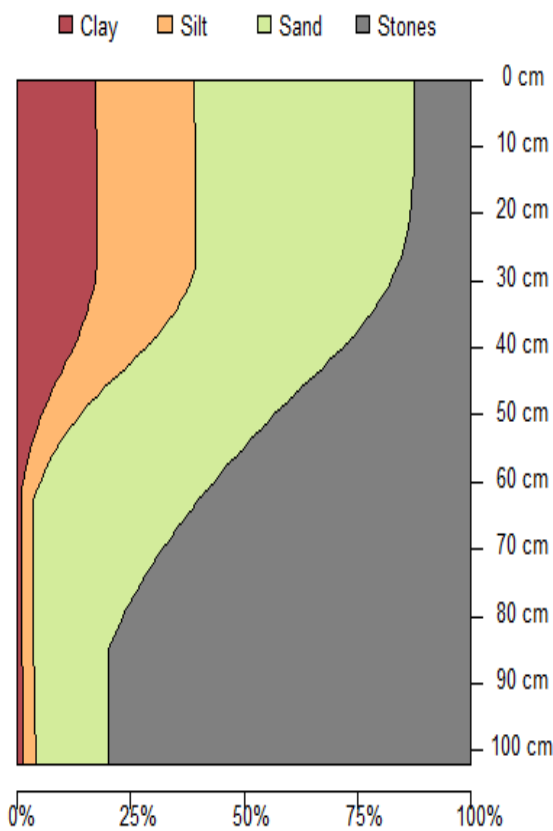
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

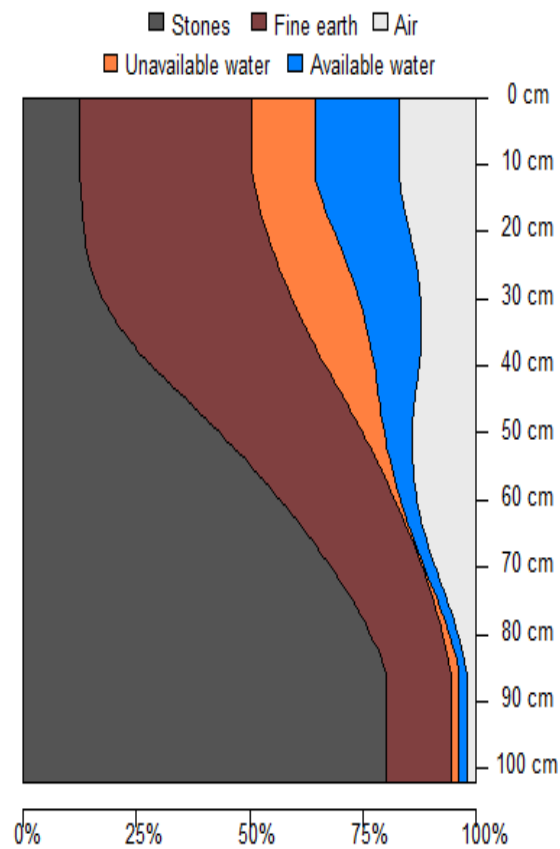
Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Stony Loamy Weak	15 - 25 cm	5 - 20 %	15 - 25 %	40 - 70 %	rapid
Stony Loamy Weak	15 - 30 cm	5 - 35 %	15 - 25 %	40 - 70 %	rapid
Very Stony Sandy Loose	15 - 40 cm	35 - 70 %	2 - 10 %	75 - 90 %	rapid
Extremely Stony Sandy	10 - 55 cm	65 - 95 %	0 - 10 %	75 - 90 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Texture



Water Retention



The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Soil physical properties

Depth class (diggability) Shallow (20 - 45 cm)	Texture profile Loam	Drainage class Well drained
Potential rooting depth Unlimited	Topsoil stoniness Moderately stony	Permeability profile Rapid
Rooting barrier No significant barrier within 1	Topsoil clay range 15 - 25 %	Depth to slowly permeable horizon No slowly permeable horizon
Depth to hard rock No hard rock within 1 m		Permeability of slowest horizon Rapid (> 72 mm/h)
Depth to soft rock No soft rock within 1 m		Aeration in root zone Unlimited
Depth to stony layer class Shallow		
Profile available water (0 - 30cm or root barrier) (0 - 60cm or root barrier) (0 - 100cm or root barrier) High (52 mm) Moderate (80 mm) Moderate (102 mm)	Dry bulk density topsoil subsoil 1.00 g/cm³ 1.30 g/cm³	

Soil chemical properties

Topsoil P retention Medium (36%)
--

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity	Contaminant management	Water management												
Structural vulnerability	N leaching vulnerability	Water logging vulnerability												
Moderate (0.55)	Medium	Very low												
Pugging vulnerability	P leaching vulnerability	Drought vulnerability - if not irrigated												
not available yet	not available yet	Moderate												
Septic tank installation category	Dairy effluent (FDE) risk category	Bypass flow												
A1 if slope > 15 deg otherwise B4	D	Medium												
		Hydrological soil group												
		A												
		Relative Runoff Potential												
		<table><tr><td>Slope</td><td>0-3°</td><td>4-7°</td><td>8-15°</td><td>16-25°</td><td>>25°</td></tr><tr><td>Risk</td><td>VL</td><td>VL</td><td>VL</td><td>VL</td><td>L</td></tr></table>	Slope	0-3°	4-7°	8-15°	16-25°	>25°	Risk	VL	VL	VL	VL	L
Slope	0-3°	4-7°	8-15°	16-25°	>25°									
Risk	VL	VL	VL	VL	L									

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- See how your soil measures up against current understanding of optimal values.
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Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Eeltz_6a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.
- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.
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Barrhill_42a.1Report generated: 6-Nov-2024 from <https://smap.landcareresearch.co.nz>

Barr_42a.1 (100% of the mapunit at location (1265433, 4998856), Confidence: Low)

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Capture of the base soil information in this region was funded by Otago Regional Council, Fertiliser Association, Dunedin Rural Development and MWLR.

Soil Classification**Soil Classification:****Typic Immature Pallic Soils (PIT)****Family Name:****Barrhill (Barr)****Sibling Name:****Barrhill_42a.1 (Barr_42a.1)****Soil profile material**

Stoneless soil

Profile texture

loam

Parent Material**Stones/rocks**

not applicable

Depth class (diggability)

Deep (> 1 m)

Soil material

schist rock

Origin

Loess on Alluvium

Soil Sibling Concept

This soil belongs to the Pallic soil order of the New Zealand soil classification. Pallic Soils have pale coloured subsoils, due to low contents of iron oxides, have weak soil structure and high density in subsurface horizons. Pallic Soils tend to be dry in summer and wet in winter. It is formed in a blanket deposit of silt sized windblown materials overlying alluvial sand silt or gravel deposited by running water, from schist parent material.

The topsoil typically has loam texture and is stoneless. The subsoil has dominantly loam textures, with gravel content of less than 3%. The plant rooting depth extends beyond 1m.

Generally the soil is moderately well drained with very low vulnerability of water logging in non-irrigated conditions, and has moderate to high soil water holding capacity. Inherently these soils have a high structural vulnerability and a moderate N leaching potential, which should be accounted for when making land management decisions.



Allan Hewitt ©

**Immature
Pallic****About this publication**

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- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Barrhill_42a.1

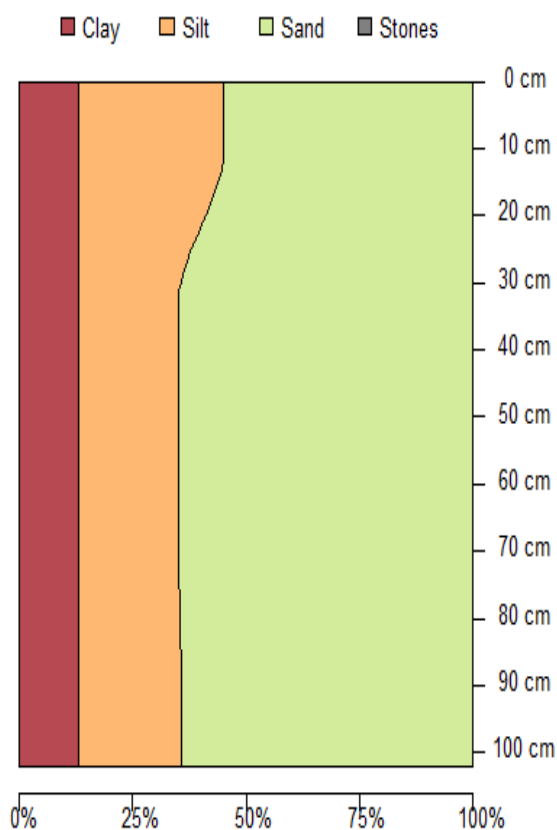
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

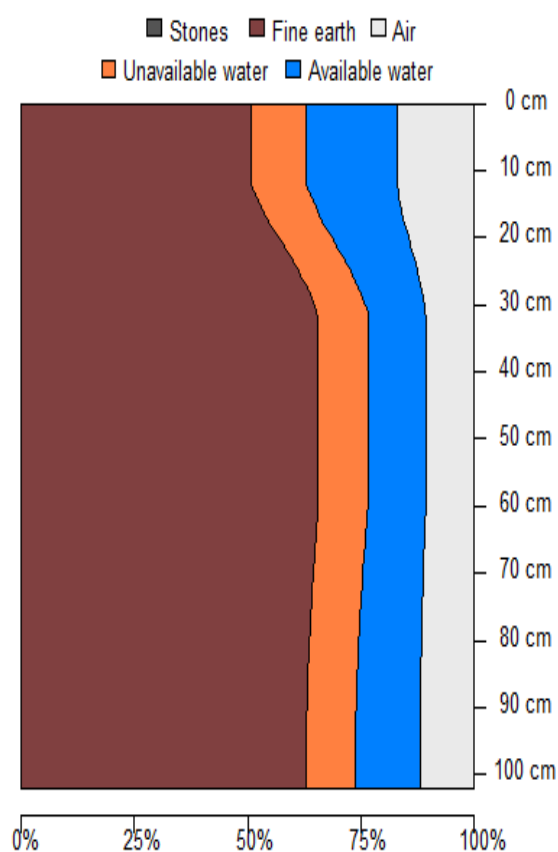
Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Loamy Weak	15 - 25 cm	0 %	8 - 18 %	40 - 70 %	rapid
Loamy Fine Firm	20 - 30 cm	0 %	8 - 18 %	40 - 90 %	moderately slow
Loamy Coarse Slightly Firm	50 - 65 cm	0 %	8 - 18 %	40 - 90 %	moderately slow

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Texture



Water Retention



The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Soil physical properties

Depth class (diggability) Deep (> 1 m)	Texture profile Loam	Drainage class Moderately well drained
Potential rooting depth Unlimited	Topsoil stoniness Stoneless	Permeability profile Moderate
Rooting barrier No significant barrier within 1	Topsoil clay range 8 - 18 %	Depth to slowly permeable horizon No slowly permeable horizon
Depth to hard rock No hard rock within 1 m		Permeability of slowest horizon Moderate (4 - 72 mm/h)
Depth to soft rock No soft rock within 1 m		Aeration in root zone Unlimited
Depth to stony layer class No significant stony layer within		
Profile available water (0 - 30cm or root barrier) High (52 mm) (0 - 60cm or root barrier) High (91 mm) (0 - 100cm or root barrier) Moderate to high (145 mm)	Dry bulk density topsoil 1.25 g/cm³ subsoil 1.60 g/cm³	

Soil chemical properties

Topsoil P retention Low (23%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity	Contaminant management	Water management												
Structural vulnerability	N leaching vulnerability	Water logging vulnerability												
High (0.68)	Medium	Very low												
Pugging vulnerability	P leaching vulnerability	Drought vulnerability - if not irrigated												
not available yet	not available yet	Low												
Septic tank installation category	Dairy effluent (FDE) risk category	Bypass flow												
A1 if slope > 15 deg otherwise B3	D	Medium												
		Hydrological soil group												
		B												
		Relative Runoff Potential												
		<table><tr><td>Slope</td><td>0-3°</td><td>4-7°</td><td>8-15°</td><td>16-25°</td><td>>25°</td></tr><tr><td>Risk</td><td>VL</td><td>VL</td><td>VL</td><td>VL</td><td>L</td></tr></table>	Slope	0-3°	4-7°	8-15°	16-25°	>25°	Risk	VL	VL	VL	VL	L
Slope	0-3°	4-7°	8-15°	16-25°	>25°									
Risk	VL	VL	VL	VL	L									

SINDI - Soil quality Indicators

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- Compare your soil with information from our soils databases.
- Assess the intrinsic resources and biological, chemical and physical quality of your soil
- See how your soil measures up against current understanding of optimal values.
- Learn about the effect each indicator has on soil quality and some general management practices that could be implemented to improve soil quality.

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Barr_42a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.
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Pigburn_1a.1

Report generated: 6-Nov-2024 from <https://smap.landcareresearch.co.nz>

Pigb_1a.1 (100% of the mapunit at location (1265846, 4998184), Confidence: Low)

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Capture of the base soil information in this region was funded by Otago Regional Council, Fertiliser Association, Dunedin Rural Development and MWLR.

Soil Classification

Soil Classification:

Weathered Fluvial Recent Soils (RFW)

Family Name:

Pigburn (Pigb)

Sibling Name:

Pigburn_1a.1 (Pigb_1a.1)

Soil profile material

Angular stony soil

Profile texture

loam

Parent Material

Stones/rocks

schist rock

Depth class (diggability)

Shallow (5 - 45 cm)

Soil material

schist rock

Origin

Alluvium

Soil Sibling Concept

This soil belongs to the Recent soil order of the New Zealand soil classification. Recent Soils are weakly developed, showing limited signs of soil-forming processes although a distinct topsoil is present, a B horizon is either absent or only weakly expressed. It is formed in alluvial sand silt or gravel deposited by running water, from schist parent material.

The topsoil typically has loam texture and is slightly stony. The subsoil has dominantly loam textures, with very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth extends beyond 1m.

Generally the soil is well drained with very low vulnerability of water logging in non-irrigated conditions, and has high soil water holding capacity. Inherently these soils have a high structural vulnerability and a low N leaching potential, which should be accounted for when making land management decisions.



Allan Hewitt ©

**Fluvial
Recent**

About this publication

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Pigburn_1a.1

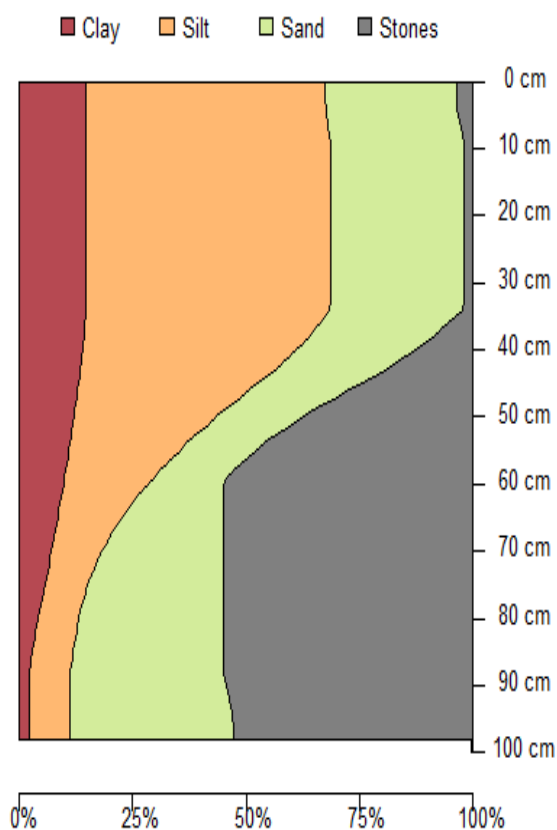
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

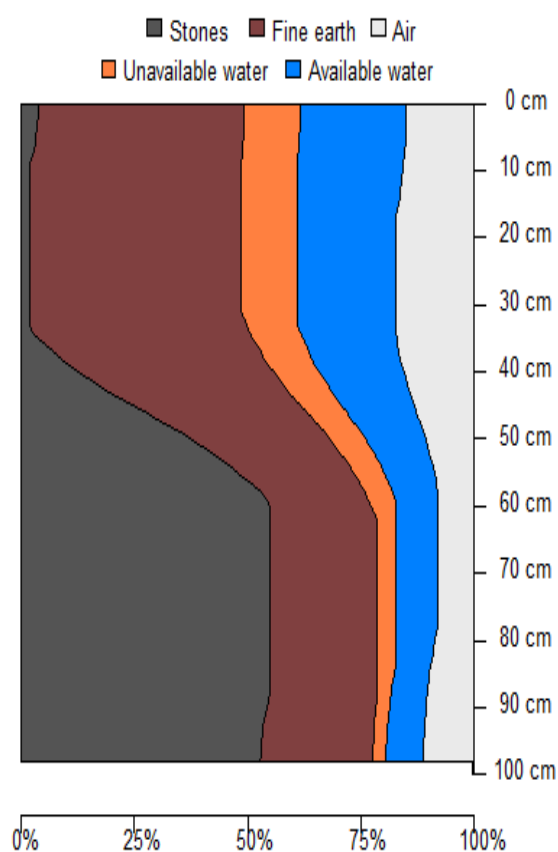
Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Loamy Weak	5 - 25 cm	0 - 4 %	10 - 20 %	20 - 40 %	rapid
Loamy Weak	20 - 40 cm	0 - 4 %	10 - 20 %	20 - 40 %	rapid
Very Stony Loamy Compact	20 - 45 cm	40 - 70 %	15 - 25 %	30 - 50 %	moderate
Very Stony Sandy Compact	10 - 30 cm	40 - 70 %	0 - 10 %	60 - 90 %	moderate

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Texture



Water Retention



The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Pigburn_1a.1

Soil physical properties

Depth class (diggability)

Shallow (5 - 45 cm)

Potential rooting depth

Unlimited

Rooting barrier

No significant barrier within 1

Depth to hard rock

No hard rock within 1 m

Depth to soft rock

No soft rock within 1 m

Depth to stony layer class

Shallow

Texture profile

Loam

Topsoil stoniness

Slightly stony

Topsoil clay range

10 - 20 %

Drainage class

Well drained

Permeability profile

Rapid over moderate

Depth to slowly permeable horizon

No slowly permeable horizon

Permeability of slowest horizon

Moderate (4 - 72 mm/h)

Aeration in root zone

Unlimited

Profile available water

(0 - 30cm or root barrier)	(0 - 60cm or root barrier)	(0 - 100cm or root barrier)
High (68 mm)	Very high (117 mm)	High (160 mm)

Dry bulk density

topsoil	subsoil
1.00 g/cm ³	1.30 g/cm ³

Soil chemical properties

Topsoil P retention

Low (19%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability

High (0.67)

Pugging vulnerability

not available yet

Septic tank installation category

A1 if slope > 15 deg otherwise B4

Contaminant management

N leaching vulnerability

Low

P leaching vulnerability

not available yet

Dairy effluent (FDE) risk category

D

Water management

Water logging vulnerability

Very low

Drought vulnerability - if not irrigated

Low

Bypass flow

Low

Hydrological soil group

B

Relative Runoff Potential

Slope	0-3°	4-7°	8-15°	16-25°	>25°
Risk	VL	VL	VL	VL	L

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Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Pigb_1a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.
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Tucker_2a.1Report generated: 12-Dec-2024 from <https://smap.landcareresearch.co.nz>

Tuck_2a.1 (100% of the mapunit at location (1265728, 4997329), Confidence: Low)

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Capture of the base soil information in this region was funded by Otago Regional Council, Fertiliser Association, Dunedin Rural Development and MWLR.

Soil Classification**Soil Classification:****Typic Orthic Recent Soils (ROT)****Family Name:****Tucker (Tuck)****Sibling Name:****Tucker_2a.1 (Tuck_2a.1)****Soil profile material**

Rounded stony soil

Profile texture

sand

Parent Material**Stones/rocks**

schist rock

Depth class (diggability)

Very shallow (5 - 20 cm)

Origin

Colluvium

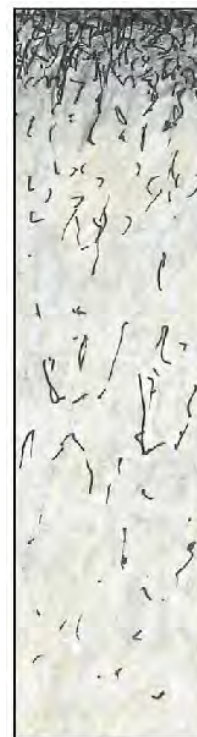
Soil Sibling Concept

This soil belongs to the Recent soil order of the New Zealand soil classification. Recent Soils are weakly developed, showing limited signs of soil-forming processes although a distinct topsoil is present, a B horizon is either absent or only weakly expressed. It is formed in weathered soil and rock material mantling slopes, from schist parent material.

The topsoil typically has sand texture and is moderately stony. The subsoil has dominantly sand textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth extends beyond 1m.

Generally the soil is well drained with very low vulnerability of water logging in non-irrigated conditions, and has moderate to low soil water holding capacity. Inherently these soils have a very high structural vulnerability and a high N leaching potential, which should be accounted for when making land management decisions.

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**Orthic
Recent****About this publication**

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Tucker_2a.1

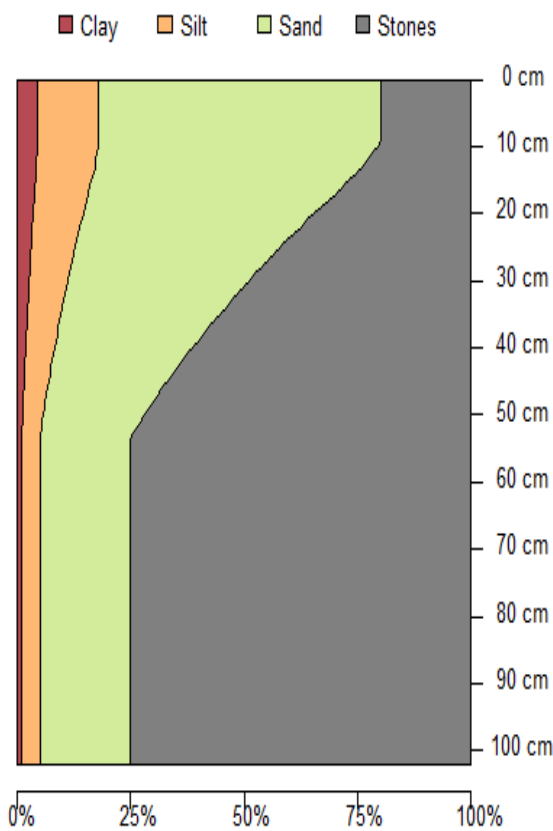
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

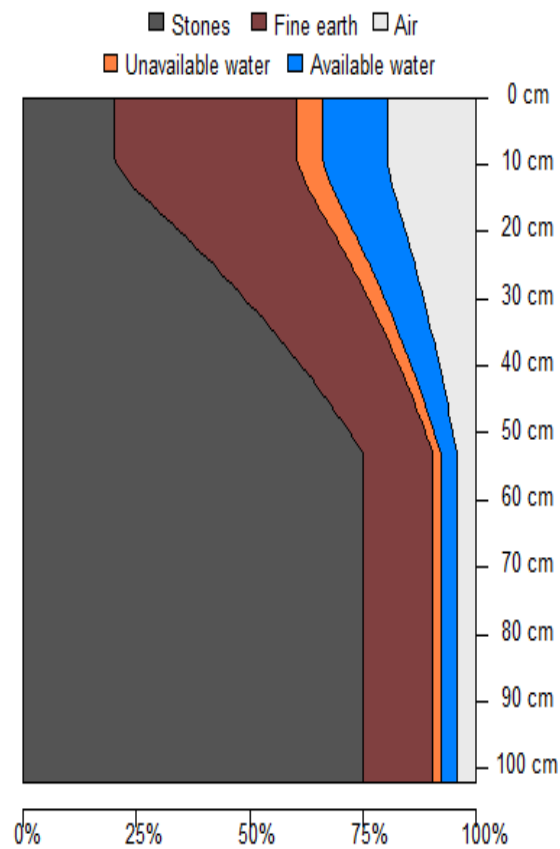
Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Stony Sandy Weak	10 - 20 cm	5 - 35 %	3 - 8 %	65 - 90 %	rapid
Extremely Stony Sandy	80 - 95 cm	60 - 90 %	0 - 8 %	70 - 90 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Texture



Water Retention



The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Tucker_2a.1

Soil physical properties

Depth class (diggability)

Very shallow (5 - 20 cm)

Potential rooting depth

Unlimited

Rooting barrier

No significant barrier within 1

Depth to hard rock

No hard rock within 1 m

Depth to soft rock

No soft rock within 1 m

Depth to stony layer class

Shallow

Texture profile

Sand

Topsoil stoniness

Moderately stony

Topsoil clay range

3 - 8 %

Drainage class

Well drained

Permeability profile

Rapid

Depth to slowly permeable horizon

No slowly permeable horizon

Permeability of slowest horizon

Rapid (> 72 mm/h)

Aeration in root zone

Unlimited

Profile available water

(0 - 30cm or root barrier)

Moderate (32 mm)

(0 - 60cm or root barrier)

Low (52 mm)

(0 - 100cm or root barrier)

Moderate to low (78 mm)

Dry bulk density**topsoil**

1.40 g/cm³

subsoil

1.40 g/cm³

Soil chemical properties

Topsoil P retention

Low (22%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity**Structural vulnerability**

Very high (0.73)

Pugging vulnerability

not available yet

Septic tank installation category

A1 if slope > 15 deg otherwise B4

Contaminant management**N leaching vulnerability**

High

P leaching vulnerability

not available yet

Dairy effluent (FDE) risk category

C

Water management**Water logging vulnerability**

Very low

Drought vulnerability - if not irrigated

Moderate

Bypass flow

High

Hydrological soil group

A

Relative Runoff Potential

Slope	0-3°	4-7°	8-15°	16-25°	>25°
Risk	VL	L	VL	VL	L

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Soil information for OVERSEER

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Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Tuck_2a.1**

Considerations when using Smap soil properties in OVERSEER

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Appendix F Impervious Area Assumptions



	Percent Pervious	Percent Impervious
High density superlots	10%	90%
Medium density super lots	15%	85%
Medium density	20%	80%
Low Density	25%	75%
School	50%	50%

Appendix G Predevelopment vs Post Development Catchment Area and Peak Stormwater Flow to Defined Outlets



PRE DEVELOPMENT		
Catchment	Area (Ha)	Outlet Node
1	21.96	1
Total	21.96	1
2	49.97	2&3
3	47.11	2&3
Total	97.08	OF2&3
4	8.78	5
Total	8.78	5
5	4.85	6
6	1.88	6
7	9.07	6
Total	15.8	6
8	1.26	7
Total	1.26	7
9	33.56	Southwestern Creek
Total	33.56	Southwestern Creek
14	36.85	Southern Creek
Total	36.85	Southern Creek
10	16.22	14
Total	16.22	14

POST DEVELOPMENT		
Catchment	Area (Ha)	Outlet
1	21.96	1
Total	21.96	1
2B	12.33	4
2A	36.87	2&3
3	52.13	2&3
Total	101.33	2&3
4	1.26	5
Total	1.26	5
5	0.60	6
6	1.25	6
7	3.99	6
Total	5.84	6
8	1.26	7
Total	1.26	7
9C	44.2	8
9B	2.09	9
9D	15.89	10
9A	5.86	Southwestern Creek
Total	68.04	Southwestern Creek
11A	19.28	Southern Creek
11B	3.12	11
11C	5.27	12+13
Total	27.67	Southern Creek
10	4.09	14
Total	4.09	14

Increase in Catchment Area
Neutral Catchment Area
Decrease in Catchment Area

Outlet Node	Pre development				Outlet Node	Post development			
	Historic		RCP8.5 2080-2100			Historic		RCP8.5 2080-2100	
	5% AEP (m³/s)	1% AEP (m³/s)	5% AEP (m³/s)	1% AEP (m³/s)		5% AEP (m³/s)	1% AEP (m³/s)	5% AEP (m³/s)	1% AEP (m³/s)
1	0.771	1.600	1.261	2.555	1	0.771	1.601	1.261	2.555
Outlet 1	0.771	1.600	1.261	2.555	Outlet 1	0.771	1.601	1.261	2.555
2	1.508	3.021	2.431	4.861	2	0.996	2.067	1.649	3.399
3	1.579	3.091	2.526	4.874	3	5.405	8.664	7.399	11.593
4	0.000	0.000	0.000	0.000	4	1.223	1.967	1.671	2.694
Northern Outlets	3.087	6.112	4.957	9.735	Northern Outlets	7.624	12.698	10.719	17.686
5	0.542	1.024	0.834	1.535	5	0.072	0.138	0.112	0.209
6	0.315	0.589	0.480	0.875	6	0.044	0.079	0.065	0.115
6	0.135	0.246	0.202	0.359	6	0.092	0.165	0.136	0.239
6	0.611	1.131	0.923	1.668	6	0.292	0.527	0.432	0.765
7	0.087	0.161	0.131	0.236	7	0.087	0.161	0.131	0.236
Western Outlets	1.690	3.151	2.570	4.673	Western Outlets	0.587	1.070	0.876	1.564
8	0.000	0.000	0.000	0.000	8	4.041	6.683	5.64	9.268
9	0.000	0.000	0.000	0.000	9	0.201	0.331	0.279	0.459
10	0.000	0.000	0.000	0.000	10	1.465	2.393	2.025	3.302
Southwestern Creek	1.325	2.592	2.100	4.023	Southwestern Creek	0.076	0.175	0.134	0.306
Southwestern Creek	1.325	2.592	2.100	4.023	Southwestern Creek	5.783	9.582	8.078	13.335
11	0.000	0.000	0.000	0.000	11	0.312	0.517	0.436	0.721
12+13	0.000	0.000	0.000	0.000	12+13	0.479	0.784	0.662	1.084
Southern Creek	1.135	2.282	1.826	3.672	Southern Creek	0.406	0.884	0.688	1.472
Southern Creek	1.135	2.282	1.826	3.672	Southern Creek	1.197	2.185	1.786	3.277
14	0.529	1.049	0.840	1.640	14	0.075	0.161	0.125	0.267
Minor Lakeside Outlets	0.529	1.049	0.840	1.640	Minor Lakeside Outlets	0.075	0.161	0.125	0.267

Attenuation ponds 1 and 2 mitigate increase in flows (not shown in this table)

Appendix H Attenuation Basin Sizing



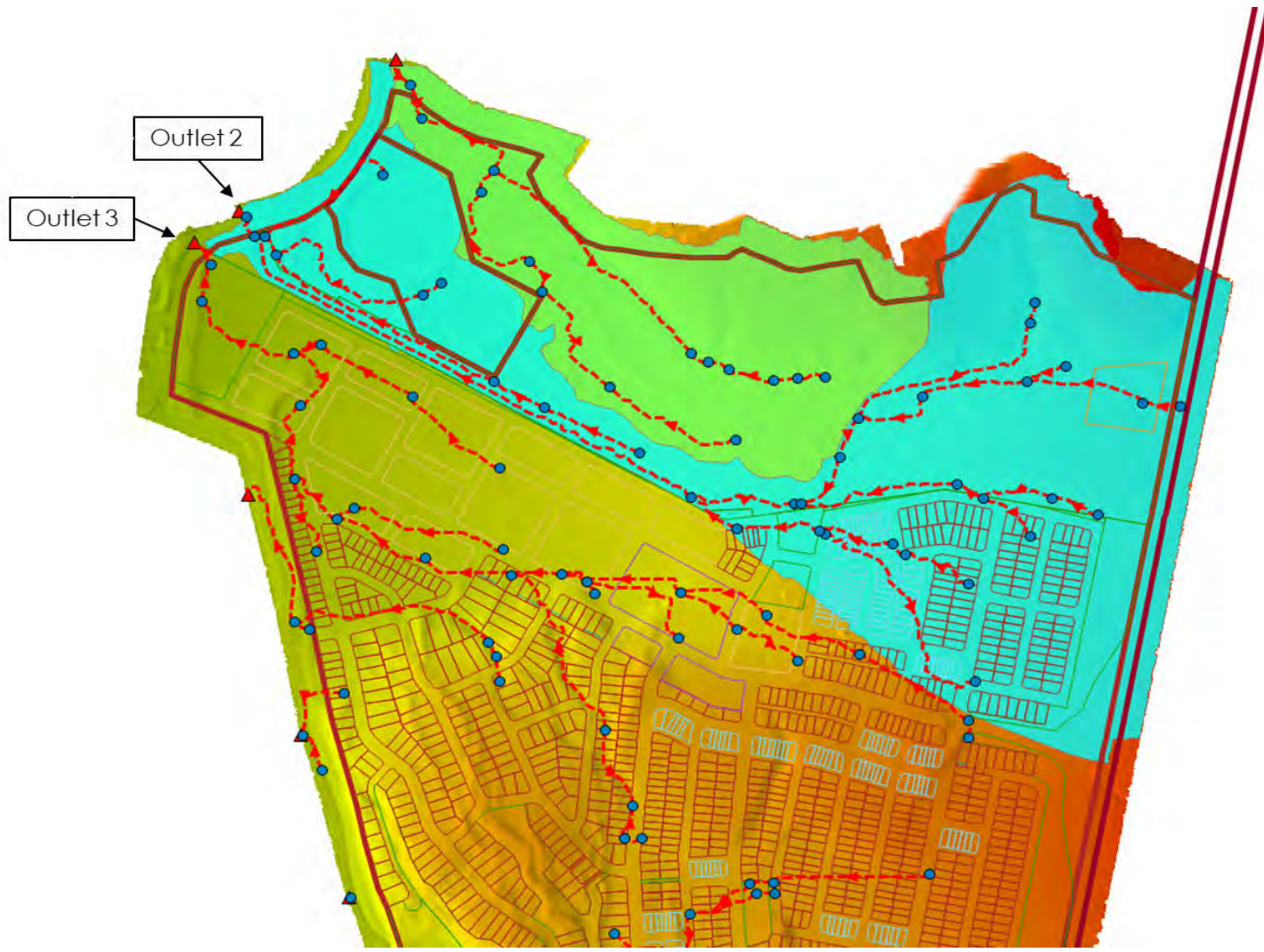
POND	NODE	PRE DEVELOPMENT - HISTORIC RAINFALL		PRE DEVELOPMENT - RCP8.5 2081-2100		NODE	POST DEVELOPMENT - HISTORIC RAINFALL		POST DEVELOPMENT - RCP8.5 2081-2100	
		5% AEP PEAK FLOW (m ³ /s)	1% AEP PEAK FLOW (m ³ /s)	5% AEP PEAK FLOW (m ³ /s)	1% AEP PEAK FLOW (m ³ /s)		5% AEP PEAK FLOW (m ³ /s)	1% AEP PEAK FLOW (m ³ /s)	5% AEP PEAK FLOW (m ³ /s)	1% AEP PEAK FLOW (m ³ /s)
1	2	1.508	3.021	2.431	4.861	2	0.996	2.067	1.649	3.399
	3	1.579	3.091	2.526	4.874	3	5.405	8.664	7.399	11.593
	Total	3.087	6.112	4.957	9.735	Total	6.401	10.731	9.048	14.992
2	J337	1.291	2.584	2.073	4.118	J004_00002	0.708	1.489	1.175	2.423
						4	1.223	1.967	1.671	2.694
	Total	1.291	2.584	2.073	4.118	Total	1.931	3.456	2.846	5.117

OPTION A - SIZE ATTENUATION LIKE FOR LIKE, SAME RAINFALL (MATCH PRE DEVELOPMENT PEAK DISCHARGE FOR A GIVEN STORM EVENT)				
Pond 1				
		Max Outflow - Pre development (m ³ /s)	Required Storage (m ³)	Required Storage Rounded (m ³)
Historic Rainfall	5 %AEP	1.51	9735	9700
	1 %AEP	2.95	11169	11200
RCP8.5 2081-2100 Rainfall	5 %AEP	2.41	11012	11000
	1 %AEP	4.64	13093	13100
Pond 2				
		Max Outflow - Pre development (m ³ /s)	Required Storage (m ³)	Required Storage Rounded (m ³)
Historic Rainfall	5 %AEP	0.58	1197	1200
	1 %AEP	1.10	1548	1600
RCP8.5 2081-2100 Rainfall	5 %AEP	0.90	1391	1400
	1 %AEP	1.70	1655	1700

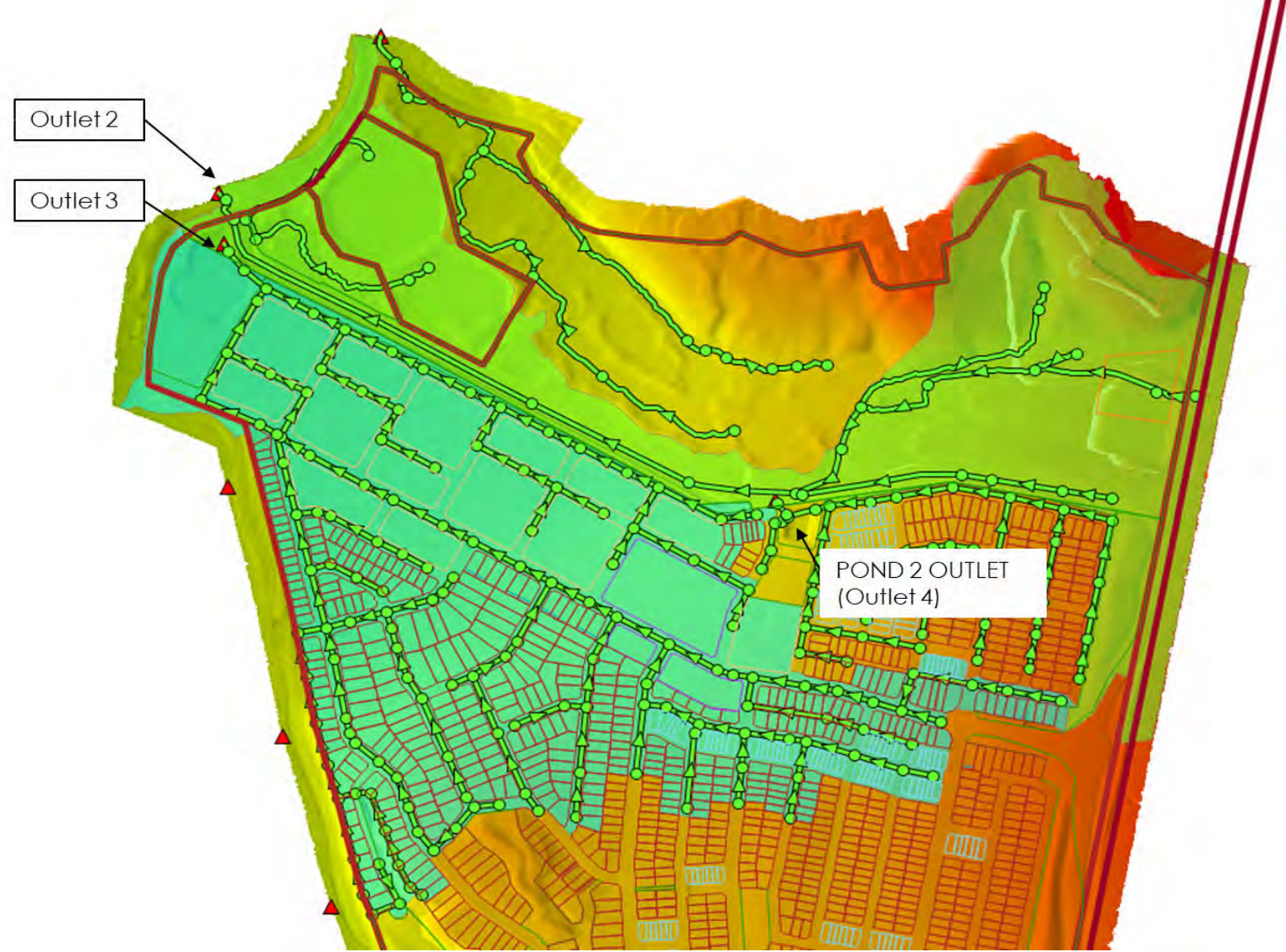
OPTION B - SIZE ATTENUATION TO LIMIT OUTFLOW TO THE 5% AEP PRE DEVELOPMENT PEAK FLOW				
Pond 1				
		Max Outflow - Pre development (m ³ /s)	5% AEP Required Storage (m ³)	1 % AEP Required Storage (m ³)
Historic Rainfall	5 %AEP	1.51	9342	19074
RCP8.5 2081-2100 Rainfall	5 %AEP	2.41	11012	22292
Pond 2				
		Max Outflow - Pre development (m ³ /s)	5% AEP Required Storage (m ³)	1 % AEP Required Storage (m ³)
Historic Rainfall	5 %AEP	0.58	1197	2771
RCP8.5 2081-2100 Rainfall	5 %AEP	0.90	1391	3314

OPTION C - SIZE ATTENUATION LIKE FOR LIKE, HISTORIC PRE FLOW VS FUTURE CLIMATE CHANGE POST FLOW (MATCH PRE DEVELOPMENT PEAK DISCHARGE FOR A GIVEN STORM EVENT)				
Pond 1				
		Max Outflow - Pre development (m ³ /s)	Required Storage (m ³)	Required Storage Rounded (m ³)
Historic Rainfall -	5 %AEP	1.51	16068	16100
RCP8.5 2081-2100 Rainfall	1 %AEP	2.95	19428	19500
Pond 2				
		Max Outflow - Pre development (m ³ /s)	Required Storage (m ³)	Required Storage Rounded (m ³)
Historic Rainfall -	5 %AEP	0.58	2254	2300
RCP8.5 2081-2100 Rainfall	1 %AEP	1.10	2725	2800

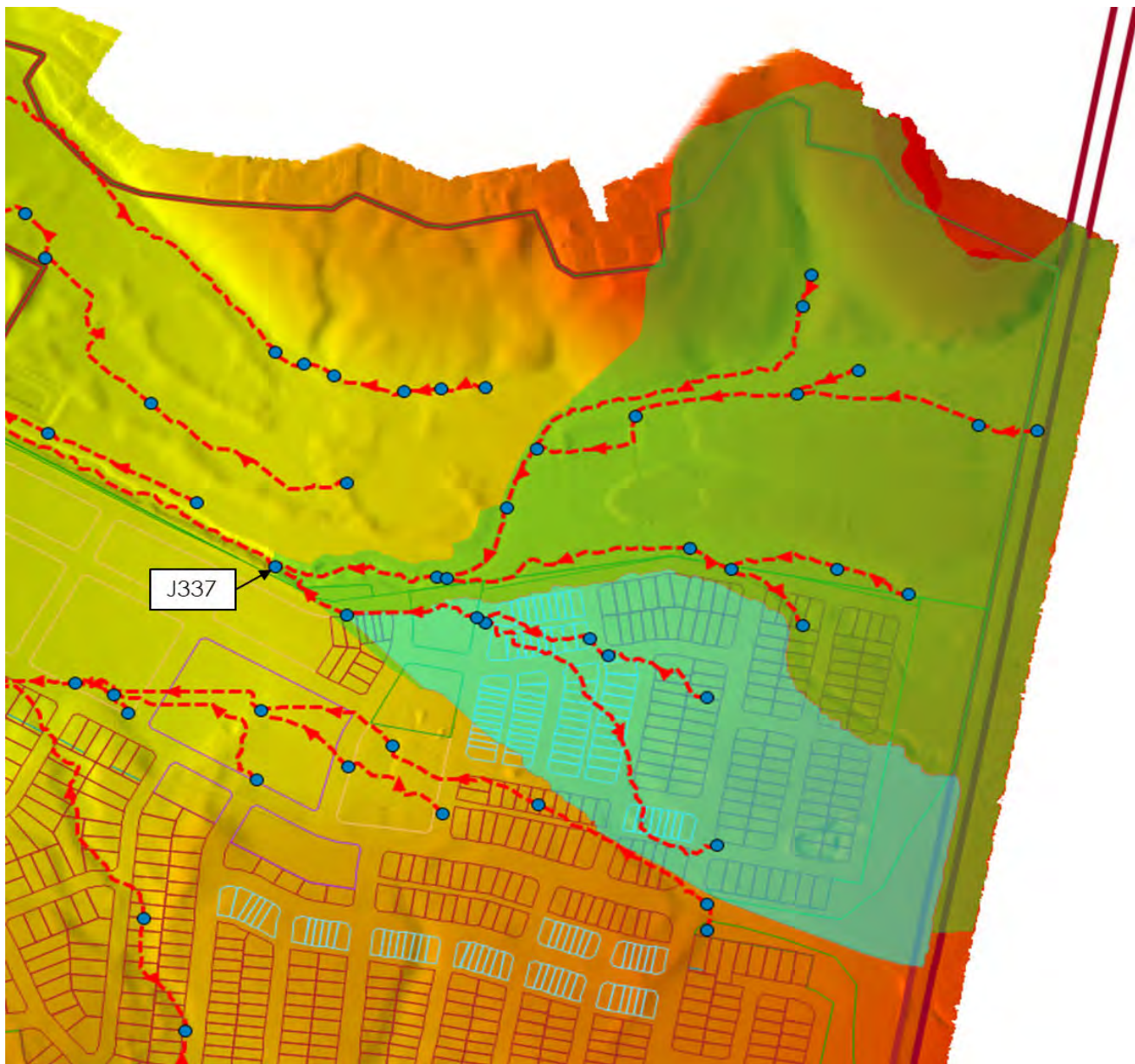
PRE DEVELOPMENT CATCHMENTS - POND 1



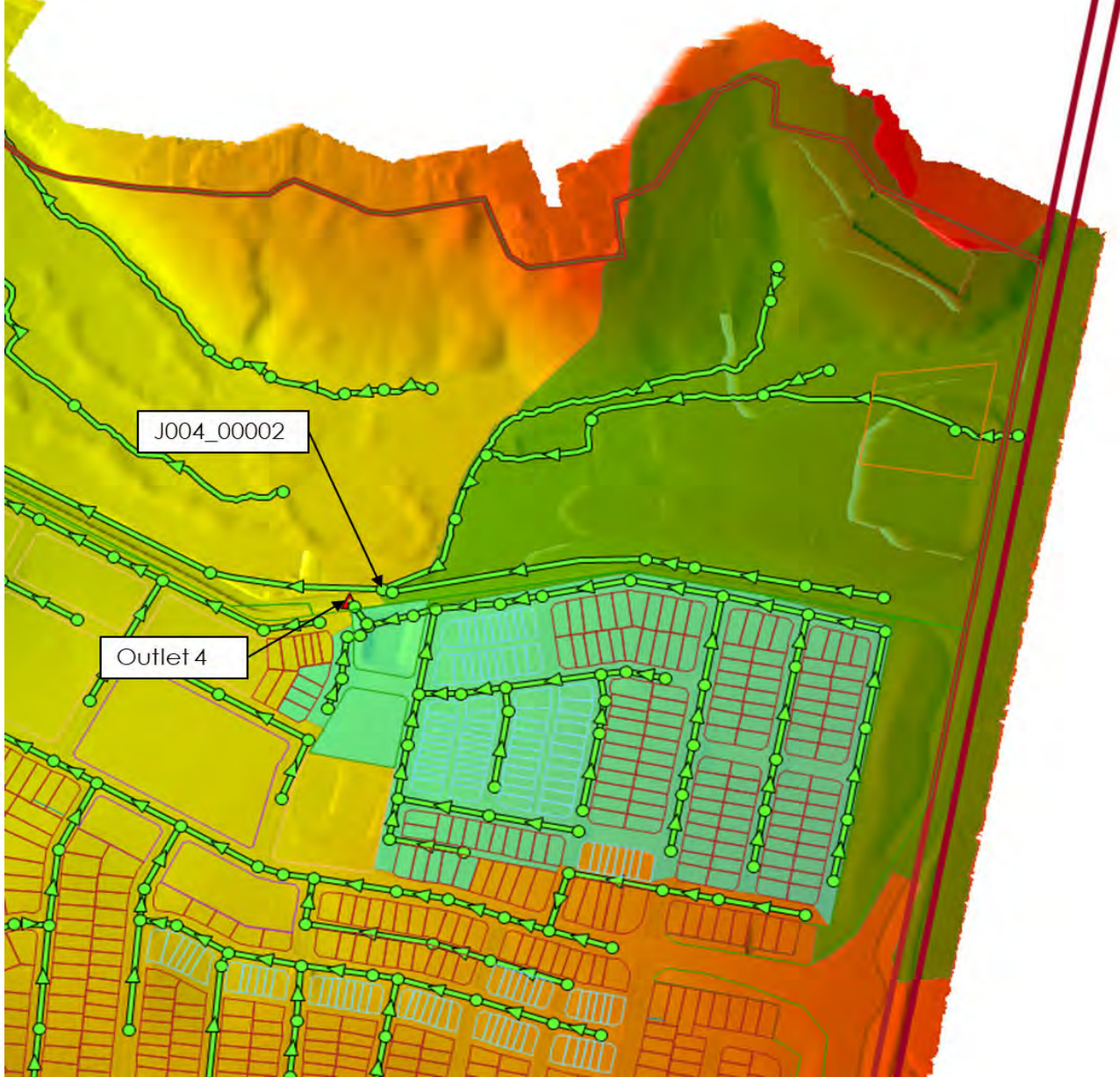
POST DEVELOPMENT CATCHMENTS - POND 1



PRE DEVELOPMENT CATCHMENTS - POND 2



POST DEVELOPMENT CATCHMENTS - POND 2





Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.



RCL Homestead Bay Limited
Suite 201 3-5
Claremont St
South Yarra 3141 Australia

Attention: David Finney, Dan Wells

Flood Diversion Assessment Homestead Bay, Queenstown

Dear David/Dan,

In accordance with the requested extension to our original Agreement dated 9th October 2024, we have undertaken updated hydraulic modelling of the proposed stormwater diversion for the site. This modelling incorporated the current proposed earthworks elevation model provided by Stantec on the 13th of May 2025.

Anticipated 1% AEP (100-year ARI) flood flows from the upstream catchments are defined in our Natural Hazard Reporting for the site (Geosolve ref: 220556.02). Stormwater outflow from within the site of 1.7 m³/s (as provided by Stantec) was also incorporated into the model. The location of this outflow is indicated in Figure 4 of the attached model results. The diversion was found to be effective in diverting all flows, with >500 mm of freeboard.

As shown in attached model results, the freeboard from maximum water surface elevation (WSE) to the banks of the diversion channels was greater than 500 mm in all locations. The WSE in the northern diversion channel is also calculated to be below the outlets of both proposed stormwater detention ponds. As a result, backflow from the diversion channel filling the detention ponds is not considered a risk.

Velocity in the diversions is anticipated to be up to 3 m/s. It is understood that scour protection and detailed channel design is to be undertaken by Stantec. Modelling utilized a Manning's n (hydraulic roughness) of 0.055 as provided by Stantec for the proposed diversion channels to reflect the design hydraulic roughness.

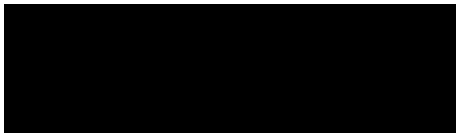
The updated hydraulic modelling was undertaken with a refined computational cell mesh (2m) within the area of the proposed diversion channels. This is considered to provide greater model accuracy within the site and has eliminated the modelled "leakage" from the southern diversion channel associated with the courser computational mesh of previous hydraulic modelling. That modelling was undertaken primarily to determine flood hazard from upstream catchments across the alluvial fan.

The hydraulic modelling calculates the diversions to be effective at conveying flood flows from upstream catchments through the site and away from areas of proposed development.

Applicability

This report has been prepared for the sole use of our client, RCL Homestead bay Ltd, with respect to the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose or in any other contexts, without our prior review and written agreement.

Yours faithfully,



Henry Wadworth-Watts
Water Resources Engineer
GeoSolve Limited

Reviewed for GeoSolve by Neil Williman, Senior Water Resources Engineer, CPEng

Attachments: HEC-RAS 2D hydraulic model results

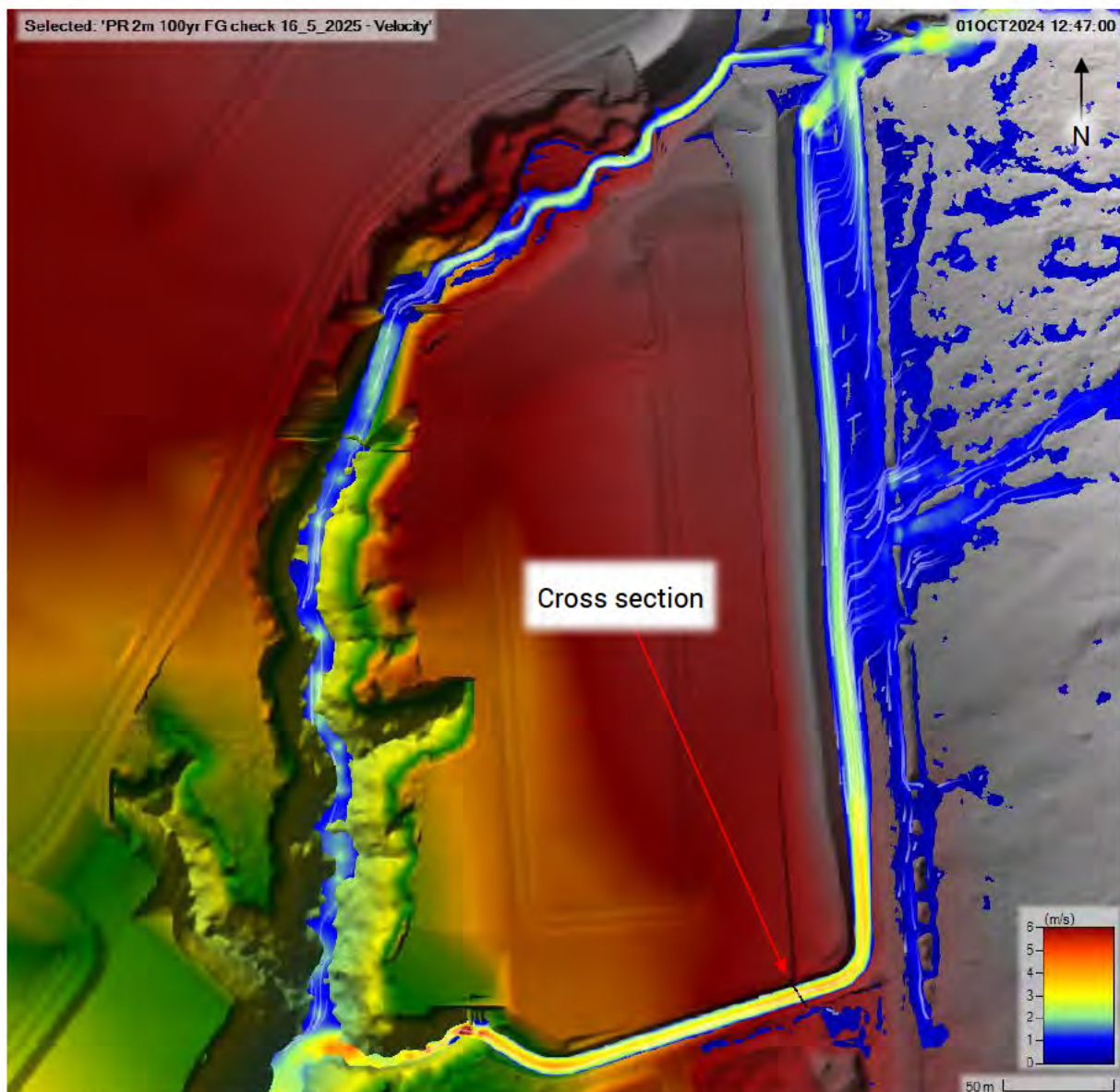


Figure 1: Flow extent and Velocity in Southern Diversion Channel, refer to previous reporting for site layout (Flow direction is east to west)

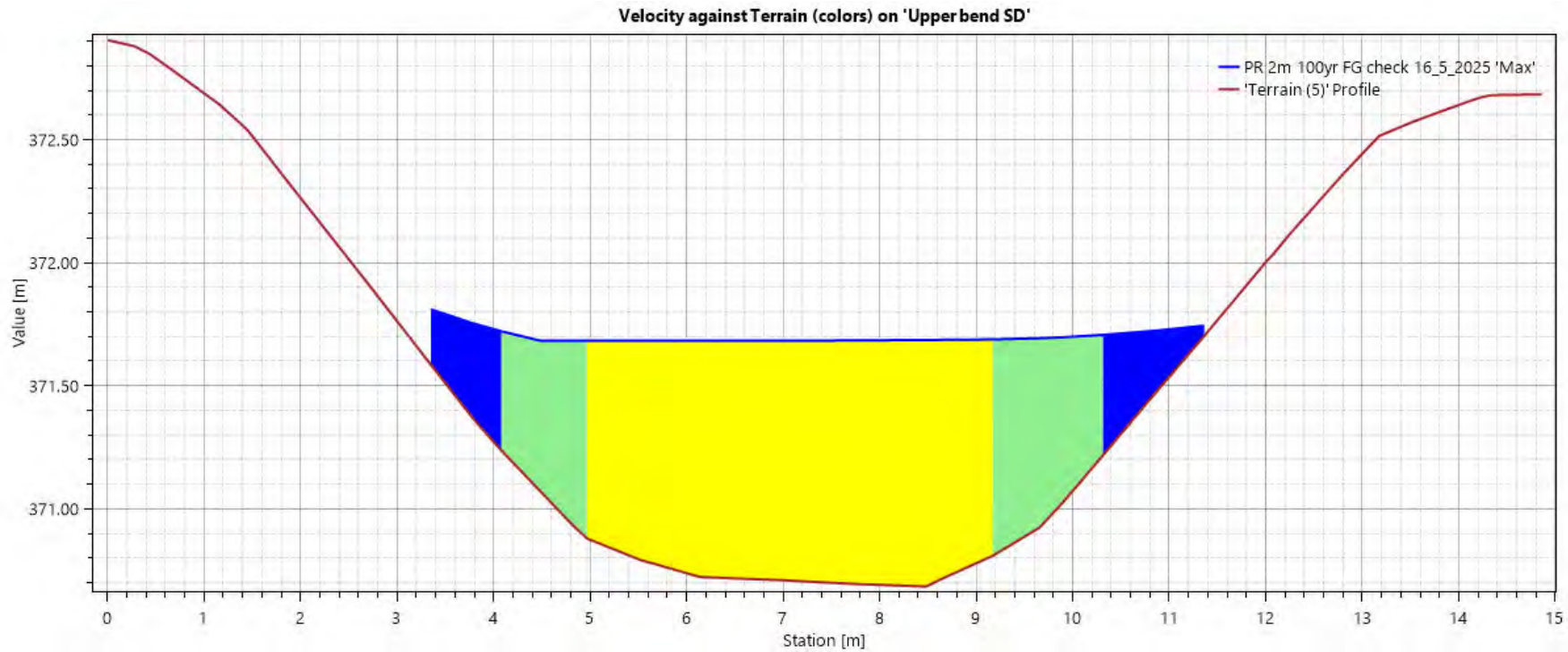


Figure 2: Cross section of maximum water surface elevation and velocity in the southern diversion channel (refer to colour scale on Figure 1 for velocity).

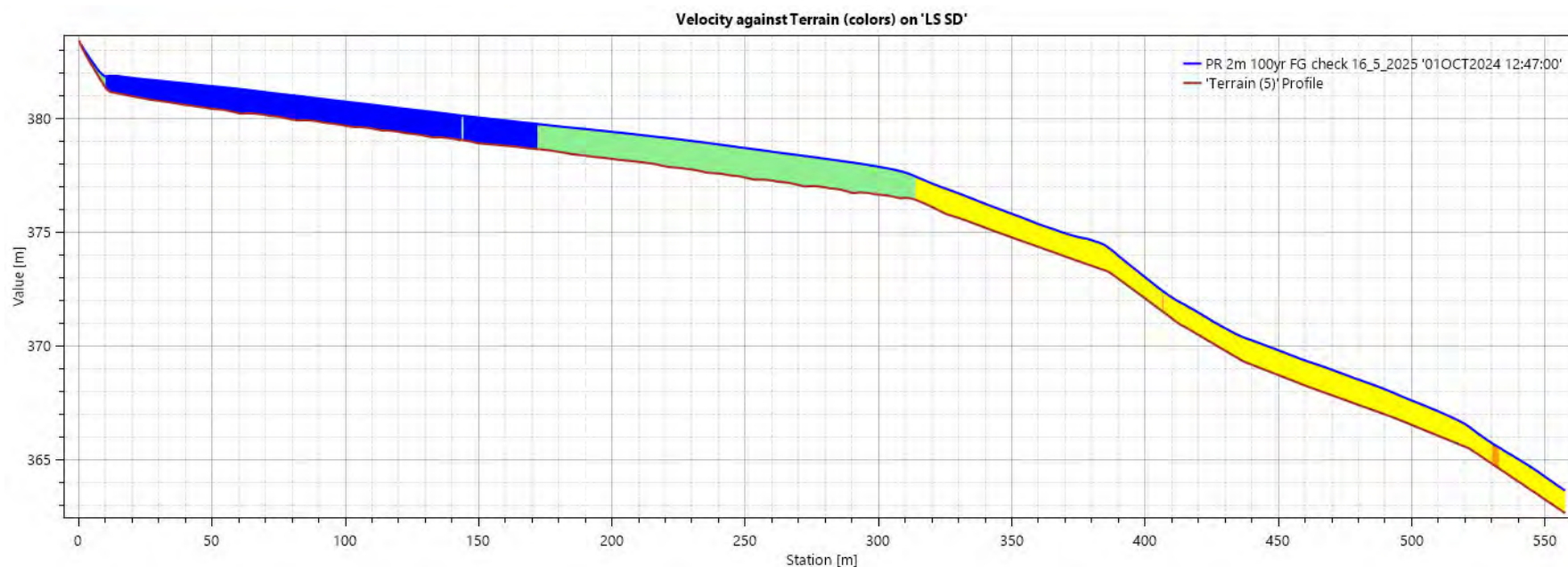


Figure 3: Long section of maximum water surface elevation and velocity in the southern diversion channel (refer to colour scale on Figure 1 for velocity).

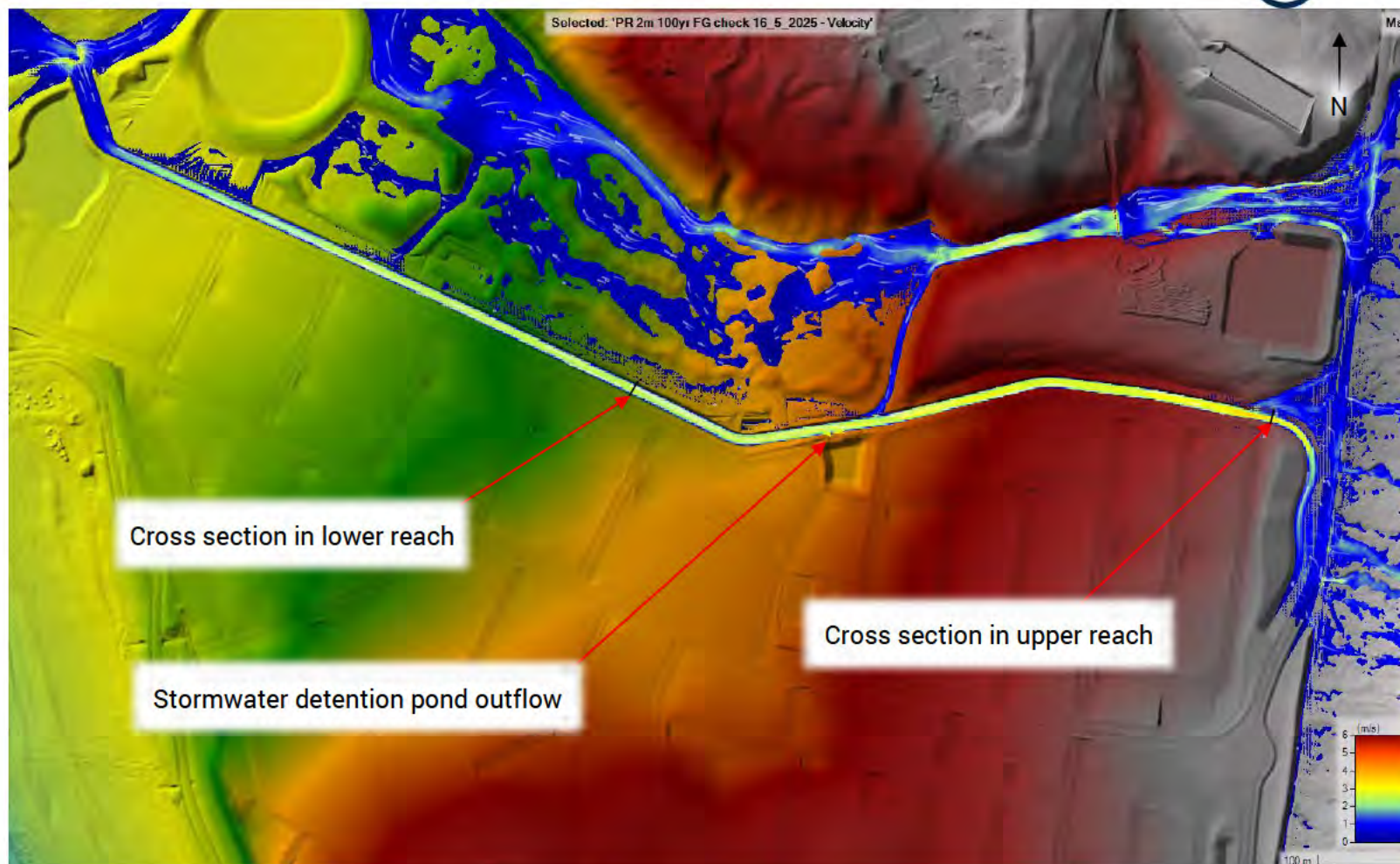


Figure 4: Flow extent and velocity in the northern diversion channel, refer to previous reporting for site layout. (Flow direction is east to west).

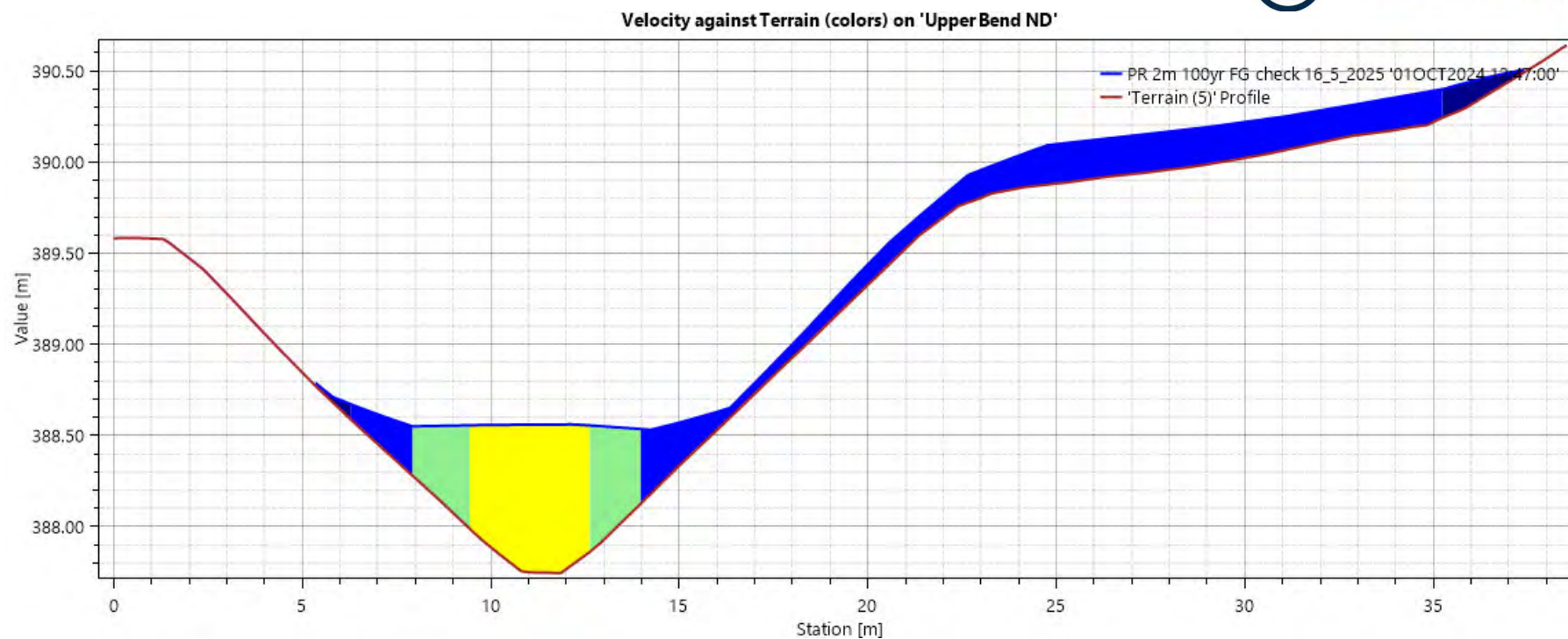


Figure 5: Cross section of maximum water surface elevation and velocity in the upper northern diversion channel (refer to colour scale on Figure 1 for velocity).

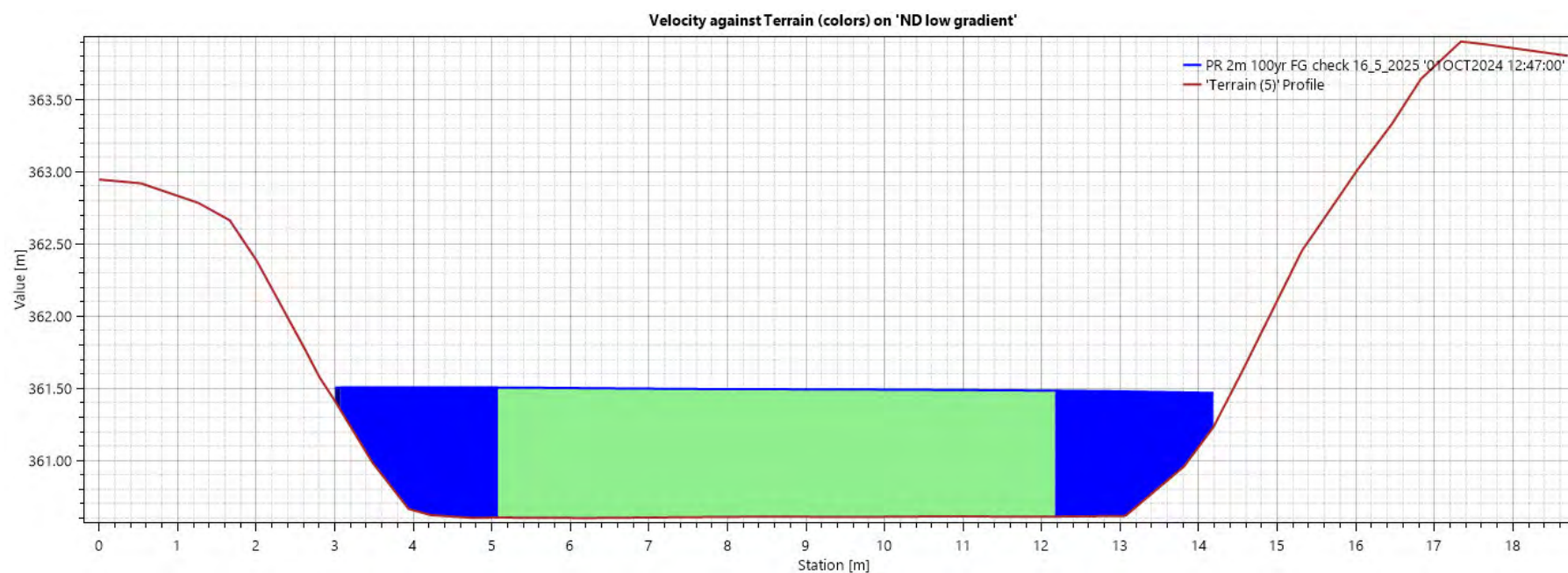


Figure 6; Cross section of maximum water surface elevation and velocity in the lower northern diversion channel (refer to colour scale on Figure 1 for velocity).

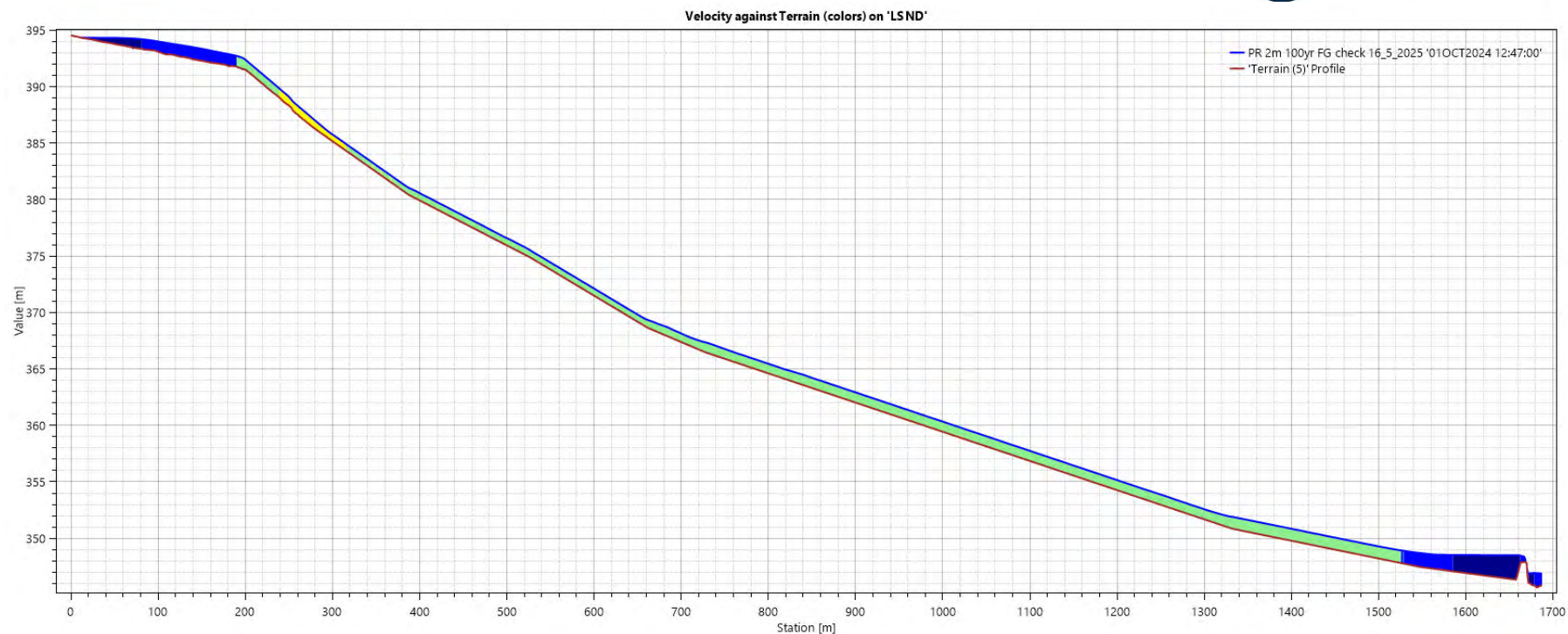


Figure 7: Long section of maximum water surface elevation and velocity in the northern diversion channel (refer to colour scale on Figure 1 for velocity).