Environmental Management Plan

Northbrook Arrowtown

August 2025

Document Control	
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A	05/12/2024	For Client	WT	TG
B	20/02/2024	Following external review	WT	TG
C	13/03/2025	ESCP updated to include stockpile location, building C extent and SRP 2 forebay.	WT	TG
D	11/04/2025	EMP updated to provide water take parameters from RM21.548.01 and incorporate into the associated dewatering methodology.	WT	TG
E	11/06/2025	Environmental representative and Project Manager details updated.	TG	TG
F	05/08/2025	Revised location of SRP 6 and ESC devices for the Lot 4 stockpile area	WT	TG

Appendices	
Appendix 1	Erosion and Sediment Control Plan Drawings
Appendix 2	Calculations for Erosion and Sediment Controls
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Emergency Contacts

Contact made with any of the following shall be undertaken with due consultation of the Environmental Representative or Project Manager.

Table 1: Emergency Contacts

Element	Emergency Contact	Details
Pollution incident	Otago Regional Council (ORC) Spill Hotline	0800 800 033 pollution@orc.govt.nz compliance@orc.govt.nz
Environmental complaint	Environmental Representative	Lewis Bellas Paul Smith Earthmoving 027 3935370
Discovery of contaminated land	Environmental Representative	
Unexpected heritage finds	Environmental Representative	
Human remains	New Zealand Police	111
Fire including bushfire	Fire and Emergency New Zealand (FENZ)	111
Public utilities	Queenstown Lakes District Council (QLDC)	(03) 441 0499 rcmonitoring@qldc.govt.nz
Internal contacts	Project Manager	Lauren Christie Winton [redacted]
Internal contacts	Environmental Consultant	Tom Grandiek Enviroscope [redacted]

1.0 INTRODUCTION

1.1 Purpose and Scope

On behalf of Patersons, Enviroscope has prepared this Environmental Management Plan (EMP) for the earthworks associated with the development of a retirement complex referred to as Northbrook Arrowtown, within the wider Waterfall Park Development, Arrowtown. This EMP aims to reduce the effects of the project's construction activities on the environment and sensitive receptors.

This EMP is prepared according to the Queenstown Lakes District Council (QLDC) QLDC Guidelines for Environmental Management Plans, June 2019 (EMP Guidelines). It is considered to have a 'High' environmental risk level as per the risk categories outlined in the EMP Guidelines.

This document will also ensure that the project aligns with the objectives and policies of the Otago Regional Council's (ORC) Plan Change 8, specifically Topic 7: Part G: Sediment from earthworks for residential development; and Otago Regional Council: Guide – Residential Earthworks in Otago.

The purpose of this EMP is to be an effective and practical reference manual for construction personnel that applies to all project activities during the construction phase and includes the following:

- Strategies to manage environmental aspects and risks, based on associated best practice.
- Provides for contingency planning.
- Provides a framework for monitoring, reporting, review and continual improvement.
- Defines roles and responsibilities.
- Procedures to investigate and resolve environmental non-conformances and initiate corrective and preventative actions.

An overview of the project and sequencing can be found in the construction methodology at **Section 2.0**.

1.2 Site Overview

The subject site, legally described as Lot 1 DP 540788, is located at 1 Ayr Avenue Arrowtown and forms part of the wider Waterfall Park Development. Major elements of previous works undertaken within the site include the realignment of Mill Creek, associated crossings, the enhancement of existing heritage buildings now known as the Ayrburn precinct, associated infrastructure and extensive landscaping and indigenous revegetation of Mill Creek.

The subject site is situated towards the North of the property, historically referred to as Waterfall Park. The work footprint sits alongside the realigned section of Mill Creek, which runs through the site from north to south, serving as the major tributary of Lake Hayes.

The Waterfall Creek area of the site is a small, confined valley with moderately steep adjoining faces that are heavily vegetated. Much of the work's area has already been modified as part of previous stages of consented earthworks and features existing retention ponds, diversion channels and access routes. This is shown in **Figure 1** below.

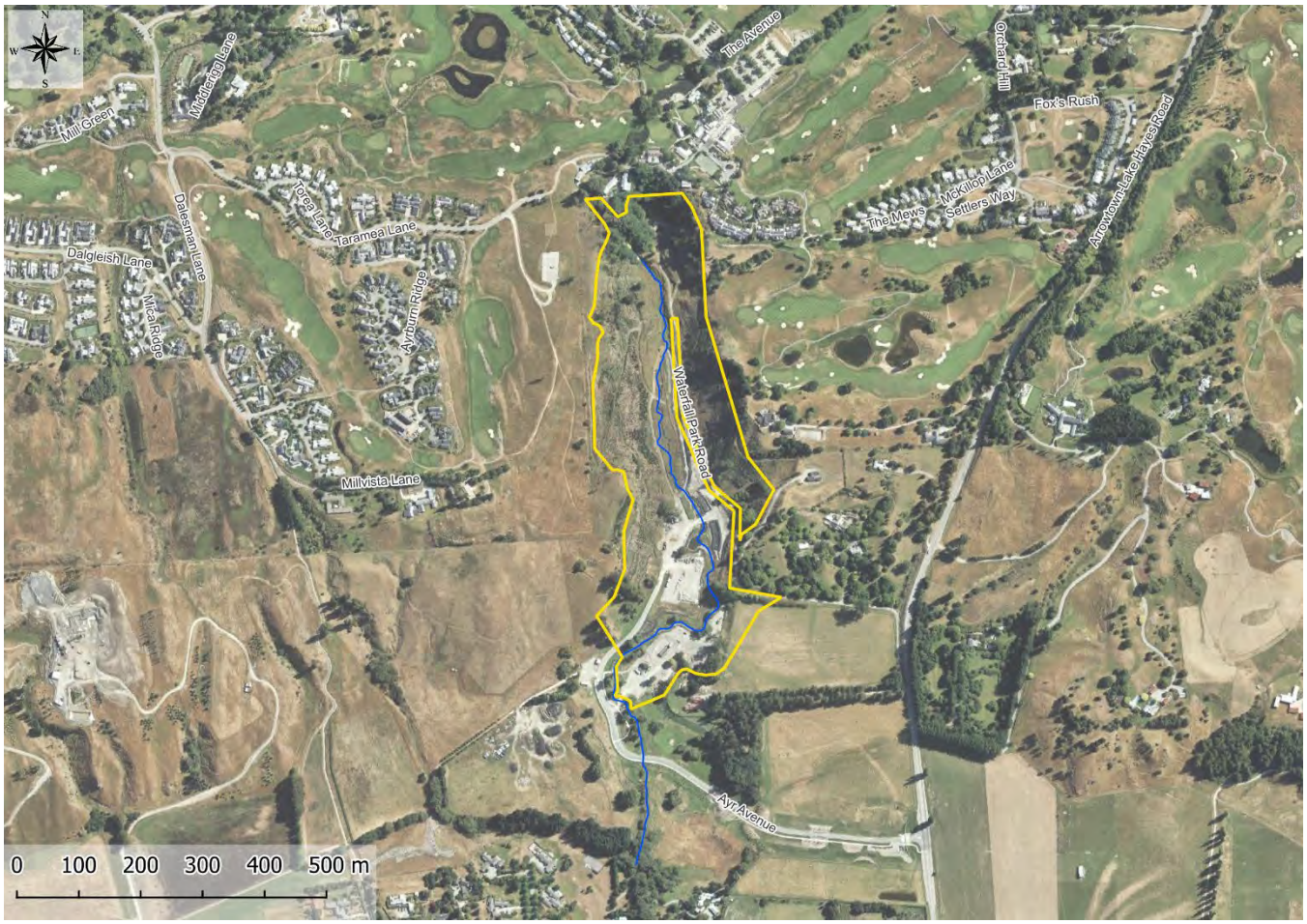


Figure 1: *Location of the site (Source: QGIS, scale 1:10,000)*

1.2.1 Soils and Geotechnical Summary

A geotechnical report has been prepared by GeoSolve dated March 2023 which details site investigations and reports on the geotechnical conditions including drainage potential. The report notes that "*the subsurface soils observed during site investigations adjacent to Mill Creek typically comprised surficial layers of topsoil, fill and floodplain deposits overlying variably interbedded layers of alluvial deposits which are underlain by lake sediments. The main geological units present adjacent to Mill Creek are as follows:* ***Topsoil*** *comprises black/dark brown, soft to firm, organic SILT with rootlets;* ***Buried topsoil*** *layers were observed to underlie fill and floodplain deposits in places comprising soft to firm, organic SILT; isolated layers of* ***uncontrolled fill*** *were observed at the surface in places and comprising grey/brown, medium dense, silty, sandy, GRAVEL, silty SAND with minor to some gravel and gravelly, silty SAND;* ***Floodplain deposits*** *were observed to underlie the topsoil in places and comprising grey, loose to medium dense SAND, silty SAND and soft to firm, grey SILT; and* ***Alluvial deposits*** *comprise variable interbedded SANDS, SILTS and GRAVELS. These deposits are generally loose to medium dense/soft to firm. Swamp/alluvial SILT and SAND deposits with a high proportion of organic material were observed in places at a depth of between 0.4 – 1.5 m bgl; and* ***Lake sediment*** *comprises grey, medium dense SANDS and silty SANDS to firm, sandy SILTS and SILTS which extend to a proven depth pf 25.5 m bgl. The base of the lake sediment unit was not observed in the test pit excavations or within some boreholes*".

The proposed works' extents are predominantly on the true left of Mill Creek on the eastern side of the valley. Due to the proposed depth of the Building C basement excavation in this scope of works, it is expected that groundwater level will be encountered during the initial excavations. This has been acutely considered throughout the preparation of this EMP, with management measures associated with groundwater discovery discussed further in **Section 4** and **Section 5** of this document.

1.2.2 Summary of Earthworks

Building A

400 m^3 of topsoil will be stripped at a 300 mm depth from the Building A footprint profile and stockpiled east of Mill Creek for future reuse. A surface area of 3,300 m^2 of washed aggregate from the temporary parking area will be stripped and stockpiled east of Mill Creek. 2,950 m^3 of pitrun aggregate (or approved equivalent) will be placed, compacted and trimmed to design subgrade level under the Building A and associated roading footprints.

Building B

TBC – not included in Stage 1

Building C – Basement Excavation and Backfill

11,500 m^3 of material will be excavated from the Building C basement and stockpiled within the nominated stockpile area. A total of 3,800 m^3 of material will be used as backfill for the basement excavation, placed in accordance with the specifications provided by Geosolve.

Buildings D-E – Temporary Laydown/Stockpile Area during Stage 1

A total of approximately 10,000 m^3 of topsoil material will be stripped, with 5,000 m^3 to be respread over the site. The remaining topsoil will be stockpiled for use in later stages of the project. 1,200 m^3 of subsoil material will be excavated and reused as fill, with an additional 1,300 m^3 of aggregate material to be imported to achieve the required 2,500 m^3 total fill volume. This aggregate material will be used to form the laydown surface during Stage 1. The total maximum extent of earthworks will be undertaken over 6.5 ha.

1.3 Associated Resource Consents

This EMP has been prepared in accordance with industry best practices to ensure that all relevant conditions of associated resource consents are addressed. Provided the activity is undertaken in accordance with this EMP, it will comply with the relevant conditions set within the associated resource consents. The resource consents associated with this project are given in **Table 2**. Associated Resource Consent Conditions are attached as **Appendix 11**.

***Table 2:** Associated resource consents*

Resource Consent Number	Related Council	Activity Description	Date of Decision Issue
RM220926	QLDC	To operate a retirement village and hotel with associated landscaping facilities.	20/11/2023

RM21.548.01	ORC	To take and use groundwater	22/12/2021
RM23.276.01	ORC	To carry out earthworks for the purpose of residential development.	04/08/2023
RM23.276.02	ORC	To discharge sediment to land in a manner that may enter water for the purpose of residential development.	04/08/2023

1.4 Suitably Qualified and Experienced Professional

This EMP has been reviewed by Tom Grandiek of Enviroscope Limited. Tom is a certified Environmental Professional (CEnvP) and holds a Bachelor of Applied Sciences degree, majoring in Environmental Management. He spent five years working in RMA compliance with local government. Tom has extensive experience in the preparation and monitoring of EMPs and ESCPs.

Tom meets the criteria of a Suitably Qualified and Experienced Professional (SQEP) for the purposes of preparing this EMP and overseeing the environmental aspects of this project.

2.0 CONSTRUCTION METHODOLOGY

2.1 Sequencing of Works

The following sequencing will ensure the earthworks are undertaken efficiently while ensuring good environmental outcomes. This is a preliminary staging methodology and may be subject to change based on site conditions encountered during construction. This methodology shall be read in conjunction with the Erosion and Sediment Control Plan (ESCP) attached as **Appendix 1**.

Preliminary works and site establishment

- Ensure the current EMP is available onsite and complete site induction with the Environmental Consultant.
- Form a new stabilised access off Ayr Avenue.
- Install clean water diversions upslope of the extent of the works, including associated stormwater infrastructure pipelines to ensure clean water is conveyed beyond the extent of the works area. These are to be done in accordance with the final engineer design.
- Install sediment settlement tank, the new forebay of SRP 2 and associated chemical treatment devices. Full sizing and dimensions are provided in **Appendix 2**.
- Install SRP 4 and SRP 5. Full sizing and dimensions are provided in **Appendix 2**. Install silt fence below SRP 4.
- Install DWDCs and associated trafficable swales and check dams, stabilising outlets to prevent erosion. Full sizing and dimensions are provided in **Appendix 2**.
- Install sheet piles on the western side of the basement, set above the 20-year ARI flood level of Mill Creek in accordance with the engineered design to prevent water from the creek entering the Building C basement excavation.
- Install the clean water diversion channel (CWDC) upslope of the proposed Stages 1B-1C stockpile area.
- Establish a stabilised access at the entrance to the proposed stockpile area.
- Install the dirty water diversion channels (DWDC), combined clean/dirty water diversion channels, engineered-design water tables and associated culverts connecting the stockpile area to sediment retention pond 6 (SRP 6).

Stages 1 – Building C Basement Excavation and Civils

- Form cut and fill batters above the proposed building platforms and immediately stabilise in accordance with geotechnical recommendations.
- Progressively form the alignment of Road 01, including associated roadside swales which shall be tied into retention devices as required. Lay skim of aggregate and compact road surface once subgrade levels are reached. This will serve as the primary haul route for this stage of the project.
- Undertake the Building C basement excavation to design levels. This shall be undertaken from north to south, leaving bays of SRP 2 operational for as long as practically possible. Any groundwater encountered during excavations shall be dewatered and treated in accordance with the dewatering best-practice methodology outlined below.
- Form building platforms to design levels, including infilling of the temporary basement excavation. Once building platforms are formed to design levels, these will be capped with clean aggregate to prevent dust generation and minimise erosive potential. The remaining surfaces shall be topsoiled, seeded or otherwise planted in accordance with the associated landscape design plan.

Stockpile Area Management

The nominated stockpile area depicted on ESCP-002, **Appendix 1**, shall be utilised for excess material generated during different stages of the Northbrook Waterfall Park development. Stockpiled material may be susceptible to erosion. As such, the following measures should be implemented to manage stockpiled material:

- Install clean water diversions upslope of stockpiled material.
- Install dirty water diversion channels (DWDCs) downslope of stockpiled material, including culverts where necessary to facilitate vehicle access whilst maintaining channel integrity.
- Where perched groundwater may be encountered, lined clean water diversion channels (CWDCs) or pipe-drop structures shall be installed to convey water beyond the extent of earthworks and/or stockpiled material. Silt fences shall be installed upslope of clean water diversions where exposed material may wash into the channel.

Groundwater Dewatering – best-practice methodology

Excavation of the basement of Building C is considered the most likely activity to result in encountering groundwater. Estimates of groundwater flows that may require pumping have been assumed based on previous works in this area and observations of an existing subsoil drain in the area, in direct contact with the water table. Likely inflows of the basement excavation during the initial excavations are likely to be between (2-8 L/s) and would likely be a consistent flow. Abstraction of groundwater must neither exceed 30 L/s, nor 77,760 m^3/month in accordance with condition 1 of RM21.548.01. The excavation, construction and subsequent infilling of the basement excavation is anticipated to be completed within twelve working weeks (subject to weather and ground conditions). The following dewatering methodology should be implemented throughout construction to limit the potential effects associated with dewatering activities.

Methodology:

- Abstraction of groundwater must not exceed 30 L/s in accordance with condition 1 of RM21.548.01.
- A water meter and datalogger must be installed in the dewatering pump in accordance with condition 4 of RM21.548.01 to measure the rate and volume of water abstracted within an accuracy range of +/- 5%. The existing flow meter shall be calibrated prior to works to ensure abstractions can be measured.
- All contained water resulting from the dewatering process will be treated via the settlement tank/SRP 2 ‘treatment train’ prior to discharge from the site, to provide the maximum level of attenuation and treatment. The controls proposed as part of these works have been designed above, what is referred to as industry best practice, prescribed by GD05.
- Form a sump within the low point of the excavation to direct ground water and any surface water to singular point. Pump from the top of the water column using a float or similar to keep the intake off the bottom of the sump. This will remove cleaner water while avoiding the mobilisation of sediments.
- Water will be pumped into a settlement tank, via an inline flow activated chemical dosing unit to achieve water quality discharge criteria. The settlement wank will be connected to the existing southern bays of SRP 2, forming a ‘treatment train’ to maximise the sediment settlement efficiency and maximise water quality, prior to discharging to Mill Creek.
- Ensure that the inlet and outlet of the ‘treatment train’ are not creating any erosion issues. An energy dissipater may need to be installed at the inlet and outlet to prevent this.
- Monitoring the discharge is critical to ensure that pumped water meets the required discharge standards in relation to water quality and quantity. Water quality is to be measured and recorded in accordance with

Appendix 9.

- In the event that dewatering volumes exceed the capacity of sediment retention devices, the contingency measures outlined below shall be implemented.

Monitoring

To assess the ongoing suitability of extracted water for discharging off site, water quality monitoring will be undertaken prior to commencement and for the duration of dewatering activities on site. Ongoing monitoring is also required to ensure the treatment solutions are functioning as intended and confirm the quality of discharged water is within acceptable ranges. Monitoring will be undertaken by the contractors nominated Environmental Representative and the Environmental Consultant. Water quality discharge criteria and recording is provided in **Appendix 9**.

Contingency

All contained water resulting from the dewatering process will be treated via the settlement tank/SRP 2 'treatment train' prior to discharge from the site, to provide the maximum level of attenuation and treatment. If this is not possible, or the volume of groundwater is too high for effective treatment, the following contingency measures should be adopted:

- On-site reuse of groundwater should be considered a priority for all dewatering activities. Dewatered groundwater from areas with low potential for contamination may be reused on site. Examples include use for dust suppression, to assist with compaction, re-injection or watering landscaped areas. Reused water must never be discharged in a manner that exceeds the capacity of sediment controls and/or generates runoff on site surfaces.
- Disposal off site to a licenced disposal facility via pumping to water carts.
- Cease works temporarily to determine additional contingency measures.

Decommissioning

- Remove erosion and sediment control devices once stabilisation has occurred across the entire site. This is generally defined as 80% vegetative cover.

2.2 Hours of Operation

Construction activities and the associated hours of operation shall comply with *NZS 6803:1999 Acoustics - Construction Noise Guidelines*. Site works may be undertaken between 0730 and 1800 hours, Monday to Saturday. No works are to be undertaken on Sundays or Public Holidays. However, this does not preclude any emergency works or works required for incident investigation or response. Additional detail relating to noise-producing activities are to be undertaken in accordance with **Section 7.0** of this EMP.

3.0 EMP IMPLEMENTATION

3.1 Environmental Roles and Responsibilities

3.1.1 Project Manager

The Project Manager is responsible for the effective implementation of the EMP and has overall responsibility for the environmental performance of the project. Duties include:

- Ensuring adequate resources are in place to implement the EMP.
- Ensuring all staff and sub-contractors operate within the guidelines of the EMP.
- Ensuring that an EMP is prepared and that environmental standards, processes and procedures meet relevant resource consent conditions.
- Overseeing the successful implementation, monitoring and review of the EMP.
- Ensuring that inspections are carried out in accordance with the relevant EMP.
- Restricting or stopping any activity that has the potential to or has caused adverse environmental effects.
- Providing notification and reporting of Environmental Incidents to Council and other environmental reports as required by The Guidelines.
- Delegating authority of the above responsibilities.

3.1.2 Environmental Representative

The Environmental Representative supports the Project Manager in the day-to-day implementation of the EMP. Duties include:

- Ensuring the installation of environmental controls as per the EMP.
- Undertaking environmental site inspections.
- Undertake water quality sampling during rainfall events.
- Overseeing the maintenance and improvement of defective environmental controls.
- Providing environmental inductions to all staff and sub-contractors.
- Assisting the project leadership in attending to Environmental Incidents and Complaints.

The Environmental Representative shall be familiar with environmental risks associated with the project, the EMP and best practice erosion and sediment control principles and practices.

3.1.3 Environmental Consultant

The Environmental Consultant (SQEP) will provide technical environmental management advice as required. Key tasks include delivering the Site Environmental Induction to core staff and providing as-built confirmation of erosion and sediment controls to Council. The Environmental Consultant shall undertake monthly monitoring of the site and submit Monthly Environmental Reports to QLDC and ORC.

3.1.4 All Staff and Sub-Contractors

All staff and sub-contractors have a responsibility to undertake all activities in accordance with the requirements of this EMP. This includes reporting any activity that has the potential to or has resulted in an Environmental Incident to the Project Manager or Environmental Representative.

3.2 Site Environmental Induction

All staff and subcontractors shall attend an Environmental Induction to ensure they are aware of the project's environmental risks as well as their responsibilities to help manage these risks. Prior to ground-disturbing activities, the Environmental Consultant will deliver the induction to core staff. During the project, the Environmental Representative will induct sub-contractors and new staff.

The site induction handout is attached as **Appendix 3** and all persons inducted will be recorded on the Induction Register attached as **Appendix 4**.

3.3 Environmental Inspections

Table 3 outlines the regular environmental inspections to be undertaken.

***Table 3:** Environmental inspections*

Environmental Inspection	Timing	Purpose
Weekly Inspection	Every seven days	A comprehensive environmental inspection will: • Confirm that all environmental controls are present, functional, and adequate. • Identify any activities that may cause an environmental incident or actual or potential environmental effects. • Identify maintenance requirements for implemented management measures. All weekly inspections shall be recorded on the Weekly Site Inspection form attached as **Appendix 5**.
Pre-Event Inspection	Prior to a significant rain event[1]	To ensure that erosion and sediment controls are present, functional, and adequate for forecast rain event. This inspection will inform any preventative work required and may result in the Rapid Response Procedure being implemented (see **Section 4.8**).

[1] A significant rain event is defined as any forecast/actual rain event of 15 mm within a 24-hour period or a rain event that can generate overland flow, noting that this varies seasonally.

Environmental Inspection	Timing	Purpose
Rain Event Monitoring	During a significant rain event	To ensure that: • Erosion and sediment control devices continue to function correctly and inform any necessary emergency responses. • Sediment retention devices are functioning effectively and have capacity available. • No dirty[2] water is crossing the boundary of the site. Observations and remediation measures taken will be recorded in a daily job diary.
Post-Event Inspection	Immediately following a significant rain event	Any observations and corrective actions should be recorded in a daily job diary.

3.4 Monthly Environmental Inspection and Reporting by SQEP

The Environmental Consultant (SQEP) will monitor the site monthly to ensure that the EMP is correctly implemented, identify any unforeseen issues arising and advise on alternative environmental solutions. The Environmental Consultant (SQEP) will also submit a Monthly Environmental Report to QLDC and ORC within five working days of the end of each month. The report will include the following information:

- Updates to the EMP and the Erosion and Sediment Control Plan (ESCP) during the month.
- Number of weekly and pre and post-rain event site inspections completed.
- Summary of corrective actions undertaken.
- Positive environmental outcomes achieved and opportunities.

3.5 Environmental Incident Management

Environmental incidents shall be responded to as soon as the project team becomes aware of them occurring. The response will generally involve oversight by the Environmental Consultant and will involve:

- Immediate cessation of the activity that caused the incident.
- Investigation into the cause of the incident.
- Initial response to bring the incident under control.
- Implement any remediation works.

The Project Manager shall notify QLDC and ORC of the details of any Environmental Incident within 12 hours of becoming aware of the incident. Notification will be through a phone call to Council monitoring staff (see Emergency Contacts in **Table 1**). The Project Team shall provide an Environmental Incident Report within ten working days of the incident occurring. The Incident Report form is attached as **Appendix 6**.

[2] 'Dirty water' is defined as water that exceeds the maximum allowable water quality value outlined in the Discharge Criteria at **Section 5.2.**

3.6 Complaints Procedure

Any complaint received will be recorded and an investigation will be carried out. The complainant will be provided with a response acknowledging receipt of the complaint and outlining corrective actions to be implemented. After the investigation, any necessary corrective actions will be carried out and a follow-up of the original complaint is to be conducted to ensure the actions implemented have been effective. All complaints will be recorded on the Complaints Register attached as **Appendix 7**.

3.7 EMP Non-Conformance and Corrective Actions

EMP non-conformances found during site inspections, monitoring or as a result of environmental incidents or complaints shall be recorded in the EMP Non-Conformance Register. The non-conformance register attached as **Appendix 8** will detail when corrective actions are due, how they are to be carried out and the close out date. The non-conformance register ensures that issues do not escalate or are missed, as well as, providing a clear record of evidence that can be used to defend any potential complaint or formal enforcement action.

3.8 Records and Registers

The records listed below will be collated onsite. If a request is made by a QLDC and ORC official, the records shall be made available to the official within 24 hours of the request being made.

- Environmental Induction Register - **Appendix 4**.
- Weekly Environmental Inspection Form – **Appendix 5**.
- Environmental Incident Reports - **Appendix 6**.
- Complaints Register - **Appendix 7**.
- EMP Non-Conformance Register - **Appendix 8**.
- Water Quality Monitoring Results - **Appendix 9**.
- Rain event inspection observation – Job diary

3.9 EMP Updates

The EMP will be regularly reviewed throughout the project to ensure the document remains fit for purpose and to drive continual improvement. This may be initiated by:

- Significant changes to the construction methodology.
- Improvements identified as a result of an Environmental Incident or Corrective Action.
- Where directed by QLDC and/or ORC's Monitoring and Enforcement team.

All EMP updates will be managed through the document control table on page one and shall be submitted to QLDC and ORC for acceptance.

4.0 EROSION AND SEDIMENT CONTROL MEASURES

4.1 Performance Criteria

Design, install and maintain erosion and sediment controls in accordance with industry best practices. Generally, this is:

- Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region 2016 (Auckland Council Guideline Document GD2016/005).
- Queenstown Lakes District Council's (QLDC) QLDC Guidelines for Environmental Management Plans, June 2019 (The Guidelines).
- Otago Regional Council's (ORC) Residential Earthworks in Otago Guidelines 2023.

4.2 Erosion and Sediment Control Principles

Erosion and sediment control ('ESC') devices shall be installed, maintained and decommissioned in accordance with the following principles:

- Erosion and sediment controls are integrated with construction planning.
- Construction is staged to minimise the duration and area of exposed soil open at any one time.
- A 'treatment train' approach so that the sediment retention devices operate as efficiently and effectively as possible.
- Separation of 'clean' and 'dirty' water with clean water to be diverted around the site to minimise the volume of dirty water needing management onsite.
- The extent and duration of soil exposure is minimised.
- Controls are always maintained in proper working order.
- Progressively stabilise and revegetate disturbed or completed areas.
- The site is monitored, and erosion and sediment control practices are adjusted to maintain the required performance standard.
- Soil erosion is minimised as far as reasonable and practical.
- Avoidance of sediment discharge off-site and protection of receiving environments.

4.3 Guidance on Erosion and Sediment Control Devices

The effective control of surface water shall be achieved through the utilisation of carefully selected erosion and sediment control devices to achieve a specific purpose. These guidelines for the devices employed on this project shall be read in conjunction with the ESCP attached as **Appendix 1** of this document. At the commencement of the project, the following components onsite will be clearly defined as detailed in **Table 4**.

Table 4: Site definition specifications

Site component	Method of Demarcation
Site boundaries	Temporary fencing or hoardings
Designated site access	Installation of stabilised access/signs

4.4 Erosion Control Practices

4.4.1 Non-Structural Controls

Staging

Only by exposing those areas that are required for active earthworks, the duration of exposure and risk of erosion/sediment discharge can be minimised. 'Earthworks staging', where the site has earthworks undertaken in smaller units over time, limits erosion. This includes isolating work areas and completing them in manageable sections. Staging is demonstrated in the Erosion and Sediment Control plan attached as **Appendix 1**.

Timing of works

Works are to be undertaken during an extended period of favourable weather where possible to reduce potential adverse environmental effects. Ensure that all disturbed areas are stabilised (temporarily or long term) and loose materials are secured prior to forecast rain events to prevent further movement of material.

Progressive rehabilitation

Disturbed areas will be progressively stabilised. It is important that when completed, exposed or disturbed areas are stabilised. Stabilisation methods will vary around the site due to differing gradients and growing mediums. Stabilisation and rehabilitation measures are outlined below:

4.4.2 Stabilisation Measures

Hydroseeding

- Hydroseed is to be applied to all completed work surfaces where practicable.
- It is recommended that a diverse seed mix that provides both short and long-term stabilising properties is utilised. A seed mix consisting of rapidly establishing perennial ryegrass, with longer establishing fescues and Browntop would be suitable. Duraveg Berm Mix supplied by PGG is an example of a seed mix with properties that will enable both rapid establishment and deep root base, which is beneficial to providing rapid stabilisation and long-term stability of the slope.

Manual broadcasting of grass seed mix

- In areas unable to be safely accessed by machinery, manual application of the selected grass seed mix should be adopted. Direct hand sowing in areas of difficult terrain should be undertaken.

Erosion matting

- Biodegradable erosion matting is to be installed on completed surfaces to prevent further erosion and to provide a growing medium for vegetation. Where and when erosion matting is utilised needs to be undertaken per the direction of the Geotechnical Engineer and Environmental Consultant. Coconut fibre matting is to be utilised on the lower grade slopes, in direct proximity to critical source areas or steeper batters that may be prone to mobilisation.
- A more robust geotextile erosion matting may be required on high-grade batters with higher susceptibility to further mobilisation of material, or areas subject to fluvial undermining.

Fertilisers

- The use of fertiliser containing nitrogen or phosphorous is prohibited within the site apart from the initial establishment of hydroseed grass areas and the initial establishment of plants.
- Organic fertiliser such as compost, manure or seaweed shall be permitted provided there is no nitrogen or phosphorous added.
- For plant establishment, fertiliser shall be limited to 1 x 10g slow-release tablet placed below the base of the rootball. There shall be no discharge of contaminants from nitrogenic or phosphatic-based fertilisers into the stormwater detention ponds.
- A record of any fertilisers used at grass/plant establishment and onwards shall be made available to the QLDC upon request.

Temporary Stabilisation – Soil binders

- Erosion control soil binders or polymers may be utilised as a temporary ground stabilising agent on exposed surfaces prior to final shaping and treatment. Polymers help bind soil particles and produce a 'laminated' surface area, reducing susceptibility to erosion. It is recommended that this is applied to long-standing stockpiles.

4.4.3 Stabilised Entranceway

The stabilised access will be installed at the entrance to the Stage 1 works area, as well as the entrance to the proposed stockpile area. The stabilised entranceways will be constructed in accordance with the schematic diagram in ESCP-003, **Appendix 1** (complete guidelines on pages 60-65 of GD05).

4.4.4 "Clean Water" Diversion Channels and Bunds

Clean water diversion channels (CWDC) will be used to capture and divert clean water from the undisturbed surfaces above the exposed works site. The purpose of these devices is to separate clean and dirty water and minimise the size of the contributing catchment.

CWDCs shall be installed upslope of the extent of the works along the haul road to intercept clean water run-on and convey discharge beyond the extent of the work area. Stormwater pipes shall be installed at a number of points along the roadside swale to segment the overall contributing catchment. These shall be installed in accordance with engineering design. These CWDCs shall be consistent with the engineering sizing and dimensions for roadside swales along Road 01, designed to accommodate rainfall events up to and including 100-year events in accordance with the *Stormwater Management Plan* prepared by CKL (March 2023).

Swales are to be stabilised in accordance with the approved SMP, including planting of banks to provide long-term filtration capacity. Until final stabilisation is achieved, clean water diversions shall be stabilised with topsoil, seed and coconut fibre matting to maintain cleanliness of flows. Silt socks/coconut coir logs shall also be installed within the swale as required to capture any residual sediment generated in the swale until full stabilisation is achieved.

A CWDC shall also be installed upslope of the proposed stockpile area to intercept clean water run-on and divert away from the stockpile area. This channel will be stabilised with coconut coir matting. Rock rip-rap should also be placed at the termination point of the channel to prevent erosion of banks above the ephemeral watercourse. Additional CWDCs shall be installed where perched ground water is encountered above the stockpile area in order to convey

clean water away from the extent of earthworks and into the ephemeral flow path gully downslope. The CWDC will be constructed in accordance with the schematic diagram in ESCP-004, **Appendix 1** (complete guidelines on pages 43-46 of GD05). Full calculations are provided in **Appendix 2**.

4.4.5 "Dirty Water" Diversion Channels and Bunds

During Stage 1, a formalised DWDC will be formed along the upslope side of existing site hoardings. This intercepts 'dirty' sheet flows generated on the laydown area and conveys flows to SRP 4. An additional section of DWDC will be installed and tied into the SRP 4 inlet to convey sheet flows away from the Building C basement excavation. The outlets of the DWDCs shall be stabilised with geofabric/rock riprap to prevent erosion of the SRP inlet.

Additionally, a compacted earth bund shall be erected around the perimeter of the Building C basement excavation to prevent runoff generated on surrounding catchments from entering the excavation. Sheet flows intercepted by these earth bunds shall be redirected towards formalised retention devices. As a contingency measure, earth bunds may need to be lined to prevent erosion along the toe of the bund.

DWDCs will be constructed in accordance with the schematic diagram in ESCP-004, **Appendix 1** (complete guidelines on pages 43-46 of GD05). Design parameters for a 'worst-case' scenario DWDC is provided in **Appendix 2**. This shall be used as a global approach across the site.

4.4.6 Combined Clean and Dirty Water Diversion Channels/Bunds

Combined clean and dirty water diversion channels/bunds comprise of a dirty water diversion channel to be formed on the inside camber of road alignments while placing material upslope of the channel to form a clean water diversion bund to intercept any clean water run-on from upslope catchments.

Both the clean and dirty water diversion elements will be formalised in accordance with the specified dimensions of the global dirty and clean water bund profiles discussed in **Section 4.4.4** and **Section 4.4.5** above. Once formed, the combined channel/bund will be consistent with the schematic depicted in ESCP-005, **Appendix 1** (complete guidelines on pages 38-46 of GD05).

4.4.7 Check Dams

Rock check dams will be deployed primarily to reduce the velocity of concentrated flows in the DWDCs. They will also act to capture some coarse sediment. The check dams will be constructed in accordance with the schematic diagram in ESCP-006, **Appendix 1** (complete guidelines on pages 50-54 of GD05).

4.4.8 Temporary Culverts

Culverts shall be used onsite to transport dirty or clean water from one side of the haul road alignment to the other. Culverts shall consist of a PVC, farm-grade, plastic drainage coil or concrete culvert depending on the diameter required. Calculations are provided in **Appendix 2** to demonstrate the culverts can accommodate the upslope run-on water. Geofabric and rock shall be placed at the outlet to prevent scour from the higher velocity water exiting the culvert. Culverts shall be constructed in accordance with the schematic diagram in ESCP-005, **Appendix 1.**

4.4.9 Temporary Stockpiles

Stockpiles will be formed as part of earthworks and be located within the nominated stockpile locations depicted in ESCP-001, **Appendix 1**. It is recommended that long-standing stockpiled material is stabilised with either grass seed or polymer to prevent erosion and generation of dust. Stockpiles shall be constructed in accordance with the schematic diagram in ESCP-012, **Appendix 1.** Refer to **Section 2.1** for the general management approach for nominated stockpile areas.

4.4.10 Pipe-Drop Structures

Pipe drop structures shall be used to transport dirty water from the sediment basin outlet to SRP 6 without causing erosion of the vegetated slope. Regular inspections will check that this water is not causing any downhill erosion and if so, rock riprap or geofabric lining may be necessary.

The pipe drop structure and flume will be constructed in accordance with the schematic diagram in ESCP-014, **Appendix 1** (complete guidelines on pages 55-60 of GD05). Full calculations are included in **Appendix 2**.

4.5 Sediment Control Practices

4.5.1 Sediment Retention Pond

Sediment retention ponds (SRPs) are to be used to capture flows from the DWDC and efficiently settle out sediments from the water column. An SRP decants off the cleaner water at the top of the water column i.e. the live storage range.

A 'treatment train' approach shall be implemented to increase the effectiveness of settlement within SRPs and maximise the cleanliness of discharge. This will generally involve the utilisation of check dams within DWDCs, as well as the utilisation of rain-activated dosing system (RADS) units to provide chemical treatment as discussed in **Section 4.5.2** below. The emphasis on staging and progressive rehabilitation of surfaces will reduce the potential generation of sediment-laden flows and minimise pressure on SRPs. This is discussed further in **Section 4.4.1** and **Section 4.4.2**.

Some existing sediment retention ponds (SRPs) were utilised during previous works within the subject site. It is proposed that these shall continue to service the contributing catchments within this scope of work. These SRPs are lined with geofabric and are chemically treated using a flow-activated dosing system and RADs units.

SRP 1: is not applicable for this initial scope of works. If applicable, this device will be reintegrated into this plan during future stages.

SRP 2: is an existing SRP located along the eastern edge of Mill Creek and is comprised of a series of bays that operate in the form of a 'treatment train'. Originally designed to accommodate a 2.09 ha catchment at 2% sizing criteria, the two northern bays are to be removed as part of the basement excavation of Building C within this scope of works. The remaining two bays will receive surface flows pumped from within the basement excavation and service the resulting C2 sub-catchment of approximately 0.5 ha. These bays provide a total retention capacity of 204 m^3, which exceeds the required storage volume of 100 m^3. It is noted that this includes sheet flow generation only, with additional groundwater base flow to be incorporated into this 'treatment train' with the adoption of a settlement tank. The forebay of SRP 2 will be removed in order to facilitate the basement excavation. A new forebay shall be installed to the immediate east of the remaining northern-most bay, constructed to provide 23.3 m^3 of storage capacity which exceeds 10% of the total

storage volume provided by the remaining bays of SRP 2 (20.4 m^3). Full calculations for the new forebay are provided in **Appendix 2**. This SRP is currently chemically treated via a flow-activated dosing system. This is discussed further in **Section 4.5.2** below. The associated CTMP shall be revised pre-construction to provide updated treatment device parameters for SRP 2. The sizing and dimensions of the remaining bays of SRP 2 are provided in schematics in ESCP-009, **Appendix 1**.

SRP 3: shall be located immediately adjacent to the southern bays of SRP 2 and receive sheet flows from the C3 sub-catchment of approximately 0.3 ha in area via a series of DWDCs. This catchment area comprises an existing laydown which is already largely stabilised with aggregate. This is expected to produce a reduced level of sediment runoff which reduces pressure on the SRP. The SRP provides a total retention capacity of 65.9 m^3, which exceeds the required storage volume of 60.0 m^3. The associated CTMP shall be revised pre-construction to provide updated treatment device parameters for SRP 3. The sizing and dimensions for SRP 3 are provided in **Appendix 2**.

SRP 4: shall be located north-west of the Building C basement excavation as depicted on ESCP-001, **Appendix 1**. This will service the C4 sub-catchment which occupies an area of approximately 0.7 ha. Surface flows generated on the laydown/stockpile surface and haul road will be directly to SRP 4 via a series of DWDCs. The SRP provides a total capacity of 154.7 m^3, which exceeds the required GD05 storage volume of 140.0 m^3. It is proposed that imported aggregate shall be used to cap a large proportion of the surface of sub-catchment C4 to facilitate use as a laydown area. This is expected to reduce the potential for sediment runoff to be generated, which is anticipated to reduce pressure on SRP 4. SRP 4 will be chemically treated to increase sediment settlement efficiency. The associated CTMP is to be revised pre-construction to provide updated RADS sizing and dimensions for SRP 4. The sizing and dimensions for SRP 4 are provided in **Appendix 2**.

SRP 5: shall be located north of the laydown/stockpile area as depicted on ESCP-001, **Appendix 1**. This will service the C5 sub-catchment which occupies an area of approximately 1.6 ha. Surface flows generated on the Building F surface and haul road will be directly to SRP 5 via a series of DWDCs. The SRP provides a total retention capacity of 126.0 m^3, which exceeds the required storage volume of 120.0 m^3. SRP 5 will be chemically treated to increase sediment settlement efficiency. The associated CTMP is to be revised pre-construction to provide updated RADS sizing and dimensions for SRP 5. The sizing and dimensions for SRP 5 are provided in **Appendix 2**.

SRP 6: shall be located approximately 200 m south-east of the proposed stockpile location for Stage 1 as depicted on ESCP-002, **Appendix 1**. SRP 6 services the nominated stockpile area, with this catchment area referred to as C6 with a catchment area of 1.75 ha. A series of existing sediment basins were utilised for treatment of 'dirty' water during previous stages of work. These devices have been upgraded through removal of sediment to reinstate a 160mm primary riser and lining to reinstate emergency spillways. See reference images on ESCP-011, **Appendix 1**. The basins shall be retained for as long as possible, acting as additional 'forebays' for SRP 6 and reducing the overall sediment load on this device. There are three sediment basins upslope of SRP6 which provide an additional 150 m^3 of additional capacity. SRP6 is sized in accordance with GD05, providing 485.33 m^3 capacity.

SRP6 and the sediment basins are chemically treated using a RADs unit in conjunction with dose rates prescribed in the CTMP provided in **Appendix 12**.

Full design specifications based on GD05 including depth, width and length are given in **Appendix 2**. The SRP will be constructed in general accordance with the schematic diagrams in ESCP-009 / ESCP-011, **Appendix 1** (complete guidelines on pages 91-105 of GD05).

4.5.2 Settlement Tank

The removal of the two existing northern bays of SRP 2 to facilitate the basement excavation reduces the overall capacity and sediment settlement potential of SRP 2, alongside the likelihood of encountering groundwater. To mitigate this, a settlement tank is proposed. This will serve as the first phase in the 'treatment train' series, and receive any groundwater and surface flows that are generated within the Building C basement excavation. The settlement tank shall ensure that any sediment that infiltrates groundwater egress can settle out of suspension prior to discharge. If treated water meets the water quality discharge criteria prescribed in **Section 5.3**, this can be discharged directly to Mill Creek. Otherwise, water shall be pumped into SRP 2 via a heavy-duty flat hose for additional treatment.

It is recommended that an XL Condor settlement tank or similar be utilised in this case. The operational flow rate of these tanks is 15 m^3/hr and takes up 20 m^2 of land area. The total capacity of the tank is approximately 5,000 L. This volume is anticipated to be sufficient. As a contingency measure, sucker trucks may be utilised to help cart water rapidly if required. Groundwater base flow rates are anticipated to be between (2-8 L/s). The rate of groundwater taken must not exceed 30 L/s in accordance with condition 1 of RM21.548.01. Refer to the dewatering methodology prescribed in **Section 2.1** of this EMP.

The existing flow activated dosing system will be utilised in conjunction with this settlement tank, if suspended sediments are present and additional treatment is necessary to meet the water quality discharge parameters. A reference image of a settlement tank is depicted in ESCP-013, **Appendix 1** (complete specifications found in the *Condor Water Treatment Systems* datasheet).

4.5.3 Chemical Treatment

Due to the soil characteristics and use of SRPs, chemical treatment will be required for this project. This requires the addition of a small dose of coagulant and/or flocculant to facilitate high-efficiency sediment deposition to the required water quality parameters prior to discharge offsite. Water quality criteria and management processes are prescribed in **Section 5**.

Bench testing has been undertaken in April 2022 to confirm chemical treatment requirements and ensure that the chemical, polyaluminium chloride (PAC) is dosed at appropriate rates to cause efficient coagulation whilst avoiding potential contaminants in receiving waterways due to high levels of alum and low pH. Due to the depth of the basement excavation of Building C, different soil types may be encountered. It is recommended that bench testing results are updated pre-construction to assess the optimum chemical dosage rates. Additional soil samples should also be taken frequently throughout excavation of the basement in order to re-assess optimum dosage rates relative to soil type. As per **Table 3** of this document, weekly and monthly monitoring will ensure frequent identification of differing soil types to determine appropriate sampling intervals.

Existing chemical treatment practices for this site involve a flow-activated dosing system, whereby chemical is dosed into existing sediment retention ponds (SRPs) proportionate to the volume of flow moving past an inline flow sensor. Guidance on how this dosing system operates is provided in the associated CTMP prepared by Cirtex in April 2022. In addition to the flow-activated dosing system, the utilisation of rain-activated dosing system (RADS) units is also recommended.

4.5.4 Standard Silt Fence

A standard silt fence will be installed between SRP 4 and Mill Creek to provide an additional protection measure and intercept any residual sediment runoff before it reaches Mill Creek. Silt fences shall be installed above the stockpile area to protect internal clean water diversions and potential spring flows. As a contingency measure, this silt fence shall be extended along the western edge of the C4 sub-catchment while batters are stabilised.

Silt fences will be installed in accordance with the schematic diagram in ESCP-012, **Appendix 1** (complete guidelines on pages 112-119 of GD05).

4.5.5 Silt Socks

Silt socks will be utilised to intercept runoff in smaller catchments, not otherwise serviced by other secondary controls. These devices are essentially mesh or fabric tubes filled with sand. Silt socks shall be installed adaptively where notable low points are identified throughout construction to intercept residual sediment runoff and protect waterways. Silt socks will be installed in accordance with the reference images in ESCP-013, **Appendix 1** (complete guidelines on pages 126-130 of GD05).

4.6 As-Built Verification

The Environmental Consultant will provide the Council with as-built confirmation to verify that the erosion and sediment controls have been installed in accordance with the approved ESCP.

4.7 Maintenance of Erosion and Sediment Control Devices

Ongoing maintenance of the site shall be undertaken according to the ESCP as follows:

Regular and Weather-Responsive Inspections:

- Daily visual checks during active earthworks.
- Prior to and Post-Rainfall Inspections: Mandatory within 24 hours before or after rainfall events.
- Weekly formal inspections by the Environmental Representative.

Prompt Corrective Action:

- Address any identified damage, blockage, or failure immediately and always before the next forecasted rainfall.
- Sediment removal and maintenance must prevent any reduction in treatment capacity.

Structural Integrity:

- Check for scouring, undercutting, collapsed batters, or overtopping.
- Ensure all outlet structures, spillways, and decant systems remain stable and functioning as per design specifications.

Access and Health & Safety:

- Maintain safe access routes for inspection and maintenance crews.

- Ensure no instability or unsafe conditions develop around ESC devices.

Table 5: Typical Maintenance Requirements

ESC Device	Maintenance Requirements
Sediment Retention Ponds (SRPs) Sediment Basins	Remove sediment at 20–30% capacity, inspect decant systems, spillways, and emergency overflow pathways.
Silt Fences / Super Silt Fences	Clear trapped sediment before it reaches 1/3 height, repair rips or leaning posts, ensure toe-in is maintained.
Diversion Channels	Remove sediment buildup, repair erosion or bank failures, keep linings (if any) secure.
Stabilised Construction Entrances	Maintain rock surfacing depth, clean any tracked sediment off public roads, maintain track matt regularly.
Check Dams	Remove sediment buildup, repair armouring (rock or geotextile) to avoid scour.

Spare erosion and sediment control products will be stored onsite at all times including but not limited to:

- Silt fencing (remainder of roll)
- Waratahs (x10)
- Spare high tensile wire
- Novacoil pipe (at least 30m)
- Silt fence clips (x50)
- Pump and generator.
- IBC of polyaluminium chloride (PAC)
- Rock rip rap for check dams and stabilised access
- Geofabric x 2 rolls
- Silt socks x 15

4.8 Rapid Response Procedure for Significant Rain Events

The Environmental Representative (ER) will maintain active and ongoing monitoring of weather forecasts from reliable sources (e.g., MetService, NIWA) throughout the duration of earthworks. The ER will ensure that sufficient preparation time is allowed for site crews to inspect, maintain, and reinforce erosion and sediment control (ESC) measures prior to any significant or adverse weather event.

Weather Forecast Monitoring:

- The ER will check and document daily weather forecasts, including short-term severe weather warnings.

Pre-Rainfall ESC Inspections:

- Conduct thorough inspections of all ESC devices (e.g., SRPs, DEBs, silt fences, diversion channels, check

dams) at least 24 hours prior to the forecast event to confirm functionality and available capacity.

Stabilisation of Exposed Areas:

- Apply temporary stabilisation measures (e.g., straw mulch, polymers/soil binders, hydroseeding, geotextiles) to any exposed, inactive, or at-risk areas.

Suspension of Earthworks:

- Temporarily cease earthworks activities on vulnerable areas prior to and during the forecast event to minimise active soil exposure.

ESC Maintenance:

- Undertake any necessary sediment removal (e.g., from SRPs, DEBs, or silt fences) and repair any structural damage or undercutting identified.

Active Monitoring During Rainfall (Where Safe):

- During prolonged rainfall events, and where safe to do so, the ER or delegated site personnel will monitor key ESC measures for overtopping, bypassing, or failure.

Emergency Repairs:

- Be prepared to undertake immediate reactive maintenance if any ESC device shows signs of failure during the event.

Snow and Ice

- Remain vigilant of the forecast and inspect ESC devices prior to forecast snow events, during thaws.
- Where possible, avoid starting new earthworks just before snow or icy conditions.
- Direct meltwater away from exposed soil and toward SRPs.
- Ensure ongoing maintenance of the drop-out pits and check dams to slow down meltwater flow to reduce erosion and promote sediment settlement.
- As soon as conditions allow, repair any damaged ESC devices and reapply mulch or geotextile fabric where needed.

Record Keeping and Reporting

All pre- and post-weather event inspections, maintenance actions, and site observations shall be recorded in the site's ESC inspection and maintenance log. Where required by consent conditions, notifications and significant event reporting (e.g., turbidity exceedances or ESC failures) will be provided to the relevant Regional Council Compliance Monitoring Officer (e.g., ORC, QLDC) in accordance with consent timeframes.

4.9 Decommissioning and Removal

Erosion and sediment control devices will remain in place until 'stabilisation' of the site has been achieved. This is generally defined as 80% vegetative cover as depicted in **Figure 2**.

It is noted that the removal of controls may result in minor soil exposure. Any soils exposed during decommissioning will be stabilised with either grass, mulch or other appropriate erosion control.

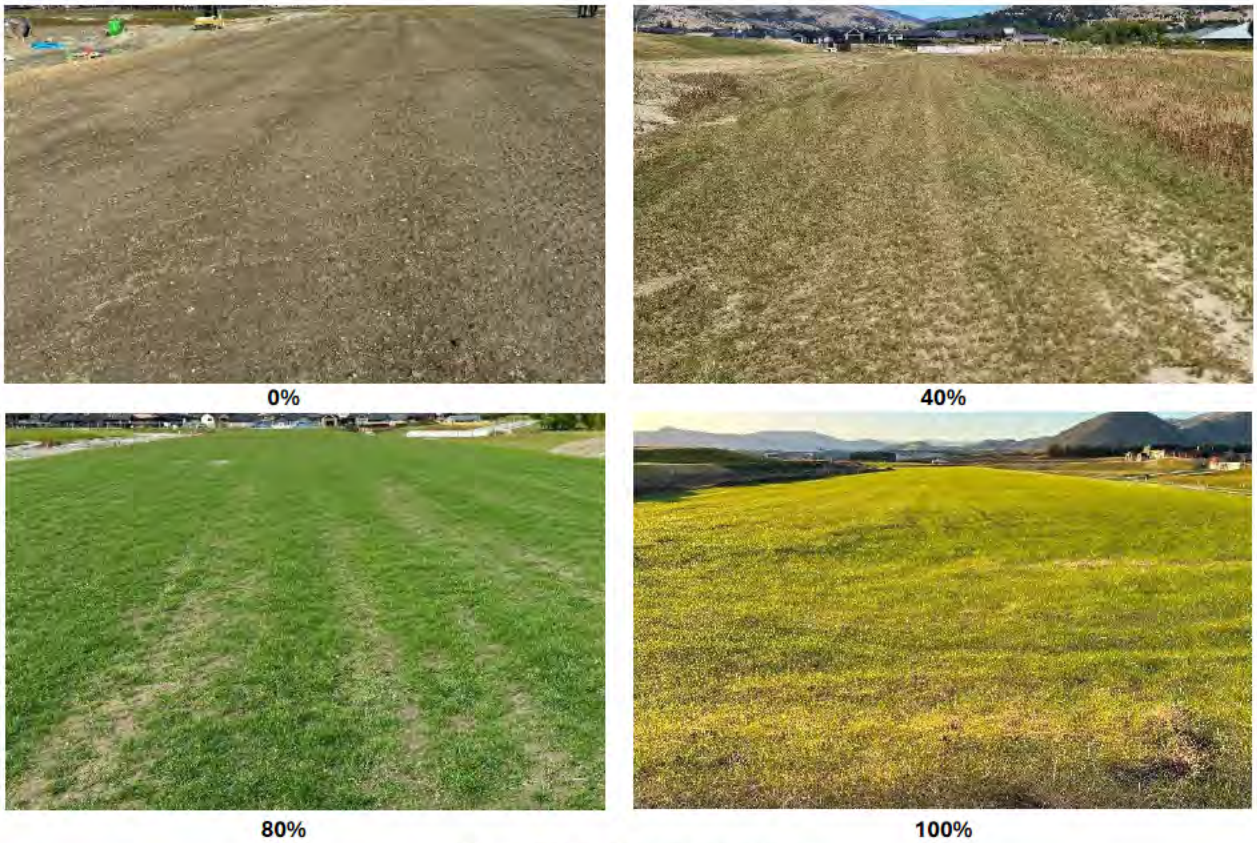


Figure 2: Visual cover estimation

4.10 Inspections and Monitoring

Details of inspections and monitoring are stated in **Section 3.3.**

4.11 Contingency Measures

The following contingency measures in **Table 6** shall be deployed as required.

Table 6: Erosion and sediment control contingency measures

Issue	Contingency Measure
Sediment-laden stormwater flowing across the site boundary	Undertake measures to stop the flow immediately. Ensure controls are installed according to the ESCP. Contact the Environmental Consultant (SQEP) who will initiate the incident response.
Controls do not appear to be working as intended	Contact Environmental Consultant (SQEP) to inspect, advise and revise ESCP as required.

Issue	Contingency Measure
The site is inappropriately exposed prior to imminent rain event	Cease works and shift effort to checking erosion and sediment controls and stabilisation via the Rapid Response Procedure outlined in **Section 4.8.**
Sediment retention devices are near capacity and more rain is forecast	Contact the Environmental Consultant (SQEP) immediately for advice.
Abatement notice issued by Council	Contact the Environmental Consultant (SQEP) immediately to advise on methods to meeting abatement notice requirements within the time stated by the abatement notice.

4.12 Erosion and Sediment Control Incident

An erosion or sediment control incident is considered to have occurred where performance criteria outlined in **Section 4.1** is not met. The incident procedures outlined in **Section 3.5** shall commence.

5.0 WATER QUALITY MANAGEMENT

Surface water bodies (rivers, streams, lakes and wetlands) provide important habitats for many species of plants, fish, birds and animals, some of which are endemic and/or threatened. To protect these values, water quality must be safeguarded, and the natural flow of the watercourse maintained to the greatest possible extent. Where flow must be reduced or diverted, mitigation is required to ensure the values of the watercourse are not degraded.

5.1 Receiving Waterbodies

The subject site is located within the wider Lake Hayes catchment; however, Lake Hayes is not considered to be within direct proximity of the development. One significant waterway (Mill Creek) and an ephemeral watercourse are located within close proximity to works extents. These waterways are discussed below and shown in **Figure 3**.

Mill Creek, a major tributary of Lake Hayes, runs adjacent to the subject site. Mill Creek discharges into Lake Hayes approximately 750 m south of the southern site boundary. It has a catchment area of 55 km^2. The catchment has been highly modified, featuring a variety of land uses including agricultural activities, forestry, rural, residential and recreational development. Mill Creek itself has undergone a realignment as part of previous consented works.

Mill Creek serves as an important spawning tributary for trout, and is fed by a number of modified tributaries. Extensive riparian planting and ecological enhancement of the surrounding valley and Mill Creek margins have been undertaken as part of the wider Waterfall Park Development. A search on NIWA's NZ River Maps database shows that Mill Creek is estimated to have a median flow of 0.188 m^3/s and to discharge 3,575 tonnes of suspended sediment per year.

A search of water quality data provided by Land Air Water Aotearoa (LAWA) shows that the overall water quality of Mill Creek is considered 'good'. The 5-year median (for data ending in December 2023) for water clarity and turbidity is low, at 0.92 m and 4.2 NTU respectively, demonstrating that Mill Creek is considered of relatively poor quality in terms of suspended fine sediment load. Mill Creek also contains relatively high levels of nitrogen due to the input of groundwater (via springs) elevating nitrogen concentrations. Mill Creek is considered naturally significant under the Otago Regional Council Regional Plan.

Lake Hayes is located approximately 1.3 km south of the site at its closest point. A search of water quality data provided by Land Air Water Aotearoa (LAWA) shows that the 5-year median (for data ending in December 2023) for Secchi disk depth is moderate, at 3.8 m. The overall water quality of Lake Hayes, based on the Trophic Level Index (TLI), is considered 'poor'. Relatively high frequencies of algae blooms are characteristic of Lake Hayes, which generates a 5-year median (for data ending in December 2023) of chlorophyll a at 26 mg/m^3. Lake Hayes is considered of minor natural and cultural significance under the Otago Regional Council Regional Plan.

An unnamed ephemeral watercourse flows through a gully immediately west of the Stages 1B and 1C stockpile area. This watercourse serves as a tributary of Mill Creek and has been modified as part of agricultural activities on the property and demonstrates low ecological values.

A key consideration is the potential to encounter groundwater, particularly in the basement excavation required to construct Building C where excavations are proposed to reach beneath the base level of Mill Creek. A dewatering methodology is provided in **Section 2.1** of this EMP. It is critical that the dewatering of any groundwater meets performance criteria before discharge Mill Creek in order to comply with consent conditions outlined in resource

consent RM23.276.02. In addition, the rate and quantity of groundwater dewatered must adhere to the abstraction parameters prescribed in condition 1 of RM21.548.01. A summary of these conditions can be found attached as **Appendix 11**. The outlet and emergency spillway of sediment retention ponds SRP 2 and SRP 3 discharge towards Mill Creek. Additionally, the outlets and emergency spillways of the proposed SRP 4 and SRP 5 will discharge towards Mill Creek.

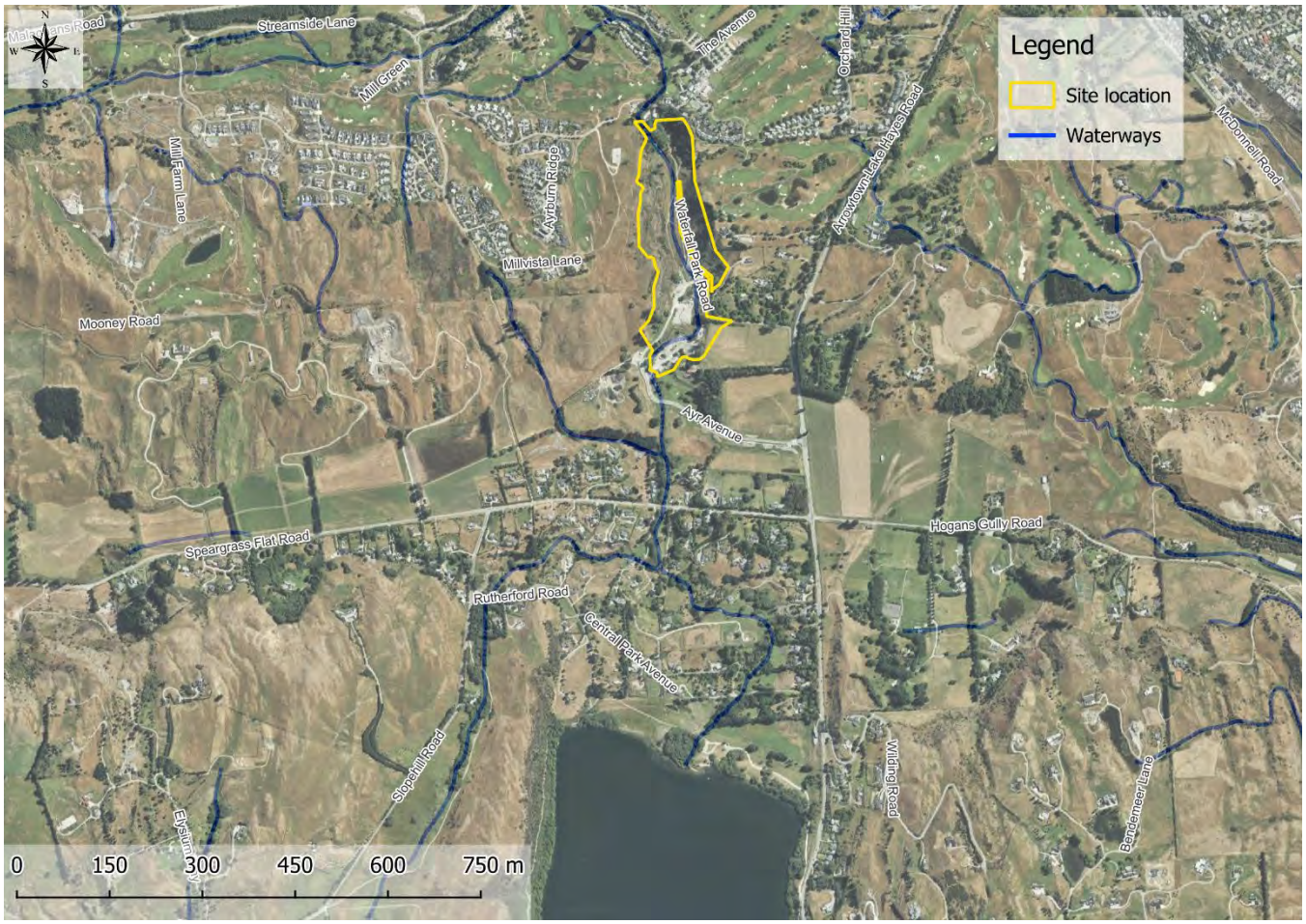


Figure 3: *Waterways within and in proximity to the site*

5.2 Legislative Considerations

5.2.1 NPS-FM

The Otago Regional Council has proposed a progressive implementation plan for meeting the NPS-FM 2017 and this includes developing a new land and water plan that will be notified by 2023 that includes objective and targets for FMUs in accordance with the requirements of the NPS-FM.

Given the industry best practice erosion and sediment control measures proposed, potential adverse effects on surface water bodies are considered to be appropriately managed and mitigated. The proposal is therefore generally consistent with the NPS-FM. Overall, the proposal is consistent with the objectives and policies of the NPS-FM.

5.2.2 Regional Plan: Water for Otago

- **Regional Plan: Water for Otago - Schedule 1A – Natural Values:** Mill Creek, located in the 'Lakes subregion', is characterised by a range of ecosystem values and is specifically recognised as providing significant habitat for the 'nationally endangered' roundhead galaxiid (a native fish species).
- **Regional Plan: Water for Otago - Schedule 1A – Natural Values:** Lake Hayes, located in the 'Lakes subregion', is specifically recognised as providing habitat for eel and trout.
- **Regional Plan: Water for Otago - Schedule 1D – Kai Tahu Values:** Mana whenua interests identified as being associated with Lake Hayes include waahi taoka. Access and customary use interests associated with Lake Hayes include mahika kai (places where food is procured and produced).

The actual and potential adverse effects on these waterbodies are expected to be mitigated through the adoption of best-practice erosion and sediment controls, and environmental management measures that avoid the generation and discharge of contaminants associated with earthworks and general construction activities. The discharge limits proposed in the Performance Criteria in **Section 5.3** are consistent with the aforementioned legislation and ensure the potential adverse effects on the receiving environment are appropriately mitigated.

5.2.3 Cumulative Effects

The development is a temporary activity and will not result in any increased pressure or change in the water quality or quantity of Mill Creek or Lake Hayes. Erosion and sediment controls are to be maintained at all times prior to site stabilisation, to ensure that the best practice approach in accordance with GD05 is adopted.

As the disturbed areas will be rapidly stabilised and stormwater attenuation for the buildings installed to mimic pre-development flow rates, the proposal is not considered to result in any cumulative effect on the surrounding environment, over time.

In addition, significant revegetation of indigenous plant communities is proposed to reinstate the landscape, enhance the ecological biodiversity of the area, as well as improve the water quality terminating from the catchment. Undertaking revegetation of the catchment will result in positive long-term cumulative effects.

5.3 Performance Criteria

Any discharge from the sites' works areas, or erosion and sediment control devices will meet the criteria in **Table 7**.

***Table 7:** Water quality discharge criteria*

Parameter	Discharge Criteria
Turbidity	A limit calibrated against the TSS limit below (typically ≤ 100 NTU[3])

[3] Turbidity can be instantly measured using a nephelometer. This is considered desirable as opposed to testing TSS which requires laboratory testing and can take several days. If the specified turbidity value is not met, a water sample will be collected and sent for TSS laboratory testing.

Parameter	Discharge Criteria
Visual Clarity (mm)[4]	100 mm (As per GD05 and Cirtex CTMP)
Total Suspended Sediment (TSS)	≤ 50 mg/L
Ground water take	Must not exceed 30 L/s, nor 77,760 m^3/month
pH[5]	5.5 – 8.5
Hydrocarbons or tannins	No visible trace
Waste	No waste or litter is visible

5.4 Management Measures

The following measures will be deployed to ensure the protection of water quality:

- Erosion and sediment controls will be implemented and maintained in accordance with the Erosion and Sediment Control Measures in **Section 4.0**.
- Refuelling, servicing and storage of hydrocarbons will be in accordance with the relevant procedures in the Chemicals and Fuels Management in **Section 10.0**.
- All concrete washing is to be undertaken in the designated concrete wash-out pit as per the design specifications in **Appendix 1**.
- All plant and equipment onsite will be inspected regularly to ensure they are of an acceptable standard.
- Stockpiling of any organic, erodible or hazardous material onsite is not to be placed within close proximity of a watercourse/major drainage line, unless appropriate controls are in place.
- All chemical treatment of sediment-laden water will be undertaken in accordance with the approved Chemical Treatment Management Plan prepared by Cirtex (April 2022).
- A water meter and datalogger must be used when undertaking groundwater dewatering activities to measure the rate and volume of water taken in accordance with condition 4 of RM21.548.01.

5.5 Monitoring

Water quality will be monitored in accordance with **Table 8**.

Table 8: *Water quality monitoring measures*

Sampling Scope	
Objective	To assess whether controlled and uncontrolled discharge, meets the Discharge Criteria referred to in **Section 5.2**.

[4] In the absence of a turbidity measure, visual clarity can be inferred from the relationship with turbidity via linear regression. If the specified visual clarity value is not met, a water sample will be collected and sent for TSS laboratory testing.

[5] pH to be tested only when chemical treatment is undertaken.

Responsibility	On site water quality sampling is to be completed by the nominated Environmental Representative. Note: SQEP is available to provide training and guidance regarding on site sampling and can provide sampling services as required.
Spatial boundaries	Discharges from within the sites' work areas and/or erosion and sediment control devices.
Frequency	A significant rain event is defined as any forecast/actual rain event of 15 mm within a 24-hour period or a rain event that can generate overland flow, noting that this varies seasonally. Where a Significant Rain Event occurs through the night, monitoring shall be undertaken the following morning.
Sampling Design	
Water Quality Criteria	As outlined in the Discharge Criteria referred to in **Section 5.2.**
Sampling Locations	At boundaries of the site where any water is flowing, specifically the following point discharges: • SRP outlets (Exact coordinates TBC upon installation). • 50 metres upstream and downstream of site boundaries, within Mill Creek
Sampling Method	• TSS – Registered laboratory • Turbidity (NTU) – Nephelometer • pH – pH meter – only if utilising chemical treatment • Gross pollutants – visual observations • Tannins – visual observations (any unusual darkening of waters?) • Hydrocarbons – visual observations (is there any oily film[6] on surface or smell?)
Quality Control	Any water quality meter will be calibrated according to manufacturer instructions. All observations will be recorded and analysed.
Dewatering Volumes	The rate and quantity of abstraction of groundwater must not exceed: i. 30 litres per second; ii. 77,760 cubic metres per month; and iii. 933,120 cubic metres in each 12 month period, commencing 1 July of any year and ending 30 June of the following year.
Recording	
Recording Results	All results will be entered into a spreadsheet and kept onsite (form attached as **Appendix 9**).
Actions	
Non-conformances	Any exceedances observed will be reported to the Project Manager/ Environmental Consultant who will investigate and ensure appropriate corrective actions are implemented immediately.

[6] Some bacteria produce a naturally occurring film on the water surface. Bacteria films breaks apart in angular shapes when disturbed whereas hydrocarbon film separates as globules.

5.6 Contingency Measures

The following contingency measures in **Table 9** shall be adopted if required.

***Table 9:** Water quality contingency measures*

Issue	Contingency Measure
Exceedance of water quality criteria	• Contact the Project Manager and Environmental Consultant (SQEP) immediately. • Works will cease or be modified to remove further risk of contamination. • QLDC and ORC will be verbally notified. • The Environmental Incident procedure will commence. • Remedial measures will be implemented and the Environmental Incident will be closed out by the Environmental Consultant (SQEP), with a copy of an Environmental Incident report to the Project Manager, QLDC and ORC.

5.7 Water Quality Incidents

A water quality incident is considered to have occurred where the water quality performance criteria outlined in **Section 5.2** is breached. The incident procedures outlined at **Section 3.5** shall commence.

6.0 DUST MANAGEMENT

Dust from construction activities, vehicle movements and stockpiles can contribute to sediment runoff and create a nuisance to the public, neighbouring properties, adjoining roads and service infrastructure. The key risks associated with dust occur during the bulk earthworks phase of the project.

There are a range of activities that may produce dust onsite including:

- General disturbance of soil (particularly during drier months).
- Inappropriate staging that does not seek to minimise the extent of exposed soil.
- Vehicle movements along haul roads.
- Sediment-tracking onto surrounding roads.
- Stockpiling of topsoil or subsoil.
- Slow or ineffective revegetation procedures.

6.1 Sensitive Receptors

Key sensitive receptors to protect from the effects of dust include customers of the Ayrburn restaurant and facilities, users of the Ayrburn Cycle Trail, and Mill Creek. Haul activity to transport material will be undertaken between the hours of 8:00am to 12:00pm to minimise the potential adverse effects on members of the public.

Due to the proposed extent of earthworks, it is recommended that the progressive rehabilitation measures discussed in **Section 4.4.1** and **4.4.2** of this EMP are utilised in conjunction with the management measures prescribed in **Section 6.3** below throughout construction.

6.2 Performance Criteria

The project must ensure that reasonable and practical measures are taken to avoid dust moving across the boundaries of the site at all times.

6.3 Management Measures

The following measures will be deployed to ensure dust generation onsite is minimised:

- Stage works where possible to minimise soil exposure extents and timeframes.
- Revegetate disturbed areas progressively throughout construction.
- Dust suppression of exposed areas and stockpiles by water trucks or other methods (e.g., k-lines) approved by the Environmental Representative. [7]
- If dust activities cannot be controlled during high winds, works will cease until favourable conditions return.
- Site access to be constructed in accordance with GD05 (detail at **Section 4.4.3**).
- All site access and surrounding roads to be swept clean regularly.

[7] Ensure a consented water take permit is approved by the local authority. If taking water from lakes and or rivers, ensure that the permitted volume of water is taken.

- Rumble grids and/or wheel washes will be provided at exits as a contingency measure as required to reduce tracking of soil onto external roads.
- A speed limit will be posted as 20 km/hr, unless deemed otherwise by the Project Manager.
- All hauling activity shall be undertaken between the hours of 8:00am and 12:00pm to minimise impact on customers of the Ayrburn facilities.
- To avoid spillage risks, trucks will not be overloaded.
- All trucks must have tail gates up and swept or cleaned prior to exiting to external roads.
- Stockpile heights are to be minimised where possible (< three metres) unless they are covered (e.g. an erosion blanket, chemical sealant, temporary cover crop or mulched).
- Long-standing stockpiles (greater than six weeks) shall be appropriately stabilised.
- Within two weeks of completion, all earth worked areas will be sown out with grass, landscaped or otherwise stabilised by an appropriate erosion control.

6.4 Monitoring

Site staff will maintain continual vigilance for any increases in wind to ensure measures are deployed prior to dust crossing site boundaries. Weekly Environmental Inspections and the Monthly SQEP Environmental Inspections will also ensure that the management measures described above are sufficient and performing effectively.

6.5 Contingency Measures

The contingency measures in **Table 10** shall be adopted if required.

***Table 10:** Dust contingency measures*

Issue	Contingency Measure
Excessive dust creation from soil disturbance	• Increase frequency of water truck spraying or increase irrigation. • Spray down excavation areas and activities where excavator bucket is operating. • Cease excavation during high winds, particularly if wind direction is likely to impact sensitive receivers.
Excessive dust creation from hauling operations	• Reduce truck speeds. • Cover or spray down loads causing dust impacts. • Apply skim of aggregate over the haul road surface. • Install shakedown devices at entry and exit points.
Excessive dust creation from stockpiles	• Spray stockpiles with water or apply a temporary polymer. • Hydro-mulch, seed or stabilise stockpiles, cover stockpiles with geofabric. • Locate stockpiles further away from sensitive receptors.
Abatement notice issued by Council	Contact the Environmental Consultant (SQEP) immediately to advise on methods to meeting abatement notice requirements within the time stated by the abatement notice.

6.6 Dust Incident

A dust incident is considered to have occurred where:

- Dust is observed crossing the boundary into sensitive receptors or,
- A justified complaint is received regarding dust emissions across the boundary of the site.

The incident procedures outlined at **Section 3.5** shall commence.

7.0 NOISE AND VIBRATION MANAGEMENT

Noise and vibration generated during construction has the potential to impact sensitive receivers by reducing comfort, impeding communication, causing cosmetic damage to structures and damaging household possessions.

The following assessment and management measures are intended for standard construction equipment that is not expected to induce noise or vibration beyond the maximum limits in the QLDC District Plan. Where upper noise and vibration levels of district plans will be breached, an Acoustic Specialist may need to be engaged to assist with the management of these nuisance effects.

Potential noise and/or vibration effects may be generated by the following:

- Excavation and earth moving plant
- Light vehicles near sensitive receptors
- Ancillary plant and equipment
- Piling equipment
- Compaction equipment
- Rock breaking
- Reversing alarms

7.1 Sensitive Receptors

Potential sensitive receptors of noise and vibration include residential properties to the east, as well as customers of the Ayrburn restaurant and facilities. Due to the separation distance between the site and residential properties, potential adverse impacts of noise and vibration are expected to be less than minor.

7.2 Performance Criteria

1. Construction activities shall meet relevant noise limits specified under Rule 36.5.13 of the Queenstown Lakes Proposed District Plan. This rule requires Construction sound at any point within the site must comply with the limits specified in Tables 2 and 3 of *NZS 6803:1999 Acoustics - Construction Noise*, when measured and assessed in accordance with that standard (see **Table 11** below).
2. Construction activities shall meet relevant vibration limits specified under Rule 36.5.10 of the Queenstown Lakes Proposed District Plan. This rule requires vibration from any activity must not exceed the guideline values given in *DIN 4150-3:1999 Effects of vibration on structures* on any structures or buildings on any other site.
3. Construction activities shall be undertaken in accordance with the permitted hours of operation outlined at **Section 2.2** of this EMP.

***Table 11:** Upper limits in dB(A) for construction work noise in residential areas for more than 20 weeks*

Time of Week	Time Period	$L_{Aeq(t)}$	L_{Afmax}
Weekdays	0630 – 0730	55 dB	75 dB

	0730 – 1800	70 dB	85 dB
	1800 – 2000	65 dB	80 dB
Saturdays	0630 – 0730	45 dB	75 dB
	0730 – 1800	70 dB	85 dB

Table 12: Vibration Thresholds for Structural Damage (PPV mm/s)

	Short Term				Long-Term
	At Foundation			Uppermost Floor	Uppermost Floor
Types of Structures	0 to 10 HZ	10 to 50 Hz	50 to 100 HZ	All Frequencies	All Frequencies
Commercial/Industrial	20	20 to 40	40 to 50	40	10
Residential	5	5 to 15	15 to 20	15	5
Sensitive/Historic	3	3 to 8	8 to 10	8	2.5

Note: When a range of velocities is given, the limit increases linearly over the frequency range.

7.3 Management Measures

The following measures will be deployed to ensure noise and/or vibration associated with the project are appropriately mitigated:

- Notify surrounding sensitive receptors prior to commencing particularly noisy or vibration inducing activities.
- Where practicable, select lower noise producing equipment or use lower noise generating alternatives.
- Regularly service equipment to ensure plant is running optimally.
- Plant and equipment to be fitted with noise control/attenuation devices as appropriate and maintained and operated in accordance with manufacturer's specifications.
- Revving of engines will be limited. All plant and vehicles will be turned off when not in use and if safe to do so.
- The use of audible alarms on mobile equipment will be limited, and two-way communication will be used.
- Undertake activities that may lead to noise or vibration effects, during reasonable and practical hours.

7.4 Monitoring

All earthworks activity will be closely monitored by the operator to ensure that noise and vibration remains within the required limits. If monitoring finds the activity cannot comply with performance criteria, an Acoustic Specialist may need to be engaged to assess the project and provide appropriate mitigation measures and monitoring. Weekly Environmental Inspections and Monthly SQEP Environmental Inspections shall include an assessment of the site to determine the effectiveness of noise and vibration management controls.

7.5 Contingency Measures

The following contingency measures in **Table 13** shall be adopted if required.

***Table 13:** Noise and vibration contingency measures*

Issue	Contingency Measure
Noise and/or vibration complaint received	Manage the complaint in accordance with the Environmental Complaints procedure in Section 3.6.
Exceedance of performance requirement criteria	The Environmental Consultant (SQEP), in consultation with the Environmental Representative, will investigate and implement actions to reduce noise and/or vibration levels to below criteria levels.
Ongoing noise and/or vibration issues	Where noise or vibration emissions consistently exceed the performance criteria despite the site staff's best efforts, an Acoustic Specialist will be engaged to assist.
Abatement notice issued by Council	Contact the Environmental Consultant (SQEP) immediately to advise on methods to meeting abatement notice requirements within the time stated by the abatement notice.

7.6 Noise and Vibration Incident

A noise or vibration incident is considered to have occurred when a justified complaint is received and on investigation is found to exceed the performance criteria. The environmental incident procedures outlined in **Section 3.4** shall commence.

8.0 CULTURAL HERITAGE MANAGEMENT

The loss or damage of cultural heritage items could be caused by construction activities. The damage or loss of artefacts can lead to the loss of culturally or historically significant items and information.

Examples of cultural heritage items include:

- Koiwi tangata (human skeletal remains).
- Waahi taoka (resources of importance).
- Waahi tapu (places or features of special significance).
- Māori artefact material.
- A feature or archaeological material predating 1900.
- Unidentified archaeological or heritage site.

8.1 Location of Known Cultural Heritage Significance

A search of QLDC's database indicates there are two historic heritage features located within the land parcel of the subject site. These are identified as the Ayrburn Homestead and Stone Farm Buildings (reference number 110) as shown in **Figure 4**. The Stone Farm Buildings have since been remediated and repurposed for commercial activity as part of consented activity. The Ayrburn Homestead remains in place approximately 72-metres west of Mill Creek. The extent of earthworks within the scope of this EMP will not result in any adverse effects on these structures.

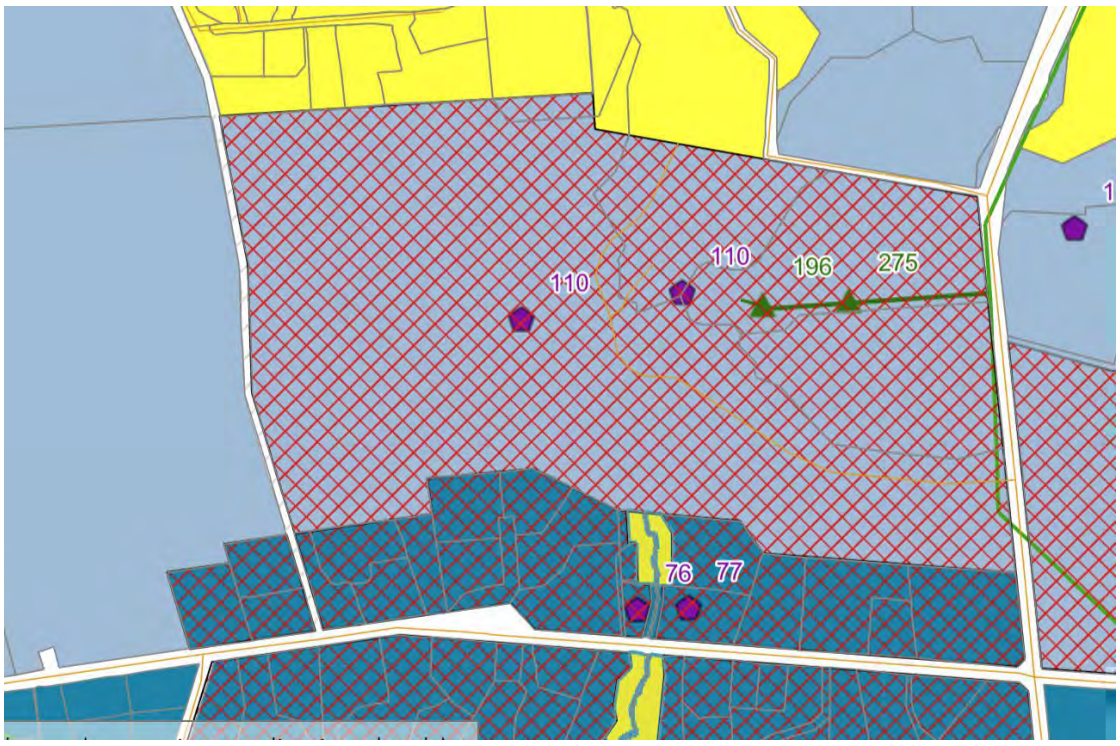


Figure 4: *Locations of areas with cultural significance ( ) Source: Source: QLDC GIS)*

8.2 Performance Criteria

- The protection of cultural heritage artefacts and places in accordance with the *Heritage New Zealand Pouhere Taonga Act, 2014*.
- Strict adherence to Heritage New Zealand's *Archaeological Discovery Protocol* (attached as **Appendix 10**) in the case of unexpected finds.

8.3 Management Measures

All works on this project will be undertaken in accordance with the obligations of the *Heritage New Zealand Pouhere Taonga Act*, 2014.

8.4 Monitoring

Weekly inspections shall include a visual assessment of the site to ensure that no new significant artefacts have been encountered. However, operators must remain vigilant for such encounters as they occur.

8.5 Accidental Finds

If any unknown artefacts are uncovered, the project will work to Heritage New Zealand's *Archaeological Discovery Protocol* (attached as **Appendix 10**).

9.0 VEGETATION MANAGEMENT

The proposed earthworks' extents are located away from established vegetation. The wider Ayrburn site has invested in significant riparian planting along Mill Creek and the grounds have been extensively landscaped. The consented development and access have been designed to limit disturbance of existing vegetation where possible.

9.1 Sensitive Receptors

Any existing indigenous riparian vegetation shall be demarcated as 'no-go zones' (also demarcated for erosion and sediment control purposes. It is noted that the majority of the proposed works area has been heavily modified as part of the previous consented activity. As such, the impact on vegetation is expected to be negligible.

9.2 Performance Criteria

- Avoid the clearance of indigenous or protected vegetation where possible during excavation works.
- Avoid the spread of noxious weeds onsite or to other sites.

9.3 Management Measures

The following measures will be deployed to manage vegetation:

- Demarcate protected vegetation areas as no go zones.
- Treating weeds prior to disturbance of the natural surface.
- Maintain existing indigenous and or any protected vegetation.
- Weed free topsoil will be retained for reuse in site rehabilitation.

9.4 Monitoring

Weekly Environmental Inspections and Monthly SQEP Environmental Inspections shall include a visual assessment of the site to determine the effectiveness of vegetation management controls.

9.5 Vegetation Incident

A vegetation incident is considered to have occurred where:

- Protected vegetation is damaged or removed.
- A no-go zone is breached.

The environmental incident procedures outlined at **Section 3.5** shall commence.

10.0 CHEMICALS AND FUELS MANAGEMENT

10.1 Sensitive Receptors

Key sensitive environmental receptors include staff members working on the site, customers of the Ayrburn restaurant and facilities, and Mill Creek.

10.2 Performance Criteria

- Chemicals and fuels are stored and used in a manner that avoids contamination of site and surrounding environment.
- All spills are cleaned up immediately and the contaminated soils/waters disposed of appropriately.

10.3 Management Measures

The following measures will be deployed to ensure chemicals and fuels associated with the project are appropriately managed.

- All hazardous substances to be stored, transported and used according to the safety data sheet requirements.
- Storage of chemicals and fuels shall be located as far as practicably possible from waterways and concentrated flows.
- Refuelling of vehicles and plant onsite will occur in the designated refuelling bay as shown in **Appendix 1**.
- All concrete washing is to be undertaken in the designated concrete wash-out pit as per the design specifications in **Appendix 1**.
- One 240 L Oil and Hydrocarbon spill kit and one 240 L Chemical spill kit will be located in close proximity to the location of liquid hazardous materials storage and refuelling areas.
- The volumes of the hazardous substances listed in **Table 14** will not be exceeded.

***Table 14:** Maximum volumes of chemicals and fuels*

Chemicals and Fuels	Maximum Volume	Storage Location
Diesel	6,000 L	5000 L in bunded tank in the laydown compound 1,000 L in tanker trailer
Unleaded Fuel	100 L	Jerry cans in lockable container
Oil	10 L	Packaging in lockable container
Lubricant (WD40 or similar)	Six Cans	Packaging in lockable container
Grease	5 L	Packaging in lockable container
Spot marking paint	2 L	Packaging in lockable container
Polyaluminium Chloride (PAC)	2 x 1,000 L	IBC tanks (1,000 L)

10.4 Monitoring

Weekly Environmental Inspections and Monthly SQEP Environmental Inspections shall include a visual assessment of the site to determine the effectiveness of chemicals and fuels management.

10.5 Contingency Measures

The following contingency measures in **Table 15** shall be adopted if required.

***Table 15:** Chemicals and fuels contingency measures*

Issue	Contingency Measure
Spills response	• Stop works in proximity to the spill and assess the safety of all personnel. • Take immediate action to contain the spill to prevent discharge into stormwater drains or natural waterways. Use spill kits to contain and treat the spill. • Notify Environmental Consultant to advise on next steps. If necessary, notify the Regional Council spill response unit. • Remove contaminated material to a suitable contained location for remediation/disposal (require any necessary approvals/permits from ORC). • The spill kits shall be replaced by an approved supplier.
Inappropriate storage	• Upgrade facility. • Clean-up of storage area. • Notify and train staff.
Inappropriate handling/transport	• Notify and train staff through toolbox meetings on the appropriate handling and transport methods.
Inadequate spill kit materials	• Order more materials. • Investigate types of chemicals onsite and consult a supplier for advice on appropriate equipment. • Develop or revise spill material monitoring and ordering system.
Inappropriate disposal of chemicals or fuels	• Provide appropriate disposal facilities or service providers. • Notify and train staff.
Inaccurate or insufficient records	• Advise staff and update records. • Monitor through inspections.

10.6 Chemicals and Fuels Incident

A chemicals and fuels incident are considered to have occurred where:

- A spill more than five litres has occurred.
- A situation is discovered where a spill of more than five litres would likely have occurred before it happens where the management measures listed above have not been followed.

The environmental incident procedures outlined at **Section 3.5** shall commence.

11.0 WASTE MANAGEMENT

Waste from construction activities can create a nuisance to the public, neighbouring properties, and adversely affect flora and fauna.

11.1 Sensitive Receptors

Key sensitive environmental receptors include staff members working on the site, customers of the Ayrburn restaurant and facilities, and Mill Creek.

11.2 Performance Criteria

- Non-recyclable waste generation is minimised, and the site and surrounds are kept free from waste at all times.
- Wastes shall be stored safely and in an organised manner until recycling, reuse, or disposal.
- Only material defined as 'cleanfill' shall be permitted to be deposited within the site.

11.3 Management Measures

The following measures will be deployed to ensure waste management associated with the project is appropriately mitigated:

- The Waste Management Hierarchy philosophy will be implemented, as illustrated in **Figure 5**.

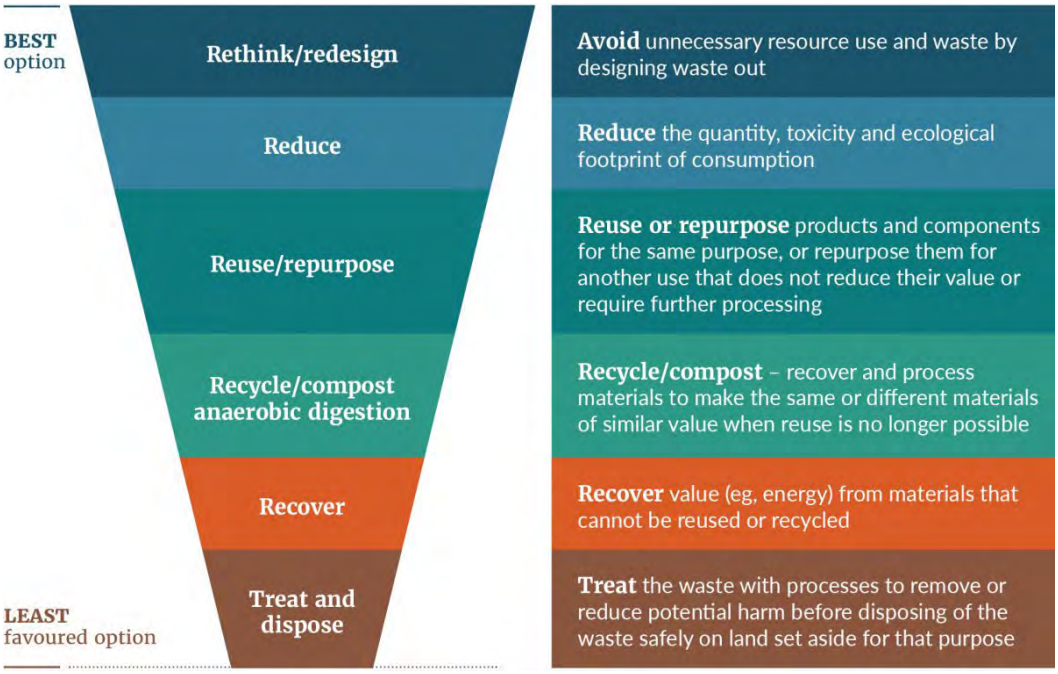


Figure 5: *The Waste Hierarchy (Source: Ministry for the Environment).*

- Measures will be implemented to ensure the site is maintained in a safe, clean and tidy state.
- Where possible, waste shall be segregated into labelled bins with lids: General, Hazardous and Recyclables.
- Wastes onsite shall be suitably contained and prevented from migrating offsite.
- The waste is to be contained so it doesn't contaminate soil, surface or ground water, create unpleasant odours or attract vermin.
- Any material dropped in or adjacent to open drains shall be recovered immediately after it occurs.
- Waste storage is not permitted in or near drainage paths.
- The burning of waste is strictly prohibited.
- No wastes shall be disposed of onsite.
- Wastes shall be removed from site regularly and at completion of works.
- Only cleanfill material will be permitted to be deposited within the site as per condition 25 of Commissioner Decision RM220926. Cleanfill is defined as material that will have no adverse effect on people or the environment, including virgin natural materials (clay, soil, rock) and other inert materials (concrete or brick) that are free of:
    - Combustible, putrescible, degradable or leachable components;
    - Hazardous substances;
    - Products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices;
    - Materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances; and
    - Liquid waste.

11.4 Monitoring

Site staff will be briefed on waste processes prior to works commencing and shall maintain continual vigilance for excess waste around the site and following appropriate disposal procedures. Weekly Environmental Inspections and Monthly SQEP Environmental Inspections shall include a visual assessment of the site to determine the effectiveness of waste management controls.

11.5 Contingency Measures

If waste items are accumulating or are stockpiled, the following contingency measures will be adopted:

- Arrange for collection by approved licensed contractor.
- Provide additional bins with lids if available.
- Remove waste offsite as soon as possible.

11.6 Waste Incident

A waste incident is considered to have occurred where:

- Waste from the site is found within a sensitive environment or where it may reasonably migrate to a sensitive environment,
- A complaint is received regarding inappropriate management of waste and on investigation is warranted.

The environmental incident procedures outlined at **Section 3.5** shall commence.

12.0 CONTAMINATED SITE MANAGEMENT

A search of Council records has indicated the presence of four potential HAIL sites within the boundary of the proposed works extent as depicted in **Figure 6** below.

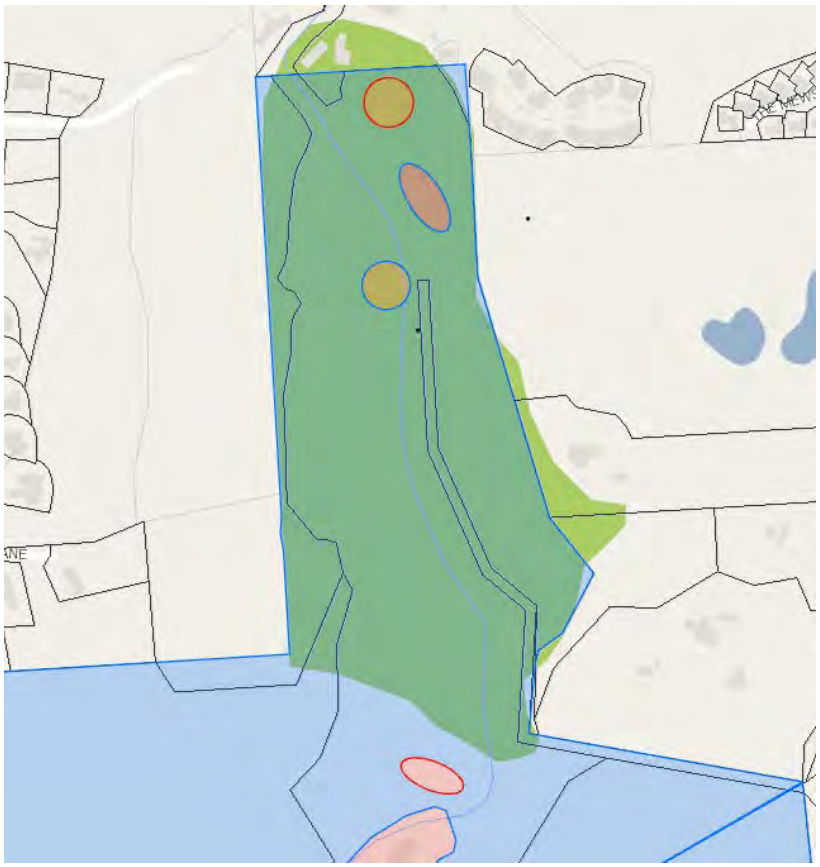


Figure 6: *HAIL sites within the boundaries of the works extent (ORC Listed Land-Use Register).*

A Preliminary Site Investigation was carried out by EC Otago Ltd in 2016 to determine the chemical characteristics of near surface soils and deeper soils where HAIL activities were more likely to have occurred. The PSI assessment notes the following:

> *"Across the greater part of the property contaminants were present at concentrations that are likely to be the natural background levels, including the surface soils near the lathe and A Frame building associated with HAIL.01692.08 or HAIL.01692.06. No contamination was detected near HAIL.01692.07 (northern landfill), however only surface soils were sampled. Contamination was only present in the deeper soils at HAIL.01692.04 (Site B). No development is proposed near HAIL.01692.07 and HAIL.01692.06, while Building F will be constructed over HAIL.016292.08... In summary, it is highly unlikely that use of the land for the proposed development will present a risk to human health as a result of soil contamination, However, caution is advised for any earthworks that occur within close proximity to HAIL.01692.07 (northern landfill) given no deeper soils have been sampled in this area."*

In summary, the PSI considers that adverse effects on soil contamination are highly unlikely, though caution is advised when operating in proximity to HAIL.01692.07 due to partial completion of sampling. According to the ORC Listed Land-use Register, HAIL.01692.07 is classified as A17: Storage tanks or drums for fuel chemicals or liquid waste. If contaminated material is encountered during construction works, the management measures prescribed in **Section 12.3** of this EMP and the PSI shall be implemented.

12.1 Sensitive Receptors

Key sensitive environmental receptors include staff members working on the site, customers of the Ayrburn restaurant and facilities, and Mill Creek.

12.2 Performance Criteria

- Effectively identify and manage any sites where contaminants are found and ensure they do not contaminate beyond the location they are found (including offsite) or present a risk to human health.
- Undertake all earthworks activities in accordance with the recommendations made within the PSI by EC Otago Ltd (2016).

12.3 Management Measures

The following measures will be deployed to ensure contaminated soil associated with the project is appropriately mitigated:

- If any evidence of contamination be noticed in the field, the personnel noting the contamination shall immediately notify the Environmental Representative.
- Any known contaminated soil to be removed must be undertaken wearing appropriate PPE.
- All imported fill material from off-site sources will be procured from a project approved quarry/source. Records of quantity and location shall be managed by the Project Engineer.
- Many of the controls required to manage potential for effects associated with low level contaminated soil is based on best practice erosion and sediment control and dust management techniques. These are outlined in **Section 4.4** and **Section 4.5** (erosion and sediment controls) and **Section 6.4** (dust controls). Both sections cover management of stockpiles.
- All surplus fill material requiring removal shall meet the Ministry for Environment definition of clean fill, as specified in Section 2.2 of the report "A Guide to the Management of Cleanfills", prepared by *Beca Carter Hollings & Ferner Ltd for the Ministry for the Environment and dated January 2002*.
- All soil or material removed from the site shall be entered into the Disposal Tracking Log.
- If materials have been approved to be removed from site, materials will be transported to the approved disposal location.
- Trucks removing or transporting any soil from the site will be covered or sealed to prevent dust, leakage or loss of materials during transport.

12.4 Monitoring

Unless any higher-level contamination is accidentally found during earthworks, no specific monitoring of soil, groundwater or water quality will occur (other than what is detailed in the water quality criteria outlined at **Section 5**).

If material is found it is expected that monitoring may be required but this shall be at the direction of the soil contamination expert.

12.5 Contingency Measures

It is not expected that contaminated material will be encountered, however this cannot be ruled out. If a potential contaminated site is identified (e.g., by landfilled waste, odour) during construction works, the following contingency measures will be undertaken:

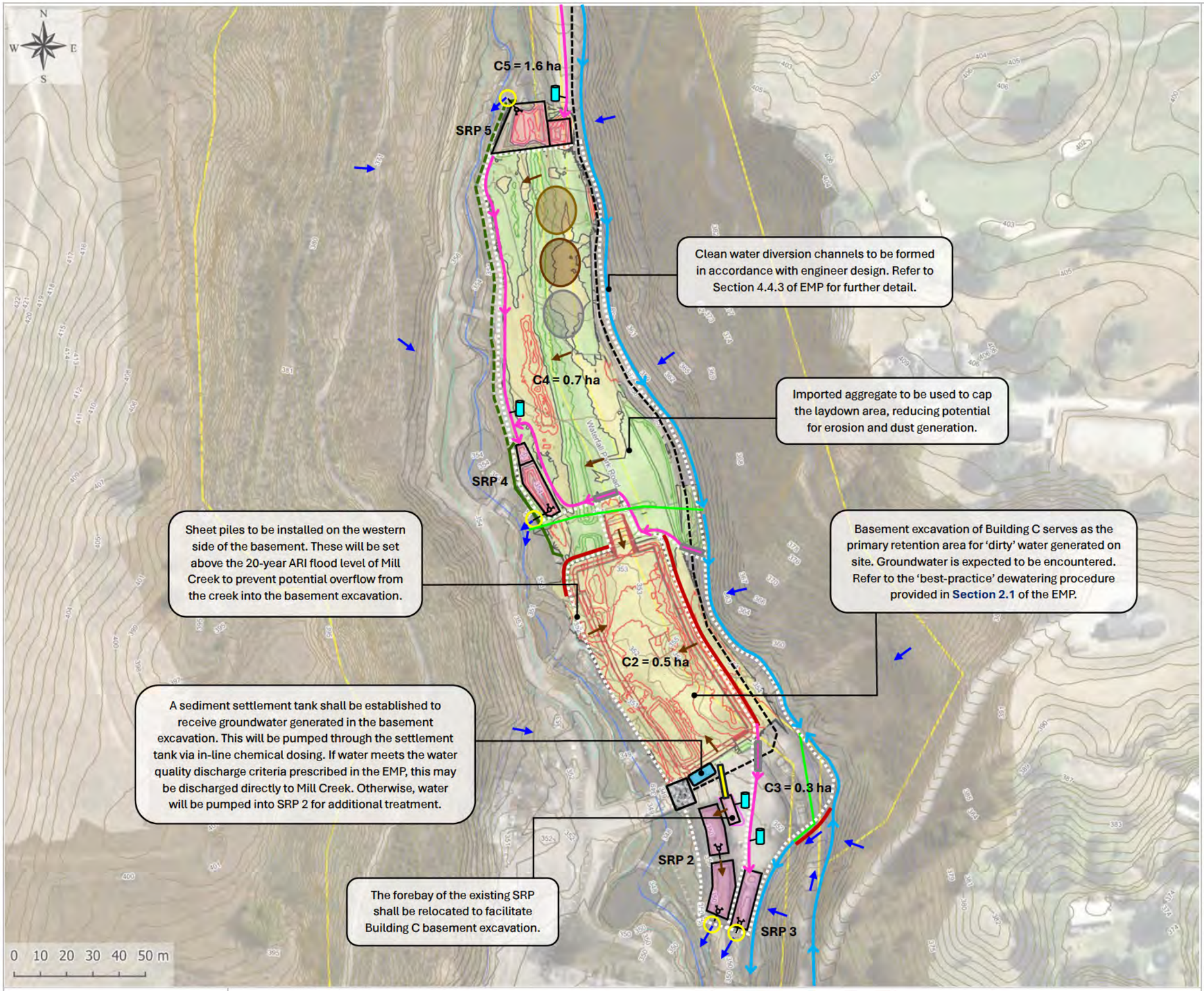
- Immediately notify the Project Manager.
- Prevent spread of contamination by installation of silt fencing, covering material with plastic or geofabric material. This will be done wearing appropriate PPE as outlined in the Health and Safety Management Plan.
- Engage the Environmental Consultant who will advise on the engagement of a Contaminated Soil expert.
- EMP to be amended to manage any new contaminated soil encountered in coordination with the contaminated soil expert (if engaged).

12.6 Contamination Incident

An environmental incident is considered to have occurred where inspection finds that excavation or other work continues within contaminated soil without report or remedial action.

The environmental incident procedures outlined in **Section 3.5** shall be followed.

APPENDIX 1 Erosion and Sediment Control Plan Drawing



Legend

	Stabilised access
	Clean water overland flow
	Dirty water overland flow
	Clean water diversion channel (CWDC)
	Dirty water diversion channel (DWDC)
	Earth bund
	Mill Creek
	Standard silt fence
	Standard silt fence (Contingency)
	Stormwater pipe (engineered-design)
	Temporary culvert
	Trafficable swale
	Temporary haul road
	Topsoil stockpile
	Subsoil stockpile
	Aggregate stockpile
	Sediment retention pond (SRP)
	Chemical dosing unit
	Sediment settlement tank
	Water sampling location

Notes

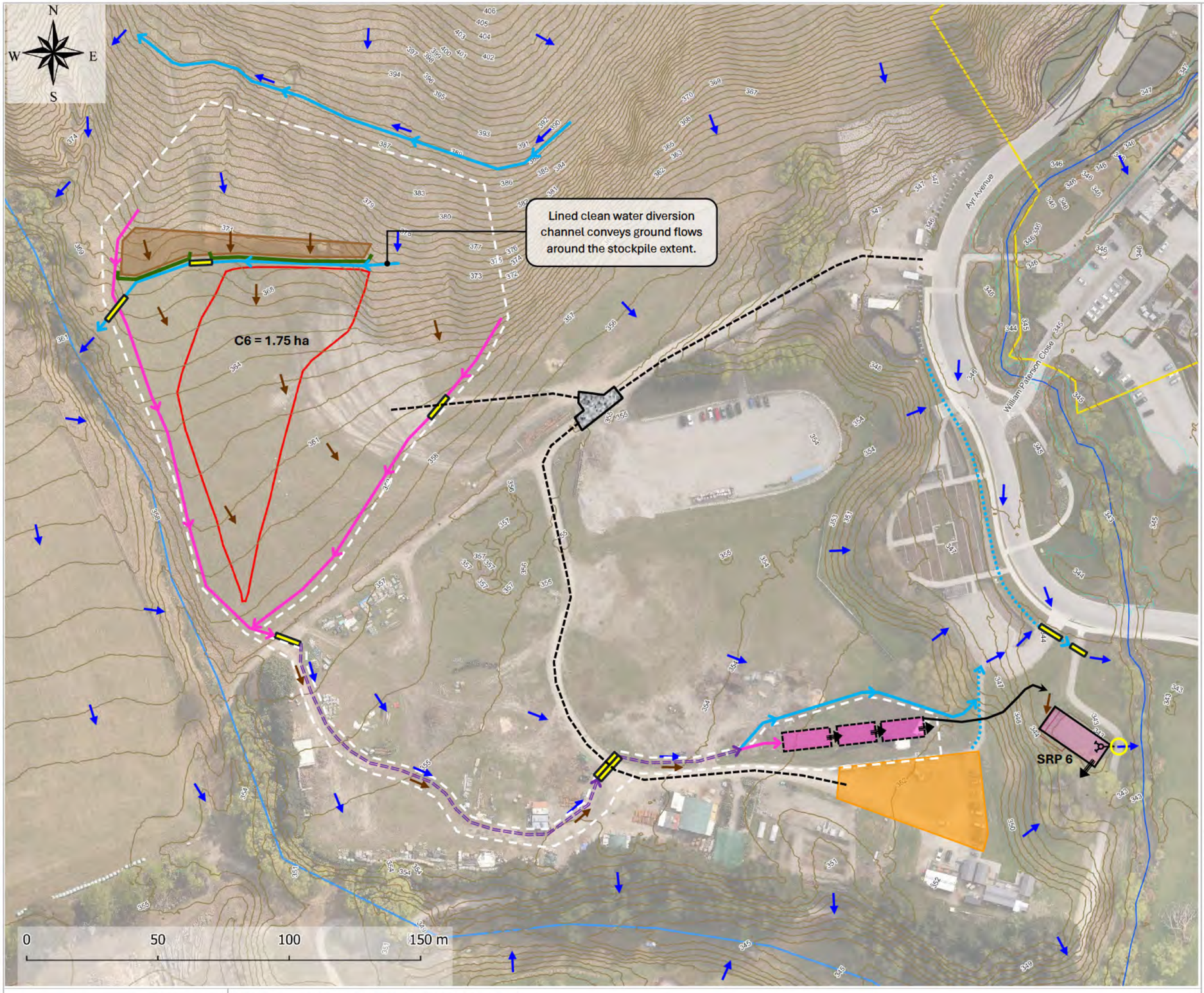
1. This plan is to be read in conjunction with the Environmental Management Plan document prepared by Enviroscope.
2. All locations of erosion and sediment control (ESC) devices are indicative and exact placement to be confirmed onsite.
3. ESC devices to be installed and maintained in accordance with Auckland Council's 'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05) and manufacturer's instructions where relevant.
4. All devices are to be inspected daily and pre and post-rain event to ensure they are fully functional.
5. QGIS – Scale 1:4000

enviroscope

Project: Northbrook Waterfall Park – Stage 1

Description: Erosion and Sediment Control Plan Drawing

Drawn	Approved	Date	Drawing No.	Revision
WT	TG	5/08/2025	ESCP - 001	F



Legend

	Stabilised access
	Laydown
	Clean water overland flow
	Dirty water overland flow
	Clean water diversion channel (CWDC)
	Engineered-design water table (Clean)
	Dirty water diversion channel (DWDC)
	Combined clean/dirty water diversion bund
	Unnamed ephemeral flow path
	Temporary culvert
	Pipe-drop structure
	Standard silt fence
	Temporary haul road
	Sediment retention pond
	Water sampling location
	Sediment basin
	Lined spillway
	Catchment
	Stockpile extent
	Topsoil strip

Notes

1. This plan is to be read in conjunction with the Environmental Management Plan document prepared by Enviroscope.
2. All locations of erosion and sediment control (ESC) devices are indicative and exact placement to be confirmed onsite.
3. ESC devices to be installed and maintained in accordance with Auckland Council's 'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05) and manufacturer's instructions where relevant.
4. All devices are to be inspected daily and pre and post-rain event to ensure they are fully functional.
5. QGIS – Scale 1:1500

enviroscope

Project: Northbrook Waterfall Park – Stockpile Area

Description: Erosion and Sediment Control Plan Drawing

Drawn	Approved	Date	Drawing No.	Revision
WT	TG	5/08/2025	ESCP - 002	F

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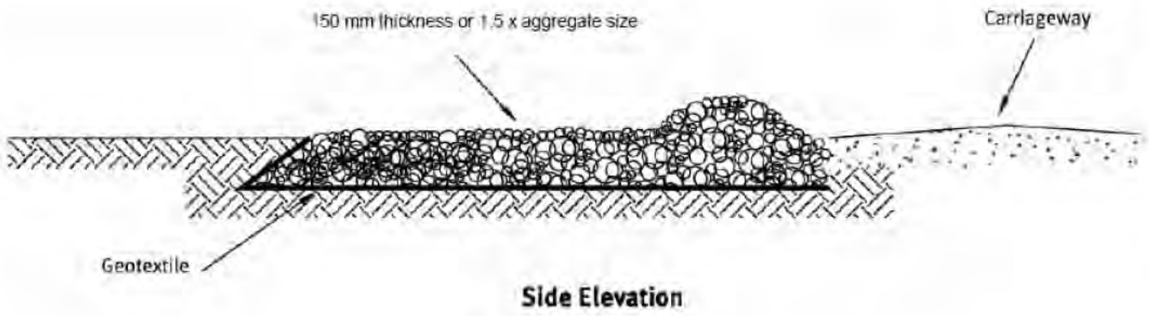
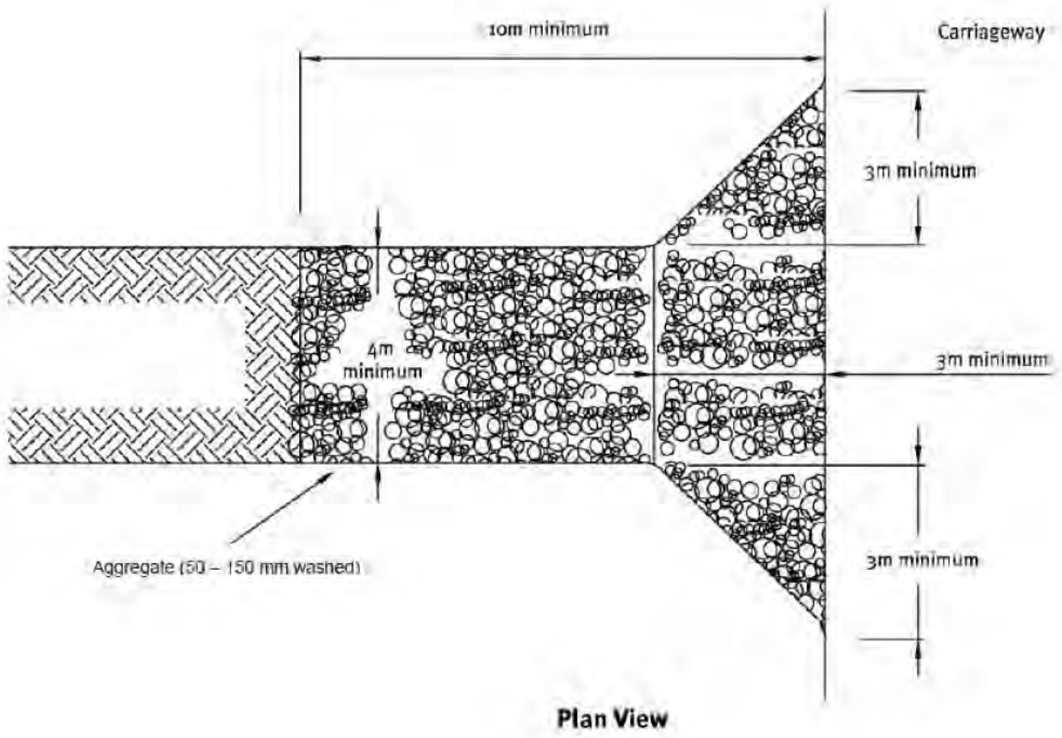
(Page 60 from GD05)



Side Elevation

Design Parameter	Specification
Aggregate size	50-150 mm washed aggregate
Minimum thickness	150 mm
Minimum length	10 m
Minimum width	4 m

- Additional aggregate may need to be added to the stabilised entranceway throughout the project to maintain the thickness.
- Any sediment that has been tracked onto the surrounding roads must be swept away at regular intervals.

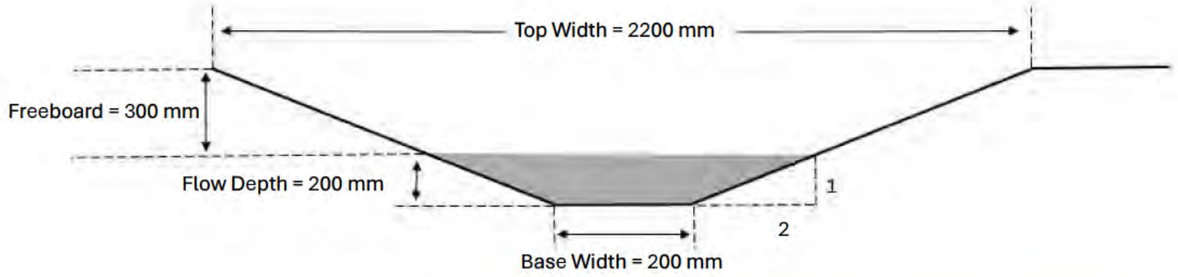


Plan View

enviroscope	**Project:** Northbrook Waterfall Park **Description:** Erosion and Sediment Control Plan - Schematics				
	Drawn	**Approved**	**Date**	**Drawing Number**	**Revision**
	WT	TG	5/08/2025	ESCP - 003	F

DIRTY WATER DIVERSION CHANNEL

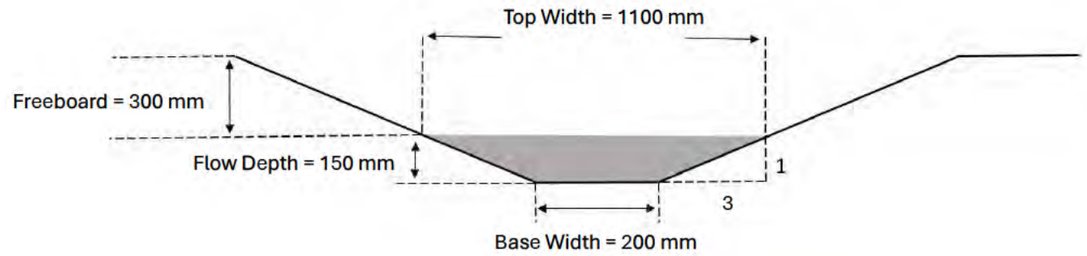
(Pages 43-46 from GD05)



- This has been designed to convey up to a 5% AEP design event.
- Check dams recommended.
- Trapezoidal shape
- Full calculations are included in **Appendix 2.**

CLEAN WATER DIVERSION CHANNEL

(Pages 38-43 from GD05)



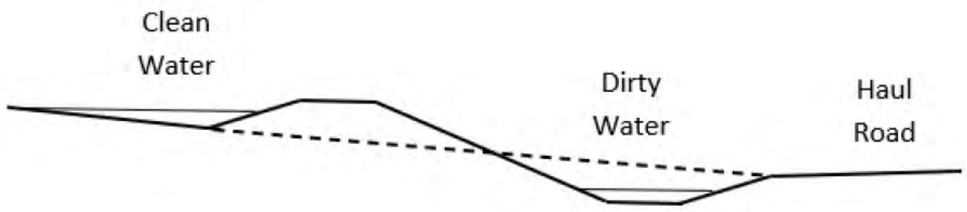
- This has been designed to convey up to a 5% AEP design event.
- Trapezoidal shape
- Full calculations are included in **Appendix 2.**

Project: Northbrook Waterfall Park

Description: Erosion and Sediment Control Plan - Schematics

Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 004	F

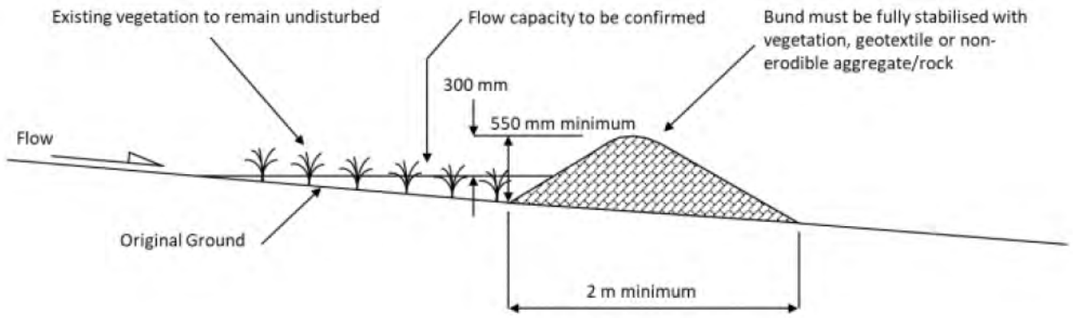
COMBINED CLEAN AND DIRTY WATER DIVERSION BUND



- Ensure bund is well compacted and stabilised.
- Dirty water diversion channel to be formed in accordance with the design specifications provided in ESCP-005 above. Bund to be formed as per clean water diversion bund specs.
- Monitor the inlet and outlet for scour.
- Ensure there are no areas of ponding or blockages along the length of the bund.

COMPACTED EARTH BUND

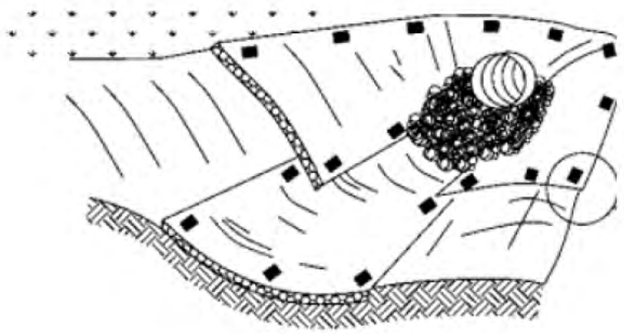
(Page 38-43 from GD05)



- Ensure bund is well compacted and stabilised.
- Monitor the inlet and outlet for scour.
- Ensure there are no areas of ponding or blockages along the length of the bund.

TEMPORARY CULVERT

(Diagram from TP90 – now GD05)



- The culvert should consist of a 300 mm PVC or farm-grade culvert to allow for heavy haul vehicles to traffic over.
- Geofabric and rock should be placed at the outlet to prevent scour from the higher velocity water exiting the culvert.
- Full calculations are included in **Appendix 2**.

TRAFFICABLE SWALE

Image from Enviroscope

- Trafficable swales should be constructed by mounding and compacting soil diagonally across the road to direct water in the direction required.
- Vehicles should be able to cross trafficable swales often.
- Rock-lining may need to be added if the swale structure is continuing to degrade by trafficking.

enviroscope	**Project:** Northbrook Waterfall Park **Description:** Erosion and Sediment Control Plan - Schematics				
	Drawn	**Approved**	**Date**	**Drawing Number**	**Revision**
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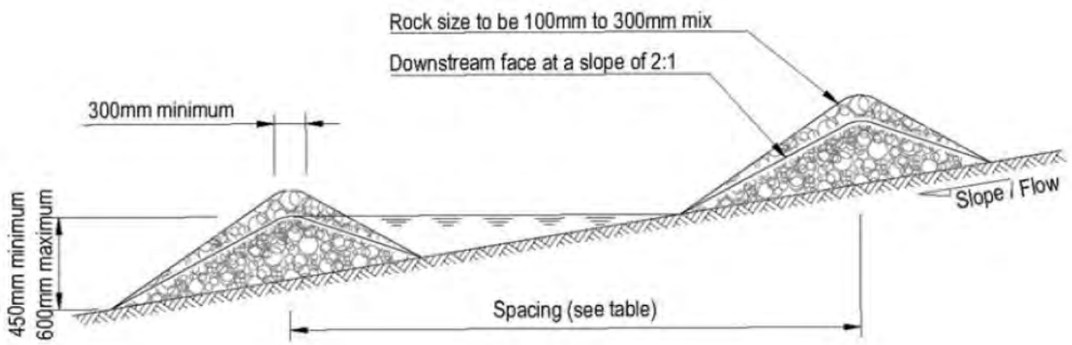
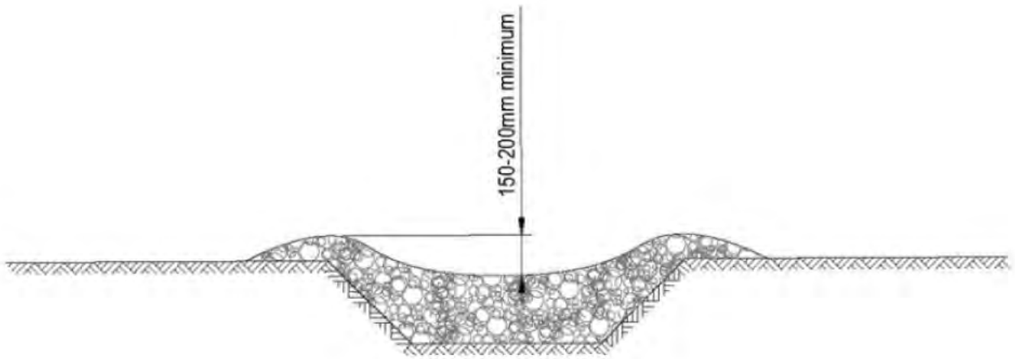
CHECK DAMS

(Page 50-54 from GD05)





Slope of site (%)	Spacing (m) of dams with a 450 mm centre height	Spacing (m) of dams with a 600 mm centre height
Less than 2%	24	30
2- 4%	12	15
4- 7%	8	11
7- 10%	5	6
Greater than 10%	Unsuitable – use stabilised channel or specific engineered design	Unsuitable – use stabilised channel or specific engineered design

- Check dams will be constructed out of 100 – 300 mm mix rock or sandbags.
- As the DWDC has a depth of 150 mm, check dams should be 150 mm high with the centre being 50-100 mm lower than the outside edges to form a spillway.

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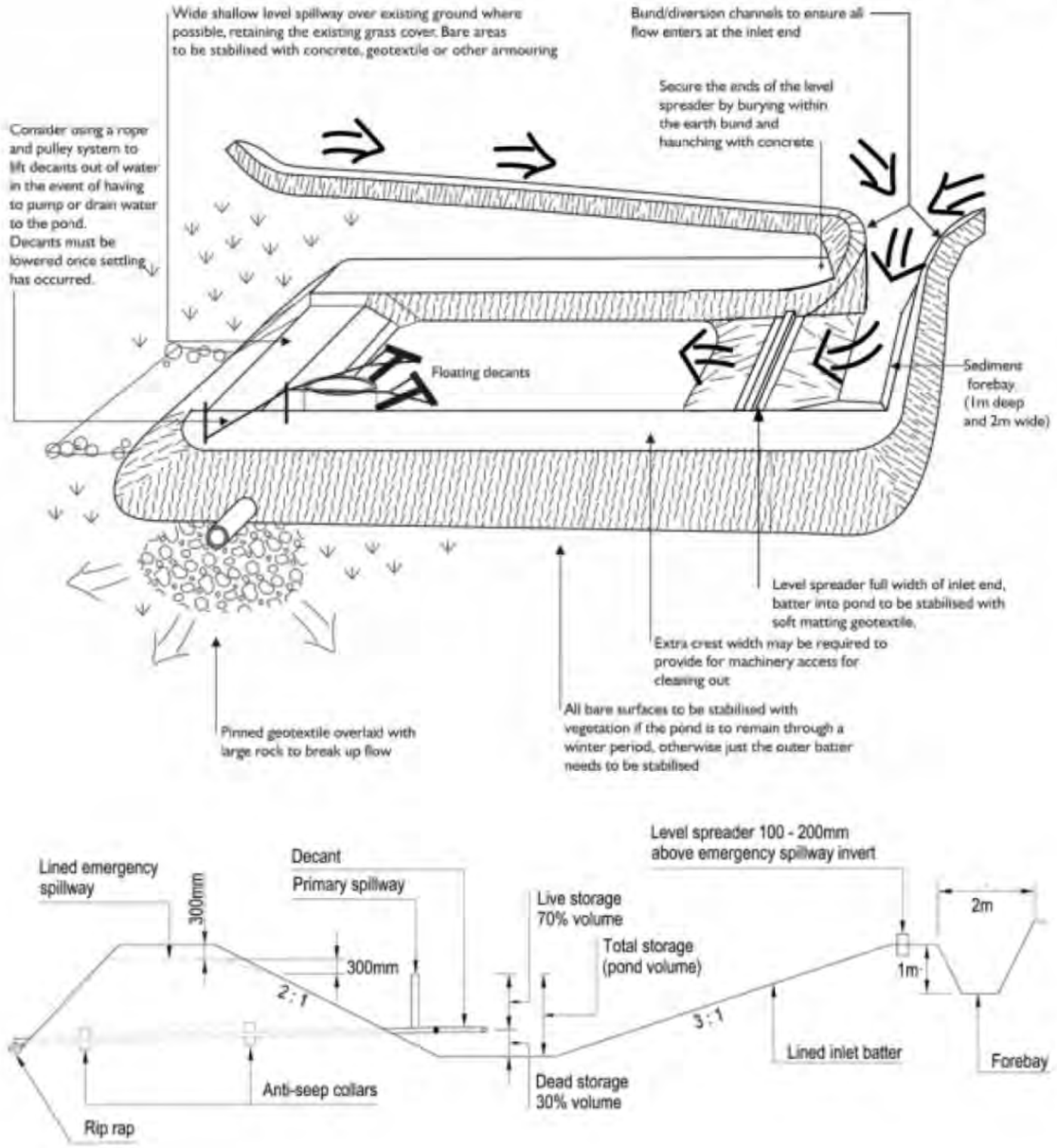
Project: Northbrook Waterfall Park

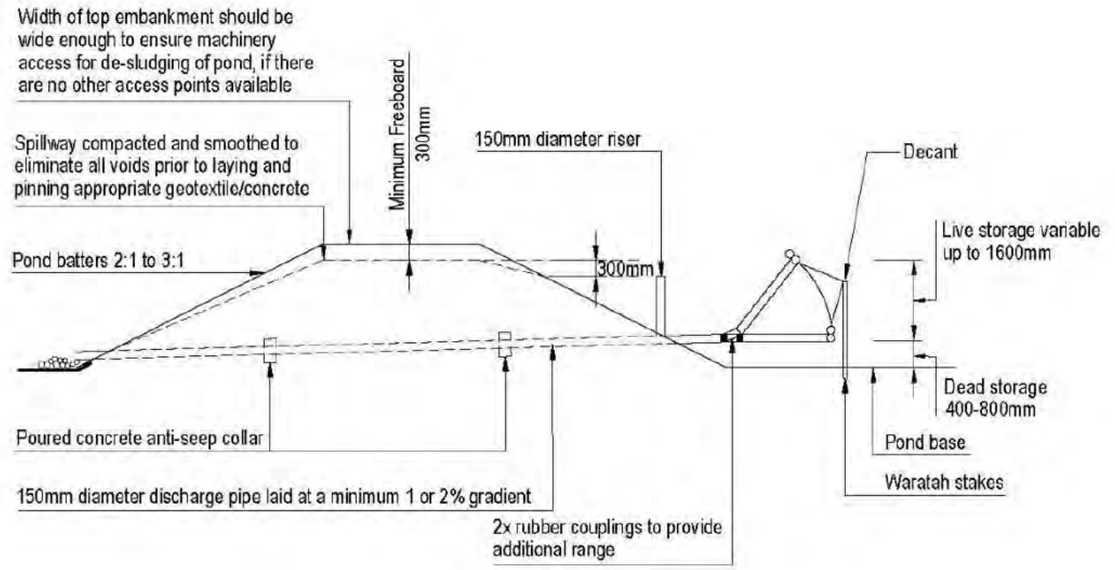
Description: Erosion and Sediment Control Plan - Schematics

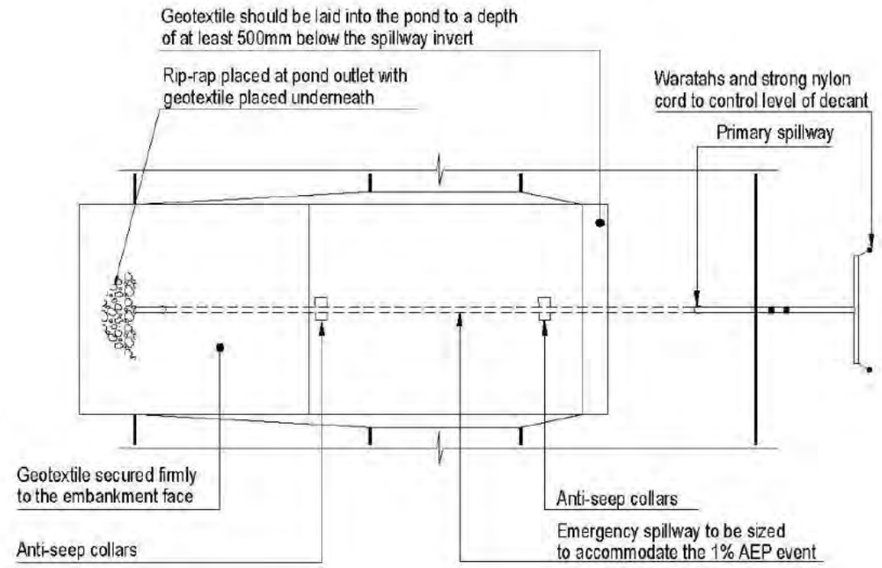
Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 006	F

SEDIMENT RENTENTION POND

Page 91-105 from GD05







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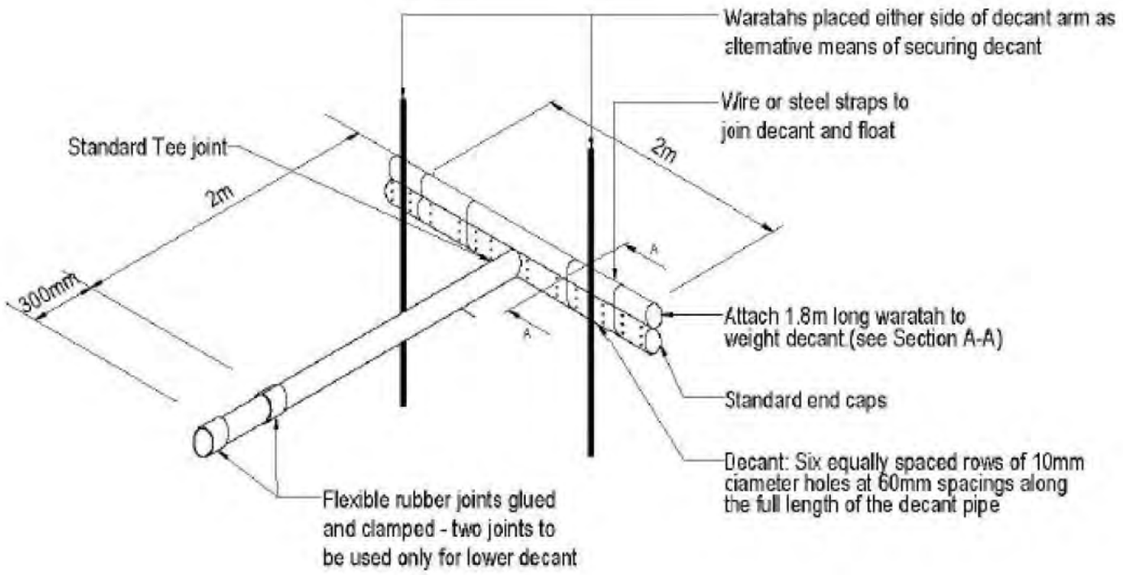
Project: Northbrook Waterfall Park

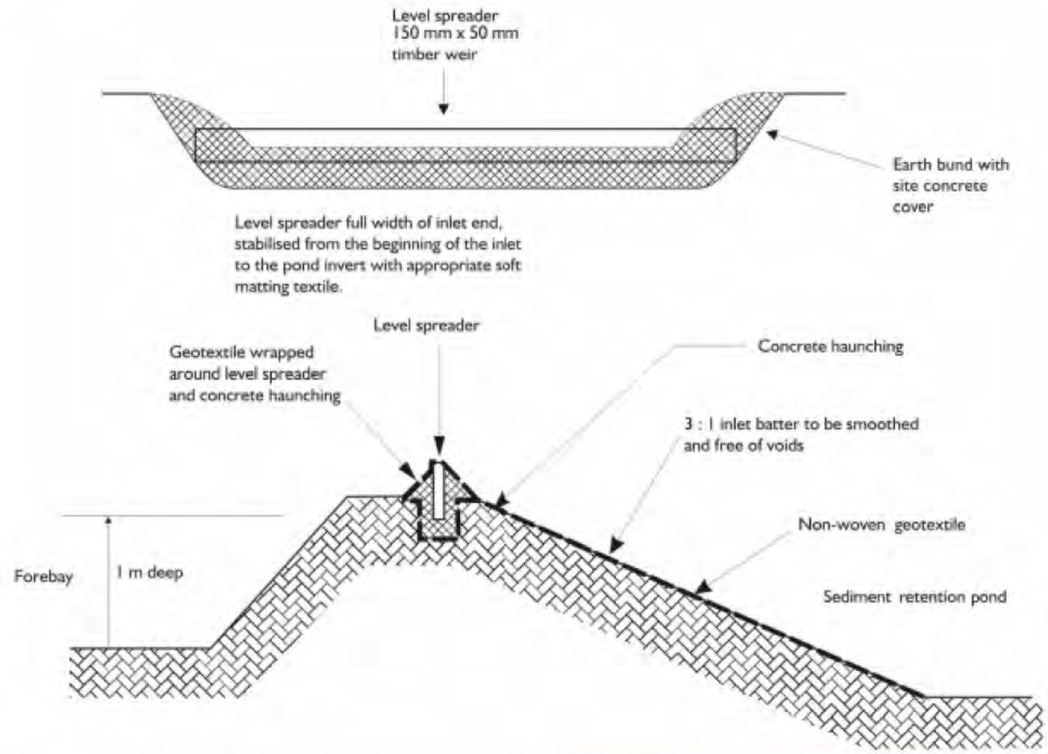
Description: Erosion and Sediment Control Plan - Schematics

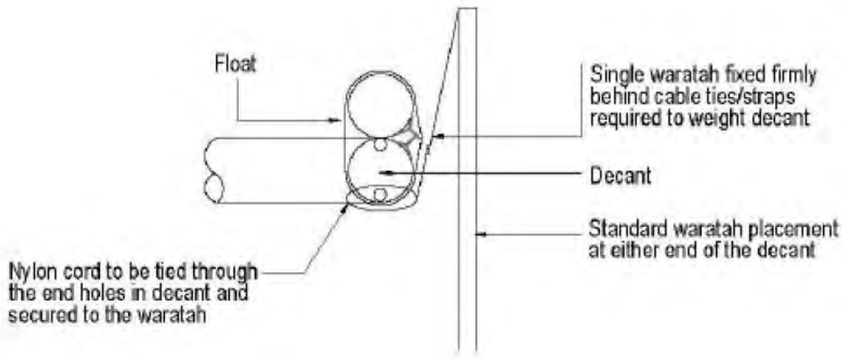
Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 007	F

SEDIMENT RENTENTION POND

Page 91-105 from GD05



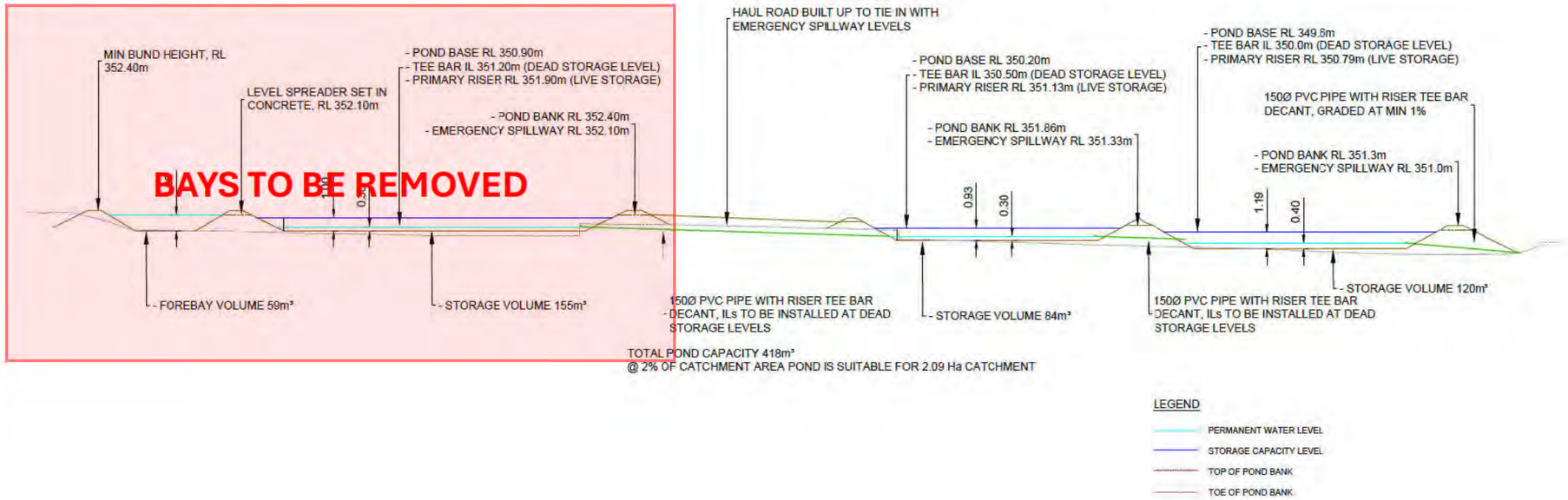




enviroscope	**Project:** Northbrook Waterfall Park **Description:** Erosion and Sediment Control Plan - Schematics				
	Drawn	**Approved**	**Date**	**Drawing Number**	**Revision**
	WT	TG	5/08/2025	ESCP - 008	F

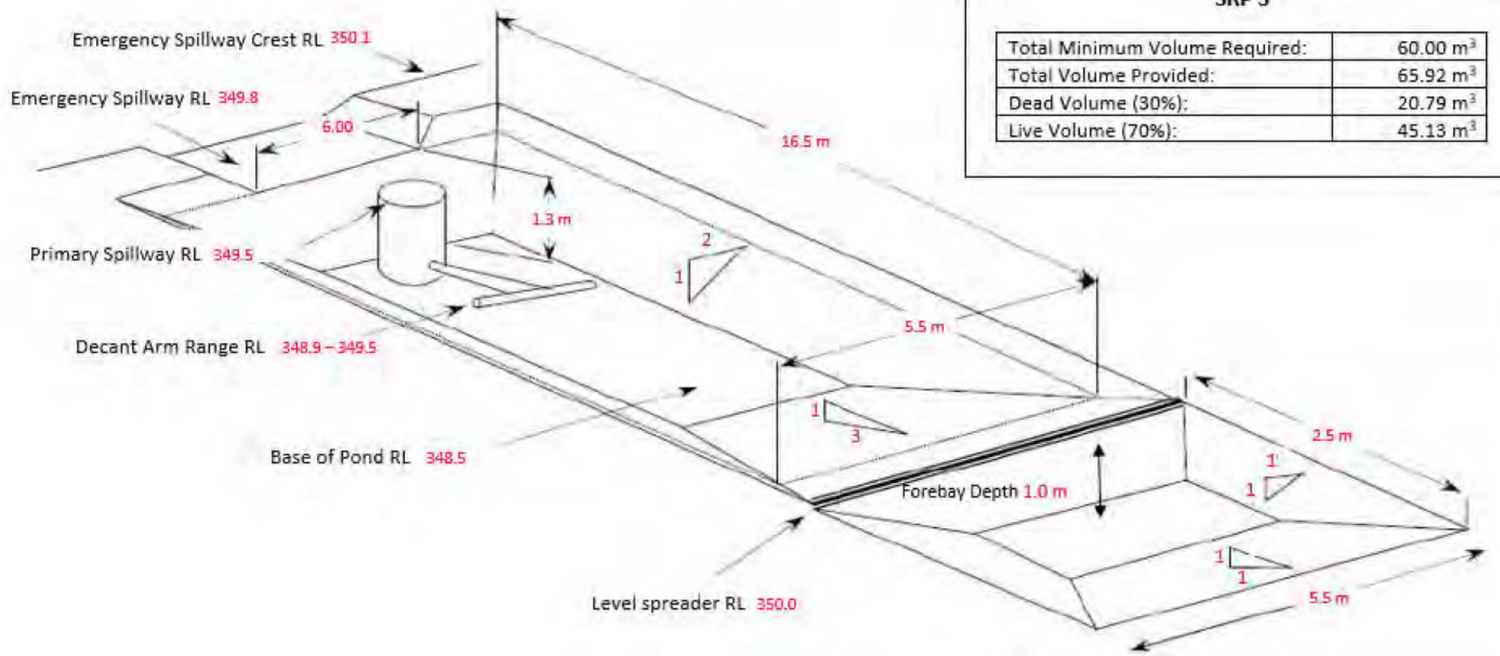
SEDIMENT RENTENTION PONDS 2 AND 3

Page 91-105 from GD05



SRP 3

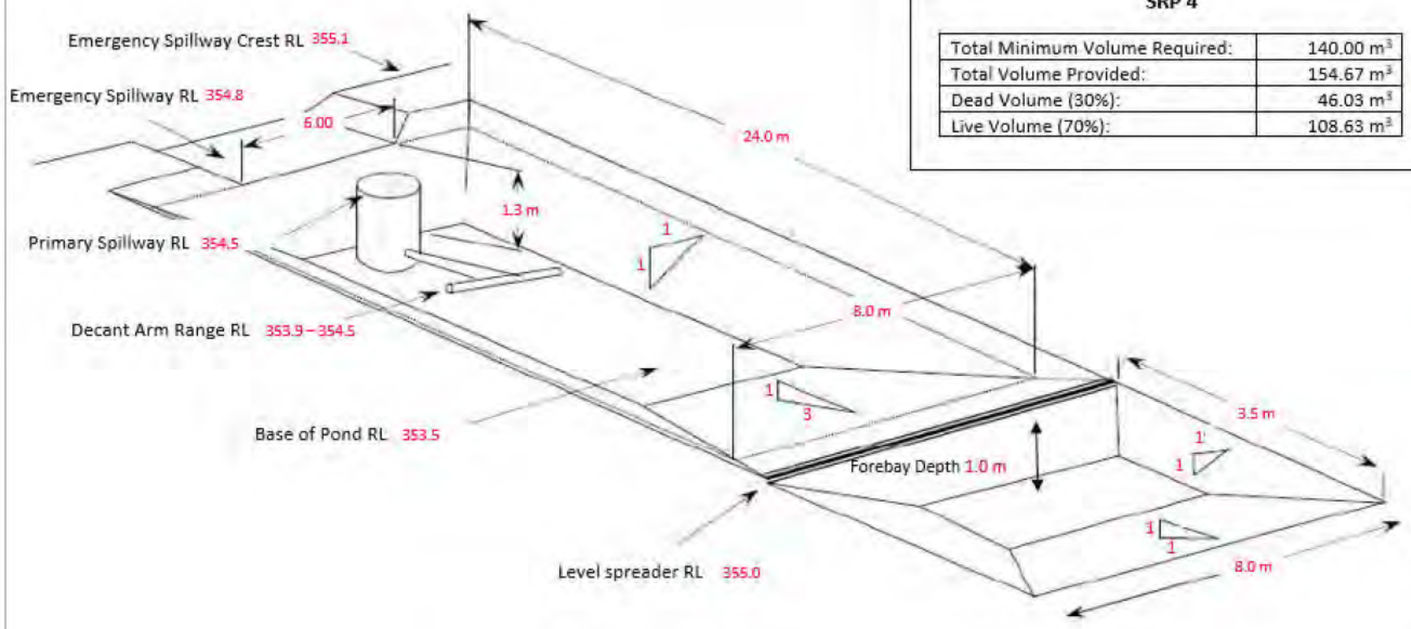
Total Minimum Volume Required:	60.00 m³
Total Volume Provided:	65.92 m³
Dead Volume (30%):	20.79 m³
Live Volume (70%):	45.13 m³



enviroscope	**Project:** Northbrook Waterfall Park **Description:** Erosion and Sediment Control Plan - Schematics				
	Drawn	**Approved**	**Date**	**Drawing Number**	**Revision**
	WT	TG	5/08/2025	ESCP - 009	F

SEDIMENT RENTENTION PONDS 4 AND 5

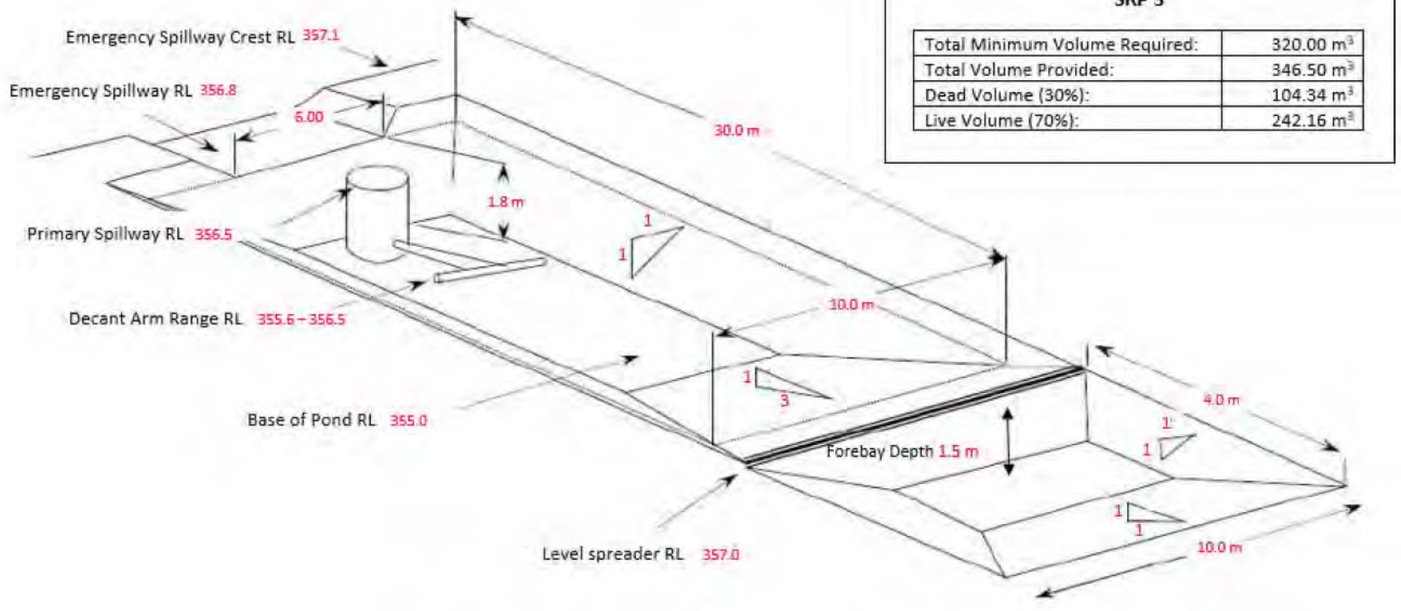
Page 91-105 from GD05



SRP 4

Total Minimum Volume Required:	140.00 m^3
Total Volume Provided:	154.67 m^3
Dead Volume (30%):	46.03 m^3
Live Volume (70%):	108.63 m^3

- See **Appendix 2** for full calculations.



SRP 5

Total Minimum Volume Required:	320.00 m^3
Total Volume Provided:	346.50 m^3
Dead Volume (30%):	104.34 m^3
Live Volume (70%):	242.16 m^3

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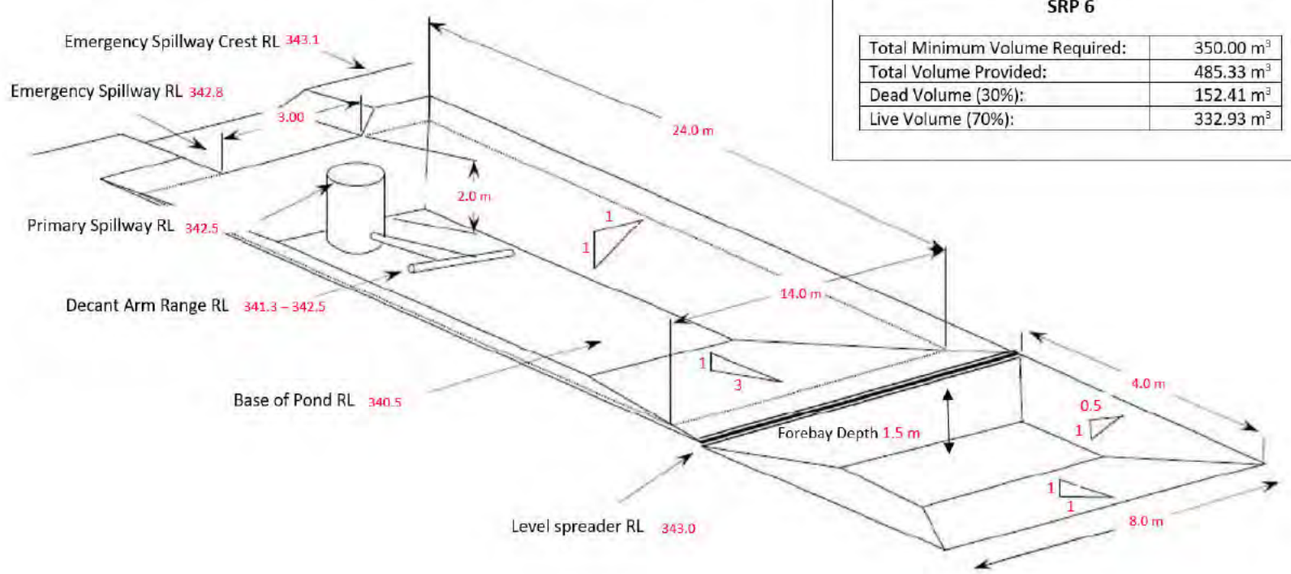
Project: Northbrook Waterfall Park

Description: Erosion and Sediment Control Plan - Schematics

Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 010	F

SEDIMENT RENTENTION POND 6

Page 91-105 from GD05



SRP 6

Total Minimum Volume Required:	350.00 m^3
Total Volume Provided:	485.33 m^3
Dead Volume (30%):	152.41 m^3
Live Volume (70%):	332.93 m^3

- See **Appendix 2** for full calculations.

SEDIMENT BASINS

Images from Enviroscope

- Sediment basins serve as additional 'forebays' for SRP 6. Sediment deposits have been cleaned out from previous stages of works.

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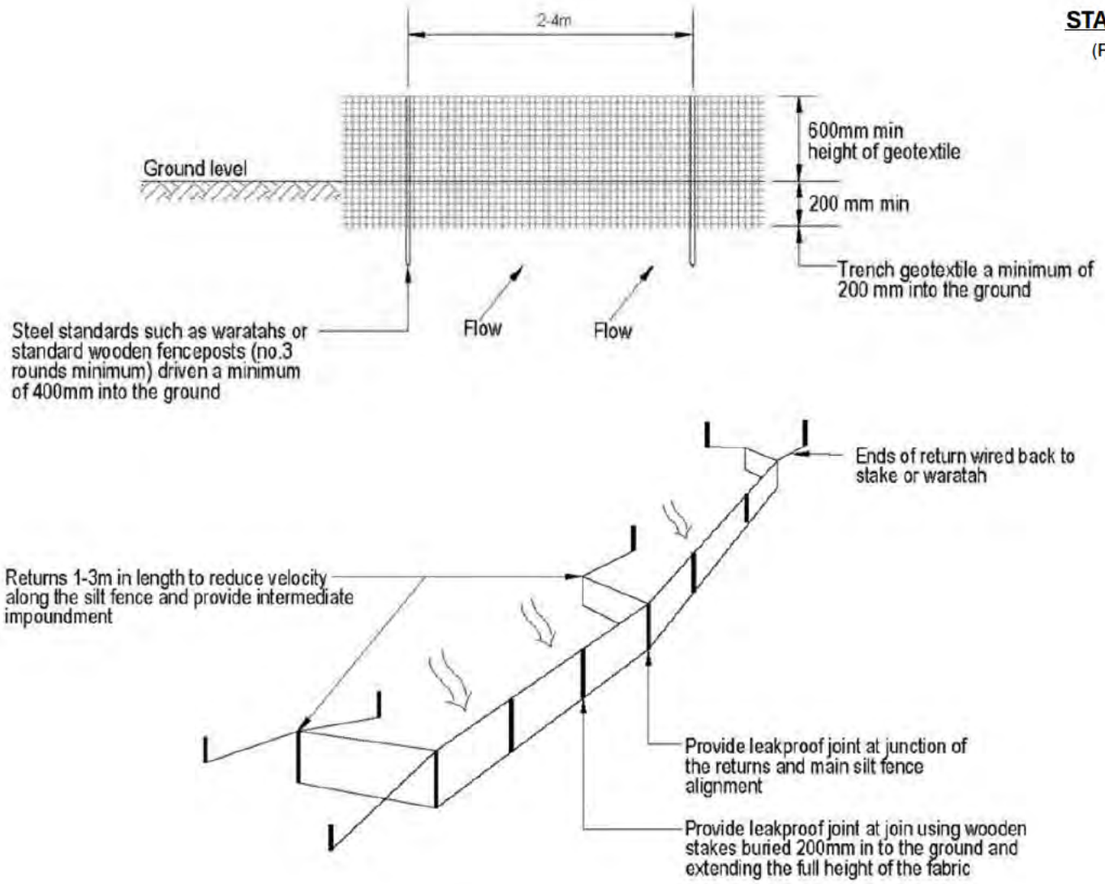
Project: Northbrook Waterfall Park

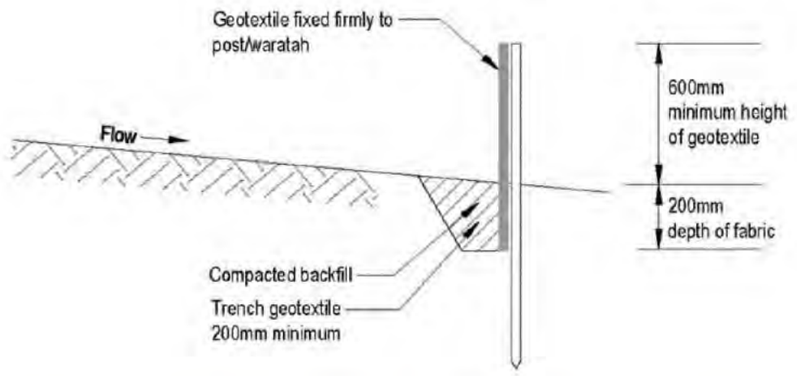
Description: Erosion and Sediment Control Plan - Schematics

Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 011	F

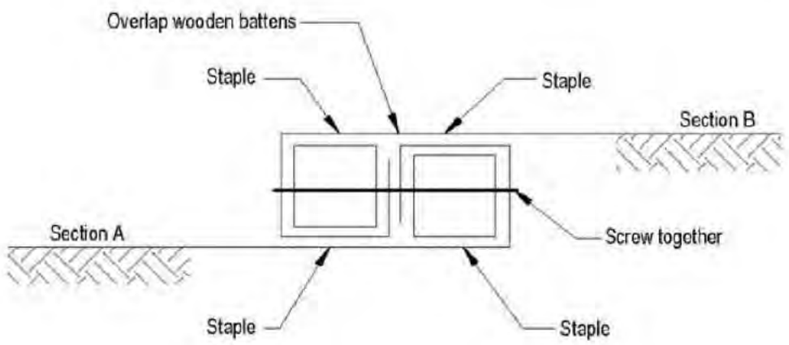
STANDARD SILT FENCE

(Page 112-119 from GD05)





Slope steepness (%)	Slope length (m) (maximum)	Spacing of returns (m)	Silt fence length (m) (maximum)
Less than 2%	Unlimited	N/A	Unlimited
2- 10%	40	60	300
10- 20%	30	50	230
20- 33%	20	40	150
33- 50%	15	30	75
Greater than 50%	6	20	40



- Ensure the silt fence is 'keyed' into the ground to form a good seal at ground level to capture water and avoid undermining.
- Silt fences should be 600 mm above ground level and 200 mm below ground level.
- Supporting waratahs should be placed at 2-4 m intervals.
- Returns should be formed at either end facing upslope to contain flows.
- It is also important that silt fences are installed along the contour of the slope to prevent ponding of water in a concentrated area of the fence.
- To be mucked out once 20% capacity reached.

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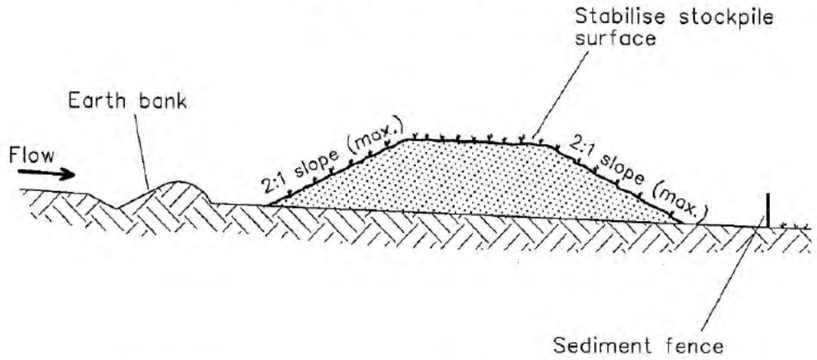
Project: Northbrook Waterfall Park

Description: Erosion and Sediment Control Plan - Schematics

Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 012	F

TEMPORARY STOCKPILES



- Temporary stockpiles should be a maximum height of two metres to mitigate wind effects and to preserve the quality of the topsoil as future planting media for revegetation.
- If the stockpile is to be left insitu for a period of 4 weeks or more it shall be seeded with grass or erosion control matting to provide erosion and dust protection.

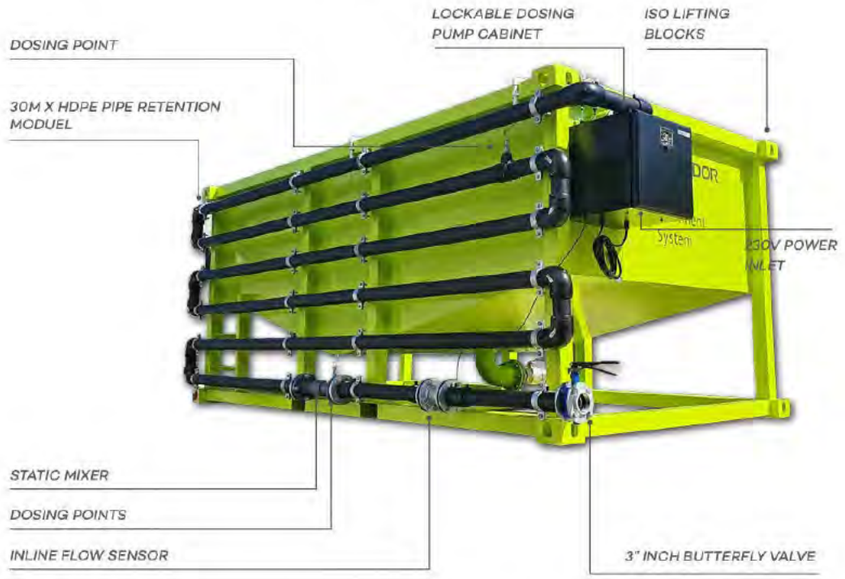
SILT SOCK

Page 126-130 from GD05

- It is important that the silt socks are secured flush with the ground to prevent sediment from undercutting the sock.
- Ensure silt socks are placed along the contour of a site.

SETTLEMENT TANK

Page 144-146 from GD05

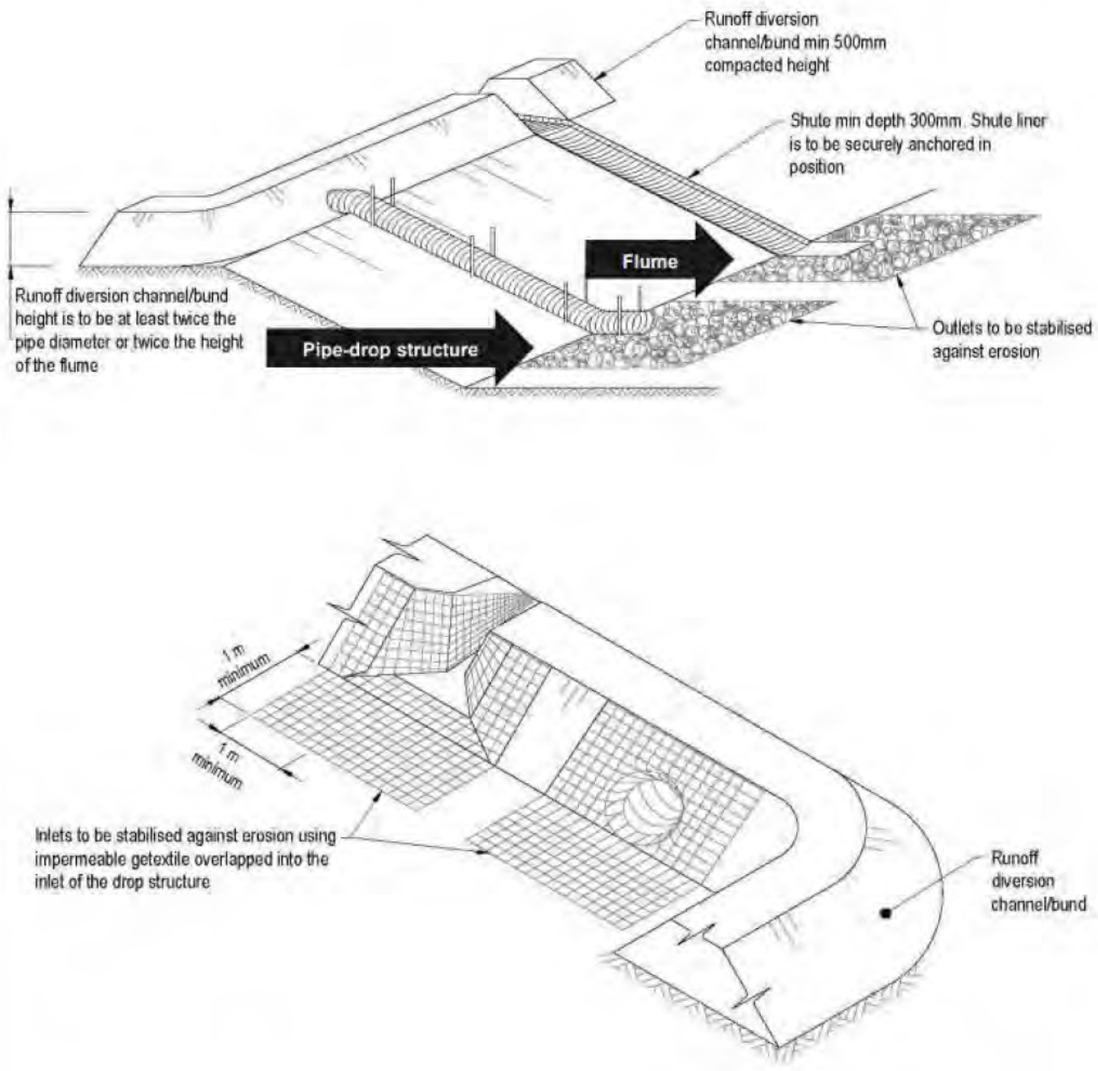


- Groundwater flows that enter the basement excavation shall be pumped to the settlement tank to be treated prior to discharge from site.
- Settlement tanks shall feed into the existing SRP 2 'treatment train'.

enviroscope	**Project:** Northbrook Waterfall Park **Description:** Erosion and Sediment Control Plan - Schematics				
	Drawn	**Approved**	**Date**	**Drawing Number**	**Revision**
	WT	TG	5/08/2025	ESCP - 013	F

PIPE DROP STRUCTURE

Page 55-60 from GD05



- Attach a 160 mm drainage coil pipe into the bund.
- The drainage coil will be unpunched and ensure all connections are water tight.
- The inlet to the pipe has a stabilised apron of coconut fibre matting.
- The pipe will be pinned every four metres to anchor it. There will be no less than two anchors equally spaced along the length of the pipe.
- Ensure the pipe extends into the SRP 6 forebay inlet and the outlet is stabilised with geofabric or rock rip rap to avoid downslope scouring.
- The pipe drop structure will be monitored and maintained regularly to ensure it operates effectively.
- See **Appendix 2** for full calculations.

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Project: Northbrook Waterfall Park

Description: Erosion and Sediment Control Plan - Schematics

Drawn	Approved	Date	Drawing Number	Revision
WT	TG	5/08/2025	ESCP - 014	F

REFUELING BAY

- Locate the hardstand as far as practicably possible from waterways and concentrated flows.
- Ensure spill kit is located nearby.

CONCRETE WASHOUT PIT

- The concrete wash out pit consists of a plastic-lined bunded pit constructed with fill or straw bales.
- After concrete washout any water shall be left to evaporate.
- Cured concrete is to be disposed of within the plastic sheet to a licensed facility.

SPILL KITS

- Spill kits should be located in the laydown area.

WASTE

- Where possible, waste shall be segregated into labelled bins.
- Wastes on site will be suitably contained and prevented from escaping off site. This may include covering skip bins during high winds.
- Waste storage is not permitted in or near drainage paths.
- Wastes will be removed from site when bin is full.

enviroscope	**Project:** Northbrook Waterfall Park **Description:** Erosion and Sediment Control Plan - Schematics				
	Drawn	**Approved**	**Date**	**Drawing Number**	**Revision**
	WT	TG	5/08/2025	ESCP - 015	F

APPENDIX 2 Calculations for Erosion and Sediment Controls

'CLEAN' WATER DIVERSION CHANNEL CALCULATIONS - NORTHBROOK WATERFALL PARK

Specifications	Value 1	Value 2	Value 3	Value 4	Value 5	Units	Reference/Notes
Site Details							
Contributing catchment					1.45	ha	QGIS - Largest contributing catchment
Design rainfall event					0.05	AEP	5% AEP as required by GD05
Time of Concentration							
Overland sheet flow path length (L)					150	m	
Hortons roughness value (n)					0.2		
Slope of surface (S)					16.0	%	
Time of Concentration (Tc)					8.1	minutes	
Rounded Tc to align with HIRDS					10	minutes	
Rational Method: Q = (C*I*A)/360							
Area ground cover	Grass	Concrete	Forest	Shrubs	Bare soil		
Proportion of catchment	1	0	0	0	0		
Runoff coefficient (C)	0.4	1	0.25	0.5	0.8		Manning's Roughness Coefficient (n)
Rainfall intensity (I)	39.8	39.8	39.8	39.8	39.8	mm	
Catchment Area (A)	1.45	0.00	0.00	0.00	0.00	ha	
Qp (Peak runoff flow)	0.0641	0.0000	0.0000	0.0000	0.0000	m3/s	Rational Method: Q = CIA
Total Qp (Peak runoff flow)					0.0641		
Channel Design							Manning's Formula Uniform Trapezoidal Channel Flow
Bottom Width					200	mm	
Batter ratio= 1 to					2	ratio	
Manning's roughness coefficient of channel (n)					0.018		Lined earth channel
Channel slope					1.5	%	
Flow depth					150	mm	
Channel depth					450	mm	300 mm freeboard provided
Flow (Q)					0.0995	m3/s	
Buffer					55	%	
Top width					2000	mm	
Additional Controls							
Drop out pit					No		
Check dams					No		
Lined					Yes		

'CLEAN' WATER CULVERT CALCULATIONS - NORTHBROOK WATERFALL PARK

Specifications	1	2	3	4	Value	Units	Reference/Notes
Pipe diameter					300	mm	
Pipe material					PVC		Farm-grade culvert to allow for heavy haul vehicles to traffic over
Pipe length					8	m	
Drop					0.5	m	
Flow velocity					5.573	m/s	
Flow discharge					0.3939	m3/s	Hazen-Williams Equation
Flow discharge in L/s					393.9	L/s	
Buffer					514	%	

WORST-CASE 'DIRTY' WATER DIVERSION CHANNEL CALCULATIONS - NORTHBROOK WATERFALL PARK

Specifications	Value 1	Value 2	Value 3	Value 4	Value 5	Units	Reference/Notes
Site Details							
Contributing catchment					1.75	ha	QGIS
Design rainfall event					0.05	AEP	5% AEP as required by GD05
Time of Concentration							
Overland sheet flow path length (L)					200	m	
Hortons roughness value (n)					0.2		
Slope of surface (S)					2.5	%	
Time of Concentration (Tc)					12.9	minutes	
Rounded Tc to align with HIRDS					10	minutes	
Rational Method: Q = (C*I*A)/360							
Area ground cover	Grass	Concrete	Forest	Shrubs	Bare soil		
Proportion of catchment	0	0	0	0	1		
Runoff coefficient (C)	0.4	1	0.25	0.5	0.8		Manning's Roughness Coefficient (n)
Rainfall intensity (I)	39.9	39.9	39.9	39.9	39.9	mm	NIWA HIRDS, 10 min (Tc), 5% AEP
Catchment Area (A)	0.00	0.00	0.00	0.00	1.75	ha	
Qp (Peak runoff flow)	0.0000	0.0000	0.0000	0.0000	0.1552	m3/s	Rational Method: Q = CIA
Total Qp (Peak runoff flow)					0.1552		
Channel Design							Manning's Formula Uniform Trapezoidal Channel Flow
Bottom Width					200	mm	
Batter ratio= 1 to					2	ratio	
Manning's roughness coefficient of channel (n)					0.025		Gravelly earth channel
Channel slope					2.5	%	
Flow depth					200	mm	
Channel depth					500	mm	300 mm freeboard provided
Flow (Q)					0.1739	m3/s	
Buffer					12	%	
Top width					2200	mm	
Additional Controls							
Drop out pit					No		
Check dams					Yes		
Geofabric lining					Yes		

'DIRTY' WATER CULVERT CALCULATIONS - NORTHBROOK WATERFALL PARK

Specifications	1	2	3	4	Value	Units	Reference/Notes
Pipe diameter					300	mm	
Pipe material					Drainage coil		
Pipe length					8	m	
Drop					0.5	m	
Flow velocity					5.573	m/s	
Flow discharge					0.3939	m3/s	Hazen-Williams Equation
Flow discharge in L/s					393.9	L/s	
Buffer					154	%	

DIRTY WATER CATCHMENT CALCULATIONS - NORTHBROOK WATERFALL PARK

Specifications	Value 1	Value 2	Value 3	Value 4	Value 5	Units	Reference/Notes
Site Details							
Contributing catchment					1.75	ha	QLDC GIS + Google Earth
Design rainfall event					0.05	AEP	5% AEP as required by GD05
Time of Concentration							
Overland sheet flow path length (L)					200	m	
Hortons roughness value (n)					0.2		
Slope of surface (S)					2.5	%	
Time of Concentration (Tc)					12.9	minutes	
Rounded Tc to align with HIRDS					10	minutes	
Rational Method: Q = (C*I*A)/360							
Area ground cover	Grass	Concrete	Forest	Shrubs	Bare soil		
Proportion of catchment	0	0	0	0	1		
Runoff coefficient (C)	0.4	1	0.25	0.5	0.8		Manning's Roughness Coefficient (n)
Rainfall intensity (I)	39.9	39.9	39.9	39.9	39.9	mm	NIWA HIRDS, 10 min (Tc), 5% AEP
Catchment Area (A)	0.00	0.00	0.00	0.00	1.75	ha	
Qp (Peak runoff flow)	0.0000	0.0000	0.0000	0.0000	0.1552	m3/s	Rational Method: Q = CIA
Total Qp (Peak runoff flow)					0.1552		

PIPE-DROP CALCULATIONS - NORTHBROOK WATERFALL PARK

Specifications	1	2	3	4	Value	Units	Reference/Notes
Pipe diameter					160	mm	
Pipe material					Drainage coil		
Pipe length					50	m	
Drop					10	m	
Flow velocity					8.09	m/s	
Flow discharge					0.25413	m3/s	Hazen-Williams Equation
Flow discharge in L/s					254.13	L/s	
Buffer					64	%	

SEDIMENT RETENTION POND 02 FOREBAY CALCULATIONS - NORTHBROOK WATERFALL PARK - REVISION D

Specification	Value	Value2	Value3		Units	Source / Notes / Reference
Forebay details		**Reduced Level (RL)**				
Forebay volume requirement (+/- 3%)				20.40	m3	10% of the total storage volume provided by the remaining bays of the existing SRP 02
Forebay length				10.40	m	
Forebay width				3.70	m	
Forebay depth			350.2	1.00	m	
Forebay internal batter ratio = 1 to				1.0	ratio	
Approximate forebay volume				23.30	m3	
Treatment train additions						
Drop out pit				No		
RADS unit				Yes		
Baffles				Yes		Existing baffles within SRP 02
Check dams				No		

SEDIMENT RETENTION POND 3 CALCULATIONS - NORTHBROOK WATERFALL PARK

Specification	Value	Value2	Value3	Units	Source / Notes / Reference
Site details					
Contributing catchment			0.30	ha	QLDC GIS
Percentage volume factor			2.00	%	
GD05 theoretical SRP volume required			60.00	m3	
SRP Design Specifications	Total Storage	Dead Storage (30%)	Live Storage (70%)		
Top length (A)	16.50	14.10	16.50	m	
Top width (B)	5.50	4.30	5.50	m	
Base length (a)	12.50	12.50	14.10	m	
Base width (b)	3.50	3.50	4.30	m	
Depth (h)	1.00	0.40	0.60	m	Measured from primary spillway down
Internal batter ratio= 1 to	1	1	1	ratio	
Actual volume (v)	65.92	20.79	45.13	m3	
Width to length ratio	3:1	3.3:1	3:1	ratio	
Buffer	9.86%			%	
Percentage of total SRP	100.00%	31.54%	68.46%	%	
External batter ratio= 1 to	2	2	2	ratio	
Forebay details		Reduced Level (RL)			
Forebay volume requirement (+/- 3%)			6.59	m3	10% of SRP volume
Forebay length			2.50	m	
Forebay width			5.50	m	
Forebay depth		349.0	1.00	m	
Forebay internal batter ratio = 1 to			0.5	ratio	
Approximate forebay volume			7.67	m3	
Level spreader details		Reduced Level (RL)			
RL of level spreader		350.0		m	
Width of level spreader			5.50	m	
Inlet batter steepness= 1 to			3	ratio	
T-bar/ Decant details		Reduced Level (RL)			
RL at base of pond		348.5		m	
Base of lower decanting arm range		348.9	0.40	m	
Base of upper decanting arm range		349.2	0.70	m	
Top decanting arm range		349.5	1.00	m	
T-bar diameter			150.00	mm	
Decant arm length			2.00	m	
Decant rate			0.90	L/sec	0.3 L/sec/1000 m3
Number of holes on T-bar			40	Holes	Cover holes on standard order T-bar to achieve this number of 10 mm diameter holes
Primary spillway details		Reduced Level (RL)			
RL at primary spillway		349.5		m	0.3 m lower than emergency spillway invert and 0.6 m lower than emergency spillway crest
Outlet pipe diameter			150.00	mm	
Emergency spillway		Reduced Level (RL)			
RL at emergency spillway invert		349.8		m	
RL at emergency spillway crest		350.1		m	0.3 m higher than emergency spillway invert
Spillway width at invert			6.00	m	
Treatment train additions					
Drop out pit			No		
RADS unit			Yes		
Baffles			No		
Check dams			Yes		

SEDIMENT RETENTION POND 4 CALCULATIONS - NORTHBROOK WATERFALL PARK

Specification	Value	Value2	Value3	Units	Source / Notes / Reference
Site details					
Contributing catchment			0.70	ha	QLDC GIS
Percentage volume factor			2.00	%	
GD05 theoretical SRP volume required			140.00	m3	
SRP Design Specifications	Total Storage	Dead Storage (30%)	Live Storage (70%)		
Top length (A)	24.00	21.40	24.00	m	
Top width (B)	8.00	6.70	8.00	m	
Base length (a)	20.00	20.00	21.40	m	
Base width (b)	6.00	6.00	6.70	m	
Depth (h)	1.00	0.35	0.65	m	Measured from primary spillway down
Internal batter ratio= 1 to	1	1	1	ratio	Inlet batter is 1:3
Actual volume (v)	154.67	46.03	108.63	m3	
Width to length ratio	3:1	3.2:1	3:1	ratio	
Buffer	10.48%			%	
Percentage of total SRP	100.00%	29.76%	70.24%	%	
External batter ratio= 1 to	2	2	2	ratio	
Forebay details		Reduced Level (RL)			
Forebay volume requirement (+/- 3%)			15.47	m3	10% of SRP volume
Forebay length			3.50	m	
Forebay width			8.00	m	
Forebay depth		354.0	1.00	m	
Forebay internal batter ratio = 1 to			0.5	ratio	
Approximate forebay volume			18.92	m3	
Level spreader details		Reduced Level (RL)			
RL of level spreader		355.0		m	
Width of level spreader			8.00	m	
Inlet batter steepness= 1 to			3	ratio	
T-bar/ Decant details		Reduced Level (RL)			
RL at base of pond		353.5		m	
Base of lower decanting arm range		353.9	0.35	m	
Base of upper decanting arm range		354.2	0.68	m	
Top decanting arm range		354.5	1.00	m	
T-bar diameter			150.00	mm	
Decant arm length			2.00	m	
Decant rate			2.10	L/sec	0.3 L/sec/1000 m3
Number of holes on T-bar			93	Holes	Cover holes on standard order T-bar to achieve this number of 10 mm diameter holes
Primary spillway details		Reduced Level (RL)			
RL at primary spillway		354.5		m	0.3 m lower than emergency spillway invert and 0.6 m lower than emergency spillway crest
Outlet pipe diameter			150.00	mm	
Emergency spillway		Reduced Level (RL)			
RL at emergency spillway invert		354.8		m	
RL at emergency spillway crest		355.1		m	0.3 m higher than emergency spillway invert
Spillway width at invert			6.00	m	
Treatment train additions					
Drop out pit			No		
RADS unit			Yes		
Baffles			No		
Check dams			Yes		

SEDIMENT RETENTION POND 5 CALCULATIONS - NORTHBROOK WATERFALL PARK

Specification	Value	Value2	Value3	Units	Source / Notes / Reference
Site details					
Contributing catchment			1.60	ha	QLDC GIS
Percentage volume factor			2.00	%	
GD05 theoretical SRP volume required			320.00	m3	
SRP Design Specifications	Total Storage	Dead Storage (30%)	Live Storage (70%)		
Top length (A)	30.00	26.20	30.00	m	
Top width (B)	10.00	8.10	10.00	m	
Base length (a)	24.00	24.00	26.20	m	
Base width (b)	7.00	7.00	8.10	m	
Depth (h)	1.50	0.55	0.95	m	Measured from primary spillway down
Internal batter ratio= 1 to	1	1	1	ratio	Inlet batter is 1:3
Actual volume (v)	346.50	104.34	242.16	m3	
Width to length ratio	3:1	3.2:1	3:1	ratio	
Buffer	8.28%			%	
Percentage of total SRP	100.00%	30.11%	69.89%	%	
External batter ratio= 1 to	2	2	2	ratio	
Forebay details		Reduced Level (RL)			
Forebay volume requirement (+/- 3%)			34.65	m3	10% of SRP volume
Forebay length			4.00	m	
Forebay width			10.00	m	
Forebay depth		355.5	1.50	m	
Forebay internal batter ratio = 1 to			0.5	ratio	
Approximate forebay volume			35.25	m3	
Level spreader details		Reduced Level (RL)			
RL of level spreader		357.0		m	
Width of level spreader			10.00	m	
Inlet batter steepness= 1 to			3	ratio	
T-bar/ Decant details		Reduced Level (RL)			
RL at base of pond		355.0		m	
Base of lower decanting arm range		355.6	0.55	m	
Base of upper decanting arm range		356.0	1.03	m	
Top decanting arm range		356.5	1.50	m	
T-bar diameter			150.00	mm	
Decant arm length			2.00	m	
Decant rate			4.80	L/sec	0.3 L/sec/1000 m3
Number of holes on T-bar			213	Holes	Cover holes on standard order T-bar to achieve this number of 10 mm diameter holes
Primary spillway details		Reduced Level (RL)			
RL at primary spillway		356.5		m	0.3 m lower than emergency spillway invert and 0.6 m lower than emergency spillway crest
Outlet pipe diameter			150.00	mm	
Emergency spillway		Reduced Level (RL)			
RL at emergency spillway invert		356.8		m	
RL at emergency spillway crest		357.1		m	0.3 m higher than emergency spillway invert
Spillway width at invert			6.00	m	
Treatment train additions					
Drop out pit			No		
RADS unit			Yes		
Baffles			No		
Check dams			Yes		

SEDIMENT RETENTION POND 6 CALCULATIONS - WATERFALL PARK

Specification	Value	Value2	Value3	Units	Source / Notes / Reference
Site details					
Contributing catchment			1.75	ha	QGIS
Percentage volume factor			2.00	%	
GD05 theoretical SRP volume required			350.00	m3	
SRP Design Specifications	Total Storage	Dead Storage (30%)	Live Storage (70%)		
Top length (A)	24.00	19.20	24.00	m	
Top width (B)	14.00	11.60	14.00	m	
Base length (a)	16.00	16.00	19.20	m	
Base width (b)	10.00	10.00	11.60	m	
Depth (h)	2.00	0.80	1.20	m	Measured from primary spillway down
Internal batter ratio= 1 to	1	1	1	ratio	Inlet batter is 1:3
Actual volume (v)	485.33	152.41	332.93	m3	
Width to length ratio	1.7:1	1.7:1	1.7:1	ratio	Space constraints have limited the length-to-width ratio. The storage capacity buffer, as well as sediment basins within the 'treatment train' upslope providing additional storage capacity, alleviates the necessity for a 3:1 ratio.
Buffer	38.67%			%	
Percentage of total SRP	100.00%	31.40%	68.60%	%	
External batter ratio= 1 to	2	2	2	ratio	
Forebay details		Reduced Level (RL)			
Forebay volume requirement (+/- 3%)			48.53	m3	10% of SRP volume
Forebay length			4.00	m	
Forebay width			8.00	m	
Forebay depth		341.5	1.50	m	
Forebay internal batter ratio = 1 to			0.5	ratio	
Approximate forebay volume			27.75	m3	Space constraints have limited the size of the forebay. Sediment basins within the 'treatment train' upslope serve as additional 'forebays' for SRP 6. This mitigates the undersized forebay.
Level spreader details		Reduced Level (RL)			
RL of level spreader		343.0		m	
Width of level spreader			14.00	m	
Inlet batter steepness= 1 to			3	ratio	
T-bar/ Decant details		Reduced Level (RL)			
RL at base of pond		340.5		m	
Base of lower decanting arm range		341.3	0.80	m	
Base of upper decanting arm range		341.9	1.40	m	
Top decanting arm range		342.5	2.00	m	
T-bar diameter			150.00	mm	
Decant arm length			2.00	m	
Decant rate			5.25	L/sec	0.3 L/sec/1000 m3
Number of holes on T-bar			233	Holes	Cover holes on standard order T-bar to achieve this number of 10 mm diameter holes
Primary spillway details		Reduced Level (RL)			
RL at primary spillway		342.5		m	0.3 m lower than emergency spillway invert and 0.6 m lower than emergency spillway crest
Outlet pipe diameter			150.00	mm	
Emergency spillway		Reduced Level (RL)			
RL at emergency spillway invert		342.8		m	
RL at emergency spillway crest		343.1		m	0.3 m higher than emergency spillway invert
Spillway width at invert			3.00	m	
Treatment train additions					
Sediment basins			Yes		Serve as additional 'forebays' and provide additional storage capacity.
RADS unit			Yes		
Baffles			No		
Check dams			Yes		

APPENDIX 3 Environmental Site Induction Handout

ENVIRONMENTAL SITE INDUCTION HANDOUT

Key Roles and Responsibilities

Role	Responsibilities
Project Manager	The Project Manager is responsible for the effective implementation of the EMP and has overall responsibility for the environmental performance of the project. Duties include: • Ensuring adequate resources are in place to implement the EMP. • Ensuring all staff and sub-contractors operate within the guidelines of the EMP. • Ensuring that an EMP is prepared and that environmental standards, processes and procedures meet relevant resource consent conditions. • Overseeing the successful implementation, monitoring and review of the EMP. • Ensuring that inspections are carried out in accordance with the relevant EMP. • Restricting or stopping any activity that has the potential to or has caused adverse environmental effects. • Providing notification and reporting of Environmental Incidents to Council and other environmental reports as required by The Guidelines. • Delegating authority of the above responsibilities.
Environmental Representative	The Environmental Representative supports the Project Manager in the day-to-day implementation of the EMP. Duties include: • Ensuring the installation of environmental controls as per the EMP. • Undertaking environmental site inspections. • Overseeing the maintenance and improvement of defective environmental controls. • Providing environmental inductions to all staff and sub-contractors. • Assisting the project leadership in attending to Environmental Incidents and Complaints. The Environmental Representative shall be familiar with environmental risks associated with the project, the EMP and best practice erosion and sediment control principles and practices.
All staff and sub-contractors	All staff and sub-contractors have a responsibility to undertake all activities in accordance with the requirements of this EMP. This includes reporting any activity that has the potential to or has resulted in an Environmental Incident to the Project Manager or Environmental Representative.

Key Environmental Locations

Environmentally sensitive receptors: Nearby residential dwellings, staff working on the site, and Mill Creek.

Key Resource Consent Conditions

It is important to comply with all resource consent conditions of RM220926 (issued by QLDC) and RM21.548.01, RM23.276.01 & RM23.276.02 (issued by ORC) in order to avoid or mitigate adverse environmental effects.

The site EMP has been prepared in response to all environmental-related conditions of consent and therefore provides direction for how compliance with these conditions will be achieved. Provided that the EMP is followed, the project will at the same time comply with all conditions of consent.

Limits of Clearing and Importance of Staging

The staging and sequencing of works is a key component to ensure that environmental effects of construction are appropriately managed. It is imperative that the sequencing outlined in Section 2.1 of the EMP is followed so that the site is stabilised in the most efficient manner.

All staff should be familiar with this sequence. Any potential changes to that sequence need to be approved by the Project Manager which will be discussed first with the Environmental Consultant.

Key Environmental Management Measures in EMP

Erosion and Sediment Control (Section 4 of EMP)

- Direction provided in Erosion and Sediment Control Plan (ESCP) in Appendix 1 of EMP.
- Separation of clean and dirty water is the most important principle to ensure that the contributing catchment of dirty water that needs to be treated is as small as possible.
- Progressive stabilisation (revegetation) of disturbed areas will ensure that the extent and duration of exposed soil is minimised. Keep it covered!
- All controls to be checked immediately before storm events to ensure they are in good-working order.
- Erosion and sediment control devices to remain in place until site is stabilised (defined as 80% vegetative cover).

Any works that disturb the controls outlined on the ESCP must be reinstated before moving to the next task.

Water Quality Management (Section 5 of EMP)

- Any water caught in the sediment devices to be re-used in dust suppression where possible and if required.
- Any observations of dirty water running offsite to be reported directly to the Project Manager.

Dust Management (Section 6 of EMP)

- Dust suppression should occur on any exposed soil on unsealed roads, this can be done using the water caught in the retention basin.
- Avoid all unnecessary vegetation clearing that exposes soil and work should be conducted in stages as this can increase the impact from dust in the event of strong winds.

- During high wind events and dust suppression is becoming difficult works must cease until more favourable weather conditions.
- Constant vigilance should be maintained onsite to ensure that dust is appropriately managed and weekly monitoring should be completed to ensure that management measures are effective.

Noise and Vibration Management (Section 7 of EMP)

- Noise producing works only be undertaken during the hours of 0730-1800 from Monday-Saturday and no works to be completed on Sundays or public holidays.
- Particularly noisy work should be completed during the middle of the day during business hours.
- Noise dampening should occur when possible.
- Weekly site inspections should be undertaken by the Environmental Representative to ensure the strategies in place are effective.

Cultural Heritage Management (Section 8 of EMP)

- If any artefacts are found works must stop within 20 meters of the discovery and the site manager notified immediately.
- The site manager must then secure the area and notify the Heritage New Zealand Regional Archaeologist, who will advise when works can begin again.

Vegetation Management (Section 9 of EMP)

- Maintain vegetated surfaces as far as reasonably possible.
- Maintain protected or indigenous vegetation.
- Complete all landscaping and or ecological restoration in accordance with approved plans.

Chemicals and Fuel Management (Section 10 of EMP)

- Chemicals and fuels are stored and used so not to cause contamination of works areas and surrounding environment.

Waste Management (Section 11 of EMP)

- Waste management on site will ensure wastes are stored safely and in an organised manner until recycling, reuse or disposal.

Contaminated Land Management (Section 12 of EMP)

- Prevent spread of contamination.
- Engage the Environmental Consultant (SQEP) to ensure that the site can be managed in accordance with statuary requirements (i.e., National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health).

Environmental Incidents

The procedure for managing environmental incidents is outlined in **Section 3.5** of the EMP, however these can be summarised as follows:

- Environmental incidents must be reported as soon as they occur, and the Project team must respond immediately to mitigate further environmental impacts.
- Investigation into the cause of the incident should be completed and a solution should be constructed to remediate the Environmental damage.
- The Project Manager must then notify the QLDC and/or the ORC of the details of the incident within 12 hours of being made aware of the incident.

Rapid Response for Storm Events

The procedure for rapid response to storm events is outlined in **Section 4.8** of the EMP, however these can be summarised as follows:

- The Project Manager will observe and understand the **weather forecast** throughout the project to ensure appropriate preparation onsite.
- If a **significant storm** event is forecast all works should stop within an appropriate amount of time to inspect ESC devices and undertake any maintenance or site stabilisation required.
- The sediment controls should be in operating condition and fully functional.
- During the storm event the site should be monitored to sure the functioning of the ESC devices and maintained if required.

When storms are forecast it is crucial that tools are downed in time for the rapid response procedure to be implemented. This will help avoid environmental incidents, potential enforcement action and site shutdown.

APPENDIX 4 Environmental Site Induction Register

Northbrook - Waterfall Park

ENVIRONMENTAL SITE INDUCTION REGISTER

Name	Organisation	Date Inducted	Induction Delivered by	Signature

APPENDIX 5 Weekly Environmental Site Inspection Form

Northbrook - Waterfall Park

WEEKLY ENVIRONMENTAL SITE INSPECTION FORM

Environmental Representative: Date:

Item	Yes	No	Comment
General			
Is the EMP available onsite?	☐	☐	
Have any environmental incidents occurred during the week? If so, provide details	☐	☐	*If yes, complete environmental incident report.
Complete description of weather for upcoming week – circle applicable			

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
						

Are there any rain events forecasted for the coming week?	☐	☐	
Have pre rain event inspections been completed?	☐	☐	
Have post rain event inspections been completed?	☐	☐	
Water Quality			
Is water quality monitoring occurring when water is flowing across the site boundaries?	☐	☐	*If yes, complete water quality monitoring form
Is there visual evidence of sediment from the construction site entering waterways/drainage lines?	☐	☐	
Does water in sediment retention devices meet water quality criteria before being discharged?	☐	☐	
Are daily visual inspections of waterways being conducted and recorded by the Project Manager?	☐	☐	
Erosion and Sediment Control			
Are works contained within the current stage and site boundaries?	☐	☐	
Are completed areas being progressively stabilised?	☐	☐	
Is there any new evidence of erosion?	☐	☐	
Are erosion and sediment controls installed as per the ESCP?	☐	☐	

Item	Yes	No	Comment
Is dirty water entering dirty water diversion channels during rain events?	☐	☐	
Do sediment controls have over 80% capacity?	☐	☐	
Cultural Heritage			
Have any finds of cultural significance been found?	☐	☐	
Noise and Vibration			
Have any complaints been received during the week?	☐	☐	*If yes, complete Complaints Register
Are nearby sensitive receptors being notified before significant noise and/or vibration causing activities?	☐	☐	
Are works only occurring within the hours of operation?	☐	☐	
Dust			
Have any complaints been received during the week?	☐	☐	*If yes, complete Complaints Register
Are works being staged to minimise soil exposure?	☐	☐	
Have completed areas been revegetated or stabilised?	☐	☐	
Is dust suppression of disturbed work areas and stockpiles occurring?	☐	☐	
Are works ceasing during high winds?	☐	☐	
Are only designated access points and haul routes being used?	☐	☐	
Is the site access and surrounding roads swept clean of sediment?	☐	☐	
Vegetation			
Are vegetated surfaces being maintained as far as reasonably possible?	☐	☐	
Contaminated Soils			
Have any contaminants been uncovered during excavations?	☐	☐	
Chemicals and Fuels			
Are all hazardous substances on site stored, transported and used according to the safety data sheet requirements?	☐	☐	
Are vehicles and plant being refuelled in the refuelling bay?	☐	☐	

Item	Yes	No	Comment
Is concrete washing being undertaken in the concrete wash-out pit?	☐	☐	
Is there an adequate supply of spill kits onsite? Have any used materials been replaced?	☐	☐	
Waste			
Is the site in a safe, clean and tidy state?	☐	☐	
Are wastes segregated into labelled bins with lids?	☐	☐	
Are skip bins not overfilled?	☐	☐	
Is waste removed from open drains and drainage paths?	☐	☐	

Actions resulting from this inspection must be forwarded to the Project Manager any actions should be recorded in the Non-Conformance Register – **Appendix 8.**

Additional Comments:

Names and Signatures of inspection attendees:

APPENDIX 6 Environmental Incident Report Form

Northbrook - Waterfall Park

ENVIRONMENTAL INCIDENT REPORT FORM

Project Address:	**Consent Number:**
Brief 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 Queenstown Lakes District Council at RCMonitoring@qldc.govt.nz and Otago Regional Council at pollution@orc.govt and compliance@orc.govt.nz. Call the QLDC Regulatory team immediately on 03 441 0499 and ORC's Pollution Hotline on 0800 800 033 for any serious or ongoing incidents that cannot be brought under immediate control.

Date and Time	Date: XX/XX/XXX Time: XX:XX hours
Description? Provide a brief and factual description of what happened during the incident, include relevant details such as: - The activity being undertaken when the incident occurred - The estimated distance to nearest waterway (include stormwater and dry courses) - The estimated distance to the nearest sensitive receiver Sketches/diagrams/photos may be referenced and appended to this report to aid in the description of the incident.	
Exact Location of the incident? Include address, landmarks, features, nearest tree, etc. Maps and plans can be attached.	
Quantity or volume of material escaped or causing incident? (provide and estimate quantity)	
Who identified the incident?	Contractor ☐ Council ☐ Community ☐ Other ☐
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 Queenstown Lakes District Council been notified? Yes ☐ No ☐ Will be notified ☐ **Has the Otago Regional Council been notified?** Yes ☐ No ☐ Will be notified ☐	

Role of person making report: Project Manager / Site Supervisor / Environmental Representative / SQEP

Name.....

Signature.....

Organisation.....

Date.....

Mobile phone number.....

APPENDIX 7 Environmental Complaints Register

Northbrook - Waterfall Park

ENVIRONMENTAL COMPLAINTS REGISTER

Complaint #	Date and Time Received	Complainant details (name, address, phone number)	Details of Complaint	Investigation and Findings	Outcome	Close out Date

APPENDIX 8 Environmental Non-Conformance Register

Northbrook - Waterfall Park

ENVIRONMENTAL NON-CONFORMANCE REGISTER

Ref Number	Date Observed	Found via (e.g., inspection, monitoring, complaint?)	Details of Non-conformance	Corrective Actions	Updated by	Close out Date

APPENDIX 9 Water Quality Monitoring Results Form

WATER QUALITY MONITORING RESULTS FORM

Date		Monitoring Trigger		Location Description	
		Yes	No	Measurement	
Is the clarity of the water more than 100 mm?		☐	☐	____ mm	
Is turbidity less than the limit calibrated against the TSS limit below?*		☐	☐	____ NTU	
Is the pH of the water between 5.5-8.5?*		☐	☐	pH ____	
Are total suspended solids less than 50 mg/L?*		☐	☐	____ mg/L	
Are hydrocarbons visible?		☐	☐		
Are tannins visible in the water?		☐	☐		
Is there any waste in the water?		☐	☐		
Description of any non-conformance and actions required: •					
Include images of sampling location:					

*Enviroscope can provide Water Quality Monitoring services to measure turbidity and pH. If NTU is exceeded, collect a water sample to send to laboratory for TSS measurement.

HOW TO: WATER QUALITY SAMPLING

1. Select a Sampling Location

Sampling a discharge

Collect sample where water crosses the site boundary or enters a sensitive receptor from a retention device. Always photograph the location you sample from.

Sampling a waterway

Collect sample from the centre of the flow and the top third of the water column where possible.

Sampling a from a Sediment Retention Device

Collect sample from the discharge location, this is either near the decanting arms, spillway, hose or the outlet pipe.

2. Collect a Water Sample

Taking a Water Sample

- ➔ Label container with site name, sampling location, date and time taken.
- ➔ Fill the container with water from the surface of your sampling location.

If you wade into the water to collect the sample, always collect the sample 'upstream' of where you're standing to avoid contamination by disturbed sediment.

Always ensure your meters are calibrated regularly to ensure accurate sampling results.

3. Measure and Record Turbidity, Clarity, and pH

Measuring Turbidity using a Turbidity Meter

- ➔ Fill the turbidity pottle with the sampled water. Wipe away any moisture on the outside of the pottle and insert it into the meter. Turn the meter on and once the standby value appears press read. Record the turbidity value.

Measuring Clarity using a field testing seechi disc

- ➔ Lower the seechi disc into the water sample until you can no longer see the disc. Then lift the seechi disc back up until the disc is just visible. Record the number where the water level sits.

Measuring pH using a pH Meter

- ➔ Submerge the probe of the pH meter into the water sample. Keep the probe in the water until the value on the meter is fixed. Swirling the probe can help the value fix faster. Record the pH value.

APPENDIX 10 Archaeological Discovery Protocol

HERITAGE NEW ZEALAND
POUHERE TAONGA

Heritage New Zealand Pouhere Taonga Accidental Discovery Protocol

This protocol does not apply when an archaeological authority issued under the Heritage New Zealand Pouhere Taonga Act 2014 is in place.

Under the Heritage New Zealand Pouhere Taonga Act (2014) an archaeological site is defined as any place in New Zealand that was associated with human activity that occurred before 1900 and provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand. For pre-contact Māori sites this evidence may be but is not limited to, bones, shells, charcoal, stones etc. In later sites of European/Chinese origin, artefacts including but not limited to bottle glass, crockery etc. may be found, or evidence of old foundations, well, drains, or similar structures. Burials/kōiwi may be found in association with any of these cultural groups.

In the event that an unidentified archaeological site is located during works, the following applies;

1. Work shall cease immediately at that place and within 20m around the site.

2. The contractor must shut down all machinery, secure the area, and advise the Site Manager.

3. The Site Manager shall secure the site and notify the Heritage New Zealand Regional Archaeologist. Further assessment by an archaeologist may be required.

4 If the site is of Māori origin, the Site Manager shall notify the Heritage New Zealand Regional Archaeologist and the appropriate papatipu rūnaka of the discovery and ensure site access to enable appropriate cultural procedures and tikaka to be undertaken, as long as all statutory requirements under legislation are met (*Heritage New Zealand Pouhere Taonga Act*, *Protected Objects Act*).

5. If human remains (kōiwi) are uncovered the Site Manager shall advise the Heritage New Zealand Regional Archaeologist, NZ Police and the appropriate papatipu rūnaka and the above process under 4 shall apply. Remains are not to be moved until such time as papatipu rūnaka and Heritage New Zealand have responded.

6. Works affecting the archaeological site and any human remains (kōiwi) shall not resume until Heritage New Zealand Pouhere Taonga gives written approval for work to continue. Further assessment by an archaeologist may be required.

7. Where iwi so request, any information recorded as the result of the find such as a description of location and content, is to be provided for their records.

8. Heritage New Zealand Pouhere Taonga will advise if an archaeological authority under the *Heritage New Zealand Pouhere Taonga Act* 2014 is required for works to continue.

It is an offence under S87 of the *Heritage New Zealand Pouhere Taonga Act 2014* to modify or destroy an archaeological site without an authority from Heritage New Zealand irrespective of whether the works are permitted or consent has been issued under the Resource Management Act.

Heritage New Zealand Pouhere Taonga Archaeologist contact details:

Nikole Wills
Regional Archaeologist Otago/Southland
Heritage New Zealand
PO Box 5467
Dunedin
Ph. [redacted], mobile [redacted]
Fax. +46 3 477 3893
[redacted]

APPENDIX 11 Associated Resource Consent Conditions

Associated Resources Consent Conditions

Condition No.	Condition	Relevant section of the EMP
	QLDC – RM220926 (Commissioners Decision)	
8.	At least 15 working days prior to any works commencing on site the Consent Holder shall submit an Environmental Management Plan ("EMP") to QLDC's Monitoring and Enforcement Team for review and acceptance. This document must be prepared by a Suitably Qualified and Experienced Person ("SQEP"). The EMP shall be in accordance with the principles and requirements of the Queenstown Lakes District Council's Guidelines for Environmental Management Plans and specifically shall address the following environmental elements as specified in the guidelines: (a) Administrative Requirements (i) Weekly site inspections (ii) Monthly environmental reporting (iii) Independent audit by Suitably Qualified and Experienced Person (iv) Notification and management of environmental incidents (v) Records and registers (vi) Environmental roles and responsibilities of personnel (including nomination of Principal Contractor) (vii) Site induction (b) Operational Requirements (i) Erosion and sedimentation (including Erosion and Sediment Control Plan) (ii) Water quality (iii) Dust (iv) Cultural heritage (v) Noise (vi) Vibration (vii) Contaminated sites (viii) Indigenous vegetation clearance (ix) Chemical and fuel management (x) Waste management The EMP (and any sub-plans such as the ESCP described in Condition 9 below) shall also be consistent with any recommendations outlined in the Geosolve report 'Geotechnical Report for Resource Consent – Northbrook Waterfall Park, Arrowtown – Lake Hayes Road' dated March 2023 ref no.150098.04.	This EMP and Section 1.4
9.	Prior to ground-disturbing activities on the initial stage of works or any subsequent new stage of works, the Consent Holder shall engage a SQEP to prepare and submit an Erosion and Sediment Control Plan ("ESCP") to QLDC's Monitoring and Enforcement Team for	Appendix 1

	review and acceptance. This plan shall be a sub-plan of the overarching EMP and must be prepared in accordance with the requirements outlined on pages 13 – 18 in Queenstown Lakes District Council's Guidelines for Environmental Management Plans. These plans must be updated when: (a) The construction program moves from one Stage to another; or (b) Any significant changes have been made to the construction methodology since the original plan was accepted for that Stage; or (c) There has been an Environmental Incident and investigations have found that the management measures are inadequate.	
10.	Prior to commencing ground-disturbing activities, the Consent Holder shall nominate an Environmental Representative for the works program in accordance with requirements outlined on pages 9 and 10 of the Queenstown Lakes District Council's Guidelines for Environmental Management Plans.	Section 3.1.2
11.	Prior to commencing ground disturbing activities, the Consent Holder shall ensure that all staff (including all sub-contractors) involved in, or supervising, works onsite have attended an Environmental Site Induction in accordance with the requirements on page 8 of the Queenstown Lakes District Council's Guidelines for Environmental Management Plans.	Section 3.2
15.	Prior to bulk earthworks operations (and vegetation clearance) for the initial stage or any subsequent new stage of works, the Consent Holder must install erosion and sediment controls in accordance with the EMP as well as provide As-built documentation for these controls by the SQEP. It is noted that earthworks required to construct the environmental management controls are allowed to commence once QLDC has provided notice that Condition 8 has been met.	Appendix 1 and Section 4.6
16.	All works shall be undertaken in accordance with the most current version of the EMP as accepted as suitable by QLDC.	Section 3
17.	The EMP shall be accessible on site at all times during work under this consent.	This EMP shall be available onsite at all times.
18.	The Consent Holder shall establish and implement document version control. QLDC shall be provided with an electronic copy of the most current and complete version of the EMP at all times.	Section 3.9
20.	The Consent Holder shall undertake and document weekly and Pre and Post-Rain Event site inspections as outlined on pages 10 and 11 of the Queenstown Lakes District Council's Guidelines for Environmental Management Plans.	Section 3.3
21.	A SQEP 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. This must include a specific audit by the SQEP of the effectiveness of the ESCP. The outcome of these inspections shall be included in the Monthly Environmental Report referred to Condition 22 below.	Section 3.4
22.	The Consent Holder shall complete and submit exception reporting to QLDC in the form of a monthly environmental report. The monthly environmental report shall be submitted to QLDC's Regulatory Department within five (5) working days of the end of each month.	Section 3.4

23.	In accordance with page 9 of the Queenstown Lakes District Council's Guidelines for Environmental Management Plans, where any Environmental Incident where the EMP has failed leading to any adverse environmental effects offsite occurs the Consent Holder shall: (a) Report to QLDC details of any Environmental Incident within 12 hours of becoming aware of the incident. (b) (b) Provide an Environmental Incident Report to QLDC within 10 working days of the incident occurring as per the requirements outlined in Section 3.3.1 of Queenstown Lakes District Council's Guidelines for Environmental Management Plans.	Section 4.12
24.	Environmental records shall be collated onsite by the Consent Holder and shall be made available to QLDC upon request; immediately if the request is made by a QLDC official onsite and within 24 hours if requested by a QLDC officer off-site. Records and registers to be managed on-site shall be in accordance with the requirements outlined on page 14 of the Queenstown Lakes District Council's Guidelines for Environmental Management Plans.	Section 3.8
25.	The Consent Holder shall ensure that only cleanfill material is deposited at the site. Cleanfill material is defined as material that when buried/placed will have no adverse effect on people or the environment, and includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of: • combustible, putrescible, degradable or leachable components; • hazardous substances; • products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices; • materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances; and • liquid waste. Acceptable materials include bricks, pavers, masonry blocks, ceramics, un-reinforced concrete, reinforced concrete where any protruding steel is cut off at the concrete face, fibre cement building products, road sub-base, tiles and virgin soils (including rock, sand, gravel, clay) - provided they are uncontaminated. Any other materials will require the prior written approval of QLDC prior to disposal at the site. Topsoil shall be used for final cover only.	Section 11.3
27.	On completion of each stage of the earthworks, the Consent Holder shall ensure the following: (a) All exposed areas shall be top-soiled and grassed/revegetated or otherwise permanently stabilised.	Section 4.4.2 and Section 4.4.3
63.	Water Monitoring: (a) The Consent Holder shall arrange for: (i) Water monitoring samples to be taken from Mill Creek for the purpose, in the manner and at the frequency detailed in subclauses (b) – (e) below; and (ii) The results of the water monitoring to be forwarded to QLDC within five working days after the results of each water sample are available. (b) Water monitoring samples must be taken and analysed against the following parameters and discharge standards:	Section 5

	<table><tr><th>Parameter</th><th>Discharge Standard</th></tr><tr><td>Total Suspended Solids (TSS)</td><td>< 50 mg/l</td></tr><tr><td>Turbidity NTU</td><td>A limit calibrated against the TSS limit above</td></tr><tr><td>Hydrocarbons, Tannins, Paint</td><td>No visible trace</td></tr><tr><td>Waste</td><td>No visible trace</td></tr></table> (d) The purpose of the water monitoring is to inform the Consent Holder and QLDC of the water quality in Mill Creek on a regular basis for a specified period, and to assist QLDC to gain a better understanding of the contribution of the site to water quality issues affecting the wider Mill Creek and Lake Hayes catchments. For that purpose, each water sample shall be tested for the same water quality parameters as are measured by the Otago Regional Council at the Mill Creek Fish Trap downstream of the site in addition to the parameters detailed in subclause (b) above. (e) Water samples shall be: (i) Taken from the upstream end of Mill Creek within the site and at the downstream end of Mill Creek within the site; and (ii) Forwarded for testing by an independent service provider qualified to test water samples for the purpose detailed in subclause (c) above. (f) Water samples shall be taken: (i) Monthly for a period of at least six months prior to commencement of any works authorised by this consent; (ii) Monthly throughout the period of the works authorised by this consent; and (iii) Quarterly (every three months) for the three year period following commencement of the commercial operation of the retirement village. (g) Wherever reasonably possible, the taking of water samples shall coincide with the monthly monitoring tests carried out by the Otago Regional Council at the Fish Trap downstream of the site.	
65.	The use of fertiliser containing nitrogen or phosphorous is prohibited within the site apart from the initial establishment of hydroseed grass areas and the initial establishment of plants. Organic fertiliser such as compost, manure or seaweed shall be permitted provided there is no nitrogen or phosphorous added. For plant establishment, fertiliser shall be limited to 1 x 10g slow-release tablet placed below the base of the rootball. There shall be no discharge of contaminants from nitrogenic or phosphatic-based fertilisers into the stormwater detention ponds. A record of any fertilisers used at grass/plant establishment and onwards shall be made available to the QLDC upon request.	Section 4.4.3
67.	Noise from the site shall comply with the following noise limits: (a) Sound from non-residential activities measured in accordance with NZS6801:2008 and assessed in accordance with NZS6802:2008 shall not exceed the following noise limits at any of the points marked R1-R12 in Figure 1 below: (i) daytime (0800 to 2000 hrs) 50dB LAeq (15 min); (ii) night-time (2000 to 0800 hrs) 40dB LAeq (15 min); and (iii) night-time (2000 to 0800 hrs) 70dB LAFmax. (b) The noise limits in (a) shall not apply to construction sound which shall be assessed in accordance with NZS6803:1999.	Section 7

69.	If the Consent Holder discovers any feature or archaeological material that predates 1900, heritage material, or disturbs a previously unidentified archaeological or heritage site, the Consent Holder shall without delay: (a) Stop work within the immediate vicinity of the discovery or disturbance; (b) Advise QLDC, the Heritage New Zealand Pouhere Taonga and in the case of Maori features or materials, the Tangata whenua and if required, shall make an application for an Archaeological Authority pursuant to the New Zealand Pouhere Taonga Act 2014; and (c) Arrange for a suitably qualified archaeologist to undertake a survey of the site. Site work may only recommence following consultation with QLDC.	Section 8
ORC – RM23.276.01 (Land Use Consent)		
4.	Prior to commencement of the residential earthworks the Consent Holder must ensure that all personnel working on the site are made aware of, and have access at all times to: a) The contents of this document; and b) The Environmental Management Plan as required by condition 8; Copies of these documents must be present on-site at all times while the work authorised by this consent is being undertaken.	This EMP shall be made available onsite at all times
6.	The Consent Holder must notify the Consent Authority in writing of the commencement date of earthworks no less than 10 working days prior to the commencement of works. The prestart notification must include the following information: c) Name and contact details of their Environmental Representative for the works.	Section 3.1.2
7.	Prior to commencing any work on site, the Consent Holder must ensure that all staff (including all sub-contractors) involved in, or supervising, works onsite have attended an Environmental Site Induction. Matters to be discussed include: a) Timeframes for key stages of the works authorised under this consent; b) Resource consent conditions; c) Erosion and Sediment Control Plan; and d) Environmental Management Plan. A record of attendance must be kept and made available to the Consent Authority upon request.	Section 3.2
8.	At least 15 working days prior to the commencement of earthwork activity, the Consent Holder must submit a finalised Environmental Management Plan (EMP) and ESCP (Erosion and Sediment Control Plan) for review and acceptance by the Consent Authority. The Consent Authority must complete the review of the EMP/ ESCP within 15 works days of it being submitted to the Consent Authority. This document must be prepared by a SQEP. The EMP/ ESCP must be based on the draft EMP/ ESCP dated 14 June 2023 and submitted as part of the application, and must address the following (as a minimum): a) Administrative Requirements i. Weekly site inspections; ii. Monthly environmental reporting; iii. Independent audit by Suitably Qualified and Experienced Person;	This EMP and Section 1.4

	iv. Notification and management of environmental incidents; v. Records and registers; vi. Environmental roles and responsibilities of personnel (including nomination of Principal Contractor); and vii. 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. Cultural heritage; and v. Chemical and fuel management. c) Sufficient detail to address the following matters: i. Specific erosion and sediment control works (locations, dimensions, capacity etc); ii. Supporting calculations and design drawings; iii. Catchment boundaries and contour information; iv. Details of construction methods; v. Timing and duration of construction and operation of control works; vi. Processes in place if unexpected contaminated land is encountered; vii. Contingency measures for snow and/ or frost events (in relation to chemical treatment) viii. 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. ix. Details relating to the management of exposed areas; and x. Monitoring and maintenance requirements.	
9.	No works must commence until the initial or any updated version of the EMP/ ESCP has been accepted, and all works must be undertaken in accordance with the most current EMP/ ESCP accepted by the Consent Authority at all times.	Section 3.9
10.	a) The Consent Holder must submit an updated EMP/ ESCP to the Consent Authority when: i. The construction program moves from one Stage to another; or ii. Any significant changes have been made to the construction methodology since the original plan was accepted; or iii. There has been an Environmental Incident and investigations have found that the management measures are inadequate. b) Any updated versions of the EMP/ ESCP must be submitted to the Consent Authority for review and acceptance. Works implementing the updated EMP/ ESCP must not commence until it has been accepted, and all works must be undertaken in accordance with the most current EMP/ ESCP accepted by the Consent Authority at all times. The	Section 3.9

	Consent Authority must complete the review of the EMP/ ESCP within 15 works days of it being submitted to the Consent Authority c) The Consent Holder must establish and implement document version control and ensure that the Consent Authority is provided with an electronic copy of the most current and complete version of the EMP and ESCP at all times.	
11.	a) Within 10 working days following installation of the specific erosion and sediment control works referred to in condition 8, and prior to the commencement of earthworks activity on the subject site, a SQEP must provide written certification that the erosion and sediment control measures have been constructed and completed in accordance with condition 8 to the Consent Authority. b) The operational effectiveness and efficiency of all erosion and sediment control measures must be maintained throughout the duration/each stage of earthwork activity, or until the site is permanently stabilised against erosion. A record of any maintenance work must be kept and be supplied to the Consent Authority on request.	Section 4.6
12.	The Consent Holder must, within 24 hours, inform the Consent Authority of any complaints received from any person about activities on the site associated with the consented works.	Section 3.6
13.	In carrying out any earthworks directly adjacent to the riverbed, the following standards must be adopted: a) Keep work areas outside flowing water to the extent practicable; b) Minimise the overall non-stabilised earthworks footprint; c) Progressively stabilise completed areas of earthworks as soon as practicable; d) Divert clean run off away from non-stabilised earthworks areas; e) Use the best practicable option to design and install a variety of perimeter controls for the management of flows of water and sediment and sediment retention; and f) If a heavy rainfall event is forecast, undertake pre-event inspections and any maintenance that is required and postpone work as required. g) In the event that a discharge occurs, the Consent Holder must notify the Consent Authority within 12 hours. In the event that a discharge occurs, works must cease immediately, and the discharge must be mitigated and/or rectified to the satisfaction of the Consent Authority.	Section 3.5, Section 4 and Appendix 1
14.	a) The Consent Holder must ensure that the operational effectiveness and efficiency of all erosion and sediment control measures specifically required by the approved EMP/ ESCP must be maintained throughout the duration of the earthworks activity. A record of any maintenance work must be kept and be supplied to the Consent Authority on request. b) Sediment removed from treatment devices must be placed on stable ground where it cannot re-enter the device or be washed into any watercourse. c) Where maintenance work is required to ensure the effectiveness of these erosion and sediment control measures, the record should include the date, time and details on the nature of any maintenance. d) The Environmental Representative (or equivalent) must ensure regular inspections of these measures, and particularly within 12 hours after any rainfall event. Where it is identified that erosion and sediment control measure have become ineffective and maintenance is required, the consent authority must be contacted within 24 hours and the erosion and sediment control measures must be reinstated to be effective, to the satisfaction of the Consent Authority.	Section 3.1.2, Section 3.5, Section 4 and Appendix 1

15.	a) This consent does not authorise work on a contaminated site. b) If unexpected contamination is discovered, the consent holder must cease all earthworks in the area of the contamination immediately and notify the Consent Authority within 5 days. Works in the area affected by contamination can only recommence once any required consents are obtained.	Section 12
16.	In order to prevent site access points from becoming sediment sources that lead to sediment laden water entering waterways from the road, the consent holder must ensure that all ingress and egress points to the site are Stabilised Construction Entrances. All construction traffic must be limited to these entrances only.	Section 4.4.4 and Appendix 1
17.	For the duration of the earthworks subject of this consent: a) All machinery must be clean, free of contaminants and in good repair, prior to entering the site; b) No construction materials may be left in a position where they could be carried away by storms, floods, waves or other natural events; c) The Consent Holder must take all practicable measures to prevent spills of hazardous substances being discharged into water or onto land in a manner that may enter water. Such measures may include, but not be limited to; i. all practicable measures must be undertaken to prevent oil and fuel leaks from vehicles and machinery; ii. fuel storage tanks and machinery must be maintained at all times to prevent leakage of oil and other contaminants; iii. no refueling of machinery or equipment must occur in the river; iv. iv. there must be no storage of fuel within 20 metres of the river; v. a spill kit, that is capable of absorbing the quantity of oil and petroleum products that may leak or be spilt must be kept on-site at all times. d) The Consent Holder must inform the Consent Authority immediately and no later than 12 hours of an oil spill and must provide the following information; i. the date, time, location and estimated volume of the spill; ii. the cause of the spill; iii. clean up procedures undertaken; iv. details of the steps taken to control and remediate the effects of the spill on the receiving environment; v. as assessment of any potential effects of the spill; and vi. measures to be undertaken to prevent a recurrence. e) All damage and disturbance caused by vehicle traffic, plant and equipment must be remedied as soon as practicable; f) All machinery, fencing, signs, chemicals, rubbish, debris and other materials must be removed upon completion of the earthworks within 30 day timeframe.	Section 10
18.	Where any incident caused by the residential earthworks has led to any adverse environmental effects occurring that have not been consented, the Consent Holder must: a) Report to Consent Authority details of the incident within 12 hours of becoming aware of the incident.	Section 3.5

	b) Identify any corrective actions taken by the Consent Holder so far. c) Provide a comprehensive Environmental Incident Report to the Consent Authority within 10 working days of the incident occurring.	
19.	As required, all sediment retention ponds, and decanting earth bunds must be chemically treated in accordance with the Chemical Treatment Management Plan (CTMP) 14 June 2023. All measures required by the CTMP must be put in place prior to commencement of the residential earthworks activity and be maintained for the duration of the residential earthworks.	Section 4.5.1, Section 4.5.2 and Appendix 12
20.	Prior to the commencement of residential earthworks activity on the subject site, a finalised Chemical Treatment Management Plan (CTMP) must be prepared in accordance with GD05 and submitted to the Consent Authority for review and acceptance. The Consent Authority must complete the review of the EMP/ ESCP within 15 works days of it being submitted to the Consent Authority. No earthwork activities must commence until acceptance in writing is provided by the Consent Authority that the CTMP meets the requirements of suitably mitigating/ avoiding adverse effects, and the measures referred to in that plan for the sediment retention ponds and decanting earth bunds have been put in place. The CTMP must include the following information as a minimum: a) Specific design details of chemical treatment system based on a rainfall activated dosing methodology for the site's sediment retention ponds; b) Monitoring, maintenance (including post rain event) and contingency programme (including a record sheet); c) Details of optimum dosage (including assumptions); d) Results of initial chemical treatment trial; e) A spill contingency plan; f) Contingency measures for snow and/ or frost events; and g) Details of the person delegated by the Consent Holder that will hold responsibility for long term operation and maintenance of the chemical treatment system and the organisational structure which will support this system. All measures required by the CTMP must be put in place prior to commencement of the residential earthworks activity and be maintained for the duration of the works that require chemical treatment.	Appendix 12
21.	a) Within 10 working days following completion or abandonment of earthworks on the subject site all areas of exposed soil must be permanently stabilised against erosion to the satisfaction of the Consent Authority. b) In accordance with condition the approved EMP/ ESCP measures to stabilise against erosion may include: i. the use of mulching ii. top-soiling and grassing of otherwise bare areas of earth iii. aggregate or vegetative cover that has obtained a density of more than 80% of a normal pasture sward. The on-going monitoring of these measures is the responsibility of the Consent Holder. c) The Consent Holder must provide photographs of the areas where work has been undertaken in order to demonstrate that appropriate stabilisation, in accordance with GD05, has been undertaken.	Section 4.4.2 and Section 4.4.3

	d) Photographs must be in colour and minimally consist of 900*1600 pixels with a file size (in JPEG format) between 0.5 and 1Mb, and to the satisfaction of the Consent Authority.	
22.	All machinery associated with the earthworks activity must be operated in a way, which ensures that spillages of hazardous substances such as fuel, oil, grout, concrete products and any other contaminants are prevented.	Section 10
24.	In the event that an unidentified archaeological site is located during works, the following will apply; a) Work must cease immediately at that place and within 20 metres around the site. b) All machinery must be shut down, the area must be secured, and the Heritage New Zealand Pouhere Taonga Regional Archaeologist and the Consent Authority must be notified. c) If the site is of Maori origin, the Consent Holder must also notify the appropriate iwi groups or kaitiaki representative of the discovery and ensure site access to enable appropriate cultural procedures and tikanga to be undertaken, as long as all statutory requirements under legislation are met (Heritage New Zealand Pouhere Taonga Act 2014, Protected Objects Act 1975). d) If human remains (koiwi tangata) are uncovered the Consent Holder must advise the Heritage New Zealand Pouhere Taonga Regional Archaeologist, NZ Police, the Consent Authority and the appropriate iwi groups or kaitiaki representative and the above process under (c) will apply. Remains are not to be disturbed or moved until such time as iwi and Heritage New Zealand Pouhere Taonga have responded. e) Works affecting the archaeological site and any human remains (koiwi tangata) must not resume until Heritage New Zealand Pouhere Taonga gives written approval for work to continue. Further assessment by an archaeologist may be required. f) Where iwi so request, any information recorded as the result of the find such as a description of location and content, must be provided for their records.	Section 8
25.	a) The area of earthworks must be progressively stabilised against erosion at all stages of the earthwork activity and must be sequenced to minimise the discharge of contaminants to groundwater or surface water in accordance with the approved EMP/ ESCP. b) Interim stabilisation measures may include but are not limited to: i. the use of waterproof covers, geotextiles, or mulching ii. top-soiling and grassing of otherwise bare areas of earth iii. aggregate or vegetative cover that has obtained a density of more than 80% of a normal pasture sward	Section 4.4.2 and Section 4.4.3
ORC – RM23.276.02 (Discharge Permit)		
3.	The discharge authorised by this consent must not result in: a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials. b) any conspicuous change in the colour or visual clarity. c) any emission of objectionable odour. d) The rendering of fresh water unsuitable for consumption by farm animals or any significant adverse effects on aquatic life.	Section 5

<table>
<tr><td></td><td>In any river, lake, artificial watercourse or wetland.</td><td></td></tr>
<tr><td>4.</td><td>The quality of the discharge must not exceed the standards specified below when sampled at locations identified in the approved EMP/ ESCP:
<table><tr><th>Parameter</th><th>Discharge Standard</th></tr><tr><td>Total Suspended Solids (TSS)</td><td>< 50 mg/l</td></tr><tr><td>Turbidity NTU</td><td>A limit calibrated against the TSS limit above.</td></tr><tr><td>pH</td><td>Stable reading between 6.5 and 8.5</td></tr><tr><td>Hydrocarbons, Tannins, Paint</td><td>No visible trace</td></tr><tr><td>Waste</td><td>No visible trace</td></tr></table></td><td>Section 5.2</td></tr>
<tr><td>5.</td><td>a) The Consent Holder must arrange for:
i. Water monitoring samples to be taken from Mill Creek for the purpose, in the manner and at the frequency detailed in subclauses b-e. below;
ii. The results of the water monitoring must be forwarded to the Consent Authority when the results of each water sample are available.
b) Water monitoring samples must be taken and analysed against the parameters and discharge standards outlined in Condition 4 above.
c) The purpose of the water monitoring is to inform the Consent Holder and the Consent Authority of the water quality in Mill Creek on a regular basis for a specified period, and to assist the Consent Authority in particular to gain a better understanding of the contribution of the site to water quality issues affecting the wider Mill Creek and Lake Hayes catchments. For that purpose, each water sample must be tested for the same water quality parameters as are measured by the Consent Authority at the Mill Creek Fish Trap downstream of the site.
d) Water samples must be:
i. Taken from the upstream end of Mill Creek within the site and at the downstream end of Mill Creek within the site;
ii. Forwarded for testing by an independent service provider qualified to water samples for the purpose detailed in subclause c. above.
e) Water samples must be taken:
i. Monthly for a period of at least six months prior to commencement of any works authorised by this consent;
ii. Monthly throughout the period of the works authorised by this consent;
iii. Quarterly (every three months) for the three year period following commencement of the commercial operation of the hotel.
iv. Whenever a rainfall event has occurred;
v. Monthly reports are required to be sent to the Consent Authority within 10 working days following the end of each month.
f) Wherever reasonable possible, the taking of water samples must coincide with the monthly monitoring test carried out by the Consent Authority at the Fish Trap downstream of the site.</td><td>Section 5</td></tr>
<tr><td>6.</td><td>In circumstances where one or more of the limits set out in condition 4 are exceeded the Consent Holder must report to the Consent Authority within 48 hours of any confirmed exceedance.</td><td>Section 3.5</td></tr>
</table>

	a) This notification must include advice of any corrective actions taken by the Consent Holder. b) A comprehensive Environmental Incident Report must be provided to the Consent Authority within 10 working days of the notification of the exceedance. This report must include: i. identification of the likely cause of the limit exceedance; ii. the effects on the receiving environment likely to arise because of the limit exceedance; iii. the management responses and remedial action undertaken so far; iv. actions that may be necessary to prevent any further limit exceedances occurring; v. identify remedial action that may be necessary and confirmation of implementation Advice note: The consent holder is required to obtain any resource consents required prior to implementing remedial action. c) Within one month of the exceedance being detected, the Consent Holder must update the EMP/ ESCP as necessary to reduce the likelihood of further exceedances and provide a copy to the Consent Authority for approval.	

APPENDIX 12 Chemical Treatment Management Plan

Introduction

Cirtex Industries has prepared this Chemical Treatment Management Plan on behalf of Wilson Contractors, for site earthworks at the Waterfall Park Developments, Ayr Avenue, Diversion Channel 4, Arrowtown, site. An electronic chemical dosing system is going to be used for treatment.

The project scope includes the construction of a temporary diversion channel to convey the flows of Mill Creek so that works can be carried out in the original creek bed and the development of environmental controls to manage water discharge on-site.

When working in the original stream bed a volume of ground water infiltration is expected and to prevent saturation of the works area, ground water will be pumped to an SRP for treatment before being discharged back into Mill Creek. The rate of ground water infiltration is unknown and expected to vary along the creek alignment. The diversion channel will remain in place for the duration of the works.

This report includes the following:

- » Bench test result from testing completed in the Geocert Laboratory.
- » The primary treatment application methodology for the site.
- » Other responsibilities in relation to system set up, management, maintenance, and spill contingency.

Electronic Dosing System (provided by Prime Pump Ltd.)

A representative soil sample was provided to the laboratory for bench testing. The tests were conducted in the Geocert Laboratory using the industry standard bench testing methodology, Appendix F1.0 of the Auckland Council GD05, Erosion and Sediment Control guidelines.

The chemical Polyaluminium Chloride was tested for use. The findings are published in the laboratory report SP-571 which is attached to this document as Appendix 2.

The treatment chemical selected for use in this plan was Cirtex Polyaluminium Chloride, because:

- It has been used extensively with Electronic Dosing Systems in the past with great success in multiple regions around New Zealand.
- It does not change the baseline pH more than one unit when applied as per the specified methods and dose rates listed in this report.
- Limited manual handling when used with an electronic dosing system, making site use safer and simpler.
- Cost effective treatment option. (Contact Cirtex to get the quoted rates for this project.)

Cirtex holds an ISO 9001:2015 certification for its quality management system

Certificate No: NZ001834-2

CONTENTS

1. SUMMARY OF FINDINGS

Laboratory bench test results:

Testing on the sample received shows that the chemical Polyaluminium Chloride gives the required visual clarity of 100mm at a **dose rate of 62 mL/m³ (4 ppm Al**).

The laboratory testing showed the natural pH of the sample to be 6.6 and it is expected that after chemical treatment the pH will not be outside the 5.5 to 8.5 pH limit (as set in GD05, refer to GD05 section F2.1.6). Vigilance with monitoring is advised and if there are any issues, please refer to section 12 of this report for contingency management.

A few important points to note:

- Good mixing after the dose point is important.
- If you come across a situation where the desired clarity is not being achieved, stop dosing and seek advice.

The test report SP-571, will give details on water clarity in mm (visual) and NTU for your reference.

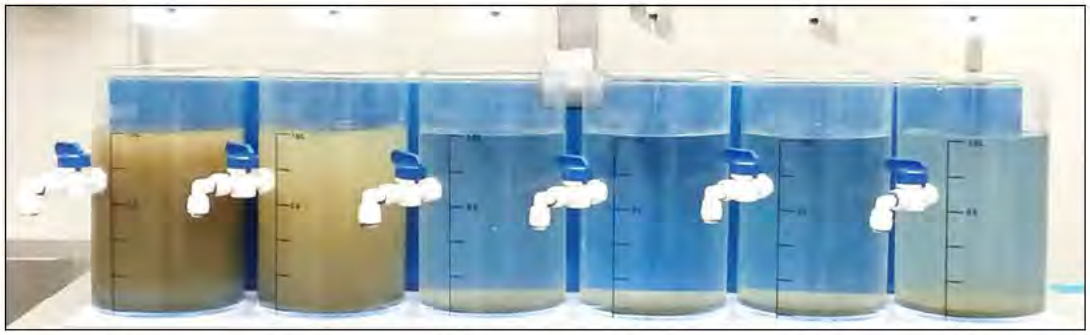
2. LABORATORY FLOC DOSING TRIALS

The laboratory test, known as a Jar Test, attempts to emulate the best representation of sediment laden runoff that is generated during a rainfall event.
For the purpose of this test, 20L of turbid water was created from a soil sample provided by the client. 6 identical jars were filled with 1L of the turbid water. CIR-PAC was added as per the following dosing schedule:

Chemical	Jar 1	Jar 2	Jar 3	Jar 4	Jar 5	Jar 6
CIR-PAC	0 ppm Control	2 ppm (Al)	4 ppm (Al)	6 ppm (Al)	8 ppm (Al)	10 ppm (Al)

The jar stirrer is then run at 120rpm for 5 minutes across all six jars and the clarity is subsequently recorded at relevant time intervals. The industry standard requirement for compliant discharge from site is 100mm of clarity at 60 minutes. For reference, the jars used for testing purposes are 100mm in diameter. A 30mm Secchi disk was used to measure the clarity of the samples at specified intervals and once the test has reached the final time point, NTU (Nephelometric Turbidity Units) readings are taken using a laboratory turbidimeter along with pH and temperature.

Sample 1 – SP-571



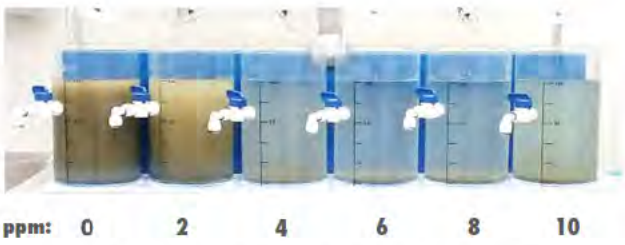
0 ppm 2 ppm 4 ppm 6 ppm 8 ppm 10 ppm

3. TEST RESULTS AND RECOMMENDATION

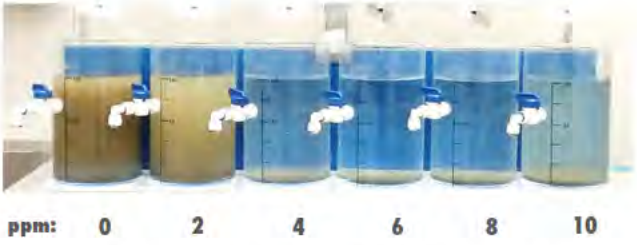
SP-571:
The following 4 photos are of the SP-571 bench test in action at 0, 5, 30 and 60-minute intervals.

0 MINUTES – CIR-PAC ADDED

5 MINUTES AFTER ADDING CIR-PAC



30 MINUTES AFTER ADDING CIR-PAC



60 MINUTES AFTER ADDING CIR-PAC

ALUMINIUM DOSE (ppm)	CLARITY (mm) 0 minutes	CLARITY (mm) 5 minutes	CLARITY (mm) 30 minutes	CLARITY (mm) 60 minutes	pH / Temperature (°C)
0	0	0	10	20	6.6 / 20
2	10	10	20	30	6.5 / 20
4	20	90	100	>100	6.5 / 20
6	30	100	100	>100	6.5 / 20
8	40	100	100	>100	6.4 / 20
10	30	90	90	90	6.3 / 20

Clarity >100mm = Green
pH change > one unit of pH from baseline = Yellow

4. DOSING SYSTEMS & COMPLIANCE

The traditional GD05/ TP90 rainfall activated dosing system was designed in conjunction with Auckland Council specifically for earthworks and construction sites. Precipitation collected on the rainfall tray is collected and diverted to a header tank which in turn stores the first 12mm of rainfall and then activates the displacement system. This falls into a displacement tank which floats inside the chemical tank. Displaced chemical is transferred via a dosing hose to the channel leading to the forebay of the sediment pond.

The electronic dosing system is flow controlled. This means that it doses chemical proportionate to the volume of water coming past an inline flow sensor in a dewatering setup. The system draws chemical from a reservoir and pumps it to an inline dose point. This is where the chemical is mixed with the sediment laden water. This dose point is normally located before a section of the dewatering system where sufficient agitation or mixing can occur prior to the water reaching the settlement phase. We normally see electronic dosing systems where sediment laden water has been pumped to either a lamella clarifier or a settling pond or tank. These systems can come in many forms but are usually solar powered and enclosed in a watertight housing. They will normally incorporate a manual override switch for setup and maintenance purposes.

The industry standard Auckland council GD05 guidelines do not specifically give guidance on electronic dosing systems for sediment control, but it does mention that specific details of alternative dosing procedures proposed should be listed in the Chemical Treatment Management Plan. We can confirm that all calculations and recommendations that have been provided in this CTMP, are to ensure that the discharge from the system complies with the local body guidelines regarding the clarity and pH of discharge to the receiving environment.

5. DOSING SYSTEM SETUP & INSTALLATION

The setup parameters for the chemical dosing systems on this site are listed in the summary of findings (section 1 of this report).

The dosing system used in this application is an electronic, flow-controlled dosing system that has been tested for use with Cirtex water treatment chemicals. The prescribed dose rate established in laboratory bench testing should be programmed into the system upon installation. Please refer to the manufacturers operating procedures for this.

The treatment system will be supplied by Prime Pump. The proposed solution is a flow activated, electronic chemical dosing system. The model of unit shall be decided by the equipment supplier and shall have sufficient capacity to enable the sedimentation process to fully complete before water is discharged.
This will be indicated by the clarity of discharge matching results achieved in laboratory testing.

If the scope of sediment generating activities increase or decrease by more than the design capacity of the treatment system, the treatment system will need to be adjusted accordingly. In these situations, it might be necessary to modify the setup of the system to control either:
- The flow rate into the system
- The retention time within the system
- The sludge levels
- The chemical dose rate or concentration

The system should be installed in accordance with the recommendations in this CTMP. The supplier of the dewatering systems will be able to provide technical assistance with the location and commissioning of the treatment system.

Consideration should be given to further activity that may take place on site when positioning the dosing system. Once the system is set up in-situ, the chemical storage tank should be filled and the system primed, to ensure that there is no delay in activation when in use.

Example of an Electronic Dosing system in operation in a dewatering application.

This report has been prepared for guidance on areas relating to chemical treatment only. Any information provided in this report regarding the equipment/ systems to be used is a guide only, and where conflicting information is identified, the manufacturers operating guide shall be used.

If you have any questions or require assistance with the equipment or systems discussed in this section, please contact the equipment supplier as follows:
Supplier: Prime Pump | Phone: 0800 482 747 | Email: Info@primepump.co.nz

6. BATCH DOSING OF PONDS, BUNDS OR TANKS

Batch dosing is not recommended without training and guidance on how to best apply it in this application. Contact Cirtex for further guidance if you have a situation where batch dosing might be required.

Batch dosing may be required if the desired clarity or pH has not been achieved via the primary dosing system and the water has been transferred to a pond, bund, or tank for further treatment.

Batch dosing calculations can be provided for this project, but we would also recommend on-site or laboratory jar testing prior to batch dosing to accurately calculate actual batch dosing requirements.

7. MONITORING AND MAINTENANCE REQUIREMENTS

It is a compliance requirement that regular monitoring and maintenance is carried out. For this project it is recommended that this is completed daily during periods where there is a high load on the treatment system and weekly during periods of standard operation.

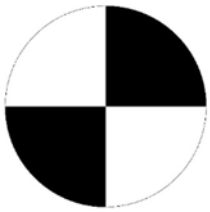
Monitoring results and maintenance activity should be recorded on the attached schedule. The monitoring and maintenance records should be stored with the treatment system or at the site/ management office and be made available to the council monitoring officer upon request.

A copy of the monitoring records shall be available on file and updated as required. The integrity of the treatment system will be checked weekly. All plumbing components should be regularly checked for blockages or leaks.

It is recommended that the advice of suitably qualified professionals is followed if there are any complications or difficulties experienced when treatment is applied as per the stated parameters and procedures outlined in this CTMP.

Methods and tips for measuring water clarity

To measure clarity, a Secchi Disk or similar measuring device should be used. This can be attached to a pole or rope/string. It is lowered vertically into the water body until it disappears and then raised again until it reappears. At this point the distance between the disc and the surface of the water should be measured. This distance is recorded as clarity.



Methods and tips for pH measurement

There are a few methods that can be used to determine the pH of a liquid:

- Using pH strips/ paper
- Using a pH Indicator solution and chemical titration (normally only done in a lab)
- Using a Digital pH probe (options for field use and laboratory applications)

The recommended method for pH measurement for treatment monitoring is using a digital pH meter made by a reputable manufacturer. These meters are simple to use and leave little room for error. They can be easily calibrated using solutions with a known pH value and are normally quite compact and simple to store.

To take a pH measurement you will need a sample from the discharge point of your sediment retention pond. If there is no discharge, this can also be taken from the pond near the decants or outlet using a sampling cup (clean cup or half-bottle that is attached to the end of a length of wood or broom handle). Take a reading from the pH probe as per the operating instructions of the device you use. You may need to wait a few moments for the device to give you a stable reading. Three readings should be taken from the sample, and the average should be taken as the pH value.

It is recommended that you store the pH probe a storage solution to ensure the longevity of the pH probe. Depending on the frequency of use it is recommended that you test the reading of the device using a calibration solution (solutions with a known pH value, also known as pH buffer solutions). pH meters from most reputable suppliers should provide readings of sufficient accuracy to be used in decision making regarding chemical treatment as outlined in this plan. If you want laboratory testing for the pH of water or soil from your site, we do have the capability to do this. This would normally not be necessary unless there are problems with treatment performance. Please contact us for more information if you require this service.

8. REPLENISHING THE CHEMICAL RESERVOIR

The reservoir tank should be refilled when the reservoir is half full, or sooner if high use is predicted. If the system is treating flows influenced by rainfall, the level of chemical in the system needs to be sufficient to treat a 100-year rainfall event should one occur. Refilling procedures will be outlined in the manufacturers operating procedures.

With an electronic dosing system, it is important to always prime the system after refilling. This will ensure that dosing begins immediately when the system is activated.

9. OBSERVATION OF WATER QUALITY

The quality of water discharged will be checked at least weekly, and the clarity determined using a Secchi disc or similar (as detailed above) and recorded on the monitoring sheet. pH shall be recorded to ensure it meets council guidelines.

10. STORAGE OF CHEMICAL ON SITE

Water treatment chemical supplied by Cirtex in 20L or 200L polyethylene containers or drums, 1,000L IBCs or 25kg powder bags, shall be kept in secure storage when on site. Chemical drums will be stored on end with the screw caps uppermost. Bags of chemical in powder form need to be kept away from water until they are used.

Replenishing the chemical reservoirs will be completed weekly as part of the regular inspection regime. We encourage the recycling of drums and containers on site wherever possible but there are organisations who will repurpose them if this is not an option. Care should be taken with the washing of drums and the rinsing of residual chemical.

11. PROCEDURE FOR TRANSPORTATION OF FLOCCULATION CHEMICALS

The transport of water treatment chemicals to and from the project will be undertaken by commercial carriers or the Cirtex delivery service in accordance with current Hazardous Goods, Traffic & Transport regulation. CIR-PAC weighs about 250kg in 200L drums and is most easily moved within the site in a loader bucket. Drum lifting chains can be supplied by Cirtex if required. The use of PAC or any other chemical must be done in accordance with the site Health & Safety Plan. The CIR-PAC MSDS is available on the Cirtex website www.cirtexcivil.co.nz or by contacting 0800 CIRTEX (247 839).

CIR-PAC MSDS LINK NUMBER: MSDS C 001 004

12. CHEMICAL SPILL CONTINGENCY PLAN

If there is a spill of water treatment chemical onto the ground it will be immediately contained using earth bunds to prevent it from entering water. The spilt chemical should be recovered if possible, using a spill kit. If the spilt chemical cannot be recovered, it should be mixed with a volume of soil equal to at least ten times the volume of spilt chemical and buried in dry soil. If there is a spill of flocculation chemicals into pond water or bunded area, discharge from the impounded water body into natural water should be prevented. Contact the Council or its representative for advice on appropriate action.

If there is a spill of chemical into flowing water i.e. a stream, river, or stormwater drain:

1. The regional council should be advised immediately.
2. If possible, the water and the spilt chemical should be pumped into a bund or pond until all the spilt chemical has been removed from the watercourse.
3. If the chemical cannot be removed from the watercourse any downstream users.

13. CONTINGENCY MANAGEMENT

A plan must be put in place to manage contingencies in accordance with site environmental management plans. Contingencies could include poor performance of the treatment system, vandalism, stormwater damage or effects of other influences on stormwater quality. The equipment supplier can provide guidance or training with regard to the use of the dewatering systems.

If the treated water is consistently very clear to depths >100 mm, it could indicate overdosing and the possibility of a lowered pH. This can present a risk to the receiving environment. If the treated water is consistently clear, the pH should be retested. Contingencies such as poor treatment performance or consistently very clear treated water should be dealt with by consultation with the appropriate organisation or its representative.

If pH falls outside the permissible range of 5.5 – 8.5, you will need to take one of the following actions after stopping all discharge from the catchment system:

1. Use the impounded water for dust control (this won't require treating it.)
2. Subject to the weather conditions at the time, and the level by which the range has been exceeded, it is possible to use pH balancing chemicals. These must be applied in accordance with the batch dosing guidelines provided in section 6 of this report.

   The pH scale is logarithmic which means that the more pH balancing chemical added, the faster the pH will change. Because of this, it is important to increase the pH dosing in small increments to ensure that you don't increase or decrease past the pH value you are aiming

for. If the pH levels require significant adjustment, it is advisable that the advice of suitably qualified professionals is requested and oversight is provided on-site.

The following chemicals have been used successfully in the past to balance pH:

- » To **Increase** the pH it is recommended that Sodium Carbonate is used.
- » To **Decrease** the pH it is recommended that Sodium Bisulphate is used.

3. Engage a laboratory to take samples and perform chemical titrations to determine appropriate chemicals and dose rates to correct pH. Implement these findings as per the recommendations in section 14 of this report.

14. TRAIING OF PERSON RESPONSIBLE FOR MONITORING AND MAINTENANCE OF CHEMICAL TREATMENT SYSTEMS

It is very important to regularly monitor and maintain the treatment system. Changing site conditions can have significant impacts on the success of the chemical treatment. Cirtex can undertake training of site personnel to carry out the required tasks and assist with understanding the basics principles of chemical treatment. Please let us know if you require this service.

15. RESPONSIBILITY

While all care has been taken in preparing this CTMP, it is based on the information provided by the client and equipment suppliers, and results may vary during the course of project works. It is the responsibility of the contractor to ensure compliance with all aspects of the appropriate regulations pertaining to these works. Cirtex would recommend that this report is refreshed at least every 6 months or more depending on the nature of the application. This will ensure dosing and flocculation designs provide the best results, as site conditions can change throughout the lifecycle of any project. All recommendations and calculations were completed in conformance with industry guidelines and best practice. This information is not to be used for any other purpose, without prior consultation and the written consent from Cirtex.
No liability is accepted for misuse of this information.

APPENDIX 1.0 - FORMS AND ATTACHMENTS

DOSING SYSTEM SETUP CONFIRMATION FORM (as built)

CONTRACTOR			
SITE			
INSTALLED BY			
CHEMICAL			
DOSE RATE			
SYSTEM	Flow (m^3/hr)	RECOMMENDATION	CHECK
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

I _____ hereby state that the above methodology has been followed and prepared in accordance with the chemical treatment management plan.

SIGNATURE: NAME:

DATE:

DOSING SYSTEM INSPECTION AND TEST RECORD FORM

Stormwater chemical treatment system monitoring and maintenance record

LOCATION		SYSTEM	
CLIENT		DOSE RATE	
DATE INSTALLED		CHEMICAL	

INSPECTED TEST DATE	TEST BY	RAW INFLOW pH	FLOW RATE THROUGH SYSTEM	OUTFLOW pH	SLUDGE LEVEL	WATER CLARITY	Site condition comments and chemical top-up records

DOSING SYSTEM MAINTENANCE CHECKLIST

Chemical treatment system - monitoring and maintenance record.			
SYSTEM LOCATION		SYSTEM TYPE	
JOB NAME		DOSE RATE	
CHECKED BY		CHEMICAL	

CHECK ITEM	INITIAL
Are there any negative impacts on the receiving environment?	
Is the system clean and free of debris?	
Are inlets and outlets clean and open?	
Are all connections tight and secure?	
Sludge level ok in the settling tank?	
Is the electronic dosing system covered, functioning well and safe?	
Is there sufficient floc in the chemical reservoir? - Is the dosing system primed to ensure immediate dosing when activated. - Chemical is clean. - The outlet pipe is in good condition and is not blocked or kinked. - The dose point and flow sensor in good working order.	
Is the documentation up to date? - Dosing system inspection and test record form - (as built) Dosing System setup confirmation form.	

Repairs/ Maintenance Actions Completed:	Completed

APPENDIX 2.0 – GEOCERT BENCH TEST REPORT

Test Date: 09/11/21

Operator: Joel Sorensen | Laboratory Manager

Approved By: Nicola Levy | Laboratory Technician

Report ID: SP-571

GEOCERT

TEST REPORT: WATER CLARITY
Waterfall Park, Arrowtown - GD05 Jar Test

CIR-PAC Dose Rate	Clarity (mm) 0 Minutes	Clarity (mm) 5 Minutes	Clarity (mm) 30 Minutes	Clarity (mm) 60 Minutes	NTU	pH	Temperature (°C)
Control Sample (No Treatment)	0	0	10	20	>800	6.6	20
2 ppm (Al) or 31 mL/m^3	10	10	20	30	>800	6.5	20
4 ppm (Al) or 62 mL/m^3	20	90	100	100	79	6.5	20
6 ppm (Al) or 94 mL/m^3	30	100	100	100	61	6.5	20
8 ppm (Al) or 125 mL/m^3	40	100	100	100	47	6.4	20
10 ppm (Al) or 156 mL/m^3	30	90	90	90	177	6.3	20
SAMPLE INFORMATION	5kg dark gray clay, contains topsoil						

TEST INFORMATION

Date Testing Commenced:
9/11/2021

Date Testing Completed:
9/11/2021

Client:
Cirtex Industries,
16 Queen Street Kopu
Thames, New Zealand - 3500

Identification Number:
361-3039-571

Laboratory Address:
2/366 Ngati Maru Highway
Thames, Waikato,
New Zealand - 3578
PO Box 470, Thames, 3540

Laboratory Ref:
SP-571

This document is only valid if it is signed by the Quality Manager. Test results only relate to the samples received. This report was performed in compliance with all the relevant Test methods listed above. Any deviations/ additions to the standards are listed in the attached test method report. The aim of the test is to try and achieve a minimum clarity of 100mm during the test period. It is noted that with some soil types this might not be achievable. KEY: "°C" = Degrees Celsius. "ppm" = parts per million. "mm" = millimetres.

Any Questions? Please let us know;
P: 0800 247 839 | **E:** info@geocert.co.nz | **W:** www.geocert.co.nz

x [redacted]
Nicola Levy
Laboratory Technician

x [redacted]
Joel Sorensen
Laboratory Manager