Erosion and Sediment Control Plan

Project Name: **Eastern Hills Reservoir**

Project No.: **OPC101031**

Date: **09/10/23**

Our water, our future.

Document Control

Panel Member	Connect Water					
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Client Council	Hutt City Council					
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2	09/10/23	Issued to WWL	S. Cheevers R. Anthony	L. Hensman	J. Dhanjee	J. Leatherbarrow

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1 Introduction

This (draft) Erosion and Sediment Control Plan (ESCP) provides a high-level overview of the erosion and sediment control principles and measures that will be implemented during the construction of the Eastern Hills Reservoir. The ESCP has been written in alignment with the Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region from Greater Wellington Regional Council (to be referred to as the 'ESC Guide') (GWRC, 2021).

The ESCP will provide certainty to certifying authorities that the earthworks can be managed with minimal effects on the environment. This document will form part of the resource consent application. A more detailed ESCP will be prepared as part of the detailed design of the reservoir and be submitted for certification prior to construction works beginning.

2 Project Description

The Eastern Hills Reservoir will be a circular 15ML, above-ground concrete reservoir with a 55.2m external diameter and an above-ground height of 8.35m. It will be located adjacent to the existing Naenae Reservoir at the top of Summit Road, Fairfield, Lower Hutt (Figure 1).

The Reservoir will be constructed at the same bottom water level (BWL) and top water level (TWL) elevation as the existing reservoir. The reservoir and pipelines will require earthworks volumes of approximately 90,000 m^3 (in-ground volume) over an area of approximately 1.5 ha, with erosion and sediment control measures required during construction. The majority of this cut will be removed from the site, with minor volumes potentially required for fill. The Reservoir will be constructed at the same bottom water level (BWL) and top water level (TWL) elevation as the existing reservoir. The reservoir and pipelines will require earthworks volumes of approximately 90,000 m^3 (in-ground volume) over an area of approximately 1.5 ha, with erosion and sediment control measures required during construction. The majority of this cut will be removed from site, with minor volumes potentially required for fill.

A new inlet pipe supplying water to the Reservoir will be constructed in a trench from a connection with the existing Naenae reservoir inlet pipe. This new connection is located at the intersection of Summit Road and Farrelly Grove with the proposed alignment, then running along the current vehicle access to the Reservoir. Both reservoirs will be supplied via the same existing bulk main from the Waterloo water treatment plant.

A new DN750 delivery pipe supplying water to the potable water network will run from the Reservoir down the hill to the north, across Waiwhetū Stream and into the potable water network along local roads, with the alignment through the roads forming part of a separate project. The Waiwhetū Stream crossing will be a submarine crossing. A DN500 pipe will connect the existing Naenae reservoir outlet to this new delivery pipe as shown in Figure 1.

A DN500 overflow/scour pipe from the reservoir will be constructed adjacent to the delivery pipe down the hill, before discharging into the Waiwhetū Stream near Balgownie Grove. The purpose of the pipe is for uncontrolled emergency discharges or controlled discharges when the reservoir needs to be drained for maintenance or inspections. The pipe will discharge via scour protection, such as riprap, directly to Waiwhetū Stream. In addition, the existing Naenae reservoir overflow pipe will be constructed to tie into the proposed Reservoir overflow pipe as shown in Figure 1.

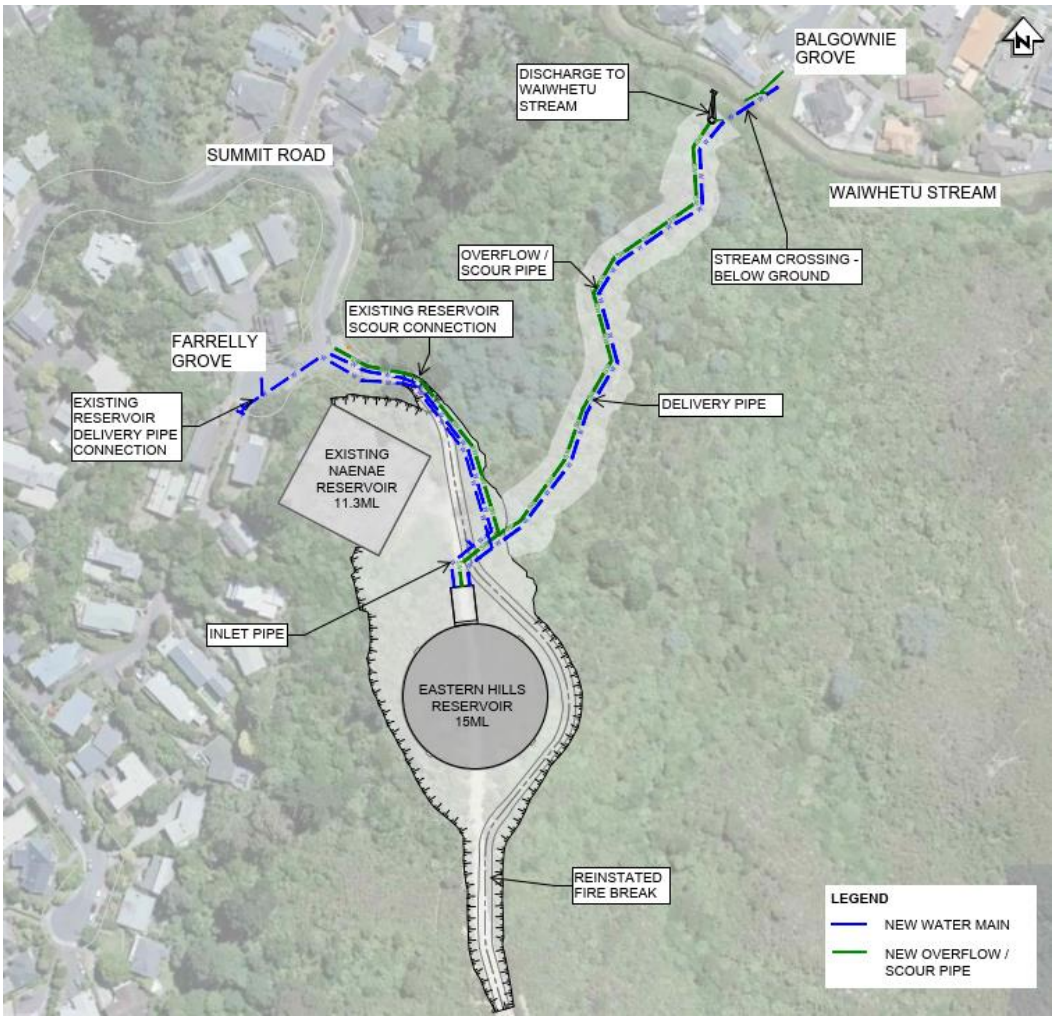


Figure 1 Eastern Hills Reservoir Site Plan

3 Erosion and Sediment Control Approach

3.1 Erosion and Sediment Contro Process

The need for this ESCP arises from the significant earthworks involved in this Project. Earthworks are a land-disturbing activity that mobilises sediment and has the potential to cause erosion due to exposing surfaces. A simplification of the erosion and sedimentation process is shown in Figure 2 (GWRC, 2021). The need for this ESCP arises from the significant earthworks involved in this Project. Earthworks are a land disturbing activity which mobilises sediment and has the potential to cause erosion due to exposing surfaces. The process of erosion and sedimentation is shown in Figure 2 (GWRC, 2021).

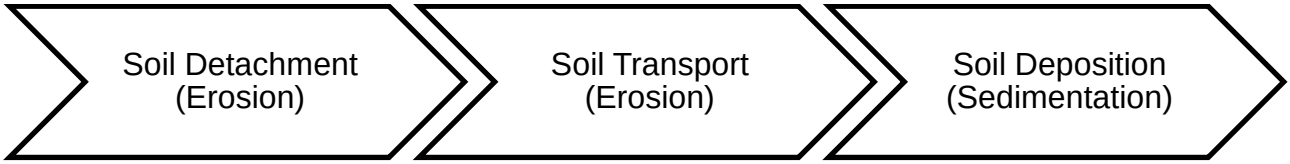


Figure 2 Simplified Erosion and Sedimentation Process

This ESCP follows the three main steps from Section C1.3 (Selecting the best management practices) in the ESC Guide (GWRC, 2021). These steps are outlined in Figure 3.

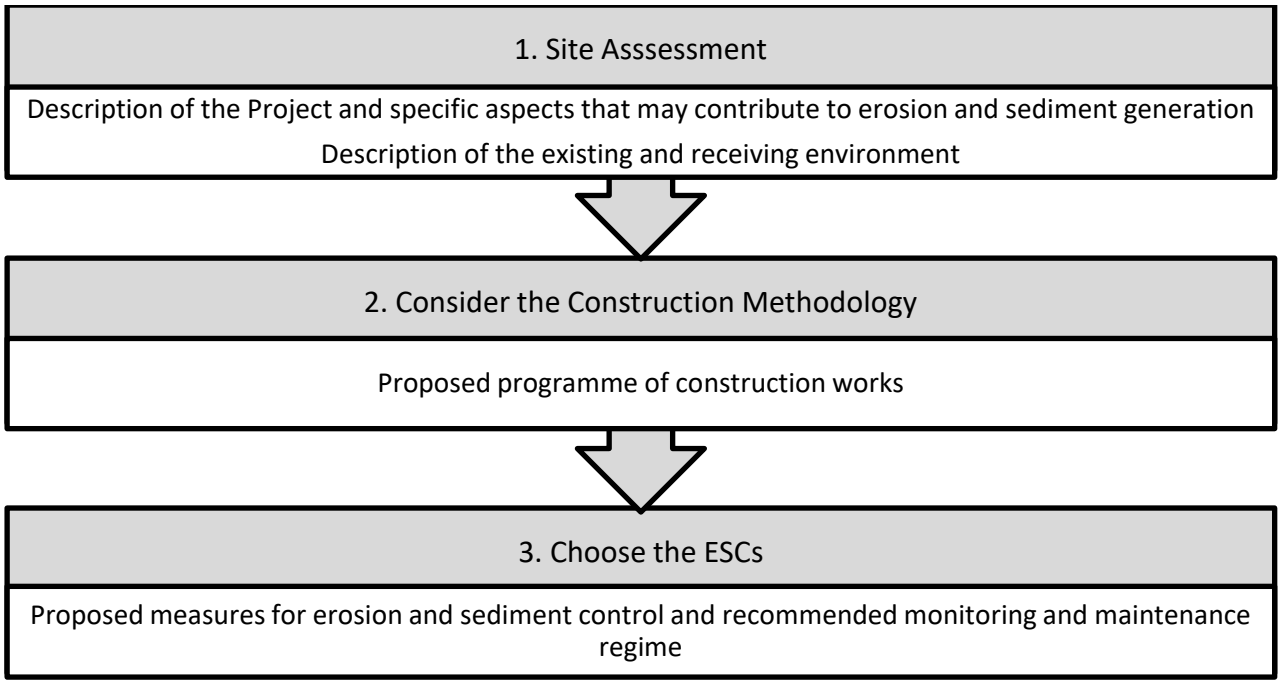


Figure 3 ESCP Steps and Report Sections

3.2 Erosion and Sediment Control Principles

This erosion and sediment control (ESC) management approach aims to align with the recommendations outlined in the ESC Guide (GWRC, 2021). The ten fundamental principles of erosion and sediment control outlined in this document are:

1) **Minimise disturbance** by adopting a minimum earthwork strategy.
2) **Stage construction** and detail both construction staging and sequencing to minimise the area of exposed earthworks and time of exposure.
3) **Protect slopes** by avoiding working on slopes when possible and adopting slope stabilisation measures if unavoidable.
4) **Protect receiving environments** by mapping out all watercourses, existing streams and proposed drainage patterns and show all limits of disturbance and protection measures. Where possible, a 10-metre buffer around watercourses will aim to be achieved. At some locations however where this may not be possible (e.g., culvert inlets/ outlets), a 2-5 metre buffer will be targeted.
5) **Rapidly stabilise exposed areas**, fully stabilise disturbed soils and exposed earthworks areas with vegetation rapidly after each stage and at specific milestones within stages.
6) **Install perimeter controls and diversions** to keep clean water out of the worked area and retain dirty, sediment-laden water within the site.
7) **Employ sediment retention devices** to capture and treat sediment-laden runoff to protect the receiving environment.
8) **Get trained and develop experience**, recommend the engagement of a trained and experienced contractor who has experience with ESCP best practice principles and ESC device construction.
9) **Adjust the ESCP as needed** and update (or recommend the update of) the ESCP to suit site adjustments and modifications as the project progresses.
10) **Assess and adjust your ESC measures** through inspection, monitoring, and maintenance control measures of the devices.

3.3 Contractor ESC Responsibilities

The appointed Contractor will review and develop this ESCP for construction. The Contractor is responsible for the following:

- Preparation of the detailed ESCP,
- Ensuring any revisions to the ESCP are approved by GWRC prior to works commencing,
- Preparation of a Site-Specific Environmental Management Plan,
- Implementation of the ESCP,
- Design and sizing for the ESC devices,
- Installation of the ESC devices,
- Inspections, maintenance, monitoring, and reporting of ESC measures,
- Auditing ESC devices,
- Training, and
- Decommissioning of ESC devices.

4 Existing Environment

This section describes features of the existing environment within and surrounding the Project site. Understanding the existing site conditions is important for understanding the erodibility and sensitivities of the receiving environment. It provides context to the development of this ESCP and the selection of ESC measures.

4.1 Topography

The proposed location of the new reservoir is uphill from the existing Naenae reservoir. Both reservoirs are on one of the ridge lines of the Hutt Valley's Eastern Hills. The section of ridgeline which will be modified for reservoir construction is approximately 65.0 m RL to 87.0 m RL (NZVD2016). The final platform level of the proposed reservoir will be cut down to approximately 66.0 m RL. Figures 4 and 5 show the topography of the site in 3D, excluding the overflow and scour pipeline that will be installed to the northeast of the reservoirs.

In terms of erosion and sediment control, there will be a small volume of stormwater entering the site from the southeast of the site, further up the ridge line. However, the main topographic concern is the rainfall that will enter the site and flow down the hill.

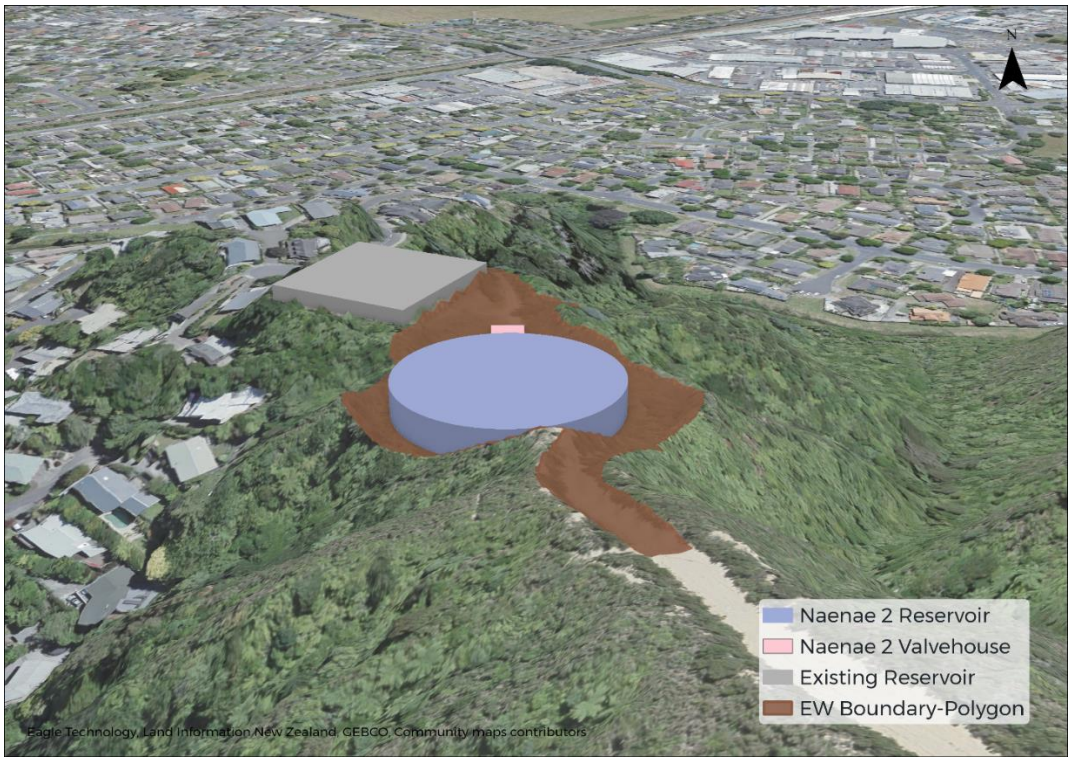


Figure 4 3D Depiction of the New Reservoir, looking down from the North

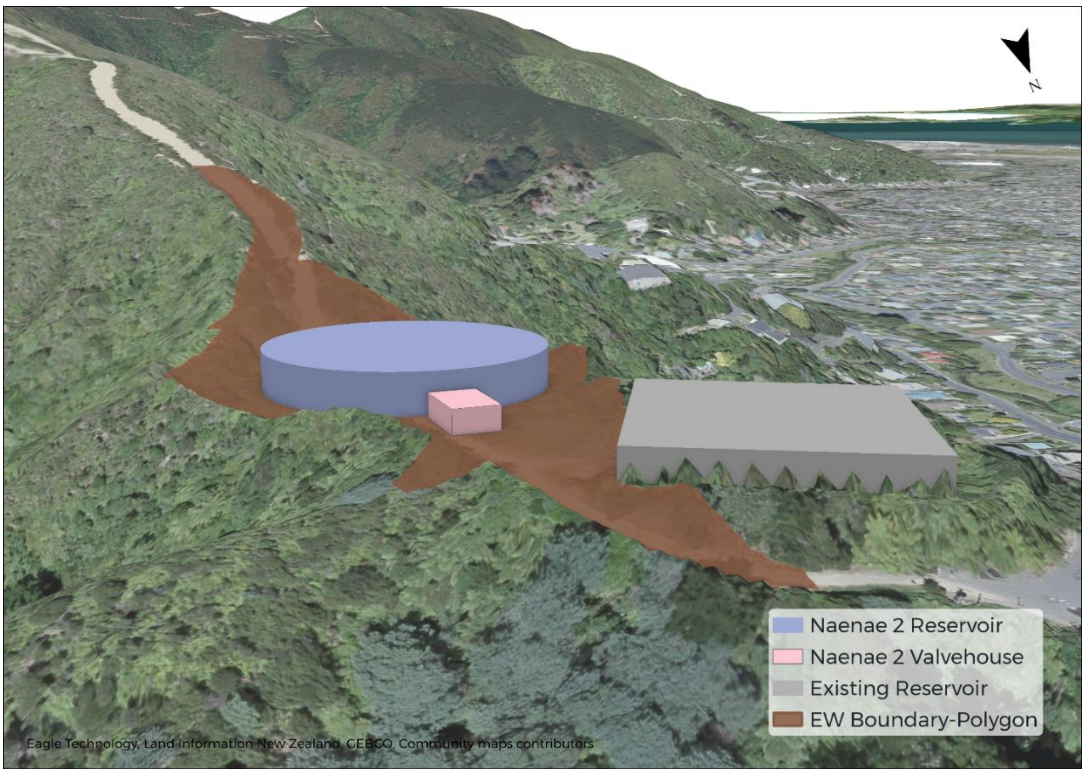


Figure 5 3D Depiction of the New Reservoir, looking up from the South

4.2 Soil and Ground Cover

The following information has been summarised from the Project's Geotechnical Interpretive Report[1]. The Project site is densely vegetated. There is a moderately to steeply inclined unsealed track that provides vehicle access to the existing Naenae reservoir. Upslope of the reservoir, the track narrows into a firebreak which is also a public access recreational track.

In a geological context, the site is within the Wellington Belt geology (Figure 6). Wellington Belt rocks mostly comprise greywacke (sandstone and siltstone) and are pervasively faulted, jointed, and veined. Based on-site observations, the groundwater level is anticipated to be at least 10 m below ground level at the top of the ridge.

[1] WSP, Geotechnical Interpretive Report (2023)

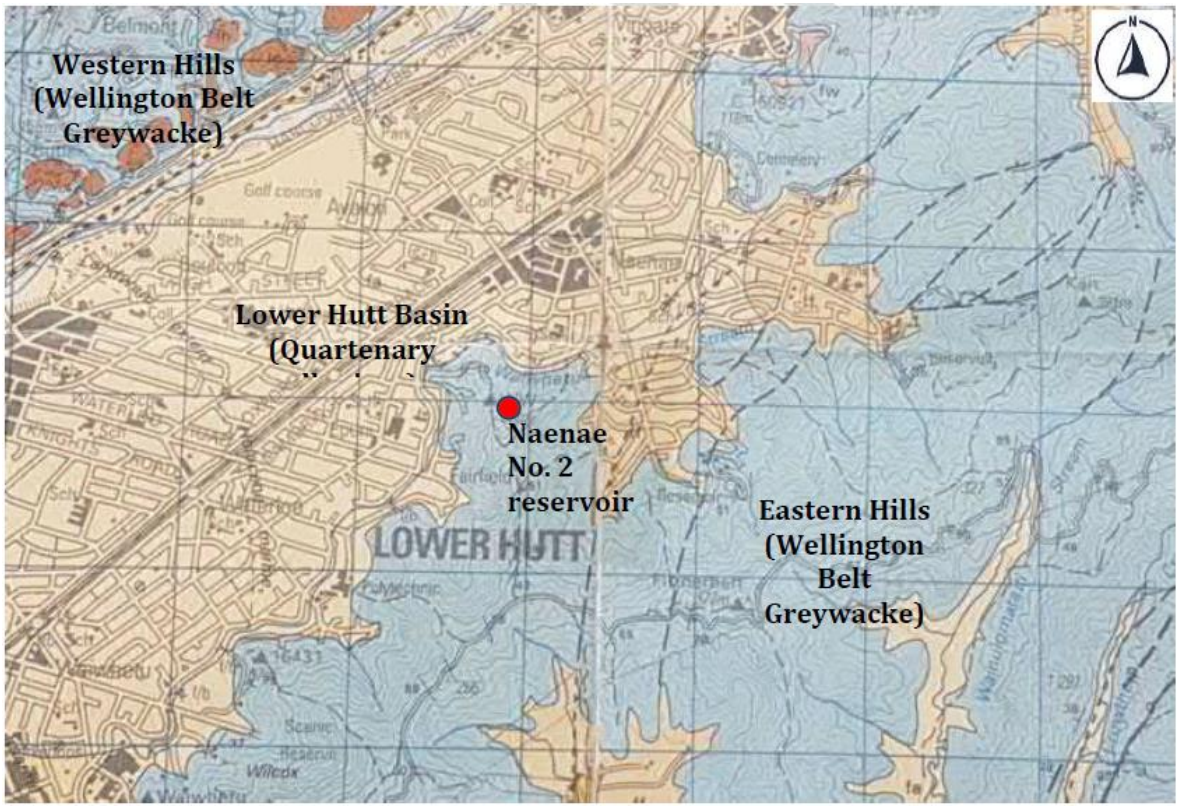


Figure 6 Extract of 1:50,000 geological map of Wellington (Begg & Mazengarb, 1996)

For the earthworks, it is expected that most of the rock can be excavated through hard digging. Ripping may be required for the less weathered and stronger rock in deeper parts of the excavation. Table 1 summarises the layers of the first 20 m of the soil/ rock below the site.

Table 1 Site soil/rock layers

Soil/Rock Layer	Typical Description	Depth to top of Layer (m)	Typical Layer thickness (m)	Cohesion, c' (kPa)
Colluvium	Clayey fine to coarse SAND with some silt and minor gravel, orangish brown. Very soft, moist.	0 – 0.5	0.5 – 1.5	30 – 80
Completely to Highly Weathered Greywacke Rock	Completely to Highly weathered, light reddish brown, SANDSTONE; extremely weak. Defects extremely closely spaced, rough and undulating to planar, infill is sand, silt and clay.	0.5 – 3.5	12 – 16	25 – 35
Moderately Weathered Greywacke Rock	Moderately weathered, light reddish grey, SANDSTONE; extremely weak. Defects very closely spaced, rough and undulating to planar, infill is sand and silt.	12 – 20	6 – 8	– 170

4.3 Receiving Environment

The closest watercourse to the site is the Waiwhetū Stream, as illustrated in Figure 7, approximately 200m northeast of the reservoirs. The Waiwhetū Stream is at approximately 10 m RL at this location and joins at the Te Awa Kairangi/ Hutt River near its mouth. It is the receiving environment for the Project Site for the purpose of this Plan.

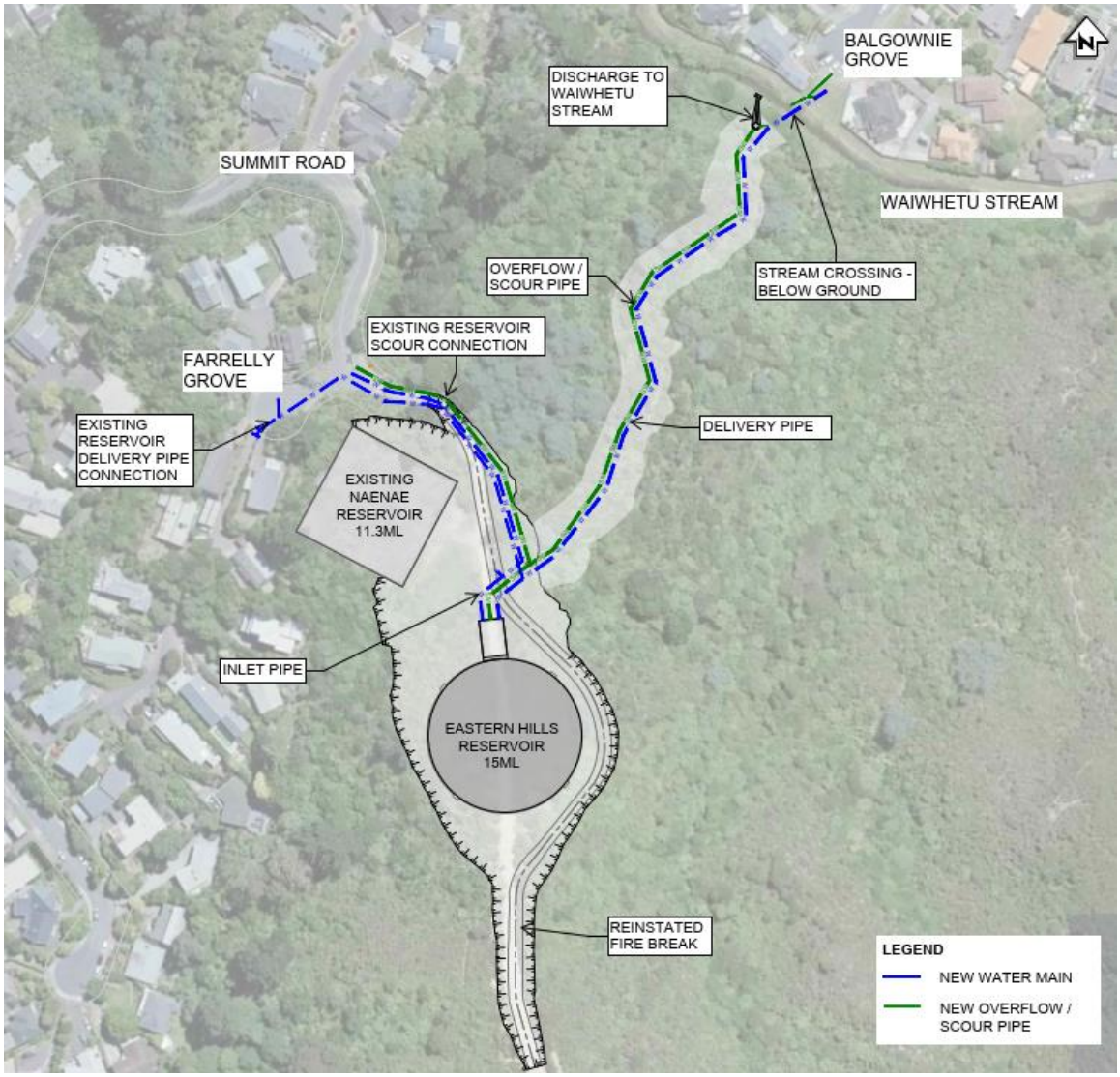


Figure 7 Approximate proposed construction envelope

The Waiwhetū Stream is graded as Wai Kino, contaminated by human waste, in the Te Oranga Wai Mana Whenua assessment framework (2021) It is also recorded as Ngā Taonga Nui a Kiwa, a water body of most importance to Mana Whenua, in the Natural Resources Plan for the Wellington Region (WWL, 2023).

Protection of the stream from the discharge of contaminated water during construction, was a recommendation of the Cultural Impact Report conducted by Raukura Consultants[2], in consultation with Kura Moeahu and Port Nicholson Block Settlement Trust.

The Waiwhetū Stream is valued by the local community. There is an active community group called 'Friends of Waiwhetū stream' that works towards improving the natural ecosystem. (Friends of Waiwhetū Stream, 2018). They have been contacted in respect to the proposed works, with consultation to be ongoing through the consenting process. The ecological assessment of the Waiwhetū stream, completed as part of the Eastern Hills reservoir consent application, has concluded that the stream has an overall ecological value of **high[3].**

Wellington Water monitor the stream water quality. One of these monitoring sites is Tilbury St, approximately 500 m southwest (downstream) of the Project site. The main water quality indicator that is monitored is E.coli. Figure 8 shows the location of the Tilbury St monitoring site, in relation to the Waiwhetū stream catchment. The cultural and community values of the Waiwhetū Stream emphasise the importance of minimising the environmental effects from the construction of the new reservoir.

Figure 8 Tilbury St monitoring site

There is also a nearby stormwater network (Figure 9), with stormwater from Balgownie Grove and the private cul-de-sac on Summit Road discharging near the proposed scour/overflow pipe outlet for the Project Site. Stormwater from Farrelly Grove/Summit Road discharges to the top of the gully adjacent to the Naenae reservoir site.

[2] Raukura Consultants, Cultural Impact Report – Naenae Drinking Water Reservoir
[3] WSP, Ecological Impact Assessment (2023), Section 7.7.1

Figure 9 Stormwater network

5 Construction Activities

Construction of the reservoir is programmed for mid-2024 to late 2026. Table 2 shows the indicative construction activities including the estimated duration of each activity. The appointed Contractor will provide a detailed programme, prior to construction.

Table 2 Main Construction activities

	Main Construction Activity	Approximate Duration[4]	Construction Period
1.	Site establishment	50 days	Earthworks Season[5] 2024/25
2.	Reservoir earthworks	220 days	
3.	Reservoir construction	340 days	2025/26
4.	Installation of scour and delivery pipelines	150 days	Earthworks Season 2025/26
5.	Waiwhetū Stream Crossing and Outfall		
6.	Landscaping and reinstatement	85 days	2026
7.	Site disestablishment	10 days	2026

Note that the appointed contractor may apply to the consenting authority to carry out 'winter works' to complete the earthworks for the reservoir within the calendar year and to reduce prolonged disruption to residents.

Key sub-activities under each main activity are as follows:

1) Site establishment:
   a) Establish fencing, signage and noise barriers, offices and facilities
   b) Establish preliminary ESC measures
   c) Ecological surveys and vegetation removal
2) Reservoir earthworks:
   a) Progressive excavation and removal of cut from site, following a benching method
   b) Development of further ESC measures such as clean water diversion and sediment retention ponds as work progresses
   c) Grading and stabilisation of site and cut slopes
3) Reservoir construction:
   a) Ground improvements under reservoir
   b) Construction of a 15ML circular, concrete reservoir with associated concrete valve house
   c) Installation of DN750 inlet pipe, DN500 cross connection and DN300 Naenae scour connection. To be completed near the end of construction
4) Installation of scour and delivery pipelines
   a) Establish ESC measures
   b) Vegetation clearance and excavation of ridgeline
   c) Installation of DN750 delivery pipe and DN500 scour/overflow pipe up the ridgeline from the Waiwhetū stream to the reservoir.

[4] Duration of some construction activities overlap.
[5] Earthworks season defined as 1st October to 31st May (based on GWRC definition of 'winter works' season as 1st June to 30th September).

   d) Installation will be open trenched in segments, with the trench backfilled as work progresses.
5) Waiwhetū stream crossing and outfall:
   a) Establish fencing, signage and noise barriers, laydown area at Balgownie Grove
   b) Establish ESC measures
   c) Scour outfall to Waiwhetū Stream with an energy dissipation structure and gabion basket installation.
   d) Below-ground stream crossing across Waiwhetū Stream for the delivery pipe. Crossing to be open trenched.
   e) Connection to bulk network at Balgownie Grove.
6) Landscaping and reinstatement:
   a) Final grading of the surface
   b) Reinstate firebreak / access track
   c) Import top soil and revegetate
   d) These works will occur throughout the construction programme
7) Site disestablishment:
   a) Final testing and commissioning activities
   b) Removal of ESC devices, minor reinstatement may be required
   c) Removal of fencing, signage and noise barriers, offices, and facilities.

6 Erosion and Sediment Control Plan

ESC is one of the major construction activities. This ESCP proposes techniques and practices required to minimise the erosion and sediment accumulation and mobility due to construction activities.

Of the construction activities identified in Section 5, four significant land-disturbing construction activities form the basis for the ESCP. These activities are:

1) Reservoir earthworks
2) Reservoir construction
3) Installation of scour and delivery pipelines
4) Waiwhetū stream crossing and outfall.

The other main construction activities have been considered as part of the four mentioned above.

6.1 Factors Influencing Erosion and Sediment Accumulation

Primary factors that influence the amount of soil loss from earthwork sites are:

- Weather
- Topography
- Soil characteristics
- Ground cover
- Duration of soil exposure
- Rainfall intensity
- Wind speed
- Vehicle movements

ESC measures may need be adapted depending on changes to the above factors.

6.2 Control Measures

All erosion and sediment control measures will be designed, constructed, and maintained in accordance with the ESC Guide (GWRC, 2021).

The proposed control measures cover three phases of work:

- Phase 1 – Pre-Construction stage (site mobilisation stage)
- Phase 2 – Construction stage
- Phase 3 – Post-Construction stage (site de-mobilisation)

This is only intended to show how controls may change throughout the works and should not limit the contractor from changing the works order or splitting the works into different phases.

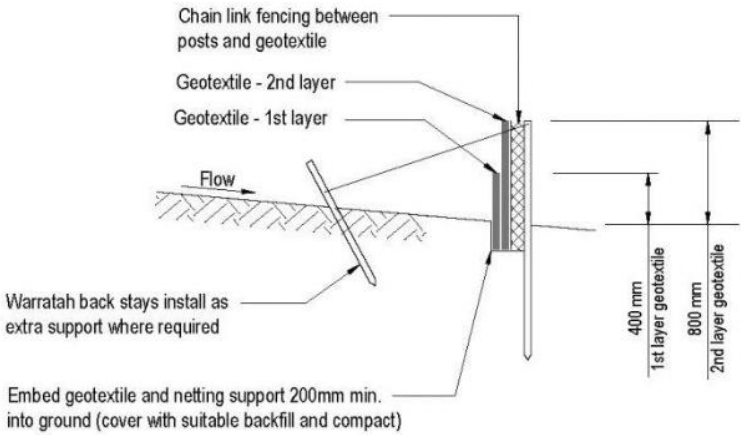
The proposed control measures, detailed in Table 3, are indicative of the types, location, and design of measures required for the site. As the works progress, the mitigation measures may need to be moved, altered, or removed. Any changes should be discussed with the certifying authority prior to implementation. Measures will be designed, unless otherwise noted, for a 5% Annual exceedance probability (AEP) rainfall event.

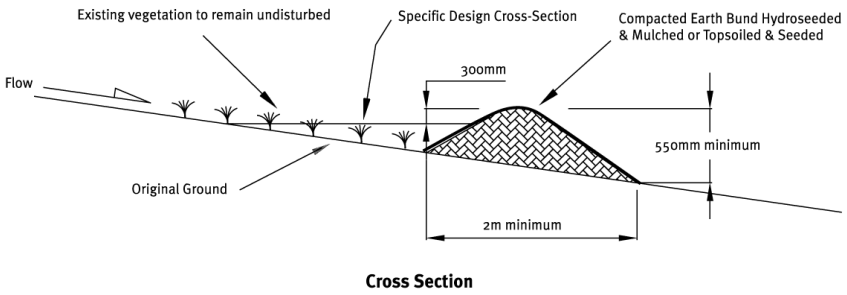
Due to the cultural and ecological significance of the Waiwhetū stream and the wetlands, special consideration is to be given to protecting these areas.

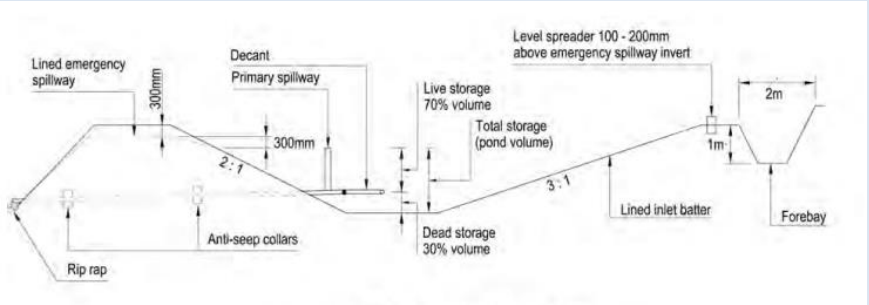
Note: The ESCP drawing showing the proposed erosion and sediment control devices and controls is in Appendix A.

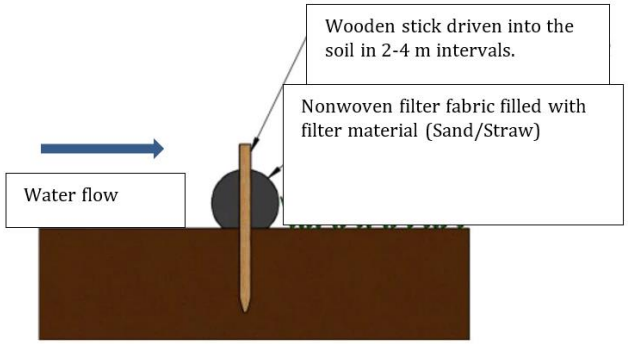
Table 3: Erosion and sediment control measures

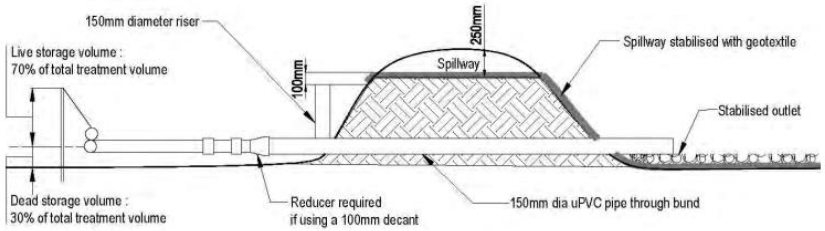
Construction Activity	Control Type	Description	Phase
1. Reservoir earthworks 2. Reservoir construction 3. Installation of scour and delivery pipelines 4. Waiwhetū stream crossing and outfall	Minimise disturbance to vegetation at the site	Having a rich vegetation cover is one of the most effective methods of reducing erosion. The Contractor must mobilise, conduct work, and demobilise while minimising disturbance to the existing vegetation.	1 & 2
1. Reservoir earthworks 2. Reservoir construction 3. Installation of scour and delivery pipelines 4. Waiwhetū stream crossing and outfall	Re-plantation	Re-plant vegetation as suited to the area and to compensate for the removed plants due to the construction work. A preliminary planting plan has been produced as part of the consent application.	3
1. Reservoir earthworks 2. Reservoir construction 3. Installation of scour and delivery pipelines 4. Waiwhetū stream crossing and outfall	Stabilise entrance and vehicle moving paths if necessary, using: • Temporary washed aggregate • Soil polymer • Lime • Gypsum • or any ground improvement technique after obtaining approval from the Engineer	Maintain a specific path for vehicle movements and stabilise the path to avoid tracking of sediment into public roads.	1, 2 & 3

Construction Activity	Control Type	Description	Phase
1. Reservoir earthworks 2. Reservoir construction 3. Installation of scour and delivery pipelines 4. Waiwhetū stream crossing and outfall	Installation of super silt fences around the perimeter of the planned excavation area as shown in Appendix A.	Super silt fences will retain the sediment within the excavated area and only allow clean water to pass through. Detail of a super silt fence is as follows (Figure 10)  **Figure 10 Super silt fence cross-section** Spacing between each post shall be 2-4 m. Geotextile material shall be: • Nonwoven. • Grab tensile strength > 440N • Tensile modulus > 0.140pa • Apparent opening size: 0.1-0.5 mm	2

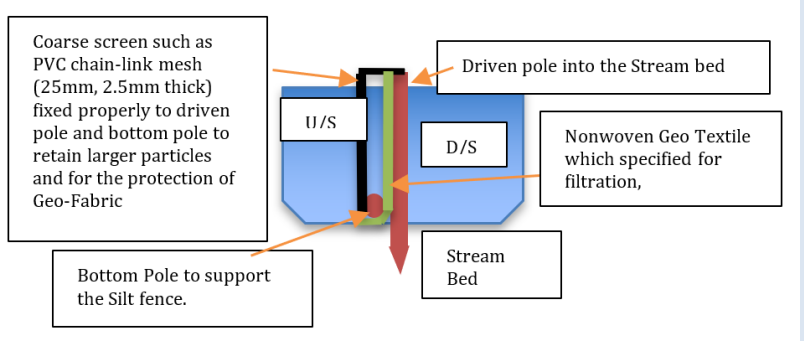
Construction Activity	Control Type	Description	Phase
Reservoir earthworks	Surface stabilisation	Stabilise exposed surfaces as soon as possible following the design cut levels being achieved. This includes the use of geotextile fabric and hydroseeding on cut slopes, and clean aggregate cover on lay-down areas.	2
1. Reservoir earthworks 4. Waiwhetū stream crossing and outfall	Construction of clean water diversion system around the site. Refer to Appendix A for proposed locations	This will prevent the clean water from entering the site and becoming contaminated.  Figure 11 Clean water diversion bund	1

Construction Activity	Control Type	Description	Phase
1. Reservoir earthworks 2. Reservoir construction	Installation of sediment retention ponds (SRP)	The dirty water runoff diversions will convey sediment-laden runoff within the disturbed area towards the SRPs for treatment. Two SRPs will remain in place and maintained until the disturbed area is protected against erosion by permanent stabilisation. Outlet water is to be discharged through a small flume and riprap at the end to the receiving environment. Velocity control barriers and sediment retention such as filter socks must be placed intermediately to control the velocity of discharged water. SRPs have been designed based on the ESCG (GWRC, 2021) considering a minimum volume of 3% of the contributing catchment area. For the purposes of this plan the SRPs have been sized at 16.1 x 6.4 x 1.1 m and 25.55 x 8.1 x 1.1 m, however, this will be reviewed and adjusted throughout the design basis to match the final design and construction methodology.  Figure 12 Potential SRP cross-section	2
1. Reservoir earthworks	Avoid movement of sediment/ bare soil from the site into the public road	Clean wheels, if necessary, at the site to avoid tracking sediment/ bare soil into the public road.	2
1. Reservoir earthworks	Cover trucks' loads while transporting the dried material	This helps to increase dust control and reduce the deposition of sediment onto public roads.	2
1. Reservoir earthworks	Use a combination of sprinklers and a water cart to maintain a damp surface	This will minimise sediment mobilisation and dust generation within the construction site.	2
1. Reservoir earthworks 2. Reservoir construction 3. Installation of scour and delivery pipelines	Maintain a slightly higher elevation at the entrance of the Farrelly Grove to retain the sediment-laden water within the site.	Although silt fences will be installed around the excavated area as necessary still sediment-laden water can convey from the site entrance through Farrelly Grove. Maintaining a slightly higher elevation at the entrance will help to retain the sediment-laden water within the site.	1 & 2

Construction Activity	Control Type	Description	Phase
1. Reservoir earthworks 2. Reservoir construction 3. Installation of scour and delivery pipelines	Installation of filter socks. Refer to Appendix A for proposed locations	To control the velocity of water from the surface runoff and discharge of SRP/DEB and retain any kind of sediment conveyed with the water. Refer Figure 13  **Figure 13 Cross section of typical filter sock**	1
2. Reservoir construction	Collection and treatment of construction water	This helps to manage the discharge of construction water more efficiently to the nearest watercourse through a small flume and riprap at the end. Velocity control barriers and sediment retention such as filter socks must be placed intermediately to control the velocity of discharged water.	2

Construction Activity	Control Type	Description	Phase
3. Installation of scour and delivery pipelines	Decanting Earth Bund (DEB) is located at the foot of the hill on the northern bank of the Waiwhetū	DEB can collect the water from the pipeline construction corridor down the hill, before discharging to the stream. The DEB shall be sized at 2% of the contributing catchment area. The DEB is to be designed based on the ESC Guide (GWRC, 2021) For the purposes of this plan, the DEB has been sized at 14.8 x 3.7 x 1 m, however, this will be reviewed and adjusted throughout the design basis to match the final design and construction methodology.  Figure 14 Cross section of a DEB	2
3. Installation of scour and delivery pipelines	Stockpile the excavated soil on top of a geotextile mat and install slit fence at the stream end to avoid sediment movement towards the stream	This reduces the sediment movement towards the stream until the trench is backfilled. Stockpiles may be along the side of the trench or, if practical, material may be shifted to the main construction platform for stockpiling	1 & 2
3. Installation of scour and delivery pipelines	Stabilise access track as ridgeline is excavated	As the access track along the alignment is excavated and formed, the exposed surface will be stabilised through the use of a combination of washed aggregate topsoiling, and hydroseeding. Use aggregate along the designated vehicle paths	2
3. Installation of scour and delivery pipelines	Grade access track to the west and construct “V” channel or earthen diversion bund	Water run-off can then be diverted to the DEB at the base of the hill to allow the treatment of water.	2
3. Installation of scour and delivery pipelines	Apply hydroseeding/suitable stabilisation method as soon as backfilling is completed	This measure helps to minimise the sediment accumulation and erosion of the backfilled surface. Use washed aggregate along the vehicle accessways until such time as permanent stabilisation can be established.	2

Construction Activity	Control Type	Description	Phase
3. Installation of scour and delivery pipelines	Use earthwork supports at deeper depths in the trench where necessary (depth > 1m). Use earthwork supports at locations where loose soil is identified.	This will strengthen the banks and avoid soil collapsing into the trench.	2
3. Installation of scour and delivery pipelines 4. Waiwhetū stream crossing and outfall	Install super silt fences along the bank of the Waiwhetū Stream.	The fences will provide additional protection to the stream from runoff from the construction area around the stream, and the scour and delivery pipe corridor.	1 & 2
4. Waiwhetū stream crossing and outfall	Installation of sheet piles to isolate the working area for the construction of stream crossing and scour discharge gabion baskets.	This method ensures isolation of the working area, allowing disturbance of the soil for construction to occur without contamination of the stream water. Care must be taken when removing the piles to ensure that loose sediment is not carried downstream. Slowly filling the dam before removing the piles can mitigate this risk. Post-construction testing will be required to ensure ESC mitigations have worked.	2
4. Waiwhetū stream crossing and outfall	Over pumping excess water from upstream to downstream	This will ensure no excess water collection, avoid flooding in the upstream area, and isolate the working area while maintaining the flow of the stream.	2
4. Waiwhetū stream crossing and outfall	Construction of breakwater upstream of Waiwhetū Stream	Construction of a breakwater using rubble will reduce the velocity of the stream flow as well as retain larger particles that move with the stream flow (which can be later removed).	2
4. Waiwhetū stream crossing and outfall	Stockpile the excavated soil on top of a geotextile mat and install a slit fence at the stream end	This reduces the sediment movement towards the stream and must be placed at both banks of the stream. Stockpiles are to be temporary. The silt fence will help to avoid sediment movement towards the stream.	1 & 2

Construction Activity	Control Type	Description	Phase
4. Waiwhetū stream crossing and outfall	Install a modified silt fence with a coarse screening system downstream of Waiwhetū Stream	This helps to retain any kind of sediment movement from flowing downstream and only allows clean water to pass through. Refer Figure 15.  Figure 15 Installation of silt fence at the downstream	1
4. Waiwhetū stream crossing and outfall	Install lamella sediment tank.	This can be used to treat water during the dewatering of the trenches near the Waiwhetū Stream. Clean water can then be discharged to the Waiwhetū Stream downstream of the work area.	2
Wetlands	Install a silt sock around the wetland buffer	The silt sock will intercept and filter runoff before it enters the wetland.	1

6.3 Construction Staging

Construction staging is one of the major aspects to be considered and can have considerable influence on erosion and sediment mobility. With works occurring over a large catchment with vegetation removal and a significant volume of earthworks, as well as works within a stream, erosion, and sediment mobility will be considered.

Earthworks (reservoir and pipeline) must be planned within the standard Earthworks season, nominally 1 October to 31 May. Where practical, exposed earthworks will be stabilised to reduce erosion during the winter months, refer to Section 6.4 for dust control measures required. The extent of exposed soil and the length of time that an area is exposed has a direct influence on the sediment yield leaving a particular area of the site. Open earthworks will be progressively stabilised to reduce the potential for erosion to occur. Work on the pipeline down the hill is programmed to be completed under a separate earthworks season to the main reservoir platform. Any areas that need to remain exposed for prolonged periods of time are to be seeded, and erosion and sediment control measures remain in place until 80% vegetation has been achieved.

Work within the Waiwhetū Stream will be planned in summer where lower flows in the stream are expected. Staging of the works and preparation is critical to reduce the time the trench through the stream is open, therefore minimising the risk of a weather event causing an overflow of the dams.

6.4 Dust Control Measures

Dust control practices are required to prevent or reduce the movement of dust from disturbed soils through the effects of wind. Water sprinkling will be used on this Project for dust control.

To minimise potable water consumption, water for dust control will be sourced from sediment ponds and decanting earth bunds, where possible.

7 Maintenance, Monitoring and Reporting

The following monitoring, maintenance, and reporting activities shown in Table 4 are recommended. This table provides several aspects of ESC that the site manager or site foreperson will assess regularly to ensure ESC measures are optimised.

Table 4 Monitoring, maintenance, and reporting activities

Control Type	Monitoring and Maintenance procedure	Frequency	Reporting Methodology	Responsible Person
Weather Forecast	Check MetService New Zealand for rainfall forecasts.	Daily	Maintain Daily Progress Reports	Contractor
Stabilise entrance and vehicle moving paths	Inspect any structure used to trap sediment from the stabilised entranceways.	Weekly or post-rain	Maintain a Site Environmental Impact & Maintenance Register	Contractor
Silt fences and silt socks	Check that silt fences are toed incorrectly. Check for tears and other damage.	Weekly or post-rain	Maintain Daily Progress Reports	Contractor
Clean Water Diversion	Inspect diversion bunds are not damaged.	Weekly or post-rain	Maintain a Site Environmental Impact & Maintenance Register.	Contractor
SRP or DEB	Check for any leakage and excessive accumulation of sediment	Weekly or post-rain	Maintain a Site Environmental Impact & Maintenance Register.	Contractor

8 Rainfall Response and Contingency Measures

Rainfall is one of the major contributing factors to erosion and sediment accumulation. Proper ESC methods will minimise the effect of heavy rainfall on the site. The MetService New Zealand website will be frequently checked for rainfall forecasts to identify any possible rainfall to occur during the construction period, managing scheduled works accordingly.

In addition, when rain is forecast, a site-specific inspection will occur to ensure Erosion and Sediment Control measures are in place and fully maintained. As part of this forecast rain response, there may be the requirement to undertake remedial works, stabilise exposed areas, and adaptive management of the Erosion and Sediment Controls. As an additional protection, the Contractor will keep a stock of material, such as PVC sheeting, to cover stockpiles and bare soil in the event of heavy rain.

In the event of a failure in an ESC device, the turbidity of the stream will be monitored, and the reported results are to be submitted to GWRC within 5 working days of the event.

8.1 Other Checks and Inspections

In addition to the devices, other on-site activities such as refuelling facilities and practices, stockpiles, dust control and construction activities will also be visually checked by the Contractor when the work is undertaken on the Site. Identified issues will be included in weekly inspection sheets. These checks intend to ensure that the Site is properly maintained at all times, and activities remain within the specified standards, including any consent conditions.

9 Reviewing and Amendments

The methodology described above in Section 6.2 is indicative and will require regular review during construction. Amendments to this plan may be required as pond clearance proceeds. Where amendments are necessary, they will be recorded and distributed to all interested parties.

Minor changes to controls implemented on-site will not require discussion with or agreement from the certifying authority. Minor changes are amendments that will not materially change the way the works are undertaken or the way in which outcomes are achieved. This includes:

- Repositioning or implementation of silt fences and super silt fences
- Installation of additional diversion bunds, check dams and inlet protection
- Changing the form of control from a diversion bund/channel to a silt or super silt fence
- Mulching, top soiling or any site stabilisation

10 Site Responsibilities

The Contractor will review this ESCP and submit a final copy to the certifying authority for certification prior to works commencing. Any significant changes to the ESCP, construction programme or works affecting erosion sediment control, will require re-submitting the ESCP to the certifying authority.

The Contractor is required to always work to the conditions, planning for adverse weather to ensure that control devices operate effectively. All enquiries, issues, and environmental management-related complaints will be referred to the site supervisor. Any complaints shall be handled in a consultative way and promptly dealt with by site staff.

This plan will be held on site for the duration of the works and regular meetings will take place to ensure that all staff are aware of site ESC requirements. Staff and visitors will be inducted on arrival on site.

11 Assumptions and Limitations

The assumptions and limitations of the draft ESCP are as follows:

1. The Erosion and Sediment Control Plan (ESCP) forms a sub-plan of the Construction Environmental Management Plan (CEMP) for the Eastern Hills Reservoir. This plan outlines the principles, methodologies, Erosion and Sediment Control measures, and monitoring practices that will be adopted during the construction phase of this contract to minimise adverse environmental effects due to land disturbing activities.
2. The ESCP has been compiled using best practice Erosion and Sediment Control guidelines from Greater Wellington Regional Council and will remain a live document to meet the evolving demands of Erosion and Sediment Control during construction. The final version of the CEMP and this ESCP will be developed by the appointed Contractor, prior to construction.

12 References

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Environment Waikato. (2006). *Best Practice Guidelines for Waterway Crossings.* Hamilton: Environment Waikato.

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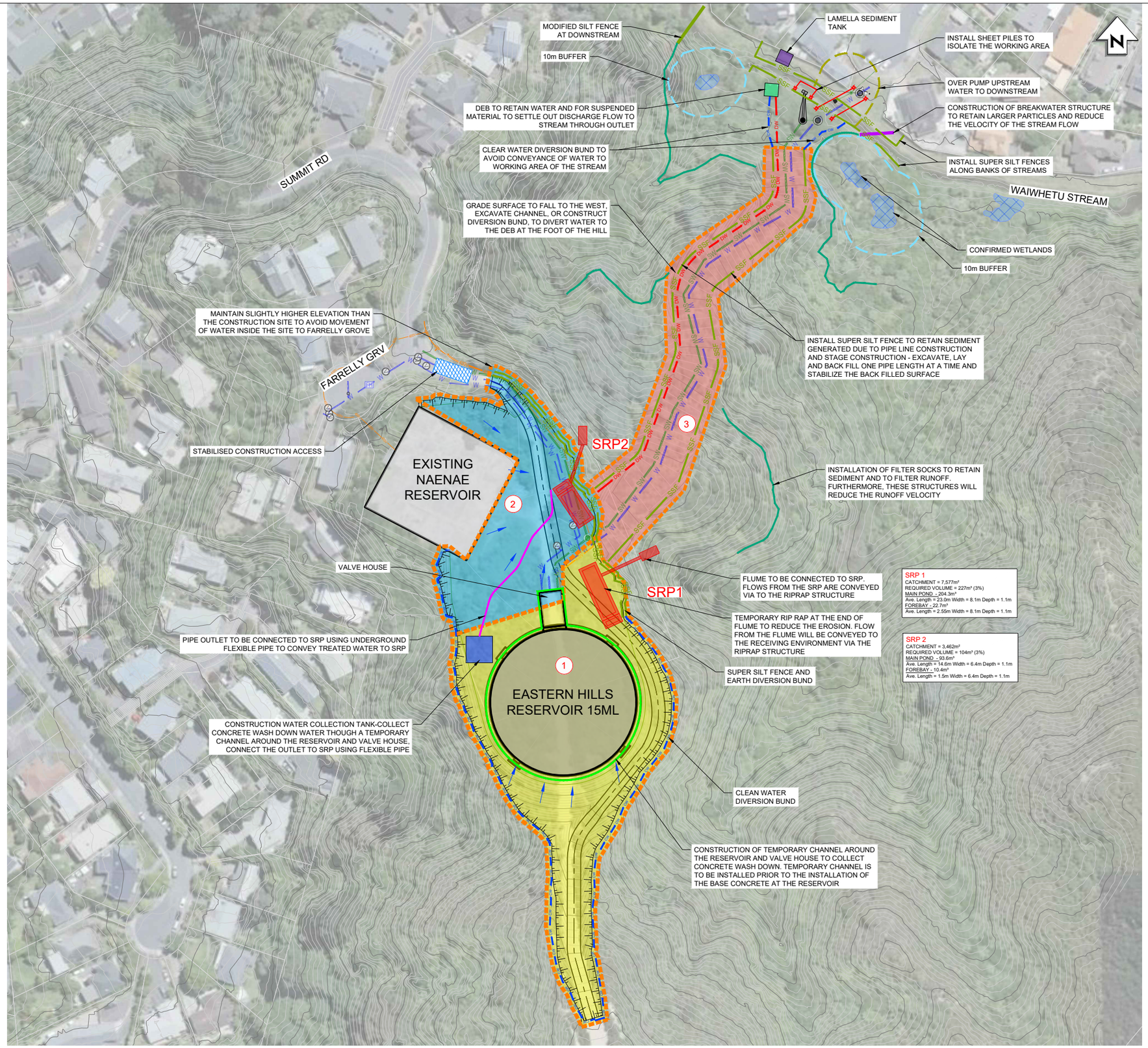
WRC. (2014). *Erosion and Sediment Control Guidelines for Soil Disturbing Activities (TR 2009/02) - Updated in 2014.* Waikato Regional Council (WRC).

WWL. (2023, June). *Waiwhetu catchment sampling*. Retrieved from Wellington Water Ltd (WWL): https://www.wellingtonwater.co.nz/resources/topic/wastewater/monitoring-and-testing/waiwhetu-catchment-sampling/

Appendices

Appendix A – ESCP Drawing



NOTES:

1. HYDROSEED CUT AND FILL SLOPES AFTER COMPLETION OR AS DIRECTED BY ENGINEER.
2. CADASTRAL INFORMATION SOURCED FORM LAND INFORMATION NEW ZEALAND DATA. CROWN COPYRIGHT RESERVED.
3. EROSION AND SEDIMENT CONTROL DEVICES ARE INSTALLED AS PER AND THE GREATER WELLINGTON GUIDELINES.
4. LOCALISED SILT FENCING OR BUNDING MAY BE REQUIRED IN ADDITION TO THAT SHOWN ON THE PLAN, AND WILL BE CONFIRMED ON-SITE WITH ENGINEER.
5. INSPECTIONS OF ALL ESC ARE TO BE MADE DAILY AND RECORDED.
6. DUE TO CHANGES OVER THE CONSTRUCTION, THIS PLAN SHOULD BE REVIEWED BY THE CONTRACTOR REGULARLY AND WHERE REQUIRED IMPROVEMENTS MADE.
7. IF REQUIRED A STABILISED CONSTRUCTION ENTRANCE TO BE INSTALLED BY THE CONTRACTOR AT THE THEIR DUMP SITE.

LEGEND:

- EARTHWORKS CATCHMENT AREAS
- CLEAN WATER DIVERSION (CW)
- EARTH DIVERSION BUND (DW)
- SUPER SILT FENCE (SSF)
- SEDIMENT RETENTION POND
- OUTLET POINT
- STABILISED ACCESS
- FLOW ARROW
- CATCHMENT AREA 1
- CATCHMENT AREA 2
- CATCHMENT AREA 3
- FILTER SOCKS
- BREAK WATER STRUCTURE
- SHEET PILES
- CONSTRUCTION WATER COLLECTION TANK
- DEB
- TREATED WATER
- MODIFIED SILT FENCE
- WETLAND (CONFIRMED)
- 10m WETLAND BUFFER
- DELIVERY / INLET PIPE (W)
- OVERFLOW / SCOUR DISCHARGE PIPE (SW)
- NEW VALVE (V)
- NEW SW MANHOLE
- NEW ROCK SWALE
- LAMELLA SEDIMENT TANK
- OVER PUMP

A1 REPRODUCTION SCALE: 100, 80, 60, 40, 20, 0mm

A3 REPRODUCTION SCALE: 50, 40, 30, 20, 10, 0mm

0 5 10 15 20 25 30 35
SCALE 1:750 AT ORIGINAL SIZE

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
0	ISSUED FOR REVIEW	G.H.	J.D.	J.L.	08/09/23

Drawing Originator: Connect Water
Connect Water
c/- WSP
PO Box 12-003 Thorndon
Wellington 6144
T 64 4 471 7000

Original Scale (A1) 1:750
Reduced Scale (A3) 1:1500

Design	R.A.	08/09/23	Approved For Construction*
Drawn	G.H.	08/09/23	-
Dsg Verifier	J.D.	08/09/23	
Dwg Check	J.D.	08/09/23	Date-

* Refer to Revision 1 for Original Signature

Client: Wellington Water

Project: WELLINGTON WATER
EASTERN HILLS RESERVOIR

Title: EROSION AND SEDIMENT CONTROL PLAN

Discipline: CIVIL
Drawing No.: 3-WW02102_C014
Rev.: 0

DOCUMENT PATH: \\CORP.ANZ\PROJECTS\NZ\3W3-WW021.02 NAENAE NO.2 RESERVOIR\HOME\700 DRAWINGS
DOCUMENT NO: 3-WW021.02_C014.DWG

DO NOT SCALE - IF IN DOUBT ASK

PLOTTED BY: PIETERSEN, RIAAN

DRAWING PLOTTED: 4-Aug-23