Lake Pūkaki Reservoir Hydro Storage and Dam Resilience Works

DRAFT Erosion and Sediment Control Plan

Meridian Energy Limited

04 November 2025

→ **The Power of Commitment**

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1. Introduction

Meridian Energy Limited (Meridian) have engaged GHD Limited (GHD), to assist with obtaining consents to authorise the operation of Lake Pūkaki below the current normal minimum level of 518.0 m above mean sea level (m RL), for a three-year period, and for civil works at Pūkaki Dam to improve the structures resilience to wave action during lower lake operational levels.

Merdian Energy Limited (Meridian) has engaged GHD to develop a draft Erosion and Sediment Control Plan (ESCP) for the proposed Pūkaki Dam rip-rap upgrade works located at the Southern end of Lake Pūkaki approximately 7.5 km North of Twizel.

1.1 Project Background

1.1.1 Waitaki Power Scheme

The Waitaki Power Scheme (WPS) is a nationally and regionally significant component of New Zealand's electricity supply infrastructure. It is New Zealand's largest and most flexible hydroelectricity power scheme and therefore has a critical role to play in the electricity system and economy. It consists of eight power stations (two owned by Genesis Energy and six owned by Meridian Energy), commissioned between 1935 and 1985, together having an installed capacity of 1,761 MW, being ~32% of New Zealand's installed hydro capacity.

Lake Pūkaki is a modified natural lake and is managed as part of the WPS. It is New Zealand's largest hydro storage lake and provides an average of 1,767 GWh of stored water in normal operating conditions, with an additional 545 GWh available during a national electricity shortage.

Meridian is currently authorised to dam the Pūkaki River to control and operate Lake Pūkaki between the levels of 518.0 m RL (normal consented minimum lake level) and 532.5 m RL (maximum consented storage level).

1.1.2 Previous Plan Changes - Waitaki Catchment Allocation Regional Plan (WAP)

The WAP is a sub regional plan and provides objectives, policies and rules for the use and development of water resources within the Waitaki Catchment. Prior to 2012, it was a prohibited activity in the WAP for Meridian to draw the lake level below 518.0 m RL.

1.1.2.1 Plan Change 1 (PC1)

In 2012, Meridian initiated Plan Change 1 (PC 1) to the WAP which sought to introduce a new minimum lake level for Lake Pūkaki during circumstances when the System Operator (SO) had commenced an Official Conservation Campaign (OCC) in regard to electricity supply. PC1 allowed additional water from Lake Pūkaki to be used for generating electricity as a permitted activity when an OCC is declared by the SO.

When assessing the potential operation of Lake Pūkaki below 518.0 m for PC1, the duration of an entire event (time below 518.0 m RL) was considered likely to be between 4-7 months (this includes the time spent operating below 518.0 m RL while the OCC was in place, as well as the time required to restore the lake level to above 518.0 m RL once an electricity supply emergency ended). Supporting technical effects assessments were submitted as part of this plan change process. It was ultimately concluded that allowing access for electricity generation purposes to water stored between 513.0 and 518.0 m RL, as a permitted activity once an OCC had been declared, was appropriate and promoted the sustainable management purpose of the RMA. PC1 was adopted by Environment Canterbury on 27 September 2012.

The technical studies completed for this project have relied on the PC1 2012 effects assessments as being appropriate and have focused on both the changes that have occurred in the environment since 2012, and the differences between the activities permitted by PC 1 and the proposed activities. This is the 'Baseline' that is referred to throughout this report.

1.1.2.2 Plan Change 3 (PC3)

PC3 included a new rule regarding the use of Lake Pūkaki between 518.0 m RL and 515.0 m RL. In addition to the PC1 Permitted Activity rule, at times of a Security of Supply Alert (SSA) initiated by the SO, the lake may be operated between the alert minimum control level of 515.0 m RL and 518.0 m RL. The rule is not a permitted activity and to implement this, Meridian applied for and was a granted resource consent in 2018 (CRC185833). This consent expired on 30 April 2025 but has been granted a section 124 continuance while the new replacement consent (CRC240441) is being processed.

1.1.3 Meridan's Application

Meridian is seeking approvals under the Fast Track Approvals Act (FTAA) to enable access to water stored in Lake Pūkaki below 518.0 m RL, without the currently applicable security of supply triggers, thereby enabling the better planning and utilisation of the available stored generating capacity. Further information on the background to the proposal and the benefits of allowing access to additional water is provided in the Substantive Application[1] document that supports the FTAA application.

Meridian is proposing to access the additional storage for a time-bound period of three years, until the end of 2028. For the purpose of this report 'Eased Access', refers to the ability to use water from Lake Pūkaki between 513.0 m RL and 518.0 m RL without a SSA or OCC being initiated by the SO. The ability to access stored water below 518.0 m RL will be incorporated into Meridian's electricity generation models and water stored in Lake Pukaki (both above and below 518.0 m RL) will continue to be managed to supply the market. The three-year period is to allow for additional generation capacity that is currently being built, to come online. For further clarification, the existing lake operation framework and proposed activity is detailed below in Table 1.

Existing Framework	Proposed Activity
Operation of Lake above 518.0 m RL (CRC905321.7).	Operation of Lake above 518.0 m RL (CRC905321.7). UNCHANGED.
Operation of Lake between 518.0 m RL and 515.0 m RL as a discretionary activity at times of a Security of Supply Alert initiated by the System Operator (CRC185833).	Operation of Lake between 518.0 m RL and 513 .0m RL for a period of 3 years without a Security of Supply Alert or Official Conservation Campaign being initiated by the System Operator.
Operation of Lake between 518.0 m RL and 513.0 m RL as permitted activity during an Official Conservation Campaign initiated by the System Operator (Permitted Activity).	

Table 1 Proposed Activity – Eased Access

In addition to the temporary ability to lower the lake level, Meridian seeks consent for the installation of rip-rap on the face of the Pūkaki dam and its left and right abutments to provide protection from wave erosion, when operating the lake below 518.0 m RL. Rip-rap will be placed to a maximum depth of 510.5 m RL, with earthworks/site preparation activities extending to a maximum depth of 509.6 m RL. Rock armouring will take a total of 12-18 weeks to complete but is expected to be done over multiple stages over several years and works may be required to be completed beyond 2028.

Meridian has stockpiled rock for this purpose on its land adjacent to the Pūkaki dam since 2014, but the rock armouring has not been undertaken due to the existing supply triggers never being initiated by the SO, with the result that the lake level has not been low enough over that period to allow the works to be completed.

[1] FOOTNOTE OF SA HERE

1.2 Purpose of this ESCP

This ESCP has been developed to support the FTAA application for the excavation and placing of the rock armouring above and below the water line of Lake Pūkaki and the stormwater runoff diversions and discharges related to the proposed construction and operation activities at the site.

The plan is developed in general accordance with the Environment Canterbury erosion & sediment control toolbox for soil disturbing activities. It outlines measures to minimise sediment discharges to water during construction.

This ESCP is draft and has been developed to support the rip-rap design and construction methodology set out in Lake Pūkaki Dam Resilience Works Report GHD 2025A. The ESCP has been prepared by a suitably qualified GHD professional (see Section 1.3) and reviewed by Rooney Earthmoving Ltd – a construction company that has undertaken similar work to the rip-rap upgrade activities required for this project. Prior to the commencement of earthworks, the ESCP will be finalised to align with the final design of the works, planned construction methodology, and any resource consent conditions, and provided to Environment Canterbury.

1.3 Report Author and Contributions

The qualifications and experience of the report authors are set out in Appendix A. The author confirms that they have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023) and agree to comply with it. In that regard the lead author confirms that this ESCP is written within their expertise, except were stated that the author is relying on the assessment of another person. The author confirms that they have not omitted to consider material facts known to them that might alter or detract from the opinions expressed.

1.4 Limitations

This report has been prepared by GHD Limited on the instructions of Meridian Energy, in accordance with the agreed scope of work. It is intended to support Meridian's application under the Fast-track Approvals Act 2024 and may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application.

While GHD Limited has exercised due care in preparing this report, it does not accept liability for any use of the report beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

2. Basis of Plan

2.1 Legislation, Guidelines and Standards

This ESCP is prepared with consideration given to:

– Erosion & Sediment Control Toolbox for Canterbury

2.2 Resource Consent Conditions and other Site Specific Rules

To be populated prior to finalising-likely include as Appendix.

2.3 Assumptions

As discussed in Section 1.2, this ESCP is expected to be adopted for the construction work. Prior to the commencement of earthworks, the ESCP will be finalised to align with the final design of the works, planned construction methodology, and any resource consent conditions, and provided to Environment Canterbury.

This ESCP has been prepared using the following assumptions:

– No significant amounts of groundwater will be encountered during excavation work.
– No specific measures have been adopted in respect of potential contaminated land. A Preliminary Site Investigation (PSI) has been completed for the site (see Appendix B) and has not identified any issues of concern for the proposed construction site. In the unlikely event that contamination is encountered an Unexpected Discovery Protocol has been included in this ESCP (Section 8).

3. Site Description

3.1 Site description

The site covers the Lake Pūkaki Main Dam area as shown in Figure 1, including:

– The upstream face of the Main Dam,
– The left and right abutments, and
– Existing rip-rap stockpiles east of the spillway and south of the Main Dam.

The surrounding hydrologic features of the site are:

– Lake Pūkaki (works will occur within the lake margin), and
– Pūkaki River which runs from Lake Pūkaki south approximately 100 m from the stored rock armouring area. In normal conditions, this river does not have any flow due to the Pūkaki Dam and diversion of all flows through the Pūkaki Canal. However, the river does flow periodically through the Pūkaki Dam spillway/Gate 19 and any sediment discharged to the riverbed will eventually be picked up by the river when flow occurs.
– The Pūkaki Canal which is located to the west of the Main Dam. Water discharges intermittently from the lake to the canal via the Gate 18 structure.

3.2 Existing Site.

The existing features on the sites include:

Main Dam and Abutments

– Constructed dam faces with placed rip-rap material over bedding and low permeability materials,
– Exposed rock and gravels and placed rip-rap material on the abutment faces,

Stockpile areas

– Exposed rip-rap stockpiles
– Gravel access road,
– Naturally established grass and some bushes with substantial exposed areas due to ongoing vehicle tracking.

Figure 1 - Locations of rock armouring stockpiles, abutments and high dam.

3.3 Receiving Environment

The proposed site works are described in GHD 2025A. The report includes a description of the proposed methodology for placement of additional rip-rap. The methodology has been used in the development of this ESCP.

From an erosion and sediment control perspective, the receiving environment includes:

- Lake Pūkaki via runoff from abutments and Main Dam faces, and sediment generated while working below the waterline within the lake margin,
- The Pūkaki Canal via sediment plumes generated within the lake, and
- The Pūkaki Riverbed via overland flow from the two rip-rap stockpile areas. This riverbed has some residual pools, however, is typically dry outside time of high-level lake overflow or intentional release. However, any sediment discharged to the riverbed will eventually be entrained by the flow when releases occur.

Construction activities in and around Lake Pūkaki pose potential risks to both the lake and the Pūkaki River. The works will be carried out near and below the lake's waterline, while the rock armouring stockpile area drains directly toward the Pūkaki River. If runoff from either the stockpile area or contracting works carries elevated levels of sediment or construction-related contaminants, it may adversely affect water quality. Additionally, in-lake operations are expected to disturb sediment associated with the constructed dam and abutment rip-rap armouring as well as any sediment that that has accumulated along the dam margin, further contributing sediment accumulation in Lake Pūkaki.

The ESCP purpose is to mitigate effects on the receiving environment to the extent practicable by collection and detention of runoff from the site.

It is noted that the environment at the site is generally beneficial with respect to potential generation of sediment due to:

- Low rainfall climate
- Typically, free draining gravel dominated substrate.

4. Construction and Programme of Works

4.1 Project Schedule

These works are proposed to occur during periods when the lake level is at a sufficiently low level to access the works area. Once a defined start date for the works is determined, the site will be established as the lake level lowers towards 518.0 m RL. As the lake levels are influenced by weather, energy demand and operational controls, an exact construction period cannot be determined, however, based on modelling (Meridian 2025), it is expected to generally occur within the months of August to November, however when lake levels are suitable for construction outside this period, the works may be progressed. When suitable lake level conditions are met, the works will be undertaken. The proposed construction methodology, as described in GHD 2025A, involves placing rip-rap in two sequential tranches, defined by elevation ranges:

– **Main Dam: Tranche 1:** Rip Rap Placement from 517.3 m RL to 514.5 m RL.
– **Abutments: Tranche 1**: Rip Rap Placement from 517 m RL to 513.0 m RL. Note: GHD 2025A includes as-built drawings for the right abutment that indicate existing rip-rap may extend down to 512.5 m RL. However, past dive surveys have only confirmed that rip rap extends to at least 517.0 m RL. The presence or absence of rip-rap below this level will be confirmed by further diver surveys. For this ESCP and GHD 2025A it has been assumed that rip-rap will need to be placed below 517.0 m RL for both abutments.
– **Main Dam: Tranche 2**: Rip-Rap Placement from 514.5 m RL to 510.5 m RL.
– **Abutments: Tranche 2:** Rip Rap Placement from 513.0 m RL to 510.5 m RL.

The trigger levels for commencing works are based on an excavator being able to work in up to 600 mm water depth while sitting on the 517.3 m RL bench. This allows for working within the lake when water levels are at or below 517.9 m RL.

Rip-rap placement for Tranche 2 will only commence once Tranche 1 is fully completed. For each tranche, work will occur concurrently across all three work zones (Main Dam and left and right abutments).

These works will include:

– Site establishment, fencing, offices and equipment to site
– Establish erosion and sediment control measures
– Constructing access tracks and ramps.
– Transporting rock armour from the current location to a designated stockpile area.
– Constructing work benches.
– Constructing toe/key along the Dam.
– Rock placement on the Dam and abutments.
– Temporary building.
– Decommission of site.

If the rip-rap placement programme is completed in a single stage, the estimated duration is approximately 12 to 18 weeks. However, it is unlikely that the lake level will be maintained below 518.0 m RL for an extended period allowing all works to be completed in a single continuous effort. Construction is likely to be undertaken in shorter periods over multiple years.

Construction activities will be restricted to the following schedule:

– Daily: 6:00 a.m to 7:30 p.m.

- No work during the following periods:
  - Good Friday to Easter Monday (inclusive)
  - 24, 25, 26 and 31 December and 1 January
  - New Zealand Public Holidays

4.2 Earthworks Volumes and Areas

Rock material has been previously stockpiled with approximately 23,000 tonnes of rock available at the two stockpile sites identified in Figure 1. This is sufficient to complete the proposed works across all three work zones down to 514.0 m RL. An additional 50,000 tonnes of rock will be required to support lake operation to 513.0 m RL, which includes rip-rap placement to 510.5 m RL, plus rip-rap bedding (as required).

In addition, there will be re-handled Zone 6 and Zone 10 materials at the dam and abutments.

The total area of the construction works including rehandled and existing stockpile areas, access tracks and rock placement areas is approximately 15 ha.

4.3 Construction Staging and Methodologies

A staging summary is provided in Table 2 and this should be read in conjunction with Section 9 GHD (2025A).

Table 2 Sequence Plance, Summary from GHD 2025

Tranche	Location	Tasks
1	Main Dam (see Figure 2 and 6)	– Establish Excavator – Construct High Dam access track to 517.3 m RL Bench – Construct Right Abutment access track to 517.3 m RL – Strip and stockpile Zone 10 material (as per Section 5.6) with 45 tonne excavator. – Establish a key toe at 514.5 m RL – Rip-rap placement will proceed in 40 m wide sections at a rate of approximately 1 section per week. –
1	Left and right abutments (see Figure 3 and 7)	– 45t Excavator strip existing rip rap to form 517.3 m RL bench and reuse material to extend bench with 45 tonne excavator. – Form groynes at 15 m intervals perpendicular to abutment face. – Place imported material on bench for running coarse. – Excavate 513.0 m RL toe key. – Place rip-rap material from toe key up the abutment, deconstructing groynes as work progresses. –
2	Main Dam (see Figure 4 and 8)	– Extend access ramp to 512.4 m RL and create a 7.3 m wide bench. – Excavate zone 6 material for reuse. – Excavate zone 8 material for off-site disposal. – Place 0.9 m of rip-rap bedding on bench for form bench at 513.3 m RL. – Excavate toe key to 509.6 m RL. – Place rip-rap from toe key (510.5 m RL) to 514.5 m RL with excavator. –
2	Left and right abutments (see Figure 5 and 9)	– Establish new construction bench at 513.4 mRL using 45 tonne or similar excavator. – Form groynes at 15 m intervals perpendicular to abutment face. – Place imported material on bench for running coarse. – Place 1.5 m rip-rap from 510.5 mRL, moving upslope and deconstructing groynes as works progresses. –

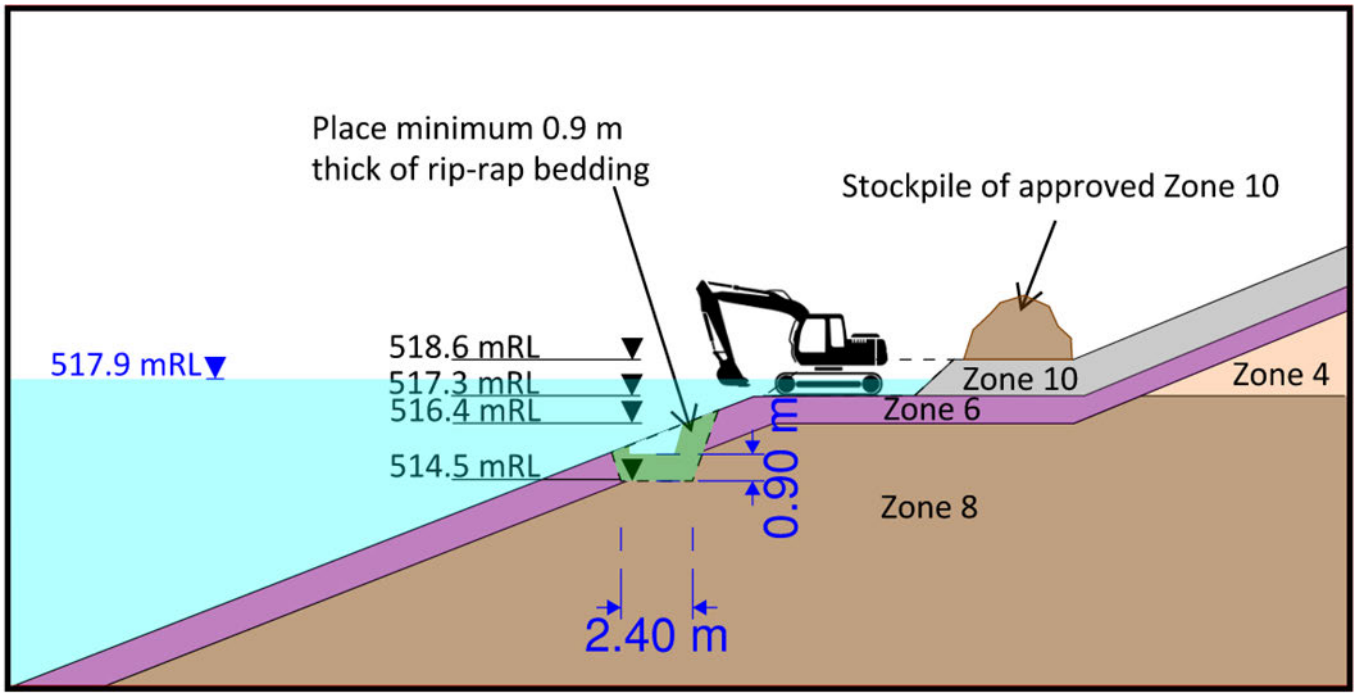


Figure 2- *Schematic sketch – Tranche 1 – Main Dam – construction of key toe at 514.5 m RL and installation of rip-rap bedding*

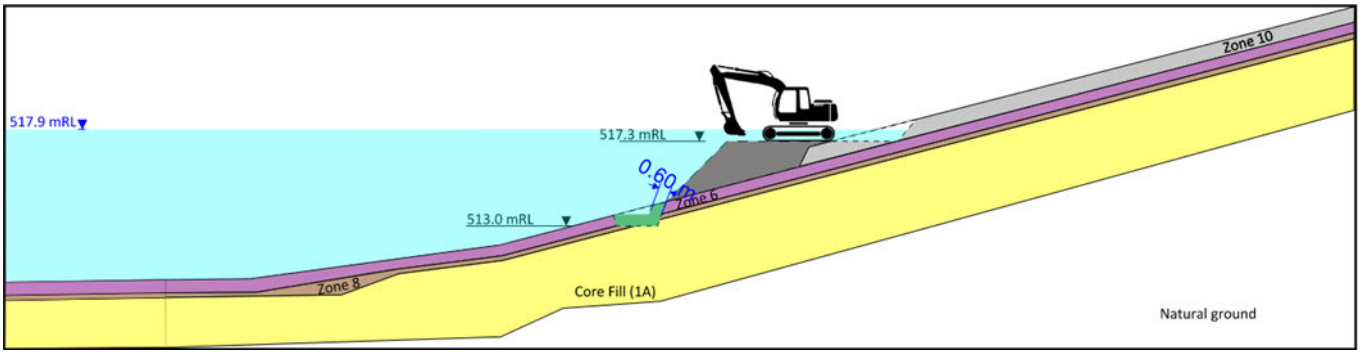


Figure 3 - *Schematic sketch – Tranche 1 – abutments - construction of key toe at 513.0 m RL and installation of rip-rap bedding*

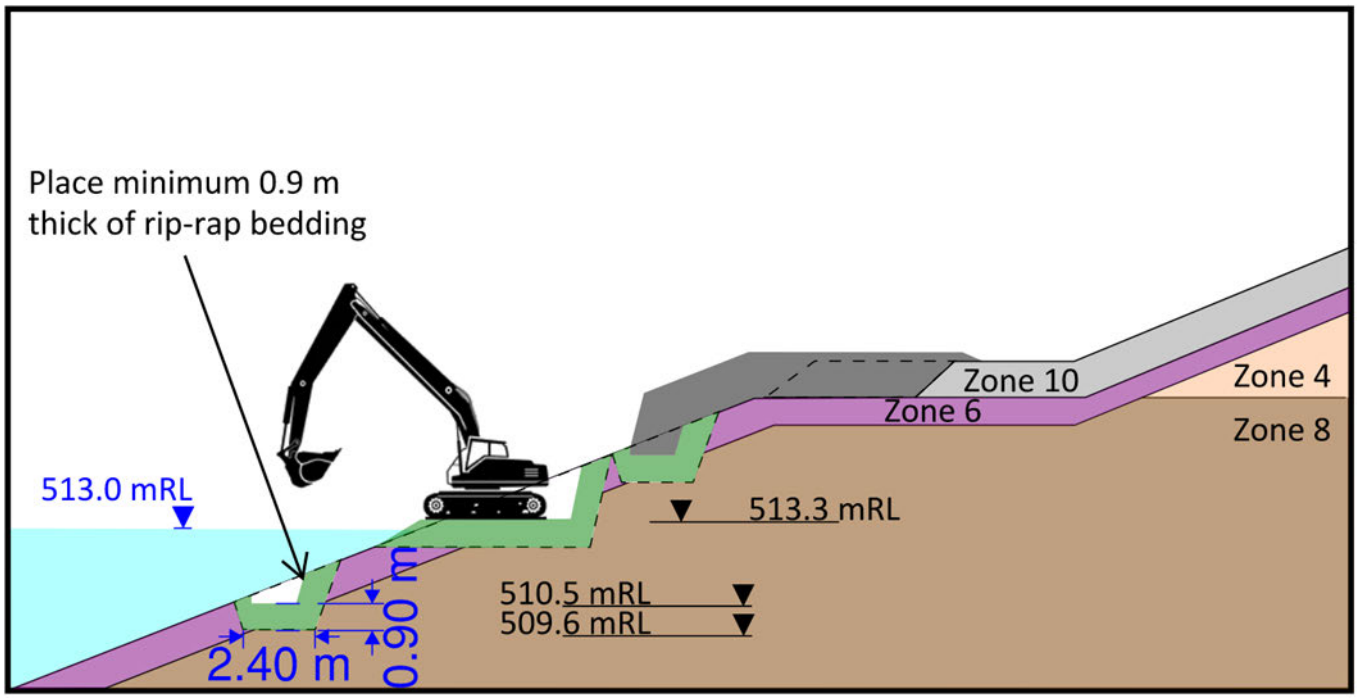


Figure 4 - Schematic sketch – Tranche 2 – Main Dam – construction of key toe and installation of rip-rap bedding

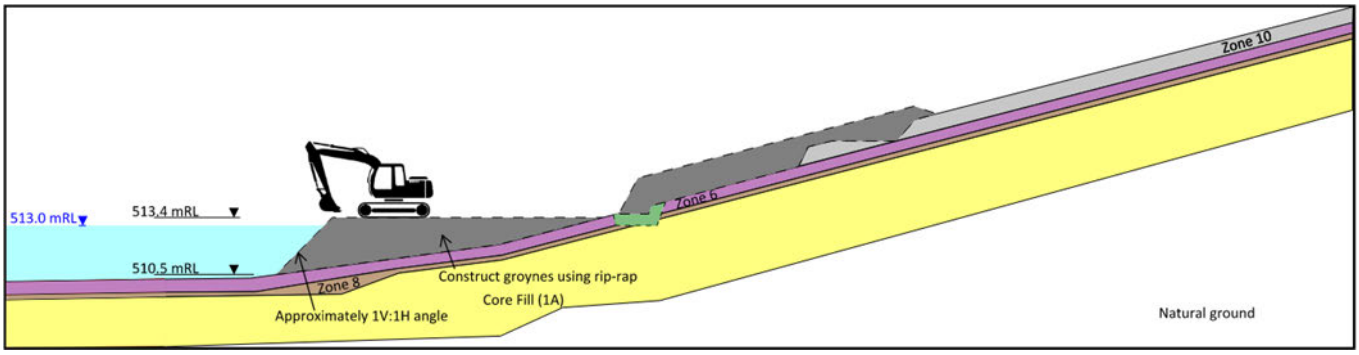


Figure 5 - Schematic sketch – Tranche 2 – abutments – construction of groynes

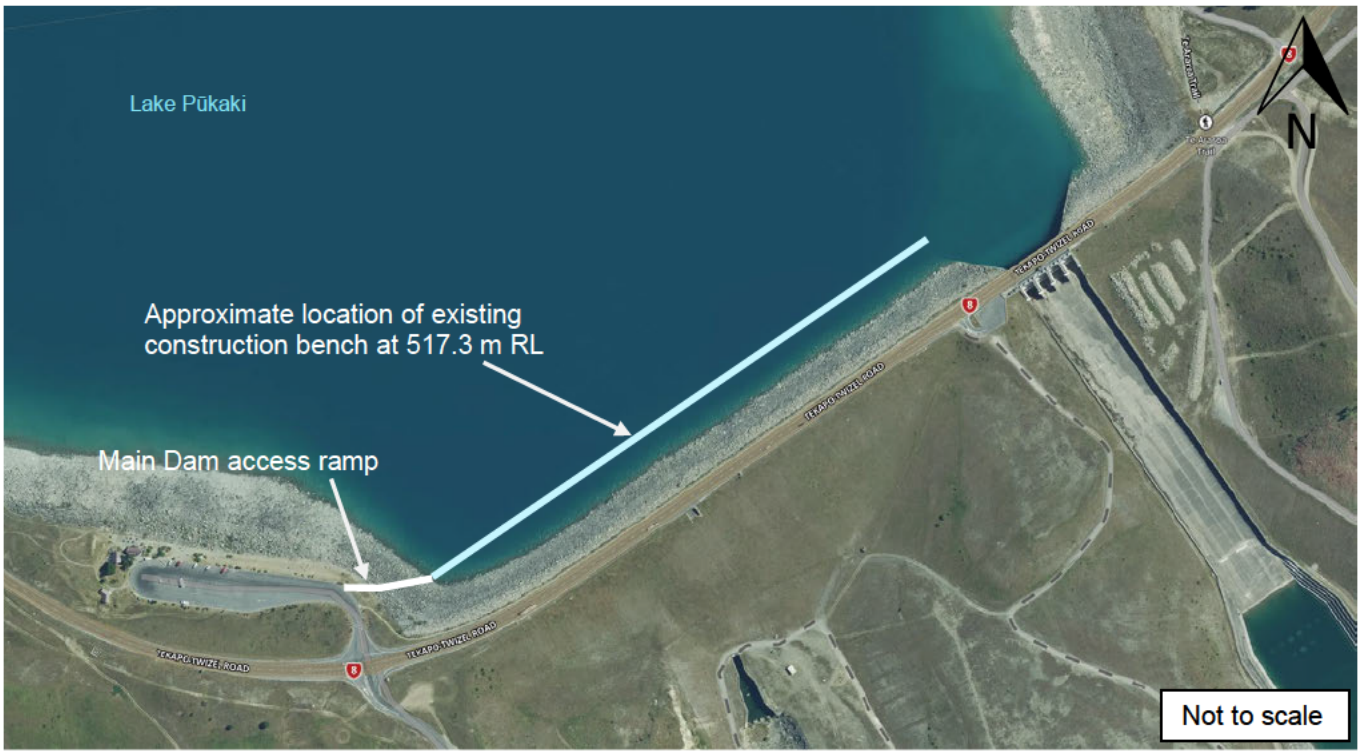


Figure 6 - Site plan (Main Dam) – Tranche 1 - indicative 517.3 m RL construction bench

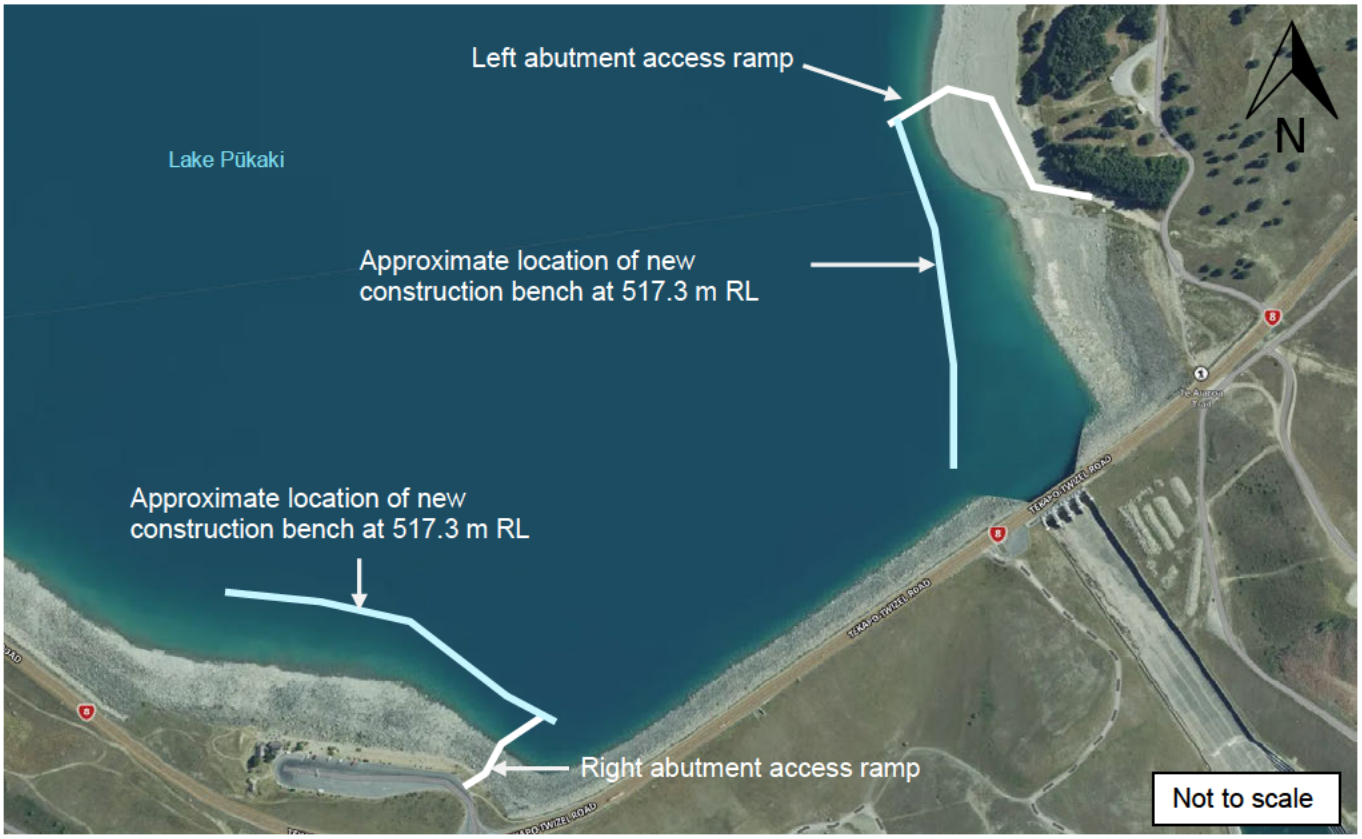


Figure 7 - Site plan (abutments) – Tranche 1 - and indicative 517.3 m RL construction bench

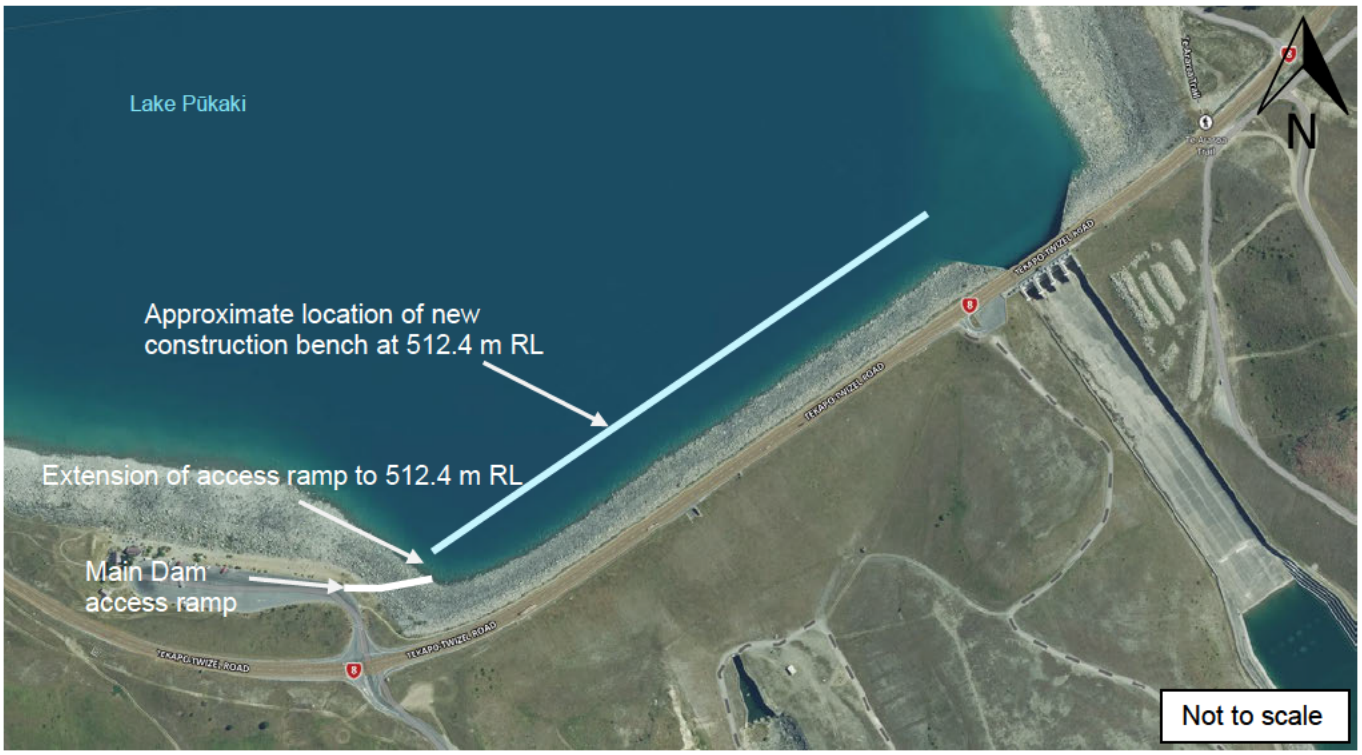


Figure 8 - Site plan (Main Dam) – Tranche 2 - indicative 512.4 m RL construction bench

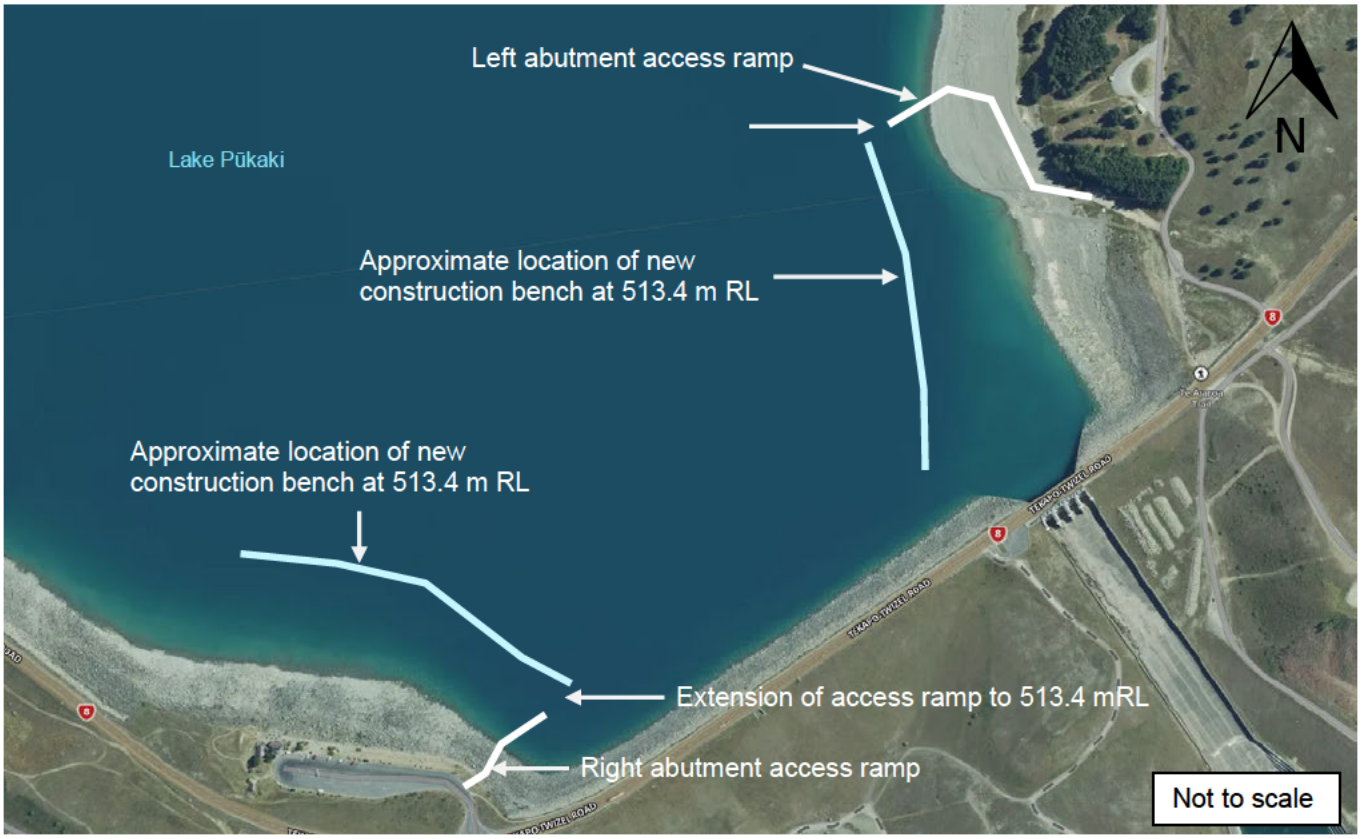


Figure 9 Site plan (abutments) – Tranche 2 - indicative 513.4 m RL construction bench

4.4 Key Equipment

A summary list of the likely large plant to be used on site is provided in Table 3 (GHD, 2025A). This does not include the site offices, traffic management units and small plant including excavators, water trucks, sweeps, etc.

Table 3 Key equipment

Resource	Count	Tasks
20t Excavator	2	Sorting and loading rock from stockpile area
45t Excavator	1	Enabling and construction work on High Dam and Right Abutment
Mercedes AXOR Heavy Duty Road Trucks	3	Carting gravels and Rock to/from High Dam and Right Abutment
AXOR 45t Excavator	1	Enabling and construction work on Left Abutment
AXOR Heavy Duty Road Trucks	3	Carting gravels and Rock to/from Left Abutment

4.5 Reinstatement

Reinstatement of the works sites will include the following activities:

End of each work period

- Removal of any temporary stockpiles created during works and replacement of stockpile rock material from commercial quarries, as required.
- Re-grassing of any rip-rap stockpile areas to match surrounding existing land. This is to be progressively undertaken as works progresses and bare ground areas exposed to minimise the duration that areas are left as bare ground.
- Temporary protection of created access ramps with zone 10 materials (rip-rap) out of the construction season to minimise erosion.

Once All Works Complete

- Removal of access ramps and permanent reinstatement with zone 10 materials (rip-rap).
- Complete re-grassing of stockpile areas and associated tracks
- Removal and reinstatement of all ESC features including silt fences and silt ponds once re-grassing has been completed.

Note stockpiles may be retained beyond the end of the works associated with this project to provide a source of material for other ongoing maintenance projects associated with the wider Lake Pūkaki engineering structures.

5. Proposed Erosion and Sediment Controls

The proposed erosion and sediment control measures are outlined on the site plan in Figure 10. These features are discussed in detail below.

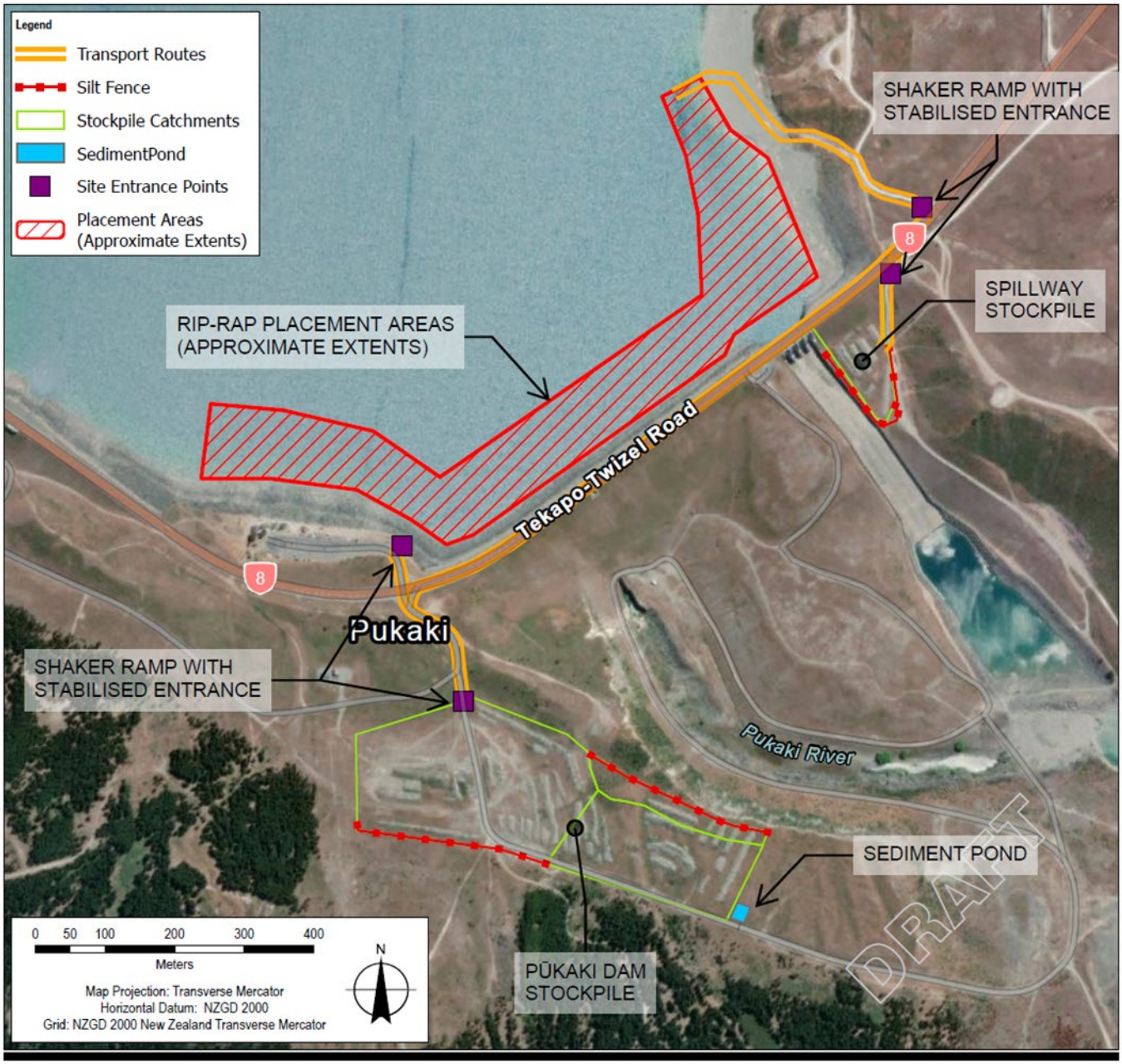


Figure 10 - Erosion and sediment control layout plan

5.1 Key sediment discharge minimisation principles

Construction timing is an important sediment discharge control for this project and the first focus for minimising disturbance from the works.

– Where possible, all works will be completed with excavators located in dry conditions and above lake water levels. Nonetheless, works will require excavator to be removing and replacing rock from below water level.

– However, given the duration required for construction and modelled lake levels, it is unlikely that there will be sufficient time to undertake all the works with lake levels below 517.3 m RL (i.e. the level of the existing construction bench) and almost certainly not for Tranche 2 works. To provide as much opportunity as

possible to complete works, it is expected that the excavator will need to sit within water for at least part of the works (to a depth of 0.6 m). Hence works will be scheduled to occur where lake levels are below 517.9 mRL and control measures for this activity is outlined in Section 5.5. The levels for commencing works are based on an excavator being able to work within 600 mm water depth while sitting on the 517.3 mRL bench for Tranche 1 and 513.4m RL for Tranche 2.

The following key principles are applied in this ESCP and are to be implemented during construction.

– Wherever possible, works will be kept to the minimum required to meet the needs of the project while also minimising soil disturbance and reducing reinstatement requirements.
– Construction works under the water line of Lake Pūkaki will be kept to a minimum.
– Where runoff flows from the rock stockpiles in sheet flows off the site, silt fences or shallow cut off drain will be used to minimise sediment runoff. Additionally, long overland flow paths with vegetation cover will offer fine sediment capture before reaching waterways. As noted in Section 3, significant runoff is only likely to occur during significant or very significant rain events.
– For areas of concentrated runoff, a sediment retention pond or soakaway pit will be constructed to treat runoff prior to discharge.
– If required, wheel wash stations and/or shaker ramps will be implemented for trucks leaving site. However, the ground conditions at the site are generally either established gravel tracks or gravel substrate and excessive mud generation is not expected.
– Regular (multiple times a day, as required) sweeping of the State Highway to remove any tracked material.
– Monitoring of the sediment plume development within Lake Pūkaki will be implemented and if required sediment curtains installed to reduce sediment migration from the works area.

5.2 Specific Control Measures for the Rock Armouring Stockpile Areas

Spillway Stockpile (see Figure 10)

The total area of the spillway stock approximately 0.8 ha. The stockpile is located downstream of the dam and is underlain by natural ground. This area has partial grass cover around the rip-rap stockpiles. The options for control of runoff are:

– Install silt fences along all down slope aspects of the site as shown in Figure 10 or shallow cut off drains at the same location,
– Install silt fences or cut off drains below removed stockpiles to further breakup the catchment into areas not greater than 0.3 ha,
– Reinstatement of the surfaces immediately after stockpiles have been completely removed – complete in stages as areas become available between periods of construction.

Pūkaki Dam Stockpile (see Figure 13)

The rock armouring stockpile area has been split into three catchment areas which drain in different directions. All sediment control measures will be constructed in accordance with **Environment Canterbury's Erosion and Sediment Control Toolbox**. The control measures for each catchment are shown in Figure 10 and are outlined as follows.

Catchment 1 drains to the south in sheet flow. The runoff from this catchment travels for approximately 1.5 km through vegetation prior to discharging to the Pūkaki River. This long flow path will allow finer sediment captured in addition to any interception measures described below.

Two options will be considered for control of runoff and sediment:

Option 1 - A Super Silt fence along the southern catchment boundary will be constructed to keep sediment in the rock armouring stockpile area. The catchment boundary has a less than 10% grade and is 280 m long therefore the spacing of returns should be 60 m. A schematic of the super silt fence is shown in Figure 11. However, ground conditions may make construction of the fence problematic with the presence of stones and boulders making the driving of stakes difficult.

Option 2 – Given the typically low rainfall conditions in the area and free draining nature of the ground a shallow cut off drain along the alignment of the silt fence shown on Figure 13 may be sufficient to intercept runoff and associated silt.

Catchment 2 drains Northeast towards the Pūkaki River. This catchment is a smaller area, and the runoff is sheet flow. As with Catchment 1, a Super Silt fence or shallow cut off drain along the northeast boundary of the catchment will provide sufficient capture of sediment. The boundary to the catchment is 280 m long and sits at the top of a steep slope. The super silt fence or drain will be located at the top of the bank where the slope is less than 10%.

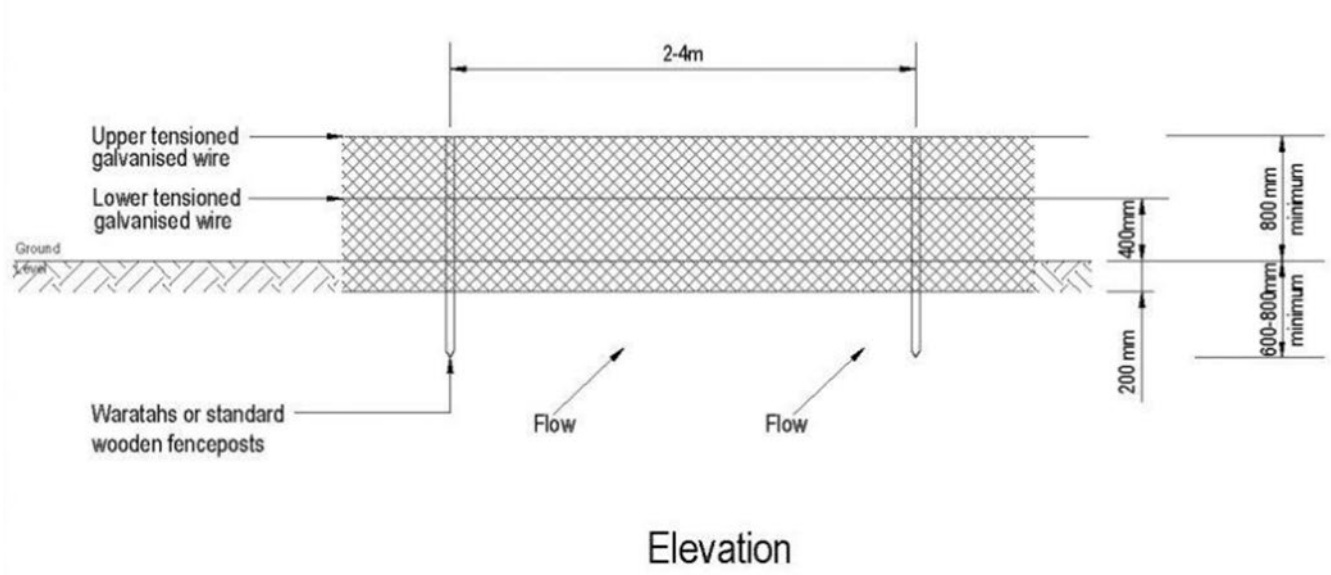


Figure 11 - Elevation view for a super silt fence provided by the ECAN Erosion and Sediment Control Toolbox

Catchment 3 drains to the South into a roadside channel. This channelised flow then flows to the Pūkaki River. At this stage of ESCP development is has been conservatively assumed that flow will be intercepted and sent to a sediment retention pond (SRP – see Figure 12) sized to store 3% of the catchment area at 900 m^3. Runoff will then be discharge through a culvert beneath the access road to stabilised ground. The discharge will flow over vegetated land from the Southern side of the access road for 1.5 km prior to meeting the Pūkaki River. During final development of the ESCP it may be deemed acceptable to utilise a soakage pit given the relatively free draining nature of the underlying ground.

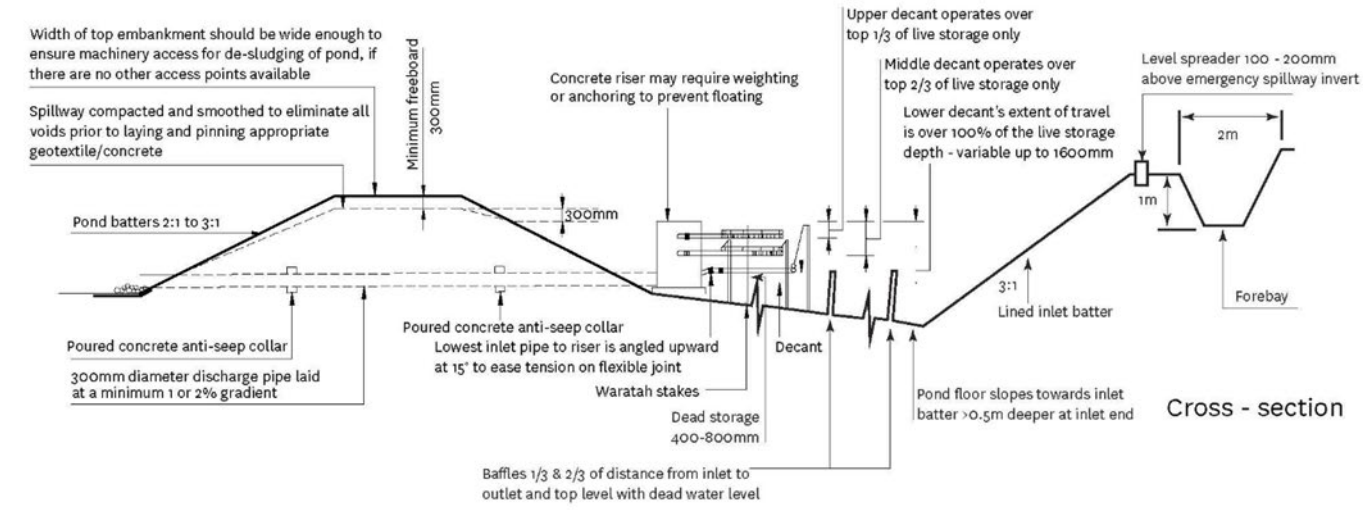


Figure 12 - Cross-section of an SRP needed for a 3-5 Ha catchment provided by the ECAN Erosion and Sediment Control Toolbox

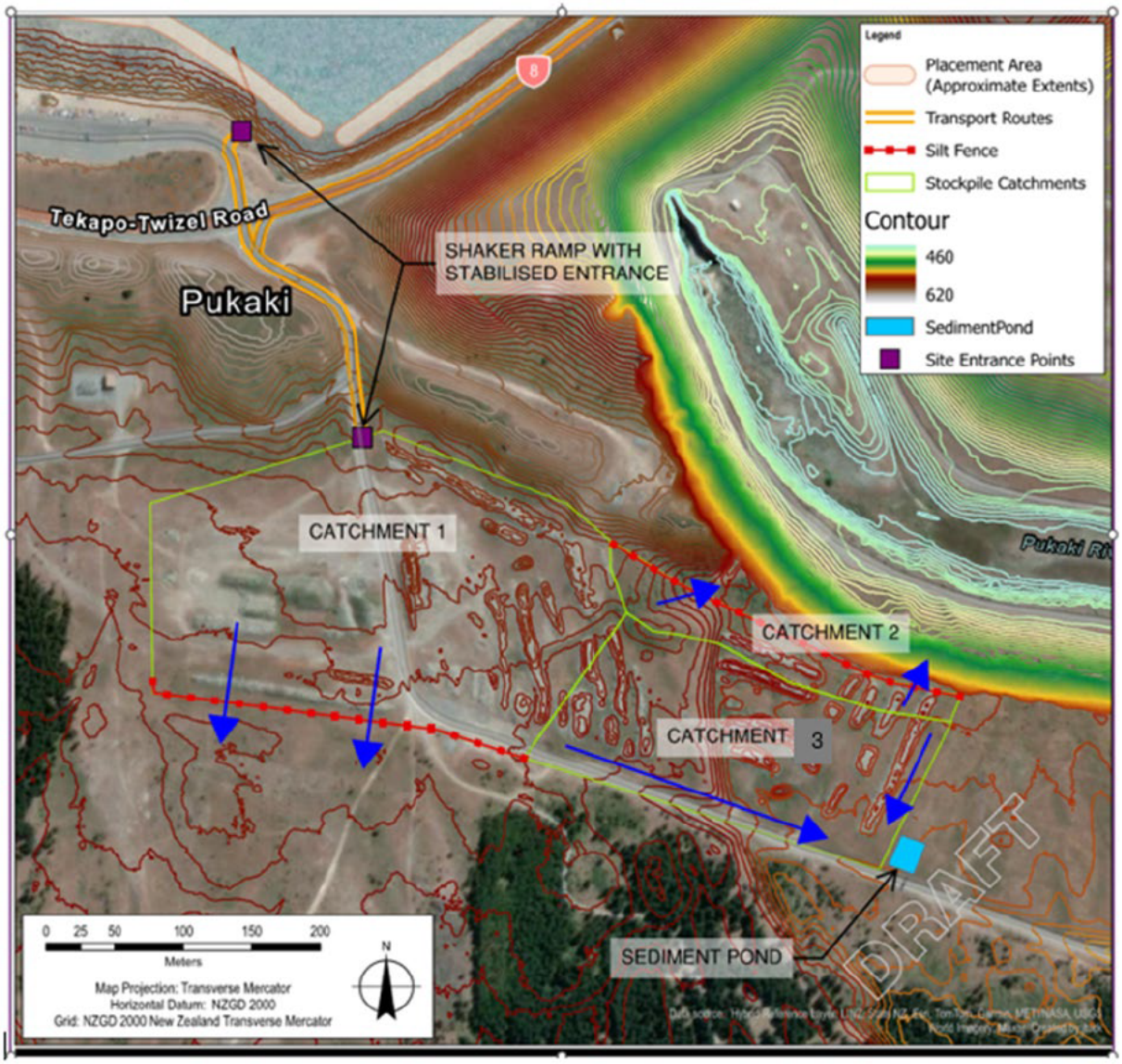


Figure 13 - Pūkaki Dam stockpile area catchment and sediment and erosion control measures.

Table 4 Catchment areas

Catchment	Area (Ha)
1	5.93
2	0.77
3	3.02

Note that the extent of catchments has been determined from Lidar information and site truthing, especially in relation to deviations along the access tracks may be required. This likely results in a larger catchment area reporting to the proposed sediment pond.

5.3 ESC measures for works near Lake Pūkaki

It is expected that the wave height in the works area will increase the size of sediment plumes. The maximum wave height from GHD (2025B) is shown in Figure 14. In events where the wave height is significant sediment is expected to be stirred up regardless of site works in the area. The works will consist of excavating and placing rock armouring above and below the water line of Lake Pūkaki. Mitigation of works below the water level are discussed in Section 5.5. For works above the water level, but near the lake in areas that will eventually be inundated as the lake rises, the following approach will be adopted.

Rock armouring and associated bedding material is generally large rock and expected to have low fines content. However, it is expected that the rock armouring and excavation works along the shoreline will result in sediment that can either be washed into the lake during a rain event or mobilised once the lake level rises and inundates the work area.

To minimise the amount of sediment within the work area, a washdown station for trucks entering the work zone may be required, depending on actual conditions at the site. However, as noted earlier in this report, under most conditions. Excessive fines generation and tracking is not expected. Additional in-lake contingency mitigation measures are discussed in Section 5.7.

Nonetheless, as the lake rises following periods of work being carried out, it is expected that there will be temporarily elevated TSS along the lake edge as recently placed and disturbed materials are inundated. This is considered to be largely unavoidable. The extent, size and duration of sediment plume will be largely dependent on the prevailing wave heights as the lake level rises. The maximum wave height from GHD (2025B) is shown in Figure 14. Calmer conditions are likely to result in a smaller plume but for a longer period. Intermediate wave conditions will generate a larger plume, but it may disperse more rapidly. Very large waves are expected to result in sediment disturbance in general around the lake regardless of site works in the area.

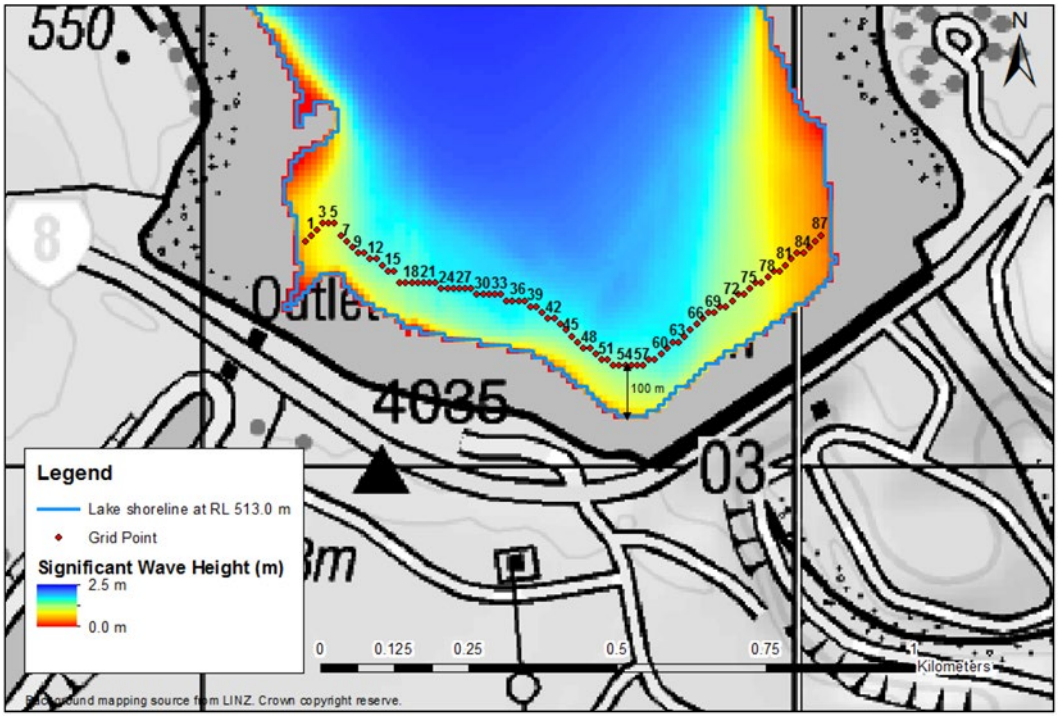


Figure 14 - Wave height at the works area of Lake Pūkaki

5.4 Transport

To transport the rock armouring to the work area, trucks must carry the rock along the routes shown in Figure 10. The publicly accessed/used State Highway and Lake need to be protected from sediment, dirt and rock discharge during transport. Therefore, several sediment control measures are available to manage State Highway crossing, if required. These control measures are shown in Figure 15 and 16 and, if required, are to be constructed in accordance with **Environment Canterbury's Erosion and Sediment Control Toolbox**. Further details for the control measures are detailed as follows:

An area of stabilised aggregate at the entrances will help to minimise sediment built up at the site entry points and tracking of material onto the highway. They are to be a minimum of 4 m wide and 10 m long. Figure 15 shows a schematic of the stabilised entranceway provided by ECAN. However, the existing entrance ways are currently generally underlain by gravel and will be inspected prior to construction commencing and further stabilisation

placed as required to both the lake front and the lay down area to meet the intent of the ECAN entranceway stabilisation.

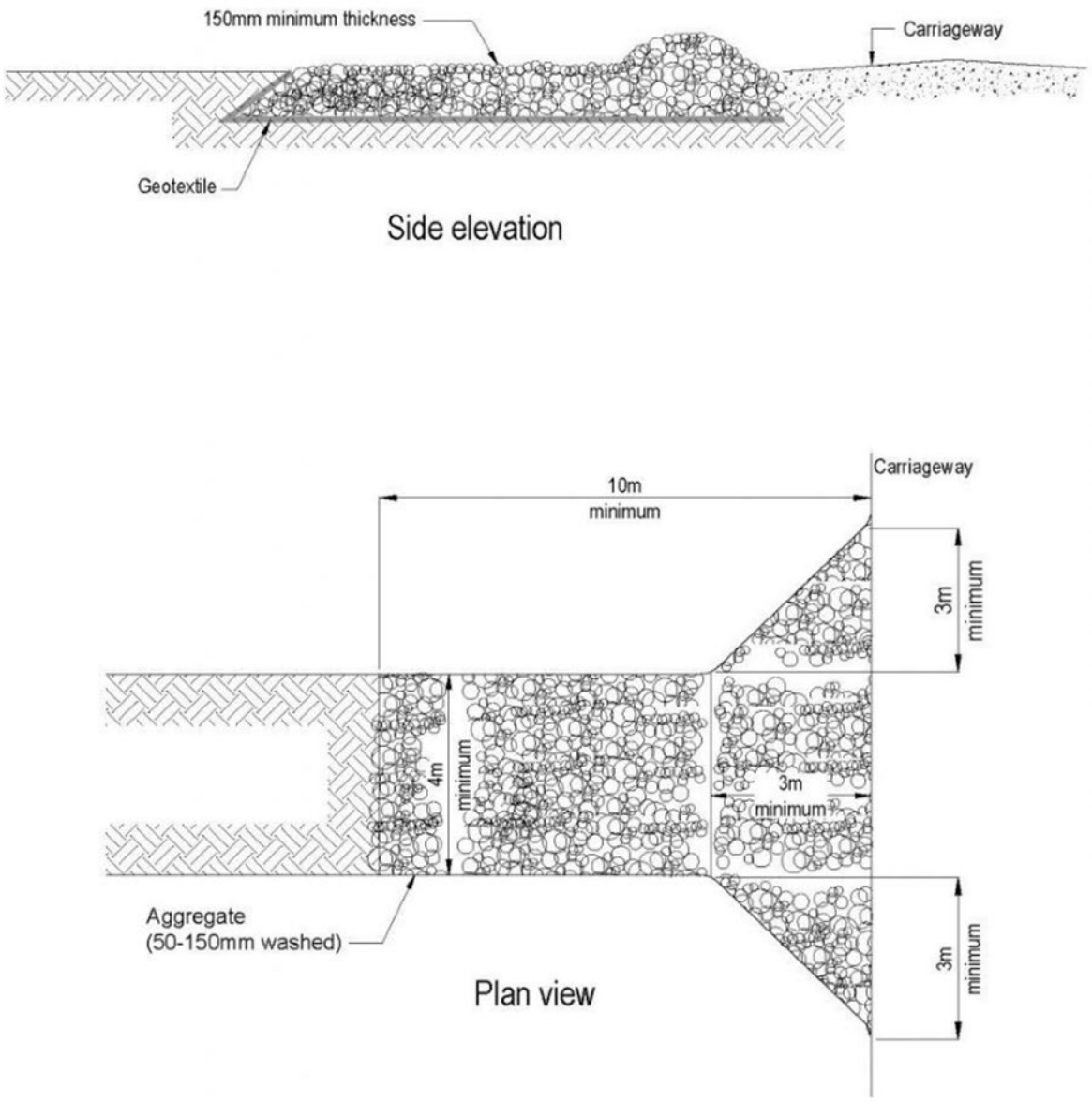


Figure 15 - Stabilised entranceways schematic from ECAN's Erosion and Sediment Control Toolbox

As discussed in Section 5.1, in the event ground and weather conditions result in unacceptable tracking of material from the site options for further mitigation include shaker ramps and wheel washes in addition to the stabilised entrance ways.

The shaker ramps are designed so that they are at least 5 m in length. See example below in Figure 16.

Figure 16 - Example of shaker ramp provided by ECAN in the Erosion and Sediment Control Toolbox.

A provisional wheel wash down station is to be located on site. If used, the water supply for this is to be provided by a water cart on site.

As discussed in Section 5.1, regardless of the measures in place it is expected that there will still be a noticeable amount of material deposited on/along the state highway. To manage this and the risk and nuisance factor to the public regular (multiple times per day) sweeping of the road is to be undertaken. This may need to extend beyond the immediate site where material is being sourced off-site.

5.5 Working within Water

Working within water is unavoidable for this proposed project. Therefore, controls need to be in place to minimise environmental effects from the proposed works.

– Works within water will be minimised, this will be done by constructing working platforms where practical to do so and implementing long reach excavator equipment.
– A single entry and exit point will be used to minimise the area of disturbance.
– All vehicles entering water will be thoroughly cleaned (washdown station) and checked for fuel and oil leaks prior to entry.
– Additional contingency measures are discussed in Section 5.7.

5.6 Temporary Stockpiling

It is anticipated that through construction, temporary stockpiling of excavated/removed materials within the work area along the margins of the lake water line will be required. To minimise the potential sediment discharge from these stockpiles, the following measures will be implemented:

– Where practicable, stockpiles will be placed away from the water line and at an elevation such that they will not be influenced by wave runup that may feasibly occur during the projected duration of the temporary stockpile, with allowance for water level raising during high rainfall events.
– Any stockpiles within the lake margin that may be left in place from one season, will be placed above the highest lake operating level and more that 20 m from the high waterline. They will be stabilised as necessary to protect against dust generation and/or sediment discharge. They will also include toe bunding to capture any sediment running off the stockpiles.

5.7 Contingency Measures

If sediment management near Lake Pūkaki proves inadequate due to excessive and unsightly sediment plumes in the lake or excessive TSS levels within discharge to the Pūkaki Canal via Gate 18, floating sediment curtains may be introduced. These curtains (e.g. Figure 17) are placed around work areas to contain sediment and are moved as construction progresses Based on the proposed 40 m wide construction section, a curtain length of approximately 120 m will be required allowing for a 20 m buffer on the work zone. This curtain would be moved approximately weekly as construction progresses.

Sediment curtains are not proposed as a primary control measure due to increased risks associated with deploying and maintaining them and recognising that the effectiveness is reduced in choppy and windy conditions. It is however proposed that these are available for use prior to works commencing in case deemed necessary.

Sediment curtains would be removed at the end of each phase of construction.

Figure 17- Example of floating sediment curtain (https://cirtexcivil.co.nz/products/silt-control/envirosieve-turbidity-curtain/)

6. Inspection and Monitoring

Daily monitoring of turbidity and suspended solids is required starting one month before construction begins. These tests should be conducted at the canal intake and the overflow spillway. Establishing baseline data at these locations will ensure a clear understanding of existing lake conditions, providing a reliable reference point for comparison during construction activities.

During the construction phase, visual monitoring of discharge water quality is to be undertaken at 3-hour intervals while the site is active, and ponds are discharging. This monitoring shall be by visual water sample comparison with prepared reference samples to confirm adequacy of treatment. The monitoring shall also visually inspect for any hydrocarbons within drains, ponds and discharges.

During the laying of rock armouring in and around Lake Pūkaki, visual monitoring of water quality is to be undertaken at 3-hour intervals while the site is active. This monitoring shall be done by visual water sample comparison with prepared reference samples to confirm the level of care taken in construction is sufficient. The locations of these sample shall be on both sides of the canal intake. The western side of the canal intake should not have any sediment disturbance so would be an ideal reference sample to compare with areas surrounding the construction works. The extent of the sediment plumes should also be assessed to ensure there is minimal disturbance.

Inspections of installed ESC features for the rock armouring area are to be undertaken daily, and maintenance carried out immediately where required.

Table 5 Monitoring and inspection schedule

Item	ESC Feature	Monitoring Schedule	Responsible Person	Notes
1	Turbidity sampling	3 hourly while works undertaken	Site Foreman / Environmental Manager	Sampling locations to be determined by a SQEP with reference samples prepared.
2	Silt fences	Daily, increased frequency during storm events	Site Foreman	Fence layout to be approved by SQEP
3	Shaker ramps and stabilised entrances	Daily	Site Foreman	
4	Highway and public access roads	2 hourly	STMS / all site staff using the route	All staff using the route to lookout for material or any rocks/stones left on roadways.
5	Sediment Pond	2 hourly during rain; daily otherwise	Site Foreman	Siting and construction of pond to be approved by SQEP.
6	Sediment Curtains (if installed)	2 hourly during work hours	Site Foreman / Environmental Manager	Installation extents to be approved by SQEP

7. Contaminant indicators and protocols

7.1 HAIL Study

A Hazardous Activities and Industries List (HAIL) assessment has been completed for the site and is included in Appendix B. The HAIL assessment concluded that while several HAIL activities were identified present within the wider area only one of these, an Underground Storage Tank (UST) has been identified as a potential risk of being a source of soil contamination at the site.

However, due to the nature of the potential contamination and the distance to the proposed works area, it is considered unlikely that contamination in soils is present at the site resulting from potential discharges from the UST which is likely located adjacent to the lookout carpark.

7.2 Unexpected Discovery Protocol for Contaminated Materials

While the HAIL assessment concluded that site contamination is unlikely, the following protocols should be followed at the site during construction works.

Contaminant indicators in soil may include:

– Cement pipe, sheet, pipe or board materials (may contain asbestos)
– Auditory assessed contamination (flowing or dripping liquid and liquid of gas leaks)
– Visually assessed contamination (buried refuse, metal objects, building material, soil or water staining/bleaching or discolouration)
– Olfactory assessed contamination (odorous materials or groundwater)

If any such indicator or other suspicious material is observed during earthworks, the following steps shall be taken:

– Advise site management and cease works immediately in the vicinity of the issue and/or isolate the area until a definitive decision is made regarding the hazard posed
– If confirmation of contamination is needed, the contractor shall engage, or instruct engagement, of a contaminated lands Suitably Qualified and Experienced Practitioner (SQEP). The SQEP can provide options for next steps including soil reuse and/or disposal

For interim management of the unexpected discovery, the following steps shall be undertaken:

– Where possible, contamination should remain in the ground or removed from the ground and securely isolated until a suitable course of action has been decided
– In the event that any soil contamination found has been excavated into trucks or stockpiles, or contaminated groundwater has been stored in a settlement tank, the contamination shall be contained to control migration or leachate formation

If any contaminated soil is discovered during the works and requires off-Site disposal, soil should be tested before any material is sent off-Site and the appropriate landfills should be consulted.

In addition to all of the above, the contractor will maintain a register of any contaminated material discovered, including location, type, quantity and any associated disposal records. The information will be provided to the SQEP writing the soil validation report.

8. Emergency Procedures

All staff need to know in advance the emergency procedures that will be implemented for any accident, including spills and accidental untreated sediment discharge reaching surface water.

Appointed Contractor to complete Emergency Procedures in accordance with their Standard Operating Procedures and Site-Specific Risk Assessment.

9. Heavy Rainfall Response and Contingency

Weather forecasts are to be monitored through the construction period to identify where periods of increased rainfall might exceed the design capacity of the installed ESC features. Where this will potentially occur, site activities will focus on reducing exposed surfaces, contouring areas of earthworks to direct flow towards the sediment ponds and reduce areas of flow concentration where practicable.

10. Plan Revisions

This ESCP is to be confirmed prior to commencing physical works. As the project progresses it is likely the ESCP will require further refinement and adjustment. Any material changes to the ESCP are to be submitted to ECan for certification.

11. Responsibilities

The responsible parties for each of the control and monitoring measures is displayed in Table 6.

Table 6 Responsible parties for control measures

Control measure	Responsible party
Sampling of water quality	Contractor
Sampling result decision making	Appointed SQEP
Visual sediment plume result decision making	Appointed SQEP
State Highway debris removal	Contractor
Maintenance and inspection of ESC features	Contractor

12. References

GHD 2025A. Lake Pūkaki Reservoir Hydro Storage and Dam Resilience Works – Pukaki Dam Rip-Rap Design and Construction Methodology 2025.

GHD 2025B. . Lake Pūkaki Reservoir Hydro Storage and Dam Resilience Works – Lake Processes and Geomorphology 2025.

Environment Canterbury 2020. Erosion & Sediment Control Toolbox

Meridian 2025 – Modelling Memo

Appendix A

CV

Jeff Tuck

Senior Water Engineer

Location

Christchurch

Experience

10 years

Qualifications/accreditations

- Master of Engineering, 2016
- Bachelor of Engineering (Hons), 2010

Key technical skills

- Construction management
- Transient modelling and design
- Water infrastructure design
- 1D and 2D hydraulic modelling of surface water and urban networks
- Water balance and mass load modelling with probabilistic assessment

Memberships

- Engineering New Zealand
- Water New Zealand

Relevant experience summary

Jeff's experience encompasses construction management, water balance modelling, risk mitigation, environmental assessment, and a focus on design of effective hydraulic infrastructure. Having undertaken design, construction monitoring and quality assurance, Jeff brings a practical aspect to his work which enables him to consider constructability when providing inputs to design projects.

Jeff's attributes include being able to think critically, analyse complex situations, and apply innovative techniques. His knowledge includes fluid mechanics, system hydraulics, hydraulic modelling and the software used to do this.

Experience demonstrating capability in construction monitoring and design

Construction Monitoring Experience

North New Brighton WW Renewals

Role: Contracts Engineer, PM
Client: Christchurch City Council
Location: Christchurch
Date(s): 2020-2022 (PC issued August 2021)

Jeff is the Contracts Engineer and GHD Project Manager for the North New Brighton WW renewals Contract which involves renewal of 2,200 m of wastewater mains and corresponding lateral connections. This role includes managing the contract and applying quality management procedures in line with the CCC construction standard specification.

Fendalton and Riccarton WW Renewals

Role: Contracts Engineer, PM
Client: Christchurch City Council
Location: Christchurch
Date(s): 2020-2024

Jeff is the Contracts Engineer and GHD Project Manager for the Fendalton and Riccarton WW renewals Contract which involves renewal of 3,000 m of wastewater mains and corresponding lateral connections. This role includes managing the contract and applying quality management procedures in line with the CCC construction standard specification.

Woolston WW Renewals

Role: GHD Project Manager
Client: Christchurch City Council
Location: Christchurch
Date(s): 2021-2023

Jeff is the GHD Project Manager for the Woolston WW renewals Contract. His role is to provide guidance and assistance to the Contracts Team on the project based on past CCC contract experience and undertake internal project management tasks.

Te Mato Vai Stage 1 and 2

Role: Engineers Representative Assistant
Client: Cook Islands Government (MFEM)
Location: Cook Islands - Rorotonga
Date(s): 2019-2021

The Te mato Vai Stage 2 project included the construction of ten water treatment plants, water intakes, storage tanks and trunk mains to supply treated water to the communities of Rarotonga. The Stage 1 project included renewals of 15 km of water mains. Jeff was an Engineer Representative Assistant and carried out construction supervision across these two projects for periods of 2019 and 2020. The role covered supervision of all aspects of the construction project on behalf of the Cook Islands Government. Further to the supervision role, re-design work was regularly carried out in response to encountered unexpected conditions.

Te Mato Vai - Road Panel | Cook Islands | 2020

Role: Engineers Representative
Client: Cook Islands Government (MFEM)
Location: Cook Islands - Rorotonga
Date(s): 2020-2021

Jeff undertook the Engineers Representative role for the Te Mato Vai Road Panel contract. This contract is setup to maintain access and provide ancillary contract works to support the Te Mato Vai Stage 2 construction works. The role includes maintaining contractual communications with the three construction companies represented on the panel and completing MSQA requirements.

Project Management Unit (PMU) | Cook Islands | 2019

Role: Design Engineer
Client: Cook Islands Government (MFEM)
Location: Cook Islands - Rorotonga
Date(s): 2020-2021

The PMU contract was setup by the Cook Islands Government with involvement by MFAT to manage the Te Mato Vai and Mei Te Vai Ki Te Vai projects. These projects focus on replacement of Rarotonga's water supply infrastructure and development of wastewater infrastructure.

Jeff's involvement included design and tendering of ancillary contracts such as minor pump stations, pipeline renewals and household metering installation contracts. The project also involved a significant community consultation component.

Hydraulic and surge modelling

Western Corridor Wastewater Servicing

Role: Hydraulic Modeller
Client: Tauranga City Council
Location: Tauranga
Date(s): 2020

As well as demonstrating his technical abilities in surge modelling and analysis, this work has also built Jeff's knowledge of the Western Corridor network.

Jeff carried out hydraulic and surge modelling on the proposed design to support design decisions and verify system capacity. The analysis included long term fatigue assessment to inform system optimisation through the design phase.

The project involves construction of a new wastewater pump station and rising main to support future development. Three phases of construction are proposed to align with staged development, where the final solution includes 6,000 m of twin DN500 PE pipelines.

Various surge analysis projects

Role: Hydraulic Modeller
Client: Various
Location: Auckland, Tauranga & Christchurch
Date(s): 2017 – on-going

The relevance of these projects is in the surge modelling and surge mitigating design works Jeff undertakes. This is similar to the work he is expected to perform on the TCC renewals programme and demonstrates his knowledge of the effects of surge on pipeline condition and ability to contribute to predictions that may affect current pipe condition and future longevity.

Among other collaborative projects and reviews, Jeff carried out surge analysis modelling for:

- Halswell wastewater rising main
- Prebbleton pump station and rising main surge analysis and capacity assessment
- Snell Algies outfall pipeline
- Castor Bay Road pump station and wastewater rising main
- Almna Road pump station and wastewater rising main
- Hingaia pump station and wastewater rising main
- Hybiscus coast distribution trunk main and water supply distribution

On these Jeff was also called upon to:

- Assess pipeline class for surge requirements
- Determine air valve placements
- Size surge protection vessels
- Undertake fatigue analysis

Christchurch Citywide Flood Model

Role: Hydraulic Modeller & Data Analyst
Client: Christchurch City Council
Location: Christchurch
Date(s): 2017 – 2019

This work highlights Jeff's ability to tackle the challenges of large and complex modelling projects.

The complexity and scale of the CFM project required Jeff to develop a range of tools using ARC-GIS, Python, Excel and Visual basic software to enable efficient model building, quality assurance and data processing.

The Citywide flood model uses DHI MIKE Flood software to create three-way coupled model with a flexible mesh of the Christchurch stormwater catchments.

Pukerimu Intake Assessment

Role: Hydraulic Modeller
Client: Waipa District Council
Location: Waikato River
Date(s): 2018 – 2019

This work demonstrates that Jeff has an understanding of the natural environment effects on design and potential impacts of infrastructure on the environment.

Using HEC-RAS 2D river modelling software Jeff assessed the low flow river levels within the Waikato River near the Pukerimu raw water intake. He used this information to determine the risk profile for the intake, which is applied in prioritising upgrades and design levels. The study further assessed the impact of the intake on river flow and levels to demonstrate acceptable environmental impacts

Wakamoekau Community Water Storage Scheme Feasibility Study

Role: Transmission & hydraulic roughness assessor
Client: Wairarapa Water Ltd.
Location: Wairarapa
Date(s): 2020

This study demonstrates Jeffs research capabilities, applying an understanding beyond 'design code' principles to generate robust models and enable fit for purpose infrastructure designs.

Jeff carried out a literature review and optimisation process to determine nominal pipeline roughness allowances to apply for efficient and accurate network modelling.

The study is part of a wider design project to irrigate of 8,000 ha of land through 150 km of pressure pipelines.

Waimea Additional Irrigation Assessment

Role: Hydraulic Modeller
Client: Waimea Irrigators Ltd.
Location: Waimea, Tasman District
Date(s): 2017

To support development of the irrigation scheme Jeff helped to develop concept designs of three irrigation networks. This included modelling each network within a hydraulic design optimisation process.

He also developed construction cost estimates for the proposed systems.

Water Intake Design

Role: Hydraulic Modeller and Designer
Client: Watercare Services Ltd.
Location: Tuakau, Waikato River
Date(s): 2017-2020

Watercare is looking to upgrade a water intake and treatment plant at Tuakau to supply 300,000 m³/d to the network and the project is in the consenting phase of works. Jeff's involvement includes producing concept designs for the screened raw water intake and pumpstation. The intake is designed to meet regulatory requirements for fish screening while accounting for river hydraulic conditions to maintain reliable supply.

In brief…

Jeff also dedicates time to providing industry based tutor time to the final year capstone project at UoC.

– **University of Canterbury, ENCI/ENNR413 Capstone Project** – Providing industry based tutoring, including lectures, tutorials and project design assistance in the final year capstone projects undertaken as part of the Civil and Natural Resource Engineering Degrees.

Career history

2017 – present	GHD, Water Engineer
2011 – 2016	Canterbury University, Postgraduate Studies, Research Assistant, Lecturer, Tutor
2009 – 2011	Opus, Intern Water Engineer
2008 – 2009	Opus, Laboratory Technician

Modelling & design software used

- ArcGIS
- Bentley WaterCAD/Hammer
- Goldsim
- HEC-RAS
- Hytran
- WANDA
- Mike by DHI (Mike Flood, Mike 11, Mike 21)
- AutoCAD

Appendix B

HAIL Report

Memorandum

Internal use only

26 August 2024

To	Amy Callaghan		
Copy to	Stephen Douglass		
From	Wendy Whitley	**Tel**	03 363 0802
Subject	Lake Pukaki HAIL areas	**Project no.**	12647815

1. Introduction

Meridian Energy propose to undertake some erosion protection measures along the southern shoreline of Lake Pukaki (the 'site'). The indicative works boundary is shown on Figure 1 below.

The site is located within a property area that has been identified on Environment Canterbury's (ECan) Listed Land Use Register (LLUR) has having three HAIL[2] activities occurring on it. The presence of potentially contaminated land will impact on the consenting requirements for discharges for the proposed works.

Figure 1: Site location (image source: Environment Canterbury GIS)

[1] Draft construction methodology provided by Meridian Energy, 7 August 2024
[2] Hazardous Activities and Industries List, October 2011, Ministry for the Environment

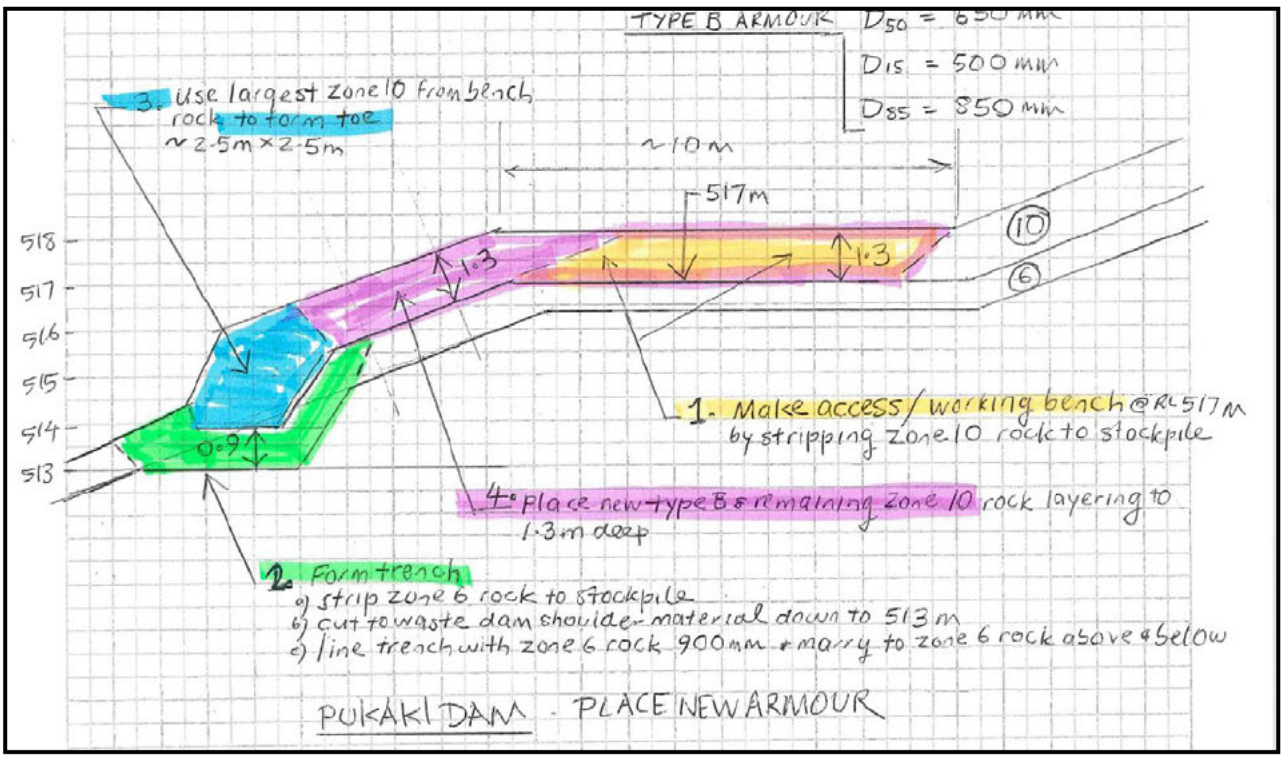


Figure 2: Draft proposed excavations and benching for placing new armour

1.1 Scope and objectives

This memo provides a high-level assessment of whether a HAIL activity is occurring or has occurred at the site and determine if there is a risk of soil contamination impacting the proposed project works, and includes:

- Review of the following information:
  - Environmental setting details including geology and groundwater from publicly available resources;
  - LLUR statement for the Property;
  - Publicly available historical aerial photographs on the ECan online GIS portal; and
  - Client provided information.
- Preparation of a preliminary Conceptual Site Model to understand the potential risks for contamination.

2. Site setting

2.1.1 Site description

The site is located in the northern portion of Lot 1 DP 368484 (the Property) and is located on the Tekapo-Twizel Road, Twizel, on the southern banks of Lake Pukaki.

Adjacent to the lake are the engineering infrastructure associated with the hydro dam and control of lake levels, and the Lake Pukaki lookout carpark with small commercial facilities and public toilets. This lookout area is a popular tourist attraction with hundreds of people visiting every day.

2.1.2 Environmental setting

The geology of the area is described as *generally unweathered bouldery till; mixtures of gravel / sand / silt / clay; in well-defined valley moraines* and *engineered fill associated with hydro-electric canals and dams; alluvial gold dredge tailings* by GNS[3].

Details for two test pits which were excavated adjacent to the lookout carpark were found on the New Zealand Geotechnical Database (NZGD). Relevant details from these testpits include:

– The soils encountered comprised a silty topsoil underlain by a fine sand with gravels and silt increasing with depth down to 1.7 m and 2 m depth.
– Groundwater was not encountered in the test pits.
– It appears the investigations were undertaken to support changes for the discharge from the public toilets. Based on the test pit logs and accompanying location plan reviewed from NZGD, there is a former dispersal bund adjacent to the carpark area and the current dispersal field is located approximately 250 m to the south of the car park (shown on Figure 3).

Based on ECan's online GIS, piezometric contours indicate that groundwater flows towards the lake and canal (north and north east). A nearby monitoring well (H38/0005) (shown on Figure 3) was installed in 1998 and the initial water level was recorded to be approximately 13.45 m below ground level (noting that ground levels and water levels are likely to vary significantly due to the engineered nature of the area).

3. Information review

3.1 LLUR

The LLUR statement for the site is attached to this memo as Attachment 1. The identified HAIL areas are shown on Figure 3 and an overview of these HAIL activities is provided in Table 1 overleaf.

Figure 3: HAIL areas (image source: Environment Canterbury GIS)

[3] **Geology 2.0.0 (gns.cri.nz)**

Table 1: HAIL activities overview

LLUR ID	HAIL activity	Comments
1540	HAIL activity A17 – storage tanks or drums for fuels, chemicals or liquid waste	It is stated on the LLUR report that a 2,000 L diesel underground storage tank (UST) is present within the outlined HAIL area. The HAIL area outlined on the LLUR statement is large and extends into the lake and the exact location of the UST is not provided. However, it is likely that the UST is located close to the lookout carpark adjacent to the commercial premises. The HAIL area is categorised as 'not investigated' on the LLUR.
367217	HAIL activity B4 – power stations, substations or switch yards	This HAIL area is located approximately 90 m to the south of the site and comprises an electrical transformer contained within a concrete bund (visible from Google Street View). It is unclear from the historical aerial photos whether this structure was always bunded. It is unlikely that contaminants, if present, from this source would migrate in surface / near surface soils as far as the site.
367219	HAIL activity B4 – power stations, substations or switch yards	This HAIL area is located approximately 200 m to the south of the site and comprises a small electricity substation. It is unlikely that contaminants, if present, from this source would migrate in surface / near surface soils as far as the site.

3.2 Historical aerial photographs

Historical aerial photographs available on ECan's online GIS for the area were reviewed. A summary of the historical aerial photographs is provided in Table 2 below and the images are attached to this memo in Attachment 2.

Table 2: Historical aerial photographs

Year	Description
1960-1964	Lake Pukaki and a dam has been constructed, however the shoreline, discharge to the river, road layout and engineering infrastructure varies significantly to the current layout. Worker's huts and structures are present approximately 120 m from the lake edge. These are located within the current lake boundary.
1965-1969	There are no significant changes along the lake edge. There are an increasing number of worker's huts further to the south.
1980-1984	The shoreline, surrounding waterways and canal, road layout and engineering infrastructure are as the current layout. The lookout carpark is present, with no adjacent structures.
2004-2010	Notable changes are visible for the structures adjacent to the lookout carpark only.

3.3 Client provided information

Information regarding the UST was requested from Meridian Energy, however they do not have records for the UST at the site. It is considered most likely that the UST is associated with the facilities at the lookout carpark.

Meridian Energy did note that a 22,000 L septic tank is located adjacent to the carpark, and two additional tanks are currently proposed.

4. Identified HAIL activities

HAIL activities within 200 m of the site are shown on Figure 3 and include:

– HAIL activity A17: Storage tanks for fuel, chemicals or liquid waste
  - The location of the fuel UST is not confirmed, however is assumed to be adjacent to the lookout carpark not within the proposed works area.

– HAIL activity B4: Power stations, substations or switchyards
  - Due to the distance from the site of these structures and that bunding is present around the transformer, it is unlikely these activities would result in shallow soil contamination at the site and therefore are discounted as a potential risk for the proposed works.

– HAIL activity G5: Waste disposal to land (excluding where biosolids have been used as soil conditioners)
  - The septic tank dispersal areas could potentially fall under this HAIL activity. The key contaminants of concern include biological hazards, which normally degrade rapidly over a short period of time, and heavy metals, that will likely have limited leachability in this environment. Due to the distance to the proposed works area of the currently in-use dispersal field and the former dispersal mound not being in-use, there is likely limited risk of soil contamination in the proposed works area from these sources.

5. Preliminary Conceptual Site Model

A preliminary conceptual site model (CSM) for the site has been developed to assess the likelihood of a complete linkage between a contaminant source(s) and potential receptors via a given pathway. This is presented in Table 3.

While several HAIL activities have been identified present within the wider Property within which the site is located, only one of these, the UST – HAIL activity A17, has been identified as a potential risk of being a source of contamination at the site.

It is considered unlikely that the UST would have been installed within the site area and is likely located adjacent to the lookout carpark / commercial premises. The potential for soil contamination to be present at the site would require migration, via soil and groundwater, of contaminants from the UST following a leak in the tank or fuel lines. There is no indication that a leak has occurred from this UST.

However, contamination, resulting from a leak, from a source such as a UST would be limited in extent both vertically and horizontally. Should this have occurred, then this activity would fall under HAIL *Activity H - Any land that has been subject to the migration of hazardous substances from adjacent land in sufficient quantity that it could be a risk to human health or the environment*.

Table 3: Preliminary conceptual site model of potential contamination at the proposed works area

Source	Pathway	Receptor	Potential linkages
UST containing fuel (Hydrocarbons, potentially lead)	Vertical migration of contaminants through soil to groundwater, and Horizontal migration of contaminants through soil.	Shallow soil (should leak have occurred in fuel lines) Groundwater Lake Pukaki Human health (site workers)	**Incomplete** Surface soils only are proposed to be disturbed for access tracks, and unlikely to intersect potentially contaminated groundwater or soils.

6. Summary

While several HAIL activities have been identified present within the wider Property within which the site is located, only one of these, the UST – HAIL activity A17, has been identified as a potential risk of being a source of soil contamination at the site.

However, due to the nature of contaminants and the distance to the proposed works area, it is considered unlikely that contamination in soils is present at the site resulting from potential discharges from the UST which is likely located adjacent to the lookout carpark.

Regards

[redacted]

Wendy Whitley
Senior Environmental Scientist

Cecilia Gately
Technical Director

Limitations

This memorandum has been prepared by GHD for Meridian Energy. It is not prepared as, and is not represented to be, a deliverable suitable for reliance by any person for any purpose. It is not intended for circulation or incorporation into other documents. The matters discussed in this memorandum are limited to those specifically detailed in the memorandum and are subject to any limitations or assumptions specially set out.

This HAIL assessment has been based on the review of limited information and is not considered to be a Preliminary Site Investigation in accordance with Ministry for the Environment (2021) Contaminated Land Management Guidelines No. 1 – Reporting on contaminated sites in New Zealand.

GHD has prepared this memorandum on the basis of information provided by the Client and others who provided information to GHD (which may also include Government authorities), which GHD has not independently verified or checked for the purpose of this memorandum. GHD does not accept liability in connection with such unverified information, including errors and omissions in the memorandum which were caused by errors or omissions in that information.

Attachments

Attachment 1

ECan Listed Land Use Register Report

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

Dear Sir/Madam

Thank you for submitting your property enquiry from our Listed Land Use Register (LLUR). The LLUR holds information about sites that have been used or are currently used for activities which have the potential to cause contamination.

The LLUR statement shows the land parcel(s) you enquired about and provides information regarding any potential LLUR sites within a specified radius.

Please note that if a property is not currently registered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR database is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; additional relevant information may be held in other files (for example consent and enforcement files).

Please contact Environment Canterbury if you wish to discuss the contents of this property statement.

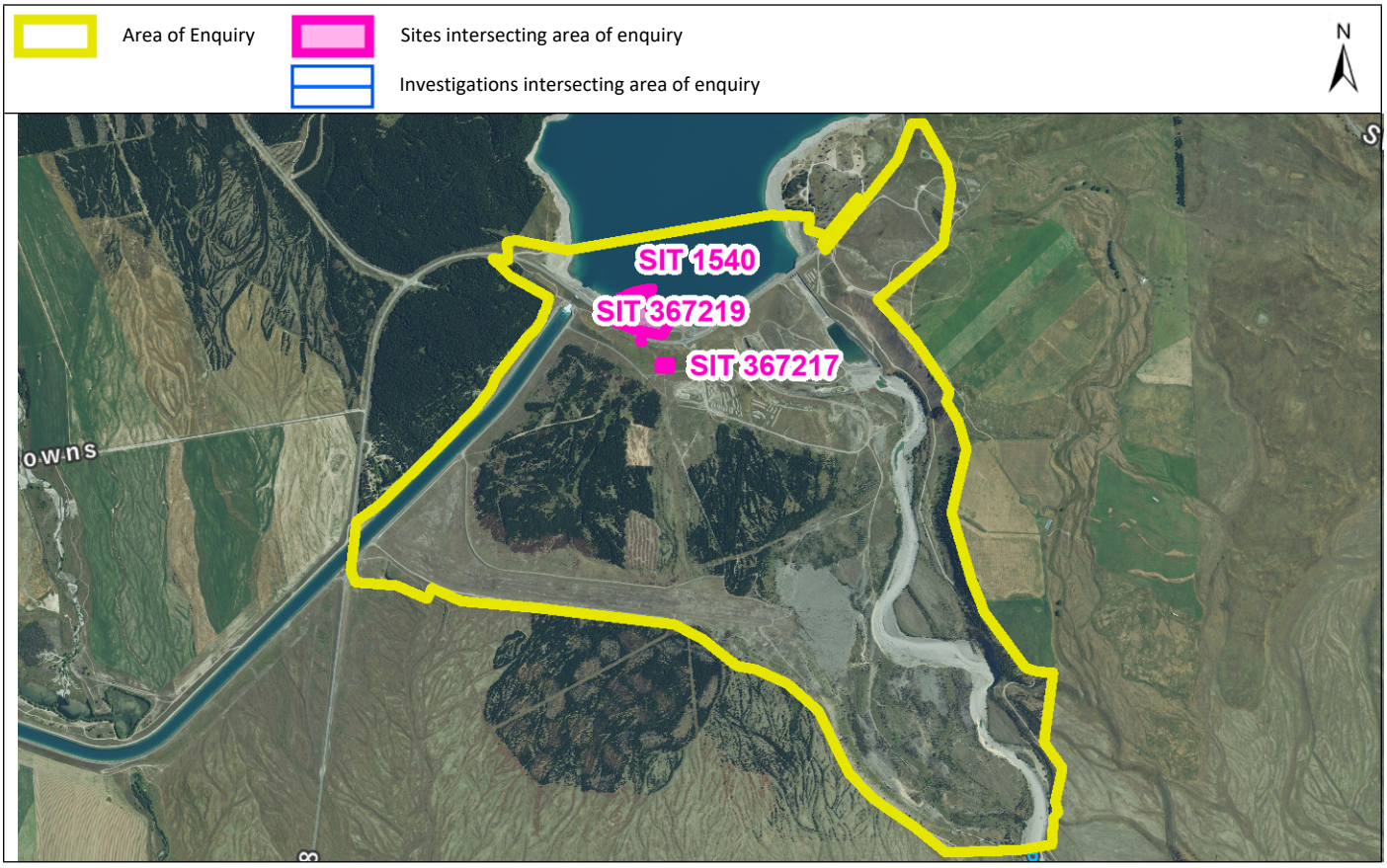
Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit ecan.govt.nz/HAIL for more information or
contact Customer Services at ecan.govt.nz/contact/ and quote ENQ386857

Date generated: 08 August 2024
Land parcels: Lot 2 DP 368484
Lot 1 DP 368484



The information presented in this map is specific to the property you have selected. Information on nearby properties may not be shown on this map, even if the property is visible.

Sites at a glance

Sites within enquiry area

Site number	Name	Location	HAIL activity(s)	Category
1540	Pukaki Canal Inlet	Glen Lyon Road, Lake Pukaki	A17 - Storage tanks or drums for fuel, chemicals or liquid waste;	Not Investigated
367217	Power station		B4 - Power stations, substations or switchyards;	Verified HAIL
367219	Substation infrastructure		B4 - Power stations, substations or switchyards;	Verified HAIL

More detail about the sites

Site 1540: Pukaki Canal Inlet (Intersects enquiry area.)

Category: Not Investigated
Definition: Verified HAIL has not been investigated.

Location: Glen Lyon Road, Lake Pukaki
Legal description(s): Lot 1 DP 368484

HAIL activity(s):

Period from	Period to	HAIL activity
?	Current	Storage tanks or drums for fuel, chemicals or liquid waste

Notes:

20 May 1999 1993: One 2000 L underground storage tank (UST), 3(c) product.

Investigations:

There are no investigations associated with this site.

Site 367217: Power station (Intersects enquiry area.)

Category: Verified HAIL
Definition: The land-use / HAIL history has been confirmed.

Location:
Legal description(s): Lot 1 DP 368484

HAIL activity(s):

Period from	Period to	HAIL activity
	Present	Power stations, substations or switchyards.

Notes:

Investigations:

There are no investigations associated with this site.

Site 367219: Substation infrastructure (Intersects enquiry area.)

Category: Verified HAIL
Definition: The land-use / HAIL history has been confirmed.

Location:
Legal description(s): Lot 1 DP 368484

HAIL activity(s):

Period from	Period to	HAIL activity
	Present	Power stations, substations or switchyards.

Notes:

Investigations:

There are no investigations associated with this site.

Disclaimer

The enclosed information is derived from Environment Canterbury’s Listed Land Use Register and is made available to you under the Local Government Official Information and Meetings Act 1987.

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Listed Land Use Register

What you need to know

Everything is connected

What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)[1]. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

[1] The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

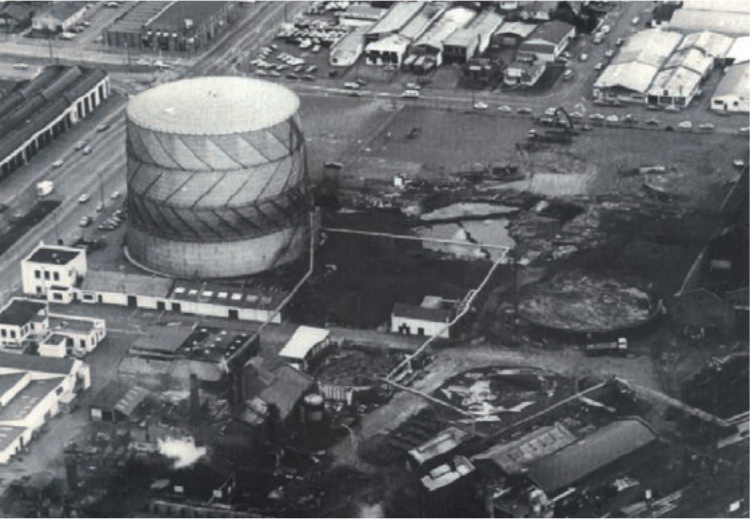
Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

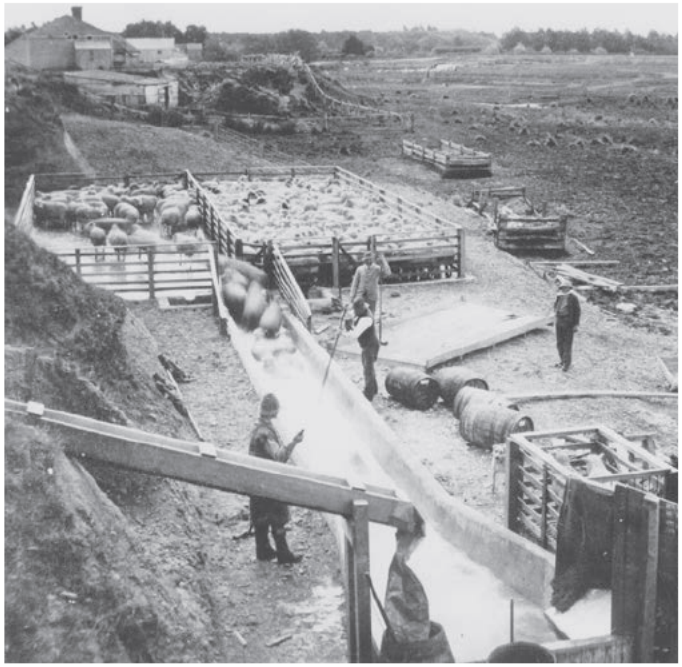
We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.



IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:
Calling from Christchurch: (03) 353 9007
Calling from any other area: 0800 EC INFO (32 4636)

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

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Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz

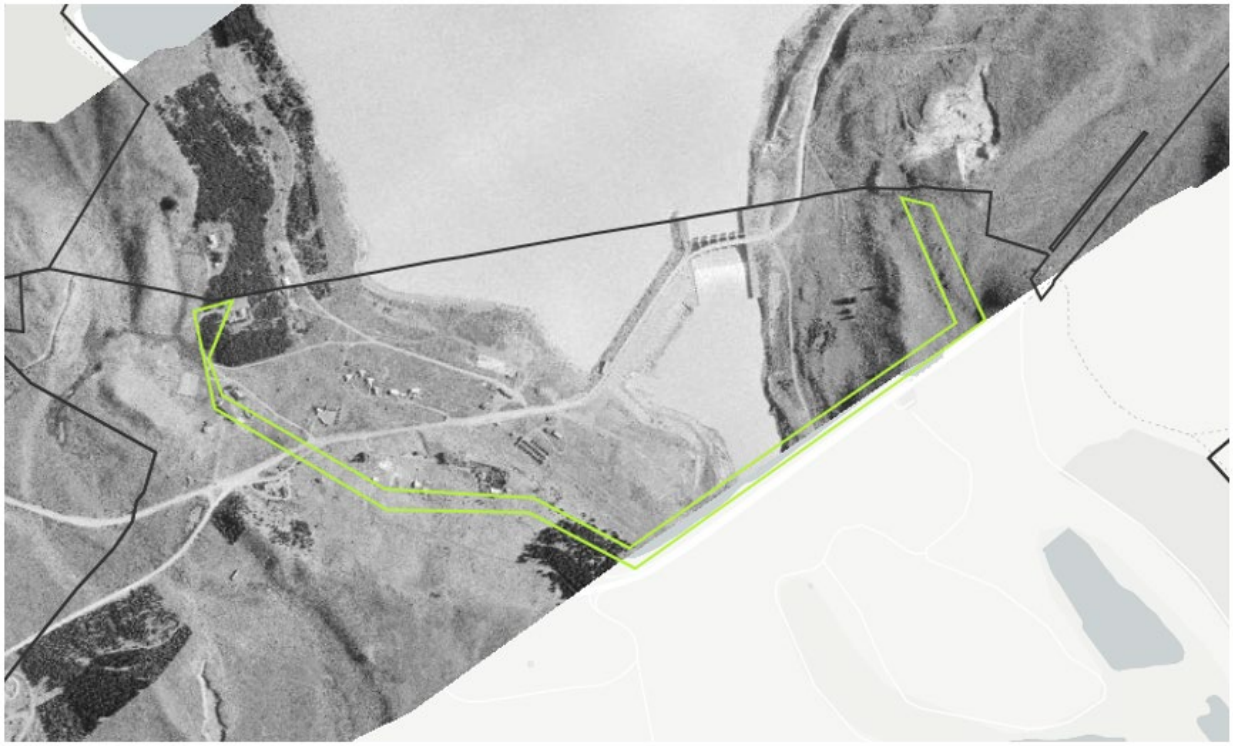
Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

E13/102

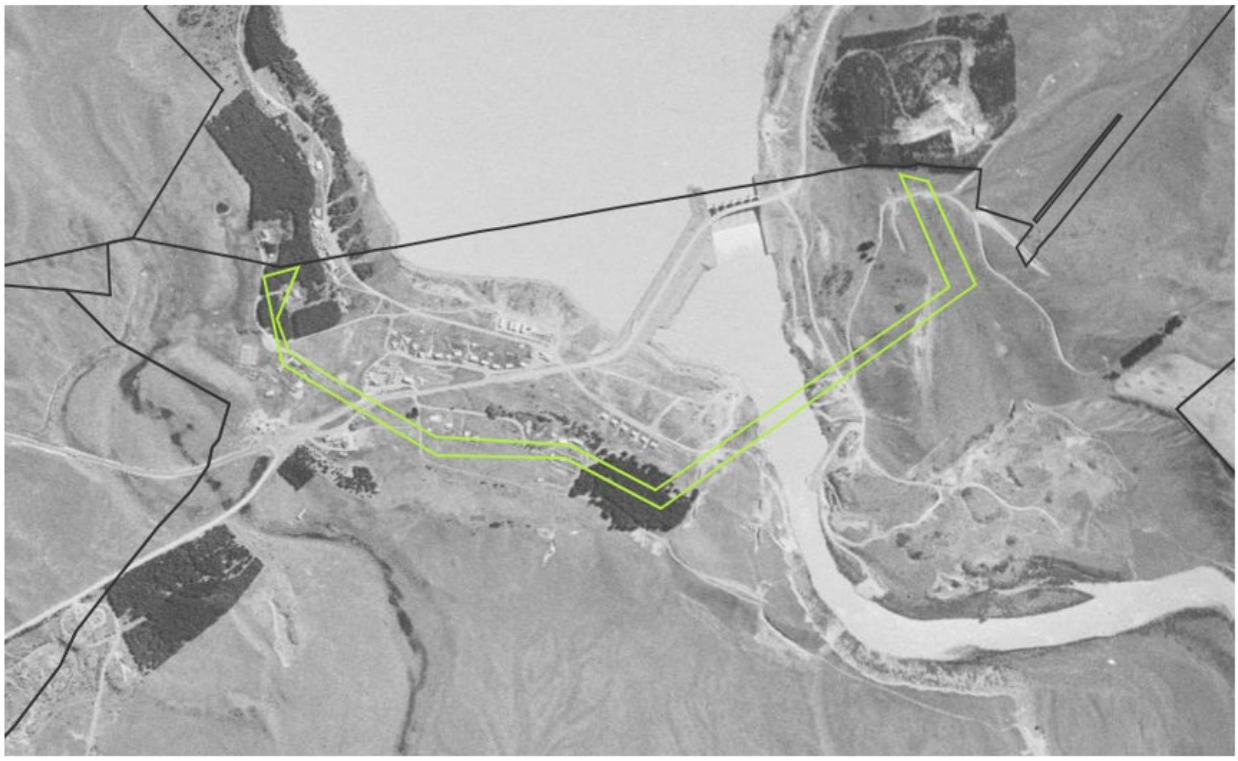
Attachment 2

Historical aerial photographs

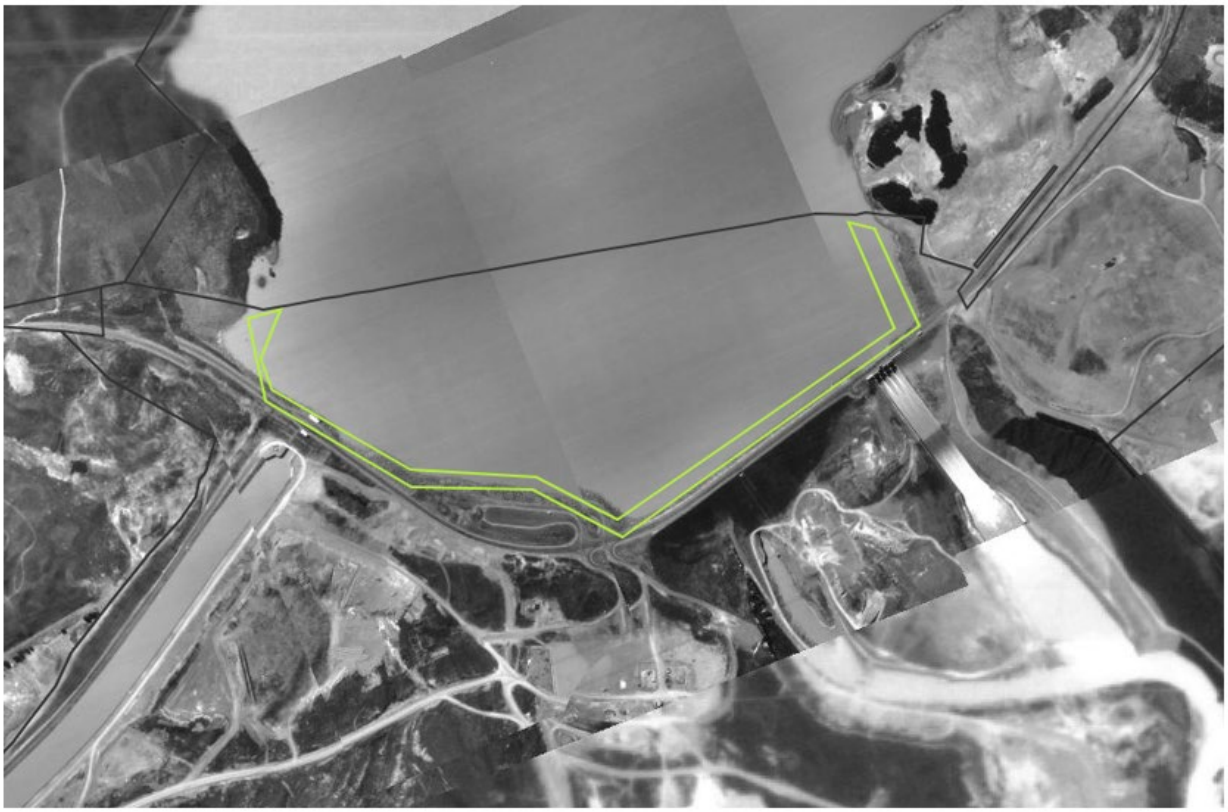
1960-1964, Source Environment Canterbury GIS



1965-1969, Source Environment Canterbury GIS



1980-1984, Source Environment Canterbury GIS



2004-2010, Source Environment Canterbury GIS

ghd.com

→ The Power of Commitment