SOUTHERNSKIES ENVIRONMENTAL

EROSION AND SEDIMENT CONTROL ASSESSMENT REPORT

Clevedon Quarry – Expansion

546 McNicol Road, Clevedon

Prepared for Stevenson Aggregates Limited

Prepared by: SouthernSkies Environmental Ltd

Date: 6 October 2026

SOUTHERNSKIES ENVIRONMENTAL

CONTENTS

1. OVERVIEW 4

1.1 Scope 4

1.2 Location and Site Description 5

1.3 Background 6

1.4 The Pit Expansion 7

1.5 Receiving Environment 7

2. DESCRIPTION OF WORKS 9

2.1 Clevedon Quarry Water Management System 9

2.2 Pit Expansion 13

2.3 Quarrying Process 14

2.4 Overburden Disppoasl Site 15

2.6 Chemical Treatment 17

3. EROSION AND SEDIMENT CONTROL PHILOSOPHY AND PROCESSES 18

3.1 Objectives 18

3.2 Design 18

3.3 Principles 19

3.4 Staging 19

3.5 Review 19

4. EROSION AND SEDIMENT CONTROL DETAILS 20

4.1 Clean Water Diversions 20

4.2 Dirty Water Diversions 21

4.3 Sediment Retention Ponds 21

4.5 Chemical Treatment 21

4.6 Silt Fences 21

4.7 As-Built Certification 21

4.8 Stockpiles 21

4.9 Dust Management 22

4.10 Stabilisation 22
4.11 Winter Works 22
4.12 Monitoring and Maintenance 22

5. ESTIMATED SEDIMENT YIELD 22

6. STATUTORY CONSIDERATIONS 23
6.1 National Policy Statement for Freshwater Management 23
6.2 Auckland Unitary Plan: Operative in Part 23

7. ASSESSMENT OF EFFECTS 24

8. SUMMARY 26

9. APPENDICES 27
Appendix A – Summary of USLE Results 28
Appendix B - Erosion and Sediment Control Drawings 29
Appendix C - Erosion and Sediment Control Construction Details 30

1. OVERVIEW

1.1 Scope

The applicant, Stevenson Aggregates Limited (SAL), seeks resource consent to expand the existing Clevedon Quarry. The Clevedon Quarry is located at 546 McNicol Road, Clevedon (the Site).

This Erosion and Sediment Control Assessment Report (ESCAR) has been prepared to support the resource consent application. It incorporates an Erosion and Sediment Control Plan (ESCP) outlining proposed erosion and sediment control (ESC) measures to manage site runoff from earthworks and streamworks required for the expansion of the quarry and including the establishment of a new overburden disposal area (OBDA). It then assesses the suitability of those measures to minimise the potential discharge of sediment to an acceptable level.

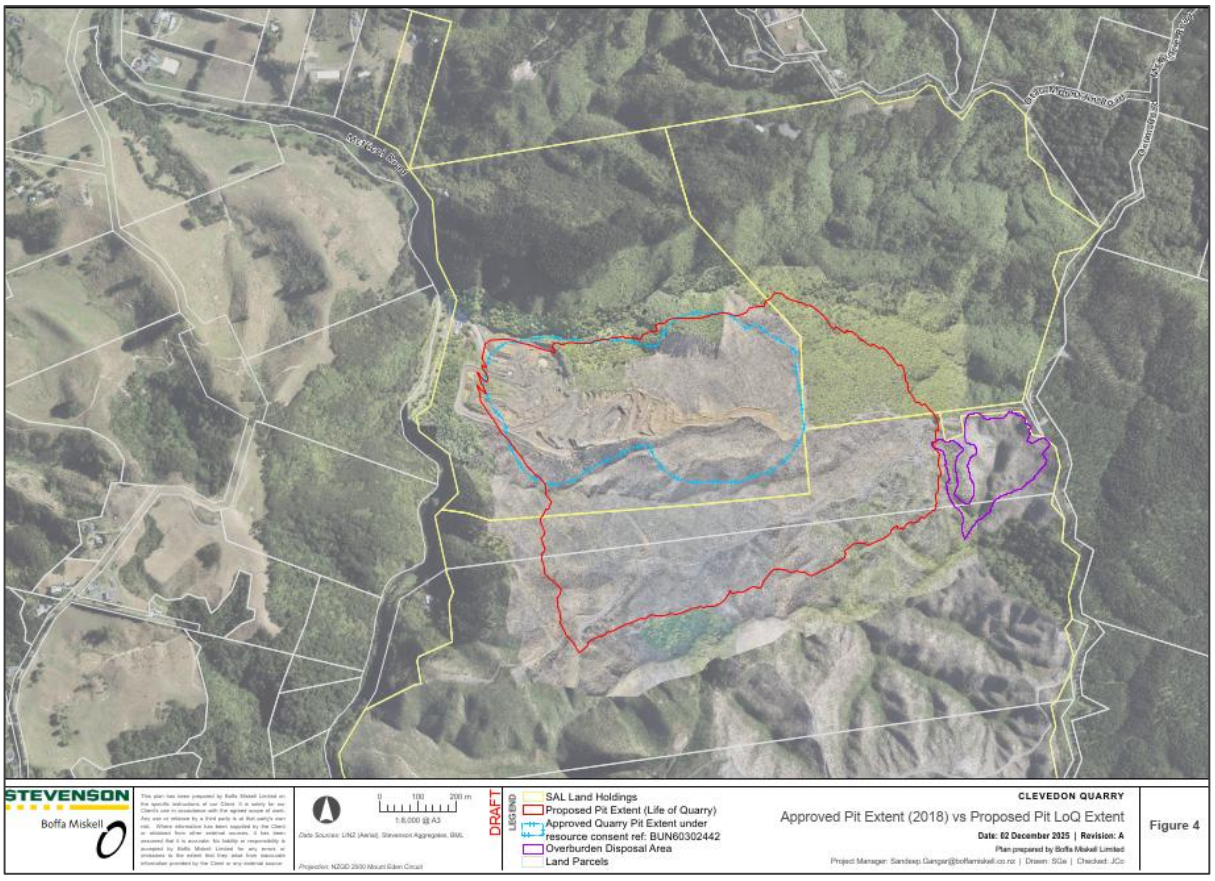


Figure 1: Existing earthworks consent area (light blue) vs additional proposed earthworks (life of quarry extent in red) plus Overburden area (purple).

Site visits were undertaken on 1 October 2025, 20 November 2025, and 21 January 2026. Campbell Stewart (Southern Skies Environmental Limited), Bryn Llewellyn (SAL), Jo Young (SAL), and Juliana Cox (SAL) attended all site visits. Jessica Urquhart (Tonkin and Taylor), Emily Afoa and Dali Salijic (Tektus) attended the visit on 21 January 2026.

This ESCAR has been assessed and prepared in accordance with design principles of the Auckland Council Guideline Document 2016/005 *Erosion and Sediment Control Guideline for Land Disturbing Activities in the Auckland Region* (**GD05**).

This ESCAR and the ESCP address the following earthwork and streamworks activities:

- Establishment of the erosion and sediment controls;
- Site establishment and enabling works;
- General earthworks, streamworks and quarry activities; and
- The establishment of the OBDA including erosion and sediment controls.

1.2 Location and Site Description

The Clevedon Quarry sits within a wider area owned by SAL, encompassing approximately 544.32ha (referred to as the SAL landholdings). The landholdings comprises a range of terrain and land use typologies, including pastoral farmland, native vegetation, exotic forestry, and the existing quarrying activity.

The site is currently predominately plantation forestry, which has been recently harvested in 2025 and replanted. The SAL landholdings are zoned Special Purpose – Quarry Zone (SPQZ) area and Rural - Rural Production Zone (R-RPZ) under the AUP. In addition, parts of the site are subject to the Significant Ecological Area (SEA) overlay and the Outstanding Natural Features (ONF) overlay. Most of the proposed quarry expansion is within the SPQZ area, however it includes an additional area outside of this zone and within the R-RPZ and SEA areas.

The zoning and planning notations relevant to the proposed expansion are outlined in the Assessment of Environmental Effects (AEE) report.

The site location and SAL landholdings are shown below (refer to Figures 2 and 3 below).

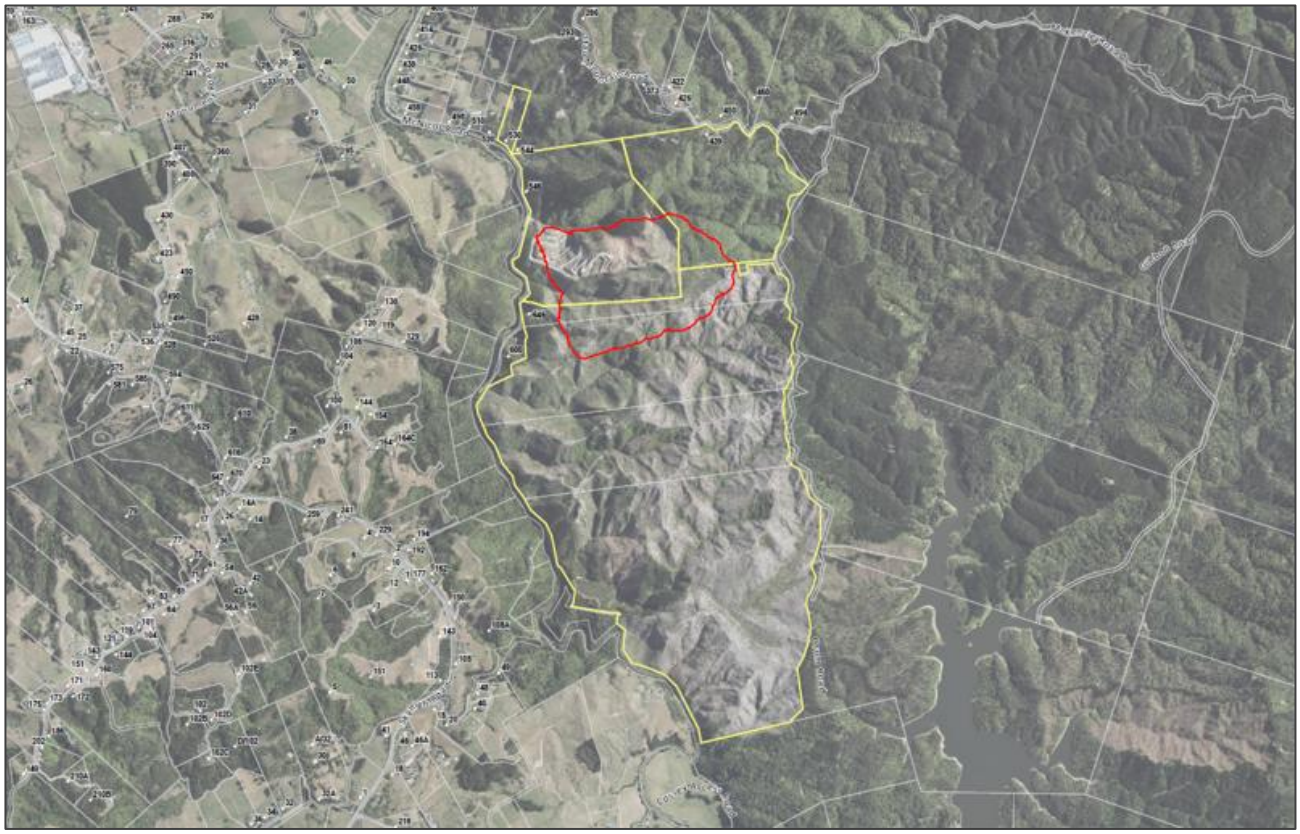


Figure 2: Site location and SAL land holdings.



Figure 3: Clevedon Quarry and Proposed Expansion Footprint.

1.3 Background

Clevedon Quarry is a regionally significant quarry that contributes to regional aggregate demand. The Clevedon Quarry has been in operation since the 1970s, initially operated by Warren Shaw Limited and is a greywacke hard rock quarry supplying high quality aggregate to the Auckland Market. In 1995 the site was purchased by Warren Fowler (Fowler Quarries Limited) and was previously known as 'Fowler Quarry'. Fulton Hogan (FH) subsequently purchased the Quarry in April 2016, and it was transferred to Fulton Hogan's subsidiary, SAL, in 2019.

FH obtained resource consent in the Environment Court in 2018[1] for an expansion to increase annual production of up to approximately 3 MT per year, totalling 60 MT of aggregate and overburden in six stages over a 35-year team. The consented quarry covers approximately 29ha in area with a consented depth of RL20 in the final stages (the current depth of extraction is RL35).

More recently, Plan Change 89 (PC89) was approved in 2024 and resulted in a rezoning to alter the extent of the SPQZ from the northern part of the site to the south and eastern direction of the current quarry area. The reason for this rezoning was to reflect the preferred direction of expansion, to avoid a SEA and Natural Stream Management Areas (NSMA), and to provide a visual and acoustic barrier between the majority of neighbouring properties. The zoning of the quarry site is SPQZ, which now extends to a total area of approximately 73.78 ha in an eastwards and southwards direction from the current quarry

Clevedon Quarry extracts approximately 200,000 to 300,000 tonnes annually.

[1] Decision [2018] NZEnvC 96

1.4 Proposed Quarry Expansion

To continue to provide a local supply of aggregate resource, SAL proposes to expand the existing quarry area within the existing site. The proposed expansion will be located to the southeast of the existing quarry. The expansion area "Life of Quarry" (LOQ) footprint is approximately 74ha, an expansion of approximately 45ha from the current 29ha consented quarry footprint. The maximum excavation level (quarry floor) will be approximately RL 22.5 m. The expansion will provide approximately 150 million tonnes (MT) of aggregate across five indicative stages, over 50 years. The annual extraction rate will remain at the currently consented limit of 3 MT tonnes per year.

The overall site layout, including indicative staging plans, is shown on the drawing set attached to the AEE report.

The proposed quarry expansion has been designed to allow for the continuous operation of the quarry. It will be serviced by the existing Clevedon Quarry ancillary site infrastructure and facilities that will be relocated from their current positions adjacent to McNicol Road, to within the expanded quarry floor. These include the "Front of House (FOH)" activities, such as the offices / workshop, weigh bridge, processing plant(s), storage bins and stockpile areas.

Clevedon Quarry has a sediment retention pond (SRP) system that has been operational for circa 15 years. The SRP discharges off site to the Stream 1 and to the Wairoa River, via a 1200mm diameter culvert beneath McNicol Road. As part of the expansion, it is proposed to construct a new extensive constructed wetland water treatment system to manage water runoff and discharge from the Clevedon Quarry. This new system will be located in the area immediately adjacent to McNicol Road that is to be levelled following the relocation of the FOH facilities as mentioned above.

The expansion works will also require streamworks, overburden site establishment, vegetation removal and mitigation offsets.

Most of the expansion area is recently (2025) harvested planation forest. The site is covered with slash and replanted pine trees. The north-eastern corner of the expansion area is native vegetation, approximately 6ha in size and is designated as a SEA under the AUP.

1.5 Receiving Environment

The main tributaries of Wairoa River in the vicinity of the Clevedon Quarry flow along the northern boundary (Stream 1) and southern boundary (Stream 2) of the current quarry footprint, which flow into the Wairoa River to the west, beneath McNicol Road. Stream 3 is located to the south of the existing quarry within an area of existing forestry.

Runoff from the existing quarry and the immediate quarry area drains westward to a quarry sump before discharging to a SRP in the north-western corner of the site, designed to treat site stormwater runoff. Water from the SRP discharges to Stream 1. Stream 1 discharges beneath McNicol Road to the Wairoa River via an existing 1200mm culvert.

The proposed constructed wetland water treatment system system will discharge via a new stabilised diversion channel to Stream 1, upstream of the existing 1200mm culvert.

Stream 2 currently delineates the southern boundary of the existing quarry. The proposed expansion will result in the loss of this stream. The stream water will flow through the quarry and discharge via the new constructed wetland water treatment system.

Stream 3 is located to the south of the proposed expansion. The proposed expansion will however result in the loss of a section of the upper catchment including the proposed location of the OBDA at the head of the catchment. Refer to Figure 4 showing the stream locations and the proposed expansion footprint.

For further information on the receiving environment, including associated ecological values, refer to the Ecological Impact Assessment.

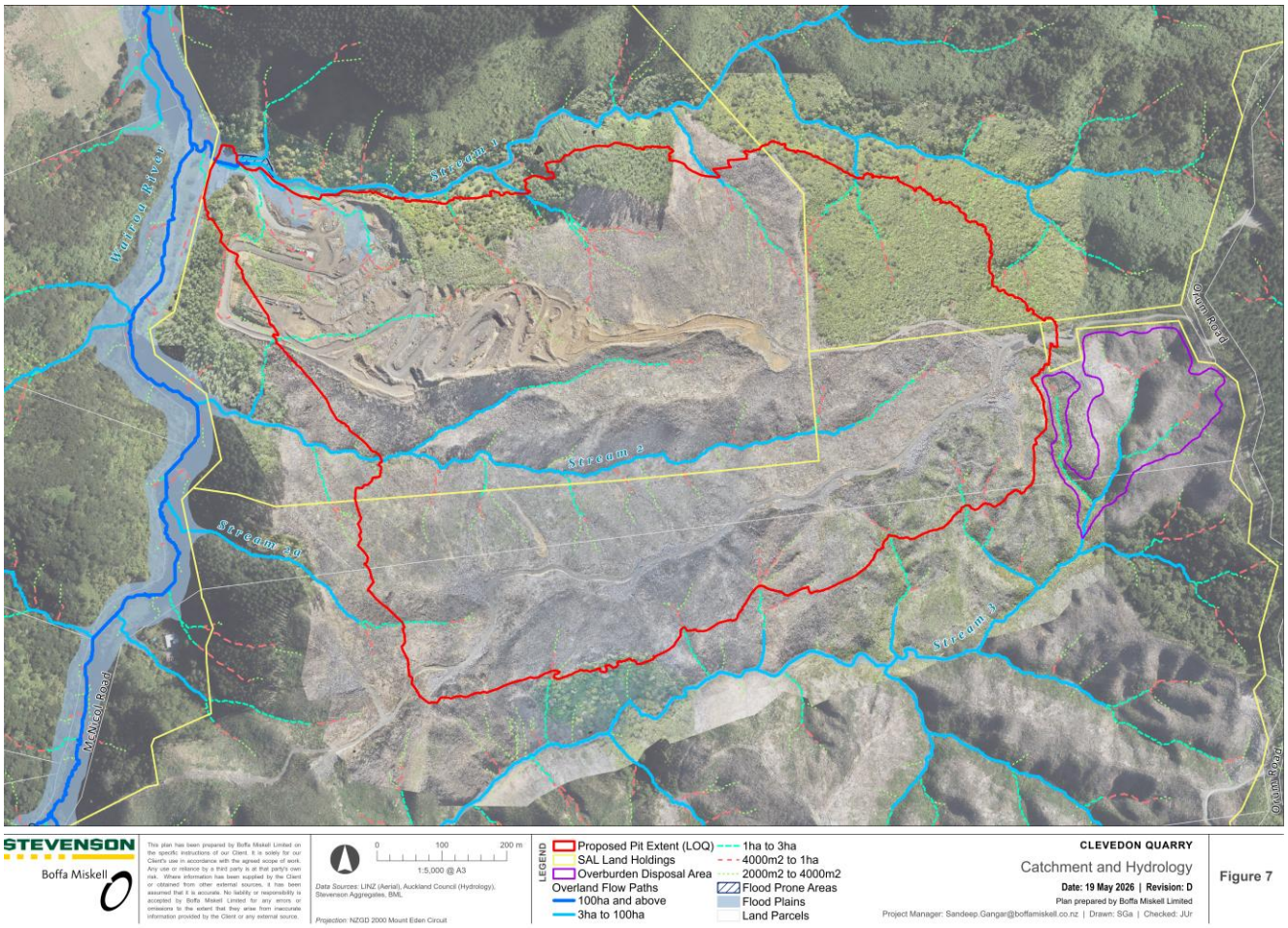


Figure 4: Stream locations and the proposed expansion footprint

2. PROPOSED QUARRY EXPANSION AND WATER MANAGEMENT SYSTEM

2.1 Clevedon Quarry Water Management System

The current Clevedon Quarry site water management system, located within the FoH area, consists of all site water being directed to the quarry sump. From the quarry sump, water discharges to the SRP located in the north-western corner of the site before discharging off site to Stream 1.

The current system will be redesigned and upgraded for the proposed quarry expansion. For specific details of the proposed constructed wetland water treatment system, refer to the Tektus Surface Water Management Report.

The quarry operations will continue during the proposed expansion and will be managed to ensure that all site water falls into, or is directed to, the quarry sediment sumps. This includes all site construction water, including water generated from washing and from the processing area, within the quarry floor.

Water will then be pumped from the sediment sump into the constructed wetland treatment system. The sediment sumps will be located within the quarry floor area located within the FoH area. They will be established to provide ease of maintenance and desilting. Operational requirements may mean that the sumps have to be relocated within the quarry floor as the quarry expands.

The sump pump will be set on a turbidity sensor, with the pump rate determined specifically by the design of the new constructed wetland water treatment system. This provides design certainty that the flow rate of water passing through the new constructed wetland water treatment system will provide the required water quality to achieve the design expectations.

Once established, the new constructed wetland water treatment system has been designed to provide the water quality treatment for the life of the quarry. As the quarry expands, the quarry sediment sumps will be enlarged to provide the holding capacity for the site (refer to Tektus Surface Water Management Report for staged volume requirements). This will allow the pump rate to remain constant, which will ensure that the flow rate through the new constructed wetland water treatment system is controlled to the design specifications.

In summary, the proposed constructed wetland water treatment system, once fully established, will be permanent. The quarry sediment sumps upstream of the constructed wetland water treatment system may be relocated depending on operational requirements within the quarry floor but will remain within the FoH area. The quarry floor volume will also enlarge as the quarry expands to provide the minimum design water volume holding capacity.

Enabling works within the FoH area are required to create the footprint to construct the new constructed wetland water treatment system. The works will need to be staged to provide for the continuous operation of the quarry and maintain the existing water treatment system until the new wetland water treatment system can become operational.



Figure 5: Current Clevedon Quarry Water Management Plan.

2.1.1 Staged Transition to the New Constructed Wetland Treatment System

The construction of the new wetland water treatment system will be staged to provide for continuous operation of the quarry and maintain the existing water treatment system until the proposed constructed wetland water treatment system can become operational.

To construct the proposed system, space needs to be created in the relatively narrow north-western corner of the site. Concept staging plans have been prepared to show at a high level how this staging will be undertaken and these are shown in Figures 6-8 below.

Stage 1

Enabling works will be required to construct the new access road to allow for the construction of the proposed constructed wetland water treatment system. A concept staging methodology is as follows:

1. During the initial works, the existing access road will be maintained and remain operational.
2. Works to construct the new access way will commence. The bulk of the earthworks can be undertaken to the south and west of the existing access road.
3. During the earthworks operations to construct the access road, quarry water management will continue to be managed via the existing pit, soakage, and SRP setup. Any construction water from the access road construction will be directed to the existing SRP.
4. For the minor area of earthworks below the existing sump and culvert to the SRP, silt fencing will be installed.
5. Upon completion of construction, the new access road will be made operational.

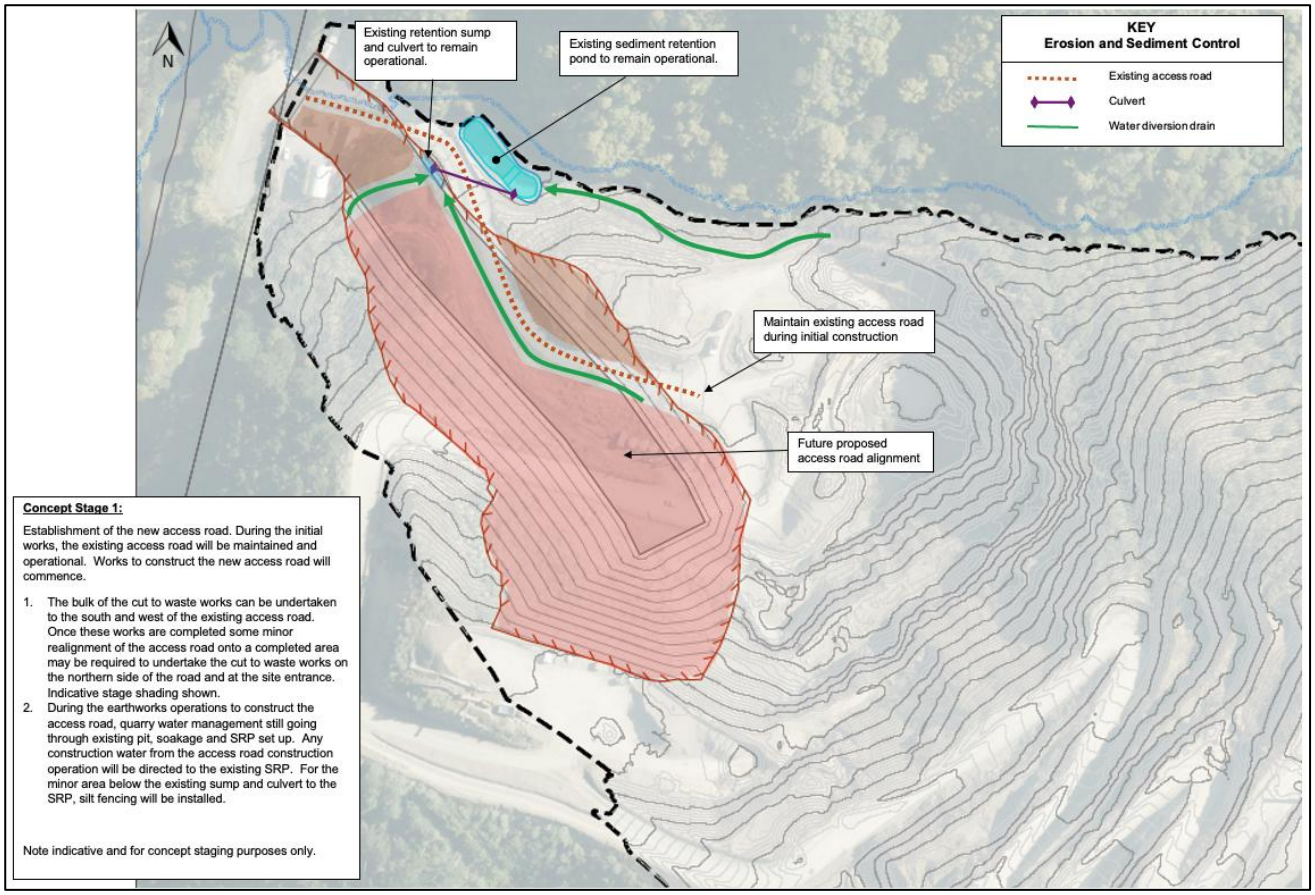


Figure 6: Concept Stage 1 - New Water Management System access road establishment.

Stage 2

During Stage 2 Works, the newly constructed access road will be fully operational. Stage 2 focuses on the establishment of the new wetland, SRP and diversion swale. A general staging methodology is as follows:

1. During the earthworks that are required to construct the new wetland, SRP and diversion, the quarry water management will still be going through the existing pit, soakage, and SRP setup.
2. Any construction phase water from the wetland, SRP, and diversion swale drain construction operations will be directed to the existing SRP. The works will be completed offline from the existing SRP (works will be undertaken without disrupting the operation of SRP) and quarry water management system.
3. The earthworks proposed in Stage 2 will be cut to waste operations.
4. Upon completion of construction, the new treatment system will be made operational.

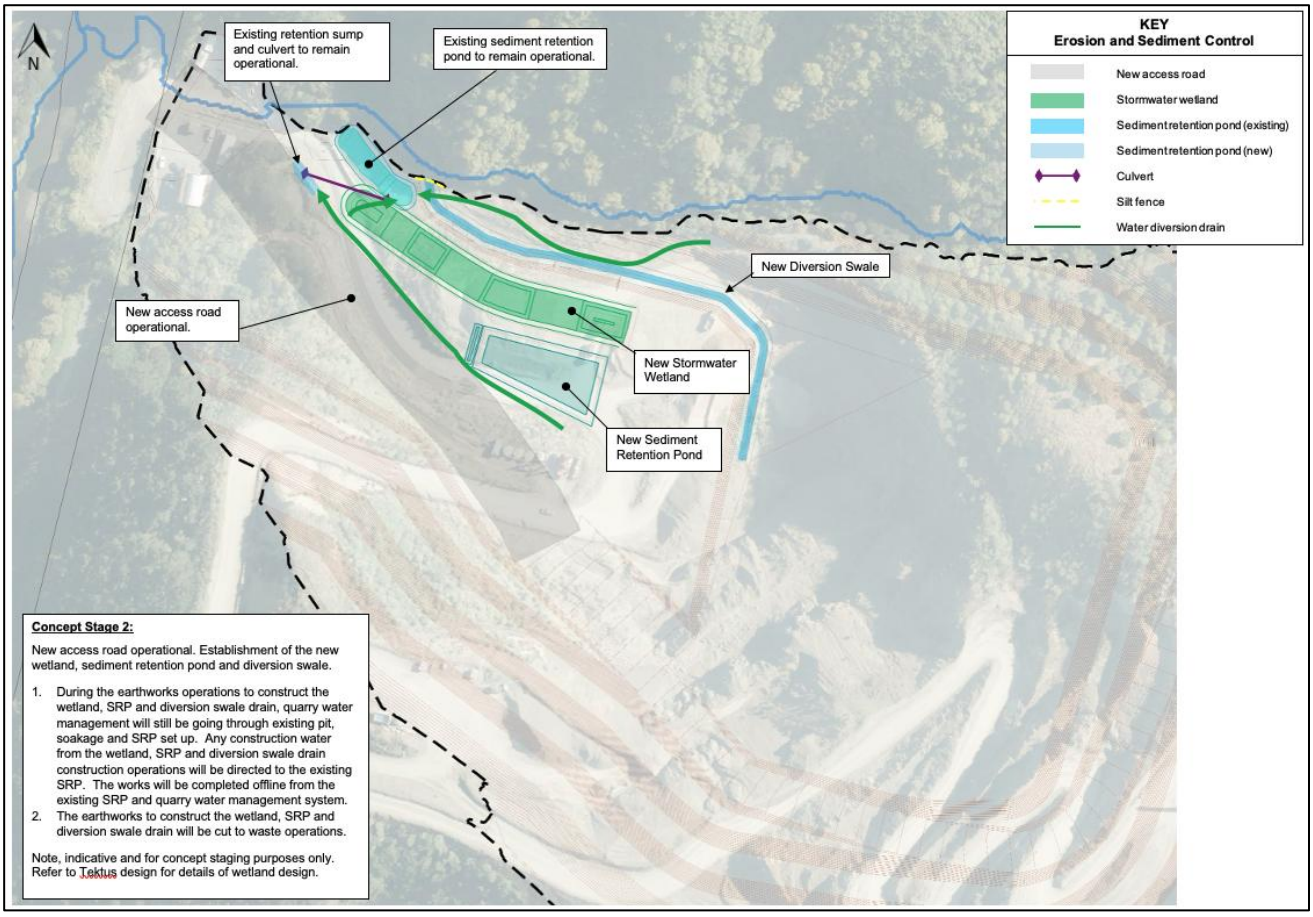


Figure 8: Concept Stage 2 New Water Management System establishment.

Stage 3

During Stage 3, the new wetland and SRP will be operational, however, the diversion swale will have a temporary outlet point. Stage 3 involves the removal of the existing SRP and sediment retention sump, as well as the completion of the final section of the diversion swale. A general staging methodology is as follows:

1. The existing SRP and retention sump will be removed, and the final (northern) section of the diversion swale will be constructed in the location of the removed SRP. These works will be completed offline from the quarry water management system. Silt fencing will be installed to provide sediment control for these works.
2. Upon completion of the final section of the diversion swale, the newly constructed wetland treatment system will now be fully operational.

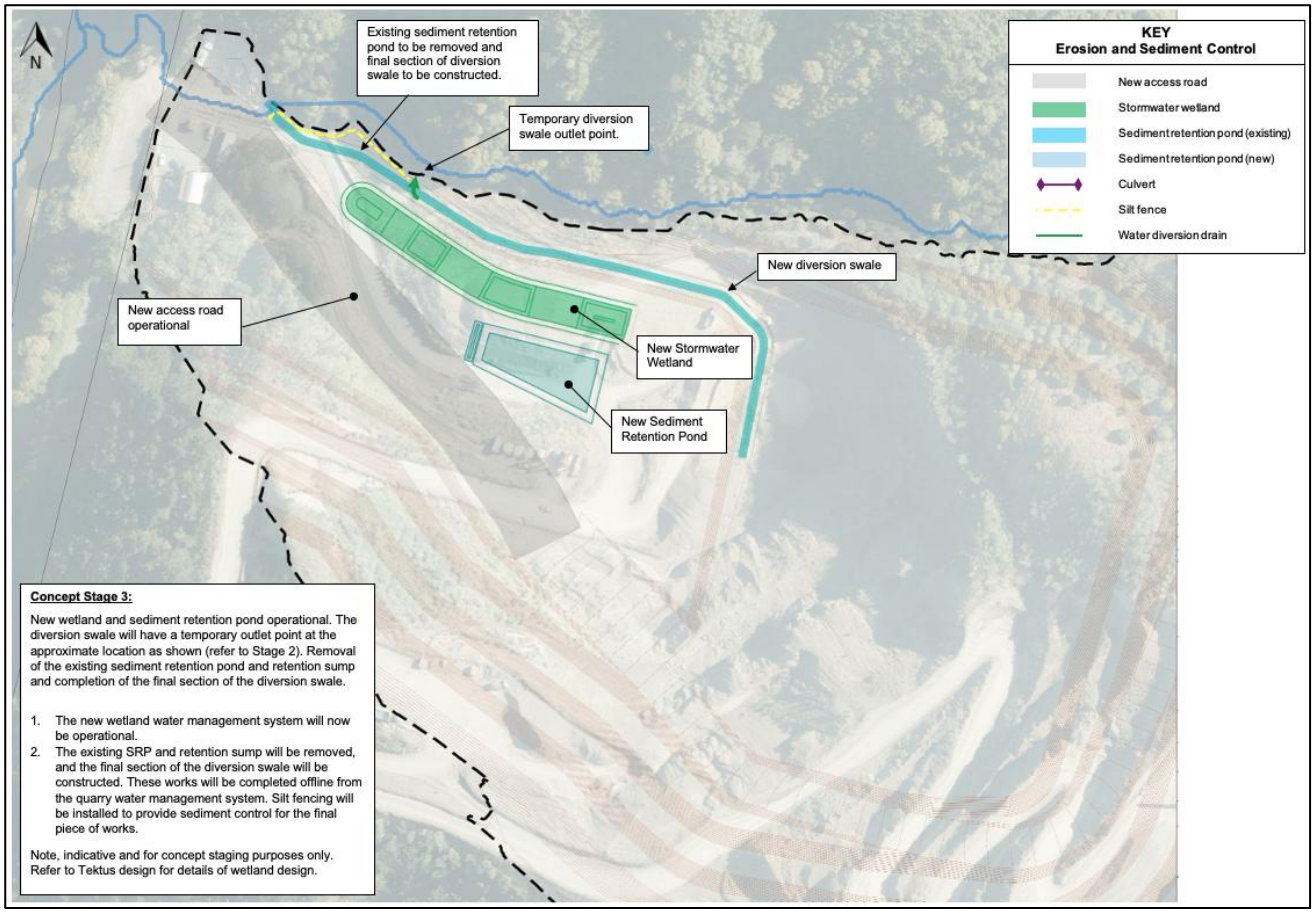


Figure 8: Concept Stage 3 New Water Management System operational.

2.2 Quarry Footprint Expansion

The quarry footprint will expand in a general south easterly direction.

Plans of the proposed expansion are appended to the AEE report. In general, the plans refer to a 10-year plan, a 20-year plan, a 30-year plan, and 40-year plan and a life of quarry pit (also referred to as the 50-year plan) drawings. The maximum pit depth indicated on those plans is RL 22.5m. The expansion of the quarry area will be incremental. The quarry footprint will deepen and widen as resource is extracted. Internal quarry roads will be constructed as the quarry expands. As the quarry footprint expands, all site water will continue to fall into the operational area of the quarry.

The enabling works required to allow for the quarry expansion to commence beyond the existing quarry extent, include the establishment of the new constructed wetland treatment system, described in section 2.1.1 with specific design details and information provided in the Tektus Surface Water Management Report.

The OBDA will be established at the eastern extent of the expansion boundary. Refer to Section 2.4 below for details of the OBDA establishment and operation.

As the quarry expands it will eventually cross over Stream 2, (at approximately 10 years). At this point, the upper catchment of Stream 2 will enter the quarry. The constructed wetland treatment system will be well established and operational long before the water load on the system increases once Stream 2 is directed into the quarry. Calculations and design have been provided by Tektus which provide for minimum pit volumes and sediment sump requirements to be in place prior to the stream cross over. The continued expansion will eventually take the majority of Stream 2 - refer to Figure 10.

2.3 Quarrying Process

The process of extracting aggregate resource involves using heavy machinery for the following processes:

Removing Existing Vegetation

Any existing vegetation within the extent of works will be removed using excavators and trucks. Note, the removal of vegetation, topsoil etc., will be progressive over the life of the quarrying operations, as and when required. Refer to the Ecological Impact Assessment report for further details regarding the removal of vegetation and timing of this removal.

Topsoil Stripping and Stockpiling

Topsoil and organic materials will be stripped, transported, and removed using excavators and trucks. The initial topsoil stripping will be used to form the erosion and sediment control clean water diversion bunds where practicable.

The removal of material will be to the OBDA.

Overburden Removal

The initial excavation of material is classed as overburden. Where possible this material will be sold off to be used as fill. The demand for overburden does however fluctuate. If at the time of overburden stripping the material cannot be sold off site, the material will be placed in the designated OBDA. The OBDA will be located at the eastern site boundary of the quarry extent, refer to Figure 9 for approximate location. Refer to section to 2.4 for details on the establishment and operation of the OBDA.

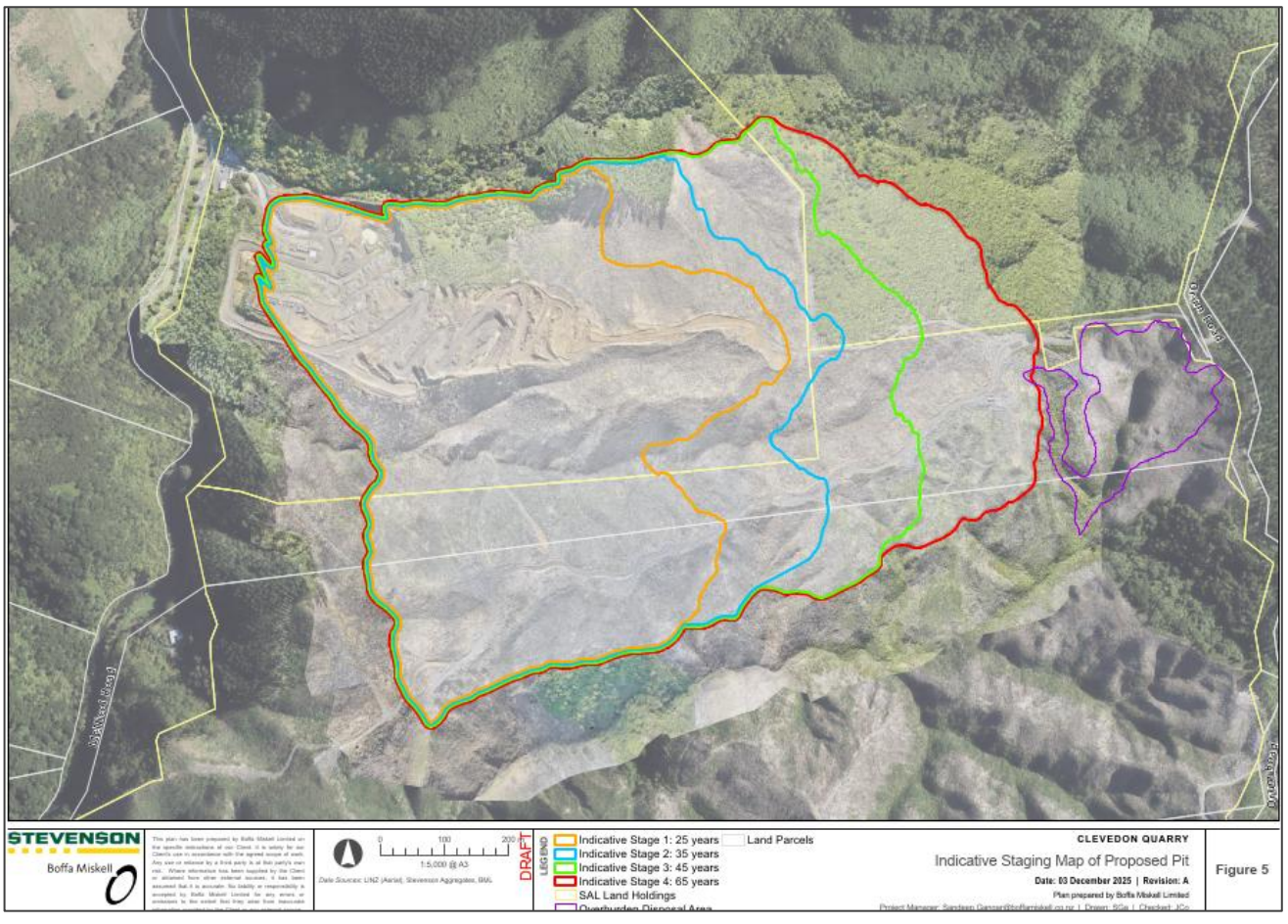


Figure 9: Quarry Expansion extent and Overburden Disposal Area.

Aggregate Extraction, Processing and Stockpiling

Quarrying of the aggregate will occur using excavators, trucks, and/or loaders, to excavate and transport the aggregate materials to existing crushing and wash area and materials stockpiles. It is expected that the existing processing and stockpile area will always remain within the quarry floor as the quarry extent expands.

2.4 Overburden Disposal Site

The OBDA will be established in a staged manner as overburden is produced. The total area of the OBDA will be approximately 4.6ha. The overburden area will be filled in two general stages.

Two SRPs will be installed to treat runoff from the construction and establishment of the area, one for Stage 1 and one for Stage 2 (identified as OB-SPR-1 and OB-SRP-2 on the ESCPs shown in Figures 10 and 11). Each of the SRPs will be sized for 3ha catchment. Perimeter bunds will be installed to direct site runoff to the SRP and to limit its catchment to no more than 3ha. The works will also be staged with progressive stabilisation to further minimise the open area to the greatest extent practicable at any given time.

Enabling works will be required to construct the SRPs due to the steep nature of the site. Engineered fill will likely be required to create suitable platforms for the SRPs. Silt fencing will be installed downslope of the SRP locations to treat any sediment laden runoff that may be generated during the SRP establishment. The silt fencing will be removed or tied back into the emergency spillways of the SRPs once the construction of the device is complete.

The OBDA and batters will be progressively stabilised as the material is placed and the expected levels are achieved. The filling and establishment of the area will be staged. As areas of the OBDA are completed, they will be progressively stabilised. The diversion bunding will be adjusted as required to ensure that the working 3ha is directed to the SRPs, and clean and stabilised areas are directed away from the SRPs as clean water discharges. The outlet from OB-SRP-1 will be piped to a stabilised surface beyond the catchment area of OB-SRP-2. The exact location of the outlet and pipe system is to be confirmed.

Existing internal quarry access roads will be used to gain access to the OBDA.

The OBDA will be operational for approximately 10 years. The placement of material will align with the expansion stages of the quarry. There will be periods when the quarry footprint is static and only minor volumes of overburden will be taken to the OBDA. This will allow for periods when additional areas of the disposal site can be temporary stabilised. Upon completion, the OBDA will be planted as part of the projects proposed wider terrestrial planting (refer to the Ecological Impact Assessment for further detail).

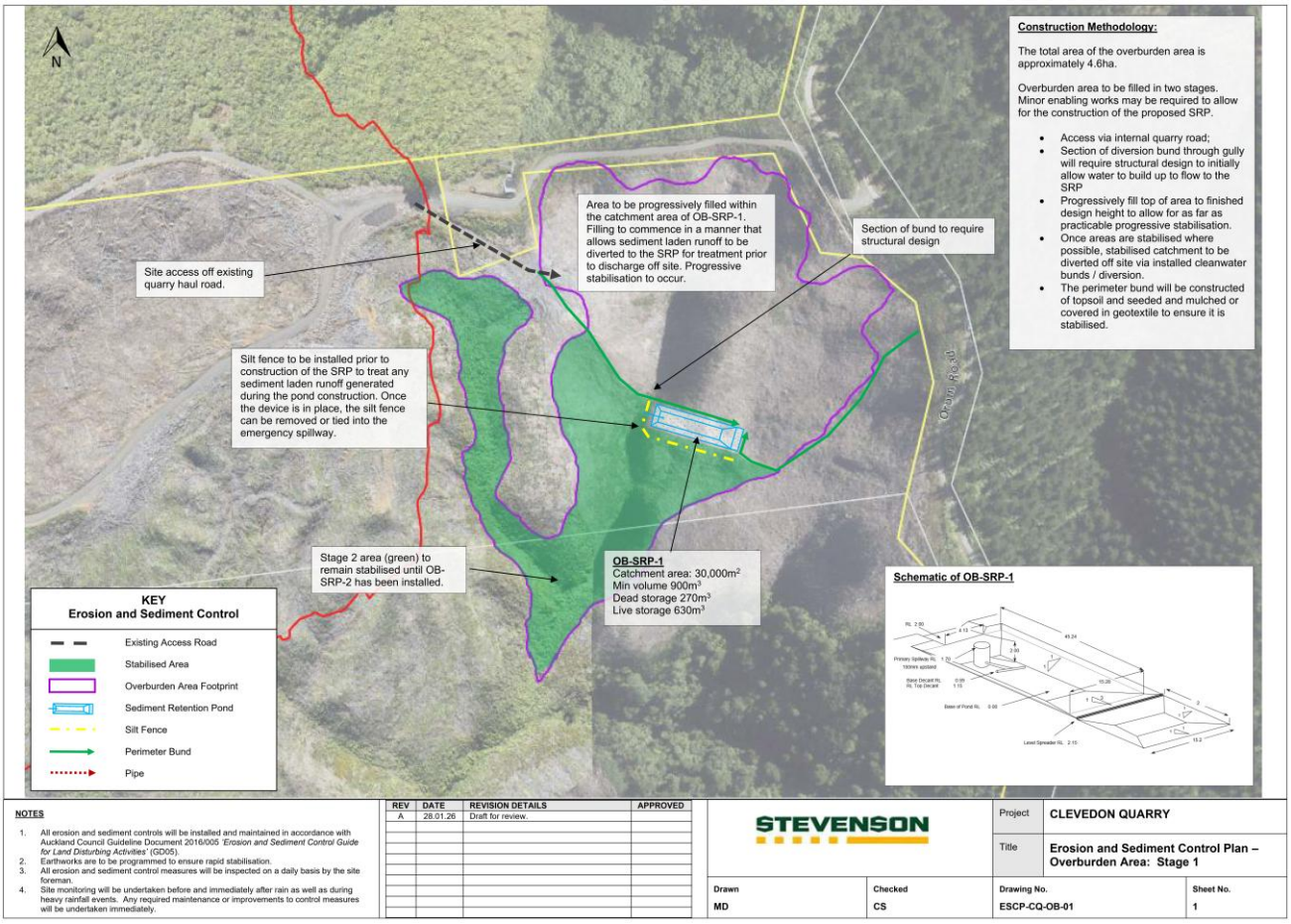


Figure 10: Overburden Disposal Area ESC – Stage 1

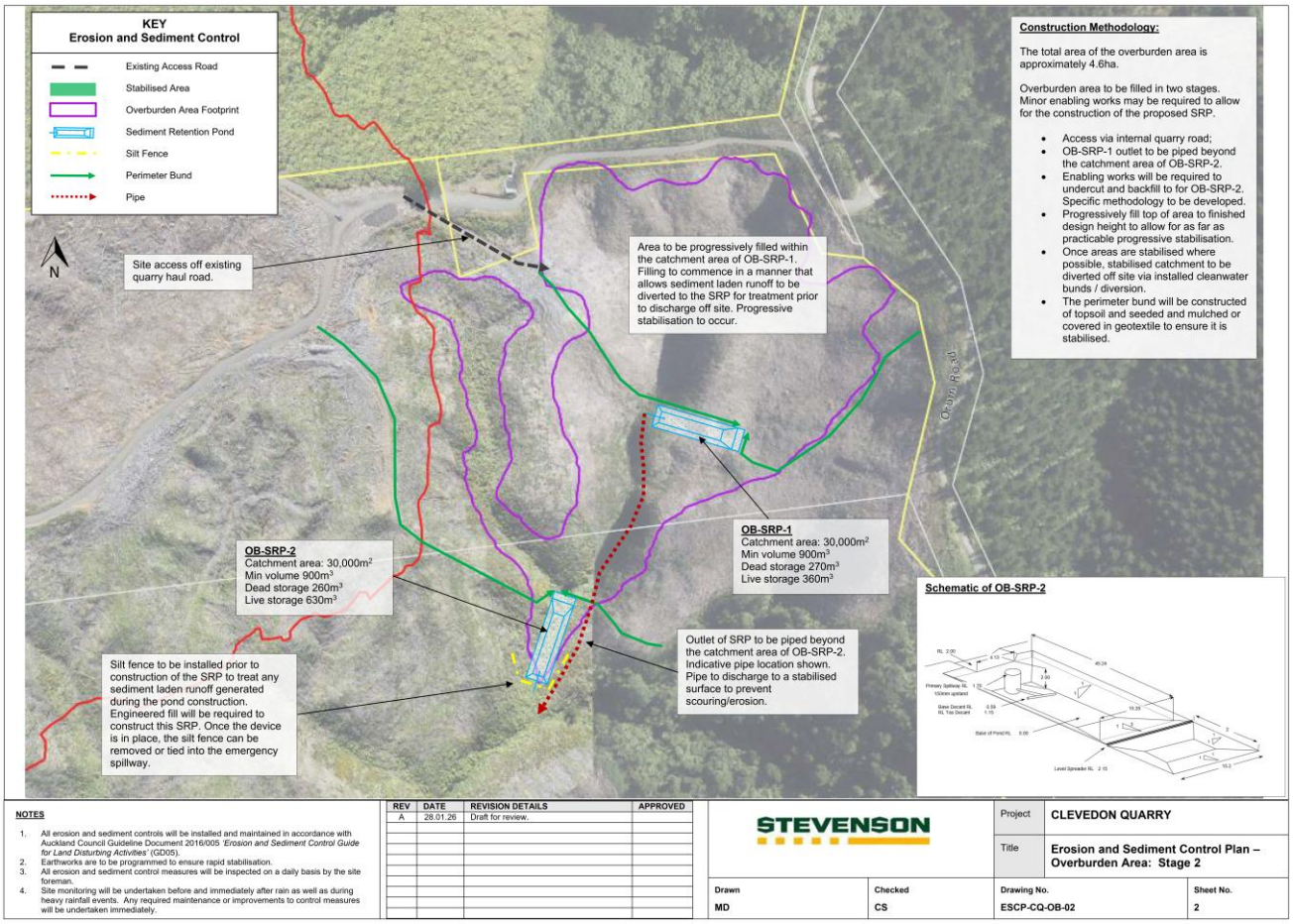


Figure 11: Overburden Disposal Area ESC – Stage 2

2.6 Chemical Treatment

The quarry operation will discharge to the quarry sediment sumps before being directed to the wetland water treatment system. Chemical treatment of the water treatment system is not anticipated. The water treatment system has been designed and sized to achieve high water quality standards without the need for chemical treatment.

In accordance with best practice, the SRPs to be installed for the OBDA will be chemically treated to enhance sediment retention efficiency. A Flocculation Management Plan (FMP) will be prepared and submitted to Council for certification prior to the commencement of overburden filling.

Chemically treated devices typically achieve 85-90%+ sediment removal efficiency. At the commencement the OBDA operations and throughout the works, monitoring and bench testing of the SRP will be undertaken in accordance with the FMP. The bench testing will include testing and analysis of several chemical options and will include "organic flocculants" to determine the best water quality outcome.

3. EROSION AND SEDIMENT CONTROL PHILOSOPHY AND PROCESSES

3.1 Objectives

The proposed quarry expansion is not considered 'traditional' earthworks. The water management systems will operate in the same manner as the existing Clevedon Quarry but with a newly designed and enlarged constructed wetland treatment system. Specifically, all site water will fall into the existing sump before being directed to the treatment system (sediment sumps and the wetland treatment system) with clean water, where practical, directed around the quarry area.

The ESCP objectives for the proposed quarry expansion are:

- To ensure that sediment discharges from the works are minimised to the greatest extent practical.
- To ensure that all ESC measures are designed and approved prior to works in a particular area.
- To ensure that all ESC measures are implemented prior to commencement of works in a particular area.
- To ensure that all contractual and regulatory requirements are met as a minimum standard.

These objectives will be measured by the project's ability to meet environmental targets as outlined below:

- No environmental or regulatory breaches (compliance with consent conditions; no prosecutions, enforcement orders, abatement or infringement notices received).
- Conduct regular environmental inspections.
- Induct all employees and subcontractors on the environmental rules and procedures relevant to the project.
- Include environment as a topic in project meetings and site talks.

3.2 Design

ESC devices for the enabling, and establishment works have been designed in accordance with the design principles of GD05, as a minimum.

The ESCP has been designed to accommodate operations being undertaken over the life of the quarry. This will provide flexibility in the management and operation of the quarry to meet the possible fluctuation of the demand of aggregate. It is expected that any updated ESCPs will be prepared and submitted to Auckland Council for certification in advance of any changes being made on site.

A set of ESC drawings with sizing specific to the enabling works to establish the new constructed wetland and to establish and operate the OBDA are provided in Appendix B for information. Actual staging and timing of the quarry development will be determined by the overall quarry management and demand for aggregate. The controls and methodologies have been designed to meet the site requirements and to meet the design philosophy of GD05.

As the quarry operations extend, upper catchment clean water will be directed around the quarry as far as practicable, while all site water will discharge to the quarry floor to be integrated into the Clevedon Quarry water management system. GD05 provides for a 'best management practice' approach to ESC for land disturbing activities developed by Auckland Council for the Auckland Region. The Clevedon Quarry water

management system (refer to sections above) provides additional control of water discharges over that achievable by an SRP. While best-practice GD05 devices such as SRPs are flow-through devices that pass water through during and immediately after rainfall, the quarry water management system provides mechanical control of when water is pumped from the sediment quarry sumps to meet the specific design specifications of the wetland treatment system.

The expansion of the quarry will be staged, and existing vegetation will be retained wherever possible, albeit noting that a large area of plantation forest within the proposed expansion footprint has recently been harvested.

Sizing and design information for the ESC measures are included in Appendix C. The general philosophies and strategies behind the ESCP are outlined below.

As-built drawings and an audit programme will ensure compliance with the design requirements and guidelines. Catchment areas (both clean and dirty) will adjust during the life of the quarry (this is discussed below) and regular audits and as-built revisions will be undertaken.

Areas will be stabilised as soon as practical and in a progressive manner.

3.3 Principles

The general principles to be adopted during the quarry expansion, and which have been incorporated into the ESCP, are as follows:

- Minimise the necessary area of disturbance as far as practically possible while meeting the development requirements of the site.
- Stage the establishment works and quarrying operations whilst progressively stabilising exposed areas following completion as far as practicable.
- Divert clean water runoff away from the active quarry works area as far as practicable, thus reducing the contributing catchment to the exposed working areas.
- Intercept, divert and impound any sediment laden runoff from exposed working areas to either prevent site discharge to the receiving environment (via the quarry floor) or as a minimum, provide treatment via sediment control devices prior to discharging into the downstream environment.
- Regularly inspect the ESC measures and undertake any maintenance necessary to maximise the sediment retention efficiency of the site.
- Undertake ongoing assessment of the ESC methodology and, if required, adjust as the work progresses.
- Ensure site staff are aware of the requirements of the ESCP and the relevant resource consent conditions.

3.4 Staging

As stated above, the quarry operations will be slowly expanded in a series of indicative stages. This will minimise the exposed area of the active quarry operations.

3.5 Review

The ESCP is a live document and will be revised / confirmed prior to the commencement of works to address:

- Final stage design;
- Associated confirmed construction methodologies; and

- Consent Conditions.

Commitment and continuous improvement to the environmental culture by management will be critical to its success and continuation. As part of continuous improvement, additional changes to the ESCP may be appropriate during the course of the quarry expansion.

These changes may be a result of:

- Any significant changes to construction activities or methods.
- Key changes to roles and responsibilities associated within the quarry expansion.
- Changes in industry best practice standards or recommended erosion and sediment controls.
- Changes in legal or other requirements (social and environmental legal requirements, Resource Consent conditions, Auckland Council objectives and relevant policies, plans, standards, specifications, and guidelines).
- Results of inspection and maintenance programmes, logs of incidents, corrective actions, internal or external assessments.
- The outcome of investigations into discharges of contaminants.

Reasons for making changes to the ESCP will be documented. Any new/updated version of the ESCP documentation will be issued with an updated version number and dated. A copy of the current ESCP document and subsequent versions will be kept for the Project records. Superseded versions will be marked as obsolete.

Any relevant revisions to the ESCP will be submitted to the Auckland Council for review and certification at least 10 days before becoming operational.

4. EROSION AND SEDIMENT CONTROL DETAILS

The erosion and sediment control methodology has been designed in accordance with best practice and the principles outlined in GD05. Note, only the enabling works to establish the proposed constructed wetland and the establishment and operations of the OBDA are considered general earthworks that will be treated via GD05 principles and controls.

All quarry expansion runoff will be controlled via the quarry sump and the quarry water management system (refer above).

Specific erosion and sediment control drawings are attached as Appendix A. Sizing and design details are provided in Appendix C.

4.1 Clean Water Diversions

Clean water diversions will be constructed to divert upper catchment clean water away from the area of work where practicable and for a long as possible. As the quarry footprint expands over time, temporary bunds and diversions will be constructed to ensure, as far as practicable, the objective of keeping clean water clean is achieved. Ultimately, the catchments will fall within the quarry footprint.

The clean water diversion bunds (for the earthworks) will likely be constructed using stripped topsoil and will be stabilised immediately following construction. This will likely include a perimeter bund around the extent

of works and stage boundaries and will be progressively installed (and removed) as the quarry operations progress.

Due to the undulating nature of the site, the maximum contributing clean water catchment area in any one area is approximately 2ha. To comply with GD05 the calculated minimum perimeter bund height installed across the site would be a minimum of 550mm to provide conveyance of the 5% AEP storm event, plus 300mm freeboard (see Figure 12 Appendix C). Calculations are provided in Appendix C for the clean water diversion bunds.

4.2 Dirty Water Diversions

Dirty water diversions will generally only be required for overburden works (establishment and operations). Once the quarry footprint excavation commences, all quarry site water will fall into the quarry floor.

The maximum contributing catchment area for the dirty water diversions is <5ha for all SRP catchments. To comply with GD05 the calculated minimum perimeter bund height installed across the site would be a minimum of 550mm to provide conveyance of the 5% AEP storm event, plus 300mm freeboard. Calculations are provided in Appendix C.

4.3 Sediment Retention Ponds

Two SRPs will be constructed for the management of the OBDA. Both devices have been sized for a maximum catchment area of 4ha. Both SRPs will discharge to Stream 3.

All SRPs have been sized and designed in accordance with GD05. Refer to Appendix C for the SRP sizing and dimensions.

4.5 Chemical Treatment

In accordance with best practice, the SRPs to be used to treat and manage the OBDA will be chemically treated to enhance sediment retention efficiency. A FMP will be prepared and submitted to Council for certification prior to the commencement of overburden filling.

4.6 Silt Fences

Silt fences will be used to treat site runoff from small areas that will not actively drain to an SRP or the quarry floor and around specific isolated works, especially the enabling works associated with the construction of the new constructed wetland treatment system and the establishment of the OBDA SRP's.

Silt fences will be installed below the footprint of the SRPs to capture any runoff generated during the construction of the ponds. Once the ponds are constructed the silt fences will be returned up either side of the emergency spillway to allow the spillway to function as designed.

4.7 As-Built Certification

Prior to earthworks and quarrying commencing within an area, as-builts for the ESCs for that area will be provided to Auckland Council. The as-built certification will confirm that the controls have been constructed in accordance with the ESCP and GD05.

4.8 Stockpiles

In general, any overburden material will be removed to the OBDA.

Other than the designated OBDA, any stockpiling will be minor, temporary, and within the catchment devices of the SRPs or the quarry floor. Any temporary stockpiles will be seeded and mulched on completion.

Topsoil

Initially topsoil will be temporarily stockpiled within the catchment areas of the SRPs and/or used for clean water (perimeter) bunds as the stages progress. Topsoil stripped during future stages of the quarry will be used to close out completed areas of the OBDA or removed off site.

4.9 Dust Management

Dust management will be managed in accordance with the Air Quality Assessment prepared by PDP (refer to Technical Report attached to the AEE).

4.10 Stabilisation

Progressive stabilisation will be undertaken as earthwork areas are completed. Note, this excludes the quarrying operations that are operating and working in rock. As stated above, any stockpiles will be stabilised immediately upon completion. As the OBDA is progressively filled, topsoil will be re-spread, and the completed area stabilised with grass seed and hay mulch.

4.11 Winter Works

The quarry establishment/enabling activities are a continuous activity throughout the year. The establishment and management of the OBDA will need to align with the quarry expansion works. Once the pit expansion operations commence all site construction water will drain to the quarry floor and is then incorporated into the Clevedon Quarry Water Management System. As such, a winter works restriction is not necessary as works during winter will not result in an unacceptable high risk of elevated sediment discharge.

4.12 Monitoring and Maintenance

All erosion and sediment control measures and methodologies will be monitored and maintained during the works in accordance with GD05. Monitoring will be undertaken before and immediately after rain events as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately, as soon as practically safe to do so.

Sediment deposits and bulges against any silt fences will be removed before sediment accumulation reaches 20% of the fabric height.

The SRPs will be cleaned out before accumulated sediment volume reaches 20% of the total volume. Forebays will be cleaned out if there is any evidence of sediment deposition.

Construction water from the quarry operations will be managed via a controlled pumping system. The pump will take water from the top of the quarry sediment retention sumps. From the sediment retention sumps, the water will discharge via gravity to the constructed wetland treatment system. The controlled pumping system will be set at a rate to ensure that the wetland treatment design water quality flow rate is not exceeded.

5. ESTIMATED SEDIMENT YIELD

An estimate of sediment yield for the works that are to be treated via GD05 devices (the enabling works and

the OBDA stockpile) has been developed using the Universal Soil Loss Equation (USLE). It is noted that the quarry operations are not part of this USLE assessment. The USLE model is based on soil erodibility and cannot effectively model the minimal erosion that will occur from low erodibility surfaces such as rock (aggregate).

A soil erodibility factor (K-factor) is a key input into the model, derived from the percentage of sand, silt and clay in the soil. A K-factor cannot be derived from rock or aggregate.

Moreover, the management of runoff from those quarry surfaces is contained within the quarry and not via a typical sediment retention device.

The table of results of these estimates are provided in Appendix A and discussed in Section 7 below. In brief:

- The OBDA will be established in a staged and progressive manner as overburden is produced. The total area of the OBDA is approximately 4.6ha. It is assumed to have an average open area of 3ha during operations.
- The OBDA is estimated to generate 3.63 tonnes per year, from a 3ha operating footprint, representing an increase from the existing current land use estimated runoff of approximately 0.34 tonnes, situation of a less than 0.3% increase in the load derived from the existing catchment each year.
- Two SRPs will be installed to treat runoff from the OBDA. The SRP's will discharge to Stream 3, which discharge to the Wairoa River approximately 2km from the OBDA. The filling and establishment of the OBDA will be staged. In addition, the overburden bund batters will be progressively stabilised as the fill levels are lifted.

6. STATUTORY CONSIDERATIONS

6.1 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management 2020 (NPSFM) contains an objective and 15 policies relating to the management of water quality and quantity, and any activities that may impact on those attributes, within the concept of Te Mana o te Wai, being:

> *the fundamental importance of water and recognises that protecting the health of freshwater protects the health and well-being of the wider environment. It protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community*.

These provisions have been taken into account in the preparation of this ESCP. The adoption of the measures detailed in the ESCP are anticipated to manage and mitigate sediment loading downstream to achieve a level of water quality management that I consider will be consistent with the objectives and policy direction of the NPSFM and in accordance with Te Mana o te Wai.

6.2 Auckland Unitary Plan: Operative in Part

Chapter B7 (Natural Resources) of the Regional Policy Statement is relevant. B7.3 seek to ensure the enhancement of degraded freshwater systems, freshwater system loss is minimised, and that any adverse effects are avoided, remedied, or mitigated. B7.4 seeks to maintain water quality in freshwater bodies and coastal waters which have good water quality, and to enhance the water quality in degraded systems.

Chapter E3 (Lakes, rivers, streams, and wetlands) of the AUP: OP provides regional plan provisions that are of most relevance to this proposal. Those provisions are Objectives E3.2 (1) to (5) and (7) and Policies E3.3

(2), (3), (7) and (8). These objectives and policies seek to ensure that activities in, on, under or over the bed of a lake, river, stream, and wetland are managed to minimise adverse effects on the lake, river, stream, or wetland.

Chapter E11 (Land Disturbance – Regional) of the AUP: OP provides the regional plan provisions directly relevant to earthworks. Those provisions are Objectives E11.2 (1)-(3) and Policies E11.3 (1)-(7).

Rule E11.8.2(1) provides the assessment criteria for consideration of the regional earthwork's activities. These are:

(a) whether applicable standards are complied with;

(b) the proximity of the earthworks to any water body and the extent to which erosion and sediment controls and the proposed construction methodology will adequately avoid or minimise adverse effects on: E11 Land disturbance – Regional Auckland Unitary Plan Operative in part 19

(i) water quality including of the coastal marine area;

(ii) ecological health including of the coastal marine area;

(iii) riparian margins;

(iv) the mauri of water; and

(v) the quality of taiāpure or mahinga mātaitai.

(c) the extent to which the earthworks minimises soil compaction, other than where it benefits geotechnical or structural performance;

(d) the proximity of the earthworks to areas of significant ecological value and the extent the design, location and execution of the works provide for the maintenance and protection of these areas;

(e) whether monitoring the volume and concentration of sediment that may be discharged by the activity is appropriate within the scale of the proposed land disturbance; and

(f) whether the extent or impacts of adverse effects from the land disturbance can be mitigated by managing the duration, season or staging of such works.

(g) the extent to which appropriate methods are used to prevent the spread of total control pest plants or unwanted organisms (as listed under the Biosecurity Act 1993), such as kauri dieback disease.

These provisions have been taken into account in the preparation of this ESCP. The adoption of the measures detailed in the ESCP are anticipated to manage and mitigate sediment loading downstream to achieve a level of water quality management that I consider will be consistent with the objectives and policy direction of the AUP: OP.

7. ASSESSMENT OF EFFECTS

The assessment of sediment yield from a large-scale project is uncertain and based on multiple assumptions. Any changes to an assumption can drastically alter the estimated yields.

In the specific case of the proposed Clevedon Quarry Expansion, only the enabling works to establish the new constructed wetland treatment system, and the establishment and operation of the OBDA is considered "traditional" earthworks and will utilise GD05 erosion and sediment control. This establishment phase covers a relatively small area over a short timeframe in the context of the quarry life. The operation of the OBDA will be operational for approximately 10 years. The OBDA will then be completed and planted.

The placement of material will align with the initial expansion stages of the quarry. There will be a period when the quarry footprint is static and only minor volumes of overburden will be taken to the OBDA. This will allow for periods when additional areas of the disposal site can be temporarily stabilised.

Once the proposed constructed wetland treatment system is formed, the quarry sump-controlled water management system takes over as the water management and treatment process for the site.

As described in previous sections, the proposed ESC approach is based on minimising the area exposed to erosion at any given time, implementing best-practice ESC measures, and diverting runoff from quarry operations to the quarry sump and to then be controlled and managed through the quarry constructed wetland water treatment system.

The estimate of sediment yield indicates that the FoH enabling works may result in a 0.9% to 2.1% increase in sediment yield from the catchment at the downstream extent of the works site during the establishment stage. Likewise, the operation of the OBDA may result in a less than 0.5% increase in sediment yield, estimated at that same downstream point.

As noted, the assumptions underlying the estimates are deliberately conservative i.e., the characteristics of the works site and further staging and reduction of open areas are likely to result in lower estimated and actual sediment yields. Similarly, it is important to note that the USLE estimates are not directly representative of actual sediment yield (loads). They provide a means of comparative analysis, and also assist the refinement of ESCPs to minimise likely sediment yield to the greatest extent practicable.

The proposed ESC methodology is the best practicable option for the proposed quarry expansion. It represents best-practice control measures, staged establishment, quarrying activities, and progressive stabilisation. It is consistent with the industry-leading approach that has appropriately minimised sediment discharges and downstream effects on multiple projects throughout the Auckland Region.

The constructed wetland establishment phase earthworks will be staged to fit around quarry operations. The efficiency of the ESC system will be further enhanced from the staging of works and progressive stabilisation, thus reducing the potential area exposed to erosion.

The quarry operation captures all site water within the sumps. Where it currently discharges via both overland and underground flow paths to an existing SRP, the system will be replaced with a significantly enhanced and enlarged wetland water treatment system.

The proposed approach to ESC as described in this report, and the corresponding assessment of potential effects therein, is provided as a technical expert. To the extent that my understanding of the life supporting capacity of receiving waters and habitats overlaps with mauri, wairua and other concepts of significance to Mana Whenua, I am satisfied that the proposed approach to ESC management will acceptably minimise potential sediment effects. On that basis, the potential discharge of treated sediment laden water during the earthworks, streamworks and subsequent quarrying operations has taken account of the relevant assessment criteria and would in my opinion, on a technical basis, be consistent with relevant policies including those that direct our consideration to matters of significance to Mana Whenua.

Overall, within the scope of my technical assessment, I consider the proposal to be consistent with the relevant provisions of the AUP: OP. The more detailed planning assessment is provided in the AEE.

On this basis, the ESC measures proposed for the establishment works and quarrying activity and predicted sediment discharges are anticipated to be consistent with the relevant statutory provisions and contribute to the outcomes they seek to achieve with respect to water quality and downstream environments.

8. SUMMARY

This ESCAR and ESCP addresses the proposed ESC measures associated with the earthworks and quarrying activities proposed to be undertaken on site for the Clevedon Quarry Expansion at the existing Clevedon Quarry site, located at 546 McNicol Road, Clevedon.

The expanded quarrying activities are estimated to continue for approximately up to 50 years.

The works will be carried out in accordance with this ESCP, the principles of GD05 and the relevant conditions of consent. The methodology proposed should ensure that any potential adverse effects of the construction of the project are appropriately managed and minimised.

9. APPENDICES

SOUTHERNSKIES ENVIRONMENTAL

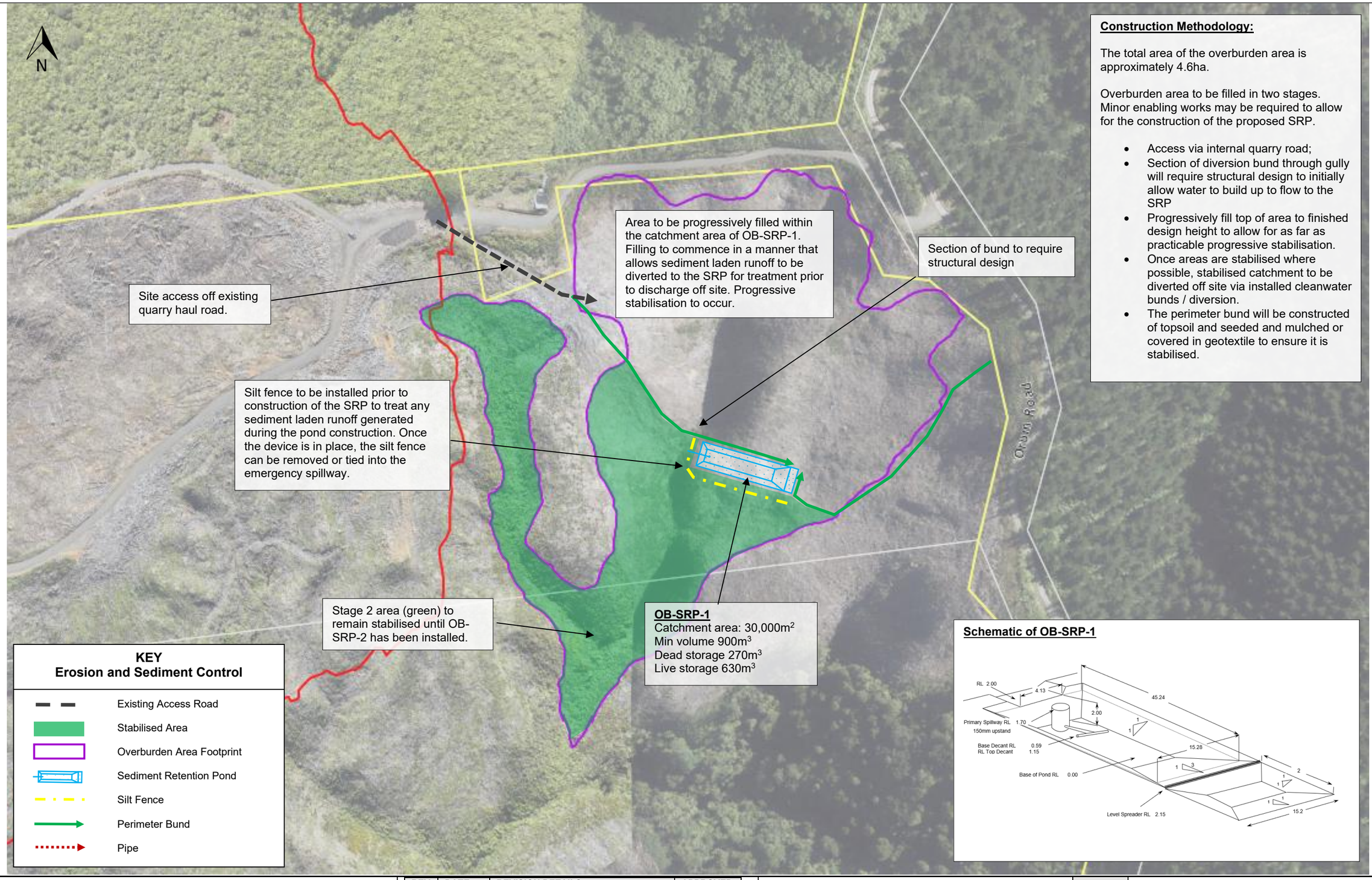
Appendix A – Summary of USLE Results

Table 1: Summary of USLE Results.

Stream	Earthworks area total (ha)	Indicative USLE Catchment calculations	Sediment yield earthworks (t/ha/yr)	Sediment load earthworks (t/yr)	Sediment yield from existing land within earthworks footprint (t/ha/yr) (using same indicative USLE catchment)	Sediment load from existing land within Project earthworks footprint (t/yr)	Sediment load difference: existing minus earthworks (t/yr)	Stream Catchment (ha)	Catchment Sediment Load (based on USLE existing land assumptions)	Catchment sediment load increase (catchment sediment load + sediment load difference)	catchment t/yr increase	% catchment increase	average catchment t/ha/yr	Earthworks area as % of catchment
							2.01							
Stream 1			0.24					110.00	26.10	28.11	2.01	7.1%	0.26	1.2%
Establishment stage 1	1.00	2.18	2.18	2.18	0.24	0.24	1.94	110	26.4	28.34	1.94	6.85%	0.258	0.9%
Establishment stage 2 - 3	0.30	0.14	0.47	0.14	0.24	0.07	0.07	110	26.4	26.47	0.07	0.26%	0.24	0.3%
total establishment phase	1.30			2.32		0.31	2.01							
Stream 3			1.097					114	125.058	125.40	0.34	0.3%	1.10	2.6%
Overburden Stockpile *	3.00	3.63	1.21	3.63	1.097	3.29	0.34	114	125.058	125.40	0.34	0.3%	1.10	2.6%

* Note total area of stockpile is approximatelty 4.6ha. The stockpile will be staged, with no greater than a maximum of 4ha exposed at any one time. The annual average is expected to be less than 3ha.

Appendix B - Erosion and Sediment Control Drawings



Construction Methodology:

The total area of the overburden area is approximately 4.6ha.

Overburden area to be filled in two stages. Minor enabling works may be required to allow for the construction of the proposed SRP.

- Access via internal quarry road;
- Section of diversion bund through gully will require structural design to initially allow water to build up to flow to the SRP
- Progressively fill top of area to finished design height to allow for as far as practicable progressive stabilisation.
- Once areas are stabilised where possible, stabilised catchment to be diverted off site via installed cleanwater bunds / diversion.
- The perimeter bund will be constructed of topsoil and seeded and mulched or covered in geotextile to ensure it is stabilised.

Schematic of OB-SRP-1

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	28.01.26	Draft for review.	

STEVENSON

Project	**CLEVEDON QUARRY**
Title	**Erosion and Sediment Control Plan – Overburden Area: Stage 1**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-CQ-OB-01	1

KEY
Erosion and Sediment Control

- Existing Access Road
- Stabilised Area
- Overburden Area Footprint
- Sediment Retention Pond
- Silt Fence
- Perimeter Bund
- Pipe

N

Site access off existing quarry haul road.

Area to be progressively filled within the catchment area of OB-SRP-1. Filling to commence in a manner that allows sediment laden runoff to be diverted to the SRP for treatment prior to discharge off site. Progressive stabilisation to occur.

Construction Methodology:

The total area of the overburden area is approximately 4.6ha.

Overburden area to be filled in two stages. Minor enabling works may be required to allow for the construction of the proposed SRP.

- Access via internal quarry road;
- OB-SRP-1 outlet to be piped beyond the catchment area of OB-SRP-2.
- Enabling works will be required to undercut and backfill to for OB-SRP-2. Specific methodology to be developed.
- Progressively fill top of area to finished design height to allow for as far as practicable progressive stabilisation.
- Once areas are stabilised where possible, stabilised catchment to be diverted off site via installed cleanwater bunds / diversion.
- The perimeter bund will be constructed of topsoil and seeded and mulched or covered in geotextile to ensure it is stabilised.

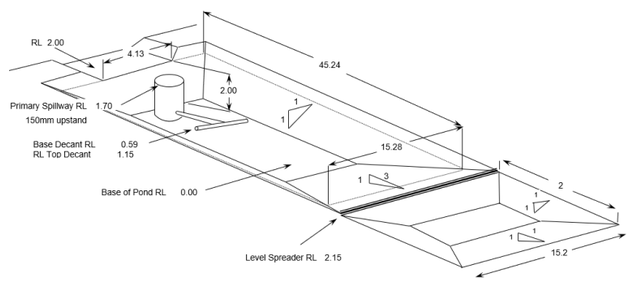
OB-SRP-2
Catchment area: 30,000m^2
Min volume 900m^3
Dead storage 260m^3
Live storage 630m^3

OB-SRP-1
Catchment area: 30,000m^2
Min volume 900m^3
Dead storage 270m^3
Live storage 360m^3

Silt fence to be installed prior to construction of the SRP to treat any sediment laden runoff generated during the pond construction. Engineered fill will be required to construct this SRP. Once the device is in place, the silt fence can be removed or tied into the emergency spillway.

Outlet of SRP to be piped beyond the catchment area of OB-SRP-2. Indicative pipe location shown. Pipe to discharge to a stabilised surface to prevent scouring/erosion.

Schematic of OB-SRP-2



NOTES

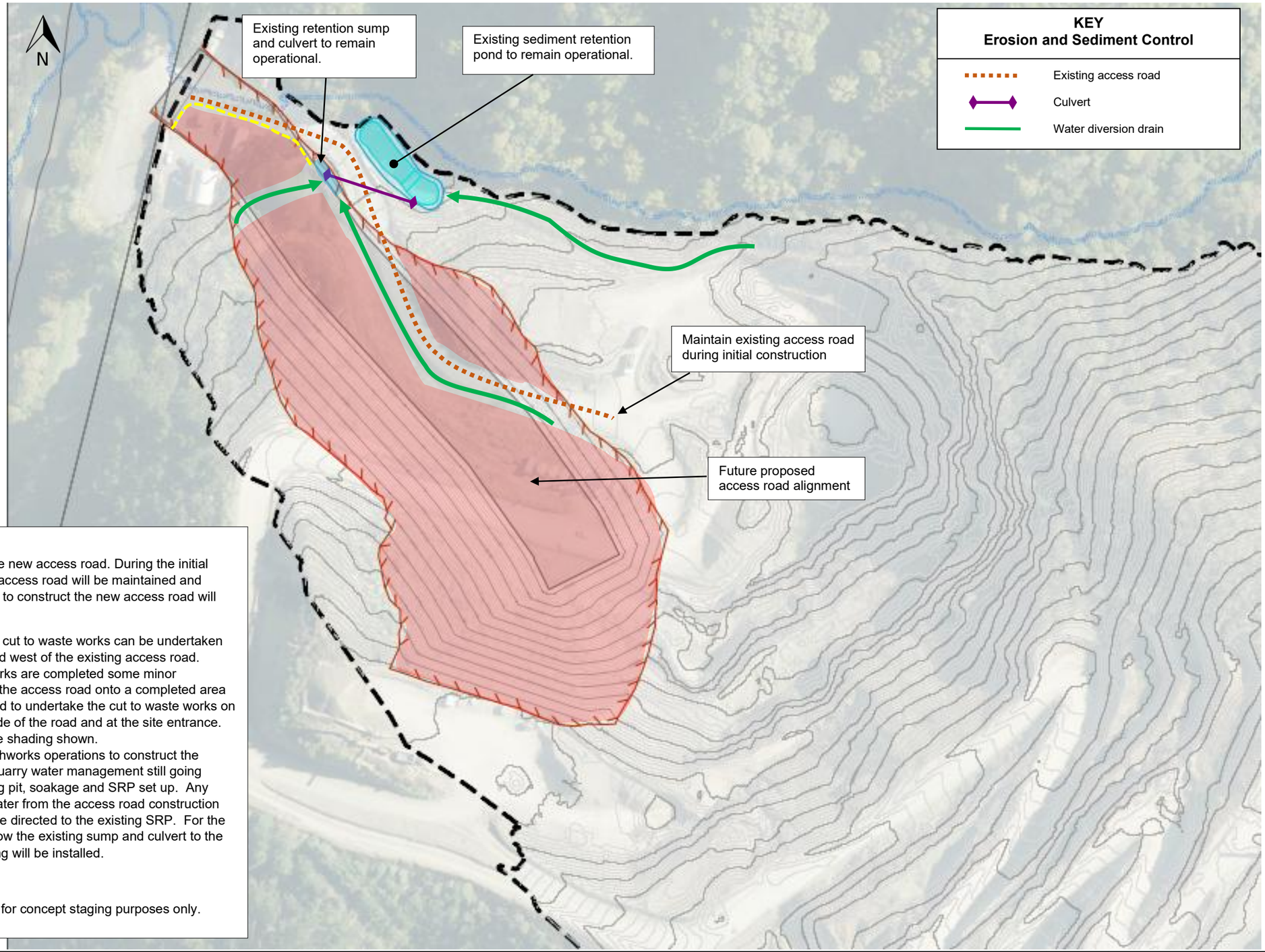
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	28.01.26	Draft for review.	

STEVENSON

Project	**CLEVEDON QUARRY**
Title	**Erosion and Sediment Control Plan – Overburden Area: Stage 2**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-CQ-OB-02	2



Concept Stage 1:

Establishment of the new access road. During the initial works, the existing access road will be maintained and operational. Works to construct the new access road will commence.

1. The bulk of the cut to waste works can be undertaken to the south and west of the existing access road. Once these works are completed some minor realignment of the access road onto a completed area may be required to undertake the cut to waste works on the northern side of the road and at the site entrance. Indicative stage shading shown.
2. During the earthworks operations to construct the access road, quarry water management still going through existing pit, soakage and SRP set up. Any construction water from the access road construction operation will be directed to the existing SRP. For the minor area below the existing sump and culvert to the SRP, silt fencing will be installed.

Note indicative and for concept staging purposes only.

GENERAL EROSION AND SEDIMENT CONTROL NOTES

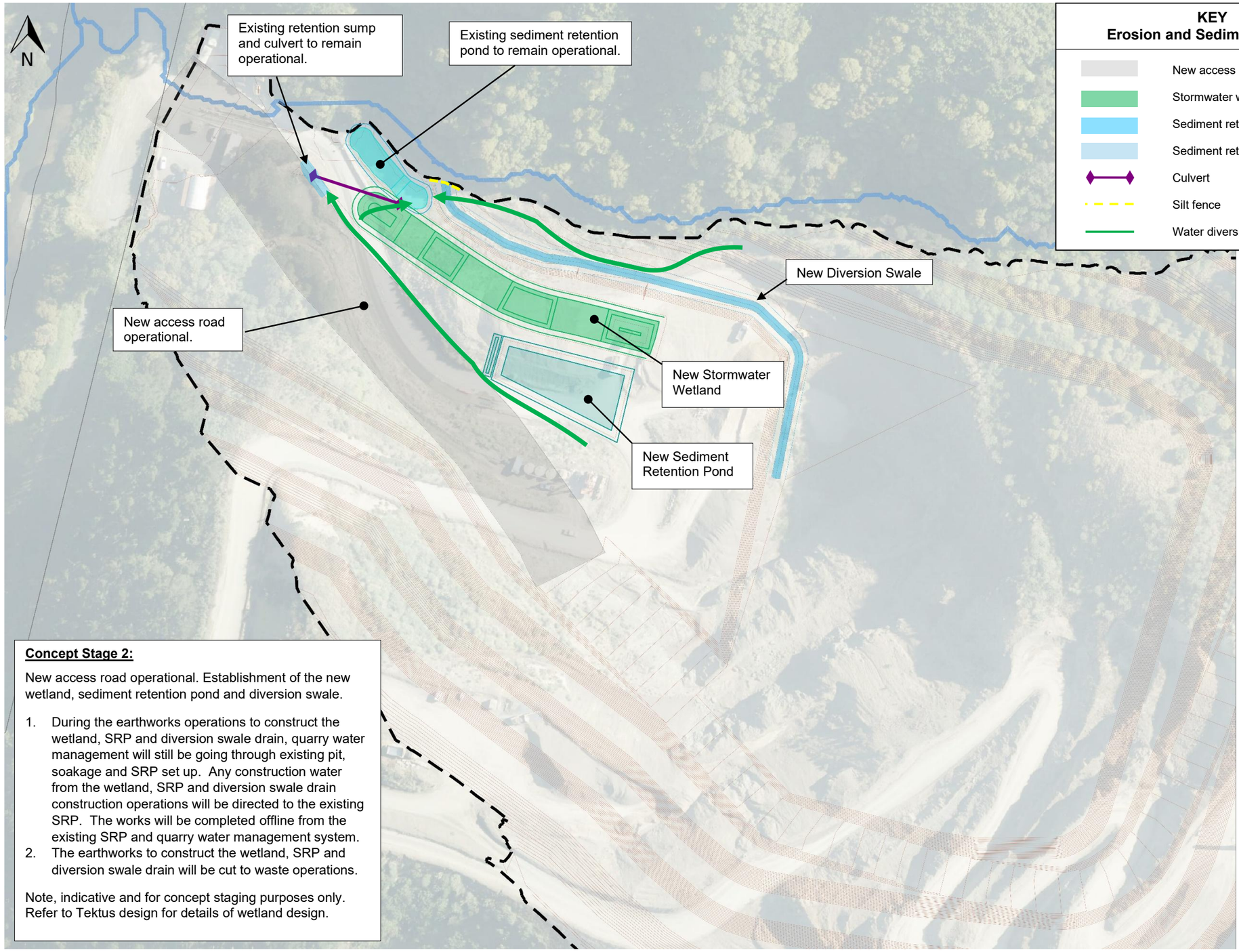
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure progressive stabilisation.
3. All erosion and sediment control measures will be inspected on a regular basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	28.01.26	Draft for review.	
B	15.06.26	Draft for review – updated Tektus wetland details	

STEVENSON

Project	**CLEVEDON QUARRY**
Title	**Erosion and Sediment Control Plan – SW Wetland Staging Concept: Stage 1**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-CQ-SW-01	1



Concept Stage 2:

New access road operational. Establishment of the new wetland, sediment retention pond and diversion swale.

1. During the earthworks operations to construct the wetland, SRP and diversion swale drain, quarry water management will still be going through existing pit, soakage and SRP set up. Any construction water from the wetland, SRP and diversion swale drain construction operations will be directed to the existing SRP. The works will be completed offline from the existing SRP and quarry water management system.
2. The earthworks to construct the wetland, SRP and diversion swale drain will be cut to waste operations.

Note, indicative and for concept staging purposes only. Refer to Tektus design for details of wetland design.

GENERAL EROSION AND SEDIMENT CONTROL NOTES

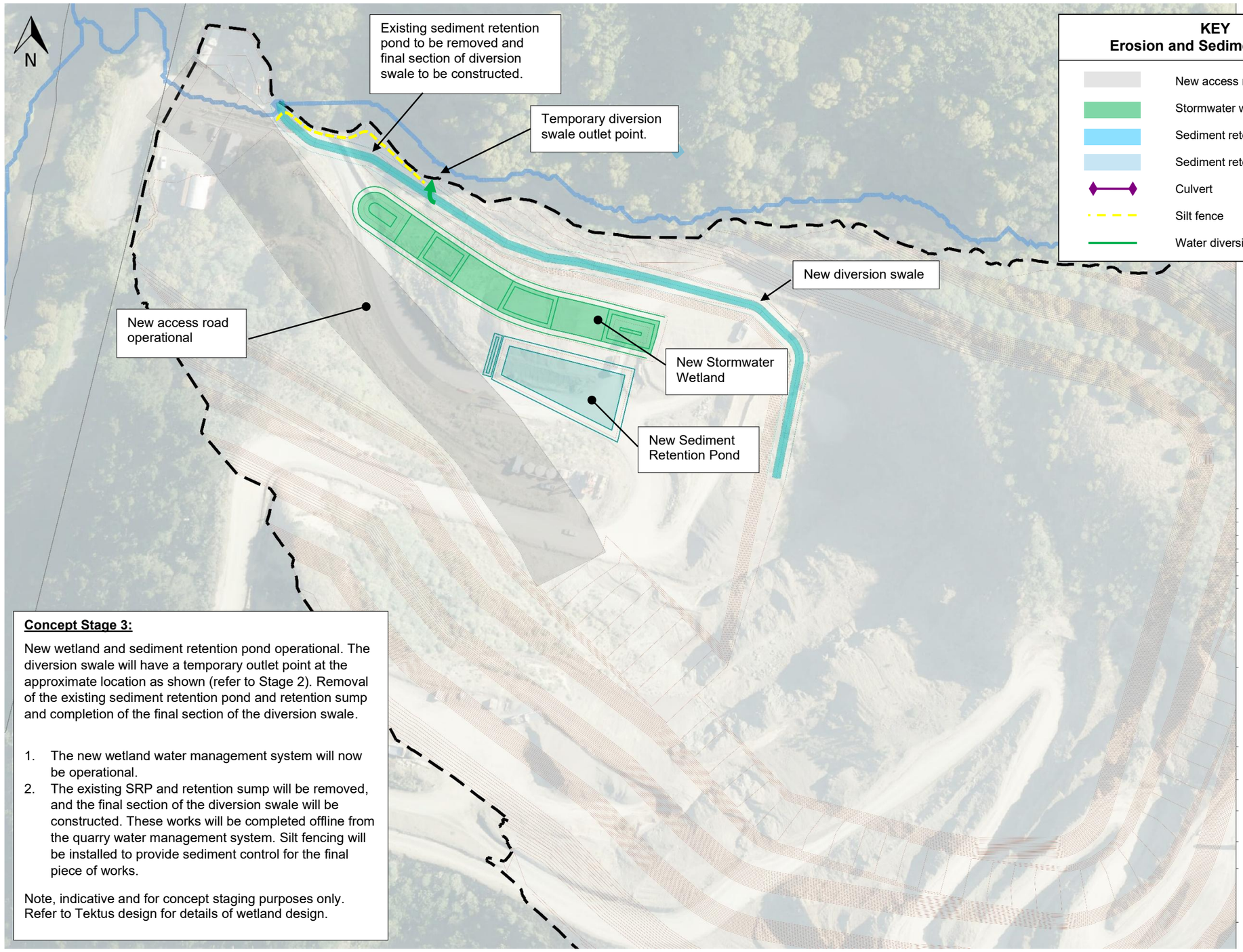
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure progressive stabilisation.
3. All erosion and sediment control measures will be inspected on a regular basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	28.01.26	Draft for review.	
B	15.06.26	Draft for review – updated Tektus wetland details	

STEVENSON

Project	**CLEVEDON QUARRY**
Title	**Erosion and Sediment Control Plan – SW Wetland Staging Concept: Stage 2**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-CQ-SW-02	2



Concept Stage 3:

New wetland and sediment retention pond operational. The diversion swale will have a temporary outlet point at the approximate location as shown (refer to Stage 2). Removal of the existing sediment retention pond and retention sump and completion of the final section of the diversion swale.

1. The new wetland water management system will now be operational.
2. The existing SRP and retention sump will be removed, and the final section of the diversion swale will be constructed. These works will be completed offline from the quarry water management system. Silt fencing will be installed to provide sediment control for the final piece of works.

Note, indicative and for concept staging purposes only. Refer to Tektus design for details of wetland design.

GENERAL EROSION AND SEDIEMNT CONTROL NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure progressive stabilisation.
3. All erosion and sediment control measures will be inspected on a regular basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	28.01.26	Draft for review.	
B	15.06.26	Draft for review – updated Tektus wetland details	

STEVENSON

Project	**CLEVEDON QUARRY**
Title	**Erosion and Sediment Control Plan – SW Wetland Staging Concept: Stage 3**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-CQ-SW-03	2

Appendix C - Erosion and Sediment Control Construction Details

Calculations are provided in Table 2 below for the clean water diversion bunds.

Table 2: Clean water diversion bunds (standard earthworks) assuming maximum clean water area for the site.

Clean water diversions					
Rainfall depth (24hr 5% AEP)	Catchment Area (maximum)	Peak Flow (m^3/s)	Slope (minimum)	Minimum Design Flow Depth	Design Flow Depth (including 300mm freeboard)
140mm	2ha	0.637	2%	250mm	550mm

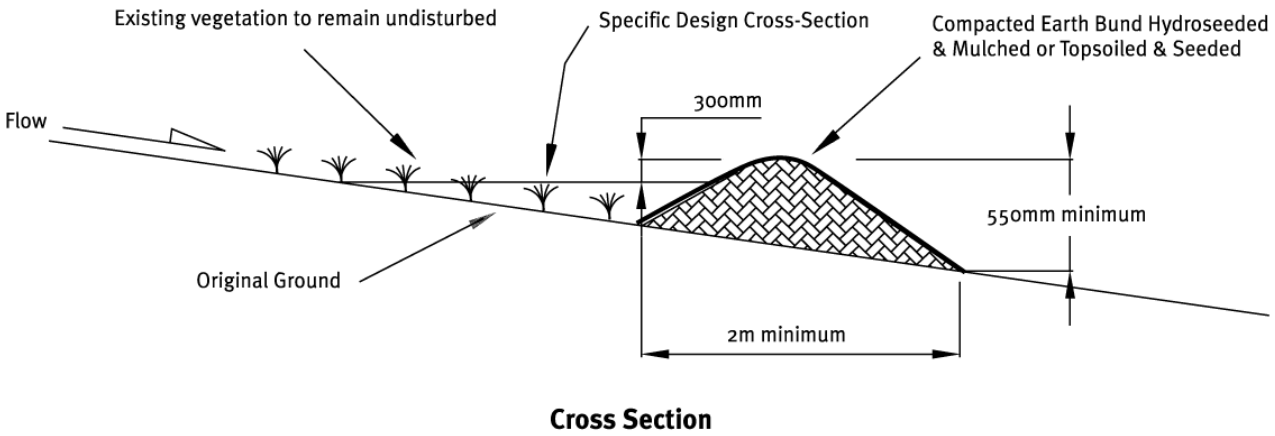


Figure 12: Cross-section of a clean water diversion bund.

Calculations are provided in Table 3 below for the dirty water diversion bunds.

Table 3: Dirty water diversion bunds assuming maximum dirty water area of 5ha.

Perimeter bunds (dirty water diversion)						
Rainfall depth (24hr 5% AEP)	Catchment Area (maximum)	Peak Flow (m^3/s)	Base Width	Slope (minimum)	Minimum Design Flow Depth	Design flow depth (including 300mm freeboard)
140mm	5ha	1.061	0.6m	2%	250mm	550mm

The minimum bund height installed across the site will be 550mm (250mm plus 300mm freeboard), which is designed to convey the 5% Annual Exceedance Probability (AEP) storm (see Figure 13).

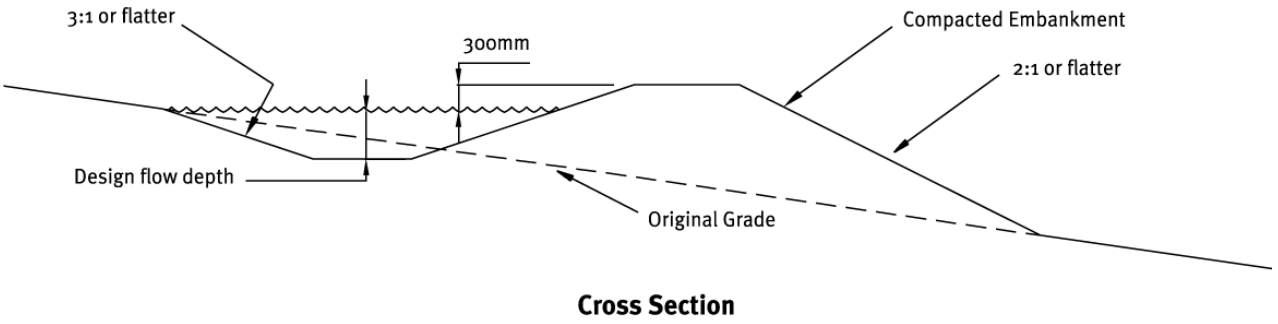


Figure 13: Cross-section of a dirty water diversion.

Figure 14 provides a schematic of silt fences that may be used on the project.

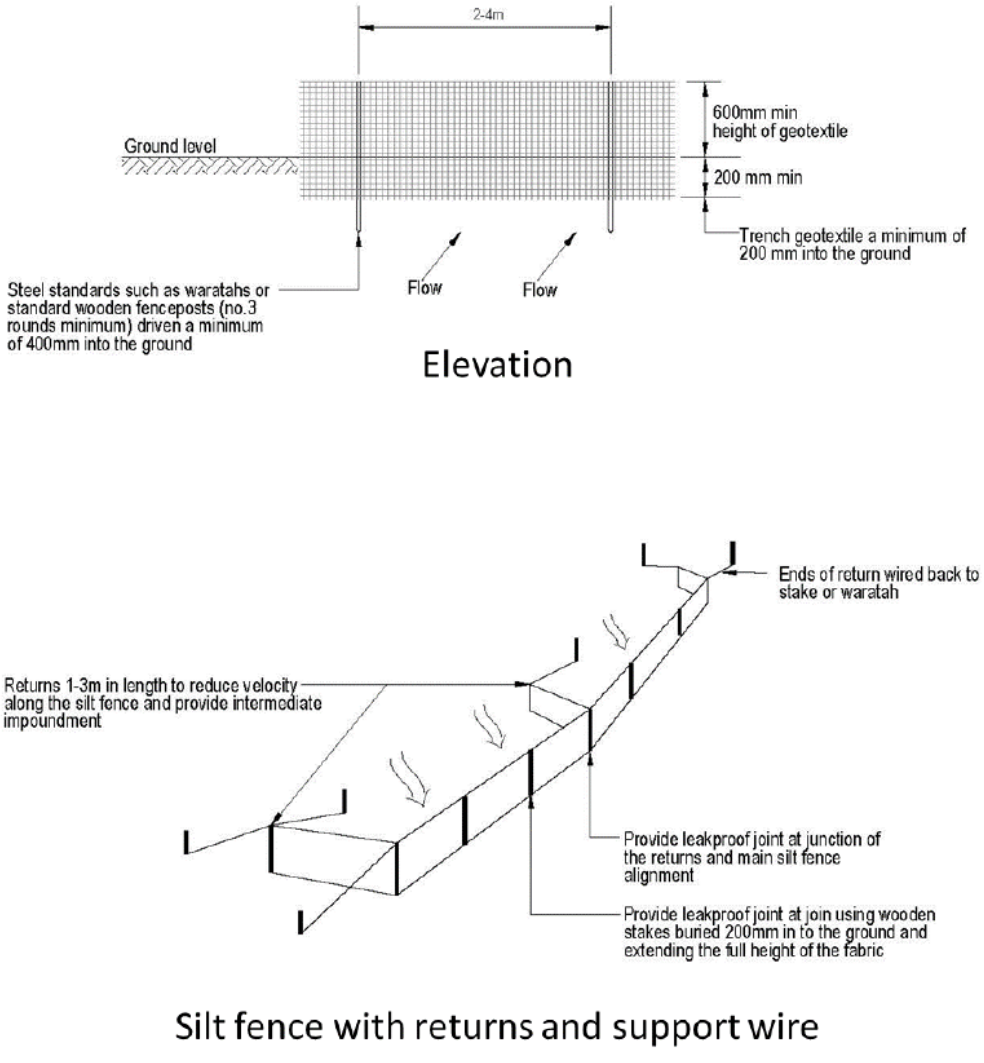


Figure 14: Schematic of a silt fence.

Table 4: Silt fence design criteria.

Slope Steepness (%)	Slope Length (m) (Maximum)	Spacing of Returns (m)	Silt fence Length (m) (Maximum)
Flatter than 2%	Unlimited	N/A	Unlimited
2 - 10%	40	60	300
10 - 20%	30	50	230
20 - 33%	20	40	150
33 - 50%	15	30	75
> 50%	6	20	40