SOUTHERNSKIES ENVIRONMENTAL

Chemical Treatment Management Plan

Huntly Quarry – Fill 5

Riverview Road,
Huntly

March 2021

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1.0 INTRODUCTION

SouthernSkies Environmental (SouthernSkies) has been engaged by Gleeson Quarries Ltd to prepare a Chemical Treatment Management Plan (CTMP) to provide treatment for the earthworks associated with Fill Area 5 (Fill 5) at the Huntly Quarry.

Fill 5 is located to the north of the existing quarry with a total catchment area of 3.56ha. Bench testing of soil samples from the fill site has previously been completed by Erosion Management Ltd. The bench test results are detailed in the Erosion and Sediment Control Plan provided in Appendix C.

The bench tests identify that a dose rate of 4mg/L of Aluminium per litre is proposed to be used on site. This is equivalent to 62mls of PAC to 1 cubic meter of sediment laden runoff.

Ongoing monitoring of treated sediment retention devices will also be required, as outlined in Appendix B of this CTMP. If the monitoring highlights any deficiencies further bench testing will be undertaken.

This CTMP details the flocculation system that will be implemented on the site to treat the sediment laden runoff during the earthworks and filling phase. The proposed system is designed to treat one Sediment Retention Pond (Pond 5) as detailed in the Erosion and Sediment Control Plan prepared by Erosion Management Ltd. Additionally, a batch doing methodology has also been provided.

2.0 RECOMMENDED FLOCCULATION SYSTEM

2.1 Rainfall Activated Dosing System

The rainfall activated dosing system has been developed specifically for earthworks sites. The system uses a rainfall catchment tray to capture rainfall with the size of the tray being determined by the required chemical dose and the land catchment size.

Rainwater caught by the catchment tray is piped into a header tank, and then into a 400L displacement tank which floats in a larger tank containing the flocculant filled to the level of an outlet pipe leading to the sediment laden diversion about 10m upstream of the sediment control device. The greater the rate of rainwater flow into the displacement tank the greater the flow of flocculant into the sediment laden runoff channel. The header tank is designed to provide for no dosing during the initial rainfall of up to 12mm of rain under dry conditions, and for attenuation of the chemical flow during the initial stages of a storm and after rain has ceased at the end of a storm.

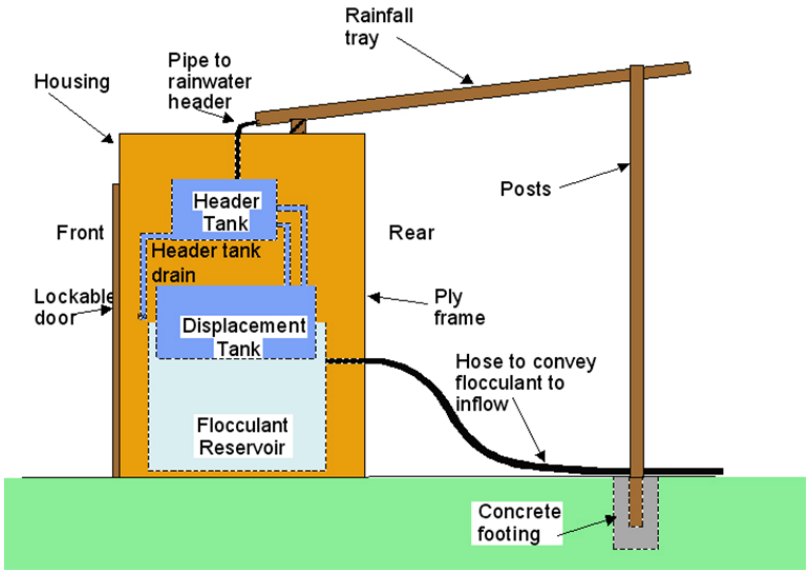

Figure 1: Traditional floc shed schematic.

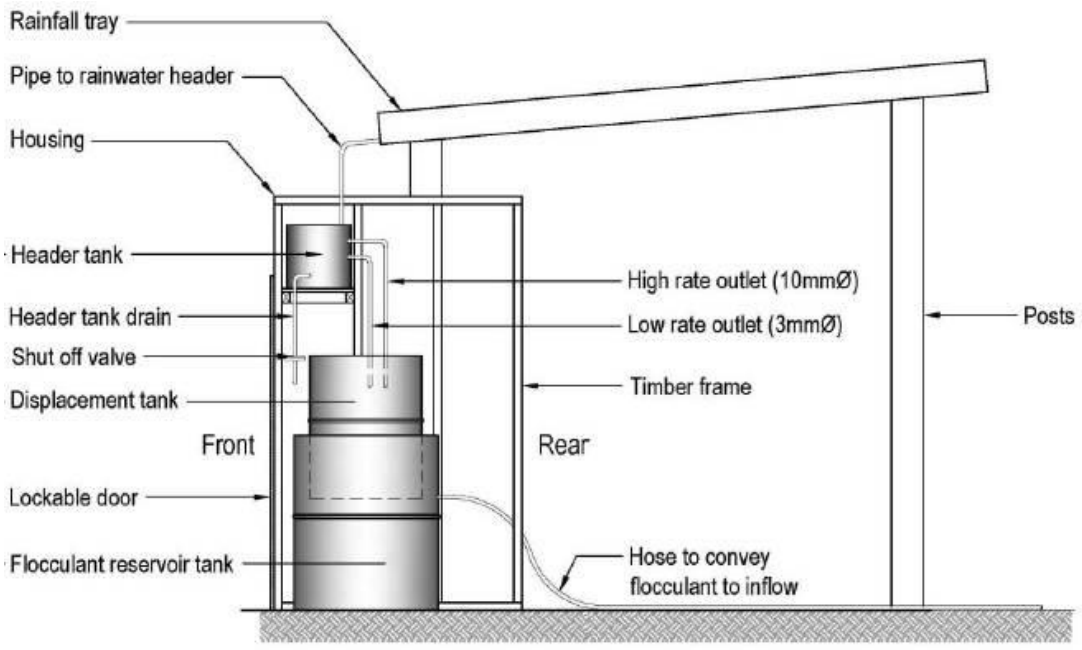

Figure 2: Components of the floc shed.

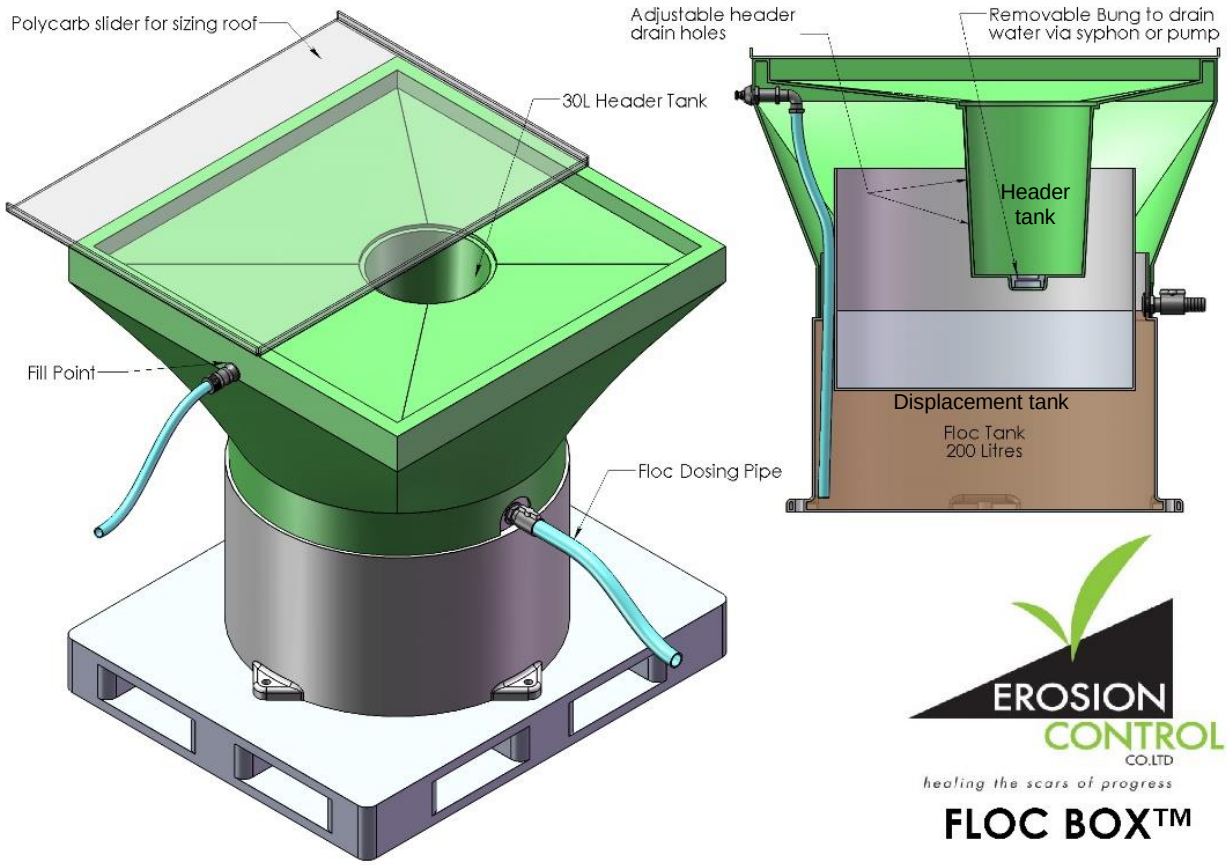

Figure 3: Components of the floc box.

2.1.1 Area of rainwater catchment tray required for rainfall activated system

The area of the rainwater catchment tray is determined by the dose required, and the area of the earthwork's catchment draining to the sediment control device.

All water flowing into the sediment control device needs to be treated, and the rainwater catchment tray size is determined by the total land catchment area draining to the sediment control device including both the 'open' area and stable areas. If the catchment area is changed, then the catchment tray size should also be changed in proportion. Reduction of the tray size is easily achieved by placing a piece of plywood on top of the upstand over the lower end of the tray, thereby allowing the rain which falls on the plywood to run to waste.

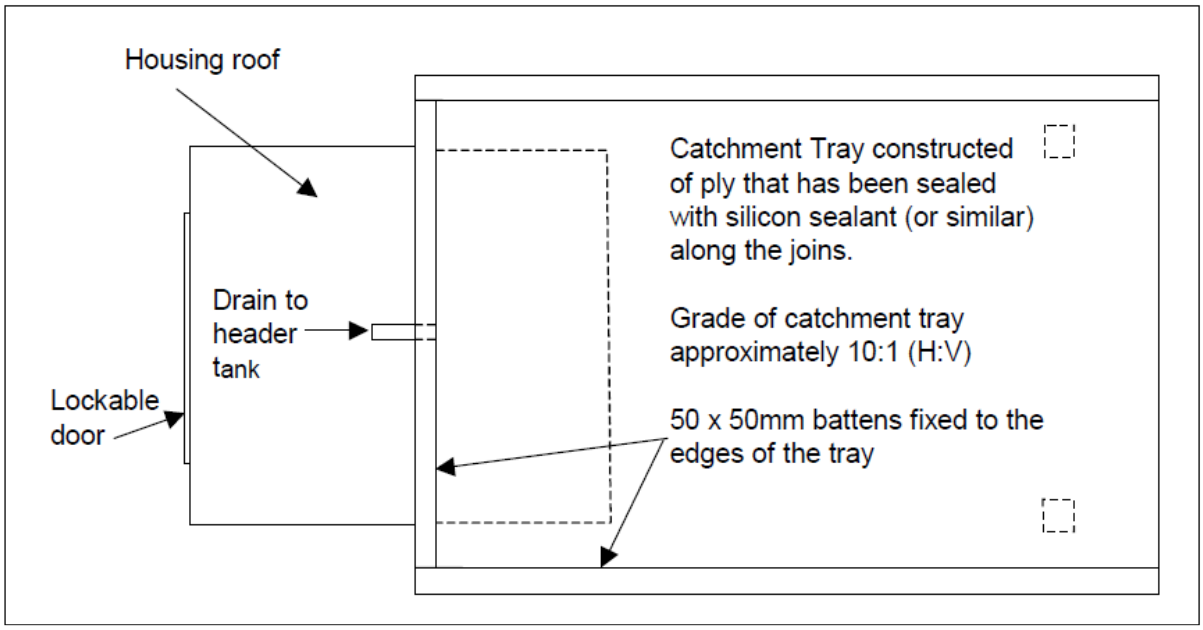

Figure 4: Roof tray design.

The required tray size is 0.75 square metres per hectare of exposed land catchment draining to the sediment control device. This is the area inside the upstand around the edge of the tray.

Sediment Control Device	Catchment Area (ha)	Tray Size (m^2)
Pond 5	3.56	2.66

2.1.2 Header Tank Outlet Spacing

Rainfall from the catchment tray is drained into a header tank. This provides a storage capacity that avoids dosing during initial rainfall following a dry period and to attenuate dosing at the beginning and end of a rainstorm event.

The volume between the drain (lowest) header tank outlet and the first dosing outlet is equal to the volume of 12mm of rain on the catchment tray and the volume between the first and second dosing outlets is the same.

Header Tank Management in summer months to be as per the GD05 guidelines:

- After 3 days without rain – reduce volume by 50%
- After 6 days without rain – empty completely

The distance between the drain and first dosing outlet, and between the two dosing outlets, for a standard header tank made from a 200-litre drum with an internal diameter of 55 cm would be:

Device name	Distance (x) (cm)	Volume (x) (L)	Distance (y) (cm)	Volume (y) (L)
Pond 5	13	32	13	32

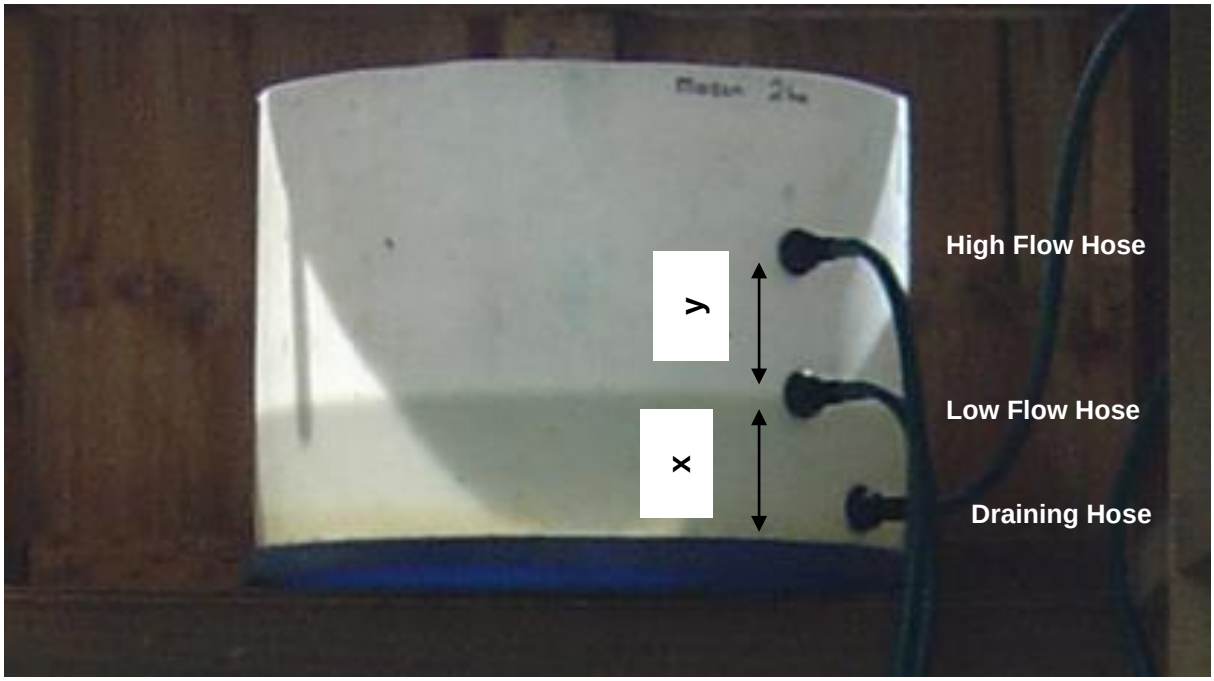

Figure 5: Header tank spacing.

2.1.3 Sediment Laden Runoff Channel and Dosing Point for Rainfall Activated System

The PAC needs to be added to the sediment laden runoff channel to provide mixing with the sediment laden runoff before it reaches the area of ponded water in the forebay or the SRP itself.

All sediment laden runoff from the catchment should be combined into a single channel if possible before it reaches the chemical dosing point which should be located at least 10 metres prior to the point where the runoff reaches the ponded water of the forebay, so the PAC can be added to and mixed with the total inflow.

The dosing point should be at a location where the chemical will fall into the sediment laden flow during periods of low flow. The end of the dosing tube should be only a few centimetres above the diversion channel to ensure that the chemical falls into the sediment laden runoff and is not blown away during periods of strong wind.

2.2 Batch Dosing

Batch dosing is not recommended as the primary dosing system. It can be utilised as additional dosing where adequate water quality has not been achieved, but with careful monitoring of pH.

Water clarity will be used to determine if there is a need to undertake batch dosing. Clarity is measured using a black disk lowered vertically into the water to be tested. A small black disc of 50-80mm diameter is attached to a 1m long stick with a centimetre scale starting at the disc. The disc is lowered into the water until it disappears, and then is raised until it just reappears. The depth of reappearance is recorded as the clarity of the water.

Water with a depth of clarity of less than 60mm should be batch dosed. If the sediment laden runoff has clarity between 60-100mm after rainfall has ceased, it should be left for 48 hours to settle. If the clarity has not reached 100mm after 48 hours, or if sediment laden runoff has to be discharged within 48 hours because the pond is full, the sediment laden runoff should be batch treated.

The batch dose rate is 62ml of PAC per m^3 of runoff.

For example: If a SRP has $100m^3$ of dirty water in it, the amount of PAC required would be 6.2L of PAC (62ml x $100m^3$ = 6,200mls, which is equivalent to 6.2L).

Table 1: Batch dosing rate based on volume of stormwater to be treated.

Volume of stormwater in pond (m^3)	Amount of chemical to be added (L)
100	6.2
200	12.4
300	18.6
500	31
1000	62

Application Procedure (batch dosing)

The chemical dose should be applied evenly over the surface of the SRP as quickly as practicable. It is best to apply the dose in one application, rather than going over the surface of the SRP two or more times.

The total dose may be applied in one of two ways.

(a) Spray.
The chemical can be applied to the surface of the pond using a sprayer that produces large drops.

(b) Bucket.
Place no more than 1 litre of chemical in a 10-litre bucket and throw the chemical onto the pond surface so that the chemical divides into drops before hitting the surface.

Following batch treatment and the settlement of the coagulated solids the SRP water can be discharged. Settlement generally requires 1-2 hours.

Timing

As the water in a SRP often develops marked temperature gradients during the day which can inhibit mixing of PAC that is added to the surface of the SRP and the settlement of coagulated solids, batch treatment should be carried out in the early morning to optimise mixing of the chemical with the sediment laden runoff and the subsequent settlement of coagulated solids.

3.0 MONITORING AND MAINTENANCE REQUIREMENTS

3.1 Routine Management and Maintenance

Instructions for routine management and maintenance of the chemical treatment system are provided in Appendix A. It is recommended that a copy of this table be kept onsite and available for review.

All monitoring records and maintenance checks and actions should be recorded on the monthly record sheet provided in Appendix B. The systems should be checked after each rainfall event, and during dry periods the systems should be checked weekly.

It is also noted that chemical treatment increases the sediment removal efficiency of the sediment controls. The sediment controls will need to be regularly desilted to ensure that the maximum volume is re established after rain events.

3.2 Contingency Management

Contingencies could include poor performance of the treatment system, or effects of other influences on sediment laden runoff quality, such as reduced pH, that might make the use of PAC inappropriate.

If the treated water in the sediment control device is consistently very clear it could indicate overdosing, and the possibility of lowered pH which can present a risk to receiving waters as a result of elevated free aluminium concentration in the discharge. If treated water is consistently clear, then the pH of the water in the sediment control should be tested.

Contingencies such as poor treatment performance or consistently very clear treated water should be dealt with by consulting the Waikato Regional Council and SouthernSkies or some other person qualified to advise on appropriate action.

A treatment chemical spill contingency plan is provided in Section 9 below.

4.0 RECORD KEEPING AND REPORTING

A copy of the maintenance record for the chemical treatment system will be kept on site (Appendix B).

A copy of the maintenance record for the chemical treatment system is to be held on site and provided to the Waikato Regional Council on request.

5.0 STORAGE OF CHEMICAL ON SITE

Bulk PAC, which can be supplied by the manufacturer in 200L polyethylene drums, should be kept in secure storage, either in a locked shed or container. PAC drums should always be

stored on end with the screw caps uppermost. Topping up of flocculent chemical will be made weekly as part of the regular inspection regime.

6.0 PROCEDURE FOR TRANSPORTATION

PAC will normally be delivered to the site by commercial carriers in accordance with current Hazardous Goods, Traffic and Transport regulation. PAC can be requested from the supplier generally in 20 litre containers, 200 litre drums and/or 1,000 litre IBCs. PAC weighs about 250kg and is most easily moved within the site in a loader bucket. The use of these or any other chemical must be done in accordance with the Site Health and Safety Plan.

7.0 CHEMICAL SPILL CONTINGENCY PLAN

If there is a spill of chemical onto the ground it should be immediately contained using earth bunds to prevent it entering water. The spilt chemical should be recovered if possible and placed in polyethylene containers. If the spilt chemical cannot be recovered, it should be mixed with a volume of soil equal to at least ten times the volume of spilt chemical. This will effectively neutralize the chemical. The soil with which the chemical has been mixed should be buried in the ground a minimum of 0.5 metres below the surface.

If there is a spill of PAC into ponded water, discharge from the pond to natural water should be prevented. If there is a spill of PAC into flowing water:

1. Waikato Regional Council should be advised immediately.
2. The volume of the spill should be recorded.
3. If possible, the water and spilt chemical should be pumped into a bund or pond until all the spilt chemical has been removed from the watercourse.
4. If the chemical cannot be removed from the watercourse any downstream users should be identified and advised.

8.0 CHAIN OF RESPONSIBILITY FOR MONITORING AND MAINTAINING

The contractor shall have primary responsibility for maintenance and monitoring the effectiveness of the chemical treatment system. The contractor will check the effect of PAC dosing on the pH of the treated water once the sediment control devices have filled for the first time and monitor pH and overall performance throughout the duration of works.

9.0 TRAINING OF PERSON RESPONSIBLE FOR MONITORING AND MAINTENANCE

If a person with experience in the monitoring and maintenance of the chemical treatment system is not available, SouthernSkies will train a person nominated by the contractor to carry out the routine monitoring and maintenance of the chemical treatment system, and to keep the required records.

APPENDIX A. INSTRUCTIONS FOR MONITORING TREATMENT SYSTEMS FOR EARTHWORKS STORMWATER

A) PAC *Dosing System*

REDUCING THE HEADER TANK WATER VOLUME.

The header tank is used to avoid dosing during the initial stages of rainfall when site conditions are dry, and no runoff is expected.

The volume in the header tank is lowered using the lowest of the three outlet tubes (draining hose).

After 3 days without rain - reduce volume to 50%.
After 6 days without rain - reduce volume to empty (level at lowest outlet).

REFILLING THE CHEMICAL RESERVOIR.

The chemical reservoir tank should be refilled when the white displacement tank is half full, or sooner if heavy rain is predicted. This is done by first emptying the displacement tank (baling with a bucket is efficient), and then refilling the black chemical reservoir tank until the PAC level is at the lower edge of the outlet.

OBSERVATION OF WATER QUALITY IN POND.

The pond water quality will be observed at least weekly, and the clarity determined using a black disk and recorded on the monitoring sheet. pH shall be recorded once the pond has filled up to ensure that chemical dosing does not have an unacceptable effect.

PERIODIC SYSTEM CHECKS.

Check that the rainfall catchment tray is not leaking – especially along the lower edge of the tray. This should be done after rainfall has ceased.

Check the lower hose with the small tube outlet, from the header tank to the displacement tank, is not blocked.

MONITORING RECORDS.

A separate sheet is provided for monitoring records for each month (Appendix B). The information to be recorded is as follows:

Visual check

Check the roof tray for leaks, the plumbing, and the hoses from the header tank. Record ‘ok’, or if maintenance is required write ‘M’ and note the requirement in the ‘Notes’ column.

How full is the header tank (%)

This is the volume between the lowest (draining hose) and the middle outlet (low flow outlet). After rain this should be either 100% after 12mm or more rain, or between 0-100% after less than 12mm rain. In summer: 50% when lowered after 3 dry days; 0% when emptied after 6 dry days.

Depth in Displacement Tank (%)

Measure depth of water in cm. Reduces to 0 when emptied.

Chemical *volume added*

Record the volume of chemical added. 1 drum of PAC = 200L, 9cm in 200L drum = 20L. The volume can also be calculated from change in water level in displacement tank where 1cm change = 4 litres of chemical.

Pond Clarity: Record using black disc near pond outlet. (Refer above).

pH: Record at the outlet end of the SRP using a digital pH meter.

APPENDIX B. CHEMICAL TREATMENT SYSTEM MONITORING AND MAINTENANCE RECORD

A) PAC *Dosing System*

Site: Huntly Quarry – Fill 5
Sediment Control Device: **Month:** **Maintenance Person:**

Date	Visual check	% Header Full	Water depth In Displacement Tank (cm)	PAC Volume Added	Water Clarity (cm)	pH	Notes on maintenance required or additional information	Initial
01								
02								
03								
04								
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APPENDIX C. EROSION & SEDIMENT CONTROL PLAN

EROSION MANAGEMENT

EROSION MANAGEMENT LTD,
35 HASTINGS PARADE, P.O. BOX 32-364, DEVONPORT,
AUCKLAND, NEW ZEALAND
TEL: 09 446 0278 FAX: 09 446 0214

Gleeson Quarries Ltd – Huntly Quarry

New Overburden Fill Site

EROSION & SEDIMENT CONTROL PLAN

Prepared for

Gleeson Quarries Ltd
17 Aerovista Place
Wiri
AUCKLAND 2241

26 August 2019

CONTENTS

DRAWINGS Erosion & Sediment Control Drawings: HQ-19-14-1 & 2

1.0 SCOPE

The removal of waste earth material (overburden) and its subsequent placement on a designated fill site is a regular undertaking at the quarry. This material is currently being placed at a fill site at the south-western corner of the quarry that has been used since the current regional consents were granted in 2000. This fill site is now near full and the current overburden stripping operation is expected to be the last[1]. It had originally been intended that a replacement fill site would form part of the applications for replacement regional consents (the current consents expire in July 2020) but the required rate of overburden removal is currently such that a new site is now required prior to the 2020 date.

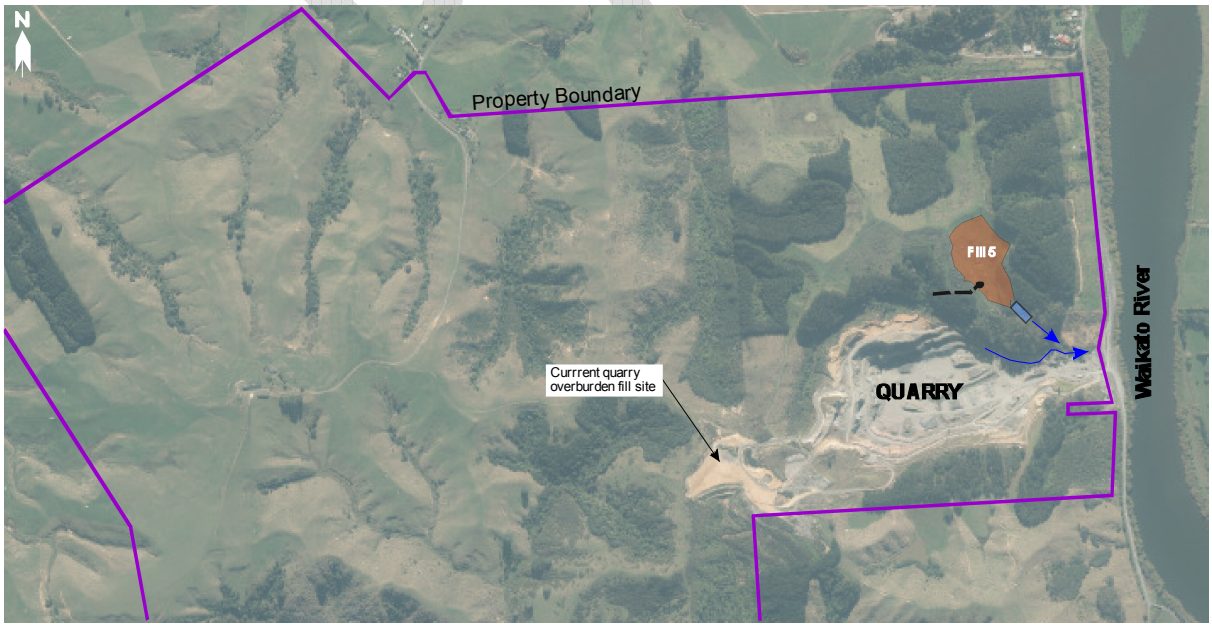
In addition to the proposed applications for replacement regional consents, design work is also currently underway for a managed fill proposal on three other fill sites to the north of the quarry. However, the timing of those applications does not fit with the more immediate need for the new overburden fill site. Because of this, a separate application is proposed for the new overburden fill site. The site is termed Fill 5 and is located on the north-eastern side of the quarry activity.

This report has been prepared to address the erosion and sediment control implications of the earthworks and overburden deposition associated with the proposal for Fill 5.

2.0 LOCATION

The proposed fill site and locality are shown on Figure 1 below.

Figure 1: Locality



[1] The limited capacity of the fill site has been flagged in the last few quarry annual monitoring reports

3.0 BACKGROUND CONSIDERATIONS

- Pines were recently harvested on the upper portion of the proposed Fill 5 site. The site is currrently a mix of logged remnant slash, pines, some regrowth native vegetation and scattered exotic weed vegetative cover.

- The site is a steep sided gully draining down to the south west. There is no permanently flowing watercourse on the area.

- There are no land contamination issues on the proposed fill area. The area is too steep for cropping to have been undertaken and there are no farming structures present (such as sheep dips or farm storage sheds) that might suggest other sources of land contamination considerations may apply.

- There are no archaeological features on the site. The nearest such site is located at the north-eastern corner of the property next to Riverview Road. This is about 400m away in a completely separate sub catchment. The proposal will not have any effects on this feature.

- The site will be for internal quarry use only and will not be open for external access.

- Specialist accompanying reports have been prepared for the proposed activity. These reports address matters such as geotechnical, ecology and landscape and are attached to the AEE. These are referred to as required.

4.0 SITE DESCRIPTION

The property and site are described in detail in the AEE. The following is a summary of the main features of the site considered relevant to this ESCP.

The fill site is located to the north-east of the quarry as shown on Figure 1. It is a steep sided gully that drains down to the south-east and to a small quarry watercourse. This then flows under Riverview Road to discharge into the Waikato River. The gully has an area of approximately 6.5 ha when measured to the lower quarry watercourse. High voltage transmission lines on the south-eastern corner of Fill 4 cut across the top (north-western) corner of the gully. The lower slopes have a mature pine/eucalypt forest cover with an indigenous understory and the trees fulfil a screening purpose for quarry activities. A small area of relatively recent indigenous planting (6 years) is below this and has covenanted protection[2]. This covenanted area will not be affected by this proposal. In the upper reaches of the gully above the exotic pine/eucalypt stand, the surface cover consists of forestry slash, rough pasture and weeds. The ecology report (see AEE) classifies the lower stretch of the site (the site of the proposed sediment retention pond) as having intermittent flow.

A sediment retention pond is proposed to be constructed in the middle of the gully. The catchment of the pond will be approximately 3.56 hectares in area. The volume of the proposed fill will be approximately 180,000m^3.

[2] Through current WRC consent 120768.

As mentioned earlier, only quarry overburden will be deposited in this fill area. No imported fill will be deposited.

Access to the site will be along quarry and overburden haul roads.

5.0 RECEIVING ENVIRONMENT

The gully drains to a freshwater stream and then to the Waikato River. The Ecology Report (see AEE) contains a full description of this watercourse. In brief, the watercourse drains south-east to first enter the quarry stream before then discharging to the Waikato River. The stream has intermittent flow in the vicinity of the proposed sediment pond. The Ecology Report classifies the ecological values of the intermittent section of watercourse as low.

The overall erosion and sediment control conclusions from the ecological assessment is that although the site's ecological values are considered low, the site is still within the tangata whenua layer of the Waikato District Plan and that site erosion and sediment controls need to be well targeted. Activities draining to the Waikato River are subject to Regional Plan Change 1 which strives to improve the water quality of the river.

6.0 PROPOSAL

The overall proposal is discussed in the AEE. This ESCP addresses the generation and potential discharge of sediment from the earthworks associated with the proposed fill operation. Aspects of the proposal relevant to erosion and sediment control are summarised below.

Fill 5 will be restricted to overburden and cleanfill material only whereas the other three fills will be associated with an imported clean and managed fill activity. Fill 5 is therefore distinctly different to the others in that it will be operated as a quarry fill site for quarry derived waste overburden only. There will be no access to or from the site from public roads.

Erosion and sediment control measures will be the first works undertaken on site. These are discussed in detail in section 7 of this ESCP, but essentially they will consist of runoff diversion bunds or channels to divert off site runoff, and a sediment retention pond located at the bottom end of the fill site to retain and treat site runoff.

Filling will be undertaken in discrete area within the fill footprint of the site. New fill areas will be opened as required and will be preceded by the required geotechnical works (see geotechnical report for details) and the necessary erosion and sediment control measures. Once the required enabling works have been completed, overburden will be brought to the site by dump truck, deposited in the relevant area and re-positioned as necessary by bulldozer (or perhaps by excavator). The surface of the fill will be shaped to direct runoff to controlled outlet points and the fill will usually be track rolled for compaction. A compactor may or may not be used.

The maximum area of land bare at any one time will be about 2 hectares.

Completed fill areas will be progressively topsoiled, grassed and returned to a permanent pastoral land use. The final landform will have a cross slope across to the final overland flow path that will be constructed on one side of the fill. The sediment retention pond will remain at the end of filling activities operation although it will be cleaned of sediment.

The footprint of the fill will be approximately 3.56 hectares in area (although the full area will never be exposed at the same time) and the completed fill will have a volume of approximately 180,000m^3.

Works are proposed to commence once approval has been received.

7.0 EROSION AND SEDIMENT CONTROL

7.1 General

The approach proposed in this ESCP is to meet or exceed regional standards and to ensure that no significant sediment–related effects occur from the activity. The control measures and methodologies that are proposed for this site have been selected after consideration of the matters discussed earlier in this report and after having regard to the various planning considerations outlined in section 9 below.

Drawings HQ-19-14-1 and HQ-19-14-2 are attached and show the erosion and sediment control approach for the site along with sediment retention pond details.

Site operations will be undertaken in general accordance with the following procedures.

- Earthworks and rehabilitation will be a progressive and ongoing activity. Although the rate of filling may vary depending on the frequency and size of overburden stripping activities, the exposed area will generally be about 2 hectares or less at any one time. New areas will be prepared for site operations only as required and only immediately ahead of filling operations. These preparatory works include the removal of unsuitable material, installation of subsurface drainage, benching etc.

- The fill will be subject to geotechnical input and control.

- The fill will be shaped and managed to ensure surface runoff is always directed to pre-selected discharge points e.g. dirty water runoff diversion channel(s), rock flume(s), the sediment retention pond etc.

- Both temporary and permanent stabilisation works will be carried out. Temporary stabilisation will include the use of mulch, fabric and aggregate whereas final completed areas will be topsoiled and grassed.

- As a minimum all control measures will be constructed and maintained in accordance with the Waikato Regional Council erosion and sediment control guideline (Technical Report 2009/02 [TR 2009/02]).

7.2 Enabling Works

Enabling works to prepare the site will be required before active filling can commence. The works will involve the installation of the required runoff and sediment control measures (discussed below) and the geotechnical establishment works (removal of unsuitable material, the establishment of structural bunds etc. – see geotechnical report in the AEE).

7.2.1 Above Site Runoff

The gully is self-contained and no offsite runoff control measures are required.

7.2.2 Sediment Control

A super silt fence will be installed at the bottom end of the work area to retain sediment while the sediment retention pond is constructed. Pond details are shown on attached drawing HQ-19-14-2. It is proposed to install a rainfall initiated chemical treatment system to supplement the treatment of the sediment retention pond. This system will be installed and operational before the commencement of filling.

7.3 Filling Operations

Filling activities will commence once the pond and chemical system are operational.

7.3.1 Above Site Runoff

Runoff diversion bunds or channels are proposed on either side of the pond and lower section of the fill to intercept and divert above catchment runoff away from the fill and around the pond. They will be constructed from topsoil stripped from the adjacent work area and shaped and compacted to form the clean water diversion bunds. The proposed diversion bund/channels will have 1v:3h side slopes, a minimum compacted height of 0.75m and be on a minimum 2% grade (to ensure fall). The 1% AEP flow depth will be 0.3m and the bund will have approximately 450mm freeboard. See calculations in Section 2, **Appendix B**.

The locations of these channels are shown on Drawing HQ-19-14-1.

7.3.2 On Site Runoff

Control of on-site runoff will be achieved by careful placement of the fill. The fill surface will be worked and shaped to direct flow to specific discharge points (and which will vary as filling progresses). Initially runoff will be directed to the gully floor and then down to the lower sediment retention pond. As the fill increases in height, runoff will be directed across and down to one side where it will be directed down to the pond. A stabilised or erosion proof rock flume or similar will be constructed at the fill/natural land interface to convey site runoff down the side of the fill to the pond. This rock flume will eventually convey runoff from the entire fill surface down to the fill pond for treatment. This is the facility used at the current overburden fill site and has been utilised for many years. Photo 1 below shows a typical quarry rock flume.

Photo 1 – Typical Quarry Rock Flume

There will therefore be ongoing management of on-site flow. Other than for the necessary control of site flow to the pond, control of other on- site runoff will be kept to a minimum to avoid the unnecessary concentration of site flows. Where additional control might be considered necessary, then this will achieved through the use of onsite compacted bunds, diversion channels, contour drains etc. Such measures may be required to direct site runoff in localised areas and their use and location will be determined by micro topographical variations and the need for erosion proof outfalls. These will be constructed at maximum 2% grades to minimise invert scour.

7.3.3 Sediment Control

A sediment retention pond is proposed at the bottom end of the site to treat sediment laden runoff from the fill operation.

The location of the pond and specific pond details are shown on Drawings HQ-19-14-1 and HQ-19-14-2 respectively. General pond details are shown below in Table 1.

Table 1: General Detail - Sediment Retention Pond

Fill	**Catchment** (ha)	**Minimum volume** (m^3)	**Depth to upstand invert (**m)	**Bottom pond edge** (m)
5	3.56	1,070	2	38 x 11.5

The pond will be constructed and maintained in accordance with the council erosion and sediment control guideline (Technical Report 2009/02).

7.3.4 Stabilisation/Rehabilitation

The fill will have a total area of about 3.5 hectares but only about 2 hectares of bare land will be exposed at any one time. This bare area will progress in a series of informal phases around the fill site. Placed fill will be compacted by track rolling or perhaps by compactor. Bare surfaces will be stabilised against erosion (topsoiled and grassed) on an ongoing basis as filling is completed in particular areas. Straw/hay mulch, fabric or similar will be applied

for temporary stabilisation as required. Areas where filling has been permanently completed will be shaped to merge naturally with the surrounding land with the final landform expected to be generally gentler and smoother than that of the current terrain. The rehabilitated fill will return the site to a pastoral farm end use consistent with the surrounding land use. An overland flow path will be created on one side of the fill and will direct site runoff down to the lower pond.

Both the filling and the site rehabilitation (stabilisation) will be carried out on an ongoing basis through the life of the fill. The rate of these works cannot be predicted because they are dependent upon the state of the economy.

The pond will be retained at the completion of filling when it will be cleaned of sediment and allowed to naturally recolonise as a wetland. Fill subsurface drains will discharge to the pond and will provide an ongoing source of water (albeit low volume) to the pond/wetland. Unless a shallower pond is required, the volume of the eventual wetland will be about the same as those of the proposed sediment pond (about 1,070 m^3 - see Table 1).

7.4 Chemicals

Bench tests of the *in situ* soils (see **Appendix C**) at the sites indicate that the common sediment control chemical (PAC) will work well at the site (Section 3.2, **Appendix C**).

It is recommended that a chemical treatment management plan is prepared for the activity prior to the commencement of filling.

7.5 Dust

Little or no dust is expected to arise from the placement of the overburden because the freshly excavated earthen material is inherently damp and does not usually generate significant levels of dust. It is more likely that dust will result from dump truck movements along the access road to and from the site and this will be controlled in the same way as for current quarry operations. Dust mitigation measures will include a maximum traffic speed of 20km/hr and the use of water carts on site to apply water for dust suppression.

In the event that objectionable levels of dust do arise from the fill operation, the incident will be fully investigated, and the appropriate amendments made to site operations and/or management as required. The investigation will include an assessment of the reasons for the event, mitigation measures and of proposed and ongoing management initiatives to ensure there is no repeat of the issue.

7.6 Monitoring & Maintenance

All erosion and sediment control measures (channels, pond, flumes etc.) will be inspected on a regular basis. 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. The forebay of the pond will be cleaned out as required, and the sediment retention pond itself cleaned when 20 % full of sediment. Diversion systems are to be inspected for scour, sediment build-up, bund/channel integrity and outlet erosion with remedial measures undertaken as required. The clarity of treated runoff will be constantly assessed to determine supplementary chemical application.

All erosion and sediment control measures will be maintained in accordance with TR 2009/02.

8.0 ASSESSMENT OF SEDIMENT RELATED EFFECTS

8.1 Overburden Fill

This fill will take the place of the current fill site located at the southwestern corner of the quarry and which is near full. Overburden only will be deposited at this site and the site is associated only with the quarry operation, not to the proposed imported fill activity. The bare areas of the current and this proposed site will be similar and therefore the sediment related effects of the new site will also be similar to that of the current site.

8.2 Effects of the Control Methodologies and Measures

WRC Plan Change 1 requires resource consent applications to assess whether the discharge treatment reflects the best practicable option (BPO) and how adverse effects are to be avoided, remedied or mitigated depending on the concerns of the particular sub catchment.

Best practicable option is defined by the RMA as meaning *the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to —*

(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and

(b) the financial implications, and the effects on the environment, of that option when compared with other options; and

(c) the current state of technical knowledge and the likelihood that the option can be successfully applied

The proposed erosion and sediment approach (methodologies and control measures) to Fill 5 has been devised with this requirement in mind. The proposed measures include both erosion control and sediment retention devices and methodologies.

The proposed erosion control methodologies and measures include undertaking earthworks in a staged manner, runoff diversion measures and methodologies to intercept, divert and direct surface runoff, and an ongoing and progressive stabilisation programme. The bare working site will be about 2 hectares in area.

Above site runoff will be controlled by the proposed diversion systems. Runoff diversion systems are proposed to be at least 750mm in compacted height to convey the 1% AEP storm flow from the upper catchments. They will have about 450mm of freeboard for this storm event and it is therefore expected that they will function well and have more than sufficient capacity to convey the flow from the largest storm. They exceed the requirements of the WRC erosion and sediment control guideline (TR 2009/02) as the proposed diversion systems are designed for a 100 year storm event whereas the guideline is for a lesser 5 year storm design.

For sediment control, the main control system is proposed to be a sediment retention pond. It is considered that such ponds are among the most effective of the sediment treatment

devices and are the most robust. Details of the pond are shown on drawing HQ-19-14-2. A super silt fence will be constructed below the pond during its construction. Sediment ponds will be constructed in accordance with regional TR 2009/02 requirements and will treat all sediment laden runoff from filling activities in the catchment. The pond has been designed for the overall fill catchment.

In addition to this, a rainfall activated chemical treatment will be installed for the pond. The efficiency of the pond with supplementary chemical treatment is taken as 95%. Additional control systems will also be used as required. These could include on-site contour drains, rock flumes, decanting earth bunds, silt fences, rock bunds etc.

All erosion and sediment retention measures constructed and maintained in accordance with WRC TR 2009/02.

The effect of these control measures and methodologies is that council standards will be met or exceeded. It is considered that they meet the BPO requirement of Plan Change 1. The effects of these controls will be to reduce the level of sediment discharged from the activity after treatment to the lowest possible levels.

An assessment of the potential sediment yield from the activity is undertaken below in Section 8.3.

8.3 Estimate of Potential Sediment Yield

The working area of the fill will usually be about 2.0 hectares in extent, a common bare area for fills such as proposed here.

An estimate of potential annual sediment yield of the proposed fill operation has been undertaken using the Universal Soil Loss Equation (USLE) – see **Appendix A**. The main USLE factors used for the assessment are as follows.

Bare area of 2.0 hectares and open for the entire year.
Rainfall factor (R): 56
Soil erodibility factor (K): 0.58
Slope length & steepness factors (LS): 2.15 and 0.26
Ground cover factor (C): 1.0
Roughness (R): 0.9
Sediment delivery ratio of 0.5
Sediment control efficiency of 95% (chemically treated pond).

It is considered that these parameters reflect a conservative approach to the proposed activity. For example, the assumed P value of 0.9 is probably an over estimate because of infiltration into the very rough and irregular fill surfaces. Also, the LS values are those from a actual current fill site and it is possible that these values may be less under this proposal.

The assessed sediment yield from the 2.0 hectare fill operation is 1.76 tonnes/year (from Appendix A). To take account of the levels of uncertainty inherent in the assessment model, a rounded off sediment yield figure of about 2 tonnes/year from the 2 hectare fill site is used for this application. As mentioned above, this is considered to be a conservative assessment and actual sediment yields are expected to be less.

8.4 Sediment Related Effects on the Receiving Environment

Because the sediment retention pond will be sized to accommodate the flow from an area greater than that of the fill alone, some treatment (albeit limited) will also be given to the undisturbed balance of the catchment. The influence of the pond will therefore be more than just treatment of site earthworks alone. With regard to the fill area alone, the USLE assessment is that about 2 tonnes/year of sediment will be discharged from the 2 hectare fill site after treatment.

A literature review of typical and naturally occurring sediment loads of nearby catchments has been undertaken (see Section 2, **Appendix A**). This review indicates that sediment yields vary from 85 t/km^2/year (Awaroa [Rotowaro]) to 115-188 t/km^2/year (Matahuru). These catchments are considered to have similar terrain and surface cover to those of the proposed fill sites. It is therefore considered that a mid-range value of about 125 t/km^2/year (1.25 t/hectare/year) is a realistic representation of current natural soil loss from the proposed fill site. No account has been taken of the recent logging that has occurred and which would have resulted in elevated sediment levels.

Using 1.25t/hectare/year as representing the current natural soil loss value from the site, the estimated current sediment yield from the 2.0 hectare fill area is therefore about 2.5 tonnes/year. This is slightly more than the 2.0 tonnes/year estimated to occur from the proposal (from section 8.3); i.e. the proposal will result in sediment levels slightly less than current levels.

Likewise, on a receiving stream environment basis, the natural annual sediment load will not increase as a result of the fill operation because the sediment yield from the fill site after treatment will be slightly less than current natural levels.

It is concluded from this assessment that the fill activity will not have an adverse sediment related effect on the environment.

After the fill has been completed, it will be returned to a pasture cover and so sediment levels will return to current levels (or perhaps be slightly less because of less steep final contours). This proposal will therefore not result in any long term sediment – related effects on the receiving environment.

9.0 CONCLUSIONS

This report addresses the erosion and sediment control implications of a proposed overburden fill activity at Gleeson's Huntly Quarry. The proposal involves the controlled placement of approximately 180,000 m^3 of overburden fill material over a number of years. The site will have a footprint of about 3.6 hectares but only about 2 hectares will actually be worked at any one time. The works will be small scale and involve a progressive system of filling/rehabilitation. It is considered that the levels of sediment that will be discharged from the fills will be slightly less than which currently occurs. The proposal will not have any long term sediment-related effects on the receiving environment.

REFERENCES

Waikato Regional Council: Erosion and Sediment Control Guidelines for Land Disturbing Activities. Technical Report 2009/02. January 2009.

Waikato Regional Council. Waikato River suspended sediment yields from the Waikato region. Technical Report 2012/01. NIWA. November 2011.

Waikato Regional Council. Catchment Environmental Monitoring Report 2013/14. Technical Report 2014/67.

Waikato Regional Council. Sediment Retention Pond. Factsheet May 2015.

Waikato Regional Council. Waikato suspended sediment indicators: State and trends. Technical Report 2014/43.

APPENDIX A

SEDIMENT YIELD ASSESSMENT

1.0 USLE ASSESSMENT

Factors:

Bare area of 2.0 hectares and open for the entire year.
R of 56 (0.00828 x $43.3^{2.2}$ x 1.7). Rainfall from HIRDS – Section 3.
K of 0.58 (42% clay, 48% clay, 10% sand). From site geotechnical information
LS of 2.15 (75 x 10% - 1.0 ha); 0.26 (75 x 2% - 1ha). From an actual fill site.
C of 1.0 (bare site)
P of 0.9 (rough & irregular)
Sediment delivery ratio of 0.5
Sediment control efficiency of 95% (chemically treated pond). Auckland information.

Area (ha)	**USLE Parameters**						**Estimated soil yield** (tonnes/yr.)	
	R	K	LS	C	P	SDR	Estimated sediment generated	Estimated sediment dischag'd[3]
1.0	56	0.58	2.15	1.0	0.9	0.5	31.42	1.57
1.0	56	0.58	0.26	1.0	0.9	0.5	3.80	0.19
Total							35.22	1.76

From this assessment, it is estimated that 1.76 tonnes of sediment/year will be discharged from the 2 ha site after treatment. Round up to 2 tonnes/year to take account of the levels of uncertainty in the USLE model and to be conservative.

2.0 NATURAL SEDIMENT LOADS AND SITE COMPARISON

The terrain of the four fill sites comprises a mix of relatively steep land (fills 2 and 5) and more gentle contours (fills 3 and 4). A literature search suggests sediment yields of nearby catchments range between about 85 t/km^2/yr. (Awaroa [Rotowaro])[4] to 115-188 t/km^2/yr. (Matahuru)[6,5,6]. These catchments are similar to the proposed fill sites for both terrain and being mostly in pasture. It is therefore considered that a mid-range value of about 125 t/km^2/year. (1.25 t/hectare/year) is a realistic representation of current natural soil loss rates from the proposed sites. It is noted that fill sites 2 and 4 sites were logged several years ago and recent background sediment levels from these areas would have been (and possibly still are) more elevated as a result. The assessed figure of 1.25t/hectare/year is however adopted as being more representative on an ongoing basis.

[3] Sediment estimated to be discharged from the site after treatment.
[4] WRC. Technical Report 2014/43.
[5] WRC. Technical Report 2014/67
[6] WRC. Technical Report 2012/01

Using 1.25 t/ha/year, the estimated current sediment yield from the 2.0 hectare fill area is about 2.5 tonnes/year. This is slightly more than the 2.0 tonne annual sediment yield estimated by the USLE assessment for the filling activity i.e. the proposal will result in sediment levels slightly less than those that currently occur naturally.

Likewise, on a receiving stream basis, the natural annual sediment load of the stream will not increase as a result of the fill operation because the sediment yield from the fill site after treatment will be the same or slightly less than natural loadings.

3.0 RAINFALL - HIRDS

HIRDS V4 Depth-Duration-Frequency Results

Site name: Huntly Fills

Coordinate system: WGS84

Longitude: 175.1472

Latitude: -37.5882

DDF Model	Parameters:	c	d	e	f	g	h	i
	Values:	-0.00026	0.415996	-0.01801	0	0.24895	-0.00886	2.991402
	Example:	Duration (hrs)	ARI (yrs)	x	y	Rainfall Depth (mm)		
		24	100	3.178054	4.600149	161.6363		

Rainfall depths (mm) :: Historical Data

ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h
1.58	0.633	8.91	12.3	14.8	19.9	26.3	39.6	50.1	62.2
2	0.5	9.76	13.5	16.2	21.8	28.8	43.3	54.8	68.1
5	0.2	12.7	17.6	21.1	28.4	37.5	56.4	71.3	88.6
10	0.1	14.9	20.7	24.8	33.3	44.1	66.2	83.7	104
20	0.05	17.3	23.9	28.7	38.6	51	76.6	96.9	120
30	0.033	18.7	25.9	31.1	41.8	55.2	83	105	130
40	0.025	19.8	27.4	32.8	44.1	58.3	87.6	111	138
50	0.02	20.6	28.5	34.2	46	60.8	91.2	115	143
60	0.017	21.3	29.5	35.3	47.5	62.8	94.3	119	148
80	0.012	22.4	31	37.1	50	66	99.1	125	156
100	0.01	23.3	32.2	38.6	51.9	68.6	103	130	162
250	0.004	27	37.3	44.7	60.1	79.4	119	151	187

43.3 = rainfall value used for USLE assessment

23.3 = rainfall value used for offsite diversion channel assessment (Appendix B)

APPENDIX B

ABOVE SITE FLOW CALCULATIONS

1.0 100 Year Flow Assessment

The largest above site catchment (1.25 hectares) is on the eastern side of the fill and pond. It is assumed that the land has slopes > 20% and a pasture surface cover.

$Q = 0.00278\ C\ I\ A$

where

c = 0.45 (pasture and grass cover on >20% clay soils)
i = 140 mm/hr (23.3 mm/10 min, 100 year duration – from HIRDS information, Section 3, Appendix A)
A = 1.25 hectares

Q_{100} = 0.22 m^3/s

2.0 Channel Size

Swale with trapezoidal cross-section **Grass length 150mm**		**Water Quality Flow**
Flow rate Q	m^3/s	**0.22**
Channel slope S		**2.0%**
Depth d	m	**0.294**
Z=1/sideslope		**3**
Manning's n for 150mm grass **(eq. 4)**		0.045
Hydraulic radius R	m	0.140
Base width b=Qn/d.R^0.67.S^0.5-Zd	m	0.006
Cross-sectional area A=bd+Zd^2	m^2	0.261
Velocity V=Q/A	m/s	0.843

The proposed diversion bund/channels with 1v:3h side slopes and 2% grade and will result in a flow depth of 0.3m for this storm event. A bund height of 0.75m will be used for contingencies and this will result in approximately 450mm freeboard for the 100 year storm event.

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APPENDIX C

GLEESON QUARRIES LTD - HUNTLY QUARRY

FILL PROPOSAL - CHEMICAL BENCH TESTS

1.0 SCOPE

Bench tests have been undertaken of soil samples from the proposed fill site to:

- assess whether the addition of chemicals would aid the settling of sediment from earthworks associated with filling activities; and,
- if so, what would be the optimum chemical dosage rate(s).

This report presents the results of the tests.

2.0 BENCH TESTS

Samples of subsoil at the site were collected and bulked to derive a composite sample. Solutions of sediment-laden water were made up from the composite soil sample and different rates of chemical applied to these solutions to assess settling characteristics. The chemical used was Polyaluminium Chloride (PAC) because this is the usual chemical used to treat runoff from earthwork sites.

The results of the tests are shown below in Table 1.

Table 1 – Bench Test Results

Al dose (mg/L)	Clarity (mm)					pH	Comments after 1 hour
	0 min	5 min	10 min	15 min	60 min		
0 (Control)	7			10	12		Heavier particles settled but strongly turbid.
3		40	50				Good settling but slightly turbid
4		95	145	150*	150*	6.1	Very rapid settling – clear. Larger flocs than 3mg/L dose rate.
5		50	70	85	85	5.7	Reasonable settling – slightly slower than the 4mg/L dose rate. Remained slightly turbid.

* Sample water depth

The effects of these tests are shown pictorially in Photo 1. The test flask marked 'Control' has no chemical; that marked '4' shows the effect of the 4mg/L chemical dose rate on settling 1 hour after dosage, and that marked '5' shows the result of the 5mg/L chemical dose rate.

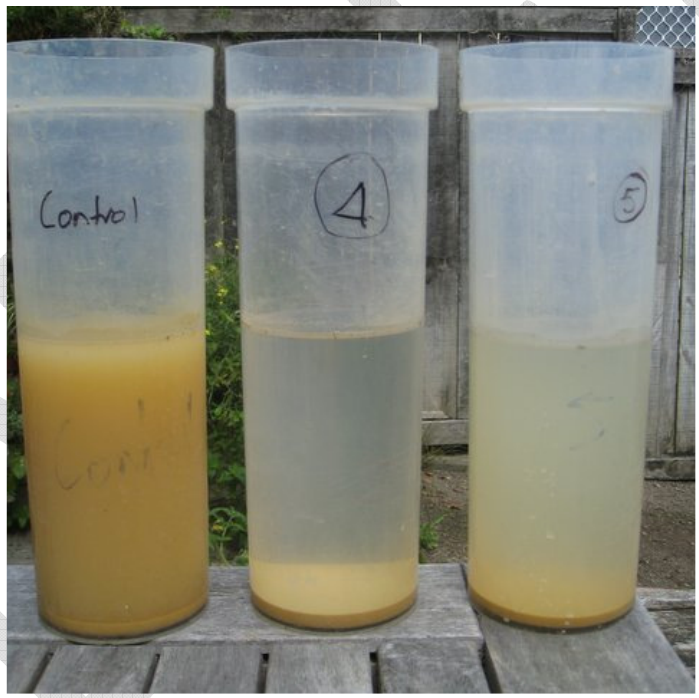


Photo 1 - Settling after 60 minutes

3.0 DISCUSSION

3.1 Bench tests

There was some natural settling without chemicals (shown by the Control in Table 1 and above in the photo) but this was slow and the clarity of the sample was essentially unaffected through the period of the test. In comparison, the 3, 4 and 5mg AL dose rates all resulted in relatively quick initial settling. Overall the 4mg AL dose rate resulted in markedly quicker

settling rates and better clarity than either of the other two dose rates as shown in Table 1 and the above photo. The resultant pH is above commonly accepted chemical treatment guidelines.

3.2 Comparison with Other Fill Sites

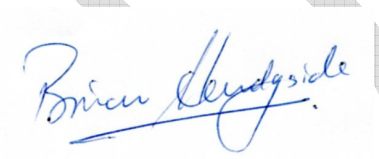
Comparison can be made with other fill sites[7] using the same PAC chemical. For example, the Thorburn Managed Fill site at Stevenson's Drury Quarry has utilised a PAC rainfall initiated treatment system at the site for nearly 6 years. During this time it has treated runoff from both an overburden only situation and also from a predominantly imported managed fill operation. The same PAC dose rate (4mg Al) has been found to work equally well for both overburden and managed fill material and it has not been necessary to change the dose rate over the last few years.

The soils at Drury are not that dissimilar to those here at Huntly and the same dose rate has been established from the bench tests. It is therefore recommended that a dose rate of 4mg AL be applied for the proposed fill activity. As with all operations, this dose rate will need to be closely monitored, particularly during the initial stages and through storm events.

4.0 CONCLUSIONS

The bench tests indicate that the addition of chemicals will assist the retention of the fine textured sediments at the site. The recommended dose rate established by the bench tests is similar to that utilised successfully on other fill sites but, like all sites, its effectiveness should be assessed on an ongoing basis to ensure that it remains appropriate.

A Chemical Management Plan is required to establish the system parameters for the new sites (e.g. roof sizes, header tank volumes, application etc.), spill provisions, site responsibilities etc. This should be done prior to the commencement of operations.



Brian Handyside
18 July 2019

[7] The author has worked on numerous other cleanfill and managed fill sites.