

Surface Water
Sampling and
Analysis Plan-Huntly
Managed Fill

Huntly Managed Fill

Prepared for:

Gleeson Managed Fill
Limited

Prepared by:

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1 Introduction

EHS Support New Zealand Ltd (EHS Support) was contracted by Gleeson Managed Fill Limited (GMF) to prepare a surface water sampling and analysis plan (SAP) for the Huntly Managed Fill facility located at 310 Riverview Road, Huntly (the site). The SAP includes a programme of surface water quality monitoring of stormwater discharges and the water quality of the receiving environment. The sampling and analysis surface water quality programme is designed to meet Condition x in Resource Consent [xxxxxxxxx] dated [x] from the Waikato Regional Council (WRC) (see **Appendix A**).

This SAP will need to be updated once the Resource Consent has been issued.

1.1 Background

This section provides an overview of the site and the receiving environment. Detailed information on the site is available in the Assessment of Environmental Effects dated 15 January prepared by Paua Planning Limited.

1.1.1 Site Location

The site is located at 310 Riverview Road approximately 4.5 km to the south of the Huntly township on the western side of the Waikato River. The details of the site are listed in **Table 1-1**.

Table 1-1 Site Legal Description

Address	Legal Description*	Approximate Area (ha)*
310 Riverview Road, Huntly	Part LOT 9 – 10 DP1278 (CT SA922/109, SA149/243), Lot 1 DP 25272 (CT SA656/223), Part Lot 11 DP 1278 (CT SA200/119), Lot 1 DPS 75436 (CT SA1276/42, SA57C/382, SA1068/288), Part Lot 11 DP 1278 (CT SA200/118), Lot 1 DPS 4285 (CT SA29C/651)	477

Notes: * Information sourced from X

The fill sites subject to this application (Fill Areas 2-4) are largely contained within Pt Lots 9 and 10 DP 1278 and Lot 1 DP 25272, north of the active quarry operation, as depicted in **Figure 1-1** and **Figure 1-2** below. Fill area 2 covers an area of 3.8ha, fill area 3 covers a total area of 4.2ha and fill area (Paua Planning, 2019). Fill area 4 covers approximately 5.1ha and once filled to capacity will contain up to 800,000m³ of managed fill

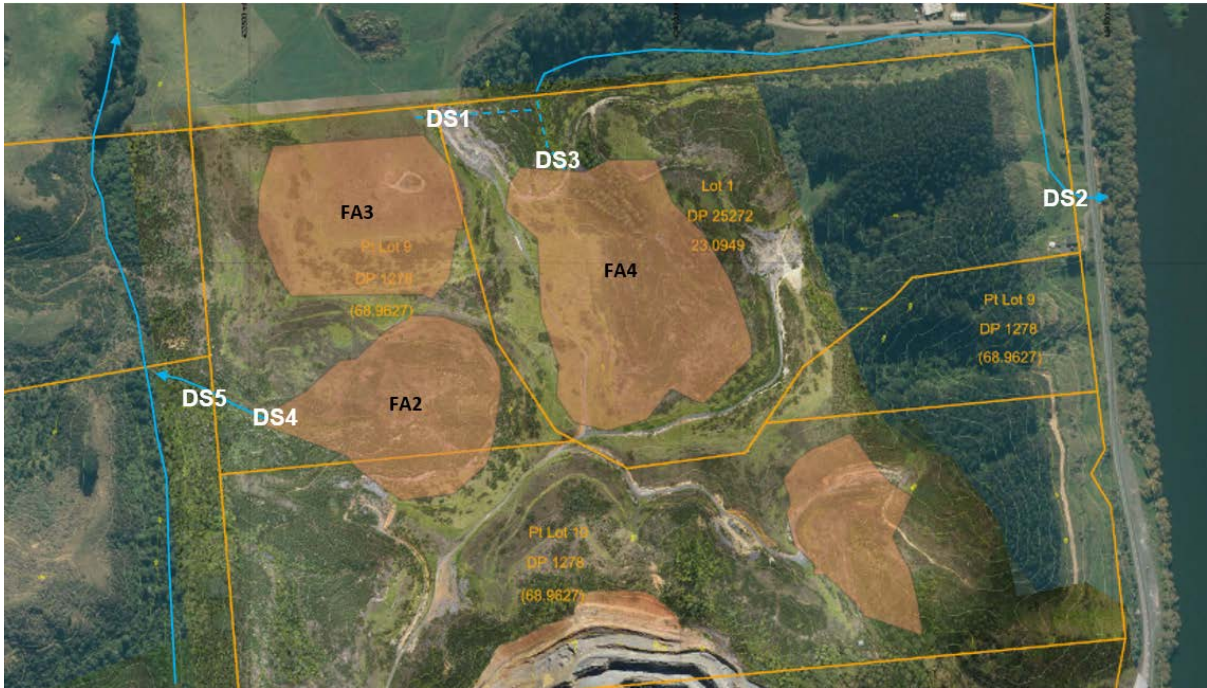


Figure 1-1 Proposed Fill Area 2-4 and indicative sampling locations (Source: Southern Skies, 2022)

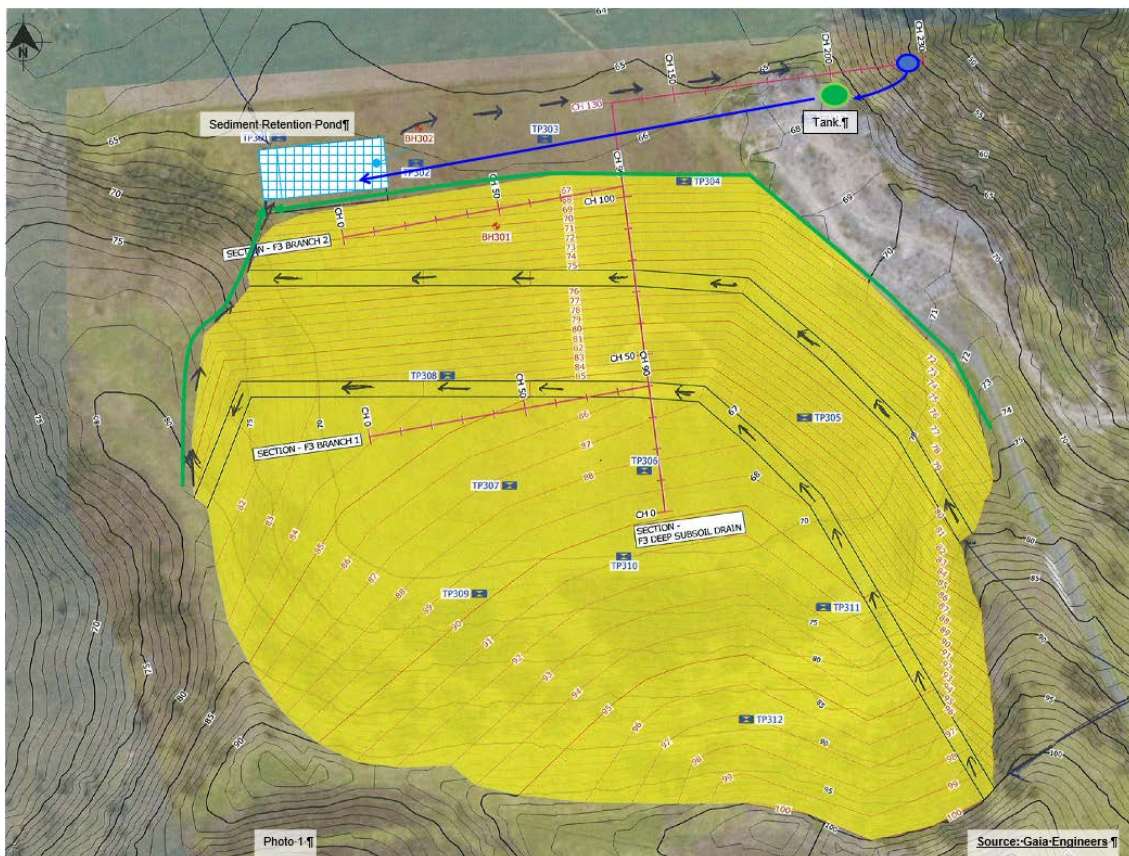


Figure 1-2 Proposed Fill Area 3 (Source: Gaia Engineers, 2022)



1.1.2 Environment Setting

The Ecological Impact Assessment report (Boffa Miskell, 2019) indicated that Fill Area 2 is part of the Lake Waahi and Lake Puketirini catchment, and Fill areas 3, and 4 are part of the Waikato River catchment. There are no permanent streams within the proposed fill areas with only ephemeral/intermittent streams observed indicating that the surface waterbodies within the proposed fill areas are not fed by groundwater but by surface water runoff.

Fill area 2 consists of a westerly orientated steep sided gully system which drains into water course 1. Fill 2 contains an existing dam/farm pond that was constructed for stock watering. The WRC Wetland Review concludes that the upstream wetland is artificial as defined by the National Environmental Standards for Freshwater Regulations 2020 (NES: FW 2020) and has formed as a consequence of the farm pond that was constructed for stock water. The ecology report identifies that the base of the gully contains an ephemeral watercourse described as having negligible ecological value.

Fill area 3 is located on a historic fill disposal site associated with a previous coal mining operation in the property immediately to the north (the O'Reilly property). Surface water runoff from Fill area 3 the site predominantly falls to the central basin of the fill area and then via drainage channels along a riprap flow path and into an ephemeral stream east of the site, which drains to the Waikato River via a second stream and culvert under Riverview Road near the entrance to the O'Reilly Coal Mine.

Groundwater within the site drain via existing groundwater drainage contours to the north and east, contributing to flows within the stream.

Stormwater from fill area 4 will be directed into a stormwater retention pond providing a minimum storage volume of 1,530m³. Clean water diversions will be used to divert adjacent clean/stabilised area away from the SRP. Design details are provided in the sediment and Erosion Control Plan see drawing ESCP-004-02.

1.1.3 Proposed Site Drainage

The fill site 3 will be drained by two drainage systems as shown in Figure 1-1 and the drainage plan provide in **Appendix A**.

To allow a commercially viable rate of fill importation and placement, deep (up to 10m) drainage will be installed to dewater the existing fill. That drainage will daylight at a manhole to be located part way down the side of the gully to the east and will be pumped back to the Holding Tank to be located near the fill site. The tank water will be analysed initially daily and then as necessary based on drainage rates. Water within the tank will be managed in accordance with Figure A2 in **Appendix A**.

Groundwater and stormwater from within and the surface of the new fill that is to be imported will be captured by a separate drainage system and directed to the Sediment Retention Pond (SRP). The SRP will discharge via a floating decant system to the gully. **Table 1-2** describes the habitat that the stormwater ponds discharge into before crossing the site boundary or into a natural waterway.



Table 1-2 Environmental Setting and Immediate Downstream Aquatic Environment of Fill Areas

Fill Area	Habitat Type ¹	Length/Area ²
Fill Area 2	No permanent water course within Fill area 2. Permeant water course downstream of Fill area 2	Unknown until detail design of SRP is completed.
Fill Area 3	Ephemeral watercourse	It is currently estimated that there will be a length of approximately 5-10m of the ephemeral stream before it crosses the boundary and joins Watercourse 2 (north of the subject site).
Fill Area 4	Ephemeral watercourse	Unknown until detail design of SRP is completed.

Notes:

1: Habitat type from Boffa Miskell Ltd Ecological Impact Assessment (Boffa Miskell, 2019)

2: Based upon information provided by Paua Planning, 2019.

There is no permanent stream upstream of the discharge from fill area 3. The ultimate receiving environment for Fill Areas 3 and 4 is the Waikato River.

1.2 References Documents

The Key Documents referenced in developing this SAP include:

- Australian New Zealand Government (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018).
- National Environment Standards – Water Quality Part 2- Sampling, Measuring, Processing and Archiving of Discrete River Water Quality Data (NEMS, 2017).
- Gaia drainage drawing – DWG 235-74-CQ-01 – copy in **Appendix A**.
- WRC Resource Consent issued for the Huntly Managed Fill – copy given in **Appendix B**.
- Erosion and Sediment Control Plan Fill Area 2 and 4 – see AEE.



2 Sampling Locations

The exact surface water sampling locations (either discharge monitoring or receiving environment monitoring) cannot be confirmed until the preliminary infrastructure has been built. This SAP will be updated on the completion of the construction work.

With respect to the selection of surface water sampling locations, the following will be considered:

- Health and safety of the samplers.
- The accessibility of the sampling location (i.e., steep slopes, water velocity of streams and ease of sampling staff to get to, on land that Gleeson staff and contractors can legally access (i.e. either on land owned by Gleeson or on public land).
- Approval to access the location from the landowner (if on land not owned by GMF). Preference will be given to sampling locations of land owned by GMF. The landowner on the property north of fill area 3, has refused permission for water samples to be collected on his land.
- The presence of a defined channel and stream bed.
- Permanent (preferable) or intermittent stream. Ephemeral waterways are not suitable for receiving water quality monitoring for consent monitoring purposes. Water may not be present or flowing at the time of sampling and the location where sampling is undertaken may change (i.e., the point of compliance cannot be defined). Intermittent streams may not be suitable during low flow conditions because they may not be flowing during part of the year.
- Depth of the surface water, with a preference for greater than 10 cm to avoid disturbing sediment during sample collection.
- If there are suitable upstream monitoring sites to allow for catchment level effects.

It should also be noted that there is no permanent waterway above the discharge from Gleeson Managed fill areas 3 and 4 into the unnamed tributary on the O'Reilly property. Nor is there a suitable Sampling location DS2 (fill area 2 and 4) is located on Gleeson property and therefore can be sampled by Gleeson staff. The purpose of monitoring location DS2 is to verify that the discharge from the managed fill will not have an adverse impact on the water quality of the Waikato River and the unnamed stream.



Figure 2-1 Indicative Layout of Fill Area 2

Notes: Sampling point DS4 at SRP outlet. Sampling point DS5 to be located 50 m downstream before confluence with western watercourse.

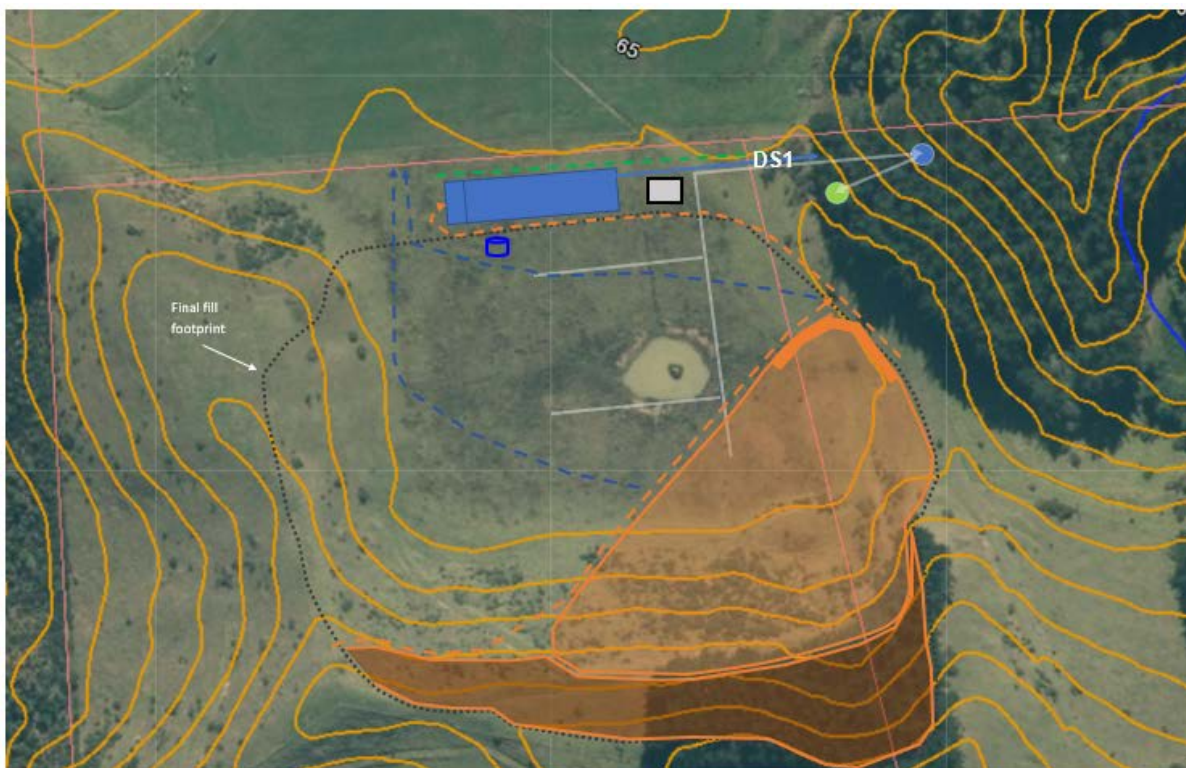


Figure 2-2 Indicative Layout of Fill Area 3

Notes: Sampling point DS1 to be at the discharge from the SRP. The downstream sampling point (DS2) is shown in Figure 2-3 below.



Figure 2-3 Indicative Layout of Fill Area 4

Notes: Sampling point DS3 located at the discharge of the SRP. Downstream sampling point DS2 is located within the GMF property before the discharge to the Waikato River. Note that there is no extent of intermittent or permanent stream between Fill Areas 3 and 4 and the northern boundary of the property.

2.1 Fill Area 2

There will be two sampling points for Fill Area 2; one at the SRP discharge point and one 50m downstream prior to that watercourse entering the western watercourse that drains to Lake Puketirini. Fill Area 2 is proposed to be located near the headwaters of the unnamed stream so there cannot be an upstream sampling point.

The exact location of the downstream monitoring points will be confirmed once detailed design of the SRP has been completed. (See **Figure 2-1**).

2.2 Fill Area 3

There will only be a single sampling point at the discharge point of the Fill Area 3 SRP. As described in Section 2 above, the downstream sampling point (DS2) will be located within GMF property prior to the culvert under Riverview Road and the confluence of the receiving watercourse with the Waikato River. That sampling point will also service Fill Area 4. Fill Area 2, there is no opportunity to collect a surface water sample upstream of Fill Area 3 (see **Figure 2-2**).

2.3 Discharge from fill Area 3 underdrains

The discharge from fill Area 3 fill underdrains and historical fill material will be pumped to the holding tank.

The discharge from the underdrains of the new imported fill will discharge to the sediment retention pond.



2.4 Fill Area 4

As for Fill Areas 2 and 3, Fill Area 4 is within the headwaters of its catchment so there is no opportunity for upstream sampling. There will be a single sampling point (DS3) at the discharge of the SRP. Downstream monitoring location DS 2 (See **Figure 2-3**) will be used to monitor the combined impact of discharges from Fill Areas 3 and 4 before they enter the Waikato River.



3 Surface Water Quality

The surface water quality monitoring programme is detailed in the following section and sampling methods used to collect surface water samples will be based upon the methodology outlined in National Environment Monitoring Standards – Water Quality Part 2- Sampling, Measuring, Processing and Archiving of Discrete River Water Quality Data (NEMS, 2017).

3.1 Monitoring Parameters

3.1.1 Downstream monitoring points from Sediment Retention Ponds

The proposed parameters for the monitoring programme for the surface water discharges including downstream monitoring locations are outlined in **Table 3-1** and **Table 3-2** respectively.

Table 3-1 Surface Water Quality Parameters at DS1 and at Discharge Points from SRP Fill Area 2 and 4, the Rationale for Selection of the Water Quality Parameters

Parameter	Rationale
Dissolved Aluminium	Requested by WRC. Sample will undergo ultra-filtration within the laboratory.
Dissolved Arsenic	Common contaminants naturally occurring in Waikato soils and from anthropogenic land use. Key indicator compound of CCA impacted soils. Indicative of behaviour of oxyanions in the environment.
Dissolved Boron	Mobility - water soluble and mobile in the environment.
Dissolved Cadmium	Contaminant from anthropogenic land use.
Dissolved Chromium	Requested by WRC.
Dissolved Copper	Common contaminant naturally occurring in Waikato soils and from anthropogenic land use.
Dissolved Lead	Common contaminants naturally occurring in soils and from anthropogenic land use.
Dissolved Nickel	Requested by WRC
Dissolved Thallium	Requested by WRC.
Dissolved Zinc	Common contaminants naturally occurring in soils and from anthropogenic land use. Moderate mobility under neutral pH conditions.
Total petroleum hydrocarbons (TPH)	Common contaminant from anthropogenic land use.
pH	Indicator of acidic discharge from sulphur-containing soils. Ability to make inorganic contaminants soluble.



Table 3-2 Surface Water Quality Parameters at DS2, the Rationale for Selection of Water Quality Parameters at Receiving Water Body Location

Parameter	Rationale
Dissolved Aluminium	Requested by WRC. Sample will undergo ultra-filtration within the laboratory.
Dissolved Arsenic	Common contaminant naturally occurring in Waikato soils and from anthropogenic land use. Key indicator compound of CCA impacted soils. Indicative of behaviour of oxyanions in the environment.
Dissolved Boron	Mobility - water soluble and mobile in the environment.
Dissolved Cadmium	Contaminant from anthropogenic land use.
Dissolved Chromium	Requested by WRC.
Dissolved Copper	Common contaminant naturally occurring in Waikato soils and from anthropogenic land use.
Dissolved Lead	Common contaminants naturally occurring in soils and from anthropogenic land use.
Dissolved Nickel	Requested by WRC.
Dissolved Thallium	Requested by WRC
Dissolved Zinc	Common contaminants naturally occurring in soils and from anthropogenic land use. Moderate mobility under neutral pH conditions.
Total petroleum hydrocarbons (TPH)	Common contaminant from anthropogenic land use.

Polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs) and tributyltin (TBT) are not included in the monitoring programme due to their low water solubility and bind strongly to organics that they are not likely to be transported far from the managed fill area and should be removed by the stormwater treatment pond.

All samples are to be laboratory filtered to meet with the requirements of National Environment Monitoring Standards – Water Quality Part 2- Sampling, Measuring, Processing and Archiving of Discrete River Water Quality Data (NEMS, 2017). Dissolved aluminium will be measured using ultra-filtration techniques to remove colloidal aluminium from clay particles.

3.1.2 Underdrain Discharge -Storage Tank

The proposed monitoring parameters for the monitoring of the underdrain discharge (storage tank) are outlined in **Table 3-3**. Water samples collected from the underdrain storage tank will be measured using a handheld or benchtop spectrophotometer to allow the site to make decisions on whether the water can be discharged into the sediment retention pond or not.



Table 3-3 Surface Water Quality Parameters, the Rationale for Selection of Water Quality Parameters at Underdrain Discharge Storage Tank

Parameter	Rationale
Total Boron	Mobility - water soluble and mobile in the environment. TCLP testing of soils indicated boron concentrations may be elevated.
Total Copper	Common contaminant naturally occurring in Waikato soils and from anthropogenic land use.
Total Lead	Common contaminants naturally occur in soils and from anthropogenic land use.
Total Zinc	Common contaminants naturally occur in soils and from anthropogenic land use. Moderate mobility under neutral pH conditions. TCLP testing of soils indicated zinc concentrations may be elevated.
pH	Indicator of acidic discharge from sulphur-containing soils. Ability to make inorganic contaminants soluble.

3.1.3 Analytical Detection Limits

Analytical detection limits should be at least five times lower than the applicable assessment criteria outlined in **Section 4**. Analytical Limits of Reporting for surface water samples are outlined in **Table 3-4**.

Table 3-4 Surface Water Quality Parameters, Sample Bottle Type, Hold Time and Proposed Analytical Detection Limits

Parameter	Sample Bottles Type	Maximum Hold Time	Analytical Detection Limits
Dissolved Metals	Plastic (see lab for advice)	24 hours (lab filter) (Chilled)/ 6 months field filter	0.0005 g/m ³
Total inorganic Elements (Storage Tank)	Plastic (acid preserved)	6 months (chilled)	0.01 g/m ³
Total petroleum hydrocarbons (TPH)	Glass (sulphuric acid preserved)	14 days (chilled)	0.5 g/m ³
pH	Not applicable	Field Measurements	0.05 pH units

3.1.3.1 Sample Containers

Surface water samples must be collected in specially designated laboratory-supplied plastic sample containers. **Table 3-4** provides an outline of bottle type for each analysis. Please consult the laboratory for further information regarding the volume of containers and the number of samples required.

3.2 Sampling Timing and Frequency

Samples shall be collected of the discharges from the inlets and outlets of all sediment retention ponds on the site once per month and after rainfall trigger events (rainfall greater than ≥ 15 mm in one hour; or ≥ 25 mm in 24 hours in the preceding 24 hours), excepting times when there are no discharges.



It is proposed that receiving environment sampling (DS2) is undertaken four times per year and that surface water discharge monitoring is undertaken five times per year (including two times that coincides with the receiving environment sampling programme).

Surface water sampling will be undertaken after the storm event (15 mm in 24 hours) as determined by the WRC rain gauge at Whangamarino Control Structure (WRC site number 1293.6) or on-site rain gauge.

The sampling of the Underdrain Discharge -Storage Tank should be undertaken either weekly (or immediately before discharge if the tank is over 80% fill) to confirm if the water will meet discharge criteria (See **Table 4-1**).

3.3 Surface Water Sampling Methodology

Surface water samples will be collected following the recommendations outlined within the National Environmental Monitoring Standards (NEMS, 2017). The methodology for undertaking visual clarity monitoring has been prepared by Erosion Management Limited and is attached in **Appendix C**.

3.3.1 Surface Water Sample Collection

3.3.1.1 Surface Water Grab Samples

Surface water samples collected shall be near-surface samples (defined as 0.2 m below the water surface in the NEMS) and collected by hand or using a sampling pole (i.e. mighty gripper). Surface water samples should be collected up stream of the field personnel and at least 10 cm from the deepest point (if possible) to avoid bed sediment from getting into the bottle.

The sampling container should be rinsed with site surface water at least three times before the surface water sample is collected.

As the sample bottles used in this project could potentially contain preservatives, it is recommended that a 500 mL unpreserved bottle be used to collect the surface water samples. The surface water sample can then be decanted into the specific labelled sample container to be sent for laboratory analysis.

The surface water sampling technique is depicted in **Figure 3-1** below.

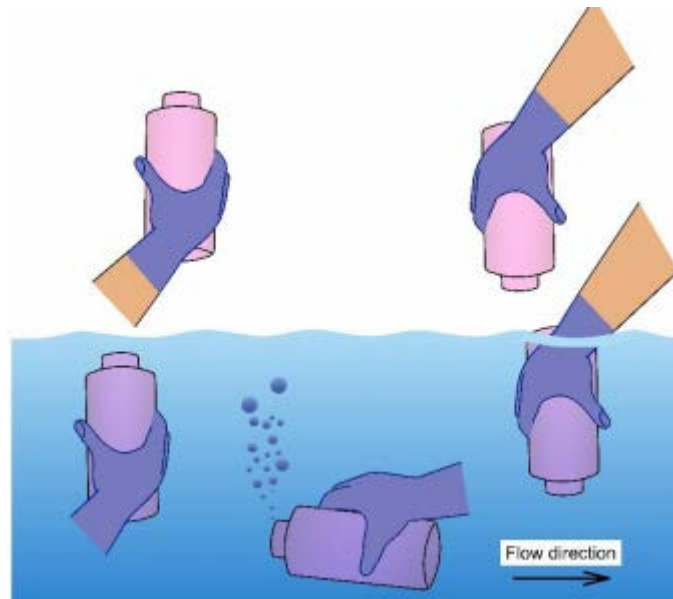


Figure 3-1 Sampling Technique for Unpreserved Sample (Source NEMS, 2017)

3.3.1.2 Field Filtration

If dissolved metals samples cannot be transported to the laboratory within 24 hours of collection, they need to be field filtered through a laboratory supplied 0.45 µm filter. Otherwise, all samples should be filtered within the laboratory. Note that dissolved aluminium requires ultra-filtration, and this can only be done within by the laboratory. Before collecting any water samples for dissolved metals, it is important to liaise with the laboratory to ensure correct sample bottles are supplied.

It is important that when collecting a sample from dissolved metals extreme care should be taken not to disturb the bottom sediments.

The general steps for undertaking field filtering are:

1. Change gloves to lab supplied trace metal gloves before touching the syringe or opening the sample container.
2. Rinse the syringe with site surface water first before collecting a sub-sample from the sampling container.
3. Attach a clean filter on the end of the syringe, avoiding contamination of the syringe and filter outlets from fingers, and discharge a few drops of the sample from the syringe/filter cartridge.
4. Depress the syringe plunger to push the remainder of the sample through the filter into the appropriate sample bottle, taking care to avoid contamination of the threads and inner surfaces of the bottle and cap.



3.3.1.3 Storage tank (Underdrain water samples)

A tap shall be fitted to the exterior of the storage tank that the underdrain water is discharged into. This tap will be used to collect water samples and should be located at least 0.5 m above the bottom of the tank to avoid sampling bottom sediments.

Method for sample collection:

1. Place a 10 L bucket beneath the tap.
2. Label sample bottle
3. Carefully turn the tap on until medium flow and allow the tap to run for 2-3 minutes (~20 L), then reduce the flow.
4. Remove the cap from the sample bottle and hold it below the cold-water tap. Do not place the cap on the ground or in your pocket and do not touch the inside of the cap.
5. Without changing the flow rate, carefully fill the bottle until it is about $\frac{3}{4}$ full. Do not overfill the bottle and do not contact the top of the bottle with the tap.
6. Turn-off the tap.
7. Place the cap back onto the bottle, tighten the cap and review the sample label to ensure details are correct.
8. Measure the pH and temperature of the water from the bucket.
9. Fill out the sampling form.

The sample from the storage tank will be analysed on-site using a HACH D 3900 spectrophotometer to determine total boron, copper, lead and zinc to confirm if they meet US EPA CMC criteria. If the results are lower than the US EPA CMC criteria and pH is between 6 to 9 pH units then the water can be discharged to the stormwater treatment pond.

Note: The water from the storage tank must never be directly discharged into the environment.

3.3.1.4 Calibration of Field Equipment

Field meters used for surface water sampling need to be calibrated and/or validated before a field visit and records of these procedures to be kept. Requirements and acceptance criteria for calibration and validation are outlined in subsection 3.1 of the National Environment Standards – Water Quality Part 2- Sampling, Measuring, Processing and Archiving of Discrete River Water Quality Data (NEMS, 2017).

Calibration solutions used to calibrate electrical conductivity and pH must be National Institute of Standards and Technology (NIST) traceable (or traceable to a certified primary standard held at an accredited national measurement standards body) and within the expiry date of the calibration solution. Expired solutions can be used to rinse the instrument prior to calibration but cannot be used to calibrate the instrument.



All field meters should be calibrated before use in the field. Calibration records from the instrument should be downloaded and stored within a central file and be available to an auditor or WRC upon request.

3.3.2 *Decontamination Procedures*

3.3.2.1 General Decontamination Considerations

Surface water sampling equipment and measurement equipment will be decontaminated before and after each use. Do not place decontaminated equipment directly onto the ground. The equipment must be placed into new, clean, clear plastic bags. Once these bags have been used, they should not be reused for clean equipment.

3.3.3 *Documentation of Sampling*

A field sheet must be completed for each surface water sample collected during the sampling event. Original copies of the field data sheets must be kept for future reference.

Fieldwork documentation must include at a minimum, the following information:

- Project name and number
- Date, time, weather conditions
- Personnel present
- Sampling location
- Type of sample
- Sample number
- Sampling method
- Sample equipment
- Time of sample collection
- Depth of water
- Visual descriptions of water
- Field measurements (pH, EC and temperature)

3.3.4 *Sample Labelling*

Note that a permanent marker or pen should be used on sample labels.

At a minimum the sample labels should contain the following information:

- Project number;
- Sample location; and
- Date of sample collection.

Clear handwriting is imperative to ensure the sample label is interpreted correctly by relevant personnel (e.g., laboratory staff). Consideration into whether the samples will be labelled prior to



field work or whilst in the field. This may depend on the type of sample and the weather conditions at the time of sampling.

3.3.5 *Sample Storage and Transport*

Labelled samples collected for laboratory testing should be placed in a storage/shipping container (e.g., chilly bin) promptly and not left exposed to sunlight where they may be subject to warming and photochemical degradation. Samples must be firmly sealed to avoid leakage and placed inside the storage bin with chilled cooler pads so that samples are evenly and quickly chilled (ideal temperature range between 4 and 10°C). Unless prior arrangements have been made with the analytical laboratory, sampling should not be scheduled on Fridays or directly prior to public holidays, to ensure that the laboratory can receive and process samples promptly within holding times. In general, the shorter the time that elapses between the collection of samples and their analysis, the more reliable the analytical results will be.

3.3.6 *Chain of Custody Procedures*

Sample shipments for analyses will be accompanied by a chain-of-custody (CoC) record. Form(s) will be completed and sent with the samples for each laboratory and each shipment (i.e., each day). If multiple shipments are sent to a single laboratory on a single day, form(s) will be completed and sent with the samples for each shipment.

The CoC record at a minimum should include the following:

- Project name and number;
- Sample type, identification number and location;
- Date and time of collection;
- Number and type of containers;
- Required analyses; and
- Signatures documenting the change of sample custody.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of the agency/organization conducting sampling. The original CoC record will accompany the samples to the analytical laboratory. The carbon copy or a scanned copy of the original CoC record must be placed in the appropriate project file. Samples must be delivered to the laboratory promptly to ensure the specified holding times are met.

The analytical laboratory can provide CoC books or electronic copies of CoC and this should be used. A CoC must be completed in full and unused or not applicable sections of the CoC form should be crossed out or N/A entered into the field.

Copies of Chain of Custody forms shall be collected and retained.



3.3.7 Quality Assurance/Quality Control

As part of the downstream monitoring programme for sampling location DS2 the following QA/QC samples should be collected:

- A duplicate sample (which is put on cold hold and only analysed if the primary sample exceeds water quality criteria).
- A laboratory-supplied trip blank (which is put on cold hold and only analysed if the primary sample exceeds water quality criteria).

The purpose of the trip blank is to verify if the sample container could be a source of dissolved zinc within the sample.



4 Surface Water Quality Assessment Criteria

Site-specific assessment criteria have been developed for both the surface water discharge samples (Sampling location DS1) and the receiving environment samples (sampling location DS2).

Since the surface water runoff discharge will be from the stormwater system, it is considered best practice (in line with common industry practice for assessing stormwater in New Zealand) to assess the water quality against acute toxicity criteria (such as US EPA Criterion Maximum Concentration) as this discharge is:

- only transient and mainly will occur during and immediately after storm events;
- discharging into an ephemeral watercourse, and;
- the sample does not take into account reasonable mixing.

The receiving environment criteria proposed comprise the ANZG (2018) 90% freshwater species protection criteria for parameter that are likely to be impacted by anthropogenic land-use activities, discharges from the old O'Reiley's Coal Mine and road runoff. For dissolved zinc the criteria shall be 80% freshwater species protection criteria as background monitoring has shown that the water quality can exceed ANZG (2018) 90% freshwater species protection criteria.

For parameters where there are no known impacts from the old O'Reiley's Coal Mine and road runoff the receiving water comprise the ANZG (2018) 95% freshwater species protection criteria.

Waikato Regional Council has requested that the Total Petroleum Hydrocarbons criteria to be set lower than the Ministry for the Environment guidelines values at 5 mg/kg. There are no published water quality criteria for Total Petroleum Hydrocarbons within the ANZG (2018) water quality criteria.

4.1 Surface Water Discharge Criteria (Sampling Location DS1 and downstream of Fill area 2 (DS4) and Fill Area DS3)

As the surface water discharge is intermittent and will only occur for a short period of time during and after a storm event, it is proposed that U.S. EPA Criterion Maximum Concentration (CMC) water quality guidelines (US EPA, 2019) are used as a basis to derive a site-specific surface water quality criteria value.

US EPA CMC guidelines (US EPA, 2019) have been developed for acute exposure scenarios (such as stormwater discharges) and are considered to be more appropriate to assess the surface water discharge from the site rather than using ANZG (2018) water quality guidelines which have been developed to assessed chronic effects on aquatic ecosystems (such as those from a continuous discharge into a water body) after reasonable mixing in the receiving water body. Dissolved metal criteria have been used for both discharge water criteria (DS1) and the receiving environment criteria (DS2) to allow a mass balance to be undertaken if required.

Where US EPA CMC values do not exist, site-specific trigger values have been derived on a case-by-case basis (see table footnotes). In the case where background concentrations may be high in the receiving environment ANZG (2018) 80% ecosystem water quality guidelines have been used. This allows for dilution with the receiving environment after reasonable mixing. In the case of boron and thallium ANZG (2018) 95% ecosystem protection values have been used as high background concentrations in the receiving environment.



In the case of arsenic and lead discharge criteria have been altered to ensure NZ drinking water Maximum Acceptable values are met¹.

Whole Effluent Toxicity Testing (WETT) of the stream water collected (using the procedure outlined in **Appendix E**) from DS2 shall be undertaken by NIWA² using three freshwater species from three different trophic levels including:

- A green algae – 72-hour growth test
- A crustacean (i.e. *Daphnia magna*) – acute 48-hour survival test
- A fish (either rainbow trout or common bully)- acute 96-hour survival test.

The stream water sample collected diluted to create a concentration series to determine a no observable effects concentration (NOEC) for zinc. This value will be used to determine the zinc discharge criteria for sampling location DS1. If the NOEC value is greater than 80% freshwater ecosystem protection outlined in ANZG (2018) then the default guideline value for 80% freshwater ecosystem protection (ANZG, 2018) for zinc will be used instead of the NOEC value determined by the NIWA WETT.

The proposed water quality criteria for the discharge at DS1 is outlined in **Table 4-1**.

Table 4-1 Water Quality Parameters and Proposed Trigger Values for Stormwater Discharge at Sampling Location DS1 and Fill Area 2 (DS4) and Fill Area 4 (DS3).

Parameter	Proposed Trigger values (mg/L)	Source and Rationale
Dissolved Aluminium (0.22 µm filter)	0.980 ¹	US EPA CMC. Intermittent discharge and Colloidal aluminosilicates may give high values
Dissolved Arsenic	0.01 ²	MoH (2018) Drinking Water Standards
Dissolved Boron	0.940 ³	ANZG (2018) 95% Guidelines. High Background values
Dissolved Cadmium	0.0008 ¹	ANZG (2018) 80% Guidelines. Allows for dilution
Dissolved Chromium (based on Cr(III))	0.57 ¹	US EPA CMC. Intermittent discharge
Dissolved Copper	0.0251 ⁵	ANZG (2018) 80% Guidelines. Allows for dilution
Dissolved Lead	0.005 ^{4,7}	ANZG (2018) 90% Guidelines. Allows for dilution and protection of drinking water ⁷ .
Dissolved Nickel	0.013 ⁴	ANZG (2018) 90% Guidelines and Protection of Drinking water
Dissolved Thallium	0.00003 ⁴	ANZG (2018) 95% Guidelines. High Background values

¹ This is a precautionary measures are the stream is not used as a drinking water source.

² The test protocols are based upon NIWA standard operating procedures, which are based upon international reference methodologies.



Parameter	Proposed Trigger values (mg/L)	Source and Rationale
Dissolved Zinc	0.031	Confirmed as being non-toxic by Whole Effluent Toxicity testing of the stream water collected from sampling location DS2.
Total petroleum hydrocarbons (TPH)	15 ⁶	MfE (1989) Petroleum Guidelines. To avoid visible sheens
pH	>5.5 (6.0 for storage tank Fill 3 underdrain) pH units	

Note: Dissolved aluminium shall be measured using 0.22 µm ultra-filtration method to remove colloidal aluminium from clay particles.

1. US EPA CMC (for aluminium the lowest CMC has been used with a water hardness of 100 mg/L, DOC equal 1 mg/L and pH 7)
2. MoH (2018) Drinking water standards
3. ANZG (2018) 95% ecosystem protection guideline value
4. ANZG (2018) 90% ecosystem protection guideline value
5. ANZG (2018) 80% ecosystem protection
6. Based upon MfE (1989) Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand recommendation of 15 mg/L.
7. Water Services (Drinking Water standards for New Zealand) Regulations 2022

4.2 Receiving Environment Criteria (Sampling location DS2 and DS5)

As the surface water eventually discharges into the Waikato River, it is proposed that mix of ANZG (2018) water quality guidelines for 90% and 95% freshwater species protection are used as a basis to derive receiving water quality criteria value. The 90% ecosystem values have been proposed as an interim guideline value until background monitoring consisting of at least twenty monitoring events over a period of 6 months is completed to establish background concentration levels. If background concentrations are less than 80% of ANZG (2018) 95% ecosystem protection levels after hardness modification are applied, then these values will be adopted.

The proposed receiving environment criteria for the downstream sampling site (DS2 and DS5) are listed below in **Table 4-2**.

Table 4-2 Water Quality Parameters and Proposed Trigger Values for Downstream Receiving Water Quality at DS2 and DS5.

Parameter	Proposed Trigger Values (mg/L)	Source and Rationale
Dissolved Aluminium	0.080 ¹	ANZG (2018) 90% Guidelines. Background may be elevated during storm conditions.
Dissolved Arsenic	0.024 ²	ANZG (2018) 95% Guidelines.
Dissolved Boron	0.940 ²	ANZG (2018) 95% Guidelines.
Dissolved Cadmium	0.0002 ²	ANZG (2018) 95% Guidelines.
Dissolved Chromium (as Chromium III)	0.0033	ANZG (2018) Default Guideline Value
Dissolved Copper	0.0014 ²	ANZG (2018) 95% Guidelines.
Dissolved Lead	0.0034 ²	ANZG (2018) 95% Guidelines.
Dissolved Nickel	0.011 ²	ANZG (2018) 95% Guidelines.



Parameter	Proposed Trigger Values (mg/L)	Source and Rationale
Dissolved Thallium	0.00003 ²	ANZG (2018) 95% Guidelines.
Total petroleum hydrocarbons (TPH)	5 ⁴	33% of the MfE (1989) Petroleum Guidelines. To avoid visible sheens on the surface of the water.

Note: Dissolved aluminium shall be measured using 0.22 µm ultra-filtration method or ultrafiltration to remove colloidal aluminium from clay particles.

1 = Based upon ANZG (2018) 90% ecosystem protection

2 = Based upon ANZG (2018) 95% ecosystem protection

3= Based upon ANZG (2018) 80% ecosystem protection

4 = Based upon MfE (1999) Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand recommendation of 15 mg/m³

L = litre

m³ = cubic metre

MfE = Ministry for the Environment

mg = milligram

mg/L = milligram per litre

mg/m³ = milligram per cubic metre

TPH = total petroleum hydrocarbons

4.3 Underdrain Storage tank

The proposed water quality criteria to determine whether the water in the underdrain storage tank can be discharged into the sediment pond are listed in **Table 4-3**.

Table 4-3 Proposed Trigger Values for Discharging Underdrain Storage Tank

Parameter	Proposed Trigger values (mg/L)	
	Level 1 Criteria	Level 2 Criteria`
Total Boron	1.0	5.0
Total Copper	0.5	1.25
Total Lead	0.1	0.25
Total Zinc	0.6	1.55

Note:

mg/L = milligram per litre

There are two proposed trigger values for determining if the water from the underdrain storage tank can be discharged into the sediment retention pond or would it require additional treatment or off-site disposal.

Level 1 criteria are based upon the discharge criteria in **Table 4-1**. For boron the level 1 criteria have been rounded up to the nearest 0.1 mg/L due to the sensitivity of the spectrophotometer and allowing for some dilution. For copper, lead and zinc the level 1 criteria have assumed 50% removal of these elements due to alum dosing³ and 10-fold dilution⁴ within the sediment retention pond (based upon a dead storage volume of the pond of 470 m³ and a total storage tank of 30 m³).

³ Alum dosing can have up to 70 to 95% removal efficiencies for most metals (Amuda, 2006).

⁴ Note that there is more than 10-fold dilution within the pond, but a 10-fold dilution has been assumed to be conservative.



The level 2 criteria in **Table 4-3** for copper, lead and zinc are based upon an assumed removal efficiency of 50%- and 25-fold dilution factor⁵ (assuming 750 m³ of water within the stormwater pond⁶). The Fill Management Plan outlines the process for determining if Level 1 or Level 2 criteria should be used. Level 1 criteria can be used under standard operating conditions of the pond and Gleeson Managed Fill Limited would just undertake standard monitoring to comply with the resource consent. Level 2 criteria would require that discharge structure to be raised to ensure that the pond would have 750 m³ of water within the pond and additional sampling would be required that the water quality did meet the stormwater discharge criteria set out in **Table 4-1** for sampling site DS1 before the water was discharged.

The boron discharge criteria for level 2 assumes no removal by alum floc and only allows for dilution to ensure it will meet discharge. However, as an additional safety factor, the maximum boron guideline value has been at 5.0 mg/L (or assuming only a 5 times dilution within the pond as an extra safety factor). This is based upon a 90% ecosystem value for boron of 5.3 mg/L derived by Golder Associates (and independently reviewed by NIWA)⁷ and a short-term boron limit of 7.5 mg/L (based upon ecotoxicity to Potamogeton Orchreastus). The Golder report concludes that current studies indicate that concentrations of up to 5 g/m³ of boron are likely to have no effect on indigenous submerged macrophytes in New Zealand watercourses⁷. After dilution with the water within the sediment retention pond, the boron concentration of the combined stormwater and underdrain groundwater should be less than 0.940 mg/L.

⁵ Note that there is more than 25-fold dilution within the pond, but a 25-fold dilution has been assumed to be conservative. Based upon $(750\text{m}^3+30\text{m}^3)/30\text{m}^3$ which gives a dilution factor of 26 times.

⁶ 750 m³ is effectively the pond half fill (total capacity 1,575 m³). The outlet structure can be adjusted to ensure that this level of dilution is obtainable.

⁷ Golder Associates (2009) Ecotoxicity of Boron to Potamogeton Orchreastus. Reported submitted to Solid Energy Limited



5 Review of Water Quality Results

When laboratory results are received by the Environmental Officer the results shall be reviewed and entered into the environmental results spreadsheet within one working day of receiving the results. Figure D-1 in **Appendix D** outlines the process for reviewing the sample results and what suggested actions for sediment retention pond discharge samples. Figure D-2 in **Appendix D** outlines the process for reviewing the sample results and what suggested actions for receiving water samples. Copy of the laboratory results should be forwarded to the Waikato Regional Council within 10 working days.

5.1 Compared Results Against Quality Control Chart

A quality control chart comparing the results from the current monitoring round against background sampling and previous sampling rounds to determine:

- Results exceed the Upper-quality control limit (UCL), or
- An obvious increasing trend within the data (i.e. three or more results trending upwards).

If the sample results are below the UCL trigger value and there is no obvious trend in the data, then a report should be forwarded to the Waikato Regional Council within 10 working days of receiving the results.

If the results indicate that there is an increasing trend over the last three rounds and the sample results are below the consent limits, then the Environmental Officer should undertake a review of:

- The sediment pond operations (including dosing rates),
- Sampling QA/QC processes,
- Laboratory QA/QC if results seem anomalous.
- receiving water quality results (upstream and downstream), and
- the material accepted within the managed fill.

~~This review to determine will determine~~ if there is an obvious cause for the increase in the water quality results. A copy of the laboratory results should be forwarded to the Waikato Regional Council within 10 working days of receiving the results.

5.1.1 Determining UCL for Inorganic Elements for Sediment Ponds Discharges

The UCL limit for the sediment pond discharges shall be 50% of the proposed trigger values, the proposed UCL are outlined in **Table 5-1**.

Table 5-1 Water Quality Parameters and Proposed UCL for Stormwater Discharge

Parameter	Proposed Trigger Values (mg/L)
Dissolved Aluminium	0.49
Dissolved Arsenic	0.005
Dissolved Boron	0.47
Dissolved Cadmium	0.0004
Dissolved Chromium (based on Cr(III))	0.033 ⁸
Dissolved Copper	0.013

⁸ Based upon ANZG (2018) low reliability multiplied by 10 (to allow for dilution).



Parameter	Proposed Trigger Values (mg/L)
Dissolved Lead	0.0028
Dissolved Nickel	0.003
Dissolved Zinc	0.015
Total petroleum hydrocarbons (TPH)	5 ⁹

The proposed UCL shall be reviewed by the Environmental Officer at least every 6 months and updated if necessary.

5.1.2 Determining UCL for Inorganic Elements for Receiving Environment

The UCL limit for inorganic elements in the receiving environment shall be 95 percentiles of the baseline monitoring data plus the previous monitoring results (updated annually), the proposed UCL are outlined in **Table 5-2**.

Table 5-2 Water Quality Parameters and Proposed Trigger Values for Downstream Receiving Water Quality

Parameter	Proposed UCL Trigger values (mg/L) ¹
Dissolved Aluminium	TBD
Dissolved Arsenic	TBD
Dissolved Boron	TBD
Dissolved Cadmium	TBD
Dissolved Chromium (as Chromium VI)	TBD
Dissolved Copper	TBD
Dissolved Lead	TBD
Dissolved Nickel	TBD
Dissolved Zinc	TBD
Total petroleum hydrocarbons (TPH)	5 ⁷

Note:

TBD = To Be Determined

5.2 Comparing results Guideline Values

If the laboratory results exceed UCL then the results should be compared against the relevant criteria in either **Table 4-1** or **Table 4-2**. If they exceed GV values in the applicable table, then the following steps should be undertaken:

- For sediment ponds check whether receiving environment samples meet the applicable criteria. Visually check ponds for any signs of any unusual discolouration or hydrocarbon sheens. If hydrocarbon sheen is noted, then immediately close the emergency shut-off valve.
- For receiving water sample check if the discharge water quality at DS1 is below the receiving criteria water criteria (for sampling location DS2 -see Table 4-2). If the discharge water quality at DS1 is below the criteria in Table 4-2 then it is unlikely that the stormwater pond is

⁹ The TPH number here is based upon 1/3 of the Ministry for the Environment, to match the downstream DS2 criteria.



the source of the elevated concentrations at DS2. If not, repeat sampling and undertake measure the flow at both the discharge site and downstream monitoring site. Environment Officer shall undertake a mass balance calculation to determine if there is sufficient dilution in the stream (an unnamed tributary of Waikato River North of Gleeson Land).

- Review records of activities on-site and if necessary, undertake on-site sampling to confirm water quality entering and exiting the sediment retention pond and confirm if correct dosing of the pond. Environment Officer may need to consult Southern Skies to confirm the correct dosing requirements of the pond.
- Compare results with site-specific trigger values and acute water quality criteria to determine if exceedance is likely to have an adverse effect on aquatic ecosystems.
- Collect another water sample and the Environmental Officer should consider testing additional parameters.
- If results confirm discharge is from the site and the second sample confirms that the discharge is exceeding water quality criteria, then the emergency shut-off valve should be closed, and additional water treatment should be undertaken to reduce the concentration of parameters to allow meet water quality criteria at monitoring location DS2. Revised water criteria for monitoring location DS1 as necessary.

Figure D-1 in **Appendix D** for a simplified flow chart outlining the process

5.3 Review of Sediment Pond Operations and Sediment Control Measures

The review Sediment Pond Operations and Sediment Control measures should include the following:

- Sampling quality assurance/ quality control procedures including if the sample has been incorrectly taken or bed sediment have potentially contaminated the sample.
- Laboratory QA/QC if results seem anomalous.
- Inspection of erosion control devices within the managed fill.
- Discuss with the Fill Manager to determine if an unusual event has at Managed Fill which might have resulted in high results.
- Dosing rate and performance of sediment retention ponds.
- If there has been a significant pH change within the sediment retention ponds.
- Review records of materials deposited within the managed fill.



6 Reporting and Review

It is proposed to forward the results of the sampling to WRC on an annual basis. It is currently envisaged that the proposed monitoring plan will be undertaken for two years. After two years, a review of the monitoring frequency and parameters requiring monitoring will be performed, and if necessary, revised in consultation with WRC.

As the SAP is a live document, it may need to be updated from time to time. Any updates of the SAP will be submitted to WRC for approval.

It is further understood that this SAP will also be linked with the Maatauranga Maaori Environmental Monitoring Plan, which is being developed between Waahi Whaanui Trust and Gleeson Managed Fill.



7 Limitations

EHS Support New Zealand Ltd (“EHS Support”) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Gleeson Managed Fill Limited and only those third parties who have been authorised in writing by EHS Support to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 8 April 2020.

The methodology adopted and sources of information used by EHS Support are outlined in this report. EHS has made no independent verification of this information beyond the agreed scope of works and EHS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to EHS Support was false.

This report was prepared on the issue date and is based on the information reviewed at the time of preparation. EHS disclaims responsibility for any changes that may have occurred after this time nor the accuracy of the information on site conditions supplied to us.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.



8 References

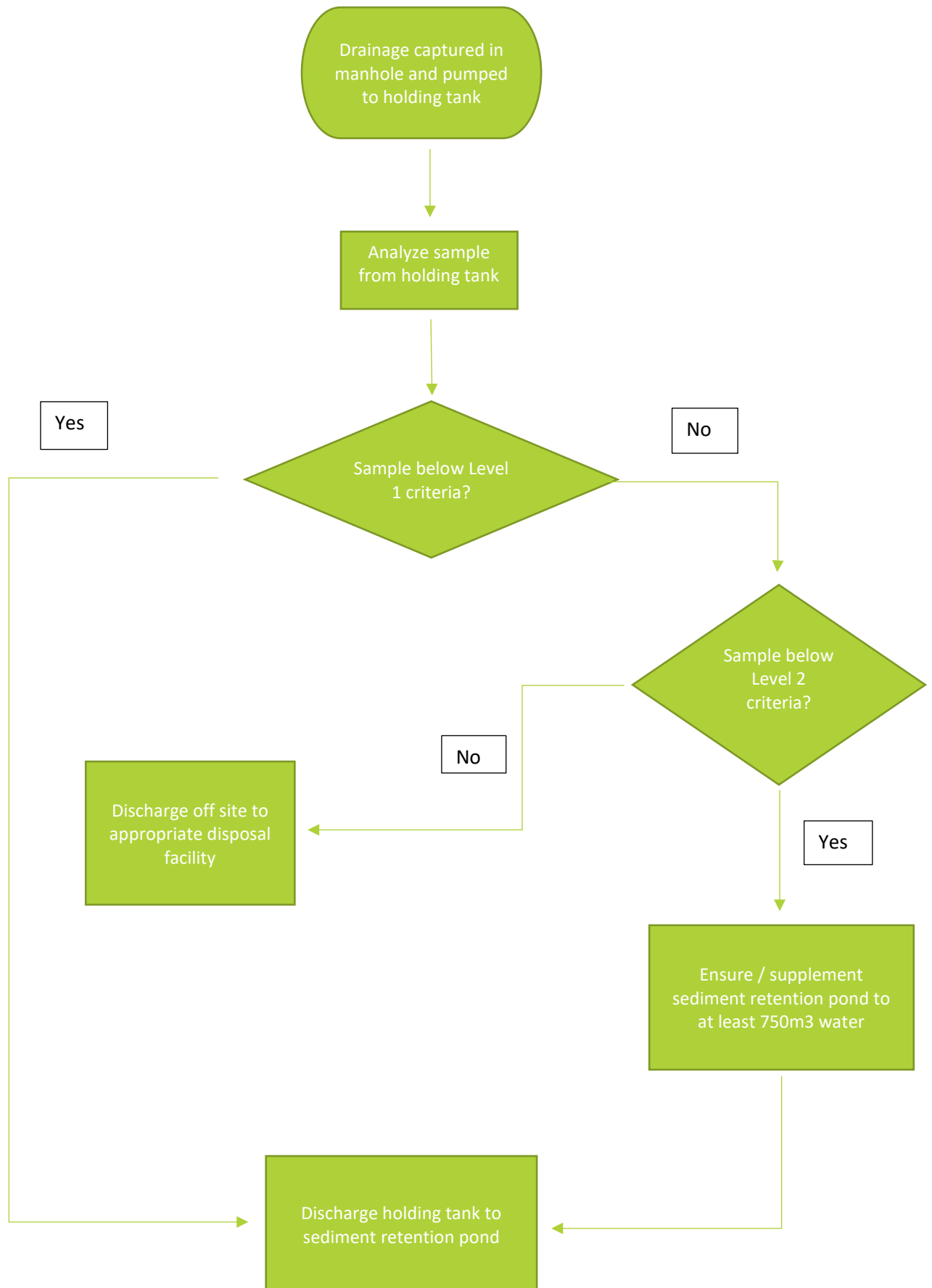
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Appendix A Drainage Plan and Flow Chart



Figure A-2: Decision Tree regarding management of underdrain water





Appendix B Resource Consent



Appendix C Sediment Monitoring Programme



Managed Fills - Sediment Sampling

A sampling programme to measure sediment levels in the water discharged from the fill site after treatment is proposed. Because most sediment is mobilised during storm events, and because there is usually minimal, if any, discharge from sediment retention ponds during dry weather, the programme is proposed to be based on rainfall. The trigger for sampling is proposed to be 20mm of rain recorded over the previous 24 hours¹⁰. From adjacent quarry rainfall records, this rainfall depth equates to about 15 events/year. It is proposed to assess sediment levels from water clarity¹¹ samples with a clarity reading of 6 cm equating to about 100 g/m³ of suspended solids¹².

For Fill 3, the proposed water clarity sampling sites are:

- Site 1: The outlet to the sediment retention pond.
- Site 32: The nearby watercourse downstream of the discharge point.

These are shown below on Figure B-1. A sampling sheet is attached as **Attachment 1**.

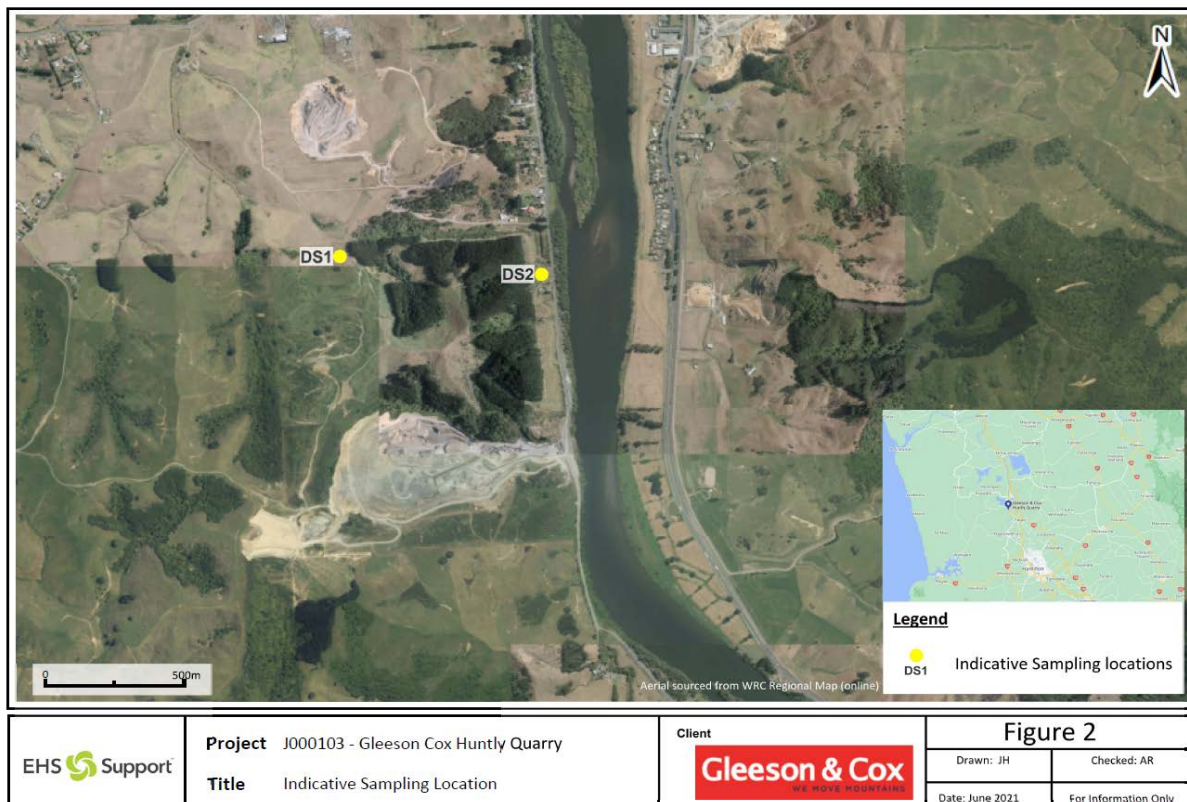


Figure C-1 Fill 3: Storm Water Clarity Sampling Points

It is proposed that the monitoring programme is undertaken for a 2-year period to assess the effectiveness of the system. Provided the results show that no significant adverse sediment-related effect is occurring on the environment, then it is proposed that the programme is discontinued. The programme can be recommenced with any significant change to site conditions or control systems.

¹⁰ This is the same threshold as used in the Waikato Expressway; Huntly Section.

¹¹ Water clarity is measured in mm: the higher the reading, the clearer the water.

¹² This is from the suspended solids-clarity relationship derived for the adjacent quarry and used for many years for the same purpose.



ATTACHMENT 1

FILL 2 – WATER CLARITY SAMPLING

1. Read daily rainfall and record the level on the sheet below once 20mm or more has fallen in the past 24 hours.
2. Storm sampling. Sample water clarity at the 3 sampling points as soon as possible once 20mm/24 hours of rain has been recorded. Record the reading on the sheet below.

Date	Rainfall (mm)	Water Clarity (mm)		
		1 Outlet of silt pond	2 Receiving Stream 30m upstream	3 Receiving Stream 30m downstream



Appendix D Flow Chart for Assessing Water Quality Results

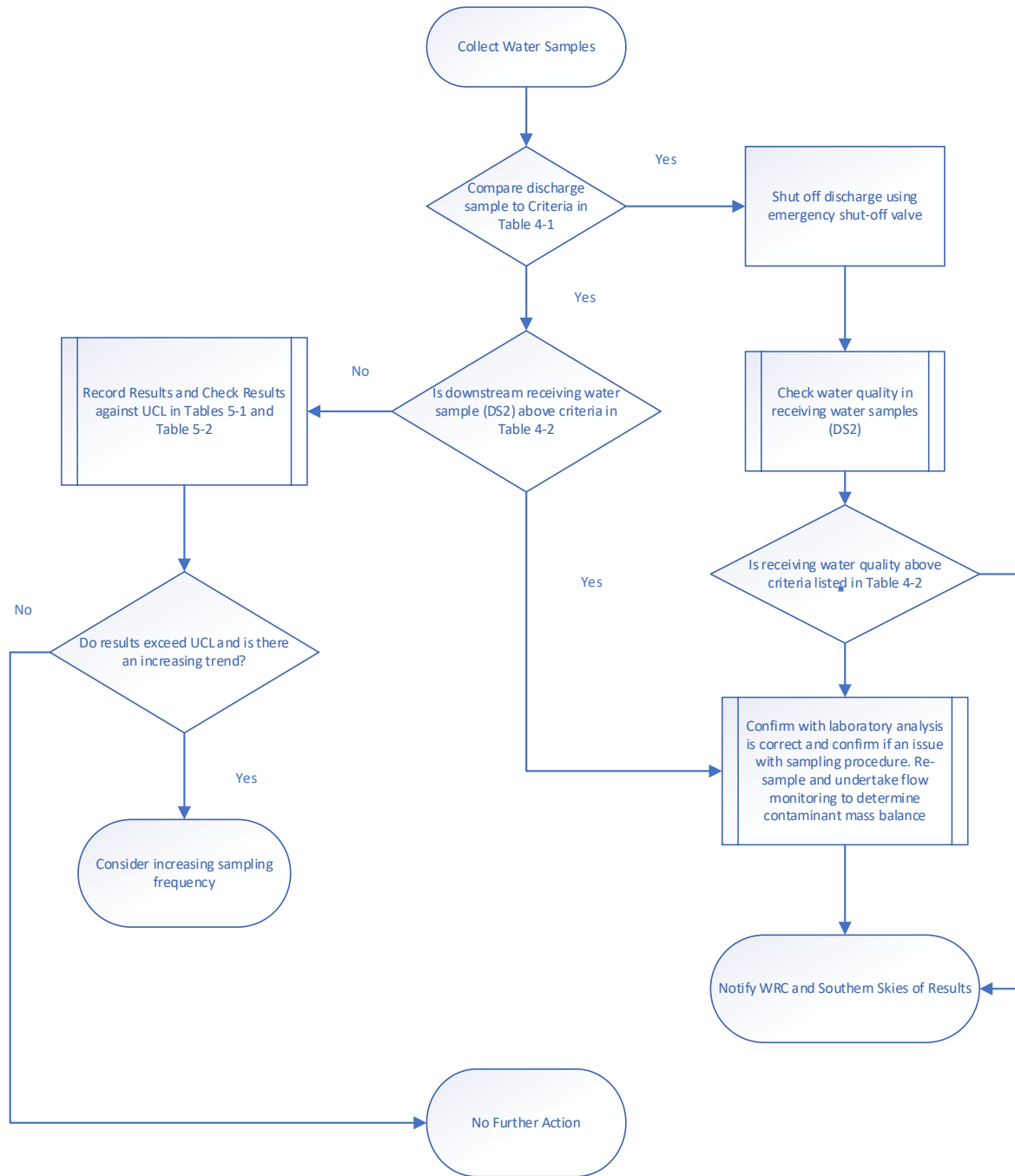


Figure D-1 Flow Chart Outlining Decision Making Process when Assessing Water Quality Results



Appendix E NIWA Effluents and Receiving Water Sampling Procedure