Assessment of Environmental Effects and Waste Acceptance Criteria

Huntly Site
300 Riverview Road
Huntly, NZ

Prepared for:

Gleeson Managed Fill Limited

Prepared by:

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Acronyms

ANZG	Australian New Zealand Government Water Quality Guidelines
ASS	Acid Sulphate Soils
ASTM	American Society for Testing of Materials
DDT	Dichlorodiphenyltrichloroethane
GMF	Gleeson Managed Fill
GNS	Geological and Nuclear Sciences
MfE	Ministry for the Environment
NES	National Environmental Standard
RCBA	Risk-Based Corrective Action
RL	Reduced Level
PAH	Polycyclic aromatic hydrocarbons
SCS	Soil Contaminants Standards
TBT	Tributyltin
TCLP	Toxicity Characteristic Leaching Procedure
TPH	Total Petroleum Hydrocarbons
WDC	Waikato District Council
WRC	Waikato Regional Council

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Units of Measure

Area	
ha	hectare
m^2	square metres
Density	
kg/m^3	kilograms per cubic metre
Electrical Conductance	
µS/cm	microsiemen per centimetre
dS/m	decisiemen per metre
mS/cm	millisiemen per centimetre
mV	millivolt
Length	
µm	micrometres
cm	centimetres
km	kilometres
m	metres
mm	millimetres
Mass	
µg	micrograms
g	grams
kg	kilograms
mg	milligrams
t	metric tonnes
Concentration by Mass	
µg/kg	microgram per kilogram
mg/kg	milligram per kilogram
Pressure	
kPa	kilopascals
Pa	Pascals
Temperature	
°C	degrees Celsius
°F	degrees Fahrenheit
K	kelvin
Velocity	
m/s	metres per second

Volume	
µL	microlitres
cL	centilitres
cm^3	cubic centimetre
GL	gigalitre
L	litres
m^3	cubic metre
mL	millilitres
ML	megalitre
Concentration by Volume	
µg/L	microgram per litre
mg/L	milligram per litre
ppmv	parts per million by volume
ppbv	parts per billion by volume

1 Introduction

EHS Support NZ Limited (EHS) has been engaged by Paua Planning Limited (PP) on behalf of Gleeson Managed Fill Limited (GMF) to assess environmental effects and develop waste acceptance criteria for a new overburden fill and managed fill areas proposed at GMF, located at 300 Riverview Road, Huntly ('the site').

In summary, the scope of work has included the following:

- A review of applicable human health and waste acceptance criteria for chemical contaminants and asbestos used at other managed fill facilities within the Waikato Region, the new managed fill criteria in the Technical Guidelines for Disposal to Land (WasteMINZ, updated August 2018), and relevant national and international human health guidelines commonly used in New Zealand;
- An assessment of the surface water quality risk using existing background contaminant concentrations in the Waikato River; and
- Developing the soil quality criteria for the capping material for the managed fill allows for future rural residential or agricultural land uses.

2 Background Information

The Huntly Quarry has been operating since 1980, and the existing overburden fill site has reached its capacity. GMF is also investigating the feasibility of establishing and operating a managed / clean fill within four gullies (Fill Areas 2, 3 and 4, as shown in Appendix A – Site Layout Plan and described below). Therefore, GMF seeks resource consent from Waikato Regional Council (WRC) and Waikato District Council (WDC) to set up four additional overburden/managed fill areas located to the north of the main quarry pit.

Area 5 has already been consented (WRC consent 141137) to accept overburden from the Quarry and therefore is not part of this assessment. Fill area 5 has been shown in Appendix A – Site Layout Plan for reference purposes only.

2.1 Proposed Activity

Three main gullies within the site's boundaries have been identified as key areas where the filling could be undertaken to optimise GMF's use of the land area – Fill Areas 2, 3, and 4 (refer to site layout plan appended). Totalling fill volume is estimated to be approximately 2,000,000 m^3, Fill Area 2 (717,000 m^3), Fill Area 3 (478,500 m^3), and Fill Area 4 (800,000 m^3) are proposed to be used to accept managed fill material.

Fill Area 1 has not been included as a potential fill area as the area may be a part of the future quarry expansion plans.

2.2 Location and Zoning

The site is located 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.

Table 1 – Site Information

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

The site is currently zoned Rural, including an Aggregate Extraction Policy Area and Aggregate Resource Policy Area under the WDC Operative District Plan (July 2018).

2.3 Environmental Setting

The environmental setting for the proposed fill areas is described below:

- Located within an area of medium to high erosion potential;
- Located adjacent to a river flood hazard zone and is not at risk of flooding;
- Not located within a wetland that has been identified as a Significant Natural Area in the Waikato District Plan;
- Not located within a catchment of, or within 10 metres of (whichever is the lesser), a sinkhole or cave entrance; and
- Not located within a significant geothermal feature.

2.4 Geology

The Institute of Geological and Nuclear Sciences (GNS) 1:250,000 scale online geological map shows that the regional geology consists of Greywacke (Hakarimata Formation, Newcastle Group and Triassic aged). The quarry lies on the northwest limb of a northeast-trending synform. This formation is an indurated siltstone, with fossiliferous sandstone higher up in the formation. Unconformably overlying this unit are members of the Tertiary aged Te Kuiti Group (laminated medium-fine grained sandstones, siltstones and thin coal beds), including erosional remnants of the Waikato Coal measures. Recent Taupo Pumice ash overlies some of the Waikato Coal measures, mostly on ridge tops. Much has been removed as part of quarry stripping investigations. The Newcastle Group Greywacke is highly weathered at the surface and less weathered with increasing depth, particularly in stream banks and beds. The less weathered greywacke is characterised by highly fractured massive bedding, moderate to well-sorted quartz sandstone with an argillaceous matrix to quartz-lithic sandstone, where lithic material is either volcanoclastic or siltstone.

2.5 Hydrogeology

The groundwater level of the main aquifer at the main quarry pit is approximately 19 m RL and approximately 12 m RL near the Waikato River. The gullies within the proposed fill areas have an elevation ranging from 47 to 66 m RL. Groundwater seepage at the base of the main quarry pit is pumped into and channelled along an unnamed stream and stormwater pond before being discharged into the Waikato River. The proposed fill areas will not intercept groundwater. The regional groundwater flow beneath the site is expected to be easterly towards the Waikato River, which runs in a northerly direction.

Based on the available hydrogeological data, there is no shallow aquifer (continuous zone pf saturation) below the proposed Fill area and the laterally discontinuous lenses of perched groundwater minimise lateral groundwater flow away from the site. This is supported by the logs and ephemeral nature of the tributaries at the site (lack of baseflow). Considering the lenses are discontinuous and are bounded by low permeability sediments, the perched groundwater is considered to be predominantly stagnant. Vertical infiltration from the perched groundwater lenses to the regional groundwater in the greywacke is possible.

Any shallow localised lenses of groundwater are likely to be intercepted by the underdrain system which will be diverted into the sediment retention ponds for treatment before being discharged.

PDP has undertaken some preliminary hydrogeological testing (falling and rising head tests) of the greywacke rocks within the quarry, and the data is presented in **Table 2**.

Table 2 – Hydraulic Properties of Greywacke at Huntly Quarry (PDP, unpublished data)

Parameter	Value
Groundwater level at the main quarry pit	19 m RL
Groundwater level close to Waikato River	12 m RL
Approximate groundwater gradient	0.01
Hydraulic conductivity	4.6×10^{-6} m/s
Effective porosity (fractured greywacke)	0.01

2.5.1 Groundwater Quality

Groundwater quality data at the site is not available as groundwater has not been intercepted by any existing monitoring wells at the quarry. Additionally, the elevation of the gullies within the proposed fill areas has an elevation of more than 49 m RL, which is approximately 30 m above the base of the main quarry pit where groundwater seeps out. The relative difference in height between the proposed managed fill sites and the quarry floor indicates that groundwater at the site is unlikely to intercept the proposed fill areas.

A summary of the groundwater quality of five monitored bores in the wider Huntly area closest to the site (approximately 10 km from the site) is presented in Table 3 below (raw data provided by the WRC is available in **Appendix B**).

Table 3 – Groundwater Summary for Huntly Bores – Selected Elements

Parameter[1,2]	Average	Minimum	Maximum
Arsenic	0.014	<0.0014	0.12
Cadmium	0.000059	<0.000059	0.000059
Copper	0.0068	<0.00064	0.059
Zinc	0.026	<0.0013	0.28

Notes:
1. Units are g/m^3
2. Values below the detection limit have not been included in calculations.

2.5.2 Groundwater Uses

A groundwater extraction bore search through WRC has indicated no bores within site, or between the managed fill and the Waikato River. The closest bore (use unknown), which is located between the main entrance to the quarry pit and the Waikato River to the southeast of the proposed fill areas (as shown in the appended site layout plan), was presumed to be abandoned during a previous investigation undertaken by PDP in 2015 (P. Namjou, pers. Comms, 2019).

Therefore, groundwater is not considered a sensitive receptor as part of this assessment.

2.6 Hydrology and Water Quality

The nearest surface waterbody to the site is the Waikato River (approximately 50 m east of the site). However, a few unnamed ephemeral/intermitted streams run through the site, located immediately north, northwest and southeast of the quarry. The unnamed ephemeral/intermitted stream to the southeast of the quarry flows into the Waioteatua stream, which eventually discharges into the

Waikato River. A small unnamed pond approximately 250 m south of the main quarry pit is unlikely to be impacted by the proposed fill areas to the north of the main quarry pit (refer to site layout plan appended).

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

The average rainfall recorded at one of the WRC Control Structures (the nearest WRC rainfall monitoring station to the site) is 1,110 mm/year.

2.6.1 Water Quality of Wetlands

The Ecological Impact Assessment report (Boffa Miskell, 2019) indicated that, in comparison with guideline values for freshwater rivers (WRC Water Quality Guidelines and 2018 Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018)), the wetlands had low pH and dissolved oxygen as well as elevated turbidity and total suspended solids, element concentrations, nitrogen and phosphorus levels. Therefore, it was concluded that the water quality parameters observed for all three wetlands observed within Fill Areas 2, 3 and 4 might represent normal wetland conditions.

2.6.2 Water Quality of Waikato River

The Huntly bridge (Tainui Bridge) monitoring site is the closest WRC hydrometric and water quality monitoring station to the site, located approximately 2.8 km downstream. EHS Support (NZ) has examined flow records of the Waikato River (taken at the Huntly Bridge) from Feb 1983 to July 2019, and the average low flow (7Q2[1]) for the Waikato River is 196 m^3/s.

A summary of the water quality of the Waikato River (taken at the Huntly Bridge) is presented in Table 4 below.

Table 4 – Water Quality of the Waikato River

Parameter[1]	Waikato River Background at Huntly Bridge	ANZG Water Quality Guidelines (2018)[2]
Antimony	ND[3]	NGV[4]
Arsenic	0.017	0.013
Boron	0.20	0.370
Cadmium	0.00012	0.0002
Chromium	0.00063	0.001
Copper	0.00078	0.0014
Mercury[5]	<0.0001	0.0006
Nickel	ND	0.0011

[1] 7Q2 = is the 7-day low flow average flow with a likely recurrence of 2 years. This figure is recommended to be used by the US EPA as a reasonable worst case exist for low flow for use in water quality modelling.

Parameter[1]	Waikato River Background at Huntly Bridge	ANZG Water Quality Guidelines (2018)[2]
Lead	0.00037	0.0034
Thallium	ND	NGV
Zinc	0.0047	0.008

Notes:
1. Units are g/m3
2. 95% ecosystem protection water quality guideline for freshwater species.
3. ND = Not detected. The analytical parameter was below the instrument detection limit.
4.NGV = No Guideline value within ANZG (2018).
5. Acid soluble.

Except for arsenic, the element concentrations of the Waikato River were generally below the 95% ecosystem protection water quality guideline for freshwater species (ANZG, 2018).

2.6.3 Water Quality of Unnamed Tributary and Lake Puketirini (Weavers Lake)

The sediment retention pond at the bottom of the gully of Fill area 2 gully discharges into the southern branch of an unnamed tributary. This unnamed tributary flows northward for about 2.2 km through farmlands via a heavily modified channel before entering a section of riparian vegetation and reserve to discharge into Lake Waihi. Some of the flow of this unnamed tributary is diverted into Lake Puketrini via an artificial channel.

Limited water quality data has been collected over the summer months from November 2021 to February 2022 (See Table C-1 in Appendix C). One additional water sample was collected in June 2020. However, the water quality dataset is not extensive and is unlikely to represent the seasonal variability of all water quality parameters.

3 Proposed Waste Acceptance Criteria

The proposed waste acceptance criteria for fill materials imported to the site are presented in Table 5. The table is annotated to indicate the source of the acceptance criteria which have been proposed.

Table 5 – Proposed Waste Acceptance Criteria for the Managed Fill

Contaminant Type	Parameter[1]	Proposed Waste Acceptance Criteria (> 2 m) (mg/kg)	Proposed SPLP Leachability Limits (mg/L)[8]	Maximum Truckload Fill Concentrations Shallow (<2 m) Clean Fill (mg/kg)
Elements	Arsenic	100[2]	-	12[3]
	Boron	45[3,10] (260)[7]	2	45[3]
	Cadmium	7.5[4,9]	-	0.65[9]
	Chromium	400[4,9]	-	55[3]
	Copper	325[4,9]	-	45[3]
	Mercury	1.5	-	0.45[3]
	Nickel	65 (320)[7]	1	35[3]
	Lead	250[10] (1,000)[7]	1	65[3]
	Thallium	23[12]	-	1
	Zinc	400[10] (2,000)[7]	1	180[3]
BTEX Compounds	Benzene	0.2[10]	-	0.0054[9]
	Toluene	1.0[9]	-	1.0[9]
	Ethylbenzene	1.1[9]	-	1.1[9]
	Total xylenes	0.61[9]	-	0.61[9]
Polycyclic Aromatic Hydrocarbons (PAH)	Benzo-a-pyrene (eq)	20[4]	-	2[9]
	Naphthalene	7.2[5]	-	0.013[11]
Total Petroleum Hydrocarbons (TPH)	C_7-C_9	120[5]	-	120[9]
	C_{10}-C_{14}	300 (1,400)[13]	-	58[9]
	C_{15}-C_{36}	20,000[14]	-	-
Others	DDT and isomers	8.4[4,6]	-	0.7[9]
	Aldrin	0.7	-	-
	Dieldrin	0.7[4,6]	-	-
	Tributyltin	6[15]	0.3[15]	
Asbestos	Refer to Table 2 of the Huntly Quarry – Asbestos Fill Management Plan (PDP, 2019).			

Notes:

1. All values in mg/kg unless otherwise stated.
2. Ministry for the Environment (MfE) 'National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health' (MfE, 2012) for a commercial/industrial outdoor worker.

3. Auckland Regional Council (ARC) 'Technical Publication 153 (TP153) – Background Concentrations of Inorganic Elements in Soils from the Auckland Region' (ARC, 2001).
4. Auckland Council (AC) 'Auckland Unitary Plan: Operative Version' (AC, 2018), Table E30.6.1.4.1.
5. MfE' Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand' (MfE, 2011). Table 4.15 Tier 1 soil acceptance criteria.
6. MfE' Identifying, Investigation and Managing Risks Associated with Former Sheep-dip Sites: A guide for local authorities' (MfE, 2006).
7. Concentrations of boron above 45 mg/kg, lead above 250 mg/kg, nickel concentrations above 65 mg/kg and zinc above 400 mg/kg in infill materials will require Synthetic Precipitation Leaching Procedure (SPLP) testing to be carried out on the fill materials before acceptance, to demonstrate that elevated concentrations of these elements will not mobilise under conditions likely to be present in the fill area. The in-brackets value is the maximum concentration that can be accepted if SPLP results are satisfactory.
8. Leachability limits from the MfE' Guidelines for the management of hazardous waste – Module 2: Landfill Waste Acceptance Criteria and Landfill Classification' (MfE, 2004) and WasteMINZ (2018) Technical Guidelines for Disposal to Land – Type 2 landfill.
9. Total concentrations from WasteMINZ (2018) for cleanfill (Class 5 landfill Waste Acceptance Criteria).
10. Ridge Road, Quarry Managed Fill Acceptance criteria (2018).
11. Canadian Council of Ministers of the Environment (CCME, 2018) Recommended Criteria for the Protection of Freshwater Life.
12. Thallium guideline value based upon US EPA Regional Screening Levels for thallium sulphate for industrial sites (see https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables)
13. Initial screening criteria based on Ridge Road. Value in bracket is the upper limit of TPH based upon criteria if soils meet BTEX and PAH criteria listed above. The higher value is based upon MfE' Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand' (MfE, 2011). Table 4.20 Tier 1 soil acceptance criteria for Protection of Groundwater quality.
14. TPH C_{15}-C_{36} value is based upon MfE' Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand' (MfE, 2011). Table 4.20 Tier 1 soil acceptance criteria for Protection of Groundwater quality and assume soil also meets PAH criteria above.
15. MfE' Guidelines for the management of hazardous waste – Module 2: Landfill Waste Acceptance Criteria and Landfill Classification' (MfE, 2004) – Class B landfills. Leachability limits are determined by the TCLP test. Waste containing TBT higher than 6 mg/kg can be accepted as long as it meets SPLP criteria of 0.3 mg/L.
16. Thallium waste acceptance criteria for shallow (less than 2 M) is based on Maximum thallium concentration in farmed soils within the Waikato (rounded down from 1.4 to 1 mg/kg) based upon data presented in Taylor, M., Kim, N., (2009) De-aluminium as a mechanism for increased acid recoverable aluminium on Waikato Soils. Australian Journal of Soil Research, 47, pp 828-838.

Fill materials placed at the proposed fill areas are expected to be similar in composition to those accepted at the Ridge Road Quarry in Tuakau. However, the proposed fill acceptance criteria for arsenic, lead, mercury, and zinc are higher than what is currently accepted at Ridge Road.

A higher waste acceptance criterion for zinc is proposed for this site than either Ridge Road Quarry or Holcim Bombay Quarry. Environmental modelling (see Section 3.1) indicated that the Waikato River has significant dilution capability for zinc. After reasonable mixing, there should be no significant change in zinc concentrations within the Waikato River. Therefore, it is recommended that Synthetic Precipitation Leaching Procedure (SPLP) testing is undertaken on all soils that contain zinc concentrations greater than 400 mg/kg and that soils above 400 mg/kg are only accepted within the managed fill if leachable zinc is lower than the proposed SPLP[2] criteria of 1 mg/L.

Due to boron, lead, and nickel mobility, it is proposed that SPLP testing is required for any fill containing these elements at concentrations that exceed the proposed SPLP trigger values outlined in Table 5. It is noted that the use of SPLP testing provides an additional level of assurance that if any discharges of boron, lead and nickel occur, they will not have an adverse impact on the receiving

[2] SPLP criteria are being used instead of TCLP because TCLP test is based upon the assumption that municipal solid waste will be co-disposed with the contaminated soil and therefore general low pH conditions as acetic acid is produced from the breakdown of organic matter (such as food waste). SPLP test assumes that the soils are exposed to rainfall, which can leach any soluble contaminants from the soil.

environment. If SPLP testing criteria are met, then soils can be accepted into the managed fill up to the concentrations indicated within the brackets in Table 5 for these elements.

Since boron can not be modelling by Risk Based Correction Action (RCBA) model, the maximum Auckland background concentration (as outlined in TP153) has been used as the waste acceptance criteria. The Auckland background number has been used in preference to the Waikato background number because some of the soil that will be deposited in the Huntly Managed Fill will come from Auckland region and the Waikato Coal Measures around Huntly are naturally elevated in boron (Edbrooke, et al., 1994).

The proposed total petroleum hydrocarbon criteria are similar to the Ridge Road Waste Acceptance criteria, except for the C_{15}-C_{36} criteria (which are higher). A higher criterion for C_{15}-C_{36} hydrocarbons is based upon the MfE (2001) Oil Industry Guidelines for groundwater protection greater than 4 m depth. Long-chain hydrocarbons (above C_{15}) are mainly waxy solids (or waxy-like liquids for the C15-C17 paraffin compounds) and have very low water solubility or are insoluble in water; therefore, are not mobile in the environment.

In addition, the criteria for BTEX are the same as the WasteMINZ criteria for a Class 5 landfill. It is proposed that BTEX criteria are used as the initial screening criteria, and waste that contains higher TPH values can be accepted if the soil meets both the BTEX and PAH criteria. These criteria, together with the PAH criteria, have been set to allow peat soils and low mobility heavily weathered/heavier end hydrocarbon material to be accepted within the managed fill but not soils that have been significantly impacted by fresh petroleum hydrocarbons that are highly mobile (i.e. petrol, diesel or waste oil). There are no Toxicity characteristics Leaching Procedure (TCLP) criteria for TPH within the MfE (2004) Landfill Waste Acceptance criteria. Instead, this document suggests that BTEX and/or PAH criteria should be used for determining the suitability for disposal of petroleum hydrocarbon waste into a landfill, which is the approach adopted here. It is expected that the waste acceptance criteria outlined in Table 5 will allow soils that contain highly weathered/relevantly immobile hydrocarbons but also ensure that there are no adverse impacts on the local receiving environment.

The waste acceptance criteria for tributyltin are adopted from the MfE (2004) Landfill Waste Acceptance Criteria for Class B landfills. Therefore, where the concentration of the tributyltin in the waste is below the screening level, there is no need to test for TCLP. Conversely, where the concentration of the tributyltin in the waste exceeds the screening level, a TCLP test may show that the tributyltin is sufficiently immobilised in the waste matrix to meet the TCLP criteria still.

All other waste acceptance criteria are lower than the NES SCSs for Commercial/Industrial workers for material placed greater than 2 metres below ground level (m bgl) and agricultural or rural residential land use for capping material (soils less than 2 m bgl). The waste acceptance criteria for thallium are based upon the US EPA regional screening level for industrial sites and are designed to protect staff working on the site.

3.1 RBCA Model

The Groundwater Services Inc. Risk-Based Corrective Action (RBCA) software package has been used to model the fate and transport of contaminants in leachate generated by the deposited waste to the surface water receptor (Waikato River).

RBCA simulates the leaching of contaminants from the soil into groundwater models using the Soil Attenuation Model (SAM). For initial screening purposes, the ASTM default soil parameters have been used in the model and a soil pH of 6.8 pH units with an organic carbon fraction of 7% based

upon information supplied by WRC on typical soils within the Waikato Region (M Taylor, pers. Comms, 2019).

Contaminant fate and transport in groundwater are simulated in the RBCA software by the Domenico3-dimensional model. This analytical solute transport model predicts inorganic and organic contaminants' advection, dispersion, and adsorption. In addition, the model produces estimates of contaminant concentrations in groundwater at selected distances from the source and allows for mixing with the surface water body.

The RBCA input and result sheets and the model outputs' tabulated results are available in Appendix D. The model uses US EPA default parameters for aqueous solubility, chemical sorption (Kd) and pH dependency for specific Kd for non-organic.

3.1.1 Ecological

The ANZG (2018) freshwater trigger values for the protection of 95% ecosystem protection have been used in this assessment[3].

The potential discharge concentrations of the contaminants of concern into the Waikato River predicted by the RBCA model are presented in Table 6, together with ANZG (2018) water quality guidelines and the existing water quality of the Waikato River.

Table 6 – Comparison of Predicted Groundwater Discharge

Parameter[1]	Predicted Discharge Concentration	Waikato River Background at Huntly Bridge	ANZG (2018) Water Quality Guidelines
Antimony	$6.3e^{-11}$	ND2	NGV[3]
Arsenic	$9.9e^{-11}$	0.017	0.013
Boron	Not Modelled[4]	0.20	0.370
Cadmium	$2.8e^{-12}$	0.00012	0.0002
Chromium	$9.5e^{-12}$	0.00063	0.001
Copper	$2.5e^{-10}$	0.00078	0.0014
Mercury	$5.5e^{-13}$	<0.0001	0.0006
Nickel	$1.4e^{-10}$	ND	0.011
Lead	$2.8e^{-9}$	0.00037	0.0034
Thallium	$2.6e^{-10}$	ND	0.000 03[5]
Zinc	$9.2e^{-10}$	0.0047	0.008

Notes:

1. Units are g/m3.
2. ND = Not detected. The analytical parameter was below the instrument detection limit.
3. NGV= No Guideline value within ANZG (2018).
4. Not Modelled. The chemical parameter could not be modelled using RCBA as physiochemical parameters are not within the default database.
5. Low-reliability guideline value.

[3] It should be noted at the time of writing this assessment (1 August 2019) the published ANZG (2018) guidelines are the same as the ANZECC (2000) guidelines for toxicants.

The results of the RBCA modelling indicate that discharge concentration from the proposed overburden and managed fill material for all parameters in Table 6 (after reasonable mixing) are likely to be less than 0.001% of the freshwater guidelines values (ANZG, 2018).

Therefore, except for arsenic (which already exceeds water quality guidelines (ANZG, 2018)), the predicted concentrations of elements within the Waikato River are likely to be below the 95% ecosystem protection guidelines (ANZG, 2018).

Therefore, it is considered that any discharge is highly unlikely to pose a risk to the ecological life of the Waikato River.

4 Average Concentration of Contaminants in Waikato Managed Fills

Table 5 above outlines the maximum concentration of various compounds that can be accepted into the managed fill.

Table 7 presents the proposed inorganic elements waste acceptance criteria for the site compared with the fill acceptance criteria and measured contaminant concentrations from selected other managed fill sites and Waikato Regional background concentrations.

The calculated 95% upper confidence limits (UCL) data from Puketutu Quarry and the Green Vision fill material shown in Table 7 demonstrate the potential mean concentration of contaminants received at the Huntly Managed Fill. It indicates that the mean concentration within the managed fills is likely to be less than the proposed waste acceptance criteria for the site.

As it is unlikely that most material accepted into the managed fill will be at the maximum concentration, the mean concentration of these compounds within the fill is expected to be significantly lower than these maximum concentrations (based on experience at other managed fills).

Table 7 – Comparison of Elements Fill Acceptance Criteria

Parameter[1]	Proposed Fill Acceptance Criteria[2]	Proposed Weighted Rolling Month Mean Concentration (mg/kg)	Three Kings/Kahikatea Waste Acceptance Criteria		95% UCL Concentrations for Green Vision Fill[3]	95% UCL Concentrations for Puketutu Quarry Fill[4]	Waikato Region Natural Background Concentrations[5]
			Shallow Fill (<2m)	Deep Fill (>2m)			
Arsenic	100	50	70	100	14.0	8.4	1.0-25
Cadmium	7.5	5.25	1	7.5	0.20	0.21	<0.03-0.3
Chromium	400	280	400	400	60	68	1-150
Copper	325	225	325	325	50	47	4-55
Mercury	1.5	1.0	0.75	0.75	0.22	0.24	0.019-0.50
Nickel	65 (320)[6]	225	320	320	129	66	0.9 – 35
Lead	250 (1,000) [6]	660	250	250	56	85	3-32
Thallium	23	15	Not measured	Not measured	Not measured	Not measured	0.057-0.60
Zinc	400 (2,000) [6]	750	1,160	1,160	141	127	9 – 180

Notes:

1. All values in mg/kg
2. See Table 5 for explanatory notes on sources of proposed fill acceptance criteria
3. Calculated from samples obtained from incoming fill accepted by Green Vision for disposal at managed fill sites, over a period December 2012 - April 2014
4. Calculated from samples obtained from incoming fill to the Puketutu Quarry Managed Fill, over a period 2000-2008
5. Upper limit background concentrations for selected elements in soil of the Waikato region, acid recoverable data (see https://www.waikatoregion.govt.nz/services/regional-services/waste-hazardous-substances-and-contaminated-sites/contaminated-sites/natural-background-concentrations/).
6. Value in brackets indicates the maximum concentration that can be accepted if SPLP testing criteria are met.
7. Boron was not included in the elements analysed for Puketutu and Green Vision, and therefore this element has not been included in this table.

5 Conceptual Site Model

A conceptual site model (CSM) aims to identify potential risks in the proposed fill areas relative to the surrounding environment. The potential sources, potential exposure pathways and potential receptors are summarised in Table 8 below.

Table 8 – Conceptual Site Model

Source	Imported managed fill material
Transport Mechanisms	• Wind erosion and atmospheric dispersions. • Leaching and groundwater transport. • Storm / surface water transport.
Exposure Pathways	• Soil ingestion. • Soil absorption. • Inhalation of particulates. • Potable water ingestion. • Recreational use / sensitive ecological habitat.
Receptors	On-site: • Industrial outdoor workers. • Groundwater. Offsite: • Rural residential. • Surface water (ecological). • Groundwater.

6 Environmental Risk Assessment

6.1 Human Health

The properties neighbouring the site are zoned Rural. Therefore, the nearest human receptors are rural residential land users located to the north, adjacent to the northeastern corner of the site (approximately 100 m to the east of the nearest proposed fill area; Fill Area 4).

The proposed soil quality criteria for the capping material (2 m cap) are lower than the NES SCSs for rural residents. Therefore, the managed fill is unlikely to pose a human health risk to on-site workers and potential future rural residents.

A groundwater extraction bore search through WRC has indicated no bores within site or between the managed fill and the Waikato River. In addition, the bore (use unknown) between the main entrance to the quarry pit and the Waikato River is located to the southeast of the proposed fill areas and has been abandoned (P Namjou, pers. Comms, 2019). Therefore, any discharge is unlikely to pose a risk to any groundwater receptors.

6.2 Ecological Receptors

Surface water and groundwater receptors are present near the proposed fill areas. Shallow and deep groundwater aquifers are present beneath the proposed fill areas, and surface water receptors are present (as detailed in Sections 2.5 and 2.6).

The calculated potential discharge concentrations from the managed fill are below the ANZG (2018) 95% ecosystem protection guidelines. Therefore, any discharge is unlikely to pose a risk to the ecological receptors in the Waikato River.

7 Proposed Control Measures

Refer to Huntly Managed Fill – Fill Management Plan (to be prepared).

7.1 Management of Acid Sulphate Soils

7.1.1 Receiving Limed Stabilised Acid Sulphate Soils

Limed and stabilise Acid Sulphate Soils (ASS) can be accepted into the Huntly Managed Fill without any further treatment provided:

- A copy of laboratory report detailing either nett acid production potential (NAPP) or determination of nett acidity and liming rate; and
- Certification from an independent consultant that liming of soils has been undertaken to neutralise soils in accordance with calculated NAPP and/or the National Acid Sulfate Soils Guidance (Sullivan et al., 2018).
- Testing of the soils verifies that the soils have been adequately neutralised. Receiving Untreated Acid Sulphate Soils

The managed fill can accept untreated ASS as long as they are managed in accordance with the acid sulphate soils management plan. This requires that the soils are:

- Limed in accordance with the calculated liming requirements determined by laboratory testing; and
- Using the procedure outlined in the Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (Government of Western Australia, 2016).

Fine-grain AgLime (crushed lime, which passes through a 1-millimetre sieve) should be used as the neutralising agent. When using AgLime, the effective neutralising value (ENV) will need to be calculated using the formula outlined in the Treatment and Management of Soil and Water in acid Sulfate Soil Landscapes (Government of Western Australia, 2016).

7.1.2 Marine Sediments

For marine sediments to be disposed into the Huntly Managed Fill they shall:

- Have a solids content of at least 20% and liberate no free liquids when transported;
- Meet the waste acceptance criteria outlined in **Table 5**; and
- Have undergone ASS testing and be limed neutralised.

7.2 Prohibited Items

The following items are prohibited from being accepted into the Huntly Managed Fill:

- Bulk liquids.
- Tyres.
- Medical and Veterinary Waste
- Coal Ash Waste.
- Lead-acid batteries (lead-acid batteries can be recycled in New Zealand).
- Used oil.
- Explosive, flammable, oxidising or corrosive substances - as defined under the HSNO Act.
- PCB wastes.
- Persistent Organic Pollutants wastes (as defined by the Stockholm Agreement).

- Drums or containers containing hazardous chemicals (including agrichemicals, solvents, petroleum compounds or toxic chemicals (as defined under the HSNO Act)).
- Viscous materials-liquids/tars/paints and painted material.
- Household Hazardous Waste.
- Vegetation, bark, wood chips and green waste.
- Municipal solid waste and domestic refuse.
- Paper, cardboard, and fabrics.
- Electrical components, cabling and insulation.
- Biosolids from municipal or industrial wastewater treatment plants.
- Radioactive materials

8 Conclusion

The proposed waste acceptance criteria are highly unlikely to pose a risk to either on-site or offsite receptors:

- Groundwater is not considered a sensitive receptor as there are no existing groundwater extraction bores in use within site or between the managed fill and the Waikato River;
- The waste acceptance criteria are less than the NES SCSs for outdoor industrial workers;
- The soil quality criteria for the capping material (shallow (<2 m) cleanfill) are less than the NES SCSs for rural residents; and
- The calculated potential discharge concentrations from the managed fill are below the ANZG (2018) 95% ecosystem protection guidelines.

9 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 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.

The methodology adopted and sources of information used by EHS 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 was false.

This report was prepared between June 2020 and 1 March 2022 and is based on the conditions encountered and information reviewed at the time of preparation. EHS disclaims responsibility for any changes that may have occurred after this time.

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.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, EHS must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

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Appendix A Site Layout Plan

Appendix B Raw Data for Five Huntly Area Bores

Appendix C Impacts on Water Quality of Lake Puketirini (Lake Weavers)

Appendix D RBCA Input/Output Result Sheets