Assessment of Environmental Effects and Waste Acceptance Criteria

Huntly Site
300 Riverview Road
Huntly, NZ

Prepared for:

Gleeson Managed Fill Limited

Prepared by:

EHS Support

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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

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

Four 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
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.

[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.

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[14]	
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 is higher than the 6 mg/kg as long as they meet SPLP criteria of 0.3 mg/L.R
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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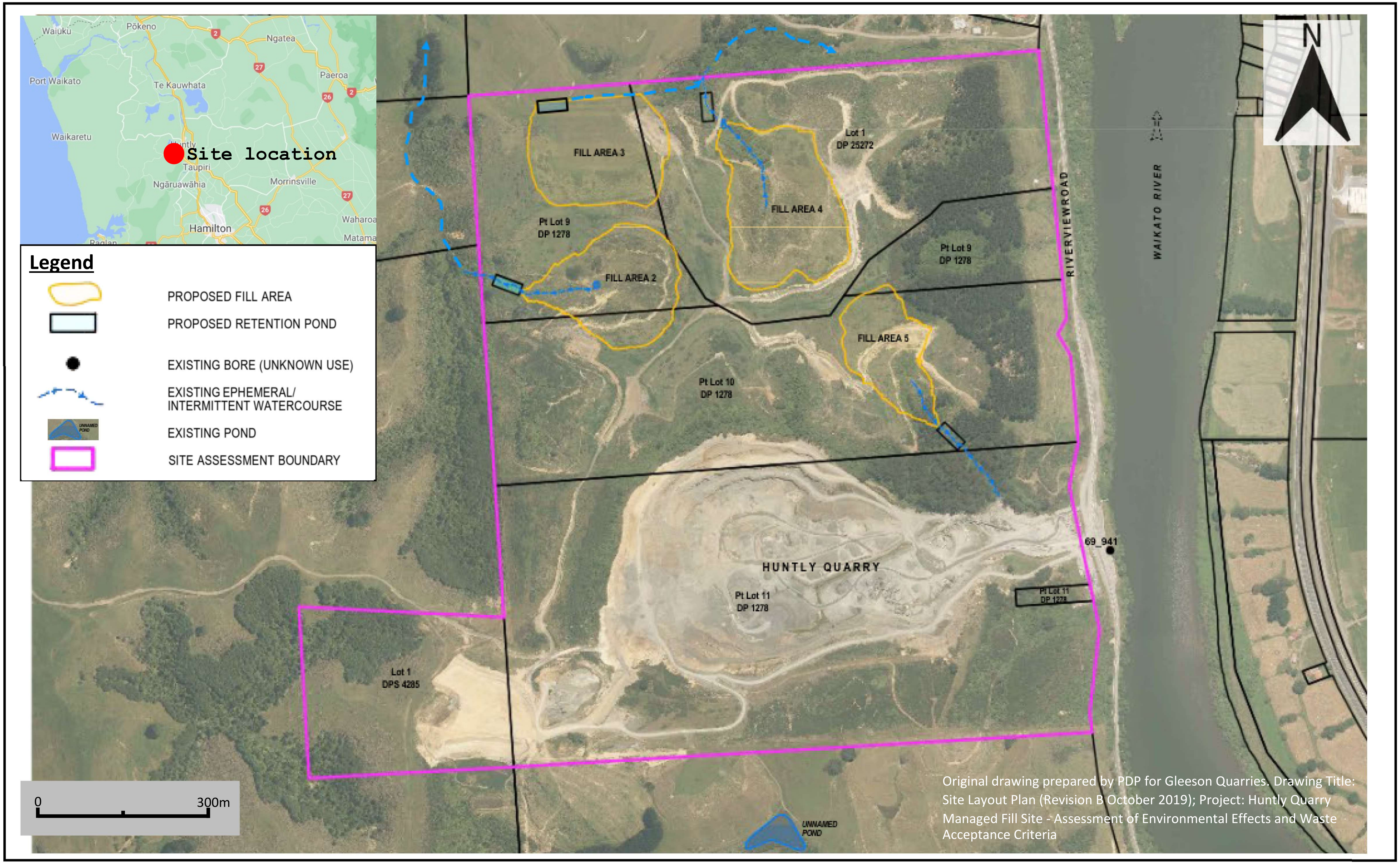
Appendix A Site Layout Plan



Original drawing prepared by PDP for Gleeson Quarries. Drawing Title: Site Layout Plan (Revision B October 2019); Project: Huntly Quarry Managed Fill Site - Assessment of Environmental Effects and Waste Acceptance Criteria

EHS Support	**Project** Huntly Managed Fill	**Client** PAUA PLANNING	Figure A1
	Title Site Layout Plan		Drawn: JH / Checked: AR
			Date: April 2022 / For Information Only

Appendix B Raw Data for Five Huntly Area Bores

Site_Station	SITE_NAME	STATION_NAME	Date_Time	As AS(235)	AsDiss(192)	AsTR(238)	AsTt(241)	Combined As(TR+Tt)	Cd TR (238)	CdDiss(192)	Cu TR(193)	Cu TR(238)	Combined (Cu TR +TR)	Zn AS(268)	Zn TR(193)	Zn TR(238)	ZnDiss(192)	ZnTt(1121)	Combined ZN TR 193, 238 + Tt1121)	MP_NAME
69_1446	Bore (Waikato)	Ohinewai School	1/06/2000																	Geological Bore Logs
69_1446	Bore (Waikato)	Ohinewai School	21/06/2000								< 0.01		< 0.01		< 0.01				< 0.01	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	18/11/2002	0.003							< 0.005		< 0.005		< 0.005				< 0.005	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	8/11/2004								< 0.005		< 0.005		< 0.005				< 0.005	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	21/11/2006			0.037		0.037			< 0.05		< 0.05		0.011				0.011	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	1/12/2008		0.0045	0.0057		0.0057	< 5.3e-005	< 5e-005		0.0011	0.0011			0.0037			0.0037	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	24/11/2010		0.0033	0.0061		0.0061	< 5.3e-005	< 5e-005		0.00195	0.00195				0.003	0.0043	0.0043	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	15/11/2012			0.0053		0.0053				< 0.00053	< 0.00053					0.002	0.002	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	23/02/2015									< 0.00053	< 0.00053					0.0028	0.0028	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	14/11/2016				0.0064	0.0064	< 5.3e-005			0.00064	0.00064					0.0102	0.0102	Groundwater Schools Monitoring
69_1446	Bore (Waikato)	Ohinewai School	13/02/2019				0.0047	0.0047				0.00106	0.00106					0.0055	0.0055	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	1/07/1994																	Geological Bore Logs
69_1897	Bore (Waikato)	Waikokowai School	1/06/2000																	Geological Bore Logs
69_1897	Bore (Waikato)	Waikokowai School	4/07/2000								< 0.01		< 0.01		0.02				0.02	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	28/06/2002	< 0.001							0.039		0.039		0.012				0.012	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	16/11/2004								< 0.005		< 0.005		< 0.005				< 0.005	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	21/11/2006 11:00:00			< 0.001		< 0.001			< 0.05		< 0.05		< 0.005				< 0.005	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	2/12/2008 15:30:00		< 0.001	< 0.0011		< 0.0011	< 5.3e-005	< 5e-005		< 0.00053	< 0.00053			0.0014			0.0014	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	29/11/2010 10:40:00		< 0.001	0.0018		0.0018	< 5.3e-005	< 5e-005		0.0031	0.0031				< 0.001	0.025	0.025	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	15/11/2012 13:45:00			< 0.0011		< 0.0011				< 0.00053	< 0.00053					0.0013	0.0013	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	17/11/2016 14:50:00				< 0.0011	< 0.0011	< 5.3e-005			0.00089	0.00089					0.036	0.036	Groundwater Schools Monitoring
69_1897	Bore (Waikato)	Waikokowai School	20/2/2019 9:35:00				< 0.0011	< 0.0011				0.0165	0.0165					0.042	0.042	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	26/7/2000 9:30:00								0.017		0.017		0.056				0.056	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	29/8/2002 17:15:00			< 0.001		< 0.001			0.015		0.015		0.038				0.038	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	16/11/2004 10:15:00								0.013		0.013		0.264				0.264	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	21/11/2006 11:50:00			< 0.001		< 0.001			< 0.05		< 0.05		0.082				0.082	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	2/12/2008 9:20:00		< 0.001	< 0.0011		< 0.0011	< 5.3e-005	< 5e-005		0.04	0.04			0.086			0.086	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	24/11/2010 9:00:00		< 0.001	< 0.0011		< 0.0011	< 5.3e-005	< 5e-005		0.023	0.023				0.0138	0.026	0.026	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	15/11/2012 9:00:00			0.0014		0.0014				0.0085	0.0085					0.0135	0.0135	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	20/2/2015 11:45:00									0.0034	0.0034					0.0103	0.0103	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	17/11/2016 9:30:00				0.0053	0.0053	< 5.3e-005			0.0188	0.0188					0.0173	0.0173	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	12/12/2016 9:00:00																	Groundwater Schools Monitoring
69_2071	Bore (Waikato)	Glen Massey School	20/2/2019 8:38:00				< 0.0011	< 0.0011				0.00107	0.00107					0.0046	0.0046	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	1/6/2000 0:00:00																	Geological Bore Logs
69_2074	Bore (Waikato)	Orini School	1/6/2000 10:45:00								< 0.01		< 0.01		0.01				0.01	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	28/6/2002 12:00:00	0.004							0.059		0.059		0.031				0.031	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	8/11/2004 10:30:00								< 0.005		< 0.005		0.017				0.017	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	17/11/2006 13:20:00			< 0.001		< 0.001			< 0.05		< 0.05		0.019				0.019	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	1/12/2008 10:00:00		< 0.001	< 0.0011		< 0.0011	< 5.3e-005	< 5e-005		0.0038	0.0038			0.0096			0.0096	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	22/11/2010 11:35:00		< 0.001	< 0.0011		< 0.0011	< 5.3e-005	< 5e-005		0.0091	0.0091				0.0117	0.0146	0.0146	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	21/11/2012 15:30:00			< 0.0011		< 0.0011				0.0042	0.0042					0.28	0.28	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	9/3/2015 9:15:00									0.0032	0.0032					0.0125	0.0125	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	21/11/2016 12:00:00				< 0.0011	< 0.0011	< 5.3e-005			0.0039	0.0039					0.0099	0.0099	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	22/11/2016 13:30:00				< 0.0011	< 0.0011	< 5.3e-005			< 0.00053	< 0.00053					0.0013	0.0013	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	28/3/2017 10:30:00																	Groundwater Schools Monitoring
69_2074	Bore (Waikato)	Orini School	18/2/2019 10:50:00				< 0.0011	< 0.0011				0.007	0.007					0.0186	0.0186	Groundwater Schools Monitoring
69_365	Bore (Waikato)	MacDonald T & C (Barr)	1/2/1994 0:00:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	11/4/1995 13:20:00											0.02						Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	20/9/1995 11:30:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	18/3/1996 11:10:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	4/10/1996 10:20:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	5/3/1997 10:45:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	15/9/1997 14:15:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	5/3/1998 13:35:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	4/6/1998 13:50:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	23/9/1998 13:55:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	17/12/1998 12:45:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	26/3/1999 9:20:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	28/6/1999 13:00:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	14/9/1999 13:20:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	17/12/1999 9:30:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	9/3/2000 8:25:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	1/6/2000 11:00:00																	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	21/9/2000 10:40:00								< 0.005		< 0.005		0.037				0.0146	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	15/12/2000 9:40:00								< 0.005		< 0.005		0.021				0.28	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	27/3/2001 14:45:00								< 0.005		< 0.005		0.03				0.0125	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	18/6/2001 10:50:00								< 0.005		< 0.005		0.036				0.0099	Groundwater Regional Water Quality

69_365	Bore (Waikato)	MacDonald T & C (Barr)	24/9/2001 13:05:00								< 0.005		< 0.005	0.009				0.0013	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	19/12/2001 10:00:00								< 0.005		< 0.005	0.019					Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	21/3/2002 14:20:00								< 0.005		< 0.005	0.018				0.0186	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	4/6/2002 9:35:00								< 0.005		< 0.005	0.019				0.019	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	6/9/2002 15:05:00								< 0.005		< 0.005	0.014				0.014	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/12/2002 11:05:00								< 0.005		< 0.005	0.017				0.017	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	28/3/2003 11:20:00								< 0.005		< 0.005	0.044				0.044	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	25/6/2003 10:50:00								< 0.005		< 0.005	0.056				0.056	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	4/9/2003 10:50:00								< 0.005		< 0.005	0.017				0.017	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/12/2003 10:06:00								< 0.005		< 0.005	0.016				0.016	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	12/3/2004 8:50:00								< 0.005		< 0.005	0.015				0.015	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	9/6/2004 11:30:00								< 0.005		< 0.005	0.017				0.017	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/9/2004 14:50:00								0.023		0.023	0.027				0.027	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	7/12/2004 9:55:00	0.011		0.01		0.01	< 5e-005		< 0.005		< 0.005	0.013				0.013	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	22/3/2005 9:38:00								< 0.005		< 0.005	0.068				0.068	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	1/4/2005 11:45:00			0.002		0.002											Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/6/2005 11:55:00								< 0.005		< 0.005	0.014				0.014	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	6/9/2005 14:00:00			0.004		0.004			< 0.005		< 0.005	0.018				0.018	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/12/2005 14:15:00			0.017		0.017			< 0.005		< 0.005	0.018				0.018	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	6/3/2006 8:50:00			0.068		0.068			< 0.005		< 0.005	0.02				0.02	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	14/6/2006 10:55:00			0.005		0.005			< 0.05		< 0.05	0.023				0.023	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	22/9/2006 10:00:00			0.006		0.006			< 0.05		< 0.05	0.016				0.016	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	15/12/2006 12:00:00			0.014		0.014			< 0.05		< 0.05	0.022				0.022	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/4/2007 10:50:00			0.02		0.02			< 0.05		< 0.05	0.018				0.018	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	11/6/2007 12:00:00	0.006							< 0.05		< 0.05	0.02				0.02	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	10/9/2007 9:30:00			0.002		0.002			< 0.05		< 0.05	0.02				0.02	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	27/11/2007 8:40:00			0.008		0.008	< 5.3e-005			0.0026	0.0026		0.031			0.031	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	14/3/2008 9:50:00			0.019		0.019				0.0045	0.0045		0.024			0.024	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	11/6/2008 11:30:00			0.0057		0.0057				0.0021	0.0021		0.021			0.021	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	12/9/2008 10:30:00			0.004		0.004				0.0027	0.0027		0.017			0.017	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	8/12/2008 10:30:00		< 0.001	0.012		0.012	< 5.3e-005	< 5e-005		0.0032	0.0032		0.019			0.019	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/3/2009 11:30:00		< 0.001	0.014		0.014	5.90E-05	< 5e-005		0.0037	0.0037		0.022			0.022	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	12/6/2009 10:50:00			0.0035		0.0035				0.0038	0.0038		0.02			0.02	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/10/2009 9:30:00		< 0.001	0.037		0.037				0.0081	0.0081				0.029	0.029	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	2/12/2009 12:30:00			0.0071		0.0071	< 5.3e-005	< 5e-005		0.0042	0.0042			0.018	0.025	0.025	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	10/3/2010 10:15:00			0.0084		0.0084				0.0036	0.0036				0.02	0.02	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	10/6/2010 10:20:00			0.0099		0.0099				0.0057	0.0057				0.021	0.021	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	21/9/2010 10:20:00			0.008		0.008				0.0042	0.0042				0.0195	0.0195	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	10/12/2010 9:25:00		< 0.001	0.003		0.003	< 5.3e-005	< 5e-005		0.00152	0.00152			0.0128	0.0143	0.0143	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	11/3/2011 9:10:00			0.0028		0.0028				0.0021	0.0021				0.0168	0.0168	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	15/6/2011 12:30:00			0.0033		0.0033				0.0037	0.0037				0.0164	0.0164	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	13/9/2011 10:15:00		< 0.001	0.009		0.009				0.0029	0.0029				0.0126	0.0126	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	24/11/2011 9:40:00		0.0013	0.0017		0.0017	< 5.3e-005	< 5e-005		0.00169	0.00169			0.0144	0.0132	0.0132	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	9/3/2012 9:20:00		0.0012	0.0022		0.0022	< 5.3e-005	< 5e-005		0.00141	0.00141			0.0151	0.0137	0.0137	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	13/6/2012 11:30:00									0.0034	0.0034				0.0166	0.0166	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	27/9/2012 10:20:00		< 0.001	0.0015		0.0015				0.00137	0.00137				0.0116	0.0116	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	30/11/2012 9:30:00			0.0062		0.0062				0.0023	0.0023				0.0135	0.0135	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	28/3/2013 9:00:00			0.0108		0.0108				0.0023	0.0023				0.0105	0.0105	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	13/6/2013 9:45:00		0.0011	0.0052		0.0052				0.0029	0.0029				0.0174	0.0174	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	11/9/2013 10:00:00		0.0011	0.0037		0.0037				0.00165	0.00165				0.0136	0.0136	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	2/12/2013 9:30:00			0.0109		0.0109				0.00191	0.00191				0.0153	0.0153	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	6/3/2014 8:30:00			0.0036		0.0036				0.0021	0.0021				0.0137	0.0137	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	12/6/2014 11:10:00			0.025		0.025				0.0023	0.0023				0.0124	0.0124	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	5/9/2014 10:30:00			0.0125		0.0125				0.0021	0.0021				0.0146	0.0146	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	4/12/2014 9:20:00			0.02		0.02				0.0036	0.0036				0.0182	0.0182	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	18/3/2015 10:30:00									0.00164	0.00164				0.0177	0.0177	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	9/6/2015 11:00:00			0.116		0.116				0.006	0.006				0.022	0.022	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	9/9/2015 10:00:00			0.0176		0.0176				0.0022	0.0022				0.0149	0.0149	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	4/12/2015 10:10:00			0.031		0.031				0.009	0.009				0.0173	0.0173	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	11/3/2016 9:30:00			0.022		0.022				0.0023	0.0023				0.0127	0.0127	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	14/6/2016 11:30:00				0.025	0.025				0.0021	0.0021				0.0134	0.0134	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	8/9/2016 10:15:00				0.0162	0.0162				0.0084	0.0084				0.0155	0.0155	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	8/12/2016 10:15:00				0.0035	0.0035	< 5.3e-005			0.00157	0.00157				0.0147	0.0147	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	28/3/2017 10:00:00				0.0028	0.0028				0.00199	0.00199				0.0185	0.0185	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	20/6/2017 11:30:00				0.054	0.054				0.0086	0.0086				0.022	0.022	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	12/9/2017 11:40:00				0.0128	0.0128				0.0113	0.0113				0.0162	0.0162	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	8/12/2017 9:45:00				0.0145	0.0145				0.0031	0.0031				0.0183	0.0183	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	23/4/2018 11:30:00				0.0114	0.0114				0.0048	0.0048				0.0156	0.0156	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	21/6/2018 10:47:00				0.0061	0.0061				0.0026	0.0026				0.019	0.019	Groundwater Regional Water Quality
69_365	Bore (Waikato)	MacDonald T & C (Barr)	6/11/2018 9:50:00				0.0022	0.0022				0.00199	0.00199				0.0198	0.0198	Groundwater Nitrate Monitoring
69_365	Bore (Waikato)	MacDonald T & C (Barr)	2/5/2019 11:52:00				0.0143	0.0143				0.0025	0.0025				0.0185	0.0185	Groundwater Nitrate Monitoring

Site_Station	SITE_NAME	STATION_NAME	Date_Time	2_4-DDD(591)	2_4-DDE(591)	2_4-DDT(591)	4_4-DDD(591)	4_4-DDE(591)	4_4-DDT(591)	Acephate(589)	Acetochlor(589)	Alachlor(589)
69_1446	Bore (Waikato)	Ohinewai School	8/11/2004 13:00:00	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00010000	< 0.00010000	< 0.00005000
69_1446	Bore (Waikato)	Ohinewai School	1/12/2008 9:20:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_1446	Bore (Waikato)	Ohinewai School	15/11/2012 14:45:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_1446	Bore (Waikato)	Ohinewai School	14/11/2016 9:00:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_2071	Bore (Waikato)	Glen Massey School	16/11/2004 10:15:00	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00010000	< 0.00010000	< 0.00005000
69_2071	Bore (Waikato)	Glen Massey School	2/12/2008 9:20:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_2071	Bore (Waikato)	Glen Massey School	15/11/2012 9:00:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_2071	Bore (Waikato)	Glen Massey School	17/11/2016 9:30:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_2074	Bore (Waikato)	Orini School	8/11/2004 10:30:00	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00010000	< 0.00010000	< 0.00005000
69_2074	Bore (Waikato)	Orini School	1/12/2008 10:00:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_2074	Bore (Waikato)	Orini School	21/11/2012 15:30:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_2074	Bore (Waikato)	Orini School	22/11/2016 13:30:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_365	Bore (Waikato)	MacDonald T & C (Barr)	16/12/2003 10:06:00	< 0.00000300	< 0.00000300	< 0.00000300	< 0.00000300	< 0.00000300	< 0.00000300	< 0.00010000	< 0.00010000	< 0.00005000
69_365	Bore (Waikato)	MacDonald T & C (Barr)	8/12/2008 10:30:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_365	Bore (Waikato)	MacDonald T & C (Barr)	30/11/2012 9:30:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000
69_365	Bore (Waikato)	MacDonald T & C (Barr)	8/12/2016 10:15:00	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00001000		< 0.00004000	< 0.00004000

Average	0.013373	0.000059	0.006785	0.026262037
Minimum	0.0014	0.000059	0.00064	0.0013
Maximum	0.116	0.000059	0.059	0.28

Notes ** *Ignored LOR*
Ignored Dissolved.

Aldrin(591)	Alpha-BHC(591)	Atrazindesethyl(589)	Atrazine(589)	Atrazinisooprop(589)	Azaconazole(589)	Azinphos-methyl(589)	Benalaxyl(589)	Beta-BHC(591)	Bitertanol(589)	Bromacil(589)	Bromopropylate(589)
< 0.00000500	< 0.00000500	< 0.00003000	< 0.00003000	< 0.00003000		< 0.00005000	< 0.00010000	< 0.00000500	< 0.00005000	< 0.00003000	< 0.00003000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00000500	< 0.00003000	< 0.00003000	< 0.00003000		< 0.00005000	< 0.00010000	< 0.00000500	< 0.00005000	< 0.00003000	< 0.00003000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00000500	< 0.00003000	< 0.00003000	< 0.00003000		< 0.00005000	< 0.00010000	< 0.00000500	< 0.00005000	< 0.00003000	< 0.00003000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000300	< 0.00000300	< 0.00003000	< 0.00003000	< 0.00003000		< 0.00005000	< 0.00010000	< 0.00000300	< 0.00005000	< 0.00003000	< 0.00003000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000
< 0.00000500	< 0.00001000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00002000	< 0.00008000	< 0.00002000	< 0.00001000	< 0.00008000	< 0.00004000	< 0.00004000

Butachlor(589)	Captan(589)	Carbaryl(589)	Carbofenothion(1290)	Carbofuran(589)	Chlorfluazuron(589)	Chlorothalonil(589)	Chlorpyfos(589)	Chlorpymethyl(589)	Chlortoluron(589)	cis-Chlordane(591)
	< 0.00003000	< 0.00010000		< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
	< 0.00003000	< 0.00010000		< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
	< 0.00003000	< 0.00010000		< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
	< 0.00003000	< 0.00010000		< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00008000	< 0.00000300
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000		< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00000500

Cyanazine(589)	Cyfluthrin(589)	Cyhalothrin(589)	Cypermethrin(589)	Delta-BHC(591)	Deltamethrin(589)	Diazinon(589)	Dichlofluanid(589)	Dichlorvos(589)	Dicloran(589)	Dieldrin(591)	Difenoconazole(589)
< 0.00003000	< 0.00005000	< 0.00005000	< 0.00005000	< 0.00000500	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000	< 0.00008000	< 0.00000500	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00003000	< 0.00005000	< 0.00005000	< 0.00005000	< 0.00000500	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000	< 0.00008000	< 0.00000500	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00003000	< 0.00005000	< 0.00005000	< 0.00005000	< 0.00000500	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000	< 0.00008000	< 0.00000500	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00003000	< 0.00005000	< 0.00005000	< 0.00005000	< 0.00000300	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000	< 0.00008000	< 0.00000300	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00008000	< 0.00001000	< 0.00006000	< 0.00002000	< 0.00004000	< 0.00008000	< 0.00020000	< 0.00000500	< 0.00008000

Dimethoate(589)	Diphenylamine(589)	Diuron(589)	Endosulfan_I(591)	Endosulfan_II(591)	Endosulfan_sulphate(591)	Endrin(591)	Endrin_aldehyde(591)	Endrin_ketone(591)	Fenpropimorph(589)
	< 0.00010000	< 0.00010000	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500		< 0.00005000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
	< 0.00010000	< 0.00010000	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500		< 0.00005000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
	< 0.00010000	< 0.00010000	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500	< 0.00000500		< 0.00005000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
	< 0.00010000	< 0.00010000	< 0.00000300	< 0.00000300	< 0.00000300	< 0.00000300	< 0.00000300		< 0.00005000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000
< 0.00008000	< 0.00008000	< 0.00004000	< 0.00001000	< 0.00001000	< 0.00001000	< 0.00000500	< 0.00000500	< 0.00001000	< 0.00004000

Fluazifop-p-butyl(589)	Fluometuron(589)	Flusilazole(589)	Fluvalinate(589)	Furalaxyl(589)	Gamma-BHC(591)	Haloxypmethyl(589)	Haloxyrmethyl(589)	Heptachlor(591)	Heptachlor_epoxide(591)
< 0.00010000	< 0.00003000	< 0.00010000		< 0.00010000	< 0.00000500		< 0.00010000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000		< 0.00004000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00010000	< 0.00003000	< 0.00010000		< 0.00010000	< 0.00000500		< 0.00010000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000		< 0.00004000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00010000	< 0.00003000	< 0.00010000		< 0.00010000	< 0.00000500		< 0.00010000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000		< 0.00004000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00010000	< 0.00003000	< 0.00010000		< 0.00010000	< 0.00000300		< 0.00010000	< 0.00000300	< 0.00000300
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000		< 0.00004000	< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500
< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00001000	< 0.00004000		< 0.00000500	< 0.00000500

Hexachlorobenzene(591)	Hexaconazole(589)	Hexazinone(589)	IPBC(589)	Iprodione(589)	Kresoxim-methyl(589)	Linuron(589)	Malathion(589)	Metalaxyl(589)	Methoxychlor(591)	Metolachlor(589)
< 0.00000500		< 0.00003000		< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00010000	< 0.00000500	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000		< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00000500		< 0.00003000		< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00010000	< 0.00000500	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000		< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00000500		< 0.00003000		< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00010000	< 0.00000500	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000		< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00000300		< 0.00003000		< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00010000	< 0.00000300	< 0.00003000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00002000	< 0.00020000		< 0.00002000	< 0.00005000	< 0.00004000	< 0.00004000	< 0.00000500	< 0.00004000

Metribuzin(589)	**Molinate(589)**	**Myclobutanil(589)**	**Naled(589)**	**Norflurazon(589)**	**Oxadiazon(589)**	**Oxyfluofen(589)**	**Paclobutrazol(589)**	**Parathiethyl(589)**	**Parathimethyl(589)**	**Pendimethalin(589)**	**Permethrin(589)**
< 0.00005000		< 0.00003000	< 0.00005000	< 0.00005000	< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00005000		< 0.00003000	< 0.00005000	< 0.00005000	< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00005000		< 0.00003000	< 0.00005000	< 0.00005000	< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00005000		< 0.00003000	< 0.00005000	< 0.00005000	< 0.00003000	< 0.00003000	< 0.00010000	< 0.00003000	< 0.00003000	< 0.00003000	< 0.00005000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000
< 0.00004000	< 0.00008000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000

Pirimicarb(589)	Pirimiphos_Methyl(589)	ppDDT(588)	Prochloraz(589)	Procymidone(589)	Prometryn(589)	Propachlor(589)	Propanil(591)	Propazine(589)	Propiconazole(589)	Pyriproxyfen(589)	Quizalethyl(589)
< 0.00008000	< 0.00003000		< 0.00003000	< 0.00003000	< 0.00005000	< 0.00003000		< 0.00003000	< 0.00005000		< 0.00010000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00006000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00008000	< 0.00003000		< 0.00003000	< 0.00003000	< 0.00005000	< 0.00003000		< 0.00003000	< 0.00005000		< 0.00010000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00006000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00008000	< 0.00003000		< 0.00003000	< 0.00003000	< 0.00005000	< 0.00003000		< 0.00003000	< 0.00005000		< 0.00010000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00006000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00008000	< 0.00003000		< 0.00003000	< 0.00003000	< 0.00005000	< 0.00003000		< 0.00003000	< 0.00005000		< 0.00010000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000		< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00006000	< 0.00020000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00020000	< 0.00002000	< 0.00004000	< 0.00004000	< 0.00004000

Simazine(589)	Simetryn(589)	Sulfentrazone(589)	TCMTB(735)	Tebuconazole(589)	Terbacil(589)	Terbufos(589)	Terbumeton(589)	Terbuthylazine(589)	Terbuthylazinedesethyl(589)	Terbutryn(589)
< 0.00003000		< 0.00005000		< 0.00003000	< 0.00005000		< 0.00005000	< 0.00003000	< 0.00003000	
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00003000		< 0.00005000		< 0.00003000	< 0.00005000		< 0.00005000	< 0.00003000	< 0.00003000	
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00003000		< 0.00005000		< 0.00003000	< 0.00005000		< 0.00005000	< 0.00003000	< 0.00003000	
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00003000		< 0.00005000		< 0.00003000	< 0.00005000		< 0.00005000	< 0.00003000	< 0.00003000	
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000
< 0.00004000	< 0.00004000	< 0.00020000	< 0.00008000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00004000	< 0.00002000	< 0.00004000	< 0.00004000

Thiabendazole(589)	Thiobencarb(589)	Tolyfluanid(589)	Total_Chlordane(591)	trans-Chlordane(591)	Triazophos(589)	Trifluralin(589)	Vinclozolin(589)	MP_NAME
		< 0.00003000	< 0.00002000	< 0.00000500	< 0.00005000	< 0.00003000	< 0.00003000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
		< 0.00003000	< 0.00002000	< 0.00000500	< 0.00005000	< 0.00003000	< 0.00003000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
		< 0.00003000	< 0.00002000	< 0.00000500	< 0.00005000	< 0.00003000	< 0.00003000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Schools Monitoring
		< 0.00003000	< 0.00001000	< 0.00000300	< 0.00005000	< 0.00003000	< 0.00003000	Groundwater Regional Water Quality
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Regional Water Quality
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Regional Water Quality
< 0.00020000	< 0.00004000	< 0.00002000	< 0.00002000	< 0.00000500	< 0.00004000	< 0.00004000	< 0.00004000	Groundwater Regional Water Quality

PARAM_SHORT_NAME	PARAM_NAME	PARAM_METHOD_ID	PARAM_METHOD_NAME	UNIT_SYMBOL	IND_PESTICIDE
2_4-DDD	2,4-DDD	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
2_4-DDE	2,4-DDE	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
2_4-DDT	2,4-DDT	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
4_4-DDD	4,4-DDD	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
4_4-DDE	4,4-DDE	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
4_4-DDT	4,4-DDT	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Acephate	Acephate	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Acetochlor	Acetochlor	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Alachlor	Alachlor	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Aldrin	Aldrin	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
ALKT	Alkalinity Total	166	Titration with acid to pH 4.5 indicator endpoint.APHA 2320B	g/m³-CACO3	0
ALKT	Alkalinity Total	167	Potentiometric autotitration to pH 4.5. APHA 2320B.	g/m³-CACO3	0
Alpha-BHC	Alpha-BHC	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
As (III)	Arsenic (III)	319	Hydride Generation Atomic Fluorescence. Aggett and Aspell, Analyst (101) 341-347 1976	g/m³	0
As (V)	Arsenic (V)	320	Calculation: Total As - As (III)	g/m³	0
As AS	Arsenic Acid Soluble	235	ICP-MS. APHA 3125B.	g/m³	0
AsDiss	Arsenic Dissolved	192	Filtered, ICP-MS	g/m³	0
AsTR	Arsenic Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
AsTt	Arsenic Total	241	ICP-MS after HNO3 digestion	g/m³	0
Atrazindesethyl	Atrazine-desethyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Atrazine	Atrazine	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Atrazinisooprop	Atrazine-deisopropyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Azaconazole	Azaconazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Azinphos-methyl	Azinphos-methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
BDiss	Boron Dissolved	192	Filtered, ICP-MS	g/m³	0
Benalaxyl	Benalaxyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Beta-BHC	Beta-BHC	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Bitertanol	Bitertanol	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
BoreWL	Static Bore Water Level	1102	The static bore or well water level as determined by the flow test method. Used by Located	m	0
Br Diss	Bromide Dissolved	444	Filtered, Ion chromatography. APHA 4110B	g/m³	0
Bromacil	Bromacil	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Bromopropylate	Bromopropylate	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
BTR	Boron Total Recoverable	193	ICP-OES after HNO3 digestion	g/m³	0
BTR	Boron Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
Butachlor	Butachlor	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Ca	Calcium	187	AAS	g/m³	0
Ca	Calcium	188	ICP-OES	g/m³	0
CaDiss	Calcium Dissolved	192	Filtered, ICP-MS	g/m³	0
Captan	Captan	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Carbaryl	Carbaryl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Carbofenothion	Carbofenothion	1290	Liquid/liquid extraction,GPC(if required),GC-MS SIM analysis.Roos et al (modified)	g/m³	1
Carbofuran	Carbofuran	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
CaTt	Calcium Total	194	ICP-MS after HNO3 digestion. APHA 3215 B.	g/m³	0
Cd TR	Cadmium Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
CdDiss	Cadmium Dissolved	192	Filtered, ICP-MS	g/m³	0
Chlorfluazuron	Chlorfluazuron	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Chlorothalonil	Chlorothalonil	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Chlorpyfos	Chlorpyrifos	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Chlorpymethyl	Chlorpyrifos-methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Chlortoluron	Chlortoluron	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
cis-Chlordane	cis-Chlordane	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Cl	Chloride	446	Colorimetry,Mercuric thiocyanate.	g/m³	0
Cl	Chloride	447	Automated ferricyanide method. APHA 4500 - CL E.	g/m³	0
ClDiss	Chloride Dissolved	452	Filtered sample, Ion chromotography. APHA 4110B.	g/m³	0

ClDiss	Chloride Dissolved	453	Filtered.Ferric thiocyanide colorimetry. Discrete Analyser. APHA 4500 - CL E	g/m³	0
Cu TR	Copper Total Recoverable	193	ICP-OES after HNO3 digestion	g/m³	0
Cu TR	Copper Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
Cyanazine	Cynanazine	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Cyfluthrin	Cyfluthrin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Cyhalothrin	Cyhalothrin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Cypermethrin	Cypermethrin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Delta-BHC	Delta-BHC	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Deltamethrin	Deltamethrin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Diazinon	Diazinon	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Dichlofluanid	Dichlofluanid	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Dichlorvos	Dichlorvos	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Dicloran	Dicloran	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Dieldrin	Dieldrin	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Difenoconazole	Difenoconazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Dimethoate	Dimethoate	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Diphenylamine	Diphenylamine	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Diuron	Diuron	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
DO	Dissolved Oxygen	76	Meter with temp. compensation. Field measurement	g/m³	0
DO	Dissolved Oxygen	1274	Field Meter	g/m³	0
DO_Percent	% Dissolved Oxygen	76	Meter with temp. compensation. Field measurement	% Sat	0
DO_Percent	% Dissolved Oxygen	1274	Field Meter	% Sat	0
DOC	Dissolved Organic Carbon	102	Filtration,acidify, persulphate oxidation, IR detection. APHA 5310 C.	g/m³	0
DOC	Dissolved Organic Carbon	104	Filter,persulphate oxidation,IR detect. Acidify,purg for Total Inorganic C. TOC = TC-TIC. APHA 5310C	g/m³	0
DRP	DRP	139	Molybdenum blue colorimetry. APHA 4500-P.	g/m³-P	0
DRP	DRP	140	Molybdenum blue colorimetry. Flow injection analyser. APHA 4500-P G	g/m³-P	0
DRP	DRP	142	Filtered. Molybdenum blue colorimetry. Discrete analyser. APHA 4500-P E	g/m³-P	0
EC25	Conductivity at 25 DegC	180	Field meter at 25 deg.C	mS/m @25°C	0
EC25	Conductivity at 25 DegC	183	Measured in lab by meter @ 25"C. APHA Method 2510B	mS/m @25°C	0
EC25	Conductivity at 25 DegC	1274	Field Meter	mS/m @25°C	0
EColi	EColi	506	MF MTec agar at 44.5"C 24hr	cfu/100ml	0
EColi	EColi	507	E Coli by membrane filtration, count on MFC agar. Confirmation by NA-MUG. APHA 9222 G	cfu/100ml	0
EColi	EColi	508	E Coli MPN. Colilert Quantitray. Apha 9223B	cfu/100ml	0
Endosulfan_I	Endosulfan I	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Endosulfan_II	Endosulfan II	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Endosulfan_sulphate	Endosulfan sulphate	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Endrin	Endrin	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Endrin_aldehyde	Endrin aldehyde	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Endrin_ketone	Endrin Ketone	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
F	Fluoride	468	Specific ion electrode.APHA 4500-FC.	g/m³	0
FColi	Faecal Coliforms	510	Membrane filtration, count on MFC agar, incubated at 44.5c for 22 hours. APHA 9222 D.	cfu/100ml	0
FeAS	Iron Acid Soluble	188	ICP-OES	g/m³	0
FeAS	Iron Acid Soluble	268	Direct aspiration AAS	g/m³	0
FeDiss	Iron Dissolved	192	Filtered, ICP-MS	g/m³	0
Fenpropimorph	Fenpropimorph	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
FeTR	Iron Total Recoverable	193	ICP-OES after HNO3 digestion	g/m³	0
FeTR	Iron Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
Fluazifop-p-butyl	Fluazifop-p-butyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Fluometuron	Fluometuron	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Flusilazole	Flusilazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Fluvalinate	Fluvalinate	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Free_CO2	Free Carbon Dioxide	177	Free Carbon Dioxide Calculation from alkalinity & pH (APHA 4500 CO2D)	g/m³-CO2	0
Furalaxyl	Furalaxyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Gamma-BHC	Gamma-BHC (Lindane)	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Haloxypmethyl	Haloxyfop-methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1

Haloxyrmethyl	Haloxyfop-r-methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
HardT	Hardness Total	207	Calculation from Ca and Mg. APHA 2340B.	g/m^3-CACO3	0
Heptachlor	Heptachlor	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m^3	1
Heptachlor_epoxide	Heptachlor epoxide	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m^3	1
Hexachlorobenzene	Hexachlorobenzene	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m^3	1
Hexaconazole	Hexaconazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Hexazinone	Hexazinone	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
I T	Iodide Total	465	Sample digestion with aqueous TMAH at 90 degrees. ICP-MS determination. APHA 3125 B	g/m^3	0
IPBC	IPBC (3-Iodo-2-propynyl-n-butylcarbamate)	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Iprodione	Iprodione	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
K	Potassium	187	AAS	g/m^3	0
K	Potassium	188	ICP-OES	g/m^3	0
KDiss	Potassium Dissolved	192	Filtered, ICP-MS	g/m^3	0
Kresoxim-methyl	Kresoxim-methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
KTt	Potassium Total	194	ICP-MS after HNO3 digestion. APHA 3215 B.	g/m^3	0
Linuron	Linuron	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
LiTR	Lithium Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m^3	0
Malathion	Malathion	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Metalaxyl	Metalaxyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Methoxychlor	Methoxychlor	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m^3	1
Metolachlor	Metolachlor	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Metribuzin	Metribuzin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Mg	Magnesium	187	AAS	g/m^3	0
Mg	Magnesium	188	ICP-OES	g/m^3	0
MgDiss	Magnesium Dissolved	192	Filtered, ICP-MS	g/m^3	0
MgTt	Magnesium Total	194	ICP-MS after HNO3 digestion. APHA 3215 B.	g/m^3	0
MnAS	Manganese Acid Soluble	268	Direct aspiration AAS	g/m^3	0
MnDiss	Manganese Dissolved	192	Filtered, ICP-MS	g/m^3	0
MnTR	Manganese Total Recoverable	193	ICP-OES after HNO3 digestion	g/m^3	0
MnTR	Manganese Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m^3	0
Molinate	Molinate	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Myclobutanil	Myclobutanil	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Na	Sodium	187	AAS	g/m^3	0
Na	Sodium	188	ICP-OES	g/m^3	0
NaDiss	Sodium Dissolved	192	Filtered, ICP-MS	g/m^3	0
Naled	Naled	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
NaTt	Sodium Total	194	ICP-MS after HNO3 digestion. APHA 3215 B.	g/m^3	0
NH4	NH4	121	Colorimetry,Phenolhypochlorite. FIA. APHA Method 4500-NH3 G (NH4-N = NH4-N + NH3-N)	g/m^3-N	0
NH4	NH4	122	Filtered.Colorimetry,Phenolhypochlorite,discrete analyser.APHA Method 4500-NH3 F(NH4-N=NH4-N+NH3-N)	g/m^3-N	0
NH4	NH4	1275	Colorimetry,Phenolhypochlorite. FIA. APHA Method 4500-NH3 H (NH4-N = NH4-N + NH3-N)	g/m^3-N	0
NNN	NNN	112	Total Oxidised Nitrogen. Automated cadmium reduction, FIA. APHA 4500 NO3 I. NO2 plus NO3	g/m^3-N	0
NO3	NO3	110	Ion Chromotography. APHA 4110B	g/m^3-N	0
Norflurazon	Norflurazon	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Oxadiazon	Oxadiazon	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Oxyfluofen	Oxyfluofen	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Paclobutrazol	Paclobutrazol	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Parathiethyl	Parathion-ethyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Parathimethyl	Parathion-methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Pendimethalin	Pendimethalin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Permethrin	Permethrin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
pH	pH	160	Field meter with temp. compensation	pH	0
pH	pH	163	Measured in lab by meter. APHA Method 4500-H+ B.	pH	0
pH	pH	1274	Field Meter	pH	0
Pirimicarb	Pirimicarb	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1
Pirimiphos_Methyl	Pirimiphos Methyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m^3	1

ppDDT	ppDDT	588	Gas chromotography, electron capture detection	g/m³	1
Prochloraz	Prochloraz	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Procymidone	Procymidone	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Prometryn	Prometryn	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Propachlor	Propachlor	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Propanil	Propanil	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Propazine	Propazine	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Propiconazole	Propiconazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
PumpDur	Pumping Test Duration	1108	Bore or Well Pump Test Duration as determined by the flow test method. Used by Located	h	0
PumpRate	Bore Pumping Rate	1106	Bore Pumping Rate as determined by the flow test method. Used by Located	m³/d	0
Pyriproxyfen	Pyriproxyfen	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Quizalethyl	Quizalofop-ethyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
S	Water Level	1	Staff Gauge/Manual Readings of Water Level	m	0
Sb TR	Antimony Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
Si DR Unk	Silica Dissolved Reactive AS Si02	471	Colorimetric,molybdenum blue complex. APHA 4500-Si E	g/m3 as SiO2	0
SiDiss	Silicon Dissolved	235	ICP-MS. APHA 3125B.	g/m³	0
Simazine	Simazine	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Simetryn	Simetryn	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
SiR	Silica Reactive	474	Filtered.Colorimetric analysis (Heteropoly Blue Complex) by discrete analyser, APHA 4500 SiO2 F	g/m3 as SiO2	0
SiTotDiss	Silicon Total Dissolved	478	Calculation:Silicon x 2.14	g/m3 as SiO2	0
SO4Chrom	Sulphate Dissolved	493	Filtered sample.Ion chromotography APHA 4110B	g/m³	0
SO4Turb	Sulphate	482	Turbidimetric. APHA 4500-SO4 E (modified).	g/m³	0
Sulfentrazone	Sulfentrazone	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
TCMTB	TCMTB	735	Busan,ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
TDSMisc	Total Dissolved Solids	61	Calculated from Electrical Conductivity	g/m³	0
Tebuconazole	Tebuconazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Terbacil	Terbacil	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Terbufos	Terbufos	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Terbumeton	Terbumeton	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Terbuthylazine	Terbuthylazine	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Terbuthylazinedesethyl	Terbuthylazine desethyl	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Terbutryn	Terbutryn	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Thiabendazole	Thiabendazole	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Thiobencarb	Thiobencarb	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Tolyfluanid	Tolyfluanid	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Total_Chlordane	Total Chlordane (cis+trans)*100/42)	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
TP	Total Phosphorus	144	Persulphate digestion, colorimetry. APHA 4500-P E (modified).	g/m³-P	0
trans-Chlordane	trans-Chlordane	591	Solid phase or liquid/liquid extraction, SPE Cleanup, GC-ECD.In-house method.	g/m³	1
Triazophos	Triazophos	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Trifluralin	Trifluralin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
Vinclozolin	Vinclozolin	589	ONOP method,Water: Solid phase or liquid/liquid extraction, GC-ECD/NPD, GC-MS.In-house method	g/m³	1
WT	Water Temperature	15	Meter.Field measurement.	°C	0
WT	Water Temperature	1274	Field Meter	°C	0
Zn AS	Zinc Acid Soluble	268	Direct aspiration AAS	g/m³	0
Zn TR	Zinc Total Recoverable	193	ICP-OES after HNO3 digestion	g/m³	0
Zn TR	Zinc Total Recoverable	238	ICP-MS after HNO3 digestion. APHA 3125B.	g/m³	0
ZnDiss	Zinc Dissolved	192	Filtered, ICP-MS	g/m³	0
ZnTt	Zinc Total	1121	ICP-MS after HNO3 digestion. APHA 3125B/US EPA 200.8	g/m³	0

LOC_KEY	SITE_NAME	STATION_NAME	EASTING	NORTHING
69_1446	Bore (Waikato)	Ohinewai School	1790788	5848310
69_1897	Bore (Waikato)	Waikokowai School	1781500	5839497
69_2071	Bore (Waikato)	Glen Massey School	1782932	5828646
69_2074	Bore (Waikato)	Orini School	1804516	5841084
69_365	Bore (Waikato)	MacDonald T & C (Barr)	1802116	5840499

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

MEMO

To: Kate Madsen

From: Paua Planning

CC:

Date: 28/07/2020

Re: Impacts on Water Quality of Lake Puketirini (Weavers Lake)

Background

Gleeson Managed Fill Limited (hereto referred to as GMF) proposes operating a managed fill at 300 Riverview Road, Huntly ('the site'), adjacent to the current Gleeson Aggregate Quarry. The site is approximately 4.5 km to the south of the Huntly township and is located on the western side of the Waikato River. GMF proposes to fill three gullies (Fill areas 2-4) with approximately 2,000,000 m^3 of managed fill. Managed Fill consists of cleanfill and contaminated clay, soil, rock and other inert materials that may have contaminants that exceed background concentrations.

Fill areas 3 and 4 (which will receive approximately 1,376,000 m^3 of fill material) discharge into the unnamed stream to the north of the site, which flows into the Waikato River. Fill area 2 (which will receive approximately 632,600 m^3 of cleanfill and managed fill) consists of a westerly orientated steep-sided gully. Fill area 2 has an ephemeral watercourse with a wetland feature located towards the lower end of the gully. Water from the wetland in the 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.

A sediment retention pond is proposed at the bottom of the gully of Fill area 2 (just above the wetland). The pond is designed to catch all of the stormwater from the gully containing fill area 2 (approximately 5.71 hectares) and uses alum floc to remove sediments and inorganic elements. The sediment retention ponds have been designed to meet the requirements of the WRC erosion and sediment control guideline (TR 2009/02), as the proposed diversion systems are designed for a 100-year storm event. The design of the sediment pond plus the alum flocculate will remove 95% of sediment and inorganic elements and should slightly decrease the total sediment loads into the unnamed tributary.

The regional groundwater flow beneath the site is expected to be easterly towards the Waikato River, which runs in a northerly direction. Therefore, any leachate discharges into the regional groundwater are likely to flow to the Waikato River.

History of Lake Puketirini

Lake Puketrini is a former open cast coal mine (referred to as being Weaver pits) that operated between 1954 and 1993 by State Coal (Mindat, 2020). Lake Puketirini was formed when the former Weaver's Opencast Mine Pit was naturally flooded.

To assist with the filling of the lake, an artificial channel was cut to divert part of the flow from the tributary into Lake Puketirini at the southeastern edge of the lake. The lake took approximately seven years to fill and has an approximate depth of 64 m and a surface area of 0.5 km^2. Approximately the bottom 130 m of the canal between the unnamed tributary and Lake Puketirini has been lined with rocks. A baffled concrete weir has been erected at the lower reaches of the tributary, which flows into Lake Puketirini. A weir has been constructed to prevent koi carp, goldfish, perch, rudd and gambusia from accessing the upstream reaches of the tributary and this weir was remediated in 2018 (Franklin et al., 2018).

Lake Puketirini has been contoured to have shallower margins around the edges, but these quickly change to very steep walls (Lynch, 2014). The mine pit has a roughly square shape and was terraced with 10-20 m breaches, and the original haul road winds its way down the breaches to the lake's floor.

The outflow at the lake's western end discharges through a canal into Lake Waahi. Two one-way gates have been installed at the outlet of the canal into Lake Waihi to prevent water from Lake Waihi from entering Lake Puketirini.

In 2006, Solid Energy New Zealand Limited gifted Lake Puketirini to Waikato District Council, and currently, the lake is managed by Waikato District Council for swimming and recreational purposes (WDC, 2009). Overall, the lake has been artificially created and is heavily engineered, and its original intended purpose was to be a recreational reserve.

Water Quality of Lake Puketirini

Lake Puketirini is the deepest lake within the Waikato Region (Hamilton et al., 2010) and is unique among Waikato lakes due to its low turbidity and relatively low nitrogen and phosphorous concentrations (Beaver, 2006). The lake's catchment is mainly pastoral, and the marginals around the lake and the catchment to the south of the lake have been impacted due to historical coal mining activities (WDC, 2009).

The water quality of Lake Puketirini is monitored periodically by Waikato Regional Council. Beaver (2006) found that the TN:TP ratio was 27:1, indicating that the lake was limited to phosphorous. More recent water quality data collected by Waikato Regional Council (2009-2019) indicates that the TN:TP ratios range between 10:1 to greater than 80:1 but averaging approximately 30:1. Changes in the TN:TP ratios are largely caused by variation in the amount of organic nitrogen entering the lake.

NIWA rates Lake Puketirini water quality as Fair to Good based on its medium chlorophyll a (Chl a) and total phosphorous concentrations. Overall, the lake is classified as Mesotrophic, meaning it has moderate nutrients. At the same time, adjacent Lake Waahi is Hypertrophic- a high amount of nutrients leading to low water clarity and algal blooms. Compared to other lowland lakes within the Waikato Region Lake Puketirini has a low median chloroform concentration of 4 mg/m^3 (cf 11-360 mg/m^3) (Hamilton et al., 2010).

Between 1996-and 2007, the pH level decreased by one unit. However, more recent data from Waikato Regional Council (2009-2019) indicates that the pH of the lake periodically increases from 7 pH units to 9.3 pH units, with the highest pH usually occurring between October to February. According to Waikato Regional Council data, the acidity (pH) of Lake Puketirini periodically exceeds the upper pH limit for recreational water quality of 8.5 pH units (ANZECC, 2000)

The depth of the lake and its relatively small surface area mean that there is relatively poor mixing within the lake, and it is thermally stratified (Beaver, 2006). This means that the waters below approximately 20 m are oxygen-poor restricting plant and animal life from this zone. Due to the severe oxygen depletion in the bottom waters of Lake Puketirini, the benthic and weed-dwelling invertebrates are restricted to the littoral zone around the edge of the lake. The Waikato District Council (2009) comments on the probability of water quality declining as the lake comes to equilibrium and contaminants from the bottom sediments are released into overlaying water.

The water clarity within the lake is very good, with a Secchi disc visibility of between 0.4 to 9.31 m (average of 4.1 m). Secchi disc visibility in lowland Waikato lowland lakes typically averages between 0.1 to 2.0 m), although Lake Taupo has an average Secchi Disc Visibility of 16 m (Hamilton et al., 2010). Analysis of Landsat 7 Enhanced Thematic Mapper Plus imagines by NIWA from 2000 to 2009 (Hicks et al., 2013) indicates that the mean concentration of suspended solids within Lake Puketirini may be decreasing over time. However, this trend is unclear in more recent data on suspended solids concentration and water clarity obtained by Waikato Regional Council.

EHS Support collected a single sample on 2 July 2020 from the lake's Western shore (-37.56905 175.13467 WGS84). The results are presented in Table 1 together with ANZG (2018) guidelines for 95% ecosystem protection and ANZECC (2000) Recreational Water guidelines. All parameters measured were significantly lower than the ANZG (2018) guidelines for 95% ecosystem protection and ANZECC (2000) Recreational Water guidelines. It should be noted. However, the concentration of boron measured in Lake Puketirini is elevated. This may be due to the impacts of historical coal mining at Weaver's pit, as coal within the Waikato is known to contain high levels of boron.

In 2009, Waikato District Council prepared a management plan for Lake Puketirini and the surrounding reserve. This Management Plan outlines eight objectives, including objectives for Environmental Quality and Recreational Opportunities.

Objective 1 for Environment Quality states that the lake remains suitable for contact recreation and Puketirini's ecological values are protected and developed. However, the management plans state that nutrients from non-point source run-off are a significant threat to the lake's water quality. It also recommends that the lake is classified as a contact recreational venue and that ongoing monitoring of phosphorous, chlorophyll a and seechi depth be undertaken.

Objective 2 for Recreational opportunities prompts the use of Puketirini as a recreational reserve.

Water Quality of Unnamed Tributary

Waikato Regional Council does not currently monitor the water quality of the Unnamed Tributary. Still, many other rural streams in the Lower Waikato Basin are regularly monitored by Waikato Regional Council. Therefore, the water quality of the tributary that flows into Lake Puketirini can be inferred from these streams. WRC monitors streams are Awaroa Stream, Whangape Stream, and Ohaeroa Stream. Gleeson Cox has collected one set of samples from the unnamed tributary, and these results, together with WRC Regional Streams from the area, are presented in Table 2. A summary of all water quality results for the untriburary are presented in Table C-1.

Based on the data in Table 2, water quality in the unnamed tributary is likely to be impacted by discharges from rural activities, which will elevate the concentration of nitrogenous compounds within the streams and reduce the clarity of the stream (as measured by black disc). In addition, the unnamed tributary appears to be sometimes elevated in aluminium, thallium and zinc relative to other rural streams. However, the source of these elements is currently not known.

Although zinc and nutrient concentrations within the unnamed tributary are higher than those measured within the lake, the water discharge in the unnamed tributary does not appear to have an adverse impact on water quality within the lake. This could be because of several reasons, including:

(a) Other discharges significantly dilute the volume of water entering the lake from the unnamed tributary into the lake (including groundwater discharges).
(b) Some nutrients and dissolved metals are being removed by natural processes or diluted by stormwater received in the stream downstream of Rotowaro Road.

Predicted water quality impacts of Leachate from Managed Fill area 2

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.

Three different scenarios have been modelled as part of this assessment, which are:

1. Scenario 1: Assuming that all the fill deposited in fill area 2 is contaminated up to the maximum allowable set by the Waste Acceptance Criteria.
2. Scenario 2: Reasonable Maximum Expected (RME) Concentration. Under this scenario, boron and thallium are estimated to be at the maximum background concentration (which the waste acceptance criteria have been set at) and all other inorganic elements at set at 60% of the maximum limit set in the Waste Acceptance Criteria.
3. Scenario 3: Most Reasonable Value. The most reasonable value (MRV) is based upon reported average concentrations of Auckland Managed Fills. For this scenario, the highest of the Auckland or Waikato background soils concentration plus 30% would be the average concentration within Fill area 2. However, this is still a conserved estimate. Most managed fills have reported that the average fill concentration within the managed fill is below the maximum Auckland background soils concentrations.

The potential groundwater discharge concentrations of the contaminants of concern into the Waikato River predicted by the RBCA model are presented in Table 3, together with ANZG (2018) water quality guidelines and the existing water quality of the unnamed stream.

The results of the RBCA modelling indicate that the surfaces water concentration will be lower than water quality guidelines within the unnamed tributary. However, it should be noted that the concentration of zinc is naturally elevated in this stream and is marginally above the water quality guidelines (See Table 2).

Potential for the Discharges to Impact on Water Quality

Based on the result of the RBCA monitoring and water quality testing, it is highly unlikely that the discharge from Fill Area 2 will adversely impact the recreational water quality in Lake Puketirini.

This is because:

(a) The predicted concentrations of inorganic elements in the discharge from managed fill area are several orders of magnitude below recreational water quality guidelines, even assuming the unrealistic assumption of the entire managed fill containing soil at the maximum concentration allowable. Estimating the realistic worst case (RME case) and most probable cases predict even changes in water quality within the unnamed tributary of approximately one order magnitude lower than the worst-case scenario. In all scenarios modelled, it is unlikely that there will be a measurable increase in the concentration of inorganic elements above current background levels caused by the discharges from the proposed managed fill. Therefore, EHS Support believes that the proposed managed fill is compatible with Objectives 1 and 2 of the Waikato District Council (2009) Puketirini Management Plan.

(b) The operation of the sediment retention ponds will remove 95% dissolved and total metals from the discharge. In addition, the stormwater treatment system will likely improve the site's water quality currently being discharged. Finally, once fill operations have ceased, reinstatement of the fill area will reduce sediment discharge from the site.

(c) The operation of the managed fill in fill area 2 is only for a short duration (2 to 5 years). Therefore, the discharges from the stormwater ponds will only be infrequent – i.e. during storm events. Therefore, the total mass load discharged during the operational life of Fill area 2 is very small in comparison to the total mass load from all other sources within the catchment.

(d) Current water quality from the tributary is already impacted by existing farming and historic coal mining activities. However, it does not appear to be having an adverse effect on water quality within Lake Puketirini. Based on the Analysis of water within Lake Puketirini the concentration of metals within the lake waters is below recreational water quality guidelines.

Limitations

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

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Whilst to the best of our knowledge information contained in this document 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 writing, unless otherwise explicitly stated in this document.

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TABLE 1 WATER QUALITY OF LAKE PUKETIRINI.

Parameter[1]	Soluble	Total Recoverable	ANZG Water Quality Guidelines (2018)[2]	ANZECC (2000) Recreational Water Quality Guidelines
Suspended Solids Concentrations		<3	NGV	
Electrical Conductivity (mS/m)	304	-	-	
Ammonia-N	<0.005			0.01
Nitrite-N	<0.001			NGV
Nitrate-N	0.0142			NGV
Chloride	17.3			400,000
Antimony	ND[3]	ND	NGV[4]	NGV
Arsenic	0.00061	0.00067	0.013	0.050
Boron	0.27	0.31	0.370	1000
Cadmium	ND	ND	0.0002	0.005
Chromium	ND	ND	0.001	0.050
Copper	ND	ND	0.0014	1,000
Iron	0.0085	0.059	NGV	0.3
Lead	ND	ND	0.0034	0.05
Mercury	ND	ND	0.0006	0.001
Nickel	0.00069	0.00069	0.0011	0.1
Thallium	ND	ND	NGV	NGV
Zinc	ND	ND	0.008	5

Table Notes
[1] Units are g/m^3
[2] 95% ecosystem protection water quality guideline for freshwater species.
[3] ND = Not detected. Analytical parameter was below the instrument detection limit.
[4] NGV = No Guideline value within ANZG (2018).

TABLE 2 WATER QUALITY OF AWAROA STREAM, OHAEROA STREAM AND WHANGAPE STREAM.

Parameter[1]	Awaroa Stream Ave (min, Max)	Ohareroa Stream Ave (min, Max)	Whangape Stream Ave (min, Max)	Unnamed Trib	WRC Water Quality Guidelines	ANZECC (2000) Recreational Water Quality Guidelines
Turbidity (NTU)	70 (14-290)	15.6 (1.8-210)			<5	
Black Disc Visibility (m)	0.9 (0.1-2)	0.9 (0.06-2.75)	0.18(0.4-1)		>1.6	
Electrical Conductivity (mS/m)	73(26.9-178)	16.7 (12.4-21.6)	21.2 (12.5-34.7)-	63.8 (15.2-113)	NGV	
Ammonia-N	0.05 (0.01-0.4)	0.018 (0.01-0.053)	0.1 (0.1-2.6)	0.017 (<0.005-0.82)	0.88	0.01
Dissolved Reactive Phosphorus	0.09 (0.004-0.054)	0.009 (0.004-0.028)	0.012(0.004-0.031)	0.04 (<0.02-0.05)	NGV	
Nitrite-Nitrate Nitrogen	0.578 (0.04-2.2)	1.6 (0.8-2.3)	0.276 (0.002-1.140)	0.32 (0.16-0.57))	*6.9*	NGV
pH	7.8 (7.2-8.3)	7.4 (6.7-8.0)	7.5 (6.8-9.2)	7.15 (6.6-7.7)	6.5-9	
TKN	0.29 (.14-.83)	0.33 (0.14-0.95)	2.2(0.28-7.2)	1.4	NGV	400,000
Arsenic	ND	ND	0.002 (0.002-0.003)	0.0008 (<0.0005-0.00078)	0.013	0.050
Zinc	0.002 (0.001-0.005)	0.004 (0.001-0.006)	ND	0.0038 (<0.001-0.0089)	0.008	5

Table Notes
1 Units are g/m^3
2 95% ecosystem protection water quality guideline for freshwater species.
3 ND = Not detected. Analytical parameter was below the instrument detection limit.
4.NGV = No Guideline value within ANZG (2018).
5. Values in brackets are the observed range of concentration. Value not in brackets is the average concentration.

	TABLE 3: COMPARISON OF PREDICTED GROUNDWATER DISCHARGE				
Parameter[1]	**Predicted Discharge Concentration (Max)**	**Predicted Discharge Concentration (MRE)**	**Predicted Discharge Concentration (MRV)**	**Unnamed Stream Background Concentration**	**ANZG (2018) Water Quality Guidelines**
Antimony	$2.9e^{-6}$	$1.5e^{-6}$	$4.4e^{-9}$	ND[2]	NGV[3]
Arsenic	$4.6e^{-6}$	$2.3e^{-6}$	$7.3\ e^{-7}$	ND	0.013
Cadmium	$1.3e^{-7}$	$9.3e^{-8}$	$1.8e^{-8}$	ND	0.0002
Chromium	$1.1e^{-6}$	$3.1e^{-7}$	$1.8e^{-7}$	0.00032	0.001
Copper	$1.2e^{-5}$	$7.5e^{-6}$	$3.9e^{-6}$	0.00097	0.0014
Mercury	$1.7e^{-8}$	$2.5e^{-8}$	$1.5e^{-8}$	<0.0001	0.0006
Nickel	$6.5e^{-6}$	$4.6e^{-6}$	$8.5e^{-6}$	0.00048	0.011
Lead	$1.3e^{-4}$	$8.6e^{-5}$	$1.1e^{-5}$	0.00032	0.0034
Thallium	$1.2e^{-5}$	$1.2e^{-5}$	$3.1e^{-7}$	0.000018	0.000 03[5]
Zinc	$4.3e^{-5}$	$1.6e^{-5}$	$2.5e^{-5}$	0.0081	0.008

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

Table C1. Water Quality Data Downstream of Fill Area 2 (page 1 of 2).

Reference	Units	20-22586-1	21-50440	21-50442	21-50443	21-50444	21-52971	21-52981	21-52978	ANZG WQG (2018) includes 202		
Sample Description		FA2	FA2	FA2	FA2	FA2	FA2	FA2	FA2	Level of Ecosystem protection		
Sample Date		22/6/2020	24/11/2021	25/11/2021	26/11/2021	29/11/2021	01/12/2021	06/12/2021	13/12/2021	95%	90%	80%
pH	pH	6	6.8	6.7	6.8	6.8	6.7	6.6	6.5			
Electrical Conductivity	µS/cm	165	154	152	153	154	169	161	162			
Total Alkalinity (CaCO3)	g CaCO3/m^3	4	30.2	25.3	26.8	29.8	23.2	24.1	22.9			
Chloride	g/m^3	16.6	27.9	27.7	27.8	27.3	28.3	27.9	27.3			
Sulfate	g/m^3	159	2.05	2.03	2.05	1.98	3.1	3.06	2.98			
Nitrate-N	g/m^3	0.573	0.158	0.159	0.162	0.156	0.289	0.286	0.287	2.4	3.8	6.9
Dissolved Reactive Phosphorus (FIA)	g/m^3	<0.002	0.002	0.003	0.004	0.003	0.002	<0.002	<0.002			
Ammonia as N	g/m^3	0.005	0.04	0.02	0.03	0.02	0.01	0.02	0.02	0.9	1.43	2.3
Sodium	g/m^3	19.3	19.6	20.2	20.3	20.2	21.6	22.4	22.2			
Potassium	g/m^3	2.5	1.6	1.7	1.7	1.6	1.6	1.7	1.7			
Calcium	g/m^3	4.8	4.5	4.7	4.5	4.5	4.2	4.4	4.3			
Magnesium	g/m^3	2.87	3.6	3.71	3.6	3.68	3.63	3.82	3.81			
Iron	g/m^3	0.674	0.778	0.705	0.723	0.818	0.43	0.44	0.44			
Manganese	g/m^3	0.0575	0.286	0.283	0.268	0.259	0.166	0.173	0.162	1.9	2.5	3.6
Sum of Anions	meq/L	NC	1.45	1.34	1.38	1.42	1.35	1.35	1.31			
Sum of Cations	meq/L	NC	1.45	1.5	1.48	1.49	1.51	1.58	1.56			
Aluminium	g/m^3	0.685	0.243	0.241	0.207	0.236	0.177	0.197	0.188	0.055	0.08	0.15
Arsenic	g/m^3	<0.00050	0.0005	<0.00050	0.00051	0.00051	<0.00050	<0.00050	<0.00050	0.024	0.094	0.36
Boron	g/m^3	0.026	0.015	0.016	0.016	0.016	0.026	0.025	0.025	0.94	1.5	2.5
Cadmium	g/m^3	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	0.0002	0.0004	0.0008
Chromium	g/m^3	0.0032	<0.00020	<0.00020	0.001	0.0037	<0.00020	0.0003	0.00024	0.0033		
Copper	g/m^3	0.00097	0.00074	0.00073	0.00073	0.0008	0.00077	0.00071	0.00077	0.0014	0.0018	0.0025
Lead	g/m^3	0.00032	0.000093	0.00016	0.000077	0.000099	0.00012	0.000077	0.00056	0.0034	0.0056	0.0094
Nickel	g/m^3	0.00048	0.0012	0.0013	0.0013	0.0014	0.00088	0.00083	0.001	0.011	0.013	0.017
Thallium	g/m^3	0.000018	0.000039	0.000041	0.000035	0.000038	0.000054	0.000042	0.000029	0.00003		
Zinc	g/m^3	0.00482	0.0044	0.0089	0.0042	0.0044	0.0017	0.002	0.0023	0.008	0.015	0.031

Notes:

Cell highlighted in yellow exceed ANZG (2018) DGV for 95% ecosystem protection

1 updates
Guideline reliability
v.high
v.high
moderate
low
moderate
v.high
v.high
unknown
v.high
moderate
low
unknown
v. High

Table C1. Water Quality Data Downstream of Fill Area 2 (page 2 of 2).

Reference	Units	22-08754	22-08755	22-08756	22-08757	22-08758	22-08759	22-08761	22-08762	ANZG WQG (2018) includ		
Sample Description		FA2	FA2	FA2	FA2	FA2	FA2	FA2	FA2	Level of Ecosystem protection		
Sample Date		02/02/2022	04/02/2022	08/02/2022	11/02/2022	15/02/2022	18/02/2022	25/02/2022	28/02/2022	95%	90%	80%
pH	pH	7.7	7.7	7.7	7.7	7.7	7.7	7.6	7.7			
Electrical Conductivity	µS/cm	1,100	1,130	1,130	1,130	1,130	1,120	1,080	1,130			
Total Alkalinity (CaCO3)	g CaCO3/m^3	127	128	125	131	128	130	133	132			
Chloride	g/m^3	18.8	18.7	18.4	18.7	18.7	18.8	18.6	18.6			
Sulfate	g/m^3	490	470	515	494	507	491	490	500			
Nitrate-N	g/m^3	0.388	0.396	0.388	0.387	0.399	0.388	0.39	0.385	2.4	3.8	6.9
Dissolved Reactive Phosphorus (Fl	g/m^3	0.003	0.004	0.005	0.005	0.004	0.004	0.004	0.004			
Ammonia as N	g/m^3	<0.005	0.01	<0.005	<0.005	0.008	<0.005	0.006	<0.005	0.9	1.43	2.3
Sodium	g/m^3	42.5	42.9	42.4	42.1	42.4	42.5	43.5	43.4			
Potassium	g/m^3	3.2	3.3	3.2	3.2	3.2	3.2	3.3	3.3			
Calcium	g/m^3	183	187	187	187	186	188	190	190			
Magnesium	g/m^3	29.2	29.5	29.2	29.3	29.4	29.7	29.4	30.2			
Iron	g/m^3	<0.0050	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050			
Manganese	g/m^3	0.0972	0.0987	0.105	0.0899	0.0972	0.102	0.103	0.104	1.9	2.5	3.6
Sum of Anions	meq/L	13.31	12.92	13.78	13.48	13.68	13.39	13.43	13.6			
Sum of Cations	meq/L	13.46	13.7	13.64	13.67	13.63	13.75	13.88	13.92			
Aluminium	g/m^3	0.0032	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.055	0.08	0.15
Arsenic	g/m^3	0.00075	0.00074	0.00088	0.0017	0.00081	0.00076	0.00081	0.00082	0.024	0.094	0.36
Boron	g/m^3	0.093	0.098	0.097	0.095	0.095	0.096	0.095	0.097	0.94	1.5	2.5
Cadmium	g/m^3	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	0.0002	0.0004	0.0008
Chromium	g/m^3	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.0033		
Copper	g/m^3	0.00023	<0.00020	<0.00020	0.00041	<0.00020	<0.00020	0.00021	0.0002	0.0014	0.0018	0.0025
Lead	g/m^3	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.0034	0.0056	0.0094
Nickel	g/m^3	0.00037	0.00038	0.00037	0.00077	0.00033	0.00042	0.00032	0.00035	0.011	0.013	0.017
Thallium	g/m^3	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.00003		
Zinc	g/m^3	<0.0010	<0.0010	<0.0010	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	0.008	0.015	0.031

Notes:

Cell highlighted in yellow exceed ANZG (2018) DGV for 95% ecosystem protection

es 2021 updates
Guideline reliability
v.high
v.high
moderate
low
moderate
v.high
v.high
unknown
v.high
moderate
low
unknown
v. High

Appendix D RBCA Input/Output Result Sheets

RBCA SITE ASSESSMENT

Input Parameter Summary

Site Name: Glesson Cox
Site Location: Huntly Quarry

Completed By: Andrew Rumsby
Date Completed: 23-Jul-19

Exposure Parameters		Residential				Commercial/Industrial		User Defined
		Child*	Adolescent	Adult	Age Adjusted**	Adult	Construct.	
ATc	Averaging time for carcinogens (yr)	70	70	70	NA	70	70	70
ATn	Averaging time for non-carcinogens (yr)	6	12	30	NA	25	1	75
BW	Body weight (kg)	15	35	70	NA	70	70	13
ED	Exposure duration (yr)	6	12	30	NA	25	1	6
τ	Averaging time for vapor flux (yr)	30	30	30	NA	30	30	-
EF	Exposure frequency (days/yr)	350	350	350	NA	250	180	350
EFD	Exposure frequency for dermal exposure	350	350	350	NA	250	180	350
IRw	Ingestion rate of water (L/day)	1	1	2	2.5	1	NA	2
IRs	Ingestion rate of soil (mg/day)	200	200	100	387	50	100	200
SA	Skin surface area (dermal) (cm^2)	2023	2023	3160	4771	3160	3160	1900
M	Soil to skin adherence factor	0.5	0.5	0.5	NA	0.5	0.5	0.04
ETswim	Swimming exposure time (hr/event)	1	3	3	NA	NA	NA	NA
EVswim	Swimming event frequency (events/yr)	12	12	12	NA	NA	NA	NA
IRswim	Water ingestion while swimming (L/hr)	0.5	0.5	0.05	0.3	NA	NA	NA
SAswim	Skin surface area for swimming (cm^2)	3500	8100	23000	15680	NA	NA	NA
IRfish	Ingestion rate of fish (kg/yr)	0.025	0.025	0.025	0.053	NA	NA	NA
Flfish	Contaminated fish fraction (unitless)	1	1	1	NA	NA	NA	NA
IRbg	Below-ground vegetable ingestion	0.002	0.002	0.006	2.053	NA	NA	NA
IRabg	Above-ground vegetable ingestion	0.001	0.001	0.002	0.887	NA	NA	NA
VGbg	Above-ground Veg. Ingest. Correction Factor	0.01	0.01	0.01	NA	NA	NA	NA
VGabg	Below-ground Veg. Ingest. Correction Factor	0.01	0.01	0.01	NA	NA	NA	NA

* = Child Receptor used for Non-Carcinogens
** = Age-adjusted rate is effective value corresponding to adult exposure factors.

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	Commercial	Residential	Surf. Water
Soil Leaching to Groundwater Ingestion	Commercial	Residential	Surf. Water
Apply MCL Values	Yes	Yes	No
Applicable Surface Water Exposure Routes:			
Swimming	NA	NA	Yes
Fish Consumption	NA	NA	Yes
Aquatic Life Protection	NA	NA	Yes
Soil:			
Direct Contact: direct combined pathways	None	NA	NA
Apply CLEA- UK SGV levels		No	
Outdoor Air:			
Particulates from Surface Soils	None	None	None
Volatilization from Soils	None	None	None
Volatilization from Groundwater	None	None	None
Indoor Air:			
Volatilization from Soils	None	NA	NA
Volatilization from Groundwater	None	None	None
Soil Leaching to Groundwater Volatilization	None	None	None

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor	0	200	50	(m)
Outdoor air inhalation receptor	NA	NA	NA	(m)
Indoor air inhalation receptor	NA	NA	NA	(m)

Target Health Risk Values		Individual	Cumulative
TR	Target Risk (carcinogens)	1.0E-5	NA
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	NA

Modeling Options	
RBCA tier	Tier 2
Outdoor air volatilization model	NA
Indoor air volatilization model	NA
Soil leaching model	ASTM leaching model
Use soil attenuation model (SAM) for leachate?	Yes
Use dual equilibrium desorption model?	No
Apply Mass Balance Limit for Soil Volatilization?	No
Apply UK (CLEA) SGV as soil concentration limit	No
Vegetable calculation options	NA
Air dilution factor	NA
Groundwater dilution-attenuation factor	Domenico model

NOTE: NA = Not applicable
Orange = Site-specific value (different from current default value)

RBCA SITE ASSESSMENT — Input Parameter Summary

Site Name: Glesson Cox
Site Location: Huntly Quarry

Completed By: Andrew Rumsby
Date Completed: 23-Jul-19

Surface Soil Column Parameters		Value			(Units)
h_{cap}	Capillary zone thickness	NA			(m)
h_v	Vadose zone thickness	NA			(m)
ρ_s	Soil bulk density	1.7			(g/cm^3)
f_{oc}	Fraction organic carbon	*0.07*			(-)
θ_T	Soil total porosity	*0.36*			(-)
		capillary	vadose	foundation	
θ_w	Volumetric water content	*0.35*	*0.34*	0.12	(-)
θ_a	Volumetric air content	*0.01*	*0.02*	0.26	(-)
K_{vs}	Vertical hydraulic conductivity	*0.00864*			(cm/d)
k_v	Vapor permeability	*1E-17*			(m^2)
L_{gw}	Depth to groundwater	*12*			(m)
pH	Soil/groundwater pH	6.8			(-)
W	Length of source-zone area parallel to wind	NA			(m)
W_{gw}	Length of source-zone area parallel to GW flow	*45*			(m)
L_{ss}	Thickness of affected surface soils	NA			(m)
A	Source zone area	NA			(m^2)
L_s	Depth to top of affected soils	0			(m)
L_{base}	Depth to base of affected soils	*10*			(m)
L_{subs}	Thickness of affected soils	*10*			(m)

Outdoor Air Parameters		Value	(Units)
U_{air}	Ambient air velocity in mixing zone	NA	(m/s)
δ_{air}	Air mixing zone height	NA	(m)
Q/C	Inverse mean concentration at the center of source	NA	
P_a	Areal particulate emission rate	NA	(g/cm^2/s)
V	Fraction of vegetative cover	NA	
U_m	Mean annual airvelocity at 7m	NA	
U_t	Equivalent 7m air velocity threshold value	NA	
F(x)	Windspeed function dependant on Um/Ut	NA	
PEF	Partculate Emission Factor	NA	

Building Parameters		Residential	Commercial	(Units)
L_b	Building volume/area ratio	NA	NA	(m)
A_b	Foundation area	NA	NA	(m^2)
X_{crk}	Foundation perimeter	NA	NA	(m)
ER	Building air exchange rate	NA	NA	(1/s)
L_{crk}	Foundation thickness	NA	NA	(m)
Z_{crk}	Depth to bottom of foundation slab	NA	NA	(m)
η	Foundation crack fraction	NA	NA	(-)
dP	Indoor/outdoor differential pressure	NA	NA	(g/cm/s^2)
Q_s	Convective air flow through slab	NA	NA	(m^3/s)
θ_{wcrack}	Volumetric water content of cracks	NA	NA	(-)
θ_{acrack}	Volumetric air content of cracks	NA	NA	(-)
BV	Building Volume	NA	NA	(m^3)
w	Building Width Perpendicular to GW flow	NA	NA	(m)
L	Building Length Parallel to GW flow	NA	NA	(m)
ν	Saturated Soil Zone Porosity	NA	NA	(-)

Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	*4.784509337*	(m)
I_f	Net groundwater infiltration rate	*30*	(cm/yr)
U_{gw}	Groundwater Darcy velocity	*12.096*	(cm/d)
V_{gw}	Groundwater seepage velocity	*1209.6*	(cm/d)
K_s	Saturated hydraulic conductivity	*1209.6*	(cm/d)
i	Groundwater gradient	0.01	(-)
S_w	Width of groundwater source zone	*50*	(m)
S_d	Depth of groundwater source zone	*4.784509337*	(m)
θ_{eff}	Effective porosity in water-bearing unit	*0.01*	(-)
$f_{oc\text{-}sat}$	Fraction organic carbon in water-bearing unit	*0.07*	(-)
pH_{sat}	Groundwater pH	6.2	(-)
	Biodegradation considered?	No	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Groundwater to Indoor Air		
α_x	Longitudinal dispersivity	2.0E+1	5.0E+0	NA	NA	(m)
α_y	Transverse dispersivity	6.6E+0	1.7E+0	NA	NA	(m)
α_z	Vertical dispersivity	1.0E+0	2.5E-1	NA	NA	(m)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	NA	NA	NA	NA	(m)
σ_z	Vertical dispersion coefficient	NA	NA	NA	NA	(m)
ADF	Air dispersion factor	NA	NA	NA	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	118.5	(m^3/s)
W_{pl}	Width of GW plume at SW discharge	100	(m)
δ_{pl}	Thickness of GW plume at SW discharge	0.01	(m)
DF_{sw}	Groundwater-to-surface water dilution factor	8.5E+7	(-)

NOTE: NA = Not applicable
Orange = Site-specific value (different from current default value)

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

SOILS (0 - 10 m): LEACHING TO GW/ DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING

	1) Source Medium	2) NAF Value (L/kg) Receptor	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2)
Constituents of Concern	Soil Conc. (mg/kg)	Off-site 2 (50 m) Surface Water	Off-site 2 (50 m) Surface Water
Antimony	1.0E+2	1.6E+12	6.3E-11
Arsenic	1.0E+2	1.0E+12	9.9E-11
Boron	1.0E+2	NA	
Cadmium	7.5E+0	2.6E+12	2.8E-12
Chromium (total)	4.0E+2	4.2E+13	9.5E-12
Copper	3.5E+2	1.4E+12	2.5E-10
Mercury	1.0E+0	1.8E+12	5.5E-13
Nickel	3.2E+2	2.3E+12	1.4E-10
Lead (inorganic)	1.0E+3	3.6E+11	2.8E-9
Tin	1.0E+2	4.4E+12	2.3E-11
TPH, TX1105, C6-C12	1.2E+2	3.9E+12	3.1E-11
TPH, TX1105, >C12-C28	1.2E+2	1.2E+13	9.7E-12
TPH, TX1105, >C12-C35	1.4E+3	1.2E+13	1.1E-10
TPH, TX1105, >C28-C35	2.0E+4	1.2E+13	1.6E-9
Zinc	2.0E+3	2.2E+12	9.2E-10
Benzene	2.0E-1	1.7E+11	1.2E-12
Ethyl benzene	1.0E+0	5.1E+11	2.0E-12
Toluene	1.0E+0	3.5E+11	2.8E-12
Xylenes (mixed isomers)	1.0E+0	6.0E+11	1.7E-12
DDT	1.0E+1	3.4E+14	3.0E-14
Naphthalene	5.0E+0	3.8E+12	1.3E-12

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Glesson Cox
Site Location: Huntly Quarry
Completed By: Andrew Rumsby

Date Completed: 23-Jul-19
Job ID: H01503100

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

SOILS (0 - 10 m): LEACHING TO GW/ DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING (cont'd)

Constituents of Concern	4) Exposure Multiplier [(IRxET+SAxZ)xEVxED]/(BWxAT) (L/kg/day) Off-site 2 (50 m) Surface Water	5) Average Daily Intake Rate (mg/kg/day) (3) x (4) Off-site 2 (50 m) Surface Water
Antimony	1.1E-3	6.9E-14
Arsenic	1.8E-4	1.8E-14
Boron		
Cadmium	1.1E-3	3.1E-15
Chromium (total)	1.1E-3	1.0E-14
Copper	1.1E-3	2.7E-13
Mercury	1.1E-3	6.0E-16
Nickel	1.1E-3	1.5E-13
Lead (inorganic)	1.1E-3	3.1E-12
Tin	1.1E-3	2.5E-14
TPH, TX1105, C6-C12	1.1E-3	3.4E-14
TPH, TX1105, >C12-C28	1.1E-3	1.1E-14
TPH, TX1105, >C12-C35	1.1E-3	1.2E-13
TPH, TX1105, >C28-C35	1.1E-3	1.8E-12
Zinc	1.1E-3	1.0E-12
Benzene	1.8E-4	2.1E-16
Ethyl benzene	1.1E-3	2.2E-15
Toluene	1.1E-3	3.1E-15
Xylenes (mixed isomers)	1.1E-3	1.8E-15
DDT	1.8E-4	5.3E-18
Naphthalene	1.1E-3	1.4E-15

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

SOILS (0 - 10 m): LEACHING TO GW/ DISCHARGE TO SURFACE WATER/ FISH CONSUMPTION

Exposure Concentration

Constituents of Concern	1) Source Medium Soil Conc. (mg/kg)	2) NAF Value (L/kg) Receptor Off-site 2 (50 m) Surface Water	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2) Off-site 2 (50 m) Surface Water
Antimony	1.0E+2	1.6E+12	6.3E-11
Arsenic	1.0E+2	1.0E+12	9.9E-11
Boron	1.0E+2	NA	
Cadmium	7.5E+0	2.6E+12	2.8E-12
Chromium (total)	4.0E+2	4.2E+13	9.5E-12
Copper	3.5E+2	1.4E+12	2.5E-10
Mercury	1.0E+0	1.8E+12	5.5E-13
Nickel	3.2E+2	2.3E+12	1.4E-10
Lead (inorganic)	1.0E+3	3.6E+11	2.8E-9
Tin	1.0E+2	4.4E+12	2.3E-11
TPH, TX1105, C6-C12	1.2E+2	3.9E+12	3.1E-11
TPH, TX1105, >C12-C28	1.2E+2	1.2E+13	9.7E-12
TPH, TX1105, >C12-C35	1.4E+3	1.2E+13	1.1E-10
TPH, TX1105, >C28-C35	2.0E+4	1.2E+13	1.6E-9
Zinc	2.0E+3	2.2E+12	9.2E-10
Benzene	2.0E-1	1.7E+11	1.2E-12
Ethyl benzene	1.0E+0	5.1E+11	2.0E-12
Toluene	1.0E+0	3.5E+11	2.8E-12
Xylenes (mixed isomers)	1.0E+0	6.0E+11	1.7E-12
DDT	1.0E+1	3.4E+14	3.0E-14
Naphthalene	5.0E+0	3.8E+12	1.3E-12

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Glesson Cox
Site Location: Huntly Quarry
Completed By: Andrew Rumsby

Date Completed: 23-Jul-19
Job ID: H01503100

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

SOILS (0 - 10 m): LEACHING TO GW/ DISCHARGE TO SURFACE WATER/ FISH CONSUMPTION (cont'd)

Constituents of Concern	4) Exposure Multiplier (IRxFIxBCFxED)/(BWxAT) (L/kg/day) Off-site 2 (50 m) Surface Water	5) Average Daily Intake Rate (mg/kg/day) (3) x (4) Off-site 2 (50 m) Surface Water
Antimony	No BCF	
Arsenic	No BCF	
Boron		
Cadmium	No BCF	
Chromium (total)	No BCF	
Copper	No BCF	
Mercury	No BCF	
Nickel	No BCF	
Lead (inorganic)	No BCF	
Tin	No BCF	
TPH, TX1105, C6-C12	No BCF	
TPH, TX1105, >C12-C28	No BCF	
TPH, TX1105, >C12-C35	No BCF	
TPH, TX1105, >C28-C35	No BCF	
Zinc	No BCF	
Benzene	1.1E-5	1.3E-17
Ethyl benzene	5.5E-4	1.1E-15
Toluene	3.2E-4	9.1E-16
Xylenes (mixed isomers)	5.9E-4	9.9E-16
DDT	2.6E-2	7.8E-16
Naphthalene	2.0E-3	2.6E-15

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

GROUNDWATER: DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING

Constituents of Concern	1) Source Medium Groundwater Conc. (mg/L)	2) NAF Value (unitless) Receptor Off-site 2 (50 m) Surface Water	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2) Off-site 2 (50 m) Surface Water
Antimony	0.0E+0	1.3E+8	0.0E+0
Arsenic	0.0E+0	1.3E+8	0.0E+0
Boron	0.0E+0	1.3E+8	0.0E+0
Cadmium	0.0E+0	1.3E+8	0.0E+0
Chromium (total)	0.0E+0	1.3E+8	0.0E+0
Copper	0.0E+0	1.3E+8	0.0E+0
Mercury	0.0E+0	1.3E+8	0.0E+0
Nickel	0.0E+0	1.3E+8	0.0E+0
Lead (inorganic)	0.0E+0	1.3E+8	0.0E+0
Tin	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, C6-C12	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, >C12-C28	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, >C12-C35	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, >C28-C35	0.0E+0	1.3E+8	0.0E+0
Zinc	0.0E+0	1.3E+8	0.0E+0
Benzene	0.0E+0	1.3E+8	0.0E+0
Ethyl benzene	0.0E+0	1.3E+8	0.0E+0
Toluene	0.0E+0	1.3E+8	0.0E+0
Xylenes (mixed isomers)	0.0E+0	1.3E+8	0.0E+0
DDT	0.0E+0	1.3E+8	0.0E+0
Naphthalene	0.0E+0	1.3E+8	0.0E+0

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Glesson Cox
Site Location: Huntly Quarry
Completed By: Andrew Rumsby

Date Completed: 23-Jul-19
Job ID: H01503100

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

GROUNDWATER: DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING (cont'd)	4) Exposure Multiplier [(IRxET+SAxZ)xEVxED]/(BWxAT) (L/kg/day)	5) Average Daily Intake Rate (mg/kg/day) (3) x (4)
Constituents of Concern	Off-site 2 (50 m) Surface Water	Off-site 2 (50 m) Surface Water
Antimony	1.1E-3	0.0E+0
Arsenic	1.8E-4	0.0E+0
Boron	1.1E-3	0.0E+0
Cadmium	1.1E-3	0.0E+0
Chromium (total)	1.1E-3	0.0E+0
Copper	1.1E-3	0.0E+0
Mercury	1.1E-3	0.0E+0
Nickel	1.1E-3	0.0E+0
Lead (inorganic)	1.1E-3	0.0E+0
Tin	1.1E-3	0.0E+0
TPH, TX1105, C6-C12	1.1E-3	0.0E+0
TPH, TX1105, >C12-C28	1.1E-3	0.0E+0
TPH, TX1105, >C12-C35	1.1E-3	0.0E+0
TPH, TX1105, >C28-C35	1.1E-3	0.0E+0
Zinc	1.1E-3	0.0E+0
Benzene	4.1E-4	0.0E+0
Ethyl benzene	3.1E-3	0.0E+0
Toluene	2.3E-3	0.0E+0
Xylenes (mixed isomers)	3.3E-3	0.0E+0
DDT	1.8E-4	0.0E+0
Naphthalene	3.2E-3	0.0E+0

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

GROUNDWATER: DISCHARGE TO SURFACE WATER / FISH CONSUMPTION

Constituents of Concern	1) Source Medium Groundwater Conc. (mg/L)	2) NAF Value (unitless) Receptor Off-site 2 (50 m) Surface Water	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2) Off-site 2 (50 m) Surface Water
Antimony	0.0E+0	1.3E+8	0.0E+0
Arsenic	0.0E+0	1.3E+8	0.0E+0
Boron	0.0E+0	1.3E+8	0.0E+0
Cadmium	0.0E+0	1.3E+8	0.0E+0
Chromium (total)	0.0E+0	1.3E+8	0.0E+0
Copper	0.0E+0	1.3E+8	0.0E+0
Mercury	0.0E+0	1.3E+8	0.0E+0
Nickel	0.0E+0	1.3E+8	0.0E+0
Lead (inorganic)	0.0E+0	1.3E+8	0.0E+0
Tin	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, C6-C12	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, >C12-C28	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, >C12-C35	0.0E+0	1.3E+8	0.0E+0
TPH, TX1105, >C28-C35	0.0E+0	1.3E+8	0.0E+0
Zinc	0.0E+0	1.3E+8	0.0E+0
Benzene	0.0E+0	1.3E+8	0.0E+0
Ethyl benzene	0.0E+0	1.3E+8	0.0E+0
Toluene	0.0E+0	1.3E+8	0.0E+0
Xylenes (mixed isomers)	0.0E+0	1.3E+8	0.0E+0
DDT	0.0E+0	1.3E+8	0.0E+0
Naphthalene	0.0E+0	1.3E+8	0.0E+0

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: Glesson Cox
Site Location: Huntly Quarry
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Date Completed: 23-Jul-19
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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

GROUNDWATER: DISCHARGE TO SURFACE WATER / FISH CONSUMPTION (cont'd)

Constituents of Concern	4) Exposure Multiplier (IRxFIxBCFxED)/(BWxAT) (L/kg/day) Off-site 2 (50 m) Surface Water	5) Average Daily Intake Rate (mg/kg/day) (3) x (4) Off-site 2 (50 m) Surface Water	MAXIMUM PATHWAY INTAKE (mg/kg/day) *(Maximum intake of active pathways soil leaching & groundwater routes.)* Off-site 2 (50 m) Surface Water
Antimony	No BCF		6.9E-14
Arsenic	No BCF		1.8E-14
Boron	No BCF		
Cadmium	No BCF		3.1E-15
Chromium (total)	No BCF		1.0E-14
Copper	No BCF		2.7E-13
Mercury	No BCF		6.0E-16
Nickel	No BCF		1.5E-13
Lead (inorganic)	No BCF		3.1E-12
Tin	No BCF		2.5E-14
TPH, TX1105, C6-C12	No BCF		3.4E-14
TPH, TX1105, >C12-C28	No BCF		1.1E-14
TPH, TX1105, >C12-C35	No BCF		1.2E-13
TPH, TX1105, >C28-C35	No BCF		1.8E-12
Zinc	No BCF		1.0E-12
Benzene	1.1E-5	0.0E+0	2.2E-16
Ethyl benzene	5.5E-4	0.0E+0	3.2E-15
Toluene	3.2E-4	0.0E+0	4.0E-15
Xylenes (mixed isomers)	5.9E-4	0.0E+0	2.8E-15
DDT	2.6E-2	0.0E+0	7.8E-16
Naphthalene	2.0E-3	0.0E+0	4.0E-15

RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

CARCINOGENIC RISK

Constituents of Concern	(1) Is Carcinogenic?	(2) Maximum Carcinogenic Intake Rate (mg/kg/day) (a) via Ingestion	(b) via Dermal Contact	(3) Slope Factor (mg/kg/day)^-1 (a) Oral	(b) Dermal	(4) Individual COC Risk (2a)x(3a) + (2b)x(3b)
		Off-site 2 (50 m) Surface Water				Off-site 2 (50 m) Surface Water
Antimony	FALSE			-	-	
Arsenic	TRUE	1.8E-14	NC	1.5E+0	1.5E+0	NC
Boron	FALSE			-	-	
Cadmium	FALSE			-	-	
Chromium (total)	FALSE			-	-	
Copper	FALSE			-	-	
Mercury	FALSE			-	-	
Nickel	FALSE			-	-	
Lead (inorganic)	FALSE			-	-	
Tin	FALSE			-	-	
TPH, TX1105, C6-C12	FALSE			-	-	
TPH, TX1105, >C12-C28	FALSE			-	-	
TPH, TX1105, >C12-C35	FALSE			-	-	
TPH, TX1105, >C28-C35	FALSE			-	-	
Zinc	FALSE			-	-	
Benzene	TRUE	2.2E-16	2.7E-16	1.5E-2	1.5E-2	7.5E-18
Ethyl benzene	FALSE			-	-	
Toluene	FALSE			-	-	
Xylenes (mixed isomers)	FALSE			-	-	
DDT	TRUE	7.8E-16	NC	3.4E-1	3.4E-1	NC
Naphthalene	FALSE			-	-	

* No dermal slope factor available--oral slope factor used.

Site Name: Glesson Cox
Site Location: Huntly Quarry
Completed By: Andrew Rumsby

Date Completed: 23-Jul-19
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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(Checked if Pathway is Complete)**

TOXIC EFFECTS

Constituents of Concern	(5) Maximum Toxicant Intake Rate (mg/kg/day) (a) via Ingestion	(b) via Dermal Contact	(6) Reference Dose (mg/kg/day) (a) Oral	(b) Dermal	(7) Individual COC Hazard Quotient (5a)/(6a) + (5b)/(6b)
	Off-site 2 (50 m) Surface Water				Off-site 2 (50 m) Surface Water
Antimony	6.9E-14	NC	4.0E-4	4.0E-4	NC
Arsenic	1.1E-13	NC	3.0E-4	3.0E-4	NC
Boron	0.0E+0	NC	2.0E-1	2.0E-1	NC
Cadmium	3.1E-15	NC	1.0E-3	1.0E-3	NC
Chromium (total)	1.0E-14	NC	1.5E+0	1.5E+0	NC
Copper	2.7E-13	NC	4.0E-2	4.0E-2	NC
Mercury	6.0E-16	NC	3.0E-4	3.0E-4	NC
Nickel	1.5E-13	NC	2.0E-2	2.0E-2	NC
Lead (inorganic)			-	-	
Tin	2.5E-14	NC	6.0E-1	6.0E-1	NC
TPH, TX1105, C6-C12	3.4E-14	NC	4.0E-2	4.0E-2	NC
TPH, TX1105, >C12-C28	1.1E-14	NC	4.0E-2	4.0E-2	NC
TPH, TX1105, >C12-C35	1.2E-13	NC	4.0E-2	4.0E-2	NC
TPH, TX1105, >C28-C35	1.8E-12	NC	4.0E-2	4.0E-2	NC
Zinc	1.0E-12	NC	3.0E-1	3.0E-1	NC
Benzene	1.4E-15	6.6E-16	4.0E-3	4.0E-3	5.1E-13
Ethyl benzene	3.2E-15	4.0E-15	1.0E-1	1.0E-1	7.3E-14
Toluene	4.0E-15	3.5E-15	8.0E-2	8.0E-2	9.4E-14
Xylenes (mixed isomers)	2.8E-15	3.7E-15	2.0E-1	2.0E-1	3.3E-14
DDT	4.0E-15	NC	5.0E-4	5.0E-4	NC
Naphthalene	4.0E-15	2.7E-15	2.0E-2	2.0E-2	3.4E-13

* No dermal reference dose available--oral reference dose used.

Site Name: Glesson Cox
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