LEVIN LANDFILL ANNUAL COMPLIANCE REPORT JULY 2019 - JUNE 2020 (AS REQUIRED BY RESOURCE CONSENTS DP6009, DP6010, DP6011, AND DP102259

PREPARED FOR HOROWHENUA DISTRICT COUNCIL

August 2021

Stantec

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V1	29/09/2020	Final	Julia O'Brien and Phil Landmark	Phil Landmark	Paul Heveldt	Roger Hulme
V2	06/08/2021	Amended Final – changes to Mass Contaminant Assessment	Phil Landmark	Julia O'Brien	Paul Heveldt	Roger Hulme

Executive Summary

Horowhenua District Council is required to carry out compliance monitoring for the Levin Landfill as part of Resource Consents DP6009, DP6010, DP6011 and DP102259.

This report summarises the findings from the July 2019 to June 2020 annual monitoring period, including monitoring results for:

- Background groundwater condition;
- The landfill leachate pond;
- Groundwater bores within the new landfill and irrigation area;
- Shallow aquifers, down-gradient of the old landfill;
- Deep aquifer;
- Hokio Stream;
- Stormwater,
- Landfill gas and odour, and
- Bio-filter.

Monitoring for other aspects of the landfill operations, such as sampling of the landfill gas flare and collection wells, are reported separately as per additional resource consent requirements.

Quality Control and Assurance

Workshop training on appropriate sampling procedures was conducted in March 2018 for all sampling personnel. No further training was undertaken in this reporting period.

Background Groundwater (Bores G1S, G1D)

The quality of the background groundwater up-hydraulic gradient from the landfill site is not subject to any resource consent conditions. However, for comparison purposes, both the ANZECC 2000 Livestock Drinking Water (LDW) trigger values and the Drinking Water Standards New Zealand (DWS NZ) guidelines were used to benchmark the quality of groundwater hydraulically up-gradient from the landfill site.

Samples from the shallow bore (G1S) exceeded the DWS NZ guidelines for iron concentrations and pH. The DWS NZ guideline for iron was also exceeded at the deep bore (G1D). These results indicate an impact on groundwater from activities outside the landfill.

It is understood that past leachate irrigation occurred in the area to the south-east of the site only and not in the south-west of the site. Therefore, dependent upon groundwater flow direction, bores D5, F2 and F3 and possibly D3(r) may be considered representative of background groundwater quality. We recommend that this be reviewed as it would provide a better understanding of background groundwater conditions, particularly given the observed changes in bores on the eastern site of the site, including G1S.

Shallow Aquifer Down-gradient to Old Landfill (Bores E2S, B1, B2, B3, C1, C2, C2DS, G2S)

Median results did not exceed the ANZECC LDW trigger values in the 2019-2020 monitoring period, and therefore the hydraulically down-gradient bores complied with the resource consent conditions.

Bores located immediately down-gradient hydraulically to the old unlined landfill continue to show elevated concentrations of leachate indicators, namely ammoniacal nitrogen, chloride and boron, and conductivity, which are above background concentrations. Bore G1S has been considered as representative of background groundwater conditions for this report. The results indicate that nitrate-nitrogen concentrations have been gradually increasing since April 2019, however concentrations are still well below the LDW trigger value.

Deep (Gravel) Aquifer (Bores E1D, C2DD, E2D)

Leachate indicator parameters in samples from deep aquifer boreholes hydraulically down-gradient of the old landfill are close to background concentrations, as defined by G1D.

The median concentration of manganese exceeded the DWS NZ GV at bore C2DD but there were no other exceedances in the three deep aquifer bores. Concentrations for key indicators such as chloride and conductivity appeared to be elevated above those observed in 'background' bores.

Hokio Stream (Surface Water Sampling Locations: HS1A, HS1, HS2, HS3)

Nitrate-N concentrations exceeded the consent limit (ANZECC AE (95%) trigger values) at HS1, HS2, and HS3 during the reporting period.

The ANZECC AE (95%) trigger values were not exceeded for any other parameters during the reporting period.

Tatana Drain

Ammoniacal-N, BOD, and Nitrate-N concentrations all exceeded the ANZECC AE (95%) trigger values at all four sites (SW1, SW2, SW3 and SW4). Note that the new consent conditions require monitoring only at SW3 which is now called "TD1".

New Landfill and Irrigation Area (Bores D1, D2, D3r, D4, D5, D6, E1S, F1, F2, F3)

None of the applicable LDW trigger values were exceeded in the bores within the new landfill and irrigation area (up-gradient of the old landfill) during the 2019-2020 reporting period. Note that no irrigation of leachate has occurred on site since 2008.

Elevated nitrate nitrogen, chloride and conductivity levels were observed in bores located hydraulically up-gradient and down-gradient of the leachate pond.

Mass Loading Evaluation

Overall, the lower concentrations predicted in the 2019-2020 mass contaminant load assessment show general agreement with actual monitoring results obtained. While there appears to be a minor impact on Hokio Stream from leachate-impacted groundwater and surface water it is noted that the stream is also potentially impacted by upstream land uses.

Stormwater Impact Monitoring (Bores E1D, E1S, D2)

Groundwater samples from shallow aquifer bores located hydraulically up-gradient and down-gradient of the stormwater soakage area and across-gradient from the new landfill had relatively similar characteristics and were consistent with results for the background bore (G1S). This indicates that the shallow aquifer water quality is not being significantly affected by stormwater that may have been in contact with refuse. Similarly, results from the deep aquifer bore did not appear to show an impact from stormwater that may have been in contact with refuse.

Landfill Gas and Odour Monitoring

Methane, carbon dioxide, and oxygen were detected at low levels within selected monitoring bores, in each of the three (for methane and carbon dioxide) and four (for oxygen) monitoring rounds in the 2019-2020 monitoring period. Potential reasons for these detections could not be determined, due to a lack of available information.

Odour monitoring at the landfill boundary has been implemented in accordance with the Odour Management Plan. Six odour inspections were undertaken during the reporting period with no further action being considered necessary.

Monthly surface methane emission monitoring is required over all temporary and capped areas of the landfill and at the bio-filter. HDC is still to arrange such testing with Envirowaste.

There are a range of inspections and maintenance requirements for the bio-filter. HDC complies with some of these but still needs to implement a daily visual check of the bio-filter, as well as monitoring and recording the pH of the filter bed media and ensuring that the media is raked and loosened each quarter.

Collection of meteorological data from an on-site weather station has been undertaken through the reporting period. The current weather station records data every 15 minutes, though the consent requires this to be at 1-minute intervals.

Abbreviations

LDW	ANZECC 2000 Livestock Drinking Water
GVs	Guideline values
HRC	Horizons Regional Council
HDC	Horowhenua District Council
WWTP	Levin Wastewater Treatment Plant
MAVs	Maximum acceptable values
SVOC	Semi-volatile organic compounds
Stantec	Stantec New Zealand
VOC	Volatile organic compounds

Horowhenua District Council

Levin Landfill Annual Compliance Report July 2019 - June 2020 (as required by resource consents DP6009, DP6010, DP6011, and DP102259

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1. Introduction

1.1 Background

Levin Landfill has been operating on the Hokio Beach Road site for over 50 years. The current resource consents for the new lined and old un-lined landfills were granted in 2002 and have been subject to two reviews since then. The latest review commenced in 2015 and was concluded in December 2019.

As consent holder for the discharge permits related to the activities that occur at the Levin Landfill, the Horowhenua District Council (HDC) is required to prepare and submit an Annual Report to Horizons Regional Council (HRC). Stantec New Zealand (Stantec) has been commissioned to prepare the Annual Report for HDC.

Table 1-1 summarises the reporting requirements and indicates where in this report the required information may be accessed. Appendix A details the consent conditions[1] that require reporting on annually. This consent is the operative consent for this reporting period.

Table 1-1: Summary of Consent Reporting Requirements

Discharge Permit & Condition No.	General Description	Section in the Annual Report
DP 6009 – condition 8	Hazardous waste disposal	Section 16
DP 6009 – condition 14	Condition of the old landfill	Section 12
DP 6009 – condition 35	Forward Annual Report to the NLG	Not applicable
DP 6010 – condition 5	Groundwater, surface water and leachate environmental monitoring	Sections 4, 5, 6 and 10
DP 6010 – condition 11(d)	Contaminant mass load projections	Section 7
DP 6010 – condition 11(e)	Significance of contaminant mass load projections	Section 7
DP 6010 – condition 14	Refuse density	Section 11
DP 6010 – condition 15(f)	Remediation of the old landfill	Section 12
DP 6010 – condition 27	Leachate irrigation	Section 13
DP 6011 – condition 3	Odour investigations at landfill boundary	Section 9
DP 6011 – condition 4(a) and 7	Landfill gas monitoring in groundwater monitoring wells	Section 9
DP 6011 – condition 4(e), 4(g) and 7	Monthly methane surface monitoring of capped areas and bio-filter	Section 9
DP 6011 – condition 4(j)	Measure and record bio-filter parameters and maintain it	Section 9
DP 6011 – condition 4(p)	Meteorological data	Section 9
DP 102259 – condition 16	Stormwater monitoring	Section 8

[1] Reviewed consent conditions as finalised on 19 December 2019.

1.2 Scope

This report is for the reporting period of July 2019 to June 2020.

Stantec staff carried out an assessment of the monitoring results and have prepared this monitoring report.

Groundwater, surface water and gas sampling (of groundwater bores) is undertaken by Downer throughout the compliance year as required by the current consent conditions. Envirowaste is responsible for undertaking gas sampling across the landfill. Laboratory analyses have been undertaken by Eurofins ELS in Lower Hutt. ELS is an IANZ (International Accreditation New Zealand) approved laboratory for the tests conducted.

2. Context

2.1 Geology and Hydrogeology

Local geology consists of dune sands at the surface with a wedge of coastal sand deposits (which thicken towards the coast) interlaid with gravels beneath. The sands are generally uniform, grey-brown, fine to medium grained. The overlying topsoil comprises of dark grey and brown fine-grained sand.

Between the site and Hokio Stream there is an area of developed pasture which is underlain by peats of unknown thickness. In recent years the owner of this land has been progressively filling the area with cleanfill, levelling and re-planting. Towards the coast there are areas of swamp. Excavations carried out on a property west of the site on Hokio Beach Road showed at least one metre of peat containing large logs.

Depressions between dunes show evidence of being below the winter water table in some areas. These areas generally are underlain by organic silts, peats or silty sands. To the south of the site some depressions appear to be permanently below the water table.

Horizons Regional Council (HRC) hydrology staff have advised in the past that "the general confined groundwater flow direction is towards the west". A conceptual model of shallow groundwater in the general region of the landfill is shown in Figure 2-1. We recommend that a review of the groundwater flow directions around both landfill sites be undertaken to ensure that the interpretations based on this general understanding are still accurate.

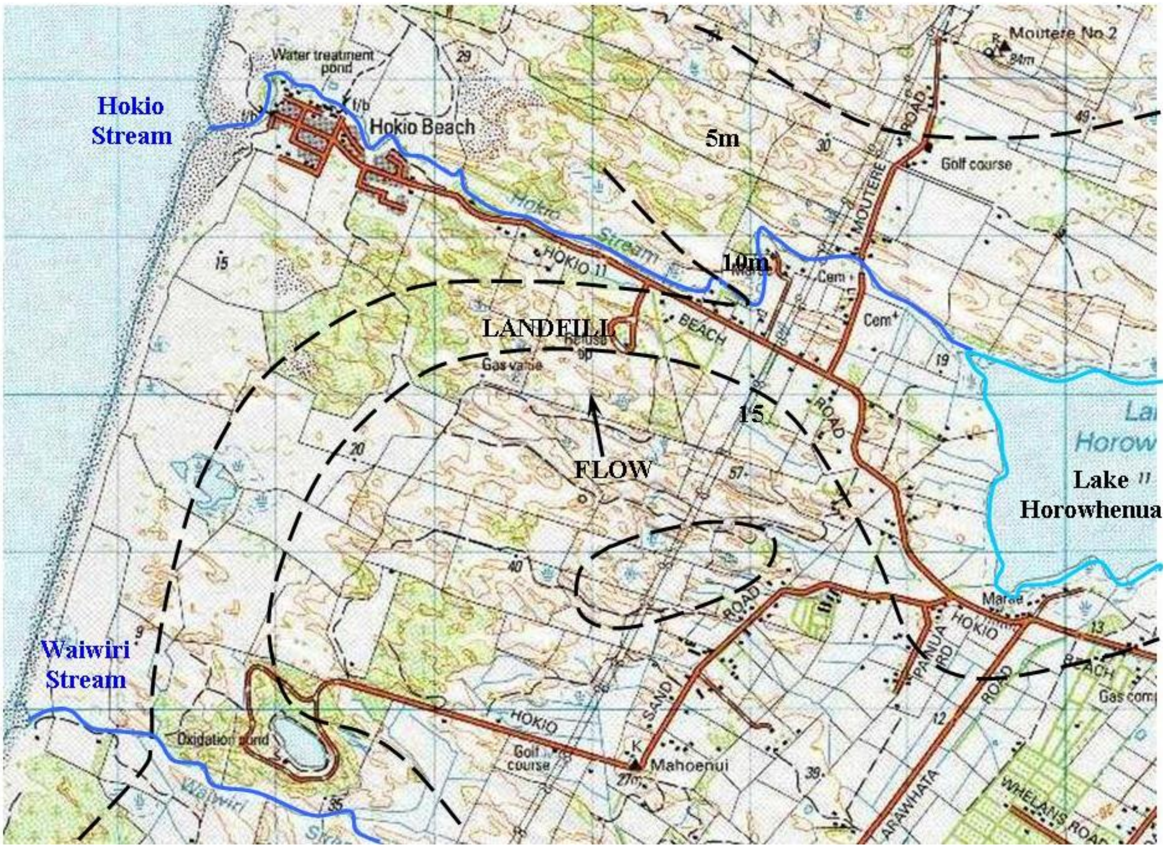


Figure 2-1: Shallow Groundwater Flow Direction

Shallow groundwater flow is in a northerly to westerly direction. Drainage patterns in the coastal strip are influenced by sand dune dominated topography. This considerably complicates the shallow groundwater flow pattern. While deeper aquifers will flow towards the coast, shallow groundwater flow will be affected by surface watercourses and topography.

The sand aquifer is shallow and has low to moderate permeability. It contains lenses of peat from swamps overlain by aeolian sand deposits.

There are a number of private bores within a 1.5km radius of the site. Sampling of groundwater on a private property was last undertaken in March 2014. The results were made available to the property owner and Horizons Regional Council.

2.2 Timeline for Landfill Development

Key milestones in the history of the Levin Landfill are outlined as follows:

- 1970s – Old landfill accepting municipal solid waste.
- 1994 – Commenced installation of groundwater monitoring bores.
- 2002 – Resource consents granted for old, unlined landfill and new landfill operations on the site.
- May 2004 – New landfill commenced operation with Stage 1A.
- 2004 – 2008 – Leachate irrigated on site.
- 2008 – Stage 2 is constructed.
- May 2008 – Leachate irrigation ceased.
- 2009 – 2010 – Resource consent review process.
- 2009 – Four new groundwater monitoring bores installed (G1D; G1S; G2S, and D3r, as a replacement for bore D3)

- 2013 – Stage 3A is constructed.
- 2015 – Stage 3B is constructed.
- 2015 – Initiation of resource consent review process.
- 2016 – Biofilter is installed.
- 2017 – Stage 3C is constructed.
- 2017 – Landfill gas flare is commissioned.
- 2019 – Finalisation of resource consent review process.

3. Monitoring Programme

The sampling programme carried out in the 2019-2020 monitoring period for discharge permits DP6009, DP6010 and DP102259 is summarised in the table in Appendix B.

Gas monitoring is carried out in July, October, January, and April each year at the groundwater bore locations, as per consent DP 6011.

Additional gas emission sampling is carried out on the surface of the landfill, as per consent DP 6011.

Since January 2010 water from the boreholes has been tested for dissolved nutrients and metals rather than total concentrations. For simplicity, results from monitoring prior to January 2010 (when samples were tested for total metal and nutrient concentrations) have not been compared to the results from January 2010 onwards. (Refer to the Site Plan in Appendix C for borehole locations).

3.1 Interpretation of Median Values and Ranges

The monitoring data collected over the 2019-2020 period covered by this report are typically analysed in terms of median values, in comparison with the relevant guidelines or trigger values identified in the applicable discharge consent. It is important to note that due to the sampling programme schedule (Appendix B), some monitoring locations are sampled only once or twice each year (i.e. annual or 6-monthly sampling) for specific parameters. In these cases, a single result or range has been presented for comparison with guidelines/trigger values, rather than a calculated median. This is because it is inappropriate to calculate median values where there are less than three data points available. Sampling frequencies for all parameters at each monitoring location have been included in the reporting tables, to provide context for the results and interpretation of trends.

3.2 Note regarding Interpretation of Non-Detected Results

For those chemical constituents which were found to be present in concentrations below laboratory detection limits during the reporting period, the results have been analysed at 50% of the laboratory limit, and a median calculated on this basis. This is standard practice when dealing with chemical concentrations in water. However, the same rule cannot be applied for faecal coliforms in the context of the Levin Landfill.

The laboratory detection limit for faecal coliforms is 4 CFU/100mL. As the resource consent requires that groundwater results for faecal coliforms be compared against the NZ Drinking Water Standard (NZDWS; for compliance), which is NIL (i.e., 0 CFU/100mL), we have indicated whether faecal coliforms have or have not been detected, rather than calculating a median as we would for chemical constituents (described above). This method has been applied in all instances where faecal coliforms are assessed for compliance with the NZDWS.

4. Groundwater Monitoring

4.1 Monitoring Rationale

From 1994 onwards 20 groundwater monitoring bores were installed at the Levin Landfill site to determine:

1. The background groundwater quality

2. The direction of groundwater flow

3. Groundwater quality down-gradient of each of the two landfilling areas and other activities on site, such as the discontinued leachate irrigation area and the leachate pond.

No monitoring has been carried out within the old unlined landfill footprint. Measurement of actual effects at various distances down-gradient of the landfill and comparison with background groundwater quality provides the most relevant information to assess effects of the landfill on groundwater quality.

Leachate from the old unlined landfill migrates in a downward direction and will mix with groundwater which flows beneath the landfill area. The chemical composition of the groundwater is expected to be affected to a greater degree immediately down-gradient (hydraulically) of the old unlined landfill due to cumulative leachate loading.

The results of the 2019-2020 compliance year have been discussed in the following sections and have been grouped based on groundwater depth. Shallow bores have also been grouped by their location relative to the old unlined landfill and new lined landfill.

4.2 Description of Monitoring Bores

A Site Plan showing the location and depth of the monitoring bores has been included in Appendix C. The following description of the spatial relationship between the bores and the landfill areas is based on the assessment of groundwater movement performed in 2011. It is recommended that the groundwater flow around the site is reviewed to confirm that the understanding provided here remains accurate.

Deep Bores

Bore G1D is located hydraulically up-gradient of both the old and new landfills in the deep aquifer. The bore at the southeast corner of the site indicates background shallow groundwater quality. Deep aquifer bore E1D is located to the west of the old, closed landfill, and deep aquifer bores C2DD and E2D are located hydraulically down-gradient from both the closed landfill and the new operational landfill.

Shallow Bores

Bore G1S is located hydraulically up-gradient of both the old and new landfills in the shallow aquifer. The bore at the southeast corner of the site indicates background shallow groundwater quality.

Bores D1, D2, D3r, D6 and E1S are located hydraulically up-gradient of the old unlined landfill. Therefore, they represent groundwater uninfluenced by leachate from the old landfill. These boreholes are located hydraulically down-gradient of the new landfill and irrigation areas. The new landfill is lined and has a leachate collection system which significantly reduces the potential for leachate to enter groundwater. Bores D4 and D5 are across or hydraulically up-gradient of the new lined landfill and the old, closed landfill and are away from any areas irrigated between 2004 and 2008. Sampling from D4 and D5 began in December 2004.

Bore F1 is located hydraulically down-gradient of the area where leachate from the lined landfill was irrigated in the south-east of the site. Bores F2 and F3 are in the vicinity of areas originally planned for leachate irrigation. It is understood that irrigation did not occur on the western side of the site and hence these bores could be used to represent background groundwater quality. This should be assessed in the next monitoring period. Leachate has not been irrigated at the site since May 2008 and it is now pumped to the Levin Wastewater Treatment Plant (WWTP) and is unlikely to be irrigated in future. Given that this irrigation has not occurred over the past 12 years, the F-series bores are used as across-gradient bores for the lined landfill.

Bores B1, B2 and B3 are located on a line parallel to the northern-most extent of tipping for the unlined old landfill (refer to Site Plan, Appendix C). They are all within 50 metres of the old unlined landfill. The B series bores are on the down-gradient edge of the old landfill, with the age of adjacent fill reducing from sample location B1 to B3. Bore B3 is located in the swampy area and, in the 2013 annual report, was suspected to be inadequately sealed because of high faecal coliform counts. However, the results for faecal coliforms at B3 have been stable since January 2016.

The C series bores are located further hydraulically down-gradient from the old unlined landfill towards Hokio Beach Road (refer to Site Plan, Appendix C). Bore C1 is located hydraulically down-gradient of bore B1. It is adjacent to a peaty swamp area, which may affect its water quality. Bore C2 is located in the vicinity of bores B2 and B3 but further hydraulically down-gradient of the old unlined landfill. It is located hydraulically down-gradient of a swampy area, which may also affect groundwater quality in this bore.

Bore C2DS which is also down gradient of the old unlined landfill is screened deeper than the other shallow bores within the coastal sands although an influence from recharge through peats is still possible.

Bore E2S is located northwest of the old landfill to detect if there is any groundwater which contains leachate moving directly towards the nearest houses downstream of the site. This bore is across gradient to the west of the B and C series bores which are within the known plume.

Bore G2S was installed in late 2009 and is located to the north hydraulically down-gradient of the old landfill by Hokio Beach Road and the entrance road to the landfill.

4.3 Background Groundwater Results

Groundwater is collected from two background bores (G1S and G1D) situated hydraulically up-gradient from the new and old landfills to the southeast of the site (See Site Plan, Appendix C). These two bores were constructed in late 2009 to enable groundwater samples to be collected from the shallow and deep aquifers. Both bores were first sampled in January 2010. Results from bores F2, F3 and D5 can also be used to characterise background shallow groundwater quality.

The water quality results (medians) for the 2019-2020 sampling year from these background bores are presented in Table 4-1. Results for key indicators have been coloured to highlight more elevated values (with colour intensity increasing with concentration), to assist in identifying areas with potential contamination issues spatially across the site (i.e., west to east).

Water quality from the natural background water hydraulically up-gradient from the landfill site is not subject to any water quality limits in the existing resource consent. However, for comparison purposes, both the ANZECC Livestock Drinking Water trigger values and the Drinking Water Standards of New Zealand (DWSNZ) maximum acceptable values (MAVs) and guideline values (GVs) for aesthetic determinants were used to benchmark the quality of water up-gradient from the landfill site.

Table 4-1: Background monitoring bores median or singular results (2019-2020 monitoring period)

Determinant	Units	DWSNZ (MAV)	ANZECC LDW	No. of samples per site	D5	F2	F3	G1S	G1D
Leachate indicators									
Ammoniacal-N	mg/L	1.17		4	0.005	0.005	0.005	0.045	0.1
Boron	mg/L	1.4	5	4	0.0225	0.035	0.015	0.015	0.045
Chloride	mg/L	250*		4	29.4	23	17.4	216	31.5
Conductivity	mS/m			4	29.65	22.4	19.9	101.8	28.15
Faecal coliforms	CFU/100mL	NIL	100	4	4	ND	ND	16	ND
pH	-	7 to 8.5*	6 to 9	4	7.3	7.25	7.25	**6.55**	7.2
Suspended Solids	mg/l			1	2.5	3	3	2.5	2.5
Phenol	mg/l			1	0.025	0.025	0.025	0.025	0.025
VFA	mg/L			1	2.5	2.5	2.5	2.5	2.5
TOC	mg/L			1	2	1.6	1.3	38.4	2
Alkalinity	mg CaCO3/L			1	63	53	53	58	59
COD	mg/l			4	7.5	7.5	7.5	78.5	7.5
BOD	mg/L			1	0.5	0.5	0.5	0.5	0.5
Nitrate-N	mg/L	11.3	90.3	4	1.26	0.64	1.355	0.055	0.005
Sulphate	mg/L	250*	1000	1	21	8.97	7.03	33.8	20.1
Hardness	mg $CaCO_3$/L	200*		1	64	37	34	59	50
Calcium	mg/L		1000	1	11.1	6.01	5.18	11.1	7.83
Magnesium	mg/L			1	8.86	5.41	5.08	7.61	7.51
Potassium	mg/L			1	7.83	5.45	5.11	5.93	6.27
Sodium	mg/L	200*		4	32.75	24.25	21.3	134	32

Determinant	Units	DWSNZ (MAV)	ANZECC LDW	No. of samples per site	D5	F2	F3	G1S	G1D
DRP	mg/L			1	0.096	0.148	0.143	0.038	0.03
Aluminium	mg/L	0.1*	5	4	0.001	0.002	0.001	0.067	0.001
Arsenic	mg/L	0.01	0.1	1	0.001	0.002	0.002	0.002	0.003
Cadmium	mg/L	0.004	0.01	1	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium	mg/L	0.05	1	1	0.001	0.0005	0.0005	0.001	0.0005
Copper	mg/L	2	0.4#	1	0.0009	0.0013	0.0005	0.0086	0.00025
Iron	mg/L	0.2*		4	0.055	0.005	0.005	**6.03**	**0.57**
Lead	mg/L	0.01	0.1	4	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L	0.4		4	0.0155	0.00335	0.00025	0.156	0.06475
Mercury	mg/L			1	0.00025	0.00025	0.00025	0.00025	0.00025
Nickel	mg/L	0.08	1	4	0.00025	0.00025	0.00025	0.00115	0.00025
Zinc	mg/L	1.5*	20	1	0.001	0.002	0.001	0.003	0.001

Note: * denotes guideline values for aesthetic determinants (G.V.), # copper trigger values range from 0.4 mg/L for sheep, up to 5 mg/L for poultry. "ND" indicates where faecal coliforms were not detected.

Bold red text – denotes an exceedance of the relevant DWSNZ standard. **Underlined** – denotes an exceedance of the ANZECC (2000) Livestock Drinking Water (LDW) trigger values.

Where the number of samples collected was 3 or 4, a median of all samples for the monitoring period is reported. Otherwise, the singular result (from the only sample collected) or a range (for two results) is reported.

For the 2019-2020 monitoring period the median pH from the samples taken from the shallow borehole (G1S) was below the DWSNZ GV range of 7 to 8.5, at 6.55 pH units. The pH recorded in this bore has been consistently low since monitoring began in 2010. The median pH values for the deeper borehole (G1D) and boreholes F2, F3 and D5 were within the DWSNZ range and the LDW trigger value range.

The DWSNZ GV (250 mg/L) for sulphate was not exceeded at G1D and G1S as it was during the January 2019 monitoring round. This represents the average trend observed at these sites and the results of the January 2019 sampling round have been considered as an anomaly.

For the 2019-2020 monitoring period the iron concentrations at G1D continued to fluctuate above the DWSNZ GV; this trend is consistent with historical data. The median iron concentration at G1S was well above the DWSNZ GV, at 6.03 mg/L (compared with the DWSNZ GV of 0.2 mg/L). This is lower than the previous monitoring period 2018-2019 which reported an Iron concentration of 13.1 mg/L at G1S.

The faecal coliform count in the shallow (G1S) bore was elevated at 16 CFU/100 mL while the deep (G1D) background bores returned a non-detectable level for this monitoring period. None of the detect levels exceeded the ANZECC LDW. It is important to note that this result may be misleading due to faecal coliforms only being detected at one site, and therefore swaying the median value to possibly misrepresent the average.

Key leachate parameters chloride and ammoniacal nitrogen recorded results below the relevant guideline values. The concentration of ammoniacal nitrogen within G1D has remained reasonably consistent in recent years with slightly higher concentrations recorded in bore G1D compared to G1S. In contrast, chloride concentrations have remained low and relatively consistent in bore G1D, while concentrations in bore G1S began increasing in 2018 and have remained significantly elevated. It is not clear what is causing the increase in chloride concentrations in a bore which is screened upgradient of both landfills and is expected to represent typical background concentrations.

4.4 Shallow Groundwater Results

This section discusses groundwater quality hydraulically up and down-gradient of the old unlined landfill footprint in the shallow unconfined aquifer (referred to as the ‘sand aquifer’). The D-series, F-series, E1S and G1S bores are all hydraulically up-gradient of the old landfill. In addition, bores D1, D2, D3r, D6 and E1S are hydraulically upgradient of the old unlined landfill but down-gradient of the new lined landfill. These bores can therefore be used as ‘early detection’ bores for leachate breakouts from the new landfill. D1 and D6 bores are also located down-gradient of the leachate pond and therefore may provide some indication of leachate leaks from the pond.

The B-series, C-series, E2S and G2S bores are all hydraulically down-gradient of the old landfill and are therefore used to assess the impact from the old unlined landfill on groundwater.

The resource consent requires results from these bores to be compared against the ANZECC 2000 Livestock Drinking Water (LDW) trigger values. The results from the 2019-2020 monitoring period for these bores are presented in Table 4-2 along with the shallow background bore results (G1S – from Table 4-1). Results for key indicators have been coloured to highlight more elevated values (with colour intensity increasing with concentration), to assist in identifying areas with potential contamination issues spatially across the site (i.e. west to east, and down-gradient to up-gradient).

A complete table of results for the bores over the last 10 years is presented in Appendix D.

4.4.1 Groundwater Quality Hydraulically Up-Gradient of the Old Landfill

Bores hydraulically up-gradient of the old landfill include bores which are down-gradient of the new landfill. These bores have been highlighted with bold text in Table 4-2 below.

None of the applicable ANZECC LDW trigger values were exceeded at groundwater bores up-gradient of the old landfill during the 2019-2020 reporting period. The results do not indicate that leachate from the new lined landfill is impacting on groundwater down-gradient of the landfill.

Concentrations of ammoniacal-N have been consistently elevated within bore D2 when compared to background bore G1S since monitoring began in both bores. Since 2015 there appears to be a slight increasing trend, and this should continue to be tracked. The D2 bore is located down-gradient of the new landfill and therefore elevated concentrations of key leachate indicator parameters such as ammoniacal-N could indicate a break-out of leachate. It is noted however that the concentration of ammoniacal-N has been consistently elevated since monitoring began in 1997, seven years before the new landfill began operation.

Bores D1 and D6 are both down-gradient of the leachate pond and have recorded increasing concentrations of nitrate-N since 2008. The increasing concentrations observed are discussed further in Section 4.6.

Bore F1 is located down-gradient of the leachate irrigation area. Irrigation ceased in 2008 and therefore it is considered unlikely the slightly elevated concentrations of DRP observed are as a result of the discharge of leachate to land in this area. The concentration of DRP recorded in this bore has been consistent since 2007.

Table 4-2: Groundwater hydraulically up-gradient of Old Landfill and down-gradient of new landfill: median or singular results (2019-2020 monitoring period)

Determinant	Units	ANZECC LDW	No. of samples per site	D5	**E1S**	D4	**D3r**	**D2**	**D6**	**D1***	F1	G1S
Leachate indicators												
Ammoniacal-N	mg/L		4	0.005	0.175	0.215	0.17	0.475	0.005	0.005	0.005	0.045
Boron	mg/L	5	4	0.0225	0.0225	0.035	0.03	0.045	0.05	0.05	0.03	0.015
Chloride	mg/L		4	29.4	29.85	47.25	21.75	34.05	18.05	36.1	50.3	216
Conductivity	mS/m		4	29.65	26.8	31.4	22	34.15	34.55	51.9	45	101.8
Faecal coliforms	CFU/100mL	100	4	4	ND	ND	ND	20	240	4	ND	16
pH	-	6 to 9	4	7.3	7.05	7.1	6.9	6.45	7.05	6.8	7.7	6.55
Suspended Solids	mg/l		1	2.5	7	5	3	17	2.5	No data	2.5	2.5
Phenol	mg/l		1	0.025	0.025	0.025	0.025	0.025	0.025	No data	0.025	0.025
VFA	mg/L		1	2.5	2.5	2.5	2.5	2.5	2.5	No data	2.5	2.5
TOC	mg/L		1	2	5.2	2.4	3.1	13.2	1	No data	5.5	38.4
Alkalinity	mg CaCO3/L		1	63	68	55	56	109	73	No data	131	58
COD	mg/l		4	7.5	7.5	7.5	7.5	33.5	7.5	7.5	11.75	78.5
BOD	mg/L		1	0.5	0.5	0.5	0.5	1.5	0.5	No data	0.5	0.5
Nitrate-N	mg/L	90.3	4	1.26	0.005	0.005	0.185	0.0275	14.3	11.5	1.505	0.055
Sulphate	mg/L	1000	1	21	9.1	12.5	6.96	0.01	4.34	No data	5.24	33.8
Hardness	mg CaCO3/L		1	64	59	62	34	87	95	No data	125	59
Calcium	mg/L	1000	1	11.1	11	11	6.81	15.4	18	No data	18.3	11.1
Magnesium	mg/L		1	8.86	7.62	8.39	4.19	11.8	12.3	No data	19.2	7.61
Potassium	mg/L		1	7.83	6.22	6.62	4.9	7.1	8.16	No data	8.95	5.93
Sodium	mg/L		4	32.75	24.35	31.95	23.2	23.2	25.75	23.5	34.55	134
DRP	mg/L		1	0.096	0.053	0.016	0.015	0.038	0.101	No data	0.172	0.038
Aluminium	mg/L	5	4	0.001	0.004	0.001	0.0015	0.009	0.002	0.006	0.001	0.067

Determinant	Units	ANZECC LDW	No. of samples per site	D5	**E1S**	D4	**D3r**	**D2**	**D6**	**D1***	F1	G1S
Arsenic	mg/L	0.1	1	0.001	0.002	0.004	0.011	0.001	0.001	No data	0.002	0.002
Cadmium	mg/L	0.01	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	No data	0.0001	0.0001
Chromium	mg/L	1	1	0.0005	0.0005	0.0005	0.0005	0.001	0.0005	No data	0.0005	0.001
Copper	mg/L	0.4#	1	0.0009	0.0006	0.00025	0.00025	0.00025	0.0057	No data	0.003	0.0086
Iron	mg/L		4	0.055	4.425	1.1705	2.905	11.97	0.005	0.02	0.005	6.03
Lead	mg/L	0.1	4	0.00025	0.000375	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		4	0.0155	0.2305	0.178	0.1845	0.3155	0.000575	0.005	0.0037	0.156
Mercury	mg/L		1	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	No data	0.00025	0.00025
Nickel	mg/L	1	4	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00115
Zinc	mg/L	20	1	0.001	0.001	0.001	0.001	0.005	0.004	No data	0.001	0.003

Note: **Bold** – denotes an exceedance of the ANZECC (2000) Livestock Drinking Water trigger values. # copper trigger values range from 0.4 mg/L for sheep, up to 5 mg/L for poultry.

Where the number of samples collected was 3 or 4, a median of all samples for the monitoring period is reported.

"ND" indicates where faecal coliforms were not detected. *Faecal coliforms were detected in a single sample at bore D2 (in January 2019) – this single result is reported rather than a median.

"No data" is where we have no data for those determinants.

*D1 had 3 samples per site

The counts for faecal coliforms should be used with caution as a high result for one sample will appear misleading as the other samples were not detected.

4.4.2 Groundwater Quality Hydraulically Down-Gradient of the Old Irrigation Area

Given that irrigation has not occurred over the past 12 years, the F-series bores are used as across-gradient bores for the lined landfill. The monitoring record for these bores has been assessed in the previous sections (Section 4.3 (Bores F2 and F3) and Section 4.4.1 (Bore F1)).

The water quality results for the F series bores are similar to those observed for background shallow groundwater quality, hydraulically up-gradient of the old landfill. Leachate indicators (conductivity, boron, chloride, and ammoniacal nitrogen) are not elevated in these bores; this is as expected since no irrigation of leachate has occurred on the site since 2008.

4.4.3 Leachate

The leachate pond has not been used to store leachate for several years. The leachate pumping system has been connected so that leachate is pumped to a manhole next to the leachate pond from where it is pumped to the Levin Wastewater Treatment Plant. Samples of leachate are now taken directly from the manhole next to the leachate pond.

The monitoring results for the leachate are **not subject to any specific guidelines or trigger values in the resource consent**. However, typical leachate characteristics for Class 1-type landfills published by the Waste Management Institute of New Zealand (*Technical Guidelines for Disposal to Land*, August 2018, WasteMINZ) have been included to contextualise the observed state of the leachate (Table 4-3).

Table 4-3: Median or range of results for Leachate (2019-2020 monitoring period)

Determinant	Units	Typical Leachate Characteristics*	No. of samples	Leachate
Leachate indicators				
Ammoniacal-N	mg/L	3.4 -1,440	6	1220
Boron	mg/L	0.54 – 20.1	6	5.83
Chloride	mg/L	45 – 2,584	6	1080
Conductivity	mS/m	308 – 27,900	6	1425
Faecal coliforms	CFU/100mL	-	6	98
pH	-	5.9 - 8.5	6	7.8
Suspended Solids	mg/l	-	4	60
Phenol	mg/l	-	4	0.05
VFA	mg/L	-	4	5.45
TOC	mg/L	17.2 - 822	4	713
Alkalinity	mg CaCO3/L	264 – 6,820	4	6075
COD	mg/l	84 – 5,090	6	2245
BOD	mg/L	12 – 3,867	4	89.5
Nitrate-N	mg/L	-	6	0.55
Sulphate	mg/L	1 - 780	4	147.75
Hardness	mg CaCO3/L	-	4	515.5
Calcium	mg/L	20 – 600***	4	106
Magnesium	mg/L	40 – 350***	4	58.65
Potassium	mg/L	10 – 2,500**	4	601.5
Sodium	mg/L	50 – 4,000**	6	909.5

Determinant	Units	Typical Leachate Characteristics*	No. of samples	Leachate
DRP	mg/L	-	4	9.375
Aluminium	mg/L	-	6	0.4065
Arsenic	mg/L	0.005 – 1.60**	4	0.35
Cadmium	mg/L	0.0005 – 0.140**	4	0.00055
Chromium	mg/L	0.005 – 50.4	4	0.4525
Copper	mg/L	0.004 – 1.40**	4	0.00585
Iron	mg/L	1.6 - 220	6	4.56
Lead	mg/L	0.001 – 0.42	6	0.002
Manganese	mg/L	0.03 – 45***	6	1.1
Mercury	mg/L	0.2 – 50***	3	0.0004
Nickel	mg/L	0.02 – 2.05**	6	0.115
Zinc	mg/L	0.009 – 24.2	4	0.0535

Notes: *for Class 1-type landfills, Table 5-5, p82, Technical Guidelines for Disposal to Land, WasteMINZ August 2018 (same as Table 4.2 of the CAE Landfill Guidelines 2000, but corrections made to Table 5-5 in line with Table 4.2).
**Data taken from Table 5-4, p81 of the same guideline, for determinants for which no differences in concentrations between the phases of landfill development could be observed in the table.
***Data taken from Table 5-4, p81 of the same guideline, for determinants during the methanogenic phase.
Where three or more samples of leachate were collected (i.e., for determinants monitored quarterly), a median of all samples for the monitoring period is reported. Otherwise, the range of results (from the two samples collected) is reported.

The median results (or observed ranges) for leachate were all within the typical leachate composition range for Class 1 landfills published in the *Technical Guidelines for Disposal to Land* (WasteMINZ 2018), except for mercury (in bold), which was below the lower range (0.2 mg/L) with a concentration of 0.0004 mg/L.

Samples of leachate were collected and analysed for volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC) in April 2019.

Five SVOCs and seven VOCs were detected from the samples and compared against the relevant ANZECC guidelines in Table 4-4 below. Of these 12 results, only two (carbofuran and diazinon) exceeded the guideline values at the 80th and 90th percentile respectively and are shown in **bold** print.

Table 4-4: SVOCs and VOCs detected in samples of leachate, 2019-2020

Determinant	Laboratory detection limit (from Eurofins-ELS) mg/L	Detected concentration (mg/L) **Q4 (April 2020)**	ANZECC 2000 default guideline value(s) for toxicants (*percentile for species protection in brackets*) (mg/L)	Common source/usage of determinant (from relevant ANZECC 2000 Volume 2, Section 8.3.7 technical briefs)
SVOCs				
Carbofuran	0.001	**0.030**	0.00006 (99th percentile) 0.0012 (95th percentile) 0.004 (90th percentile) 0.015 (80th percentile)	Insecticides applied to fruit, vegetable, and cereal crops.
Metribuzin	0.0001	0.0004	Not defined	No brief available
Diazinon	0.0001	**0.0005**	0.00000003 (99th percentile) 0.00001 (95th percentile) 0.0002 (90th percentile) 0.02 (80th percentile)	A phosphorothioate OP pesticide, commonly used on a variety of crops and animals (farm and pets) to control insects, mites, and flies. It is also used for pest control in a wide range of situations.
Naphthalene	0.0001	0.0025	0.0025 (99th percentile) 0.016 (95th percentile) 0.037 (90th percentile) 0.085 (80th percentile)	A Polycyclic Aromatic Hydrocarbon (PAH) found in runoff from road surfaces; generally produced from anthropogenic combustion processes
Pyrene	0.0001	0.0001	Not defined	No brief available
VOCs				
Naphthalene	0.0005	0.0030	0.0025 (99th percentile) 0.016 (95th percentile) 0.037 (90th percentile)	As described above

Determinant	Laboratory detection limit (from Eurofins-ELS) mg/L	Detected concentration (mg/L) Q4 (April 2020)	ANZECC 2000 default guideline value(s) for toxicants (*percentile for species protection in brackets*) (mg/L)	Common source/usage of determinant (from relevant ANZECC 2000 Volume 2, Section 8.3.7 technical briefs)
			0.085 (80th percentile)	
Benzene	0.0013	0.0025	Not defined	No brief available
Chlorobenzene	0.0011	0.0018	Not defined	No brief available
cis-1,2-Dichloroethene	0.0005	ND	Not defined	No brief available
n-Butylbenzene	0.0005	ND	Not defined	No brief available
o-Xylene	0.0005	0.0144	0.2 (99th percentile) 0.35 (95th percentile) 0.47 (90th percentile) 0.64 (80th percentile)	Hydrocarbon; used in aviation fuel and polyester manufacture.
p-Isopropyltoluene	0.0005	ND	Not defined	No brief available
Styrene	0.0005	0.0098	Not defined	No brief available
tert-Butylbenzene	0.0005	ND	Not defined	No brief available
Toluene	0.0005	0.0052	0.18	Hydrocarbon; fuel additives (vehicles)
Total p,m Xylene, Ethylbenzene	0.0015	0.0154	Not defined	No brief available

Note: 'ND' indicates where a determinant was not detected in a sample.

4.4.4 Groundwater Quality Hydraulically Down-Gradient of the Old Landfill

Water sampling was carried out to characterise the groundwater quality in a series of shallow bores situated hydraulically down-gradient of the old landfill.

Results for all parameters were below the ANZECC Livestock Drinking Water trigger values in the 2019-2020 monitoring period, and therefore the hydraulically down-gradient bores **complied with the resource consent conditions**. Results for key indicators in Table 4-5 have been coloured to highlight more elevated values (with colour intensity increasing with concentration), to assist in identifying areas with elevated contaminant concentrations indicating the presence of the leachate plume from the old landfill spatially across the site (i.e., west to east).

Elevated concentrations were observed as follows:

- Leachate indicators (boron, chloride, ammoniacal-N and conductivity) were more elevated in the western-most down-gradient bores (B3 and C2) but not in bore E2S.
- The concentrations often varied significantly between the bores, though bores E2S and G1S were consistently lower than the other results. This indicates the leachate plume is not moving directly towards the nearest houses downstream of the site.

Selected down-gradient bores were also analysed for volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC) in April 2020. The following substances were detected (with bore locations in parentheses):

- Carbofuran (B3, C2DS)
- Bis(2-ethylhexyl)adipate (B1)

- 1,2,4-Trimethylbenzene (B3, B2)
- 1,3,5-Trimethylbenzene (B3)
- Benzene (B3, C2, B2)
- Isopropylbenzene (B3, B2)
- Sec-Butylbenzene (B3, B2, B1)
- 1,2-Dichloroethane (B3, B2, B1)
- 1,2-Dichlorobenze (B2)
- 1,3-Dichlorobenze (B3, B2)
- Cis-1,2-Dichloroethene (B3)
- 1,4-Dichlorobenze (B2)
- Chlorobenzene (B3, B2)

The range of concentrations detected at each location are detailed in Table 4-6. The ANZECC 2000 guideline for toxicants (90^{th} percentile species protection) was exceeded at bore C2DS, for carbofuran.

Table 4-5: Median or singular result for hydraulically down-gradient groundwater monitoring bores (2019-2020 monitoring period) – *bores listed L to R (west to east)*

Determinant	Units	ANZECC LDW	No. of samples	E2S	B3	C2	C2DS	B2	C1	B1	G2S	G1S
Leachate indicators												
Ammoniacal-N	mg/L		4	0.25	142	163	1.625	44.65	0.585	8.79	0.015	0.045
Boron	mg/L	5	4	0.05	1.285	1.83	0.88	1.195	0.595	0.6	1.065	0.015
Chloride	mg/L		4	41.2	178	430	124.5	108.85	248	211	325	216
Conductivity	mS/m		4	44.65	279	322	174	182.5	135	145	188	101.8
Faecal coliforms	CFU/100mL	100	4	ND	ND	8	ND	28	ND	30	ND	16
pH	-	6 to 9	4	7.65	7.05	7.05	6.7	6.8	6.65	7	6.95	6.55
Suspended Solids	mg/l		1	2.5	74	516	52	9	40	3	8	2.5
Phenol	mg/l		1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
VFA	mg/L		1	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
TOC	mg/L		1	2.9	70.6	45.6	32	31.7	16.6	22.8	15.6	38.4
Alkalinity	mg CaCO3/L		1	146	1180	818	716	723	249	624	427	58
COD	mg/l		4	7.5	181.5	134	93	79.5	73	64.5	61	78.5
BOD	mg/L		1	0.5	3	3	3	0.5	1	0.5	0.5	0.5
Nitrate-N	mg/L	90.3	4	0.005	0.05	0.05	0.05	32.55	0.005	8.305	0.005	0.055
Sulphate	mg/L	1000	1	0.01	0.01	42.3	0.01	8.85	32.6	2.85	5.86	33.8
Hardness	mg CaCO3/L		1	119	509	277	589	546	306	670	304	59
Calcium	mg/L	1000	1	26	89.7	54.7	134	117	52.2	122	61	11.1
Magnesium	mg/L		1	13	69.2	34	61.7	61.6	42.6	88.9	36.8	7.61
Potassium	mg/L		1	6.46	91.5	91.5	16.7	57.6	16.7	29.9	25.5	5.93
Sodium	mg/L		4	42.2	146.5	231	111.5	101.3	144	126.5	248	134
DRP	mg/L		1	0.621	0.031	0.013	0.122	0.021	0.011	0.105	0.018	0.038

Determinant	Units	ANZECC LDW	No. of samples	E2S	B3	C2	C2DS	B2	C1	B1	G2S	G1S
Aluminium	mg/L	5	4	0.001	0.004	0.021	0.001	0.011	0.0075	0.0045	0.002	0.067
Arsenic	mg/L	0.1	1	0.001	0.035	0.002	0.003	0.006	0.0005	0.001	0.0005	0.002
Cadmium	mg/L	0.01	1	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium	mg/L	1	1	0.0005	0.005	0.002	0.0005	0.001	0.0005	0.0005	0.0005	0.001
Copper	mg/L	0.4#	1	0.00025	0.0007	0.0017	0.00025	0.0031	0.0008	0.0094	0.001	0.0086
Iron	mg/L		4	0.0385	0.885	0.555	14.825	0.431	2.94	0.02	0.1	6.03
Lead	mg/L	0.1	4	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		4	0.3875	3.845	0.0587	2.86	3.285	0.3665	7.4	0.189	0.156
Mercury	mg/L		1	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Nickel	mg/L	1	4	0.00025	0.01035	0.0041	0.00245	0.00195	0.0008	0.0016	0.004	0.00115
Zinc	mg/L	20	1	0.003	0.001	0.009	0.001	0.004	0.001	0.005	0.006	0.003

Note: **Bold red text** – denotes an exceedance of the ANZECC (2000) Livestock Drinking Water trigger values. Where the number of samples collected was 3 or 4, a median of all samples for the monitoring period is reported. Otherwise, the singular result (from the only sample collected) or a range (for two results) is reported.

*Faecal coliforms were detected in one of the two samples collected in the reporting period at both C1 and C2. In these cases, the single detected result is reported rather than a median.

"ND" indicates where faecal coliforms were not detected.

Table 4-6: SVOCs and VOCs detected in samples from down-gradient groundwater bores, 2019-2020

Determinant	Laboratory detection limit (from Eurofins-ELS) mg/L	ANZECC 2000 DGV (mg/L)*	Detected concentrations at down-gradient bores (mg/L)					Common source/usage of determinant (from relevant ANZECC 2000 Volume 2, Section 8.3.7 technical briefs)
			B3	C2	C2DS	B2	B1	
SVOCs								
Alachlor	0.0001	Not defined	*ND*	ND	ND	ND	ND	Not available
Carbofuran	0.001	0.00006 (99th percentile) 0.0012 (95th percentile) 0.004 (90th percentile) 0.015 (80th percentile)	**0.011**	ND	***<u>0.004</u>***	ND	ND	Insecticides applied to fruit, vegetable and cereal crops
Bis(2-ethylhexyl)adipate	0.0001	Not defined	ND	ND	ND	ND	0.0001	Not available
VOCs								
1,2,4-Trimethylbenzene	0.0005	Not defined	0.0008	ND	ND	*0.0005*	ND	Not available
1,3,5-Trimethylbenzene	0.0005	Not defined	0.0007	ND	ND	*ND*	ND	Not available
Benzene	0.0005	0.6 (99th percentile) 0.95 (95th percentile) 1.3 (90th percentile) 2.0 (80th percentile)	0.0015	0.0011	ND	*0.0011*	ND	Hydrocarbons in solvents (adhesives, resins, inks, cleaners, degreasers) as well as paints and lacquers.
Isopropylbenzene	0.0005	Not defined	0.0008	ND	ND	0.0006	ND	Not available
Sec-Butylbenzene	0.0005	Not defined	0.0007	ND	ND	0.0007	0.0007	Not available
Styrene	0.0005	Not defined	ND	ND	ND	ND	ND	Not available
Toluene	0.0005	0.18	ND	ND	ND	ND	ND	Hydrocarbon; fuel additives (vehicles)
1,2-Dichloroethane	0.0005	Not defined	0.0009	ND	ND	0.0007	0.0006	Not available
1,2-Dichlorobenze	0.0005	0.120 (99th percentile) 0.160 (95th percentile) 0.200 (90th percentile) 0.270 (80th percentile)	ND	ND	ND	0.0006	ND	Industrial solvent; no specific information on 1,2-Dichlorobenze.

Determinant	Laboratory detection limit (from Eurofins-ELS) mg/L	ANZECC 2000 DGV (mg/L)*	Detected concentrations at down-gradient bores (mg/L)					Common source/usage of determinant (from relevant ANZECC 2000 Volume 2, Section 8.3.7 technical briefs)
			B3	C2	C2DS	B2	B1	
1,3-Dichlorobenze	0.0005	0.160 (99th percentile) 0.260 (95th percentile) 0.350 (90th percentile) 0.520 (80th percentile)	0.0008	ND	ND	0.0008	ND	Industrial solvent; no specific information on 1,3-Dichlorobenze.
Cis-1,2-Dichloroethene	0.0005	Not defined	0.0005	ND	ND	ND	ND	Not available
1,4-Dichlorobenze	0.0005	0.040 (99th percentile) 0.060 (95th percentile) 0.075 (90th percentile) 0.100 (80th percentile)	ND	ND	ND	0.0005	ND	Industrial solvents; 1,4-Dichlorobenzene is used in predominately air deodorants and insecticides.
Chlorobenzene	0.0005	Not defined	0.0011	ND	ND	0.0098	ND	Industrial solvents; chlorinated effluents (e.g. treated trade waste)

* ANZECC 2000 default guideline value(s) for toxicants (percentile for species protection in parentheses). Results in **bold** exceed the 99th percentile ANZECC DGV, results underlined exceed the 95th percentile. Results in italics were collected in April 2019; all other results collected in January 2019. A range indicates where a substance was detected in both January and April 2019.

"ND" refers to non-detected determinants.

4.5 Deep Gravel Aquifer Results

The resource consent requires results from gravel (deep) aquifers be compared against the DWSNZ limits. A complete table of results for the gravel aquifer bores over the last 10 years is presented in Appendix D.

Median or singular concentrations for parameters analysed during the 2019-2020 monitoring period for the three bores intercepting the gravel aquifer (E1D, C2DD and E2D) are provided in Table 4-7.

Results for the background deep-bore G1D have also been included in Table 4-7 for comparison. This is the only background bore in the deep aquifer. Results for key indicators have been coloured to highlight more elevated values (with the highest being of a darker shade) to assist in identifying areas with potential contamination issues spatially across the site (i.e., west to east, and down-gradient to up-gradient).

Faecal coliforms were not detected at any of the gravel aquifer bores during the 2019/20 monitoring period.

The DWSNZ GV were **exceeded** for two parameters as follows:

- Iron (at G1D; median of 0.57 mg/L was over double the DWSNZ GV of 0.2 mg/L)
- Manganese (at C2DD; median of 0.6035 mg/L was 51% higher than the DWSNZ GV of 0.4 mg/L)

Overall, the concentrations of the key leachate indicator parameters within the deeper bores are much lower than observed within shallow groundwater, as would be expected.

Table 4-7: Gravel aquifer median or singular results (2019-2020 monitoring period) – *bores listed L to R (west to east)*

Determinant	Units	DWSNZ (MAV)	No. of samples per site	E2D	E1D	C2DD	G1D
Leachate indicators							
Ammoniacal-N	mg/L	1.17	4	0.3	0.205	0.33	0.1
Boron	mg/L	1.4	4	0.015	0.06	0.065	0.045
Chloride	mg/L	250*	4	46.85	38.85	39.35	31.5
Conductivity	mS/m		4	34.7	45.65	52.4	28.15
Faecal coliforms	CFU/100mL	NIL	4	ND	ND	ND	ND
pH	-	7 to 8.5*	4	7.7	7.6	7.55	7.2
Suspended Solids	mg/l		1	14	2.5	3	2.5
Phenol	mg/l		1	0.025	0.025	0.025	0.025
VFA	mg/L		1	2.5	2.5	2.5	2.5
TOC	mg/L		1	2.1	3.1	4.2	2
Alkalinity	mg CaCO3/L		1	76	155	194	59
COD	mg/l		4	7.5	7.5	7.5	7.5
BOD	mg/L		1	0.5	0.5	0.5	0.5
Nitrate-N	mg/L	11.3	4	0.005	0.005	0.005	0.005
Sulphate	mg/L	250*	1	12.4	0.01	0.03	20.1
Hardness	mg CaCO3/L	200*	1	83	131	168	50
Calcium	mg/L		1	23.1	31.8	43.8	7.83
Magnesium	mg/L		1	6.14	12.4	14.3	7.51
Potassium	mg/L		1	5.67	5.03	6.32	6.27
Sodium	mg/L	200*	4	28.6	36.85	32.95	32
D.R. Phosphorus	mg/L		1	0.198	0.411	0.667	0.03

Determinant	Units	DWSNZ (MAV)	No. of samples per site	E2D	E1D	C2DD	G1D
Aluminium	mg/L	0.1*	4	0.001	0.001	0.001	0.001
Arsenic	mg/L	0.01	1	0.001	0.007	0.003	0.003
Cadmium	mg/L	0.004	1	0.0001	0.0001	0.0001	0.0001
Chromium	mg/L	0.05	1	0.0005	0.0005	0.0005	0.0005
Copper	mg/L	2	1	0.00025	0.00025	0.00025	0.00025
Iron	mg/L	0.2*	4	0.05	0.045	0.022	**0.57**
Lead	mg/L	0.01	4	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L	0.4	4	0.2305	0.253	**0.6035**	0.06475
Mercury	mg/L		1	0.00025	0.00025	0.00025	0.00025
Nickel	mg/L	0.08	4	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	1.5*	1	0.001	0.001	0.001	0.001

Note: * denotes guideline values for aesthetic determinants (G.V.); **Bold red text** – denotes an exceedance of the DWSNZ.** faecal coliforms within bore C2DD were analysed four times over the monitoring period rather than twice (as undertaken in the other bores). Where the number of samples collected was 3 or 4, a median of all samples for the monitoring period is reported.

4.6 Groundwater Quality Discussion

4.6.1 Sampling Quality Control and Assurance

Stantec, on request by HDC, conducted a sampling quality control workshop in March 2018 to address issues identified in previous monitoring periods regarding inconsistencies in sampling procedures, turn-around times between sampling and receipt of the samples by the laboratory, and recording of site information. The purpose of the workshop, attended by HDC and Downers staff members involved in water quality monitoring, was to assist staff members to comply with standard sampling and recording protocols, as required by the resource consent conditions.

4.6.2 Background

Current monitoring results indicate that shallow background groundwater quality in bore G1S continues to be characterised by low pH. The median concentration of iron in bore G1D continues to fluctuate above the DWSNZ GV. The presence of iron is likely due to hydrogeological conditions found at the site and is common in groundwater in this area.

Sulphate concentration in bore G1S has decreased during the 2019-2020 monitoring period compared to the significant increase seen during the 2018/19 monitoring period, compared with the historic monitoring record.

Historically (and within this report) bores G1S and G1D have been used to represent reference background conditions, for comparison with the down-gradient bores. It is noted however the D2, F5 and F3 bores are also screened up-gradient within the shallow aquifer and record lower concentrations of key leachate indicators. It is possible therefore that one or a combination of these bores may be more appropriate as a reference background.

4.6.3 Shallow Aquifer Hydraulically Up-Gradient of the Old Landfill

Previously the Nitrate-nitrogen concentrations were most elevated in bores D1 and D6. The median concentrations of nitrate-nitrogen in these two bores appear to have decreased compared to the previous two reporting periods (as shown In Table 4-8).

Table 4-8: Comparison of median nitrate-N concentrations in up-gradient bores with previous two reporting periods (2017–2018, and 2018-2019)

Reporting period	Median concentration of nitrate-N (mg/L) in up-gradient groundwater bores	
	D1	**D6**
2019/20	11.5	14.3
2018/19	36.8	22.9
2017/18	24	16.85

Concentrations for other leachate indicators such as boron, chloride and ammoniacal nitrogen were consistent with background concentrations and historic monitoring records for the 2019-2020 reporting period.

4.6.4 Shallow Aquifer Hydraulically Down-Gradient of the Old Landfill

Leachate indicators (such as chloride, ammoniacal-nitrogen and boron) have been detected at elevated concentrations in bores situated hydraulically down-gradient of the old landfill, particularly bores B1, B3 and C2 (compared with lower concentrations at bores B2, C1 and C2DS). Boron is the only leachate indicator with an assigned ANZECC LDW trigger value (5 mg/L) and this was not exceeded in any of the shallow aquifer down-gradient bores. However, the water quality in samples from E2S is similar to those from the shallow aquifer hydraulically up-gradient of the site (D- and F-series bores, and G1S). Concentrations of landfill leachate indicators such as chloride and boron are much lower at E2S than at the other down-gradient bore locations. It is therefore likely that this bore is not intercepting the leachate plume originating from the old unlined landfill.

Bores B1, B2, B3 and C2 all appear to be located and screened within the leachate plume. There has been some variability in the concentration of the key leachate indicators recorded in these bores, with some bores (predominantly B2) showing a general decrease and others (predominantly C2) showing a general increase in leachate indicator concentrations over time. When assessed as a whole, there appears to be a decreasing or stable trend in the key leachate indicators across these four bores.

However, boron and ammoniacal-nitrogen concentrations have been gradually increasing at bores B3 and C2 since monitoring began. Concentrations of both indicators have been fairly stable for the past two monitoring periods (2018-2019 and 2019-2020) but are still elevated compared to pre-2018 records.

It is recommended that groundwater levels are recorded at the same time as any scheduled groundwater quality monitoring events from October 2019 onwards, to enable further assessment of groundwater flow directions. Any groundwater bores which are not currently used for monitoring of water quality should be checked to determine whether it is possible to record groundwater levels at those locations. The locations and frequencies at which groundwater levels are recorded should be reviewed as part of the 2020/2021 annual report.

4.6.5 Leachate

Results from the 2019-2020 monitoring period are within the range of data obtained from recent previous rounds. The concentrations of parameters are all well within the range reported for Class 1 landfills in the *Land Disposal Guidelines*. A number of SVOCs and VOCs were detected in leachate samples collected in January 2019 and April 2019, but these were all well below the ANZECC 2000 DGVs for toxicity in freshwater, with the exception of carbofuran and diazinon.

4.6.6 Deep Gravel Aquifer

Faecal coliforms were not detected within the deep C2DD and E2D bores during this reporting period. However, the DWSNZ GV for manganese was exceeded within bore C2DD.

4.6.7 Overall Groundwater Quality

Conductivity, boron, chloride and ammoniacal nitrogen are all indicators of the presence of landfill leachate at the site, and are not generally observed in elevated concentrations up-hydraulic gradient of the old landfill, except in many of the bores on the eastern side of the site where chloride, calcium and sulphate and hence conductivity are all elevated. The four leachate indicator parameters have been graphically plotted for all groundwater bores and this is presented in Appendix E.

5. Hokio Stream

5.1 Description of Sampling Locations

Hokio Stream is sourced from Lake Horowhenua (within the Lake Horowhenua Water Management Zone [Hokio sub-zone *Hoki_1b*], under Schedule A of the HRC One Plan (2014)) and flows through a rural farming area for much of its course. The stream passes through the Hokio Beach settlement near the coast and has a small estuary at its mouth.

The Hokio Stream catchment forms a narrow band through the coastal dunes from Lake Horowhenua to the Tasman Sea. The length of the stream itself is approximately eight kilometres. The stream is associated with several areas of swampy ground throughout its length. These areas are generally covered in a thick growth of flax making the stream largely inaccessible in these regions but providing excellent cover and habitat for eels and whitebait. Hokio Stream is classified as having a stream order of four, with “warm, dry” climate and low elevation under the New Zealand River Environment Classification (REC2, NIWA 2010).

Stream samples were taken by grab sampling at sites HS1A, HS1, HS2 and HS3 (Figure 5-1) to investigate if landfill leachate present within the shallow groundwater down-gradient of the landfill is affecting the water quality of Hokio Stream. Sites HS1A and HS1 are situated up-stream of the old landfill, HS2 is situated alongside the old landfill and up-stream of the Tatana Property Drain discharge, and HS3 is located approximately 50m down-stream of the landfill site property boundary and the Tatana Property Drain discharge.

The physico-chemical conditions measured at HS1A and HS1 are assumed to be representative of the combined ‘background’ (i.e., originating from upstream of the landfill), while HS2 and HS3 include landfill discharge-related flows in the Hokio Stream.

Figure 5-1: Hokio Stream Sampling Locations (HS1A, HS1, HS2 and HS3)

5.2 Sampling Results

The range of water quality monitoring results recorded for the 2019-2020 compliance year are presented in Table 5-1. A full set of results for Hokio Stream over the last 10 years is presented in Appendix D. The analytical results have been compared with the ANZECC AE (95%) trigger values as per the consent conditions.

All parameters monitored complied with the ANZECC AE trigger values except for Nitrate – N. The **consented limit (the ANZECC AE 95% trigger value) for Nitrate -N was exceeded** at HS1, HS2 and HS3 (based on median values for the reporting period).

Table 5-1: Hokio Stream median or range of water quality results (2019-2020 monitoring period)

Determinant	Units	No. of samples per site*	ANZECC AE (95%)	HS1A	HS1	HS2	HS3
Leachate indicators							
Ammoniacal-N	mg/L	6	2.1	0.02	0.035	0.1	0.065
Boron	mg/L	6	0.370	0.06	0.055	0.055	0.055
Chloride	mg/L	6	-	24.3	24.1	25.45	25.35
Conductivity	mS/m	6	-	25.2	24.4	25.2	25.4
Faecal coliforms	CFU/100mL	6	-	320	355	435	305
pH	-	6	-	7.8	7.85	7.75	7.7

Determinant	Units	No. of samples per site*	ANZECC AE (95%)	HS1A	HS1	HS2	HS3
Suspended Solids	mg/L	4	-	23	37.5	32	32.5
Phenol	mg/L	4	0.320	0.04	0.0325	0.0325	0.0325
VFA	mg/L	4	-	4.9	4.9	4.9	4.9
TOC	mg/L	4	-	8.1	7.4	7.15	7.3
Alkalinity	mg CaCO3/L	4	-	61	56.5	59.5	60.5
COD	mg/L	6	-	24	30.5	27	32
BOD	mg/L	4	2	0.9	1.95	1.95	1.95
Nitrate-N	mg/L	6	0.16	0.14	**0.37**	**0.4**	**0.425**
Sulphate	mg/L	4	-	18.1	18.05	17.95	17.95
Hardness	mg CaCO3/L	4	-	65	67	65.5	68
Calcium	mg/L	4	-	13.8	14.4	14.25	14.65
Magnesium	mg/L	4	-	7.43	7.53	7.4	7.6
Potassium	mg/L	4	-	2.88	3.14	3.215	3.47
Sodium	mg/L	6	-	21	20.1	20.7	21.15
DRP	mg/L	4	-	0.005	0.005	0.0065	0.005
Aluminium	mg/L	6	0.055	0.011	0.0135	0.017	0.013
Arsenic	mg/L	4	0.024	0.0005	0.0005	0.0005	0.0005
Cadmium	mg/L	4	0.0002	0.0001	0.0001	0.0001	0.0001
Chromium	mg/L	4	0.001	0.0005	0.0005	0.0005	0.0005
Copper	mg/L	4	0.0014	0.0008	0.00105	0.00115	0.00135
Iron	mg/L	6	-	0.019	0.047	0.038	0.0385
Lead	mg/L	6	0.0034	0.0004	0.00025	0.00025	0.00025
Manganese	mg/L	6	1.9	0.0173	0.017	0.0242	0.0259
Mercury		3	0.0006	0.0004	0.0004	0.0004	0.0004
Nickel	mg/L	6	0.011	0.0004	0.00025	0.00025	0.000325
Zinc	mg/L	4	0.008	0.001	0.001	0.001	0.001

Note: **Bold** – denotes an exceedance of the ANZECC AE (95%) trigger values. Where the number of samples collected was 3 or more, a median of all samples for the monitoring period is reported.

* HS1A had 3 samples collected unlike the other sites

Figure 5-2 depicts faecal coliform counts at all four monitoring locations within the Hokio Stream since 1994. The concentration has historically varied across all sites, with frequent exceedances of the ANZECC 2000 LDW trigger values at all locations for this parameter.

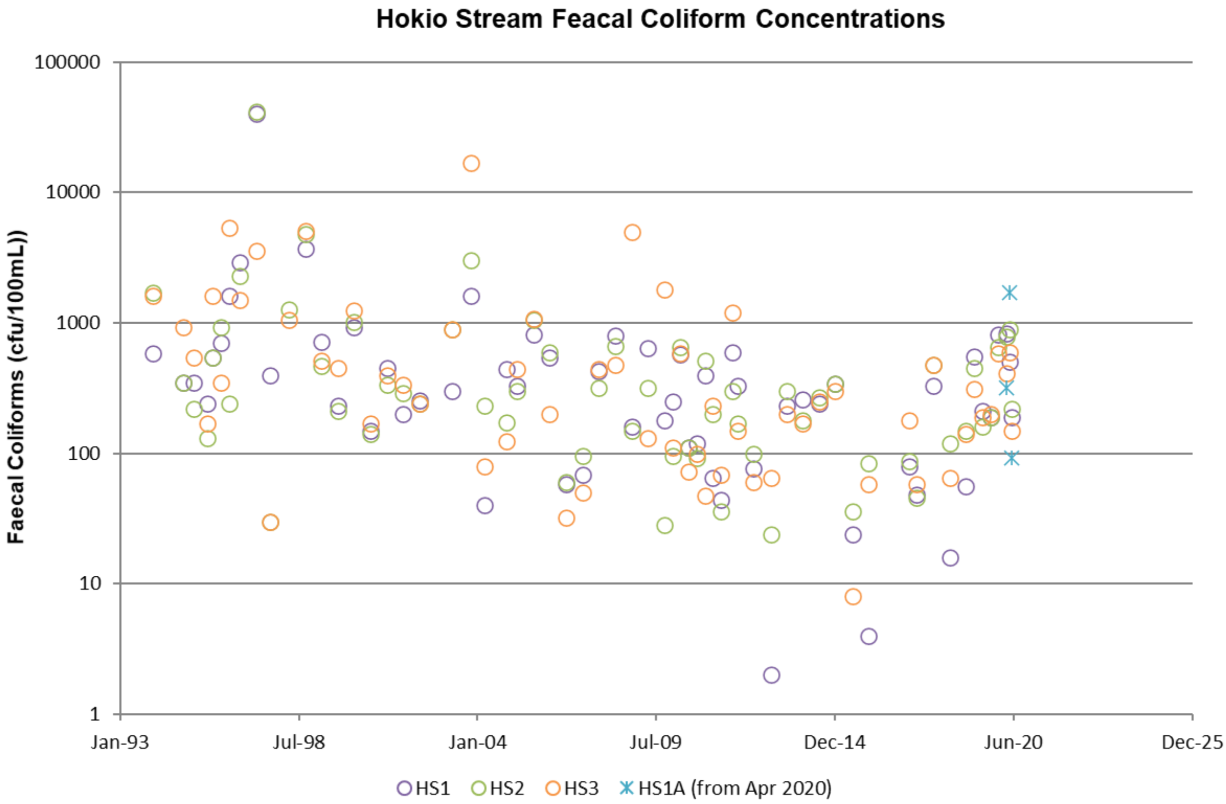


Figure 5-2: Hokio Stream Faecal Coliform Counts, since 1994

Figure 5-3 below plots the ammoniacal-nitrogen concentration in the Hokio Stream against the Horizons One Plan guideline value for Hokio Stream since 1994. All sites sampled within Hokio Stream meet the Horizons guideline for ammoniacal-nitrogen for most of the time.

Conductivity and concentrations of ammoniacal-nitrogen and chloride have been reviewed for all Hokio Stream sites, in the context of the historical monitoring record. Historic results (and those for the latest monitoring period, 2019-2020) for conductivity and chloride are presented in Figure 5-4 and Figure 5-5 below.

These parameters are used as indicators of presence of leachate in Hokio Stream. Conductivity and chloride have been monitored since 2003, and ammoniacal-nitrogen has been monitored since 1994 (although the trend for only the last ~10 years has been included in this report). On review of these historical records, it appears that all three parameters are relatively stable, and there is no clear increase or decrease at each of the locations over the long term.

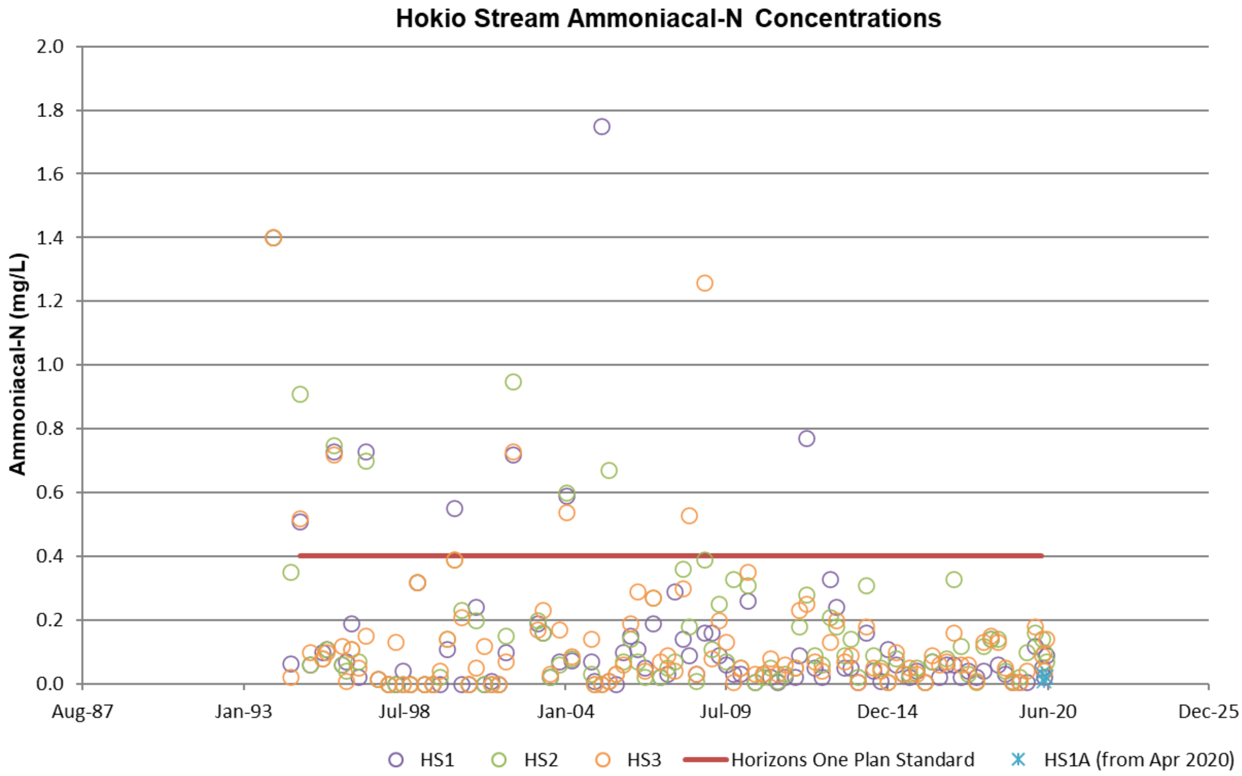


Figure 5-3: Ammoniacal-Nitrogen Concentrations measured in Hokio Stream, since 1994

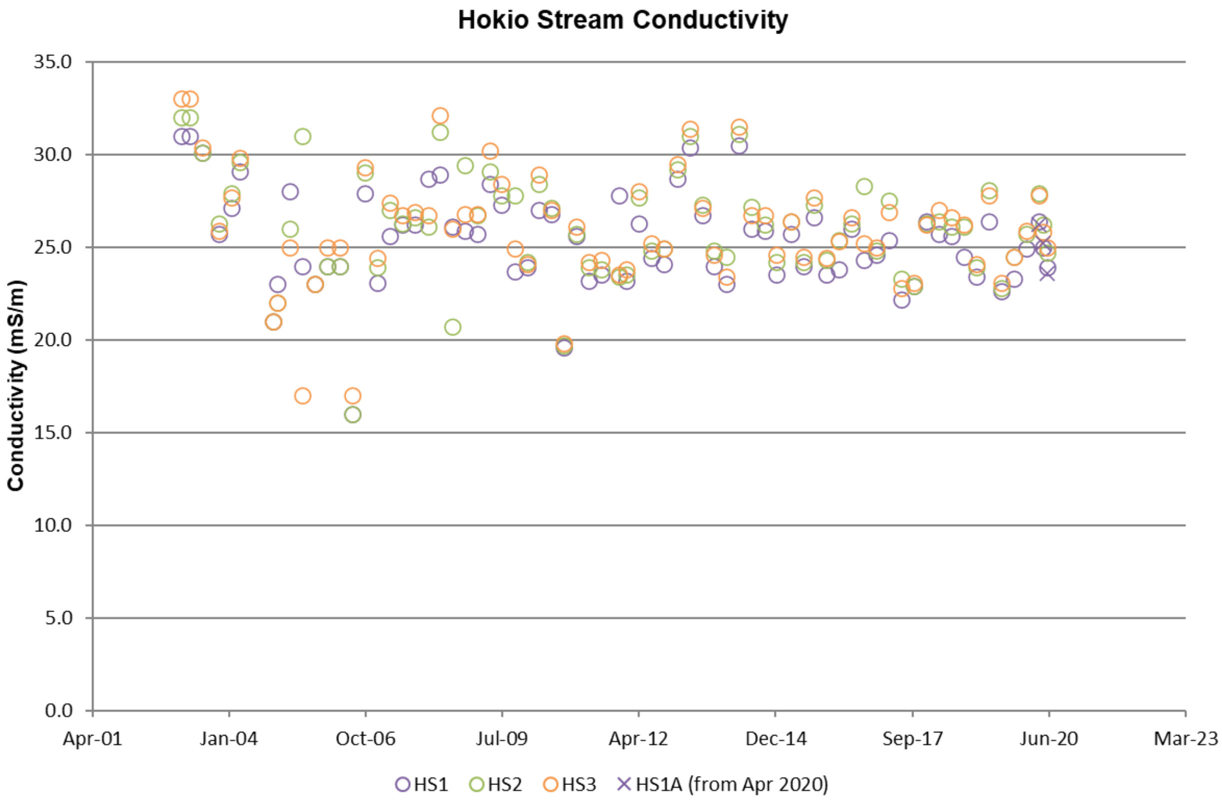


Figure 5-4 Conductivity measured in Hokio Stream since 2003

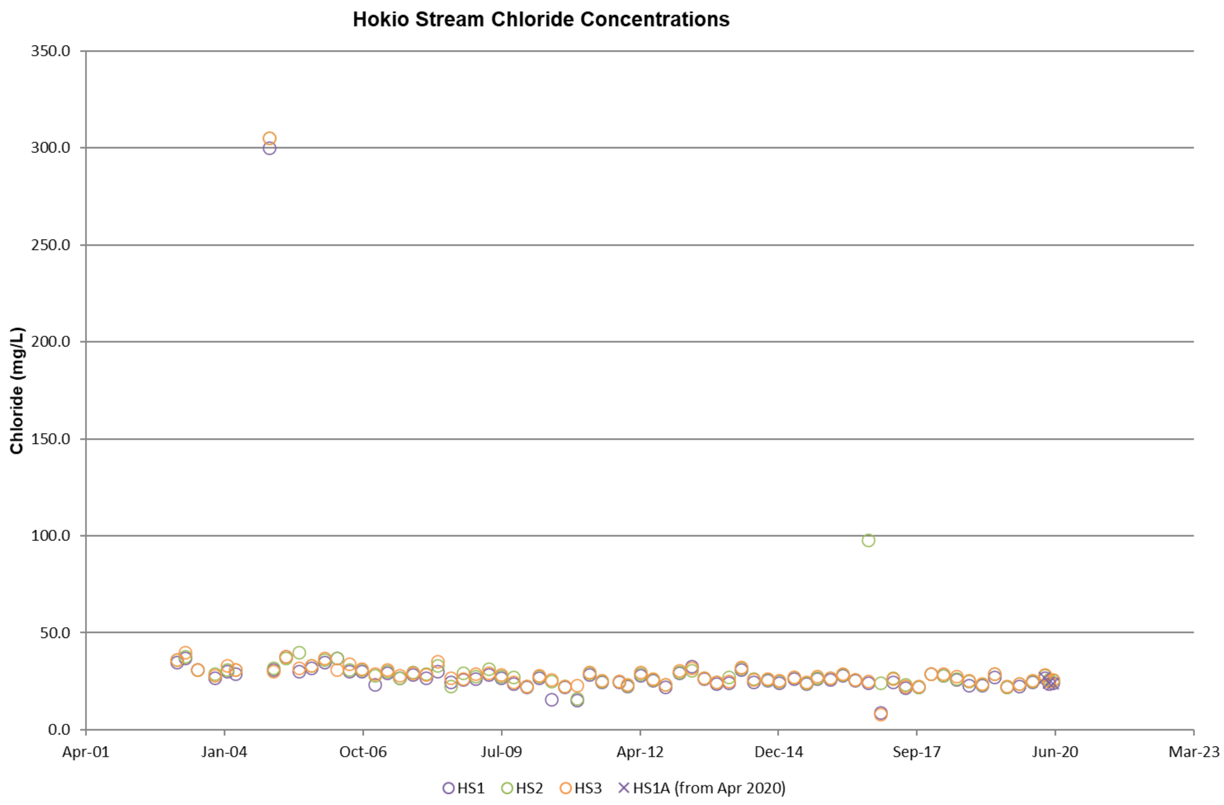


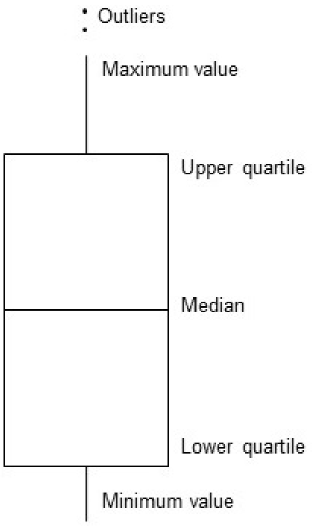
Figure 5-5 Chloride measured in Hokio Stream since 2003

5.3 Surface Water Quality Analysis

An assessment of differences in water quality results between Hokio Stream sites upstream (HS1, HS1A, HS2, and downstream (HS3)) of the landfill has been undertaken for selected contaminants based on samples collected over the nine-year period from July 2011 to June 2020 inclusive. This included generation of box plots (Figure 5-6 to Figure 5-9) to enable a visual assessment of the data. In summary, there is some evidence for a downstream increase in ammoniacal-nitrogen, conductivity, COD, and chloride concentrations between sites HS1 and HS3.

The following guide should be used to interpret the box plots in Figure 5-6 to Figure 5-9:[2]

[2] We note that in the box plots presented here, outliers were determined as being any values outside a range of over 1.5 times the interquartile range (IQR). The 'maximum' value is equal to the largest value no further than 1.5 times the IQR, while the 'minimum' value is equal to the smallest value no further than 1.5 times the IQR. Plots were generated using the geom_plot() function in R.



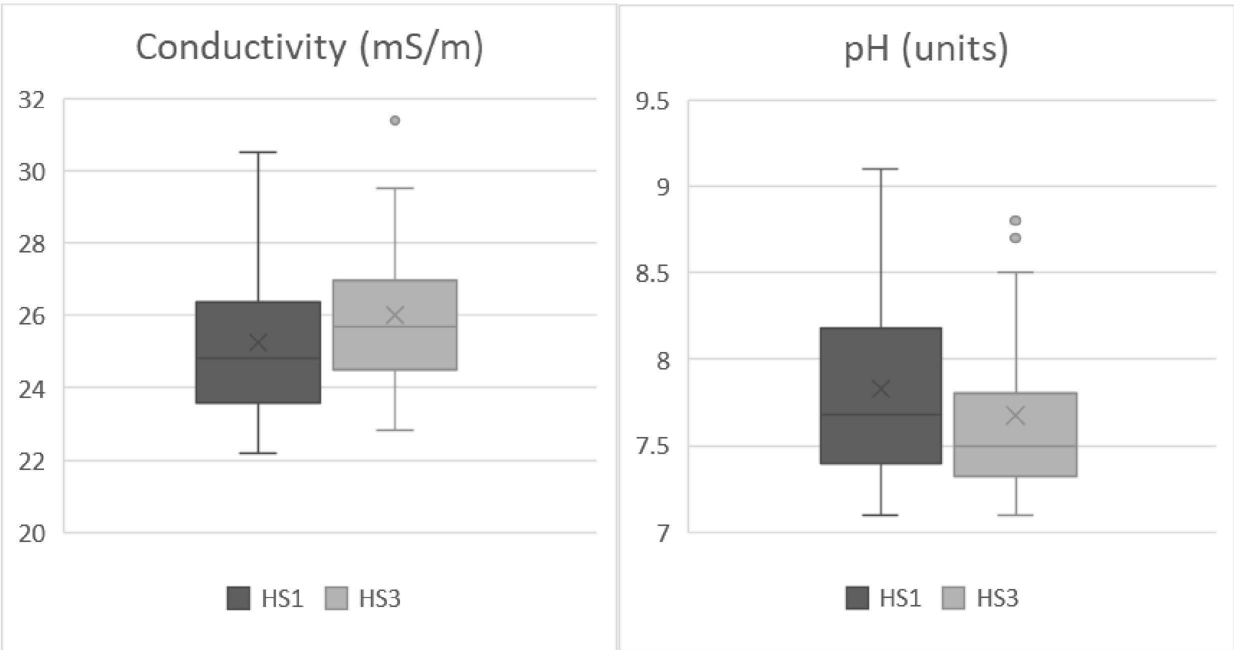


Figure 5-6 Box plots of paired water quality results (Conductivity and pH) for Hokio Stream sites HS1 and HS3, 2011 – 2020; n = 38 (for both parameters).

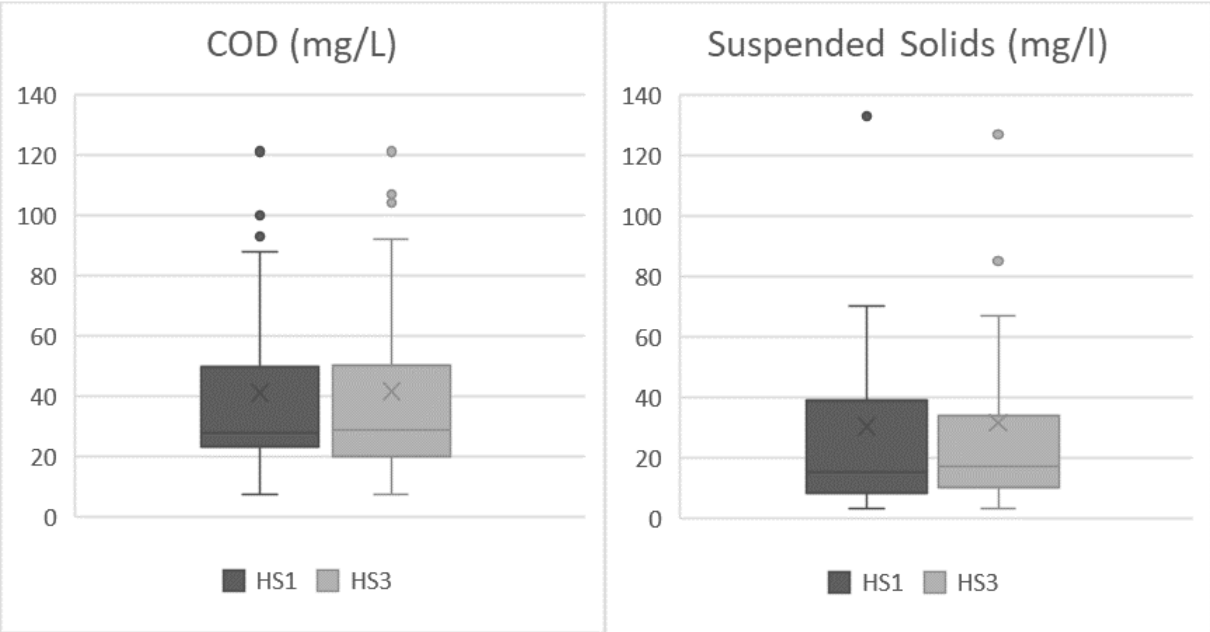


Figure 5-7 Box plots of paired water quality results (Chemical Oxygen Demand and Total Suspended Solids) for Hokio Stream sites HS1 and HS3, 2011 – 2020; *n* = 38 (COD), *n* = 21 (TSS).

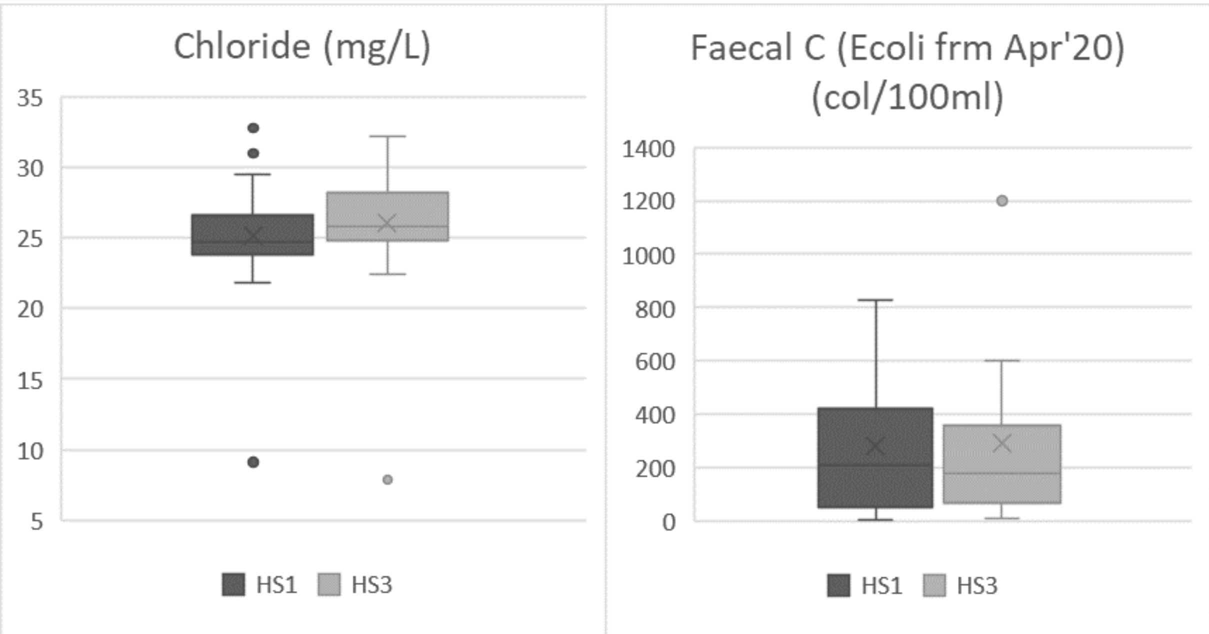


Figure 5-8 Box plots of paired water quality results (Chloride and Faecal Coliforms) for Hokio Stream sites HS1 and HS3, 2011 - 2020; *n* = 38 (Chloride), *n* = 23 (Faecal coliforms).

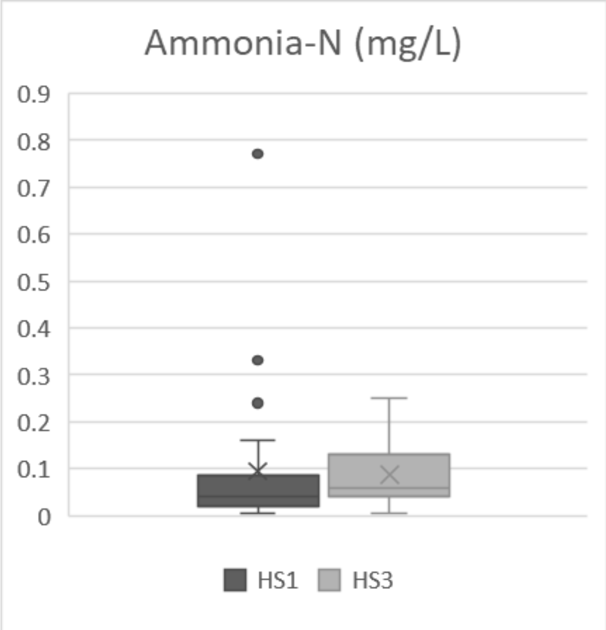


Figure 5-9 Box plots of paired water quality results (Ammoniacal-nitrogen) for Hokio Stream sites HS1 and HS3, 2011 – 2020; *n* = 38

6. Tatana Property Drain

6.1 Description of Sampling Locations

Stantec was commissioned by the Horowhenua District Council in March 2015 to undertake a review of the water quality within a private drain located to the north of the Levin Landfill and to provide recommendations as to whether further monitoring and/or remediation was required. The report noted that water in the shallow drain was being impacted by landfill leachate within the vicinity of the unlined closed section of the landfill. The drain also interacts with the shallow groundwater aquifer, with groundwater emerging (daylighting) as surface water to the north of the landfill.

Horizons Regional Council has requested that surface water in this drain along the Tatana property's boundary be monitored quarterly. Four sampling points were selected to represent upstream (SW1), midstream (SW2 & SW3) and downstream (SW4) flows at the Tatana property (see Figure 5-1).

The 2015 resource consent review (finalised in December 2019) has changed the requirements for sampling the Tatana Drain.

Sampling at SW1, SW2 and SW4 was discontinued after January 2020, and only SW3 has continued to be sampled from April 2020. SW3 is now called "TD1".

Since this report provides results up to and including the April 2020 quarter, we have provided those results already received for all of the sampling points along the Tatana Drain, including the additional sampling required at TD1 (formerly SW3).

6.2 Sampling Results

The review of the resource consent conditions was finalised in December 2019. Changes have been made to some of the surface water and groundwater monitoring conditions and HDC is in the process of acting on all the changes. The sampling that was done in the July 2020 sampling round has been in line with what has been done previously, but different parameters have been applied to assess the surface water sampling results, as required by the new consent conditions. In line with the new consent conditions, the median results have been compared to the ANZECC AE (95%) trigger values instead of ANZECC LDW trigger values used in the 2018-2019 annual report.

Median values have been presented in Table 6-1, because all monitoring locations within Tatana's drain were sampled four times throughout the monitoring period, for all parameters except faecal coliforms.

During the 2019-2020 monitoring period, samples were collected in July 2019, October 2019, and January 2020 and sampling has been discontinued for SW1, SW2 and SW4 since April 2020. The median water quality results for all parameters met the ANZECC AE (95%) trigger values, except for ammoniacal-N, BOD, and nitrate-N concentrations, with these results indicated in ***bold italics*** in Table 6-1.

Table 6-1: Tatana's Property Drain median water quality results

Determinant	Units	No. of samples per site	ANZECC AE (95%)	SW1	SW2	SW3 (now TD1)	SW4
Leachate indicators							
Ammoniacal-N	mg/L	4	2.1	***96.8***	***36.8***	***5.505***	***6.5***
Chloride	mg/L	4	-	227	159	70.8	88.1
Conductivity	mS/m	4	-	253	161	59.5	82.9
pH	-	4	-	7.4	7.6	7.45	7.7
Faecal coliforms	CFU/100mL	1	-	100	690	315	650
Suspended Solids	mg/L	4	-	88	15	75	11
COD	mg/L	4	-	346	142	100.5	73
Total Kjeldahl Nitrogen (TKN)	mg/L	4		96.2	38.9	10	10.4
BOD	mg/L	4	2	***56***	***9***	***10***	***3***
Nitrite-N	mg/L	4		0.14	0.28	0.03	0.04
Nitrate-N	mg/L	4	0.16	***2.06***	***2.77***	***0.225***	***0.4***
Total-N	mg/L	4		98.2	45.3	8.79	11.4
Iron	mg/L	4	-	0.5	0.43	1.190	0.46
Manganese	mg/L	4	1.9	0.965	0.606	0.1895	0.518

Note: **Bold** – denotes an exceedance of the ANZECC AE (95%) trigger values.

Ammoniacal-N, BOD, and nitrate-N concentrations all exceeded the ANZECC AE (95%) trigger values at all four sites.

Monitoring location SW1 (the start of the drain) recorded the highest median concentrations for all parameters analysed, except for faecal coliforms, pH, nitrite-nitrogen, and nitrate-nitrogen. Median pH was also lowest at SW1 for the 2019-2020 reporting period.

Concentrations of parameters; manganese, nitrate-nitrogen, nitrite-nitrogen, total-nitrogen, faecal coliforms, ammoniacal-nitrogen, conductivity, and chloride were all lowest at mid-stream (SW3) than at the other sites which are further downstream. Iron was the only parameter at mid-stream (SW3) which was the highest in concentration as compared to further upstream and further downstream.

Concentrations of suspended solids, conductivity, COD, TKN, BOD, chloride, ammoniacal-nitrogen, total N and manganese were typically lower at the downstream end of the drain (SW4) compared with the furthest upstream location (SW1).

The Tatana Property drain appears to be intercepting leachate-contaminated shallow groundwater, and then discharging directly to the Hokio Stream. The key leachate parameters (ammoniacal nitrogen, conductivity and chloride) are all lower within the drain than in the shallow groundwater bores which are screened in the leachate plume. There was an increase observed in ammoniacal-nitrogen, conductivity, and chloride between sites HS1 and HS3. The median concentration values for conductivity did increase between HS2 and HS3 (where the Tatana property drain joins Hokio Stream), but by a very small margin.

The monitoring of Tatana's Drain indicates **non-compliance with the required ANZECC AE (95%) trigger values**.

7. Mass Loading Evaluation for the Hokio Stream

This section summarises the consent requirements and assessment of effects of landfill leachate in respect of mass loading projections for the Hokio Stream.

Consent conditions 11(d) and 11(e) of the Discharge Permit 6010 require, respectively, that an evaluation of contaminant mass load projections for the discharge of parameters from the landfill to the Hokio Stream is undertaken annually and that the significance of the findings be determined. The relevant consent text is provided in Appendix A.

7.1 Background

A Mass Contaminant Loading Assessment was originally completed for Levin Landfill in April 2011. The modelling incorporated many simplifying assumptions and the conservative estimation of parameters, including:

- That all aquifer through-flow discharges to the Hokio Stream. This is considered unlikely but has been incorporated into the model to provide a worst-case assessment.
- An assumed worst-case scenario, that no attenuation of contaminants occurs between the monitoring wells and the discharge point into the Hokio Stream.
- Estimation of input parameters including hydraulic conductivity 'K' has been conservative.
- Full vertical mixing of contaminants in the aquifer was assumed to the relevant depth of plume considered.
- A low flow of 174 L/s in the Hokio Stream was assumed. This is significantly lower than the mean flow of approximately 900 L/s and therefore will generally provide a worst-case assessment.

In combination these assumptions mean that the predicted downstream concentrations are likely to be significantly higher than in reality.

The assumptions underpinning the mass loading calculations have been reviewed in an attempt to identify any other factors which may be influencing the observed changes in spatial patterns in the plume that is referred to in Section 4.4.4.

For this monitoring period some additional changes have been made to the mass loading assessment assumptions, as explained in the next section.

7.2 Mass Loading Analysis Update

The input data into the model spreadsheet includes groundwater quality within the leachate plume and upstream and downstream water quality within the Hokio Stream (HS1 and HS3 respectively). The data for the last five years were used to recalculate the input information which is summarised in Table 7-1. Medians over five years are considered appropriate to use given that some parameters in the indicator list (e.g. sodium) are only tested once per year.

Bores B2, B3, C1, C2, C2DS and G2S have been used to represent the leachate plume in undertaking the mass loading analysis. Bores B2 and B3 have been included in the mass loading analysis this year because of the high concentrations of parameters that are being recorded at that bore. It is noted that bore G2S is likely to be at the edge of or outside the leachate plume and therefore may no longer be representative of the main body of the leachate plume.

As in previous years, the shallow groundwater 'background' concentration of contaminants was included in the calculation to determine if any changes in the Hokio Stream water quality are influenced by background concentrations of contaminants in shallow groundwater. For this annual report, bores, D5, F2, and F3 have been included as being representative of background water quality. In contrast, bore G1s has been removed from the analysis to provide a better representation of the background water quality.

For the bores representing the leachate plume, the maximum and median results from the last five years for ammonia-N, boron, chloride, sodium, nitrate-N and DRP have been averaged and compared to the values used last year. Many of the maximum and median values have increased in comparison with corresponding values reported in the 2018-2019 annual report for most parameters. Those values which have increased are shaded in grey in Table 7-1. The differences in the median concentrations from last year may be misleading since bores B2 and B3 have been included in the results for this year's report, though not for 2018-2019, i.e., the data sets are different, so the comparison is not "apples for apples".

Table 7-1: Updated Model Input Data 2015-2020

Site	Ammoniacal-N g/m³	Boron g/m³	Chloride g/m³	Sodium g/m³	Nitrate-N g/m³	DRP g/m³
HS1 (upstream) **5-year median**	0.035	0.055	24.65	21.10	1.375	0.022
HS3 (upstream) **5-year median**	0.060	0.060	25.8	21.45	1.400	0.024
D5, F2, F3 (background groundwater) **5-year median**	0.01	0.023	26.4	25.533	1.4033	0.127
Bores representing leachate plume (B2, B3, C1, C2, C2DS, G2S) **average of maximum values** (over 5-years)	78.36	1.732	400.2	279.7	11.7183	0.117
Bores representing leachate plume (B2, B3, C1, C2, C2DS, G2S) **average of median values** (over 5-years)	57.90	1.111	223.8	179.3	1.2442	0.028
Bores representing leachate plume - average of maximum values (*removing background*)	78.35	1.695	358.1	248.4	8.5483	-0.030*
Bores representing leachate plume - average of median values (*removing background*)	57.89	1.088	197.4	153.8	-0.1592*	-0.099*

The median concentration of nitrate-nitrogen when the background concentration is factored out gives a negative concentration (as indicated by results with an asterisk * in Table 7-1). The same holds for both the maximum and median concentrations for DRP. Essentially this indicates that the background concentrations of nitrate-nitrogen and DRP are higher than that found in the leachate plume, which implies that leachate is not influencing the concentrations of those two parameters in groundwater down-gradient of the old landfill.

The plume width has been estimated as 300-500 m; this estimate has been retained within the mass contaminant loading model since 2014.

The predicted downstream concentrations of leachate indicators in the Hokio stream were calculated based on the average of maximum and median values from the leachate plume bores (B2, B3, C1, C2, C2DS and G2S). The ranges of results obtained are presented in Table 7-2. For comparison, the median results for the upstream and downstream sample locations (HS1 and HS3) are also included in Table 7-2. The detailed mass contaminant loading calculation is included in Appendix F.

The predicted downstream concentrations at HS3 are similar, both when background concentrations are included and when they are excluded.

The predicted range of concentrations from the 2019-2020 mass contaminant load assessment shows general agreement with actual monitoring results obtained from HS3. The concentrations obtained by sampling at the upstream site (HS1) and the predicted concentrations for the downstream site (HS3) meet ANZECC Lowland River DGV for 95th percentile species protection, the LDW trigger values and the Horizons One Plan guideline values, except for ammoniacal-N, nitrate-N, and DRP. Concentrations of ammoniacal-N, nitrate-N, and DRP at both sites exceeded the ANZECC Lowland River DGV for 95th percentile species protection. Nitrate-N and DRP exceeded the Horizons One Plan concentrations at both sites.

The inference from these results is that the leachate contamination within the groundwater plume from the old landfill area is affecting the quality of water in the Hokio Stream to a minor extent only. By far the greatest contributions to the concentrations of measured parameters in the Hokio Stream are arising from sources unrelated to the old landfill and are in fact originating from upstream of the landfill site

The water quality of the Hokio Stream is influenced strongly by the urban and rural catchments. The actual and predicted results indicate that the impact from the Levin Landfill on the Hokio Stream is likely to be minimal within the wider catchment context.

Table 7-2: Predicted Leachate Impact on Hokio Stream 2019-2020

		Ammoniacal-N g/m³	Boron g/m³	Chloride g/m³	Sodium g/m³	Nitrate-N g/m³	DRP g/m³
Guideline values	ANZECC 2000 DGVs for Freshwater (Table 3.3.10 Lowland River, *Table 3.4.1 95% protection)	0.021 / 0.9*	0.37*	-	-	0.444	0.01
	ANZECC LDW trigger values	NA	5	-	-	90.3	NA
	Horizons One Plan - Hokio Stream (Schedule E)	0.4	-	-	-	0.167 (SIN)	0.01
Predicted range of downstream concentration including background concentrations		**0.05-0.49**	0.06 – 0.06	24.71 – 26.85	21.15 – 22.61	**1.37 – 1.44**	**0.022 – 0.023**
Predicted range of downstream concentration excluding background concentrations		**0.05-0.49**	0.06 – 0.06	24.70 – 26.60	21.14 – 22.43	**1.37 – 1.42**	**0.021 – 0.022**
Actual 2015-2019 median upstream concentration (HS1)		**0.035**	0.055	24.655	21.10	**1.375**	**0.022**
Actual 2015-2019 median downstream concentration (HS3)		**0.060**	0.060	25.8	21.45	**1.40**	**0.024**

Note: bold text indicates predicted exceedances of the ANZECC lowland river DGVs, underlined text indicates exceedance of the Horizons One Plan for the Hokio Stream. There were no predicted exceedances of the ANZECC Livestock Drinking Water trigger values or the ANZECC toxicity 95% protection trigger values.

7.2.1 Current assumptions

The assumptions currently applied to calculate mass loads for contaminants from the landfill are summarised below.

Flow volume of Hokio Stream

A minimum flow of 174 L/s (15,034 m^3/day) is assumed in the Hokio Stream. This has been applied since 2011; the flow volume selected represents a conservative approach as it is significantly lower than the mean flow of 900 L/s.

Extent of the groundwater aquifer

Various combinations of aquifer width and depth are applied in the calculations as part of the sensitivity analysis; results are therefore reported as ranges.

The assumptions applied in each combination are depicted in Figure 7-1.

		Thickness (m)		
		5	10	15
Width (m)	300	1500	3000	4500
	400	2000	4000	6000
	500	2500	5000	7500

Figure 7-1 Assumptions for aquifer extent applied in mass load calculations (screenshot from model spreadsheet, 2020)

Hydraulic conductivity (*k*)

Mass load calculations assume a hydraulic conductivity of 0.00002 m/s (1.73 m/day) (this can range between 0.5 – 2.0 m/day based on field data collected in July 2012).

Hydraulic gradient (*i*)

A value of 0.0059 has been maintained since 2011. This was developed based on groundwater level monitoring undertaken between 2004 and 2010. We would recommend that this is reviewed using groundwater level data recorded during the next year's sampling events.

Background groundwater quality

Calculations have been run to account for background groundwater quality by removing loads from bores D2, F2 and F3 (as representation of 'background) from the calculations for 5-year averaged maximum and median values. A second series of calculations has been done including background groundwater quality which shows that there is minimal difference between including or excluding the background water quality concentrations.

8. Stormwater Discharges

Condition 16 of Discharge Permit 102259 requires that annual monitoring to determine the effects of stormwater soakage on groundwater quality be carried out on site. This can be done in conjunction with the sampling of groundwater under Condition 15 of Discharge Permit 102259.

As shown in the Site Plan in Appendix C, stormwater is discharged to a central inter-dune depression located to the west of the access road leading to the lined landfill area. From here it soaks to groundwater. When groundwater levels are high in winter, water tends to pond in the inter-dune depression.

Based on the current understanding of groundwater flow directions, bores D3r and F3 are hydraulically up-gradient of the stormwater soakage area, and bores E1D, E1S, D4 and D2 are hydraulically down-gradient.

The environmental monitoring results for the last 10 years are presented in Appendix D. Table 8-1 below summarises compliance for the 2019-2020 sampling period with the ANZECC 2000 LDW trigger values. Compliance is assessed on the basis of median values across the reporting period.

Table 8-1: Summary of Selected 2019-2020 Bore Results for Stormwater Consent

Borehole	ANZECC 2000 LDW	Comments
D3r (background)	Complies	Nil
F3 (background)	Complies	Nil
E1D	Complies	Nil
E1S	Complies	Nil
D4	Complies	Nil
D2	Complies	Nil

The results indicate that groundwater quality in the bores D3r, F3, E1S, D4 and D2 is similar to that of the background bore (G1S). However, we note that the suitability of bore G1S as a representation of background groundwater quality is to be confirmed following a review of groundwater flow directions, once sufficient groundwater level data have been collected.

9. Landfill Gas and Odour Monitoring

The resource consent review that was concluded in December 2019 introduced new reporting requirements for landfill gas and odour monitoring under Discharge Permit 6011.

Condition 8F of Discharge Permit 6011 requires the Permit Holder to maintain a log of all other inspections, investigations and actions taken in accordance with all monitoring and odour inspection conditions of the consent. A summary is to be included in the Annual Report which follows under this section.

9.1 Odour Monitoring at Landfill Boundary

Condition 3 of Discharge Permit 6011 requires the Permit Holder to undertake monitoring at the landfill boundary for offensive odour or dust. This is to be in accordance with the methodology set out in the Odour Management Plan, as required under condition 4(m)(iii) of Discharge Permit 6011.

HDC has carried out six odour assessments at the landfill boundary. A summary of the results is given below.

- 10 March 2020 – wind direction from NW, very weak odour detected, described as "a bit pleasant" with the odour character being "herbal, green, cut grass".
- 2 April 2020 – wind direction from NW, weak odour detected, described as "a bit pleasant" with the odour character being "herbal, green, cut grass".
- 1 May 2020 – wind direction from SW, very weak odour detected, described as "a bit unpleasant" with the odour character being "landfill gas".
- 1 May 2020 – wind direction from S-SW, distinct odour detected, described as "a bit pleasant" with the odour character being "herbal, green, cut grass".
- 25 June 2020 – wind direction from NE, very weak odour detected, described as "neutral" with the odour character being "herbal, green, cut grass".
- 25 June 2020 – wind direction from N, weak odour detected, described as "a bit unpleasant" with the odour character being "musty, earthy, mouldy".

In all cases the conclusions were the same; i.e., odour was detected but was not considered objectionable at any location for any duration or frequency. No further action was undertaken.

9.2 Gas Detection in Groundwater Monitoring Wells

Condition 4(a) of Discharge Permit 6011 requires landfill gas sampling to be undertaken at each bore on every occasion that groundwater sampling is carried out.

Landfill gas monitoring commenced in January 2010. **Low concentrations of methane (CH_4) were detected** during the July 2019, October 2019, and January 2020 monitoring rounds, as follows:

- 11 July 2019 – CH_4 detected in bores; D4, F1, G1s, G1d, D1, D2, D6, F3, D3, D5, E1s, E1d, B1, E2d, E2s, C2ds, C2dd, C2, B3s, B2, C1, G2s, F2 (maximum of 0.09 ppm[3] detected at bore G1d).
- 3 October 2019 – CH_4 detected in bores; D2, D3, D5, B1, G2s, C2, C2dd, C2ds, B3s, B2 (maximum of 7 ppm[4] detected at bore C2).
- 7 January 2020 – CH_4 detected in bores; E1s, D4, D3r, D2 (maximum of 0.08 ppm[5] detected at bores D4 and D3r).

Carbon dioxide (CO_2) was detected at low levels (<3 ppm) across all of the bores monitored in July 2019, January 2020, and March 2020.

The records indicated that **no hydrogen sulphide(H_2S) was detected** during the monitoring period.

Oxygen (O^2) was detected at low levels (between 15.9% and 22%[4]) during all four monitoring periods at all bores, except in October 2019 at bores C1 and G2s.

Refer to Appendix G for the results. We note that the results were collected by a third party on behalf of HDC, and we have not been able to independently verify details regarding the data provided to us (and presented in Appendix G), such as the units of measurement, and potential reasons for the exceedances (such as equipment malfunction, or other operational cause).

It is recommended that gas detection results be provided to HDC and the party responsible for compiling the quarterly reports as soon as they are available, rather than waiting for the Annual Report.

9.3 Monitoring of Surface Emissions and Bio-filter

Condition 4(e) of Discharge Permit 6011 requires the Permit Holder to undertake monthly methane surface monitoring of the temporary and capped areas of the landfill and the bio-filter.

HDC is arranging to have this monitoring undertaken by Envirowaste but this has not yet commenced.

Monitoring of the landfill gas wells and flare is required under the resource consent obtained for the landfill gas flare and so is not reported on in this Annual Report.

Condition 4(j) of Discharge Permit 6011 sets out the requirements for monitoring and recording data at the bio-filter. The table below sets out a summary of the requirements and notes the extent to which compliance has been achieved.

Table 9-1: Summary of Bio-filter Inspections and Maintenance

Requirement	Comments	Compliance
Daily visual inspection	Not fully consistent. Daily checks to be delegated to contractor. HDC staff carry out visual checks when on site.	No
Continuous display of fan discharge differential pressure	Differential pressure and moisture content available on SCADA from June 2020.	Yes
Weekly monitoring and recording of the bio-filter bed moisture content	Done through SCADA telemetry	Yes

[3] Units of measurement are not included in the data record (Appendix G). We have assumed that concentrations were recorded in parts per million (ppm) for the purpose of our analysis, however records could also have been percentages (%). We have not been able to verify the original units applied.
[4] Units of measurement are not included in the data record (Appendix G). We have assumed that concentrations were recorded in parts per million (ppm) for the purpose of our analysis, however records could also have been percentages (%). We have not been able to verify the original units applied.
[5] Units of measurement are not included in the data record (Appendix G). We have assumed that concentrations were recorded in parts per million (ppm) for the purpose of our analysis, however records could also have been percentages (%). We have not been able to verify the original units applied.

Weekly recording of pressure across the bio-filter bed	Done through SCADA telemetry	Yes
Weekly recording of the pH of the bio-filter media	Not implemented	No
Quarterly raking and loosening of bio-filter media	Not done[6]	No

9.4 Meteorological Data

Condition 4(p) of Discharge Permit 6011 requires the Permit Holder to collect meteorological data from an on-site weather station. Condition 4(q) requires the Permit Holder to provide that information to the Regional Council.

The following data has been collected over the reporting period at 15-minute intervals and averaged to one-hour time periods:

- wind direction and speed
- air temperature
- barometric pressure
- relative humidity
- rainfall.

The information collected meets the consent requirements except that monitoring was to have been at 1-minute intervals and was to be averaged to 10-minute time periods. It is not known if HDC has discussed this slight departure with the Regional Council.

10. Monitoring Results Compliance

This section contains a brief summary of compliance (or otherwise) with the resource consent conditions for the landfill site. This summary should be considered in the context supplied throughout this report, especially around the existing consent requirements for monitoring (i.e. where a single sample is required per year) and where non-compliance has been reported as a result of a low/marginal detection as opposed to a significantly elevated result.

10.1 Groundwater - Sand Aquifer

Consent conditions for the site (Discharge Permit 6010, Condition 11) require shallow groundwater quality to be compared with ANZECC 2000 LDW trigger values. These values were not exceeded by median results during the 2019-2020 monitoring period.

10.2 Groundwater - Gravel Aquifer

Condition 12 of Discharge Permit 6010 requires groundwater quality within the deeper gravel aquifer to be compared with DWSNZ values.

There were two exceedances in samples from bores monitoring the Gravel Aquifer during the 2019-2020 monitoring period:

- The iron concentration in G1D exceeded the NZDWS GV
- The manganese concentration in C2DD exceeded the NZDWS GV

Historically both iron and manganese concentrations have exceeded the NZDWS GVs and so these exceedances are not considered to be significant.

[6] Completed after end of June 2010.

10.3 Surface Water – Hokio Stream and Tatana's Drain

Consent conditions for the site (Discharge Permit 6010, Condition 11) require that surface water quality in the Hokio Stream and Tatana Drain be compared with ANZECC AE (95%) trigger values.

The nitrate-N concentrations exceeded the trigger value at sites HS1, HS2, and HS3 in the Hokio Stream.

At Tatana's Drain, samples from the SWI, SW2, SW3 (now TD1), and SW4 monitoring sites all exceeded the trigger values for ammoniacal-N, BOD, and nitrate-N.

It is recognised that there is contamination of the groundwater arising from leachate from the old, closed landfill. As determined from site observations, flows within the Tatana Drain are literally a trickle, particularly during the summer periods and whilst the Tatana Drain connects to the Hokio Stream, the volume flow within the Tatana Drain is significantly less[7] than that of the Hokio Stream and any effects from the inflow of Tatana Drain water to the Hokio Stream will be rapidly diluted.

The significance of the Tatana Drain from an ecological point of view has not been established, however it is known to have been developed by the owner of the property and is periodically cleaned out by the owner using an excavator. On that basis, the ecological values of the drain are likely to be low.

10.4 Stormwater

Groundwater bores E1D, E1S, D4 and D2 are currently understood to be located hydraulically down-gradient of the stormwater soakage area on the site, and groundwater quality in these bores was compared with the ANZECC 2000 LDW trigger values. There were no exceedances of the LDW trigger values during the 2019-2020 monitoring period.

10.5 Landfill Gas and Odour Monitoring

Odour monitoring was carried out on six occasions at the landfill boundary in accordance with the methodology described in the Odour Management Plan. No further action was considered necessary following the inspections.

Concentrations of methane, carbon dioxide, hydrogen sulphide and oxygen were monitored quarterly during the 2019-2020 monitoring period and a copy of gas monitoring results is provided in Appendix G. The existing consent does not require assessment of the concentrations of landfill gases detected against any limits.

Monthly surface methane emissions monitoring is required over all temporary and capped areas of the landfill and at the bio-filter. HDC is still to arrange such testing with Envirowaste.

There are a range of inspections and maintenance requirements for the bio-filter. HDC complies with some of these but still needs to implement a daily visual check of the bio-filter, as well as monitoring and recording the pH of the filter bed media and ensuring that the media is raked and loosened each quarter.

HDC is required to collect meteorological data from an on-site weather station. This has been undertaken throughout the reporting period, though currently weather data is recorded every 15-minutes as opposed to the 1-minute interval stated in the consent conditions.

11. Refuse Density

Condition 14 of Discharge Permit 6010 requires that the in-situ density of the waste be checked each year through an annual survey of the landfill and borrow areas. The compaction density is required to be between 600 and 800kg/m^3 (0.6 – 0.8 tonnes/m^3).

The methodology used is the same that has been used for the past 13 years of compaction analyses. The evaluation was performed using waste quantity data obtained from weighbridge records and the corresponding volume of airspace used from sequentially performed surveys.

Refuse disposal data for the period from 7 May 2019 to 30 June 2020 was provided by MidWest Disposals Ltd. The volume of airspace used in the landfill was determined from the comparison of sequential

[7] Flow in the Tatana Drain has been estimated to be between 10L/s and 50L/s, whereas the average flow reported in the Hokio Stream (September 1980 – June 1982) was 833L/s.

topographic surveys performed in May 2019 and June 2020. The topographic survey information is provided in Appendix H. The airspace consumed by refuse and daily cover was 58,287m^3.

The results of the evaluation are summarised Table 11-1.

Table 11-1: Refuse Density 2010 –2020

Year	11-12	12-13	13-14	14-15	15-16	16-17	17 - 18	18 - 19	19 - 20
Volume used (m^3)	37,756	37,799	44,058	37,962	36,599	30,004	39,192	32,437	58,287
Waste tonnage (tonnes)	33,040	32,784	38,141	35,834	36,981	29,894	36,420	30,160	38,132
Apparent density (tonnes/m^3)	0.88	0.87	0.87	0.94	1.01	1.00	0.93	0.93	0.65
Airspace rate of use (m^3/tonne)	1.14	1.15	1.16	1.06	0.99	1.00	1.08	1.08	1.53

The Apparent Density for the year 2019-2020 was 0.65 tonnes/m^3 which is the lowest it has been in the past ten years which casts doubt on the results. Further investigations are being carried out to determine if there is an error in some of the data used for the calculations.

Despite this, the compaction density still meets the consent requirement to be above 0.6t/m^3.

Other observations that have been made include:

- The waste tonnage received at the landfill between 7 May 2019 and 30 June 2020 (ie. 420 days) was 38,132 tonnes. Pro-rated to a year, this gives a figure of 33,139 tonnes.
- In the previous year the pro-rated annual waste tonnage was 35,975 tonnes.
- In real terms, the 2019/2020 annual tonnage decreased by 7.9% compared to the 2018/2019 year's tonnage.
- There was an estimated 9,140m^3 of clay capping used on the landfill in 2019/2020. This is a significant and necessary volume and is on account of the way in which the landfill is being progressively developed higher than the surrounding area. Note that approximately half of this volume (4,758m^3) has come from excavating the clay capping on top of Stage 1A. This is not reflected in volume calculations because there is additional void created when the clay is excavated and then that clay has been used in the bunds which are assumed to occupy the same volume.
- There was an estimated 4,405m^3 of sand excavated from the borrow area, and which, presumably, was all used for cover purposes. The percentage of sand to refuse is 8% which is significantly less than the 26% figure from the previous year (year 2018/2019).
- This past year there was an estimated 1,740m^3 of crushed glass having been used in the landfill.
- There was an estimated 138m^3 of cleanfill used for cover and 674m^3 of aggregate used for roading purposes.
- Approximately 957m^3 of greenwaste mulch was used as a sand protection layer over the front face, top and side slopes of the landfill.
- This past year no imported wood/bark was used for daily cover.
- The estimated fill volume available for Stages 1A, 2 and 3 developed with side slopes of 1V:3H is 129,000m^3. This volume is required to accommodate the waste and the future final cover/capping layer. The final cover/clay capping volume has been assessed to be 21,700m^3 (this does not include the clay volume needed for the front face and sides of the landfill where there is effectively no remaining airspace available). This leaves 107,300m^3 for waste, and at the current annual usage rate of 50,700m^3 (33,139 tonnes at 1.53m^3/tonne), the expected remaining life of Stages 1A, 2 and 3 would be 2.1 years. This is conservative in that it assumes that this year's figures are accurate. If one assumed

a rate of airspace use of 1.1m³/tonne, which is in line with previous years, then the remaining life would increase to about 2.9 years.

12. Old Landfill Remediation

Condition 15 of Discharge Permit 6010 required the old landfill (Area A) to be remediated by April 2011. The remediation was to encompass:

- Grading the landfill faces and cap to a final slope of between 1V : 3H and 1V : 4H
- Slope the final landfill surface to promote run-off to the outside of the footprint to prevent ponding on the landfill surface
- Ensure the landfill cap incorporates a layer of at least 700mm in thickness. Where extra material is required it must be of clayey soil origin
- Establish grass or tussock vegetation on the capped landfill.

Condition 15(f) of Discharge Permit 6010 requires that the condition of the unlined landfill be reported annually, together with any maintenance carried out in the previous year.

The capping of the old landfill was carried out as outlined in the 2010 -2011 Levin Landfill Compliance Report.

The old landfill area has good grass cover. Clayey material that will be useful elsewhere on the landfill has been stockpiled on a small area on top of the old landfill.

In order to monitor settlement, ten monitoring points were established on top of the old landfill as part of the survey which was carried out in June 2014. The locations of the monitoring points are shown in Appendix I. Also shown is the extent of settlement estimated by comparing this year's survey information with that done last year. The maximum settlement since monitoring began is 242mm, with an accuracy of ±10mm. The location of maximum settlement is on top of the clay stockpile and compared to the previous year indications, there has been a further 31mm of settlement. Given that the stockpile was not compacted, settlement is to be expected in this location and therefore the result is of no concern. Note that settlement of the old landfill is to be expected as the underlying waste degrades.

The next highest total settlement value is 214 mm. This is located in the same area where settlement occurred in the previous year. As has been noted in previous years, some minor depressions have formed on the surface of the old landfill, and these have been exacerbated through vehicles tracking onto the landfill in winter, causing localised rutting. This is a minor matter but should be addressed as soon as practicable to prevent further damage to the capping. It is noted that the maximum settlement that occurred in the past year is 48 mm and that this area exhibits ponding. This could cause water to seep into the landfill, rather than being shed off it and so is of concern.

As has been noted previously, it is recommended that any areas where ponding is occurring, or there are vehicle tracks, be filled in with clayey soil. This will need to be done after the rainy season because any vehicle driving on the capping of the old landfill when it is wet will cause further rutting. It would be useful to carry out a further visual inspection of the old landfill surface after a period of rain because the presence of ponding water will help identify areas where localised settlement has occurred and where additional filling with clayey soils is required.

HRC's compliance report[8] requires that the areas where ponding is occurring be filled with capping material and that this work be completed by 29 January 2021.

13. Leachate Irrigation

In 2004, the old landfill site stopped receiving waste and the first stage of the new lined landfill began operating on site. Initially leachate from the lined landfill was collected in a leachate pond and irrigated on site. Leachate irrigation to the area of pine trees to the south-east of the lined landfill was curtailed at the end of 2008 and leachate was recirculated to Stage 1A.

[8] "*Levin Landfill Compliance Report – 1 July 2017 – 18 December 2019*"; Horizons Regional Council, 27 July 2020.

At the beginning of June 2009 a pipeline was extended from the leachate pond to the Levin Wastewater Treatment Plant (WWTP), allowing leachate to be pumped directly to that facility. From June 2009 until December 2012 most of the leachate was pumped to the Levin WWTP with some leachate being re-circulated through Stage 1A (about 5m^3 per day when operating). Since January 2012 all of the leachate (about 50m^3 per day) has been pumped to the Levin WWTP.

Modifications made to the leachate pumping system allows leachate from the leachate pond to be pumped to a manhole located next to the leachate pond, from where it is pumped to the Levin WWTP. This allows leachate pumping to occur without having to fill up the leachate pond which was thought o be a possible source of odour.

14. Site Walkover Records

Condition 28 of Discharge Permit 6010 requires that the landfill be inspected for leachate breakout, settlement and other adverse environmental effects at least once per month until such a time as discharge of refuse to the landfill ceases.

The current landfill is inspected weekly and observations recorded on the Weekly Site Walkover Sheet. No leachate breakouts were recorded during the 2019/2020 reporting period. There were no other signs of ground settlement and other adverse environmental effects detected during the 2019-2020 reporting period. A copy of the weekly site walkover records is not included in this report but can be provided by HDC if required.

The old landfill is surveyed for settlement as described in Section 12 of this report.

15. Vermin and Pest Control

Condition 29 (5) of Discharge Permit 6010 requires that the landfill be inspected for the presence of vermin, birds and other pests and that appropriate measures be taken to control them.

Through observation the operator is aware of the presence of feral cats. Shooting of feral cats and seagulls is carried out regularly. Bait stations are used and the operator will be aware of the need to replace baits if there is more increased vermin activity.

16. Hazardous Waste Disposal

Hazardous waste is waste that poses a present or future threat to people or the environment as a result of one or more of the following characteristics:

- explosiveness
- flammability
- capacity to oxidise
- corrosiveness
- toxicity
- eco-toxicity

Envirowaste keeps a log of hazardous waste received which indicates that no loads of hazardous waste were received over the past year and HDC has confirmed that no applications were received for the disposal of hazardous waste.

17. Landfill Development

Reporting on the development that has occurred at the landfill over the previous year and noting what is proposed for the coming year is not a requirement of the conditions of consent. However, it has been included in this Annual Report for information purposes.

The following development occurred at the landfill site in 2019/2020:

- Further bunding and capping was provided at the back (eastern side) and the southern side of Stage 2.
- The borrow area was extended further in a westerly direction to provide additional sand for cover purposes.
- Additional vertical gas wells were installed on top of the landfill (Stages 2 and 3).

The following development activities are proposed for 2020/2021:

- Further extension of the landfill gas collection network, including installation of vertical gas wells on top of the landfill.
- Bund construction and capping on the side slopes of the landfill as the height of it is increased above the surrounding in-situ ground.
- Remediation of a small part of the top of the old unlined landfill.

18. Conclusions

Horowhenua District Council is required to carry out compliance monitoring as part of Resource Consents DP6009, DP6010, DP6011 and DP102259. This report summarises the findings from the July 2019 to June 2020 monitoring period.

During the 2019-2020 monitoring period, there was one exceedance (for nitrate-N) observed in samples at sites HS1, HS2, and HS3 in the Hokio Steam during the 2019-2020 monitoring period.

Twelve individual SVOCs and VOCs were also detected at low levels in the leachate pond with the ANZECC 2000 90^{th} and 80^{th} percentile trigger values for carbofuran and diazinon being exceeded.

Background groundwater quality in bore G1S is characterised by low pH levels and elevated chloride, sulphate, calcium and iron concentrations in the shallow aquifer. Bore G1D also had an elevated iron concentration and the iron concentrations at G1S and G1D both exceeded the DWSNZ guidelines.

Concentrations of leachate indicators in bores hydraulically down-gradient from the new landfill are comparable to background concentrations, with the exception of bores D2 and D6 (where other factors may be involved).

Monitoring results for all shallow bores down-hydraulic gradient of the old landfill indicated leachate influence, with elevated concentrations of ammoniacal nitrogen, chloride, conductivity, and boron. The leachate plume appears to have a confined radius northward and is not extending to the north-west and the north-east. The plume width is estimated at 300-500 m; a key model assumption which has been retained since 2014.

As outlined in Section 7, mass load calculations were undertaken to predict a range of contaminant concentrations in the Hokio Stream for specific indicator parameters (ammoniacal-nitrogen, boron, chloride, sodium, nitrate-nitrogen and dissolved reactive phosphorus). The mass load calculation compares these predicted concentrations with median and maximum concentrations (averaged over five years) in the bores which are considered to be most representative of the leachate plume, these being bores B2, B3, C1, C2, C2DS and G2S. This year's assessment confirmed that the predicted concentrations are in general agreement with the actual concentrations measured in the Hokio Stream. The monitoring results also indicate that the impact from the landfill on the Hokio Stream is likely to be minimal, with a much greater influence arising from sources unrelated to the landfill within the Stream's urban and rural catchments.

The drain on the Tatana Property is intercepting leachate-contaminated shallow groundwater prior to discharging to the Hokio Stream. The key leachate parameters (ammoniacal nitrogen, conductivity and chloride) are all present in lower concentrations within this drain than in the shallow groundwater bores which are screened in the leachate plume. There was some evidence for an increase in ammoniacal-nitrogen, conductivity, and chloride concentrations between sites HS1 and HS3. Concentrations at the monitoring sites SWI, SW2, SW3 (now TD1), and SW4 all exceeded the trigger values for ammoniacal-N, BOD, and nitrate-N.

Monitoring data for the 2019-2020 period indicates that stormwater from the landfill is not impacting groundwater, as groundwater quality in shallow bores down-gradient from the soakage area reflected that observed in the background bore (G1S). The suitability of bore G1S as a representative bore for background groundwater quality assessment requires a review, given the characteristics and trends noted in this report.

The annual survey shows compaction levels meet the resource consent requirements but are well below what has been recorded in previous years. There is doubt over some the information used to calculate the compaction density and this is being investigated further.

Monitoring of the old landfill shows that settlement is occurring, which is not unexpected. However, there is an area where some minor ponding is occurring and there are some vehicle tracks ruts that tend to collect water. These areas need to be filled in with clayey soil. This will need to be done after the rainy season to avoid any further damage of the landfill cap. It would be useful to carry out a further visual inspection of the old landfill surface after a period of rain because the presence of ponding water will help identify areas where localised settlement has occurred and where additional filling with clayey soils is required. The remediation work needs to be done by 29 January 2021 to comply with HRC's directive in its latest compliance report.

Changes to the resource consent conditions following the 2015 consent review process have increased the requirements for undertaking landfill gas and odour monitoring.

Odour monitoring at the landfill boundary has been implemented in accordance with the methodology described in the Odour Management Plan. No further action was considered necessary following the six odour inspections undertaken during the reporting period.

Gas detection within the groundwater monitoring wells has been undertaken when groundwater has been sampled. The results show a slight indication of methane on occasions, and a significant presence in one bore on a single occasion. The results are provided by a third party and confirmation of the units used (i.e., either ppm or %) has not yet been verified. It is recommended that gas detection results be provided to the party compiling the quarterly reports as soon as the gas results are available. This will help identify if there are issues that need to be considered further at individual bores.

Monthly surface methane emissions monitoring is required over all temporary and capped areas of the landfill and at the bio-filter. HDC is still to arrange such testing with Envirowaste.

There are a range of inspections and maintenance requirements for the bio-filter. HDC complies with some of these but still needs to implement a daily visual check of the bio-filter, as well as monitoring and recording the pH of the filter bed media and ensuring that the media is raked and loosened each quarter.

HDC is required to collect meteorological data from an on-site weather station. This has been undertaken through the reporting period. Weather data is collected at 15-minute intervals, as opposed to the 1-minute intervals stated in the consent conditions.

19. Recommendations

A series of recommendations are made below, which will improve the understanding of the impact of the landfill.

1. During the next annual report the bore logs for all bores should be accessed and the screening depths assessed to build a picture of the impact on groundwater at various depths.
2. Identify any further locations where additional bores could add value to the monitoring record. At a minimum, more frequent monitoring of groundwater levels in existing bores would greatly improve the level of certainty associated with the assumptions used to calculate mass loads.
3. The relative level of the base of the Hokio Stream and Tatana property drain at the monitoring locations should be determined so that the water levels can be interpreted.
4. Investigate whether there are any bores north of the Hokio Stream that could be reviewed and potentially sampled to build a picture of the influence of leachate in groundwater beyond the stream.
5. Investigate options for gauging Hokio Stream, to more accurately quantify flow volume under a range of flow conditions.
6. Carry out a further visual inspection of the old landfill surface after a period of rain to identify areas where localised settlement has occurred and where additional filling with clayey soils is required.

7. Instigate the surface methane emissions monitoring of temporary and capped areas of the landfill and bio-filter, as required by the resource consent conditions.
8. Implement daily visual checks of the bio-filter, record the pH of the filter media bed weekly and ensure the filter media is raked quarterly.

As a direct result of the findings of this annual report (for the 2019-2020 period) we recommend that the following additional actions be completed to improve understanding of the impact of the landfill, and the quality of future reports:

9. Depth to water in all groundwater bores monitored and the referenced water level of the Tatana property drain and the Hokio Stream at the monitoring locations should be recorded whenever samples are currently collected for water quality analysis, as a minimum. Bores that are not currently sampled for groundwater quality should also be assessed, to determine whether it would be possible to monitor groundwater levels at those locations. This information can be used in subsequent monitoring reports to review the assumptions with respect to the interactions between the landfill areas, groundwater and surface water. Once groundwater levels have been recorded for a year, the frequency and location of groundwater level monitoring should be reviewed to determine whether the amount of information being obtained is suitable to allow the required assessment of interactions between landfill areas, groundwater and surface water.
10. Assess the size of contributing catchments between the weir at the outlet from Lake Horowhenua (where flow has previously been estimated) and HS1, to determine whether these catchments make a significant contribution to flow (and therefore determine whether the current flow estimate applied for the mass load calculations is appropriate).
11. Review the suitability of bores used as reference background water quality monitoring locations.
12. Review the estimated width and direction of the leachate plume and check that the bores used in the mass balance calculations still provide a good representation of the leachate plume quality.
13. Review groundwater flow directions around both landfill sites to ensure that the interpretations in the annual report are still accurate.
14. Landfill gas monitoring records should include information about weather conditions on the date of each sampling event (including atmospheric pressure and ambient temperature), and units of measurement need to be clearly marked. These records need to be provided to the party compiling the quarterly reports as soon as they become available.
15. Confirm with the Regional Council that the meteorological data being collected is sufficient to comply with the resource consent requirements.
16. Undertake a site inspection of the old landfill surface after a period of rain to identify areas where water is ponding and where additional filling with clay capping is required.
17. Undertake to fill low-lying areas on the surface of the old landfill with clayey soil by 29 January 2021.

Appendices

Appendix A Relevant Consent Conditions

Relevant Consent Conditions

The Annual Report is required to meet the following consent conditions:

- Discharge Permit 6009 – Discharge solid waste to land
  - ✓ Condition 8

    "The Permit Holder shall develop and implement a procedure for the landfill operator, such that potentially hazardous material, as listed in Annex 1 attached to and forming part of this permit, will not be accepted for disposal at the Levin landfill without specific authorization. The Operations Manager of the Horowhenua District Council, or some other designated person, is able at their discretion to accept quantities of such wastes. The waste shall be accompanied by a Hazardous Waste Manifest, as listed in Annex 1, which will form part of the permanent record and shall be reported by the Regional Council by 30 September each year for the term of this Permit.

  - ✓ Condition 14

    "The Permit holder shall submit an annual report to the Regional Council by 30 September each year for the duration of this Permit documenting the condition of the unlined landfill and any maintenance carried out during the previous year. The annual report shall address but not be limited to those aspects listed in Conditions 14(n) to 14(r) above. The annual report shall include a plan of the unlined landfill specifically documenting the shape of the closed landfill and any changes during the previous year related to Condition 14(q) [The annual report can be written in conjunction with the annual report required as part of Condition 15 (f) for Consent Number 6010]"

  - ✓ Condition 35 (b)

    "The Permit holder shall … Forward an annual report to members and to the Regional Council and the District Council"

- Discharge Permit 6010 – Discharge landfill leachate onto and into ground
  - ✓ Condition 5

    "The results of monitoring under Conditions 3 and 4 of this Permit shall be reported to the Regional Council by 30 September each year for the duration of this Permit"

  - ✓ Condition 11(d)

    "The Permit Holder shall annually review the data derived from the groundwater monitoring program and evaluate contaminant mass load projections for discharges from the landfill to the Hokio Stream. The contaminant mass load projections shall be based primarily, but not exclusively, on the monitoring data obtained for the "B", "C" and "X" series bores indicated in Table D of this discharge permit. The annual report required under Condition 5 shall include the following information:

    i. A summary of the methodology used to calculate the mass load projections.

    ii. The calculated mass loads transported in the groundwater and comparable mass loads in the Hokio Stream.

    iii. An analysis of the implications of the mass load calculations with respect to ensuring discharges from the landfill would not result in a decline in the water quality in the Hokio Stream under Condition 3"

✓ Condition 11 (e)

"Should the groundwater parameters tested for under Condition 3 of this consent, and subsequent evaluation and indicative assessment of contaminant mass loads under Condition 11 (d) of this consent indicate that contaminants sourced from either the closed or active areas of the Levin Landfill are likely to result in a significant effect associated with the landfill leachate as identified through an investigation under Condition 3, then Condition 11(c) applies.

✓ Condition 14

"In-situ refuse density shall be determined through annual calculation based on information derived from topographic surveys of the landfill and borrow areas, and from weighbridge records. The survey should be carried out within one month of the anniversary of the previous survey"

✓ Condition 15 (f)

"The Permit holder shall submit an annual report to the Regional Council by 30 September each year for the duration of this Permit documenting the condition of the unlined landfill and any maintenance carried out during the previous year. The annual report shall address but not be limited to those aspects listed in Conditions 15(a) to (e) above. The annual report shall include a plan of the unlined landfill specifically documenting the shape of the closed landfill and any changes during the previous year. [The annual report can be written in conjunction with the annual report required as part of Condition 14 for Consent Number 6009]"

✓ Condition 27

"The Permit holder shall keep a log of:

a) The dates and times of leachate irrigation;

b) The total volume of leachate irrigated daily;

c) The volumes of leachate irrigated to specific areas;

d) Weather and ground conditions during irrigation;

e) Observations made during the weekly inspections of the pump, irrigation system;

f) and irrigation areas; and

g) Repairs and maintenance carried out on the irrigation system.

Copies of this log shall be forwarded to the Regional Council's Environmental Protection Manager on 28 February and 31 August of each year that the irrigation system is operated.

- Discharge Permit 6011 – Discharge landfill gas, odour and dust to air

✓ Condition 4 (g)

"The Permit shall include records of surface emission monitoring for methane must be included in the Annual Report required by Condition 39 of Discharge Permit 6009 and must also be provided to Manawatu-Wanganui Regional Council on request.

- ✓ Condition 7

  "The Permit Holder shall also keep a record of landfill gas monitoring results including:

  a) Date and time of sampling

  b) The concentrations of gasses detected

  c) Weather conditions at the time of sampling.

  The monitoring results shall be made available to the Regional Council on a quarterly basis"

- ✓ Condition 8F

  "The Permit Holder shall maintain a log of all other inspections, investigations and actions taken in accordance with all monitoring and odour inspection conditions of this consent. The inspection and investigation log shall be made available to the Manawatu-Wanganui Regional Council on request and submitted in summary form in the Annual Report".

- Discharge Permit 102259 – Discharge stormwater to land and potentially to groundwater via ground soakage

  - ✓ Condition 16

    "The results of monitoring under Condition 14 of this permit shall be reported to Horizon Manawatu's Team Leader Compliance by 31 August each year for the duration of this Permit beginning 31 August 2003. The annual report shall be supplemented by the raw water quality analysis data being forwarded to the Regional Council as soon as practically possible following the receipt of laboratory analysis certificates".

Appendix B Monitoring Programs

LEVIN LANDFILL - SUMMARY OF SURFACE AND GROUNDWATER MONITORING REQUIREMENTS (July 2019 - April 2022).

(The testing regime is based on Consent Conditions following the completion of the 2015 Resource Consent Review process).

Reports Due		Sampling Month	Table A (Condition 3, DP 6010)				
			Deep Aquifer Bores				
Annual	Quarterly		C2dd	E1d	E2d	G1d	Xd1[(1)]
Sep-19	Aug-19	Jul-19	I	I + SW	I	I	C + A
	Nov-19	Oct-19	I	I + SW	I	I	C + A
	Feb-20	Jan-20	I	I + SW	I	I	C + A
	May-20	Apr-20	C + A	C + A	C + A	C + A	C + A
Sep-20	Aug-20	Jul-20	I	I + SW	I	I	I
	Nov-20	Oct-20	I	I + SW	I	I	I
	Feb-21	Jan-21	I	I + SW	I	I	I
	May-21	Apr-21	C + A	C + A	C + A	C + A	C + A
Sep-21	Aug-21	Jul-21	I	I + SW	I	I	I
	Nov-21	Oct-21	I	I + SW	I	I	I
	Feb-22	Jan-22	I	I + SW	I	I	I
	May-22	Apr-22	C + A	C + A	C + A	C + A	C + A

Sampling Month	Table B (Condition 3, DP 6010)																
	Shallow Aquifer Bores																
	C1	C2	C2ds	D4	B1	B2	B3s	E1s	E2s	D1[(2)]	D2[(2)]	D3r[(2)]	D6[(2)]	G1s	G2s	Xs1[(1)]	Xs2[(1)]
Jul-19	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A
Oct-19	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A
Jan-20	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A
Apr-20	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A
Jul-20	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A
Oct-20	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A
Jan-21	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C + A	C + A
Apr-21	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A
Jul-21	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I
Oct-21	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I
Jan-22	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I
Apr-22	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A

Sampling Month	Table B (Condition 3, DP 6010)				Table C (Condition 3, DP 6010)						
	Irrigation Bores				Hokio Stream[(4)]				Tatana Drain	Leachate Pond[(5)]	
	D5[(3)]	F1[(3)]	F2[(3)]	F3[(3)]	HS1	HS1A	HS2	HS3	TD1		
Jul-19	I	I	I	I + SW	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	I	Monthly Comprehensive for 2	
Oct-19	I	I	I	I + SW					C		A
Jan-20	I	I	I	I + SW					I		
Apr-20	C + A	C + A	C + A	C + A					C		A
Jul-20	I	I	I	I + SW					I		
Oct-20	I	I	I	I + SW					C		A
Jan-21	I	I	I	I + SW					I		
Apr-21	C + A	C + A	C + A	C + A					C		A
Jul-21	I	I	I	I + SW	Discontinue after 2 years	I	I	I	I	I	
Oct-21	I	I	I	I + SW		C	C	C	C	C	
Jan-22	I	I	I	I + SW		I	I	I	I	I	
Apr-22	C + A	C + A	C + A	C + A		C	C	C	C	C + A	

Measure groundwater level and sample all bores for CH_4, CO_2 and O_2 each time that groundwater is sampled (Condition 4a of DP 6011)

Notes:
(1) Bores to be developed by Consent Holder
(2) See table below
(3) If irrigation re-commences then the annual sampling is to change from comprehensive + 3 times indicator to bi-annual comprehensive + indicator (Clause D of Condition 3, DP 6010) .
(4) See table below
(5) See table below
C Comprehensive list (see below)
I Indicator list (see below)
A Annual Pesticide and SVOC analysis
SW Add sodium and iron analysis (for stormwater consent 102559)

A reduction in sampling frequency at any **groundwater monitoring point** is conditional on (Clauses A - D of Condition 3, DP 6010):

A. Completion of the initial monitoring program;
B. Good consistency of groundwater sample analysis results, or a clearly identified reason for inconsistent results that excludes the contaminant source being landfill operations, stored waste or leachate;
C. No decline in groundwater quality as determined from indicator parameter trends over a period of four consecutive sampling rounds;
D. If a well being monitored on a conditional frequency becomes non-compliant with condition C, the monitoring frequency for that well should return to the initial monitoring frequency until conditions B and C are again being fulfilled.

(2) If site management planning indicates any **early detection monitoring well** is likely to become buried or otherwise destroyed within the following year as a result of normal operations (Clauses E - H, Condition 3, DP 6010):

E. This must be communicated to the regional council;
F. A replacement well is to be constructed in a position agreed upon with Horizons Regional Council
G. The replacement well should be installed in a position suitable to act as a early detection well and be classed as an early detection well;
H. The replacement well should be constructed as a nested well (or two separate wells) with screens positioned in both shallow and deep aquifers.

(4) A reduction in sampling frequency at the **Hokio Stream monitoring locations (HS1A, HS2 and HS3)** is conditional on (Clauses I - L, Condition 3 of DP 6010):

I. No signficant increases in the concentrations between monitoring sites HS1A and HS3, for parameters exceeding the trigger values contained in Table C1 at Site HS3.
J. A statistical analysis approach is to be used to determine if there is a significant increase in contaminant levels between HS1A and HS3.
K. Following the 24 month monitoring period, there shall be no significant increases in concentrations between monitoring sites HS1A and HS3.
L. If the Hokio Stream monitoring locations are being sampled on a conditional frequency and do not meet condition K, the monitoring frequency for all three monitoring locations (HS1A, HS2 and HS3) shall return to the base case intensive monitoring until conditions J and K are again being fulfilled.

(5) A reduction in sampling frequency at the **leachate pond outlet** is conditional on (Clauses M - P, Condition 3, DP 6010):

M. Completion of the initial 2 year monitoring program;
N. Good consistency of water sample analysis results, or a clearly identified reason for inconsistent results;
O. No decline in water quality over a period of four consecutive sampling rounds;
P. If the leachate pond outlet is being sampled on a conditional frequency and becomes non-compliant with condition O, the monitoring frequency should return to the base case intensive monitoring until conditions N and O are again being fulfilled.

COMPREHENSIVE PARAMETER LIST (Table E of Condition 3, DP 6010)

Characterising parameters	pH
	electrical conductivity (EC)
	alkalinity
	total hardness
	suspended solids
Oxygen demand	COD and $scBOD_5$
Nutrients*	NO3-N, NH4-N, DRP and SO_4
Metals*	Al, As, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Zn and Hg
Other elements	B, Ca, Cl, K and Na
Organics	Total organic carbon, total phenols, volatile acids
Biological	E. coli

* Analyses performed for nutrients and metals are for dissolved rather than total concentrations

INDICATOR PARAMETER LIST (Table F, Condition 3, DP 6010)

Characterising parameters	pH
	electrical conductivity (EC)
Oxygen demand	COD and $scBOD_5$
Nutrients*	NO3-N and NH4-N
Metals*	AL, Mn, Ni, Pb and Hg
Other elements	B and Cl
Biological+	E. coli

* Analyses performed for nutrients and metals are for dissolved rather than total concentrations

+ E. coli added from April 2019 sampling onwards

LEVIN LANDFILL - SUMMARY OF SURFACE AND GROUNDWATER MONITORING REQUIREMENTS (April 2020 - January 2023).

(The testing regime is based on Consent Conditions following the completion of the 2015 Resource Consent Review process).

			Table A (Condition 3, DP 6010)					Table B (Condition 3, DP 6010)																					Table C (Condition 3, DP 6010)						
Reports Due		Sampling Month	Deep Aquifer Bores					Shallow Aquifer Bores																	Irrigation Bores				Hokio Stream(4)				Tatana Drain	Leachate Pond(5)	
Annual	Quarterly		C2dd	E1d	E2d	G1d	Xd1(1)	C1	C2	C2ds	D4	B1	B2	B3s	E1s	E2s	D1(2)	D2(2)	D3r(2)	D6(2)	G1s	G2s	Xs1(1)	Xs2(1)	D5(3)	F1(3)	F2(3)	F3(3)	HS1	HS1A	HS2	HS3	TD1		
	May-20	**Apr-20**	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	Monthly Comprehensive for 2 Years	C	Monthly Comprehensive for 2	A
Sep-20	**Aug-20**	**Jul-20**	I	I + SW	I	I	C	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C	C	I	I	I	I + SW					I		
	Nov-20	**Oct-20**	I	I + SW	I	I	C	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C	C	I	I	I	I + SW					C		A
	Feb-21	**Jan-21**	I	I + SW	I	I	C	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C	C	I	I	I	I + SW					I		
	May-21	**Apr-21**	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A					C		A
Sep-21	**Aug-21**	**Jul-21**	I	I + SW	I	I	C	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C	C	I	I	I	I + SW					I		
	Nov-21	**Oct-21**	I	I + SW	I	I	C	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C	C	I	I	I	I + SW					C		A
	Feb-22	**Jan-22**	I	I + SW	I	I	C	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	C	C	I	I	I	I + SW					I		
	May-22	**Apr-22**	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	C + A	Discontinue after 2 years	C	C	C	C	C + A	
Sep-22	**Aug-22**	**Jul-22**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I	I	I	I	I + SW		I	I	I	I	I	
	Nov-22	**Oct-22**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I	I	I	I	I + SW		C	C	C	C	C	
	Feb-23	**Jan-23**	I	I + SW	I	I	I	I	I	I	I + SW	I	I	I	I + SW	I + SW	I	I + SW	I + SW	I	I + SW	I	I	I	I	I	I	I + SW		I	I	I	I	I	

Measure groundwater level and sample all bores for CH_4, CO_2 and O_2 each time that groundwater is sampled (Condition 4a of DP 6011)

Notes:

(1) Bores to be developed by Consent Holder

(2) See table below

(3) If irrigation re-commences then the annual sampling is to change from comprehensive + 3 times indicator to bi-annual comprehensive + indicator (Clause D of Condition 3, DP 6010) .

(4) See table below

(5) See table below

C Comprehensive list (see below)

I Indicator list (see below)

A Pesticide and SVOC analysis

SW Add sodium and iron analysis (for stormwater consent 102559)

A reduction in sampling frequency at any **groundwater monitoring point** is conditional on (Clauses A - D of Condition 3, DP 6010):

A. Completion of the initial monitoring program;
B. Good consistency of groundwater sample analysis results, or a clearly identified reason for inconsistent results that excludes the contaminant source being landfill operations, stored waste or leachate;
C. No decline in groundwater quality as determined from indicator parameter trends over a period of four consecutive sampling rounds;
D. If a well being monitored on a conditional frequency becomes non-compliant with condition C, the monitoring frequency for that well should return to the initial monitoring frequency until conditions B and C are again being fulfilled.

(2) If site management planning indicates any **early detection monitoring well** is likely to become buried or otherwise destroyed within the following year as a result of normal operations (Clauses E - H, Condition 3, DP 6010):

E. This must be communicated to the regional council;
F. A replacement well is to be constructed in a position agreed upon with Horizons Regional Council
G. The replacement well should be installed in a position suitable to act as a early detection well and be classed as an early detection well;
H. The replacement well should be constructed as a nested well (or two separate wells) with screens positioned in both shallow and deep aquifers.

(4) A reduction in sampling frequency at the **Hokio Stream monitoring locations (HS1A, HS2 and HS3)** is conditional on (Clauses I - L, Condition 3 of DP 6010):

I. No signficant increases in the concentrations between monitoring sites HS1A and HS3, for parameters exceeding the trigger values contained in Table C1 at Site HS3.
J. A statistical analysis approach is to be used to determine if there is a significant increase in contaminant levels between HS1A and HS3.
K. Following the 24 month monitoring period, there shall be no significant increases in concentrations between monitoring sites HS1A and HS3.
L. If the Hokio Stream monitoring locations are being sampled on a conditional frequency and do not meet condition K, the monitoring frequency for all three monitoring locations (HS1A, HS2 and HS3) shall return to the base case intensive monitoring until conditions J and K are again being fulfilled.

(5) A reduction in sampling frequency at the **leachate pond outlet** is conditional on (Clauses M - P, Condition 3, DP 6010):

M. Completion of the initial 2 year monitoring program;
N. Good consistency of water sample analysis results, or a clearly identified reason for inconsistent results;
O. No decline in water quality over a period of four consecutive sampling rounds;
P. If the leachate pond outlet is being sampled on a conditional frequency and becomes non-compliant with condition O, the monitoring frequency should return to the base case intensive monitoring until conditions N and O are again being fulfilled.

COMPREHENSIVE PARAMETER LIST (Table E of Condition 3, DP 6010)

Characterising parameters	pH
	electrical conductivity (EC)
	alkalinity
	total hardness
	suspended solids
Oxygen demand	COD and scBOD$_5$
Nutrients*	NO3-N, NH4-N, DRP and SO_4
Metals*	Al, As, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Zn and Hg
Other elements	B, Ca, Cl, K and Na
Organics	Total organic carbon, total phenols, volatile acids
Biological	E. coli

* Analyses performed for nutrients and metals are for dissolved rather than total concentrations

INDICATOR PARAMETER LIST (Table F, Condition 3, DP 6010)

Characterising parameters	pH
	electrical conductivity (EC)
Oxygen demand	COD and scBOD$_5$
Nutrients*	NO3-N and NH4-N
Metals*	AL, Mn, Ni, Pb and Hg
Other elements	B and Cl
Biological+	E. coli

* Analyses performed for nutrients and metals are for dissolved rather than total concentrations

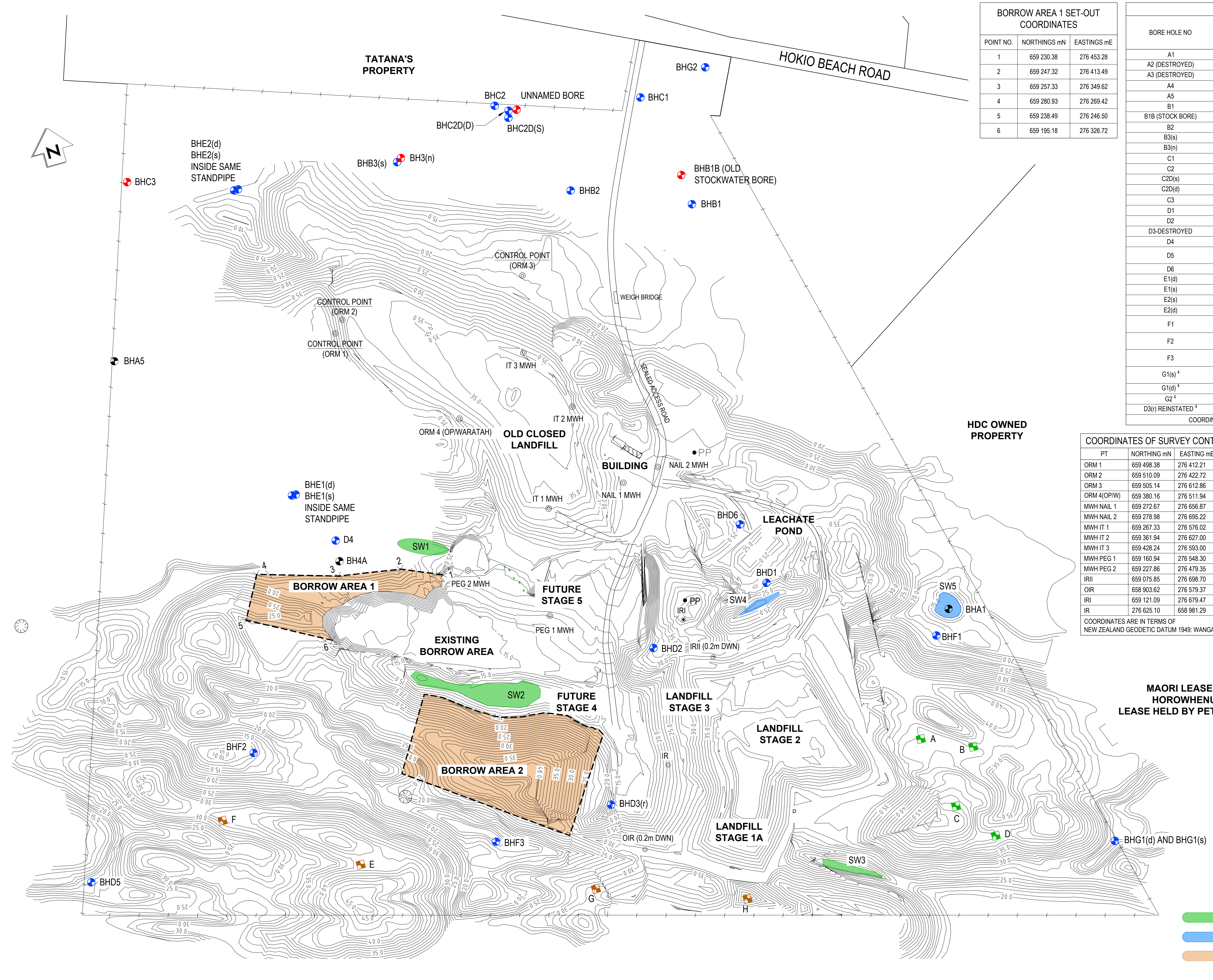
+ E. coli added from April 2019 sampling onwards

Appendix C Site Plan

BORROW AREA 1 SET-OUT COORDINATES		
POINT NO.	NORTHINGS mN	EASTINGS mE
1	659 230.38	276 453.28
2	659 247.32	276 413.49
3	659 257.33	276 349.62
4	659 280.93	276 269.42
5	659 238.49	276 246.50
6	659 195.18	276 326.72

BORE LOCATIONS AND DETAILS

BORE HOLE NO	NORTHING mN	EASTING mE	R.L. (m)	DEPTH OF WELL (m)	PIEZOMETER DIAMETER (mm)	FUNCTION
A1	659 060.15	276 944.89	12.95			SHALLOW AQUIFER
A2 (DESTROYED)						SHALLOW AQUIFER
A3 (DESTROYED)						SHALLOW AQUIFER
A4	659 271.67	276 354.72	10.10			SHALLOW AQUIFER
A5	659 530.47	276 185.91	9.62			SHALLOW AQUIFER
B1	659 561.81	276 797.35	9.04	4.3	40	SHALLOW AQUIFER
B1B (STOCK BORE)	659 530.08	276 799.91	9.28	10		
B2	659 576.32	276 683.50	9.42	3.5	50	SHALLOW AQUIFER
B3(s)	659 651.19	276 519.52	7.76	2.83	50	SHALLOW AQUIFER
B3(n)	659 654.26	276 524.38	7.49	2.33	32	DEEP AQUIFER
C1	659 649.64	276 777.83	7.47	3.60	50	SHALLOW AQUIFER
C2	659 680.80	276 631.22	7.50	2.81	32	SHALLOW AQUIFER
C2D(s)	659 671.19	276 641.63	10.13	12.88	32	SHALLOW AQUIFER
C2D(d)	659 671.19	276 641.63	10.11	18.85	32	DEEP AQUIFER
C3	659 704.29	276.246.89	7.22	2.8	32	SHALLOW AQUIFER
D1	659 134.97	276 771.65	27.46	23.69	50	EARLY DETECTION
D2	659 101.02	276 642.06	32.12	29.46	50	EARLY DETECTION
D3-DESTROYED						
D4	659 293.20	276 356.60	17.97	17.0		SHALLOW AQUIFER
D5	659 020.80	276 022.40	20.65	18		SHALLOW AQUIFER BACKGROUND
D6	659 200.31	276 761.08	26.41	16.07	50	EARLY DETECTION
E1(d)	659 349.54	276 329.48	20.91	37.80	32	SHALLOW AQUIFER
E1(s)	659 349.54	276 329.48	20.91	20.05	32	DEEP AQUIFER
E2(s)	659 667.30	276 354.69	13.15	15.24	32	SHALLOW AQUIFER
E2(d)	659 667.30	276 354.69	13.15	28.66	32	DEEP AQUIFER
F1	659 037.10	276 925.50	18.90	15.0	50	SHALLOW AQUIFER LEACHATE IRRIGATION
F2	659 105.00	276 218.00	13.50	10.2	50	SHALLOW AQUIFER LEACHATE IRRIGATION
F3	658 951.7	276 434.0	16.70	10.5	50	SHALLOW AQUIFER LEACHATE IRRIGATION
G1(s) [4]	658 786	277 046	24	15	50	SHALLOW AQUIFER BACKGROUND
G1(d) [4]	658 786	277 046	24	31.5	50	DEEP AQUIFER BACKGROUND
G2 [4]	659 673	276 835	8	4	50	SHALLOW AQUIFER
D3(r) REINSTATED [4]	658 953	276 552	18	10	50	EARLY DETECTION
COORDINATES ARE IN TERMS OF NEW ZEALAND GEODETIC DATUM 1949: WANGANUI CIRCUIT						



COORDINATES OF SURVEY CONTROL MARKS			
PT	NORTHING mN	EASTING mE	RL
ORM 1	659 498.38	276 412.21	38.94
ORM 2	659 510.09	276 422.72	34.98
ORM 3	659 505.14	276 612.86	21.10
ORM 4(OP/W)	659 380.16	276 511.94	30.92
MWH NAIL 1	659 272.67	276 656.87	27.61
MWH NAIL 2	659 278.98	276 695.22	28.40
MWH IT 1	659 267.33	276 576.02	30.03
MWH IT 2	659 361.94	276 627.00	33.70
MWH IT 3	659 428.24	276 593.00	32.74
MWH PEG 1	659 160.94	276 548.30	32.99
MWH PEG 2	659 227.86	276 479.35	30.49
IRII	659 075.85	276 698.70	30.04
OIR	658 903.62	276 579.37	30.35
IRI	659 121.09	276 679.47	40.00
IR	276 625.10	658 981.29	21.30
COORDINATES ARE IN TERMS OF NEW ZEALAND GEODETIC DATUM 1949: WANGANUI CIRCUIT			

SOIL MONITORING LOCATIONS	CO-ORDINATES		LEVEL (m)
	NORTHING mN	EASTING mE	
PEG A	658 938.80	276 882.30	39.2
PEG B	658 917.00	276 932.10	39.5
PEG C	658 862.70	276 899.00	46.1
PEG D	658 822.90	276 930.40	40.4
PEG E	658 965.50	276 294.00	36.6
PEG F	659 046.20	276 169.10	32.9
PEG G	658 878.00	276 520.20	32.6
PEG H	658 827.40	276 667.60	23.5

NOTES:

1. LEVELS ARE TOP OF STANDPIPE. WHERE THERE IS NO STANDPIPE, LEVELS ARE TOP OF PVC PIPE.
2. BHA2, BHA3 AND BHD3 HAVE BEEN LOST DUE TO SITE WORKS.
3. "A" SERIES BORE HOLES ARE AUGER HOLES ONLY AND MAY NOT BE ABLE TO BE LOCATED.
4. BORES INSTALLED IN AUG 2009. DETAILS ARE APPROXIMATE.
5. CONTOUR INTERVALS: 5m MAJOR, 1m MINOR

LEGEND

- MONITOR BORES CURRENTLY SAMPLED (FROM JAN 2010)
- BORES NOT SAMPLED
- SHALLOW HANDAUGER STANDPIPES NOT ABLE TO BE LOCATED
- SOIL SAMPLING LOCATION PEG - MONITORED
- SOIL SAMPLING LOCATION PEG - NOT MONITORED
- EXISTING STORMWATER SOAKAGE AREA
- PROPOSED STORMWATER SOAKAGE AREA
- PROPOSED BORROW AREAS

NOT FOR CONSTRUCTION

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

REV	REVISIONS	DRN	CHK	APP	DATE
B	FOR INFORMATION - BORROW AREA AND LANDFILL AREA UPDATES	BCJ	PSL	PSL	22.09.20
A	FOR INFORMATION	BCJ	PSL	PSL	26.08.19

SURVEYED	MWH	
DESIGNED	N/A	-
DRAWN	Brent James	08.2019
CAD REVIEW	Brent James	22.09.20
APPROVED	Phil Landmark	22.09.20
PROF REGISTRATION:		

Stantec

Client:

HOROWHENUA DISTRICT COUNCIL
LEVIN LANDFILL

MONITORING BORES, SOIL SAMPLING LOCATIONS & BORROW AREAS
SITE PLAN, LOCATION AND DETAILS

Status Stamp: **FOR INFORMATION ONLY**

Date Stamp: **22.09.20**

Scales: 1:2000 (A1) 1:4000 (A3)

Drawing No.: 310101088-19-001-G001

Rev.: B

26/08/2019 9:35 a.m.

pw:\\asiavpwint05.mwhglobal.com:AP_PROJECTS\Documents\New Zealand Clients\Horowhenua District Council\80500724 (310101088) - Levin Landfill Volumes\2019\General\310101088-19-001-G001

Appendix D Tabulated Analysis Results

B1 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		1.02	1.39	1.0770	1.39	1.14	0.875	1.01	1.33	1.15	0.96	1.06	1.16	1.035	0.57	0.65	1.24	0.983	1.28	0.937	1.2	0.6	0.19
pH		6 to 9	7.0	7.8	7.000	6.9	7.8	7.0	7.0	7.6	7.2	6.9	6.9	6.7	6.9	7.1	7.5	7.2	7	7.2	6.8	6.9	7.3	6.9
Suspended Solids	mg/l		7	19	3.00	*3*				*3*	*3*				10			18					19	
Phenol	mg/L		0.025	0.025	0.0250	*0.025*				*0.005*	*0.025*				*0.025*			0.0015					0.025	
VFA	mg/L		2.5	5	2.50	*2.5*				*2.5*	*2.5*				5			2.5					2.5	
TOC	mg/L		16.0	27.6	22.80	22.8				17.2	14.7				13.3			7.5					27.6	
Alkalinity	mg CaCO3/L		333	624	624.00	624				519	309				299			52					357	
Conductivity	mS/m		197	355	145.00	276	167	123	119	190	156	181	191	168	196	219	223	26.9	316	291	268	297	312	197
COD	mg/L		79	136	64.50	60	69	87	58	102	92	71	49	113	41	51	129	33	122	136	115	7.5	99	51
BOD (scBOD frm Apr'20)	mg/L		2.3	22	0.50	0.5				1.0	*1.5*				22			3					11	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	180	30.00	ND	20	40	*ND*	*2*	*2*				*2*			180					2	
Chloride	mg/L		440	867	211.00	506	283	139	118	297	269	366	422	331	447	508	432	26.5	798	807	710	768	666	529
Nitrate-N	mg/L	90.3	2.71	13.0	8.3050	1.50	8.16	8.45	9.46	1.13	3.16	4.32	3.02	0.23	*0.05*	0.32	0.73	2.39	0.71	1.1	6.41	3.97	1.59	3.1
Sulphate	mg/L	1000	32.55	56.0	2.850	2.85				9.84	47.0				45.9			19.2					56	
Ammonia-N	mg/L		19.6	48.2	8.790	16.80	9.79	7.10	7.79	18.1	11.1	11.9	14.9	23.0	21.0	21.1	16.9	0.16	38.5	30.9	34.5	38.8	43.4	40.8
Hardness	mg CaCO3/L		519	797.0	670.00	670				470	379				568			78					797	
Calcium	mg/L	1000	99	148.0	122.00	122				90.8	66.7				108			17.9					148	
Magnesium	mg/L		66	104.0	88.90	88.9				59.0	50.9				72.4			8.13					104	
Potassium	mg/L		22.3	41.1	29.90	29.9				23.3	18.2				21.3			3.66					41.1	
Sodium	mg/L		150	280.0	126.50	257	132	121	111	145	124	150	143	128	145	157		25.5	246	280	231	246	195	192
D.R. Phosphorus	mg/L		0.104	0.79	0.1050	0.105				0.104	0.099				0.104			0.016					0.789	
Aluminium	mg/L	5	0.006	0.0	0.00450	0.005	0.004	0.004	0.007	0.004	0.002	0.004	0.002	0.006	0.005	0.008	0.015	0.009	0.006	0.022	0.044	0.012	0.006	0.007
Arsenic	mg/L	0.5	0.001	0.001	0.0010	0.001				*0.0005*	*0.0005*				0.0005			0.0005					0.001	
Boron	mg/L	5	0.60	1.20	0.600	1.20	0.53	0.56	0.64	0.89	0.49	0.41	0.35	0.49	0.43	0.55	1.08	0.06	0.49	0.68	0.82	1.02	1.08	0.84
Cadmium	mg/L	0.01	0.0001	0.00	0.00010	*0.0001*				0.0003	0.0004				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.00	0.00050	*0.0005*				*0.0005*	*0.0005*				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.0052	0.009	0.009400	0.0094				0.0058	0.0055				0.0048			0.001					0.0046	
Iron	mg/L		0.047	0.2	0.020	0.032	0.02	0.01	0.02	0.047	0.017	0.02	0.01	0.04	0.088	0.06		0.117	0.06	0.04	0.09	0.11	0.069	0.07
Lead	mg/L	0.1	0.0003	0.008	0.000250	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.0006*	*0.00025*	*0.00025*	*0.00025*	0.0007	0.0006	0.0011	0.00025	0.0007
Manganese	mg/L		11.5	24	7.40	17.50	8.56	5.97	6.23	11.0	8.28	9.85	10.4	9.38	12.6	12.0	9.10	0.0331	19.6	14.6	15.6	16.7	22.3	17.1
Mercury	mg/L		0.00025	0.0003	0.000250	*0.00025*																		
Nickel	mg/L	1	0.0020	0.01	0.00160	0.0045	0.0019	0.0010	0.0013	0.0033	0.0017	0.0016	0.0014	0.0028	0.0020	0.0021	0.0024	*0.00025*	0.0017	0.0017	0.002	0.0029	0.0042	0.0042
Zinc	mg/L	20	0.006	0.021	0.0050	0.005				0.007	0.003				0.020			0.001					0.021	

If value is <, divide by 2 and make *italic*

B2 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		1.26	1.75	1.4450	1.65	1.45	1.21	1.44	1.61	1.46	1.3	1.41	1.48	1.12	0.65	0.94	0.89	1.09	1.75	1.178	1.53	0.67	1.15
pH		6 to 9	7.1	7.50	6.80	6.9	7.1	6.6	6.7	7.2	6.9	7.0	7.1	6.8	7.2	7.0	7.0	7.4	7.1	7.4	7.4	7	7.5	7.2
Suspended Solids	mg/l		8	42	9.00	9				*3*	*3*				7			10					42	
Phenol	mg/L		0.025	0.03	0.0250	*0.025*				*0.025*	*0.025*				*0.025*			0.0015					0.025	
VFA	mg/L		2.5	10	2.50	*2.5*				6	*2.5*				10			2.5					2.5	
TOC	mg/L		35.6	129	31.70	31.7				25.6	26.4				39.4			43.2					129	
Alkalinity	mg CaCO3/L		640	985	723.00	723				688	466				591			545					985	
Conductivity	mS/m		165	244	182.50	209	176	189	135	186	152	151	138	172	173	117	157	158	191	145	157	241	244	220
COD	mg/L		88	310	79.50	81	84	78	50	112	36	81	70	91	81	108	93	101	7.5	124	153	38	310	270
BOD (scBOD frm Apr'20)	mg/L		2	21	0.50	*0.5*				*1.5*	*1.5*				*3*			7					21	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	3	48	28.00	*ND*	4	28	48	*2*	*2*				*2*			16					2	
Chloride	mg/L		105	255	108.850	141	94.7	123	87.2	125	101	90.6	83.5	136	98.2	33.2	95.3	89.9	170	110	109	223	134	255
Nitrate-N	mg/L	90.3	7.34	44	32.550	21.8	44.2	34.7	30.4	4.03	16.9	18.4	16.5	19.0	0.36	0.02	4.61	6.54	2.28	6.27	8.56	4.3	0.34	3.73
Sulphate	mg/L	1000	58.90	123	8.850	8.85				19.6	45.7				123.0			72.1					120	
Ammonia-N	mg/L		34	81	44.650	51.6	43.8	45.5	21.4	55.2	43.6	32.6	30.0	49.5	77.0	35.4	14.1	15.8	47	9.77	19.7	81.4	30.9	27.3
Hardness	mg CaCO3/L		321	546	546.00	546				410	235				244			322					320	
Calcium	mg/L	1000	65	117	117.00	117				90.6	50.1		1.1		64.7			65.7					62.6	
Magnesium	mg/L		40	61.6	61.60	61.6				44.6	25.6				19.9			40.1					39.7	
Potassium	mg/L		57.3	68	57.60	57.6				56.9	47.4				68.1			36.8					66.9	
Sodium	mg/L		148	375	101.30	115.0	99.6	103	85.0	132	130	122	114	148	154	131		184	210	197	268	193	375	341
D.R. Phosphorus	mg/L		0.035	0.05	0.0210	0.021				0.029	0.035				0.053			0.037					0.034	
Aluminium	mg/L	5	0.019	0.07	0.0110	0.009	0.011	0.011	0.017	0.012	0.014	0.018	0.016	0.018	0.062	0.045	0.036	0.029	0.038	0.02	0.057	0.018	0.073	0.046
Arsenic	mg/L	0.5	0.003	0.006	0.0060	0.006				0.003	0.003				0.003			0.001					0.003	
Boron	mg/L	5	1.35	2.71	1.19500	1.69	1.02	1.37	0.92	1.20	1.07	0.78	0.93	1.25	1.25	1.24	1.33	1.41	1.78	1.97	2.54	2.21	2.71	2.02
Cadmium	mg/L	0.01	0.0001	0.00	0.00010	*0.0001*				*0.0001*	*0.0001*				*0.0001*			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.00	0.0010	0.001				0.001	*0.0005*				0.001			0.0005					0.002	
Copper	mg/L	0.4	0.0035	0.0148	0.00310	0.0031				0.0018	0.0026				0.0039			0.0063					0.0148	
Iron	mg/L		0.140	2.0	0.4310	0.722	1.34	0.14	0.04	0.264	1.06	0.09	0.09	1.23	1.97	0.36		0.052	0.11	0.02	0.09	0.27	0.312	0.05
Lead	mg/L	0.1	0.0003	0.003	0.000250	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0009	0.0025
Manganese	mg/L		2.0	4	3.2850	4.33	3.43	3.14	2.27	2.72	1.93	2.06	1.17	1.74	1.54	1.61	0.995	0.84	2	0.463	0.273	2.45	2.62	2.51
Mercury	mg/L		0.00025	0.0003	0.000250	*0.00025*																		
Nickel	mg/L	1	0.0036	0.013	0.001950	0.0030	0.0021	0.0018	0.0010	0.0018	0.0018	0.0027	0.0029	0.0017	0.0038	0.0047	0.0046	0.0043	0.0053	0.004	0.0051	0.0045	0.0132	0.0068
Zinc	mg/L	20	0.010	0.032	0.00400	0.004				0.003	*0.001*				0.016			0.02					0.032	

B3 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		0.15	0.30	0.14250	0.15	0.1	0.135	0.21	0.27	0.2	0.15	0.2	0.24	0.3	0	0	0.15	0.1	0.3	0	0	0.2	0.03
pH		6 to 9	6.9	7.4	7.050	7.1	7.0	6.9	7.1	7.0	6.9	6.8	6.9	6.9	6.9	6.9	7.2	7.4	7.2	6.9	7	7	6.8	6.9
Suspended Solids	mg/l		101.5	160	74.00	74				111	84				108			160					95	
Phenol	mg/L		0.025	0.03	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		2.5	10	2.500	2.5				6	2.5				2.5			10					2.5	
TOC	mg/L		71.65	89.8	70.60	70.6				72.7	67.4				79.1			89.8					56.7	
Alkalinity	mg CaCO3/L		1245	1490	1180.00	1180				1290	1280				1210			1490					1150	
Conductivity	mS/m		291	371	279.00	288	254	270	294	324	318	319	297	304	309	329	350	371	265	225	245	253	275	268
COD	mg/L		206	699	181.50	213	150	119	221	624	199	310	249	699	240	281	72	239	313	163	123	7.5	115	85
BOD (scBOD frm Apr'20)	mg/L		5.0	12	3.00	3				3	3				7			12					7	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	4	#NUM!	ND	ND	ND	ND	2	2				4			2					2	
Chloride	mg/L		203	269	178.00	194	172	177	179	213	219	238	200	220	198	217	264	269	205	139	167	181	209	210
Nitrate-N	mg/L	90.3	0.1	12	0.050	0.05	0.02	0.05	0.05	0.050	0.005	0.005	0.05	0.05	0.05	11.6	0.68	0.38	0.2	0.92	0.005	0.36	0.2	0.005
Sulphate	mg/L	1000	0.6	2	0.010	0.01				0.01	0.33				1.94			0.95					1.44	
Ammonia-N	mg/L		155	198	142.00	143	140	141	170	170	179	185	166	174	173	177	198	186	109	98.4	104	92.7	107	85.7
Hardness	mg CaCO3/L		513	747	509.00	509				517	475				374			747					694	
Calcium	mg/L	1000	102	158	89.70	89.7				105.0	98.6				86.8			158					128	
Magnesium	mg/L		65.50	90.8	69.20	69.2				61.8	55.2				40.4			85.2					90.8	
Potassium	mg/L		103	135	91.50	91.5				109	104				101			135					80	
Sodium	mg/L		151	184	146.50	152	129	141	157	170	155	178	158	151	141	154		184	132	131	140	135	142	160
D.R. Phosphorus	mg/L		0.04	0.1	0.0310	0.031				0.043	0.044				0.058			0.044					0.031	
Aluminium	mg/L	5	0.004	0.01	0.0040	0.007	0.005	0.003	0.003	0.007	0.004	0.004	0.003	0.004	0.009	0.007	0.005	0.007	0.004	0.003	0.011	0.004	0.004	0.004
Arsenic	mg/L	0.5	0.019	0.035	0.0350	0.035				0.020	0.026				0.011			0.01					0.017	
Boron	mg/L	5	1.17	1.84	1.2850	1.40	0.80	1.17	1.40	1.38	1.31	0.89	0.90	1.34	1.51	1.67	1.67	1.84	1.08	0.96	0.94	0.85	1.17	0.87
Cadmium	mg/L	0.01	0.00010	0.00	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.005	0.01	0.0050	0.005				0.005	0.005				0.005			0.007					0.004	
Copper	mg/L	0.4	0.011	0.040	0.00070	0.0007				0.0027	0.0017				0.0184			0.0291					0.0395	
Iron	mg/L		0.9	1.4	0.8850	1.03	1.40	0.74	0.34	1.37	0.857	1.11	0.90	1.30	0.709	1.01		1.31	0.87	0.52	0.96	0.7	0.558	0.72
Lead	mg/L	0.1	0.00025	0.000	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		4.4	7	3.8450	4.84	3.86	3.39	3.83	3.94	3.32	2.68	2.87	2.75	2.08	4.39	5.32	4.73	6.5	4.66	4.31	5.69	5.78	6.61
Mercury	mg/L		0.000250	0.00025	0.000250	0.00025																		
Nickel	mg/L	1	0.01090	0.023	0.010350	0.0136	0.0106	0.0085	0.0101	0.0117	0.0126	0.0131	0.0113	0.0110	0.0127	0.0226	0.0166	0.0187	0.0108	0.0071	0.008	0.0079	0.0093	0.0092
Zinc	mg/L	20	0.006	0.074	0.0010	0.001				0.003	0.001				0.009			0.074					0.014	

C1 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		0.22	3.6	0.430	0.55	0.31	3.6	0.20	0.22	0.24	0.12	0.22	0.31	0.4	0	0	0	0.1	0.22	0.1	0.2	0.47	0.32
pH		6 to 9	6.7	7.0	6.650	6.7	7.0	6.6	6.6	6.8	6.9	6.7	6.4	6.5	6.7	6.9	6.5	6.6	6.9	6.7	6.5	6.6	6.9	6.6
Suspended Solids	mg/l		31.5	206	40.00	40				21	62				10			23					206	
Phenol	mg/L		0.025	0.03	0.0250	0.025				0.025	0.025				0.025			0.0015					0.025	
VFA	mg/L		2.5	6	2.500	2.5				2.5	2.5				5			6					2.5	
TOC	mg/L		15.6	22.3	16.60	16.6				13.8	14.6				16.0			15.1					22.3	
Alkalinity	mg CaCO3/L		269.5	415	249.00	249				262	222				343			277					415	
Conductivity	mS/m		127.0	177	135.00	127	143	127	145	116	99	132	150	134	121	89.2	99.9	110	119	136	177	141	111	124
COD	mg/L		53	134	73.00	54	76	85	70	45	36	51	48	49	60	134	69	45	58	115	108	7.5	39	47
BOD (scBOD frm Apr'20)	mg/L		2	3.0	1.00	1				1.5	3				1			1.5					1.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2.00	16	#NUM!	ND	ND	ND	ND	2	16				2			2					2	
Chloride	mg/L		220.50	380	248.00	217	252	244	283	193	156	239	298	244	158	97.3	138	170	167	265	374	224	120	202
Nitrate-N	mg/L	90.3	0.005	0	0.0050	0.005	0.005	0.005	0.05	0.005	0.005	0.005	0.49	0.05	0.05	0.005	0.005	0.05	0.01	0.005	0.005	0.04	0.005	0.005
Sulphate	mg/L	1000	13.5	32.6	32.600	32.6				18.7	19.4				3.93			8.24					2.72	
Ammonia-N	mg/L		0.335	2.91	0.5850	2.91	0.41	0.41	0.76	0.59	1.10	0.27	0.37	0.33	0.35	0.28	0.18	0.22	0.26	0.21	0.3	0.34	0.23	0.32
Hardness	mg CaCO3/L		271.0	306	306.00	306				261	196				293			218					281	
Calcium	mg/L	1000	49.35	52.2	52.20	52.2				49.4	36.4				51.7			39					49.3	
Magnesium	mg/L		35.9	42.6	42.60	42.6				33.4	25.5				41.8			29					38.3	
Potassium	mg/L		11.40	17	16.70	16.70				9.88	11.4				10.3			11.9					11.4	
Sodium	mg/L		144.00	200	144.00	122	157	151	137	119	116	145	190	168	126	95.3		125	147	144	200	148	114	144
D.R. Phosphorus	mg/L		0.02	0.02	0.01100	0.011				0.016	0.020				0.024			0.016					0.01	
Aluminium	mg/L	5	0.007	0.0	0.00750	0.009	0.005	0.006	0.010	0.005	0.014	0.007	0.002	0.007	0.006	0.011	0.019	0.012	0.006	0.007	0.034	0.005	0.008	0.003
Arsenic	mg/L	0.5	0.0005	0.001	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Boron	mg/L	5	0.580	0.85	0.5950	0.57	0.47	0.62	0.69	0.45	0.57	0.48	0.50	0.66	0.60	0.59	0.52	0.56	0.65	0.57	0.63	0.7	0.85	0.59
Cadmium	mg/L	0.01	0.0001	0.000	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.00050	0.0	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.0010	0.00	0.00080	0.0008				0.0012	0.0005				0.00025			0.0014					0.0019	
Iron	mg/L		2	5	2.9400	2.53	3.35	0.78	3.49	0.577	2.14	4.50	0.07	0.95	0.856	1.30		1.95	1.77	3.17	3.14	2.2	1.1	0.38
Lead	mg/L	0.1	0.0003	0.00	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.0007	0.00025	0.00025	0.00025	0.00025	0.0017	0.0006	0.0006	0.00025	0.0006	0.0013	0.00025	0.00025	0.00025
Manganese	mg/L		0.370	0.6	0.36650	0.410	0.323	0.197	0.419	0.328	0.241	0.388	0.379	0.356	0.411	0.439	0.234	0.286	0.4	0.342	0.472	0.611	0.423	0.359
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.0011	0.003	0.00080	0.0012	0.0009	0.0006	0.0007	0.0008	0.0007	0.0010	0.0008	0.0008	0.0009	0.0031	0.0014	0.0012	0.0011	0.001	0.0018	0.0011	0.0013	0.0011
Zinc	mg/L	20	0.00	0.022	0.0010	0.001				0.003	0.001				0.019			0.001					0.022	

C2 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC	Median	Maximum	Annual	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
		STOCK			Median													resampled June-17						
Water level	mBGL		0.35	2.84	0.3900	0.47	0.42	0.245	0.36	0.44	0.385	0.33	0.34	0.4	2.84	0.05	0	0.42	0.27	0.18	0.175	0.46	0.6	0.28
pH		6 to 9	7.0	7.5	7.050	7.2	6.9	7.0	7.1	7.1	7.0	6.8	7.0	6.9	6.9	6.9	7.2	7.3	7	6.9	7	6.8	7.1	7.1
Suspended Solids	mg/l		217	726	516.00	516				21	14				102			332					726	
Phenol	mg/L		0.025	0.025	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		2.5	9	2.50	2.5				2.5	2.5				2.5			9					2.5	
TOC	mg/L		48.3	58	45.60	45.6				47.2	48.3				48.3			58.1					48.9	
Alkalinity	mg CaCO3/L		1039	1220	818.00	818				968	939				1110			1220					1120	
Conductivity	mS/m		327	414	322.00	346	372	298.0	242	296	320	324	252	283	395	393	396	414	398	393	329	334	288	96.4
COD	mg/L		147	765	134.00	127	157	113	141	472	244	145	115	765	221	160	69	126	209	743	257	148	124	7.5
BOD (scBOD frm Apr'20)	mg/L		3	10	3.00	3				3	3				3			3					10	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	6	3900	8.00	ND	8	4	3900	1070	2				16			4					2	
Chloride	mg/L		373	590	430.00	492	524	368	170	292	377	366	210	292	527	588	516	561	590	539	340	456	275	37.2
Nitrate-N	mg/L	90.3	0.05	11	0.050	0.08	0.005	0.05	0.05	0.05	0.005	0.005	0.05	0.05	0.05	10.8	0.01	0.03	0.02	8.35	0.005	0.005	0.005	0.19
Sulphate	mg/L	1000	17.75	42	42.30	42.3				11.4	25.5				21.4			14.1					0.84	
Ammonia-N	mg/L		157.0	186	163.00	169	181	157	124	141	157	174	134	132	171	171	177	186	164	169	145	140	121	0.005
Hardness	mg CaCO3/L		377	553	277.00	277				236	293				482			553					461	
Calcium	mg/L	1000	73	121	54.70	54.7				51.4	61.4				105			121					83.8	
Magnesium	mg/L		44	60.5	34.00	34.0				26.0	32.4				53.0			60.5					53.1	
Potassium	mg/L		88	115	91.500	91.5				78.3	85.3				114			115					75.5	
Sodium	mg/L		260	378	231.00	291	256	206	183	262	295	230	187	233	311	276		378	349	325	291	260	216	39.2
D.R. Phosphorus	mg/L		0.019	0	0.0130	0.013				0.024	0.021				0.023			0.016					0.01	
Aluminium	mg/L	5	0.0095	0.0	0.0210	0.041	0.024	0.007	0.018	0.013	0.011	0.006	0.010	0.015	0.012	0.006	0.008	0.009	0.006	0.005	0.015	0.009	0.013	0.001
Arsenic	mg/L	0.5	0.00150	0.002	0.0020	0.002				0.002	0.001				0.001			0.002					0.001	
Boron	mg/L	5	1.83	2.24	1.830	2.24	1.64	1.85	1.81	2.17	2.06	1.60	1.55	1.94	2.01	1.97	2.06	2.07	2.13	1.56	1.74	1.62	1.76	0.07
Cadmium	mg/L	0.01	0.0001	0.00	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.002	0.0	0.0020	0.002				0.002	0.002				0.002			0.002					0.002	
Copper	mg/L	0.4	0.0014	0.007	0.00170	0.0017				0.0005	0.00025				0.0046			0.001					0.0066	
Iron	mg/L		0.5	2.5	0.5550	0.158	0.48	0.63	2.48	0.994	1.48	0.48	0.28	0.38	0.311	0.46		0.274	0.46	0.24	0.34	0.46	0.248	0.09
Lead	mg/L	0.1	0.00025	0.001	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		0.1370	0.46	0.05870	0.0650	0.0820	0.0512	0.0524	0.0558	0.0778	0.0923	0.0734	0.0755	0.187	0.326	0.241	0.238	0.264	0.267	0.16	0.271	0.185	0.114
Mercury	mg/L		0.00025	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.0060	0.01	0.00410	0.0017	0.0052	0.0033	0.0049	0.0060	0.0060	0.0054	0.0049	0.0061	0.0064	0.0080	0.0071	0.008	0.0075	0.007	0.0063	0.0055	0.0065	0.00025
Zinc	mg/L	20	0.010	0.019	0.0090	0.009				0.002	0.003				0.010			0.012					0.019	

C2DD Monitoring Bore HDC Levin Landfill (Deep)

Determinand		NZDW	Median	Maximum	Annual	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
		MAV			Median													resampled June-17					(resample)	
Water level	mBGL		2.53	3.5300	2.4900	3.07	2.59	2.39	2.26	2.69	2.51	2.47	2.5	2.895	2.65	2.31	2.46	2.32	2.44	2.54	3.53	2.87	2.95	2.59
pH		7 to 8.5*	7.4	8.0	7.550	7.7	8.0	7.4	7.4	7.4	7.4	7.4	7.3	7.4	7.3	7.4	7.6	7.7	7.4	7.3	7.4	7.5	7.5	7.4
Suspended Solids	mg/l		20	43	3.00	3				27	3				19			43					21	
Phenol	mg/L		0.03	0.03	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		3	25	2.50	2.5				2.5	2.5				2.5			2.5					25	
TOC	mg/L		4.2	5.2	4.20	4.2				3.9	4.0				4.2			4.4					5.2	
Alkalinity	mg CaCO3/L		189	199	194.00	194				186	192				182			199					186	
Conductivity	mS/m		50.9	62	52.40	52.5	55.2	51.6	52.3	50.6	51.0	51.1	62.4	52.0	49.0	48.9	50.0	51.6	8.8	49.9	49.7	50.7	51.6	50.7
COD	mg/L		7.5	47	7.50	7.5	7.5	7.5	7.5	7.5	7.5	47	23	7.5	24	7.5	7.5	20	7.5	7.5	22	7.5	7.5	21
BOD (scBOD frm Apr'20)	mg/L		0.50	1	0.50	0.5				0.5	0.5				0.5			0.5					1	
Faecal C (Ecoli frm Apr'20)	col/100ml	NIL	2	4	#NUM!	ND	ND	ND	ND	2	2		2	2	4			2					2	
Chloride	mg/L	250*	36.8	47	39.350	40.5	41.0	38.2	38.2	37.7	37.7	39.0	46.5	36.8	35.3	35.6	34.9	35.9	12.2	36	36.3	36.4	36.5	36.7
Nitrate-N	mg/L	11.3	0.01	0.31	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.28	0.31	0.03	0.005	0.07	0.01	0.03	0.005	0.005	0.16
Sulphate	mg/L	250*	0.1	0.1	0.030	0.03				0.02	0.02				0.12			0.1					0.12	
Ammonia-N	mg/L	1.17	0.32	1	0.330	0.33	0.33	0.32	0.33	0.37	0.32	0.32	0.36	0.32	0.02	0.005	0.28	0.31	0.68	0.36	0.37	0.41	0.09	0.005
Hardness	mg CaCO3/L	200*	162	169	168.00	168				161	163				148			169					155	
Calcium	mg/L		42.0	44	43.80	43.8				41.5	42.4				38.5			44.4					39.5	
Magnesium	mg/L		13.8	14.3	14.30	14.3				13.9	13.7				12.7			14					13.7	
Potassium	mg/L		6.2	7.1	6.320	6.32				5.54	6.33				5.45			6.07					7.06	
Sodium	mg/L	200*	39	44	32.950	39.4	39.4	15.3	26.5	37.5	40.8	40.6	43.1	30.9	36.4	37.6		41.6	12.4	43.9	36.4	41.1	40.5	38.8
D.R. Phosphorus	mg/L		0.655	0.7	0.66700	0.667				0.660	0.671				0.602			0.649					0.567	
Aluminium	mg/L	0.1*	0.003	0.0	0.0010	0.001	0.001	0.001	0.006	0.002	0.001	0.006	0.003	0.001	0.003	0.002	0.004	0.004	0.021	0.001	0.011	0.004	0.008	0.001
Arsenic	mg/L	0.01	0.0030	0.005	0.0030	0.003				0.003	0.003				0.003			0.004					0.005	
Boron	mg/L	1.4	0.0650	0.11	0.0650	0.07	0.07	0.06	0.05	0.06	0.06	0.05	0.07	0.06	0.07	0.10	0.06	0.06	0.05	0.08	0.11	0.07	0.07	0.06
Cadmium	mg/L	0.004	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	0.05	0.0005	0.001	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	2	0.000	0.0020	0.000250	0.00025				0.00025	0.00025				0.0010			0.00025					0.002	
Iron	mg/L	0.2*	0.030	0.2	0.0220	0.02	0.04	0.02	0.01	0.016	0.017	0.03	0.01	0.02	0.054	0.05		0.029	0.05	0.03	0.12	0.07	0.184	0.07
Lead	mg/L	0.01	0.0003	0.001	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0011	0.00025
Manganese	mg/L	0.4	0.5815	0.98	0.60350	0.583	0.701	0.624	0.488	0.533	0.555	0.580	0.668	0.583	0.0917	0.153	0.608	0.61	0.0045	0.664	0.711	0.982	0.21	0.234
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	0.08	0.0003	0.001	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0007	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0008	0.0006	0.0009	0.0008
Zinc	mg/L	1.5*	0.00	0.080	0.0010	0.001				0.001	0.001				0.008			0.003					0.08	

* = GV

C2DS Monitoring Bore HDC Levin Landfill (shallow)

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		2.4	3.0000	2.3650	2.43	2.3	2.12	2.51	2.435	2.26	2.2	2.73	2.31	0.37	2.34	2.40	2.28	2.53	2.65	2.795	3	2.98	2.69
pH		6 to 9	6.8	7.5	6.700	7.0	6.7	6.7	6.7	7.0	6.8	6.6	6.8	6.7	6.7	6.7	7.5	7	6.8	6.8	6.8	6.8	6.8	6.8
Suspended Solids	mg/l		104.0	208	52.00	52				104	56				208			114					104	
Phenol	mg/L		0.025	0.0250	0.0250	*0.025*				*0.025*	*0.025*				*0.005*			0.0015					0.025	
VFA	mg/L		2.5	8	2.50	*2.5*				*2.5*	*2.5*				*2.5*			6					8	
TOC	mg/L		31.4	40	32.00	32.0				28.8	30.8				32.8			40.3					26.9	
Alkalinity	mg CaCO3/L		737.0	942	716.00	716				662	758				839			942					600	
Conductivity	mS/m		177	231	174.00	170	182	170	178	157	173	231	173	202	200	187	215	218	200	178	171	175	141	153
COD	mg/L		86	150	93.00	89	97	82	100	73	77	115	91	150	105	96	105	102	33	81	74	7.5	55	71
BOD (scBOD frm Apr'20)	mg/L		3.0	7	3.000	*3*				*3*	*3*				1			3					7	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	2	#NUM!	*ND*	*ND*	*ND*	*ND*	*2*	*2*				*2*			2					2	
Chloride	mg/L		134	192	124.50	125	124	111	133	110	109	142	110	150	154	139	187	192	152	135	131	134	137	103
Nitrate-N	mg/L	90.3	0.02	0.1	0.050	*0.005*	*0.05*	*0.05*	*0.05*	*0.050*	*0.005*	*0.005*	*0.05*	*0.05*	*0.05*	*0.05*	*0.005*	*0.005*	0.02	0.01	*0.005*	*0.005*	*0.005*	*0.005*
Sulphate	mg/L	1000	0.01	2	0.010	*0.01*				*0.01*	0.03				*0.01*		1.54	0.1					0.01	
Ammonia-N	mg/L		1.540	1.79	1.6250	1.79	1.71	1.54	1.45	1.77	1.57	1.18	1.59	1.41	1.69	1.33		1.33	1.42	1.55	1.75	1.63	1.35	1.51
Hardness	mg CaCO3/L		606	961	589.00	589				568	606				690			961					606	
Calcium	mg/L	1000	164.5	268	134.000	134				132	144				185			268					185	
Magnesium	mg/L		58.95	70.6	61.70	61.7				58.0	59.9				55.2			70.6					34.8	
Potassium	mg/L		16.15	17.5	16.70	16.7				14.6	15.6				15.1			17.1					17.5	
Sodium	mg/L		129	166	111.50	115	108	105	132	104	113	166	141	137	129	116		136	119	153	141	142	130	129
D.R. Phosphorus	mg/L		0.03	0.12	0.1220	0.122				0.070	0.029				0.039			0.026					0.022	
Aluminium	mg/L	5	0.001	0	0.0010	0.001	0.010	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.002	0.004	0.002	0.003	0.003	*0.001*	*0.001*
Arsenic	mg/L	0.5	0.0020	0.0030	0.0030	0.003				0.001	0.002				0.001			0.002					0.002	
Boron	mg/L	5	0.99	1.48	0.880	0.87	0.52	0.89	1.01	0.82	0.86	0.79	0.64	1.01	0.83	0.96	1.05	1.23	1.17	1.48	1.46	1.21	1.31	0.96
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	*0.0001*				*0.0001*	*0.0001*				*0.0001*			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.00	0.0005	*0.0005*				*0.0005*	*0.0005*				*0.0005*			0.001					0.0005	
Copper	mg/L	0.4	0.000	0.00	0.000250	*0.00025*				*0.00025*	*0.00025*				*0.00025*			0.00025					0.00025	
Iron	mg/L		5	22.5	14.8250	22.5	20.2	4.55	9.45	3.75	19.1	17.1	2.04	9.12	1.3	19.8		16.4	3.48	5.27	4.73	2.96	4.72	2.79
Lead	mg/L	0.1	0.00025	0.0	0.000250	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L		3.59	6.0	2.8600	2.75	2.93	2.92	2.80	2.40	2.87	4.53	3.22	4.23	3.96	6.04	5.97	5.45	5.46	3.78	3.39	4.06	3.86	2.63
Mercury	mg/L		0.000250	0.0003	0.0002500	0.00025																		
Nickel	mg/L	1	0.0037	0	0.002450	0.0029	0.0026	0.0015	0.0023	0.0021	0.0023	0.0037	0.0027	0.0030	0.0027	0.0038	0.0037	0.0038	0.0049	0.0043	0.0047	0.0042	0.0043	0.0038
Zinc	mg/L	20	0.004	0.029	0.00100	*0.001*				*0.001*	*0.001*				0.006			0.006					0.029	

D1 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		17	17.4700	16.6850	17.23	16.72	16.65	16.32	16.915	16.77	16.615	16.79	16.85	16.71	16.75	16.86	17.1	17	17.15	17.16	17.21	17.47	16.94
pH		6 to 9	6.800	7.6	6.80		7.6	6.8	6.7	6.8	6.8	6.6	6.7	6.7	6.9	6.9	6.7	6.7	6.8	6.7	6.7	6.8	7.5	6.7
Suspended Solids	mg/l		10	95	#NUM!					*3*	*3*				25			10					95	
Phenol	mg/L		0.03	0.03	#NUM!					*0.025*	*0.025*				*0.025*			0.0015					0.025	
VFA	mg/L		6	7	#NUM!					*2.5*	*6.0*				*2.5*			6					7	
TOC	mg/L		1.4	1.4	#NUM!					1.1	1.4				1.2			1.4					1.4	
Alkalinity	mg CaCO3/L		107	151	#NUM!					114	151				68			107					76	
Conductivity	mS/m		52.4	63.6	51.900		46.6	52.3	51.9	52.4	58.2	60.2	56.4	49.7	44.3	46.6	61.5	61	55.6	50	63.6	59.6	51.5	54.5
COD	mg/L		7.5	37	7.500		*7.5*	7.5	*7.5*	*7.5*	*7.5*	37	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	*7.5*	18
BOD (scBOD frm Apr'20)	mg/L		1.5	1.5	#NUM!					*1.5*	*1.5*				*0.5*			1.5					1.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	3	180	4.00		*ND*	*ND*	4	*2*	*2*				180			4					2	
Chloride	mg/L		40.50	55.2	36.10		30.3	36.1	36.9	32.4	36.9	36.6	41.8	30.9	26.9	31.9	50.5	50.1	41.6	40.5	51.8	55.2	49.5	48.4
Nitrate-N	mg/L	90.3	20.70	33.2	11.500		10.6	11.5	13.0	14.7	16.7	20.9	20.7	18.4	24.9	22.1	25.1	24.2	17.7	18.4	33.2	29.8	23.7	22.3
Sulphate	mg/L	1000	5.43	6	#NUM!					6.27	6.44				5.43			3.99					2.47	
Ammonia-N	mg/L		0.005	0.09	0.00500		*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	0.09	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Hardness	mg CaCO3/L		135	166	#NUM!					135	153				121			166					135	
Calcium	mg/L	1000	25.0	32.2	#NUM!					25.0	29.1				22.9			32.2					21.6	
Magnesium	mg/L		17.9	22	#NUM!					17.5	19.5				15.4			22					17.9	
Potassium	mg/L		9.30	10.2	#NUM!					9.3	10.2				7.62			9.21					9.39	
Sodium	mg/L		38.2	54.2	23.500		39.4	14.2	23.5	41.1	54.2	44.9	43.1	38.6	36.5	33.8		42.3	45.6	38.9	34.7	34.1	33.7	37.7
D.R. Phosphorus	mg/L		0.084	0.1	#NUM!					0.092	0.084				0.096			0.075					0.065	
Aluminium	mg/L	5	0.003	0.0	0.006000		0.009	*0*	0.006	*0.001*	*0.001*	*0.001*	0.002	*0.001*	0.005	0.018	0.003	0.001	0.002	0.003	0.005	0.018	0.003	0.001
Arsenic	mg/L	0.5	0.001	0.001	#NUM!					0.001	0.001				0.001			0.001					0.0005	
Boron	mg/L	5	0.05	0.10	0.05000		0.05	0.05	*0.015*	*0.015*	0.05	*0.015*	0.04	0.04	0.06	0.06	0.07	0.07	0.08	0.1	0.08	0.05	0.07	0.05
Cadmium	mg/L	0.01	0.0001	0.000	#NUM!					*0.0001*	0.0002				*0.0001*			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.001	#NUM!					*0.0005*	*0.0005*				*0.0005*			0.0005					0.0005	
Copper	mg/L	0.4	0.000	0.000	#NUM!					*0.00025*	*0.00025*				*0.00025*			0.00025					0.00025	
Iron	mg/L		0.006	4.7	0.02000		0.02	*0.005*	4.66	*0.0025*	0.015	*0.005*	*0.005*	*0.005*	0.008	0.03		0.0025	0.005	0.005	0.03	0.06	0.007	0.005
Lead	mg/L	0.1	0.00025	0.001	0.0002500		*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0005	0.0011	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0008	*0.00025*	*0.00025*
Manganese	mg/L		0.004	0.22	0.0050		0.0050	*0.00025*	0.218	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0080	0.0208	0.0008	0.0006	0.0007	0.0038	0.017	0.0139	0.0247	0.0067
Mercury	mg/L		#NUM!	0.0000	#NUM!																			
Nickel	mg/L	1	0.00025	0.001	0.0002500		*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0006	*0.00025*	*0.00025*
Zinc	mg/L	20	0.0020	0.03	#NUM!					*0.001*	*0.001*				0.003			0.002					0.026	

D2 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		21.5	22.6	21.4750	21.66	21.35	21.25	21.6	21.5	21.37	21.235	21.42	21.39	21.35	21.47	21.5	22.64	21.635	21.665	21.78	21.4	21.82	21.74
pH		6 to 9	6.5	7.1	6.450	6.3	6.8	6.5	6.4	6.7	6.4	6.4	6.5	6.4	6.7	6.5	6.7	6.5	6.5	6.8	6.5	6.6	7.1	6.6
Suspended Solids	mg/l		9	17	17.00	17				10	7				12			3					7	
Phenol	mg/L		0.025	0.025	0.02500	0.025				0.025	0.025				0.025			0.0015					0.025	
VFA	mg/L		4	10	2.500	2.5				2.5	6				10			6					2.5	
TOC	mg/L		12.6	13.7	13.20	13.2				11.9	13.7				12.1			12.1					13.1	
Alkalinity	mg CaCO3/L		98	109	109.0	109				100	101				96			87					80	
Conductivity	mS/m		33	38	34.150	33.6	31.1	34.7	37.6	34.9	35.4	38.2	34.9	36.0	35.0	33.5	30.6	33.3	30.8	31.5	32.8	25.5	28.7	28.6
COD	mg/L		37	89	33.50	31	36	35	32	21	37	58	37	43	44	27	89	39	30	30	41	23	7.5	46
BOD (scBOD frm Apr'20)	mg/L		2.3	3	1.500	1.5				1.5	3				3			1.5					3	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	20	20.00	ND	ND	ND	20	2	8				2			2					2	
Chloride	mg/L		38.4	45	34.050	32.8	32.9	35.2	42.1	39.0	41.3	44.9	41.6	41.9	40.5	39.8	37.0	38.6	36.6	38.2	41.1	35.1	34.2	32.2
Nitrate-N	mg/L	90.3	0.005	0.4	0.02750	0.005	0.05	0.05	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.39	0.01	0.02	0.005	0.005	0.005	0.03	0.14	0.005
Sulphate	mg/L	1000	1.79	5	0.01000	0.01				1.99	1.58				4.96			1.22					2.3	
Ammonia-N	mg/L		0.43	0.50	0.4750	0.49	0.43	0.47	0.48	0.50	0.45	0.47	0.43	0.43	0.47	0.39	0.48	0.39	0.43	0.4	0.4	0.32	0.38	0.37
Hardness	mg CaCO3/L		87	89	87.00	87				87	89				86			78					68	
Calcium	mg/L	1000	15.1	16.4	15.400	15.4				14.6	15.2				16.4			14.9					12.7	
Magnesium	mg/L		11.4	12.3	11.800	11.8				12.3	12.3				11.0			9.94					8.8	
Potassium	mg/L		6.2	7.3	7.100	7.10				7.32	6.69				5.28			5.4					5.63	
Sodium	mg/L		26	34	23.20	32.6	26.0	7.84	20.4	27.6	29.3	31.6	32.1	25.2	28.0	25.7	27.9	29	23.8	24.6	25.8	25.8	25.6	34
D.R. Phosphorus	mg/L		0.043	0.06	0.038000	0.038				0.039	0.032				0.055			0.046					0.051	
Aluminium	mg/L	5	0.015	0.0	0.00900	0.014	0.026	0.004	0.001	0.014	0.012	0.015	0.014	0.015	0.010	0.022	0.009	0.015	0.027	0.014	0.022	0.016	0.021	0.022
Arsenic	mg/L	0.5	0.001	0.0020	0.0010	0.001				0.001	0.0005				0.001			0.002					0.002	
Boron	mg/L	5	0.030	0.05	0.0450	0.04	0.05	0.05	0.03	0.015	0.03	0.015	0.015	0.04	0.03	0.05	0.015	0.03	0.015	0.015	0.04	0.015	0.04	0.015
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.001	0.0010	0.001				0.001	0.0005				0.0005			0.001					0.001	
Copper	mg/L	0.4	0.0007	0.001	0.000250	0.00025				0.00025	0.00025				0.0014			0.0013					0.0012	
Iron	mg/L		11.85	16.4	11.9700	15.0	14.9	9.04	0.02	11.9	8.22	10.3	13.0	8.12	8.51	16.40	6.76	13.3	14.8	10.5	11.8	3.93	12.1	13.8
Lead	mg/L	0.1	0.0004	0.00	0.0002500	0.00025	0.0014	0.00025	0.00025	0.00025	0.0006	0.00025	0.00025	0.0027	0.00025	0.0014	0.0005	0.00025	0.0011	0.0008	0.0012	0.0047	0.00025	0.00025
Manganese	mg/L		0.309	0.413	0.31550	0.306	0.332	0.325	0.0153	0.338	0.300	0.335	0.306	0.339	0.300	0.413	0.313	0.321	0.305	0.311	0.32	0.228	0.228	0.29
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.00025	0.009	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0006	0.0007	0.0007	0.0005	0.00025	0.0093
Zinc	mg/L	20	0.013	0.034	0.00500	0.005				0.006	0.007				0.019			0.024					0.034	

D3r Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		4.7950	5.1200	4.68250	4.89	4.67	4.695	4.56	4.874	4.745	4.62	4.81	4.775	4.44	4.39	4.65	4.86	4.85	4.79	4.847	4.93	5.12	4.8
pH		6 to 9	6.8	7.3	6.90	7.0	7.2	6.8	6.8	6.9	6.8	6.7	6.8	6.7	6.7	6.7	6.5	6.6	6.8	6.8	6.7	6.7	7.3	6.6
Suspended Solids	mg/l		16.5	72	3.0	3				3	8				72			25					33	
Phenol	mg/L		0.03	0.025	0.0250	0.025				0.025	0.025				0.025			0.0015					0.025	
VFA	mg/L		4	7	2.50	2.5				2.5	6				2.5			6					7	
TOC	mg/L		2.3	3.1	3.10	3.1				2.9	2.6				1.5			1.9					1.8	
Alkalinity	mg CaCO3/L		74	144	56.0	56				56	57				116			91					144	
Conductivity	mS/m		30.6	53.6	22.0	21.4	22.0	22.0	23.0	53.6	22.1	24.3	27.3	28.2	33.4	30.5	29.4	30.6	33.9	35.2	36.3	37.9	40.8	40.8
COD	mg/L		7.5	40	7.50	7.5	18	7.5	7.5	7.5	7.5	40	7.5	7.5	19	16	7.5	7.5	7.5	7.5	7.5	7.5	7.5	15
BOD (scBOD frm Apr'20)	mg/L		1.5	3	0.50	0.5				1.5	1.5				3			3					1.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	2	#NUM!	ND	ND	ND	ND	2	2				2			2					2	
Chloride	mg/L		24.40	34.5	21.750	21.7	22.0	21.8	21.6	22.7	22.4	22.2	22.5	23.5	21.8	25.9	25.3	25.3	27.6	29.3	29.3	30.1	31.7	34.5
Nitrate-N	mg/L	90.3	0.215	0.65	0.1850	0.18	0.29	0.19	0.17	0.21	0.20	0.27	0.35	0.36	0.27	0.65	0.55	0.59	0.21	0.22	0.005	0.22	0.06	0.03
Sulphate	mg/L	1000	7.32	9.15	6.960	6.96				8.48	7.68				5.86			9.15					6.53	
Ammonia-N	mg/L		0.17	0.23	0.170	0.18	0.17	0.17	0.12	0.17	0.17	0.17	0.17	0.18	0.19	0.06	0.18	0.17	0.13	0.005	0.23	0.23	0.18	0.005
Hardness	mg CaCO3/L		47.5	108	34.00	34				35	36				69			59					108	
Calcium	mg/L	1000	9.49	20.8	6.810	6.81				7.17	6.99				14.3			11.8					20.8	
Magnesium	mg/L		5.815	13.6	4.190	4.19				4.24	4.49				8.08			7.14					13.6	
Potassium	mg/L		6.0	10.1	4.90	4.90				4.53	5.30				6.71			7.28					10.1	
Sodium	mg/L		27.90	34.7	23.20	27.3	25.10	8.79	21.3	26.1	25.9	23.3	25.3	25.6	28.9	28.1	27.7	31.8	30.9	32.1	29.4	31.7	34.7	31.7
D.R. Phosphorus	mg/L		0.016	0.063	0.0150	0.015				0.016	0.013				0.063			0.016					0.017	
Aluminium	mg/L	5	0.001	0.016	0.00150	0.0010	0.002	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.001	0.005	0.001	0.001	0.001
Arsenic	mg/L	0.5	0.005	0.011	0.0110	0.011				0.004	0.007				0.002			0.004					0.005	
Boron	mg/L	5	0.04	0.05	0.030	0.015	0.03	0.03	0.03	0.015	0.03	0.015	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.015	0.05	0.04	0.05	0.04
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.0005	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.00025	0.000	0.000250	0.00025				0.00025	0.00025				0.00025			0.00025					0.00025	
Iron	mg/L		2.880	9.0	2.9050	2.86	2.95	4.00	2.20	0.83	2.47	2.90	3.81	0.98	1.86	2.36	3.61	1.77	3.97	0.47	8.97	7.87	0.408	3.51
Lead	mg/L	0.1	0.00025	0.001	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		0.3165	0.650	0.18450	0.176	0.193	0.201	0.160	0.171	0.189	0.228	0.244	0.284	0.370	0.398	0.370	0.349	0.442	0.121	0.462	0.488	0.65	0.433
Mercury	mg/L		0.000250	0.0003	0.0002500	0.00025																		
Nickel	mg/L	1	0.00025	0.0011	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.001	0.005	0.0010	0.001				0.001	0.001				0.005			0.001					0.002	

D4 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		8.1700	11.0000	8.330	8.25	8.7	8.01	8.41	11	8.115	7.985	8.17	8.17	4.36	7.68	7.9	8.16	8.305	8.11	8.185	8.27	8.72	8.08
pH		6 to 9	7	7.8	7.10	7.1	7.7	7.1	6.9	7.1	7.0	6.8	7.0	6.9	6.9	7.0	7.2	6.9	6.9	7	6.9	7	7.8	7
Suspended Solids	mg/l		4.0	14	5.0	5				3	3				12			3					14	
Phenol	mg/L		0.03	0.03	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		3	6	2.50	2.5				2.5	2.5				5.0			6					2.5	
TOC	mg/L		2.4	3	2.40	2.4				2.1	1.9				2.4			2.5					2.3	
Alkalinity	mg CaCO3/L		55	58	55.0	55				53	52				55			57					58	
Conductivity	mS/m		30.60	34.4	31.40	31.3	31.5	32.7	29.4	27.1	29.7	34.4	32.0	34.2	31.9	27.5	30.5	31.1	32.4	28.1	30.6	30.6	28.2	29.7
COD	mg/L		7.5	21	7.50	7.5	7.5	7.5	7.5	7.5	7.5	20	7.5	18	7.5	16	7.5	7.5	7.5	7.5	21	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		1.0	2	0.50	0.5				1.5	1.5				0.5			1.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	8	#NUM!	ND	ND	ND	ND	2	2				8			2					2	
Chloride	mg/L		44.9	58.0	47.250	44.6	49.2	53.5	45.3	38.5	44.6	58.0	48.1	50.7	45.1	39.1	41.2	40.5	48.7	37.6	47.2	45.7	41.2	44.5
Nitrate-N	mg/L	90.3	0.005	0.3	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.13	0.03	0.005	0.005	0.02	0.02	0.05	0.005	0.005	0.29
Sulphate	mg/L	1000	13.80	20.0	12.50	12.5				11.2	14.9				20.0			15.9					12.7	
Ammonia-N	mg/L		0.17	0.24	0.2150	0.21	0.21	0.23	0.22	0.23	0.22	0.24	0.22	0.22	0.05	0.11	0.17	0.17	0.16	0.14	0.16	0.17	0.15	0.005
Hardness	mg CaCO3/L		54	62	62.0	62				48	54				62			54					52	
Calcium	mg/L	1000	9.435	11.0	11.00	11.0				9.26	9.61				10.8			8.95					8.98	
Magnesium	mg/L		7.44	8.52	8.390	8.39				5.96	7.17				8.52			7.7					7.15	
Potassium	mg/L		6.24	6.87	6.620	6.62				4.64	6.06				5.68			6.87					6.42	
Sodium	mg/L		32.1	38	31.950	31.7	31.4	33.7	32.2	29.1	32.8	35.6	31.5	32.9	32.8	31.9	33.4	38.1	32.7	31.4	31.4	32.3	29.9	31.2
D.R. Phosphorus	mg/L		0.023	0.06	0.01600	0.016				0.021	0.023				0.058			0.023					0.027	
Aluminium	mg/L	5	0.001	0.02	0.00100	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.002	0.001	0.001	0.001	0.001	0.023	0.001	0.002	0.001
Arsenic	mg/L	0.5	0.0020	0.004	0.0040	0.004				0.002	0.003				0.0005			0.002					0.001	
Boron	mg/L	5	0.023	0.06	0.0350	0.04	0.015	0.03	0.04	0.015	0.015	0.04	0.015	0.06	0.04	0.015	0.015	0.04	0.015	0.015	0.04	0.03	0.04	0.015
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.001	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.00025	0.001	0.000250	0.00025				0.00025	0.00025				0.0010			0.00025					0.0005	
Iron	mg/L		0.53	1.9	1.17050	1.51	0.831	0.77	1.91	0.15	0.83	0.91	0.35	1.23	0.628	0.37	0.36	0.226	0.38	0.44	0.8	0.34	1.09	0.11
Lead	mg/L	0.1	0.00025	0.0011	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0011	0.00025	0.00025	0.00025
Manganese	mg/L		0.1745	0.213	0.1780	0.189	0.175	0.175	0.181	0.151	0.175	0.211	0.186	0.213	0.0025	0.136	0.174	0.174	0.171	0.147	0.175	0.17	0.178	0.0098
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.00025	0.00	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0023	0.00025	0.00025	0.0007
Zinc	mg/L	20	0.001	0.003	0.00100	0.001				0.001	0.001				0.003			0.001					0.001	

D5 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		9.7800	10.4200	9.7650	9.93	9.76	9.755	9.77	9.93	9.79	9.665	9.9	9.8	9.2	9.29	9.58	9.54	9.7	9.68	9.82	9.9	10.42	9.8
pH		6 to 9	7	7.9	7.30	7.4	7.9	7.2	7.0	7.1	7.4	7.1	7.0	7.0	7.2	7.0	7.2	7.2	7.2	7	7.2	7	7.7	7
Suspended Solids	mg/l		3	9.0	2.50	2.5				3	3				9			3					2.5	
Phenol	mg/L		0.02	0.0	0.0250	0.025				0.025	0.005				0.005			0.0015					0.025	
VFA	mg/L		3	8	2.50	2.5				2.5	2.5				8			2.5					2.5	
TOC	mg/L		1.9	2.1	2.00	2.0				1.9	2.1				1.8			1.8					1.7	
Alkalinity	mg CaCO3/L		62	67	63.0	63				66	67				57			61					55	
Conductivity	mS/m		27.8	38	29.650	29.9	29.4	30.7	28.7	31.2	31.8	31.1	25.0	29.7	24.8	24.1	27.8	27.1	26.7	26.3	27.8	37.6	24.2	24.7
COD	mg/L		7.5	55	7.50	7.5	7.5	7.5	22.0	7.5	21.0	55.0	7.5	7.5	7.5	20	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		0.5	0.5	0.50	0.5				0.5	0.5				0.5			0.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	4	4.00	ND	ND	ND	4	2	2				2			2					2	
Chloride	mg/L		29.15	62.2	29.40	29.1	30.0	29.5	29.3	29.9	31.5	32.2	29.2	27.3	23.8	23.6	27.7	27.7	27.5	38.7	40.2	62.2	25.1	24.5
Nitrate-N	mg/L	90.3	1.69	3.0	1.260	1.18	1.34	1.15	1.45	1.03	0.86	0.97	1.07	0.99	2.39	2.25	1.68	1.7	2.86	2.1	2.97	2.44	2.82	2.67
Sulphate	mg/L	1000	18.7	28.3	21.00	21.0				24.2	28.30				9.81			16.3					10.6	
Ammonia-N	mg/L		0.005	0.01	0.0050	0.005	0.01	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Hardness	mg CaCO3/L		63	72	64.0	64				67	72				48			62					47	
Calcium	mg/L	1000	11.05	12.7	11.10	11.1				11.7	12.7				8.89			11					7.84	
Magnesium	mg/L		8.57	9.72	8.860	8.86				9.03	9.72				6.20			8.27					6.56	
Potassium	mg/L		6.39	7.8	7.830	7.83				6.55	7.36				4.43			6.23					5.8	
Sodium	mg/L		27.6	37	32.750	32.5	29.4	33.0	36.8	32.1	33.1	27.6	23.1	27.7	25.2	23.8		29.1	25.6	23.9	26.5	33.1	25.2	23.9
D.R. Phosphorus	mg/L		0.102	0.14	0.0960	0.096				0.100	0.084				0.138			0.103					0.136	
Aluminium	mg/L	5	0.001	0	0.0010	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.005	0.012	0.001	0.001	0.001	0.004	0.002	0.002	0.002	0.001
Arsenic	mg/L	0.5	0.001	0.001	0.0010	0.001				0.001	0.001				0.0005			0.001					0.0005	
Boron	mg/L	5	0.015	0.04	0.02250	0.04	0.03	0.015	0.015	0.030	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.03	0.015	0.015	0.04	0.03	0.03	0.015
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.001	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.0008	0.002	0.00090	0.0009				0.0005	0.0005				0.0010			0.0007					0.0017	
Iron	mg/L		0.04	0	0.0550	0.070	0.06	0.05	0.005	0.043	0.113	0.07	0.03	0.07	0.006	0.04		0.059	0.005	0.34	0.03	0.01	0.00025	0.005
Lead	mg/L	0.1	0.00025	0.0011	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0011	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		0.0117	0.05	0.01550	0.0193	0.0148	0.0162	0.0035	0.0109	0.0203	0.0203	0.0078	0.0140	0.0032	0.0125	0.0450	0.0379	0.002	0.0507	0.0026	0.0106	0.0019	0.0007
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.00025	0.0009	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0005	0.00025	0.00025	0.00025	0.0009	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.003	0.017	0.0010	0.001				0.001	0.001				0.004			0.007					0.017	

D6 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16 (resampled)	Oct-15
Water level	mBGL		16.522	17.3	16.30500	16.62	16.23	16.22	16.38	16.523	16.36	16.21	16.38	16.4	17.3	16.3	16.41	16.66	16.52	16.59	16.795	16.79	16.73	16.56
pH		6 to 9	6.9	7.3	7.050	7.1	7.1	7.0	6.8	7.0	6.8	6.7	6.7	6.8	6.9	6.9	6.6	6.8	6.8	6.7	6.9	7.1	6.9	7
Suspended Solids	mg/l		3.0	65	2.50	2.5				3	3				22			3					65	
Phenol	mg/L		0.03	0.025	0.0250	0.025				0.025	0.025				0.025			0.0015					0.01	
VFA	mg/L		3	25	2.500	2.5				2.5	2.5				16			2.5					25	
TOC	mg/L		1	1.2	1.00	1.0				0.9	1.0				1.0			1					1.2	
Alkalinity	mg CaCO3/L		74.0	84	73.0	73				75	73				60			84					80	
Conductivity	mS/m		42.00	63.3	34.550	37.2	29.1	31.9	41.9	43.4	44.5	45.5	46.5	42.1	37.1	27.7	43.1	43	42.3	63.3	54.8	35.9	39.6	30.8
COD	mg/L		7.5	45	7.50	7.5	7.5	7.5	7.5	7.5	7.5	45	33	7.5	7.5	7.5	7.5	7.5	7.5	7.5	19	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		1.25	1.5	0.50	0.5				1.5	1.5				0.5			1.5					1	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	34	240	240.0	240	ND	ND	ND	2	2				110			16					52	
Chloride	mg/L		26.60	47	18.050	19.8	14.2	16.3	27.7	26.4	26.2	28.8	31.0	26.8	19.5	14.1	30.9	30.5	28.1	47.3	45.2	28.1	22.4	19.7
Nitrate-N	mg/L	90.3	16.35	32	14.300	16.9	11.1	11.7	17.7	21.7	22.9	23.8	22.9	19.9	17.9	11.5	15.8	15.3	15.5	32	22.2	15.5	13	10.9
Sulphate	mg/L	1000	3.87	5	4.340	4.34				4.82	4.85				3.40			3.13					3.12	
Ammonia-N	mg/L		0.005	0.01	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Hardness	mg CaCO3/L		98	104	95.0	95				104	101				82			103					69	
Calcium	mg/L	1000	18.3	19.5	18.00	18.0				18.5	18.5				15.7			19.5					12.5	
Magnesium	mg/L		12.70	13.2	12.30	12.3				13.1	13.2				10.5			13.1					9.05	
Potassium	mg/L		7.6	8.67	8.160	8.16				7.31	8.67				6.46			7.88					7.21	
Sodium	mg/L		35.9	52	25.750	33.9	26.7	9.72	24.8	37.9	38.4	40.9	38.9	35.9	30.0	24.9		39.4	39.5	51.8	43.5	36	33.6	31.2
D.R. Phosphorus	mg/L		0.0975	0.1	0.1010	0.101				0.093	0.094				0.122			0.086					0.115	
Aluminium	mg/L	5	0.004	0.0	0.0020	0.003	0.001	0.001	0.016	0.001	0.001	0.001	0.001	0.032	0.010	0.008	0.004	0.003	0.007	0.002	0.034	0.004	0.005	0.023
Arsenic	mg/L	0.5	0.001	0.0010	0.0010	0.001				0.001	0.001				0.001			0.001					0.001	
Boron	mg/L	5	0.040	0.070	0.050	0.05	0.05	0.05	0.03	0.03	0.07	0.05	0.05	0.05	0.05	0.06	0.04	0.03	0.03	0.015	0.04	0.015	0.015	0.04
Cadmium	mg/L	0.01	0.0001	0.0	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.005	0.00050	0.0005				0.0005	0.005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.000	0.006	0.00570	0.0057				0.00025	0.00025				0.00025			0.00025					0.001	
Iron	mg/L		0.020	14	0.0050	0.0025	0.005	0.005	14.2	0.0025	0.0025	0.005	0.005	0.080	0.024	0.02		0.021	0.01	0.02	0.05	0.005	0.033	0.05
Lead	mg/L	0.1	0.00025	0.002	0.0002500	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0019	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0006	0.00025	0.00025	0.0006
Manganese	mg/L		0.0022	0.4	0.0005750	0.0009	0.00025	0.00025	0.372	0.00025	0.00025	0.00025	0.00025	0.0037	0.0041	0.0051	0.0019	0.0031	0.0018	0.0025	0.0038	0.0024	0.0018	0.0092
Mercury	mg/L		0.000250	0.0003	0.0002500	0.00025																		
Nickel	mg/L	1	0.00025	0.000	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.003	0.02	0.00400	0.004				0.001	0.001				0.002			0.005					0.017	

E1S Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		11.4	12.0000	11.3560	11.51	11.327	11.385	11.25	11.495	11.35	11.235	11.41	11.39	11.27	11.29	11.37	11.14	11.47	11.54	11.52	11.74	12	11.56
pH		6 to 9	7	7.6	7.050	7.2	7.1	7.0	6.9	7.6	7.3	6.8	7.1	6.9	7.1	7.0	7.1	6.9	7.1	7	7.5	7	7.5	7
Suspended Solids	mg/l		5	17	7.00	7				3	3				13			3					17	
Phenol	mg/L		0.03	0.03	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		3	9	2.50	2.5				2.5	2.5				9			8					2.5	
TOC	mg/L		3.5	5.2	5.20	5.2				3.7	3.7				2.4			3.2					1.9	
Alkalinity	mg CaCO3/L		55.0	68	68.0	68				61	58				47			52					43	
Conductivity	mS/m		28.3	45	26.80	27.1	26.6	26.9	26.7	26.7	26.4	26.9	26.9	27.7	28.9	29.5	29.8	29.9	27.6	32.2	45	30.4	32.5	33.8
COD	mg/L		8	126	7.50	7.5	19	7.5	7.5	25.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	23	7.5	23	7.5	7.5	126
BOD (scBOD frm Apr'20)	mg/L		0.5	2	0.50	0.5				1.5	1.5				0.5			0.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	2	#NUM!	ND	ND	ND	ND	2	2				2			2					2	
Chloride	mg/L		41.90	54.1	29.850	28.7	29.7	30.0	30.7	33.5	33.6	35.6	35.1	37.9	43.0	44.6	42.8	43.1	43.8	50.5	41	45.9	53.4	54.1
Nitrate-N	mg/L	90.3	0.005	0.0	0.0050	0.005	0.005	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Sulphate	mg/L	1000	12.75	22	9.100	9.1				11.2	11.4				14.1			16.2					21.8	
Ammonia-N	mg/L		0.16	0.21	0.1750	0.17	0.16	0.18	0.18	0.18	0.16	0.21	0.15	0.16	0.15	0.14	0.16	0.15	0.08	0.13	0.19	0.14	0.11	0.14
Hardness	mg CaCO3/L		52.0	59	59.00	59				52	52				51			52					54	
Calcium	mg/L	1000	9.0	11	11.00	11.0				9.56	9.19				8.28			8.82					8.71	
Magnesium	mg/L		7.265	7.9	7.620	7.62				6.76	7.14				7.36			7.17					7.9	
Potassium	mg/L		6.1	6.84	6.220	6.22				5.02	6.01				5.17			6.84					6.74	
Sodium	mg/L		29.3	36.1	24.350	28.9	25.80	9.45	22.9	28.1	29.3	28.2	25.9	26.4	29.3	27.9	31.7	34.4	33.2	32.8	36.1	31.8	35	34.6
D.R. Phosphorus	mg/L		0.1	0.07	0.0530	0.053				0.054	0.065				0.055			0.037					0.033	
Aluminium	mg/L	5	0.003	0.0	0.0040	0.006	0.006	0.001	0.002	0.002	0.006	0.003	0.003	0.006	0.004	0.006	0.004	0.003	0.009	0.002	0.001	0.004	0.003	0.002
Arsenic	mg/L	0.5	0.002	0.0020	0.0020	0.002				0.002	0.002				0.002			0.001					0.0005	
Boron	mg/L	5	0.015	0.1	0.02250	0.03	0.015	0.015	0.04	0.015	0.015	0.015	0.015	0.015	0.03	0.015	0.015	0.03	0.015	0.015	0.06	0.015	0.04	0.015
Cadmium	mg/L	0.01	0.000100	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.001	0.001	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.00055	0.001	0.00060	0.0006				0.0005	0.00025				0.0008			0.0009					0.00025	
Iron	mg/L		3.305	4.7	4.4250	4.65	4.22	4.63	0.02	3.97	4.22	3.79	3.79	3.94	3.08	4.22	3.39	1.72	1.46	1.39	0.04	3.22	1.49	2.17
Lead	mg/L	0.1	0.0009	0.024	0.0003750	0.0005	0.00025	0.0023	0.00025	0.0009	0.0006	0.0008	0.0019	0.0014	0.0033	0.00025	0.0008	0.001	0.0238	0.0011	0.00025	0.0011	0.00025	0.0016
Manganese	mg/L		0.207	0.24	0.230500	0.243	0.219	0.242	0.0353	0.209	0.219	0.208	0.192	0.207	0.157	0.224	0.210	0.207	0.144	0.166	0.214	0.172	0.168	0.192
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.0003	0.0019	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0019	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.001	0.001	0.00100	0.001				0.001	0.001				0.001			0.001					0.001	

E1D Monitoring Bore HDC Levin Landfill

Determinand		NZDW MAV	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		11.3650	12.1400	11.290	11.38	11.25	11.165	11.33	11.43	11.27	11.135	11.27	11.28	12.14	10.94	11.22	11.52	11.35	11.4	11.654	11.63	11.76	11.44
pH		7 to 8.5*	7.5	8.1	7.60	7.7	7.9	7.5	7.5	8.1	7.5	7.6	7.5	7.5	7.5	7.5	7.7	7.5	7.7	7.5	6.9	7.8	8	7.6
Suspended Solids	mg/l		11	61	2.50	2.5				3	27				15			7					61	
Phenol	mg/L		0.03	0.025	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		3	3	2.500	2.5				2.5	2.5				2.5			2.5					2.5	
TOC	mg/L		3.00	5.1	3.100	3.1				2.8	3.2				2.9			2.9					5.1	
Alkalinity	mg CaCO3/L		157.5	161	155.00	155				160	161				161			151					144	
Conductivity	mS/m		45.40	46	45.650	45.5	45.8	45.9	45.2	45.7	45.6	45.5	45.5	45.2	45.9	44.0	44.4	44.8	42.9	45.2	31.7	45.3	45.8	46
COD	mg/L		7.5	55	7.50	7.5	7.5	7.5	45	7.5	37	38	7.5	7.5	23	18	7.5	7.5	7.5	7.5	55	7.5	7.5	18
BOD (scBOD frm Apr'20)	mg/L		1	2.0	0.500	0.5				2	0.5				0.5			1.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	NIL	2	2	#NUM!	ND	ND	ND	ND	1.5	2.0				2			2					2	
Chloride	mg/L	250*	39.35	52	38.850	38.7	38.2	39.0	39.4	39.3	39.0	39.6	39.6	37.9	39.3	40.9	40.7	40.8	42.9	39.4	51.8	39.6	38.7	38.3
Nitrate-N	mg/L	11.3	0.005	0	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005
Sulphate	mg/L	250*	0.01	0	0.010	0.01				0.01	0.01				0.01			0.1					0.01	
Ammonia-N	mg/L	1.17	0.2	0.26	0.2050	0.20	0.19	0.21	0.21	0.23	0.20	0.22	0.19	0.20	0.20	0.24	0.25	0.22	0.26	0.02	0.14	0.19	0.13	0.12
Hardness	mg CaCO3/L	200*	134	141	131.00	131				124	141				137			136					129	
Calcium	mg/L		32.4	34.7	31.800	31.8				28.7	34.7				33.5			33					31	
Magnesium	mg/L		12.75	13.1	12.400	12.4				12.6	13.1				13.0			12.9					12.5	
Potassium	mg/L		5.03	5.39	5.030	5.03				5.03	4.96				4.38			5.39					5.32	
Sodium	mg/L	200*	36.5	44	36.850	36.5	37.2	14.7	43.9	35.9	39.6	37.3	42.0	39.5	36.1	35.6	33.7	40.2	32.9	37	32.1	36.4	35.9	37.7
D.R. Phosphorus	mg/L		0.393	0.44	0.41100	0.411				0.391	0.395				0.389			0.435					0.338	
Aluminium	mg/L	0.1*	0.002	0.01	0.00100	0.001	0.003	0.001	0.001	0.001	0.003	0.001	0.002	0.004	0.002	0.001	0.001	0.001	0.008	0.002	0.004	0.001	0.002	0.008
Arsenic	mg/L	0.01	0.007	0.009	0.00700	0.007				0.007	0.008				0.006			0.009					0.007	
Boron	mg/L	1.4	0.05	0.06	0.0600	0.06	0.06	0.06	0.04	0.015	0.05	0.04	0.06	0.04	0.05	0.05	0.04	0.05	0.05	0.05	0.04	0.05	0.06	0.06
Cadmium	mg/L	0.004	0.00010	0.000	0.000100	0.0001				0.0001	0.0001				0.0001			0.0001					0.0004	
Chromium	mg/L	0.05	0.0005	0.0005	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	2	0.0003	0.000	0.000250	0.00025				0.00025	0.00025				0.00025			0.00025					0.00025	
Iron	mg/L	0.2*	0.0500	1.8	0.0450	0.03	0.05	0.04	0.05	0.037	0.036	0.05	0.11	0.07	0.084	0.05	0.06	0.044	0.09	0.05	1.76	0.03	0.045	0.1
Lead	mg/L	0.01	0.0003	0.0041	0.0002500	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0019	0.0007	0.0021	0.00025	0.0019	0.0041
Manganese	mg/L	0.4	0.250	0.287	0.2530	0.248	0.274	0.258	0.235	0.241	0.229	0.256	0.252	0.259	0.200	0.256	0.268	0.273	0.287	0.0063	0.193	0.252	0.168	0.194
Mercury	mg/L		0.000250	0.0003	0.0002500	0.00025																		
Nickel	mg/L	0.08	0.00025	0.0008	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0005	0.00025	0.00025	0.0008	0.0007
Zinc	mg/L	1.5*	0.00100	0.001	0.00100	0.001				0.001	0.001				0.001			0.001					0.001	

* = GV

E2S Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		4.77	5.90	4.770	4.97	4.79	4.635	4.75	4.965	4.77	4.665	4.76	4.8	4.57	4.28	4.40	4.2	4.495	4.59	5.52	5.71	5.9	5.62
pH		6 to 9	7.5	8	7.650	7.6	7.9	7.7	7.4	7.5	7.4	7.4	7.5	7.3	7.4	7.5	7.6	7.7	7.5	7.6	7.5	7.6	7.9	7.4
Suspended Solids	mg/l		8.0	24	2.50	2.5				3	3				18			13					24	
Phenol	mg/L		0.025	0.03	0.0250	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		3	7	2.50	2.5				2.5	6				2.5			7					2.5	
TOC	mg/L		2.90	3.3	2.90	2.9				2.7	3.1				2.9			2.3					3.3	
Alkalinity	mg CaCO3/L		147.5	151	146.00	146				149	150				151			78					132	
Conductivity	mS/m		45	46.9	44.650	44.9	44.5	44.8	44.2	44.5	44.5	44.6	35.0	45.0	44.9	44.5	44.7	37.7	44.7	44.3	46.9	37	44.4	35.2
COD	mg/L		7.5	27	7.500	7.5	27	7.5	7.5	7.5	7.5	7.5	7.5	7.5	22	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		1.0	2	0.500	0.5				1.5	1.5				0.5			1					1	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	20	#NUM!	ND	ND	ND	ND	2	2				20			4					2	
Chloride	mg/L		41.40	56.1	41.20	40.7	41.8	41.0	41.4	41.8	42.1	42.0	48.0	41.7	41.4	41.4	40.4	56.1	41	41.2	40.8	50.9	40.8	38.7
Nitrate-N	mg/L	90.3	0.005	0.40	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.04	0.005	0.005	0.005	0.005	0.005	0.005	0.12	0.02	0.17
Sulphate	mg/L	1000	0.070	14	0.010	0.01				0.01	7.54				0.13			14.1					0.01	
Ammonia-N	mg/L		0.28	0.39	0.250	0.25	0.25	0.26	0.25	0.27	0.25	0.26	0.28	0.25	0.14	0.28	0.29	0.37	0.34	0.39	0.39	0.35	0.33	0.28
Hardness	mg CaCO3/L		114	120	119.00	119				112	120				115			108					108	
Calcium	mg/L	1000	25.85	33.2	26.000	26.0				25.4	26.5				25.7			33.2					23.9	
Magnesium	mg/L		11.90	13	13.000	13.0				11.9	12.9				12.3			6.05					11.7	
Potassium	mg/L		6	6.46	6.460	6.46				5.45	5.93				5.28			5.11					6.3	
Sodium	mg/L		40.3	45	42.20	41.2	42.7	41.7	44.5	40.6	44.1	45.0	33.6	39.0	39.7	40.1	40.4	31.1	42.8	41.8	38.7	23.3	39.3	32.9
D.R. Phosphorus	mg/L		0.568	0.62	0.6210	0.621				0.567	0.576				0.568			0.141					0.372	
Aluminium	mg/L	5	0.001	0.0	0.0010	0.004	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.008	0.001	0.001	0.003	0.004	0.001	0.003	0.014	0.001	0.013
Arsenic	mg/L	0.5	0.001	0.002	0.0010	0.001				0.001	0.002				0.001			0.001					0.001	
Boron	mg/L	5	0.050	0.060	0.050	0.05	0.04	0.05	0.05	0.015	0.05	0.04	0.015	0.05	0.05	0.06	0.05	0.015	0.06	0.05	0.06	0.015	0.06	0.05
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.001	0.0005	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.00025	0.001	0.000250	0.00025				0.00025	0.00025				0.0005			0.00025					0.00025	
Iron	mg/L		0.065	1.30	0.03850	0.047	0.03	0.02	0.05	0.055	0.070	0.09	0.06	0.14	0.139	0.08	0.06	0.088	0.12	0.06	0.06	1.3	0.042	0.44
Lead	mg/L	0.1	0.00025	0.01	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.0015	0.00025	0.00025	0.0005	0.0020	0.00025	0.00025	0.00025	0.0014	0.0009	0.001	0.0046	0.00025	0.0089
Manganese	mg/L		0.383	0.473	0.38750	0.386	0.389	0.283	0.404	0.376	0.380	0.406	0.248	0.419	0.286	0.473	0.432	0.294	0.419	0.388	0.433	0.309	0.364	0.336
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.0004	0.01	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0006	0.0009	0.0006	0.0007	0.00025	0.0007	0.007	0.0007	0.00025	0.0009	0.0012
Zinc	mg/L	20	0.0080	0.06	0.00300	0.003				0.001	0.011				0.055			0.005					0.012	

E2D Monitoring Bore HDC Levin Landfill

Determinand		NZDW MAV	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		5.4525	6	5.680	5.79	5.7	5.58	5.66	5.81	5.69	5.62	5.7	5.7	5.44	5.15	5.36	5.18	5.465	5.415	4.66	4.95	5.09	4.67
pH		7 to 8.5*	7.6	8.0	7.70	7.7	8.0	7.7	7.6	7.6	7.7	7.5	7.6	7.4	7.6	7.4	7.8	7.6	7.8	7.6	7.8	7.4	7.9	7.3
Suspended Solids	mg/l		13	25	14.00	14				3	11				25			3					14	
Phenol	mg/L		0.03	0.03	0.02500	0.025				0.025	0.025				0.005			0.0015					0.025	
VFA	mg/L		3	5	2.500	2.5				2.5	2.5				5			5					2.5	
TOC	mg/L		2.3	3.1	2.10	2.1				1.9	2.1				2.5			3.1					2.6	
Alkalinity	mg CaCO3/L		79	154	76.00	76				76	82				83			154					70	
Conductivity	mS/m		35	44.9	34.70	35.4	34.6	34.4	34.8	34.9	36.7	35.2	35.0	33.8	34.8	36.8	38.5	44.9	42	35.2	38.6	44.6	35.9	44.4
COD	mg/L		7.5	51	7.50	7.5	20	7.5	7.5	7.5	30	41	7.5	7.5	27	18	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		1	2	0.50	0.5				1.5	0.5				1			0.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	NIL	2	4	#NUM!	ND	ND	ND	ND	2	2				4			2					2	
Chloride	mg/L	250*	47.25	66.7	46.850	47.8	45.0	45.9	48.2	48.4	50.5	49.0	48.4	44.9	43.4	52.4	53.5	41.2	66.7	46.7	50	40.9	45.1	41
Nitrate-N	mg/L	11.3	0.01	0.8	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.22	0.005	0.005	0.02	0.01	0.25	0.005	0.005	0.81	0.56
Sulphate	mg/L	250*	10.05	12.4	12.40	12.4				10.0	10.7				9.55			0.1					10.1	
Ammonia-N	mg/L	1.17	0.30	0.5	0.30	0.30	0.29	0.29	0.30	0.34	0.34	0.30	0.29	0.29	0.23	0.53	0.35	0.33	0.31	0.01	0.39	0.42	0.04	0.1
Hardness	mg CaCO3/L	200*	92	128	83.00	83				75	101				94			128					90	
Calcium	mg/L		28.05	29.7	23.10	23.1				20.0	29.7				29.0			29.5					27.1	
Magnesium	mg/L		6.06	13.3	6.140	6.14				5.97	6.46				5.31			13.3					5.42	
Potassium	mg/L		5.5	5.7	5.670	5.67				5.40	5.11				4.40			5.71					5.74	
Sodium	mg/L	200*	28.4	45	28.60	30.2	30.0	10.9	27.2	28.1	31.0	32.5	26.0	41.3	24.4	33.3		45.4	28.4	23.3	23.9	41.6	23.3	38.1
D.R. Phosphorus	mg/L		0.26	0.51	0.1980	0.198				0.148	0.218				0.292			0.512					0.323	
Aluminium	mg/L	0.1*	0.002	0.0	0.0010	0.001	0.001	0.001	0.001	0.001	0.003	0.001	0.002	0.001	0.004	0.005	0.002	0.003	0.008	0.001	0.005	0.004	0.001	0.007
Arsenic	mg/L	0.01	0.001	0.0020	0.0010	0.001				0.002	0.0005				0.0005			0.002					0.0005	
Boron	mg/L	1.4	0.02	0.06	0.0150	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.03	0.015	0.06	0.015	0.015	0.03	0.05	0.03	0.06
Cadmium	mg/L	0.004	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	0.05	0.0005	0.00	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	2	0.00043	0.0011	0.000250	0.00025				0.00025	0.00025				0.0010			0.0006					0.0011	
Iron	mg/L	0.2*	0.1	10.5	0.050	0.046	0.07	0.05	0.05	0.052	0.064	0.06	0.03	0.07	0.134	0.18		0.103	0.19	0.05	0.07	0.04	0.052	0.25
Lead	mg/L	0.01	0.00025	0.0022	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0007	0.00025	0.001	0.0013	0.00025	0.00025	0.0022	0.0007	0.0017
Manganese	mg/L	0.4	0.2	0.57	0.230500	0.234	0.232	0.229	0.219	0.230	0.231	0.237	0.193	0.228	0.133	0.570	0.286	0.428	0.321	0.0505	0.276	0.443	0.107	0.144
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	0.08	0.0003	0.0022	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0022	0.00025	0.0008	0.00025	0.00025	0.00025	0.001	0.0006	0.001
Zinc	mg/L	1.5*	0.0050	0.048	0.0010	0.001				0.001	0.001				0.013			0.009					0.048	

* = GV

F1 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		7.88	8.38	7.9450	8.38	7.97	7.92	7.89	8.21	8.04	7.71	7.98	8.09	7.59	7.42	7.62	7.82	7.8	7.73	7.875	8.2		7.75
pH		6 to 9	7.0	7.9	7.70	7.6	7.8	6.8	7.9	7.6	7.2	6.8	6.8	6.8	6.9	6.9	7.0	6.9	6.9	7	7	7	7.5	7
Suspended Solids	mg/l		3	3	2.50	2.5				2.5	3				2			3					2.5	
Phenol	mg/L		0.025	0.03	0.0250	0.025				0.025	0.005				0.025			0.0015					0.025	
VFA	mg/L		3	3	2.50	2.5				2.5	2.5				2.5			2.5					2.5	
TOC	mg/L		5.9	9.6	5.50	5.5				6.2	5.4				6.8			9.6					3.6	
Alkalinity	mg CaCO3/L		132	157	131.0	131				144	130				132			157					63	
Conductivity	mS/m		47.1	55	45.0	46.6	43.4	42.4	46.8	47.2	48.0	50.6	52.3	52.5	54.5	55.0	53.0	53.1	46.9	27.6	48.7	43.9	31.7	42.1
COD	mg/L		16.0	40	11.750	16	7.5	7.5	30	18	7.5	40	28	25	22	7.5	31	20	7.5	7.5	25	7.5	7.5	16
BOD (scBOD frm Apr'20)	mg/L		0.50	4.0	0.50	0.5				0.5	0.5				0.5			1.5					4	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	200	#NUM!	ND	ND	ND	ND	2	2				200			2					2	
Chloride	mg/L		54.00	97	50.30	49.4	51.0	51.8	49.6	48.2	57.6	74.0	50.9	48.0	69.6	96.5	51.0	55	54.7	56.9	46.5	53.3	54.7	58.2
Nitrate-N	mg/L	90.3	0.78	3.1	1.505000	1.01	1.47	1.96	1.54	0.78	1.31	1.96	0.21	0.28	1.20	3.07	0.19	0.52	0.64	1.17	0.06	0.22	0.32	0.78
Sulphate	mg/L	1000	4	5	5.240	5.24				2.90	4.32				4.19			2.32					4.69	
Ammonia-N	mg/L		0.005	0	0.0050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.24	0.005	0.005	0.005	0.005	0.005	0.005	0.08	0.005
Hardness	mg CaCO3/L		127	156	125.0	125				121	128				156			139					87	
Calcium	mg/L	1000	19.0	26.7	18.30	18.3				17.4	19.7				26.7			22.2					13.3	
Magnesium	mg/L		19.2	22.7	19.20	19.2				18.8	19.1				22.7			22.6					13	
Potassium	mg/L		7.84	8.95	8.950	8.95				7.78	7.90				7.57			8.48					7.27	
Sodium	mg/L		40.00	48	34.550	42.9	38.4	14.3	30.7	39.5	46.4	41.5	46.6	48.0	45.9	41.8		44.7	40.4	39.6	38.3	40	31.9	36.1
D.R. Phosphorus	mg/L		0.164	0.17	0.1720	0.172				0.171	0.160				0.168			0.157					0.124	
Aluminium	mg/L	5	0.002	0	0.0010	0.001	0.001	0.001	0.003	0.001	0.001	0.003	0.001	0.001	0.001	0.014	0.001	0.003	0.005	0.002	0.003	0.002	0.002	0.001
Arsenic	mg/L	0.5	0.002	0.002	0.0020	0.002				0.002	0.002				0.001			0.002					0.002	
Boron	mg/L	5	0.023	345	0.030	345	0.03	0.03	0.015	0.03	0.015	0.015	0.015	0.015	0.015	0.04	0.015	0.015	0.015	0.015	0.04	0.03	0.04	0.03
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.001	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.002	0.00	0.00300	0.0030				0.0021	0.0018				0.0020			0.0034					0.0017	
Iron	mg/L		0.005	0.0	0.0050	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.008	0.04		0.005	0.005	0.005	0.005	0.005	0.009	0.005
Lead	mg/L	0.1	0.00025	0.0020	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0020	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		0.0042	0.032	0.003700	0.0044	0.0028	0.0030	0.0133	0.0040	0.0029	0.0028	0.0061	0.0052	0.0118	0.0319	0.0091	0.0034	0.0024	0.0075	0.0089	0.0016	0.0052	0.002
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.0003	0.0014	0.000250	0.00025	0.00025	0.00025	0.0014	0.0006	0.00025	0.00025	0.0007	0.0006	0.00025	0.0006	0.0008	0.0006	0.00025	0.00025	0.0008	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.0010	0.006	0.00100	0.001				0.001	0.001				0.001			0.002					0.006	

F2 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		2.940	5.27	4.1875	3.11	5.27	5.265	2.87	2.995	2.865	2.74	2.94	2.91	3.84	2.55	2.77	2.81	2.915	2.92	3.04	3.07		2.99
pH		6 to 9	7	7.7	7.25	7.2	7.5	7.0	7.3	7.0	7.2	7.0	7.0	6.9	7.0	7.0	7.1	7.2	7	7.1	7.3	7.1	7.7	7.1
Suspended Solids	mg/l		3	140	3	3				2.5	3				140			3					2.5	
Phenol	mg/L		0.02	0.025	0.025	0.025				0.025	0.005				0.005			0.0015					0.025	
VFA	mg/L		7	8	2.5	2.5				2.5	6				8			7					8	
TOC	mg/L		1.6	10.2	1.6	1.6				1.4	1.5				10.2			1.6					1.6	
Alkalinity	mg CaCO3/L		53	54	53	53				52	53				54			53					47	
Conductivity	mS/m		25	40.5	22.4	22.1	22.2	22.6	22.9	22.3	22.5	22.8	23.6	23.5	25.1	25.5	25.5	25	25.1	25.5	26.1	26.7	26.8	26.9
COD	mg/L		7.5	51	7.5	7.5	7.5	7.5	51	7.5	7.5	33	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	18	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		0.5	0.5	0.5	0.5				0.5	0.5				0.5			0.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	2	#NUM!	ND	ND	ND	ND	2	2				2			2					2	
Chloride	mg/L		27.5	31.6	23	23.2	22.7	23.4	22.8	23.7	24.2	24.9	25.0	24.2	27.3	28.6	28.4	27.6	28.8	28.9	27.7	30.7	31.1	30.9
Nitrate-N	mg/L	90.3	1.44	4.6	0.64	0.33	0.55	0.73	0.74	0.57	0.66	1.00	1.19	0.92	1.12	2.19	2.02	1.68	1.94	2.79	3.41	2.19	3.04	3.66
Sulphate	mg/L	1000	10.800	12.5	8.97	8.97				10.1	9.42				12.5			11.7					11.5	
Ammonia-N	mg/L		0.005	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Hardness	mg CaCO3/L		42	48	37	37				39	39				45			48					46	
Calcium	mg/L	1000	6.94	8.1	6.01	6.01				6.32	6.40				7.47			8.1					7.72	
Magnesium	mg/L		6.05	6.76	5.41	5.41				5.55	5.64				6.46			6.76					6.54	
Potassium	mg/L		5.180	6	5.45	5.45				4.47	5.21				4.63			5.15					5.82	
Sodium	mg/L		27.0	31	24.25	26.1	24.7	23.6	23.8	25.6	28.1	28.2	22.1	26.6	27.0	26.0		30.1	27.3	26.5	28.2	29.6	29.1	31.4
D.R. Phosphorus	mg/L		0.14	0.16	0.148	0.148				0.146	0.142				0.158			0.125					0.134	
Aluminium	mg/L	5	0.001	0.01	0.002	0.002	0.001	0.002	0.002	0.001	0.001	0.003	0.001	0.001	0.005	0.006	0.001	0.001	0.001	0.001	0.003	0.002	0.001	0.001
Arsenic	mg/L	0.5	0.001	0.002	0.002	0.002				0.001	0.002				0.001			0.001					0.001	
Boron	mg/L	5	0.04	0.04	0.035	0.03	0.04	0.03	0.04	0.03	0.04	0.015	0.015	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.03	0.04	0.04
Cadmium	mg/L	0.01	0.0001	0.0001	0.0001	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.001	0.0005	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.001	0.001	0.0013	0.0013				0.0009	0.0010				0.0012			0.001					0.0008	
Iron	mg/L		0.005	0.0	0.005	0.018	0.005	0.005	0.005	0.014	0.020	0.01	0.005	0.01	0.008	0.005		0.0025	0.02	0.005	0.005	0.005	0.005	0.005
Lead	mg/L	0.1	0.00025	0.003	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0025
Manganese	mg/L		0.00365	0.036	0.00335	0.0360	0.0050	0.0017	0.0010	0.0088	0.0075	0.0036	0.0008	0.0029	0.0037	0.0104	0.0017	0.0025	0.0068	0.0006	0.002	0.0063	0.0141	0.0044
Mercury	mg/L		0.000250	0.0003	0.00025	0.00025																		
Nickel	mg/L	1	0.00025	0.001	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0013	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.001	0.007	0.002	0.002				0.001	0.001				0.001			0.001					0.007	

F3 Monitoring Bore HDC Levin Landfill

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		5.3	5.47	4.13	5.43	2.83	2.83	5.45	5.44	5.31	5.19	5.38	5.35	4.95	4.98	5.22	5.25	4.34	5.27	5.415	5.47		5.35
pH		6 to 9	7	7.8	7.25	7.8	7.5	7.0	7.0	7.3	7.2	7.0	7.0	7.0	7.0	7.0	7.1	7	7.3	7	7.1	7.1	7.6	7.2
Suspended Solids	mg/l		5	87	3	3				2.5	6				29			3					87	
Phenol	mg/L		0.02	0.025	0.025	0.025				0.025	0.005				0.005			0.0015					0.025	
VFA	mg/L		5	9	2.5	2.5				2.5	6				5			9					5	
TOC	mg/L		1.4	1.7	1.3	1.3				1.2	1.4				1.4			1.3					1.7	
Alkalinity	mg CaCO3/L		45	53	53	53				45	45				43			44					42	
Conductivity	mS/m		20.60	23	19.9	19.2	18.4	20.6	20.6	20.4	20.2	21.5	20.4	20.5	22.9	20.6	21.2	21.6	23.2	22.8	21.4	21	17.7	20.6
COD	mg/L		7.5	56	7.5	7.5	7.5	7.5	56	15	7.5	29	7.5	7.5	30	22	7.5	7.5	7.5	7.5	22	7.5	7.5	7.5
BOD (scBOD frm Apr'20)	mg/L		0.5	2	0.5	0.5				0.5	0.5				0.5			0.5					2	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	2	#NUM!	ND	ND	ND	ND	2	2				2			2					2	
Chloride	mg/L		22.7	33	17.4	15.4	14.7	19.4	20.6	21.9	21.3	26.8	23.0	22.9	29.6	24.1	25.0	25.6	30.3	32.5	21.3	22.5	24.4	21
Nitrate-N	mg/L	90.3	1.085	2	1.355	1.11	1.19	1.93	1.52	0.88	0.74	0.97	0.82	0.86	1.19	1.16	1.29	1.28	1.14	1	0.79	1.09	1.02	0.93
Sulphate	mg/L	1000	9.36	11.8	7.03	7.03				11.8	10.7				9.14			9.57					7.65	
Ammonia-N	mg/L		0.005	0.0	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Hardness	mg CaCO3/L		38	42	34	34				37	38				42			38					38	
Calcium	mg/L	1000	6	6.71	5.18	5.18				5.63	5.92				6.71			6					6.24	
Magnesium	mg/L		5.60	6.22	5.08	5.08				5.45	5.70				6.22			5.67					5.52	
Potassium	mg/L		5.03	5	5.11	5.11				4.62	4.95				4.47			5.32					5.13	
Sodium	mg/L		22.0	26	21.3	23.0	20.6	9.08	22.0	22.0	24.1	22.0	20.6	22.7	22.7	21.2	23.5	25.7	23.9	21.1	24.3	23.9	21.7	20.2
D.R. Phosphorus	mg/L		0.1350	0.14	0.143	0.143				0.139	0.131				0.139			0.123					0.109	
Aluminium	mg/L	5	0.001	0.03	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.027	0.010	0.001	0.001	0.003	0.002	0.002	0.001	0.007	0.003
Arsenic	mg/L	0.5	0.001	0.002	0.002	0.002				0.001	0.002				0.001			0.001					0.001	
Boron	mg/L	5	0.015	0.03	0.015	0.015	0.03	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.03
Cadmium	mg/L	0.01	0.0001	0.0001	0.0001	0.0001				0.0001	0.0001				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.0005	0.001	0.0005	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.001	0.002	0.0005	0.0005				0.00025	0.0006				0.0012			0.00025					0.0015	
Iron	mg/L		0.0050	0.2	0.005	0.0025	0.005	0.005	0.005	0.0025	0.0025	0.005	0.005	0.005	0.026	0.01	0.005	0.0025	0.005	0.005	0.005	0.005	0.005	0.005
Lead	mg/L	0.1	0.00025	0.000	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L		0.000	0.018	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0018	0.0064	0.00025	0.0009	0.00025	0.0009	0.00025	0.0005	0.0077	0.0016
Mercury	mg/L		0.000250	0.0003	0.00025	0.00025																		
Nickel	mg/L	1	0.00025	0.000	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	20	0.00100	0.005	0.001	0.001				0.001	0.001				0.003			0.001					0.005	

HS1A (from Apr 2020) Hokio Stream Upstream

Determinand		ANZECC AE (95%)	Median	Maximum	Annual Median	Jun-20	May-20	Apr-20
pH		-	7.8	8.3	7.80000	7.6	8.3	7.8
Suspended Solids	mg/l	-	23	36	23.00000	20	36	23
Phenol	mg/L	0.32	0.040	0.04	0.04000	0.040	0.040	0.025
VFA	mg/L	-	4.9	4.9	4.90000	4.9	4.9	2.5
TOC	mg/L	-	8.1	8.4	8.10000	6.3	8.4	8.1
Alkalinity	mg CaCO3/L	-	61	67	61.00000	52	67	61
Conductivity	mS/m	-	25.2	26.2	25.20000	23.6	25.2	26.2
COD	mg/L	-	24	35	24.00000	22	35	24
BOD (scBOD frm Apr'20)	mg/L	2	1	5.9	0.90000	0.9	5.9	0.5
Faecal C (Ecoli frm Apr'20)	col/100ml	-	320	1700	320.00000	92	1700	320
Chloride	mg/L	-	24	26.6	24.30000	23.9	24.3	26.6
Nitrate-N	mg/L	0.16	0.14	0.44	0.14000	0.440	0.140	0.04
Sulphate	mg/L	-	18.10	18	18.10000	18.1	14.4	18.1
Ammonia-N	mg/L	2.1	0.02	0.03	0.02000	0.020	0.010	0.03
Hardness	mg CaCO3/L	-	65	69	65.00000	62	65	69
Calcium	mg/L	-	14	14.7	13.80000	13.8	13.8	14.7
Magnesium	mg/L	-	7	7.85	7.43000	6.8	7.4	7.85
Potassium	mg/L	-	2.9	3.27	2.88000	2.78	2.88	3.27
Sodium	mg/L	-	21.0	22.6	21.00000	21.0	20.4	22.6
D.R. Phosphorus	mg/L	-	0.005	0.018	0.00500	0.004	0.005	0.018
Aluminium	mg/L	0.055	0.011	0.015	0.01100	0.015	0.008	0.011
Arsenic	mg/L	0.024	0.0005	0.0005	0.00050	0.0005	0.0005	0.0005
Boron	mg/L	0.37	0.060	0.06	0.06000	0.06	0.05	0.06
Cadmium	mg/L	0.0002	0.0001	0.0001	0.00010	0.0001	0.0001	0.0001
Chromium	mg/L	0.001	0.0005	0.0005	0.00050	0.0005	0.0005	0.0005
Copper	mg/L	0.0014	0.001	0.0011	0.00080	0.00070	0.00110	0.0008
Iron	mg/L	-	0.019	0.027	0.01900	0.027	0.014	0.019
Lead	mg/L	0.0034	0.0004	0.0004	0.00040	0.00040	0.00040	0.00025
Manganese	mg/L	1.9	0.0173	0.0385	0.01730	0.0062	0.0173	0.0385
Mercury	mg/L	0.0006	0.0004	0.0004	0.00040	0.00040	0.00040	0.00025
Nickel	mg/L	0.011	0.0004	0.0004	0.00040	0.00040	0.00040	0.00025
Zinc	mg/L	0.008	0.001	0.001	0.00100	0.001	0.001	0.001

HS1 Hokio Stream Upstream

Determinand		ANZECC AE (95%)	Median	Maximum	Annual Median	Jun-20	May-20	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16
pH		-	7.750	9.1	7.850	7.7	8.3	7.7	7.8	8.1	7.9	8.2	9.1	7.7	7.4	7.8	7.4	7.4	7.3	7.4	7.4	7.8	7.4	9
Suspended Solids	mg/l	-	36.00	133	37.5000	52	36	39		36		70	3		8		133		15	15				
Phenol	mg/L	0.32	0.0250	0.04	0.03250	0.040	0.040	0.025		0.025		0.025	0.005				0.03		0.01	0.0015				
VFA	mg/L	-	4.900	60	4.900	4.9	4.9	2.5		60		6	2.5		6		2.5		25	2.5				
TOC	mg/L	-	7.600	13.4	7.400	6.0	9.0	7.9		6.9		9.7	7.6		5.4		13.4		6.9	6.9				
Alkalinity	mg CaCO3/L	-	55.00	77	56.500	52	65	61		49		77	57		46		59		41	47				
Conductivity	mS/m	-	24.550	26	24.400	23.9	25.0	26.4	24.9	23.3	22.6	26.4	23.4	24.5	25.6	25.7	26.4	22.9	22.2	25.4	24.6	24.3	26	23.8
COD	mg/L	-	29.50	100	30.500	33	27	28	51	36	27	77	33	100	21	43	88	27	24	31	17	25	21	60
BOD (scBOD frm Apr'20)	mg/L	2	3.00	7.0	1.950	0.9	5.9	0.5		3		7	2		1.5		3		3.0	1.5				
Faecal C (Ecoli frm Apr'20)	col/100ml	-	190.00	830	355.000	190	500	830	810	190	210	550	56		16		330		48	80				
Chloride	mg/L	-	24.50	29	24.100	24.2	24.0	26.6	24.7	22.7	22.1	27.4	22.8	22.9	25.9	28.1	29.1	22.0	21.8	24.6	9.11	24.4	25.5	28
Nitrate-N	mg/L	0.16	0.370	2.7	0.370	0.440	0.110	0.04	0.30	1.43	1.95	0.005	0.05	1.32	1.52	0.19	0.03	2.74	2.48	2.45	0.005	1.65	1.73	0.005
Sulphate	mg/L	-	17.70	24	18.050	18.2	14.5	17.9		21.6		8.5	17.7		23.8		16.7		17.5	19.9				
Ammonia-N	mg/L	2.1	0.04000	0.14	0.0350	0.090	0.020	0.05	0.12	0.005	0.005	0.005	0.03	0.06	0.14	0.04	0.02	0.04	0.02	0.06	0.06	0.02	0.07	0.005
Hardness	mg CaCO3/L	-	65.00	72	67.000	64	70	71		60		72	63		65		68		60	69				
Calcium	mg/L	-	14.60	15.1	14.400	14.0	14.8	15.1		12.9		15.0	13.4		14.6		14.7		13.1	14.9				
Magnesium	mg/L	-	7.5300	8.30	7.530	7.07	7.99	8.03		6.81		8.30	7.22		6.98		7.53		6.53	7.69				
Potassium	mg/L	-	3.110	3.51	3.1400	2.78	2.96	3.51		3.32		3.17	1.59		2.74		3.11		3.25	3.39				
Sodium	mg/L	-	21.10	26.8	20.100	20.3	21.7	23.3	18.0	19.9	14.8	24.5	21.2	19.1	21.7	21.2	24.9	21.0	17.5	23.4	22.9	19.2	20.4	26.8
D.R. Phosphorus	mg/L	-	0.019	0.39	0.0050	0.004	0.006	0.019		0.0025		0.275	0.163		0.020		0.388		0.010	0.013				
Aluminium	mg/L	0.055	0.0140	0.036	0.01350	0.014	0.007	0.008	0.021	0.027	0.013	0.005	0.008	0.011	0.010	0.014	0.017	0.021	0.020	0.01	0.014	0.014	0.019	0.01
Arsenic	mg/L	0.024	0.00050	0.004	0.00050	0.0005	0.0005	0.0005		0.0005		0.003	0.002		0.0005		0.004		0.0005	0.0005				
Boron	mg/L	0.37	0.060	0.1	0.0550	0.06	0.06	0.07	0.05	0.05	0.05	0.06	0.05	0.05	0.04	0.06	0.05	0.06	0.05	0.05	0.09	0.07	0.07	0.07
Cadmium	mg/L	0.0002	0.00010	0.00	0.00010	0.0001	0.0001	0.0001		0.0001		0.0001	0.0001		0.0001		0.0001		0.0001	0.0001				
Chromium	mg/L	0.001	0.00050	0.00	0.00050	0.0005	0.0005	0.0005		0.0005		0.0005	0.0005		0.0005		0.0005		0.0005	0.0005				
Copper	mg/L	0.0014	0.000900	0.01	0.001050	0.00070	0.01100	0.0009		0.0012		0.00025	0.0007		0.00025		0.0016		0.0016	0.0012				
Iron	mg/L	-	0.0690	0.2	0.0470	0.044	0.028	0.011	0.05	0.068	0.07	0.107	0.076	0.05	0.058	0.09	0.064	0.12	0.081	0.087	0.13	0.06	0.07	0.04
Lead	mg/L	0.0034	0.000250	0.000	0.000250	0.00040	0.00040	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L	1.9	0.019400	0.09	0.0170	0.0091	0.0158	0.0339	0.0404	0.0140	0.0182	0.0915	0.0094	0.0259	0.0299	0.0733	0.0183	0.0216	0.0055	0.0196	0.0192	0.0308	0.0164	0.0095
Mercury	mg/L	0.0006	0.00040	0.0004	0.00040	0.00040	0.00040	0.00025																
Nickel	mg/L	0.011	0.000250	0.000	0.000250	0.00040	0.00040	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	0.008	0.00100	0.00	0.0010	0.001	0.001	0.001		0.001		0.001	0.001		0.001		0.001		0.001	0.001				

HS2 Hokio Stream Beside Landfill

Determinand		ANZECC AE (95%)	Median	Maximum	Annual Median	Jun-20	May-20	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16
pH		-	7.7	8.9	7.750	7.6	8.1	7.7	7.8	7.9	7.7	7.9	8.9	7.5	7.4	7.7	7.4	7.3	7.2	7.3	7.4	7.5	7.5	7.9
Suspended Solids	mg/l	-	27	130	32.000	87	33	24		31		66	3		8		130		20	27				
Phenol	mg/L	0.32	0.03	0.04	0.03250	0.040	0.040	0.025		0.025		0.025	0.005				0.025		0.01	0.0015				
VFA	mg/L	-	5	30	4.900	4.9	4.9	2.5		30		6	2.5		2.5		8		25	2.5				
TOC	mg/L	-	7.6	13.7	7.150	6.1	8.7	7.6		6.7		9.5	7.4		5.5		13.7		9.7	7.6				
Alkalinity	mg CaCO3/L	-	59	79	59.500	54	67	65		52		79	59		48		59		43	54				
Conductivity	mS/m	-	26	28	25.200	24.7	26.2	27.9	25.7	24.5	22.8	28.1	23.9	26.1	26.1	26.4	26.3	22.9	23.3	27.5	24.8	28.3	26.3	25.4
COD	mg/L	-	30	157	27.000	24	25	21	48	29	31	86	29	92	24	39	100	23	31	39	16	157	26	104
BOD (scBOD frm Apr'20)	mg/L	2	3	10.0	1.950	0.9	6	0.5		3		8	2		2		3		10	3				
Faecal C (Ecoli frm Apr'20)	col/100ml	-	190	900	435.000	220	900	790	650	190	160	450	150		120		480		46	88				
Chloride	mg/L	-	26	98	25.450	25.7	25.9	28.0	25.2	24.0	22.3	28.8	23.6	25.3	26.3	27.9	29.1	22.3	23.3	27	24.2	98	25.8	28.6
Nitrate-N	mg/L	0.16	0.405	2.7	0.400	0.500	0.170	0.08	0.30	1.47	2.02	0.005	0.08	1.32	1.53	0.19	0.02	2.71	2.46	2.44	0.59	0.31	1.79	0.005
Sulphate	mg/L	-	17.5	24	17.950	18.6	14.7	17.3		21.4		8.4	17.8		23.8		16.7		17.5	19.6				
Ammonia-N	mg/L	2.1	0.09	7.66	0.100	0.070	0.100	0.14	0.16	0.10	0.02	0.01	0.04	0.14	0.14	0.12	0.005	0.03	0.12	0.33	0.08	7.66	0.07	0.005
Hardness	mg CaCO3/L	-	68	78	65.500	63	68	74		63		75	68		65		69		62	78				
Calcium	mg/L	-	14.60	17.8	14.250	13.9	14.6	15.9		13.5		15.8	14.5		14.7		14.9		13.8	17.8				
Magnesium	mg/L	-	7.700	8.58	7.400	6.87	7.76	8.35		7.04		8.58	7.57		6.94		7.70		6.74	8.13				
Potassium	mg/L	-	3.1	3.85	3.2150	2.88	3.11	3.62		3.32		3.40	1.65		2.8		3.12		3.61	3.85				
Sodium	mg/L	-	21.6	68	20.7000	21.3	21.7	24.3	17.4	20.1	15.0	25.4	21.8	20.6	21.5	22.6	24.7	20.0	18.5	23.9	22.6	68.3	20.6	24.7
D.R. Phosphorus	mg/L	-	0.02	0.391	0.00650	0.004	0.009	0.020		0.0025		0.266	0.171		0.022		0.391		0.016	0.014				
Aluminium	mg/L	0.055	0.0110	0.077	0.0170	0.021	0.005	0.007	0.023	0.027	0.013	0.003	0.008	0.012	0.009	0.011	0.004	0.025	0.019	0.009	0.007	0.011	0.077	0.011
Arsenic	mg/L	0.024	0.001	0.004	0.00050	0.0005	0.0005	0.0005		0.0005		0.003	0.002		0.0005		0.004		0.0005	0.0005				
Boron	mg/L	0.37	0.06	0.2	0.0550	0.06	0.06	0.07	0.05	0.05	0.05	0.06	0.05	0.06	0.04	0.05	0.07	0.05	0.05	0.06	0.07	0.24	0.05	0.06
Cadmium	mg/L	0.0002	0.0001	0.00	0.00010	0.0001	0.0001	0.0001		0.0001		0.0001	0.0001		0.0001		0.0001		0.0001	0.0001				
Chromium	mg/L	0.001	0.0005	0.00	0.00050	0.0005	0.0005	0.0005		0.004		0.0005	0.0005		0.0005		0.0005		0.0005	0.0005				
Copper	mg/L	0.0014	0.0009	0.00	0.001150	0.00070	0.00090	0.0016		0.0014		0.00025	0.0007		0.00025		0.0017		0.0018	0.0011				
Iron	mg/L	-	0.07	0.6	0.0380	0.026	0.021	0.010	0.05	0.077	0.07	0.051	0.093	0.06	0.062	0.08	0.032	0.14	0.070	0.099	0.1	0.59	0.17	0.04
Lead	mg/L	0.0034	0.00025	0.003	0.000250	0.00040	0.00040	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L	1.9	0.0273	0.96	0.02420	0.0120	0.0232	0.0420	0.0424	0.0252	0.0199	0.105	0.0110	0.0466	0.0357	0.0522	0.0352	0.0265	0.0179	0.0281	0.0227	0.963	0.0226	0.0107
Mercury	mg/L	0.0006	0.0004	0.0004	0.00040	0.00040	0.00040	0.00025																
Nickel	mg/L	0.011	0.00025	0.00	0.000250	0.00040	0.00040	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0025	0.00025	0.00025	0.00025	0.0015	0.00025	0.00025
Zinc	mg/L	0.008	0.0010	0.002	0.0010	0.001	0.001	0.001		0.001		0.001	0.001		0.001		0.001		0.002	0.001				

HS3 Hokio Stream Downstream

Determinand		ANZECC AE (95%)	Median	Maximum	Annual Median	Jun-20	May-20	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16
pH		-	7.6	8.8	7.70	7.6	8.0	7.6	7.7	7.8	7.7	7.9	8.8	7.4	7.4	7.6	7.4	7.2	7.2	7.2	7.5	7.6	7.3	8.5
Suspended Solids	mg/l	-	21.0	127	32.50	85	31	21		34		67	3		11		127		14	18				
Phenol	mg/L	0.32	0.0250	0.04	0.03250	0.040	0.040	0.025		0.025		0.025	0.005				0.025		0.01	0.0015				
VFA	mg/L	-	5	30	4.90	4.9	4.9	2.5		30		9	2.5		6		2.5		25	2.5				
TOC	mg/L	-	7.5	12.8	7.30	6.1	9.5	7.8		6.8		9.0	7.4		5.6		12.8		7.3	7.5				
Alkalinity	mg CaCO3/L	-	58.0	78	60.50	56	65	65		51		78	59		49		59		42	52				
Conductivity	mS/m	-	25.6	28	25.40	25.0	25.8	27.8	25.9	24.5	23.1	27.8	24.1	26.2	26.6	27.0	26.2	23.1	22.8	26.9	25	25.2	26.6	25.3
COD	mg/L	-	31	107	32.00	36	33	23	53	27	31	107	31	82	24	47	104	18	29	33	20	28	19	87
BOD (scBOD frm Apr'20)	mg/L	2	3	9.0	1.950	0.9	5.9	0.50		3		9	1		2		3		3	3				
Faecal C (Ecoli frm Apr'20)	col/100ml	-	190	600	305.00	150	600	410	580	200	190	310	140		65		480		58	180				
Chloride	mg/L	-	26	29	25.350	25.8	25.2	28.3	25.5	23.7	22.4	29.1	23.7	25.5	27.7	28.8	28.9	22.7	22.6	26.5	7.89	25.1	26.1	29
Nitrate-N	mg/L	0.16	0.425	2.7	0.4250	0.540	0.200	0.09	0.31	1.46	2.09	0.005	0.09	1.34	1.54	0.17	0.03	2.69	2.48	2.39	0.005	1.58	1.75	0.005
Sulphate	mg/L	-	17.5	24	17.950	18.4	14.5	17.5		21.2		8.5	17.9		23.6		16.6		17.5	19.2				
Ammonia-N	mg/L	2.1	0.06	0.2	0.0650	0.140	0.040	0.09	0.18	0.04	0.005	0.005	0.05	0.13	0.15	0.13	0.01	0.06	0.06	0.16	0.07	0.06	0.09	0.005
Hardness	mg CaCO3/L	-	68.0	78	68.00	66	70	73		63		72	68		68		66		61	78				
Calcium	mg/L	-	14.80	17.9	14.650	14.5	14.8	15.8		13.5		15.4	14.8		15.3		14.4		13.5	17.9				
Magnesium	mg/L	-	7.590	8	7.600	7.27	7.93	8.20		7.14		8.23	7.59		7.29		7.27		6.52	8.13				
Potassium	mg/L	-	3.4	3.7	3.470	3.32	3.05	3.64		3.62		3.53	1.70		2.84		3.48		3.44	3.66				
Sodium	mg/L	-	22	26	21.150	23.2	21.9	23.8	18.5	20.4	15.6	24.8	21.6	20.9	22.6	23.2	24.1	20.3	17.8	25.5	22.9	18.3	20.9	25
D.R. Phosphorus	mg/L	-	0.024	0.391	0.0050	0.004	0.005	0.024		0.0050		0.268	0.176		0.024		0.391		0.012	0.016				
Aluminium	mg/L	0.055	0.013	0.0	0.0130	0.012	0.009	0.005	0.014	0.034	0.014	0.012	0.007	0.013	0.010	0.013	0.016	0.013	0.019	0.009	0.008	0.008	0.016	0.015
Arsenic	mg/L	0.024	0.001	0.004	0.00050	0.0005	0.0005	0.0005		0.0005		0.003	0.002		0.0005		0.004		0.0005	0.0005				
Boron	mg/L	0.37	0.06	0.1	0.0550	0.06	0.06	0.07	0.05	0.05	0.05	0.06	0.05	0.05	0.04	0.06	0.06	0.06	0.05	0.06	0.07	0.05	0.06	0.06
Cadmium	mg/L	0.0002	0.0001	0.00	0.00010	0.0001	0.0001	0.0001		0.0001		0.0001	0.0001		0.0001		0.0001		0.0001	0.0001				
Chromium	mg/L	0.001	0.0005	0.00	0.00050	0.0005	0.0005	0.0005		0.0005		0.0005	0.0005		0.0005		0.0005		0.0005	0.0005				
Copper	mg/L	0.0014	0.0010	0.003	0.001350	0.00080	0.00100	0.0030		0.0017		0.00025	0.0007		0.00025		0.0019		0.0016	0.001				
Iron	mg/L	-	0.1	0.3	0.03850	0.037	0.018	0.021	0.04	0.106	0.09	0.044	0.101	0.06	0.081	0.09	0.052	0.10	0.081	0.117	0.11	0.06	0.06	0.07
Lead	mg/L	0.0034	0.00025	0.000	0.000250	0.00040	0.00040	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Manganese	mg/L	1.9	0.02475	0.09	0.02590	0.0150	0.0213	0.0406	0.0475	0.0279	0.0239	0.0921	0.0125	0.0494	0.0375	0.0558	0.0179	0.0255	0.0096	0.0331	0.0257	0.024	0.019	0.016
Mercury	mg/L	0.0006	0.0004	0.0004	0.000400	0.00040	0.00040	0.00025																
Nickel	mg/L	0.011	0.0003	0.001	0.0003250	0.00040	0.00040	0.00025	0.00025	0.00025	0.0005	0.00025	0.00025	0.00025	0.00025	0.0006	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	0.008	0.001	0.001	0.0010	0.001	0.001	0.001		0.001		0.001	0.001		0.001		0.001		0.001	0.001				
Horizons One Plan Standar	NH4							0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
ANZECC Stock Drinking Wa	Feacs							100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Leachate Pond

(sampled at pump station as of 2017)

Determinand		Typical Leachate*	Median	Maximum	Annual Median	Jun-20	May-20	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16
pH		5.9 - 8.5	7.9	8.9	7.80	7.9	8.2	7.9	7.7	7.7	7.7	8.0	7.6	7.8	7.4	7.9	7.9	7.9	7.5	7.8	8.4	8.7	8.7	8.9
Suspended Solids	mg/l		64	191	60.00	80	90	35		40		136	72		106		33		64	49				
Phenol	mg/L		0.07	0.25	0.050	0.04	0.06	0.25		0.025		0.025	0.13				0.08		0.10	0.0015				
VFA	mg/L		24.0	81	5.450	5	6	2.5		12		45	15		6		24		56	81				
TOC	mg/L	17.2 - 822	662.0	820	713.00	622	804	804		530		820	753		385		662		530	631				
Alkalinity	mg CaCO3/L	264 - 6820	5840	7260	6075.00	5780	6370	6750		4950		7260	6480		3270		6250		4870	5840				
Conductivity	mS/m	264 - 27900	1042	1610	1425.00	1420	1490	1610	1430	1210	1350	1.7	1530	1290	860	953	1530	1180	1130	141	665	474	662	767
COD	mg/L	84 - 5090	2125	5570	2245.00	2200	1550	2330	2220	2270	3690	3680	2790	2220	2030	1640	5570	1820	1570	2020	1500	771	249	3820
BOD (scBOD frm Apr'20)	mg/L	Dec-67	137	198	89.50	79	81	98		146		146	137		110		105		190	105				
Faecal C (Ecoli frm Apr'20)	col/100ml		1000	320000	98.00	100	200	24	12	96	2000	1000	100		320000		57000		2400	50				
Chloride	mg/L	100 – 5000**	947	1290	1080.00	1170	1150	1210	1010	857	1010	1290	1140	834	654	781	1170	914	803	1120	800	634	847	1010
Nitrate-N	mg/L		0.38	18.80	0.550	8.93	11.80	0.25	0.50	0.05	0.60	0.05	0.08	0.05	1.99	3.99	0.60	0.02	1.07	18.8	0.05	7.17	0.66	0.03
Sulphate	mg/L	1 - 780	88.30	193	147.750	294	210	54.8		85.5		137	88		193		129		94.0	53.8				
Ammonia-N	mg/L	3.4 -1440	996	1620	1220.00	1170	1300	1450	1270	1010	1100	1620	1320	1140	616	783	1350	981	886	1170	313	163	292	364
Hardness	mg CaCO3/L		578	659	515.50	514	517	522		414		607	578		620		549		659	440				
Calcium	mg/L		113	157	106.00	113	106	106		85.3		119	113		157		112		157	90.2				
Magnesium	mg/L		65	77	58.650	55.9	61.4	62.3		48.8		74.7	71.7		54.9		65.0		64.6	52				
Potassium	mg/L		698	835	601.50	832	7.85	648		555		750	698		463		740		557	727				
Sodium	mg/L		808	1140	909.50	887	1050	993	815	738	932	1140	1020	799	562	695	1010	770	826	941	656	537	687	824
D.R. Phosphorus	mg/L		8.99	13.00	9.3750	6.99	9.71	13.0		9.04		11.9	11.7		4.57		8.99		6.27	7.91				
Aluminium	mg/L		0.311	0.780	0.40650	0.577	0.026	0.586	0.506	0.307	0.186	0.683	0.780	0.461	0.276	0.205	0.391	0.314	0.232	0.367	0.23	0.094	0.193	0.229
Arsenic	mg/L	45 - 2584	0.372	0.554	0.350	0.405	0.001	0.388		0.312		0.399	0.504		0.372		0.554		0.293	0.364				
Boron	mg/L		5.62	8.0	5.830	8.06	0.07	5.69	5.97	5.34	7.05	8.03	6.62	5.50	5.74	4.81	5.72	5.55	5.04	7.11	4.1	3.14	4.15	4.49
Cadmium	mg/L		0.0005	0.001	0.000550	0.0010	0.0001	0.0010		0.0001		0.0002	0.0005		0.0001		0.0005		0.0001	0.0005				
Chromium	mg/L	30 – 1600**	0.457	0.709	0.45250	0.697	0.000	0.709		0.208		0.628	0.666		0.301		0.465		0.340	0.457				
Copper	mg/L	0.005 – 50.4	0.0102	0.0193	0.005850	0.0225	0.0007	0.0073		0.0044		0.0080	0.019		0.0193		0.0128		0.0102	0.0143				
Iron	mg/L		4.00	6.18	4.560	4.30	5.61	5.25	4.42	2.53	4.70	6.18	6.18	4.10	2.66	2.42	4.36	4.41	3.90	4.73	1.51	0.61	1.44	1.68
Lead	mg/L	1.6 - 220	0.0019	0.0093	0.00200	0.0052	0.0004	0.0025	0.0017	0.0009	0.0023	0.0020	0.005	0.0019	0.0021	0.0019	0.0025	0.0093	0.0014	0.0027	0.00025	0.0007	0.0008	0.00025
Manganese	mg/L		1.05	2.36	1.10	1.16	0.0992	1.04	1.15	0.852	1.22	1.11	1.47	0.893	1.04	1.06	1.15	2.36	1.15	1.02	0.412	0.24	0.385	0.538
Mercury	mg/L		0.00250	0.00250	0.00040	0.00040	0.00040	0.0025																
Nickel	mg/L		0.099	0.140	0.1150	0.147	0.0005	0.125	0.107	0.0729	0.123	0.126	0.140	0.0952	0.0820	0.073	0.115	0.104	0.0782	0.102	0.0807	0.0542	0.0762	0.0783
Zinc	mg/L	0.001 – 0.42	0.068	0.172	0.05350	0.155	0.001	0.068		0.039		0.049	0.148		0.172		0.068		0.074	0.102				

* for Class 1-type landfills, Table 5-5, p79, Technical Guidelines for Disposal to Land,, WasteMINZ April 2016.

G1S

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		14.2450	14.6	14.265	14.52	14.21	14.11	14.32	14.53	14.31	14.13	14.25	14.375	14.02	13.74	14.04	14.21	14.29	14.09	14.24	14.45	14.61	14.07
pH		6 to 9	6.4000	6.9	6.550	6.9	6.6	6.5	6.3	6.4	6.3	6.2	6.1	6.2	6.6	6.5	6.7	6.3	6.4	6.5	6.4	6.4	6.4	6.4
Suspended Solids	mg/l		3.0000	1350	2.50	2.5				3	3				251			3					1350	
Phenol	mg/L		0.0100	0.03	0.0250	0.025				N/a	0.005				0.025			0.0015					0.01	
VFA	mg/L		2.5000	61	2.50	2.5				N/a	2.5				8			2.5					61	
TOC	mg/L		18.9500	38.4	38.40	38.4				11.0	10.2				21.2			16.7					33.8	
Alkalinity	mg CaCO3/L		56.5000	86	58.00	58				40	24				70			55					86	
Conductivity	mS/m		65.6000	181	101.80	65.9	81.6	122	126	136	181	129	167.0	136.0	46.3	41.6	41.9	43	45.7	44.1	54.2	56.3	65.3	55.6
COD	mg/L		60.5000	123	78.50	99	107	43	58	111	93	61	44	7.5	62	53	44	38	58	84	60	45	96	94
BOD (scBOD frm Apr'20)	mg/L		1.5000	3	0.50	0.5				1.5	3.0				3			1.5					1.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	9.0000	52000	16.00	16	ND	ND	ND	2	2				52000			2					50	
Chloride	mg/L		128.5000	513	216.00	130	156	276	330	362	513	300	420	389	70.1	68.9	69.7	74.5	69.3	61.7	103	109	119	127
Nitrate-N	mg/L	90.3	0.1400	1.27	0.0550	0.06	0.05	0.05	0.25	0.30	1.27	0.26	0.36	0.37	0.46	0.27	0.22	0.25	0.03	0.04	0.02	0.04	0.02	0.01
Sulphate	mg/L	1000	31.2500	1920	33.80	33.8				60.9	1920				21.6			17.8					28.7	
Ammonia-N	mg/L		0.0400	0.15	0.0450	0.04	0.04	0.05	0.06	0.08	0.05	0.05	0.09	0.08	0.02	0.02	0.03	0.02	0.03	0.01	0.03	0.04	0.05	0.04
Hardness	mg CaCO3/L		111.5000	373	59.00	59				214	373				79			72					144	
Calcium	mg/L	1000	20.0000	73.9	11.10	11.1				43.0	73.9				14.2			13.3					25.8	
Magnesium	mg/L		14.9000	45.7	7.610	7.61				25.9	45.7				10.5			9.51					19.3	
Potassium	mg/L		6.6300	13.2	5.930	5.93				10.1	13.2				4.71			4.97					7.33	
Sodium	mg/L		62.8500	170	134.00	94.2	117	170	151	144	156	136	136	115	51.6	44.2	50.4	49.2	51.7	53.7	49.7	54.9	61	64.7
D.R. Phosphorus	mg/L		0.0220	0.043	0.0380	0.038				0.022	0.043				0.022			0.021					0.017	
Aluminium	mg/L	5	0.04150	0.140	0.0670	0.137	0.113	0.021	0.013	0.014	0.013	0.018	0.005	0.012	0.036	0.067	0.032	0.031	0.075	0.047	0.048	0.054	0.105	0.14
Arsenic	mg/L	0.5	0.0010	0.002	0.0020	0.002				0.001	0.001				0.0005			0.001					0.001	
Boron	mg/L	5	0.0150	0.02	0.0150	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Cadmium	mg/L	0.01	0.00010	0.0002	0.00010	0.0001				0.0001	0.0002				0.0001			0.0001					0.0001	
Chromium	mg/L	1	0.00050	0.001	0.0010	0.001				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.00490	0.0404	0.00860	0.0086				0.0025	0.0018				0.0072			0.0026					0.0404	
Iron	mg/L		6.4300	25.1	6.030	3.49	4.62	7.44	8.29	14.8	19.3	9.4	11.3	10.9	0.327	2.26	3.79	3.24	5.42	1.67	3.41	8.43	0.631	25.1
Lead	mg/L	0.1	0.000250	0.011	0.000250	0.00025	0.0006	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0030	0.00025	0.00025	0.0007	0.0093	0.0036	0.0053	0.0014	0.0053
Manganese	mg/L		0.16500	0.46	0.1560	0.0635	0.136	0.176	0.180	0.269	0.415	0.212	0.286	0.237	0.100	0.0634	0.0693	0.0605	0.104	0.11	0.134	0.154	0.189	0.46
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.00110	0.0026	0.001150	0.0016	0.0020	0.0007	0.0007	0.0010	0.0012	0.0008	0.0009	0.0009	0.0010	0.0009	0.0008	0.0007	0.0013	0.0014	0.0016	0.0014	0.0026	0.0016
Zinc	mg/L	20	0.00250	0.021	0.0030	0.003				0.002	0.004				0.001			0.002					0.021	

G1D

Determinand		NZDW MAV	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		14.665	15.85	14.7250	15.05	14.8	14.635	14.65	15.85	14.89	14.68	14.38	14.86	14.63	14.24	14.05	14.54	14.765	14.49	14.58	14.93	15.06	14.56
pH		7 to 8.5*	7.2	7.8	7.200	7.7	7.2	7.2	7.0	7.6	7.4	7.0	7.1	7.0	7.1	7.0	7.3	7	7.3	7.4	7.2	7.4	7.8	7.2
Suspended Solids	mg/l		3	28	2.500	2.5				3	3				28			3					11	
Phenol	mg/L		0.03	0.025	0.02500	0.025				N/a	0.005				0.025			0.0015					0.025	
VFA	mg/L		5	8	2.500	2.5				N/a	6				5.0			2.5					8	
TOC	mg/L		2.1	2.6	2.000	2.0				2.0	2.1				2.6			2.3					2.1	
Alkalinity	mg CaCO3/L		60	63	59.00	59				63	60				50			60					60	
Conductivity	mS/m		28.2	46	28.1500	28.3	28.0	28.0	28.6	28.6	29.1	29.6	30.8	30.8	26.6	28.8	28.5	26.9	24.6	10.4	25.2	26.1	25.9	22
COD	mg/L		7.5	63	7.500	7.5	7.5	7.5	63	17	7.5	28	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	39
BOD (scBOD frm Apr'20)	mg/L		1	3	0.50	0.5				1.5	3				0.5			1.5					0.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	NIL	2	5000	#NUM!	ND	ND	ND	ND	2	2				5000			2					2	
Chloride	mg/L	250*	32.1	37	31.50	31.5	31.5	31.9	31.5	32.7	33.1	34.6	36.5	36.0	33.7	34.5	34.5	32.3	27.4	13.5	30.2	29.8	29.8	28.8
Nitrate-N	mg/L	11.3	0.005	0.2	0.0050	0.005	0.005	0.005	0.005	0.005	0.11	0.005	0.005	0.005	0.02	0.005	0.005	0.005	0.01	0.23	0.06	0.01	0.005	0.005
Sulphate	mg/L	250*	18.8	1790	20.10	20.1				20.2	1790				17.4			16.1					12.4	
Ammonia-N	mg/L	1.17	0.09	0.11	0.10	0.10	0.09	0.10	0.09	0.10	0.07	0.10	0.11	0.09	0.09	0.09	0.10	0.1	0.11	0.005	0.07	0.09	0.11	0.09
Hardness	mg CaCO3/L	200*	50	53	50.0	50				49	53				52			50					44	
Calcium	mg/L		8.27	8.7	7.830	7.83				8.06	8.72				8.63			8.47					7.42	
Magnesium	mg/L		7.22	7.57	7.510	7.51				6.97	7.57				7.39			7.04					6.29	
Potassium	mg/L		5.6	6.27	6.270	6.27				5.58	5.77				4.77			5.25					5.6	
Sodium	mg/L	200*	29.9	37.7	32.0	32.0	32.0	37.7	19.0	31.7	34.1	34.4	33.5	35.3	29.9	29.8		33.1	26.2	10.4	28.4	29.3	26.8	23.5
D.R. Phosphorus	mg/L		0.054	0.314	0.0300	0.030				0.047	0.314				0.060			0.039					0.071	
Aluminium	mg/L	0.1*	0.003	0.020	0.0010	0.002	0.001	0.001	0.001	0.004	0.020	0.003	0.001	0.004	0.005	0.001	0.001	0.001	0.006	0.002	0.005	0.001	0.003	0.018
Arsenic	mg/L	0.01	0.003	0.003	0.0030	0.003				0.003	0.003				0.002			0.002					0.002	
Boron	mg/L	1.4	0.030	0.05	0.0450	0.04	0.05	0.015	0.05	0.04	0.04	0.015	0.015	0.03	0.03	0.03	0.015	0.03	0.015	0.015	0.03	0.015	0.015	0.015
Cadmium	mg/L	0.004	0.0001	0.0002	0.00010	0.0001				0.0001	0.0002				0.0001			0.0001					0.0001	
Chromium	mg/L	0.05	0.0005	0.0005	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	2	0.00025	0.0006	0.000250	0.00025				0.00025	0.0006				0.00025			0.00025					0.00025	
Iron	mg/L	0.2*	0.300	2.43	0.570	0.44	0.70	0.19	1.49	0.647	2.43	0.22	0.19	0.40	0.248	0.33		0.308	0.3	0.05	0.23	0.15	0.0625	0.57
Lead	mg/L	0.01	0.0003	0.0200	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0011	0.0008	0.00025	0.00025	0.0044	0.0058	0.0079	0.0015	0.0025	0.02
Manganese	mg/L	0.4	0.0648	0.071	0.064750	0.0703	0.0645	0.0580	0.0650	0.0616	0.0654	0.0688	0.0589	0.0704	0.0690	0.0626	0.0701	0.0705	0.0661	0.0019	0.0637	0.064	0.0625	0.0689
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	0.08	0.00025	0.0003	0.000250	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025
Zinc	mg/L	1.5*	0.001	0.054	0.0010	0.001				0.001	0.003				0.001			0.001					0.054	

* = GV

G2S

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17 resampled June-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
Water level	mBGL		2.15	2.55	2.280	2.55	2.38	2.145	2.18	2.51	2.25	2.26	2.06	2.36	2.25	1.67	1.76	1.76	1.94	1.9	1.945	2.4		2.06
pH		6 to 9	7.0	7.9	6.950	7.0	6.9	7.0	6.6	7.1	6.9	6.7	6.7	6.6	6.8	7.0	7.0	7.3	7.2	7.3	7	6.8	7.9	6.9
Suspended Solids	mg/l		6	92	8.00	8				2.5	3				92			3					16	
Phenol	mg/L		0.03	0.025	0.0250	0.025				N/a	0.005				0.025			0.0015					0.025	
VFA	mg/L		3	8	2.500	2.5				N/a	2.5				8			6					2.5	
TOC	mg/L		12.7	15.6	15.60	15.6				14.6	12.9				12.5			9.3					4.5	
Alkalinity	mg CaCO3/L		421	523	427.00	427				523	418				424			401					173	
Conductivity	mS/m		175	286	188.00	190	267	133	186	177	200	131	189	189	173.0	16.1	136	154	264	218	286	101	50.8	154
COD	mg/L		45	148	61.00	53	69	22	90	80	148	60	36	27	44	27	23	24	103	77	63	45	7.5	34
BOD (scBOD frm Apr'20)	mg/L		2.0	3	0.500	0.5				2.5	3.0				3			0.5					1.5	
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2	16	#NUM!	ND	ND	ND	ND	2	2				16			4					2	
Chloride	mg/L		309	715	325.00	323	616	194	327	246	376	160	332	318	272	300	224	246	604	540	715	137	37.2	512
Nitrate-N	mg/L	90.3	0.01	3.17	0.0050	0.005	0.005	0.005	0.05	0.005	0.005	0.005	0.005	0.005	0.05	0.005	0.01	0.01	0.03	0.08	0.06	0.01	0.35	0.07
Sulphate	mg/L	1000	1.300	5.9	5.860	5.86				1.07	2.79	0.005			2.21			1.3					0.23	
Ammonia-N	mg/L		0.005	0.06	0.0150	0.02	0.02	0.005	0.01	0.005	0.01	0.005	0.06	0.01	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Hardness	mg CaCO3/L		292	415	304.000	304				312	415				279			275					145	
Calcium	mg/L	1000	65.5	92	61.0000	61.0				66.5	91.6				64.7			66.3					37.3	
Magnesium	mg/L		33	45.1	36.8000	36.8				35.4	45.1				31.0			28.5					12.6	
Potassium	mg/L		25.9	35.0	25.5000	25.5				25.0	35.0				26.3			32.4					6.83	
Sodium	mg/L		244.0	375	248.00	272	281	187	224	244	250	178	248	245	221	172		221	320	298	375	160	37.7	275
D.R. Phosphorus	mg/L		0.024	0.418	0.01800	0.018				0.024	0.013				0.028			0.023					0.418	
Aluminium	mg/L	5	0.004	0.059	0.00200	0.003	0.001	0.004	0.001	0.001	0.003	0.004	0.001	0.006	0.002	0.005	0.007	0.001	0.006	0.01	0.01	0.004	0.001	0.005
Arsenic	mg/L	0.5	0.0005	0.003	0.00050	0.0005				0.0005	0.0005				0.0005			0.0005					0.003	
Boron	mg/L	5	0.75	1.27	1.0650	1.21	1.15	0.57	0.98	1.27	0.95	0.73	0.66	0.77	0.82	0.52	0.66	0.93	0.85	0.59	0.83	0.56	0.07	0.63
Cadmium	mg/L	0.01	0.0001	0.0004	0.000100	0.0001				0.0001	0.0001				0.0001			0.0001					0.0004	
Chromium	mg/L	1	0.0005	0.0005	0.000500	0.0005				0.0005	0.0005				0.0005			0.0005					0.0005	
Copper	mg/L	0.4	0.0055	0.0080	0.001000	0.0010				0.0080	0.0046				0.0064			0.0069					0.0022	
Iron	mg/L		0.050	0.44	0.1000	0.032	0.08	0.12	0.44	0.048	0.187	0.05	0.13	0.13	0.109	0.24		0.042	0.04	0.03	0.05	0.02	0.016	0.03
Lead	mg/L	0.1	0.00025	0.0011	0.0002500	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.0008	0.00025
Manganese	mg/L		0.090	0.416	0.18900	0.215	0.416	0.0928	0.163	0.133	0.171	0.0586	0.0879	0.121	0.149	0.0322	0.0213	0.0378	0.0954	0.0189	0.0668	0.0651	0.24	0.0186
Mercury	mg/L		0.000250	0.0003	0.0002500	0.00025																		
Nickel	mg/L	1	0.0035	0.0052	0.004000	0.0046	0.0038	0.0033	0.0042	0.0043	0.0039	0.0040	0.0029	0.0036	0.0039	0.0034	0.0027	0.0038	0.0052	0.0029	0.0023	0.0025	0.0007	0.0028
Zinc	mg/L	20	0.008	0.044	0.00600	0.006				0.001	0.001				0.015			0.009					0.044	

Tatana extra sampling SW1 (discontinued since Apr 2020)

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
pH		6 to 9	7.1	7.7	7.40		7.4	7.4	7.7	6.9	6.9	7.2	6.9	7.0	7.0	7.1	7.3	6.9	7.2	7.4	7.1	7.6	7	6.9
Suspended Solids	mg/l		254	8700	88.00		536	59	88	225	353	254	688	110	1150	224	69	584	8700	93	144	2010	3320	65
Conductivity	mS/m		249	325	253.00		261	253	222	283	271	212	243	240	277	247	237	251	325		196	263		
COD	mg/L		315	6570	346.000		346	494	153	748	329	228	451	283	578	140	139	315	6570	469	85	933	136	111
BOD (scBOD frm Apr'20)	mg/L		45	2070	56.00		56	14	264	64	61	87	80	8	45	31	1.5	20	1920	16	26	2070	391	12
Faecal C (Ecoli frm Apr'20)	col/100ml	100	150	23000	100.00		200	69	100	23000														
Chloride	mg/L		227	463	227.000		215	243	227	463	239	229	230	218	233	228	211	225	239	169	176	205	237	162
Nitrate-N	mg/L	90.3	0.27	3.08	2.060		3.08	2.06	0.12	0.65	1.80	2.44	0.15	0.05	0.13	2.26	0.21	0.12	0.04	0.28	0.27	0.04	0.03	0.35
Ammonia-N	mg/L		92.6	138	96.80		100	96.8	77.4	82.0	110	73.2	94.8	92.6	111	83.3	84.1	103	138	59.5	57.4	105	136	63.8
Iron	mg/L		1.07	22.9	0.500		0.30	0.50	1.65	0.89	1.07	0.74	1.65	1.21	1.05	1.24	0.96	0.81	22.9	0.710	1.37	18.1	3.01	0.71
Manganese	mg/L		0.954	1.33	0.9650		0.998	0.806	0.965	0.409	0.969	0.586	0.928	1.10	0.969	1.16	1.15	0.821	0.419	0.927	1.02	0.482	0.383	0.954
TKN	mg/L		93.9	198	96.20		111	96.2	77.6	91.9	119	77.4	93.9	91.3	116	93.8	87.9	97.5	198	62.3	53.2	120	152	65.3
Nitrite-N	mg/L		0.03	0.2	0.140		0.15	0.14	0.03	0.20	0.15	0.16	0.01	0.005	0.02	0.09	0.02	0.02	0.03	0.03	0.03	0.15	0.005	0.03
Total Nitrogen	mg/L		98.2	136	98.200		100	98.2	81.2	88.9	119	82.2	99.3	96.5	111	89.5	88.5	105	136	62.4	60.5	124	134	67.8

Tatana extra sampling SW2 (discontinued since Apr 2020)

Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
pH		6 to 9	7.5	74	7.60		7.6	7.9	7.4	74.0	7.5	8.0	7.3	7.3	7.6	7.4	7.4	7.2	7.8	7.8	7.4	7.5	7	7.2
Faecal C (Ecoli frm Apr'20)	col/100ml	100	1595	71800	690.00		71800	690	54	2500														
Suspended Solids	mg/l		45	421	15.00		383	15	14	49	11	26	65	53	58	42	18	3	3	11	45	421	258	239
Conductivity	mS/m		170	228	161.00		176	161	120	168	178	155	173	213	228	153	148	183	187		141	172		
COD	mg/L		142	393	142.000		393	142	96	230	136	186	105	261	322	99	109	116	80	96	134	211	343	204
TKN	mg/L		43.8	78.7	38.900		62.6	38.9	24.0	23.3	50.8	30.1	43.8	70.0	78.7	36.9	33.8	47.2	52.1	28.9	29.4	60.4	62.3	45.5
BOD (scBOD frm Apr'20)	mg/L		18	191	9.00		191	9	6	23	34	17	58	10	10	21	1.5	17	3	12	18	67	75	37
Chloride	mg/L		168	281	159.00		174	159	126	281	180	177	195	219	193	164	160	197	166	146	164		157	160
Nitrite-N	mg/L		0.14	0.54	0.2800		0.53	0.28	0.09	0.12	0.54	0.43	0.05	0.03	0.22	0.03	0.14	0.19	0.14	0.12	0.05	0.05	0.005	0.21
Nitrate-N	mg/L	90.3	2.76	8.67	2.7700		1.96	5.40	2.77	1.65	5.20	8.67	3.88	0.49	0.56	7.28	5.64	3.55	0.94	1.7	0.99	0.37	0.005	3.7
Ammonia-N	mg/L		40.7	74.3	36.800		50.1	36.8	22.0	18.2	46.8	27.1	43.5	68.7	74.3	33.1	30.7	42.6	49.7	22.3	31.7	57.7	56.1	40.7
Total Nitrogen	mg/L		50.0	81.5	45.300		60.3	45.3	27.3	24.8	54.2	41.2	50.6	72.9	81.5	44.6	38.9	50.9	54.3	27.3	34.9	56.2	53	50
Iron	mg/L		0.5	2.2	0.4300		0.43	0.37	0.66	1.05	0.25	0.47	0.40	0.28	0.47	0.68	0.36	0.35	0.23	0.854	0.52	1.51	2.23	0.28
Manganese	mg/L		0.691	1.350	0.60600		0.879	0.606	0.522	0.373	0.691	0.532	0.746	1.35	0.986	0.946	0.705	0.739	0.712	0.51	0.645	0.615	0.998	0.666

Tatana extra sampling TD1 (Formerly SW3 prior to Apr 2020)

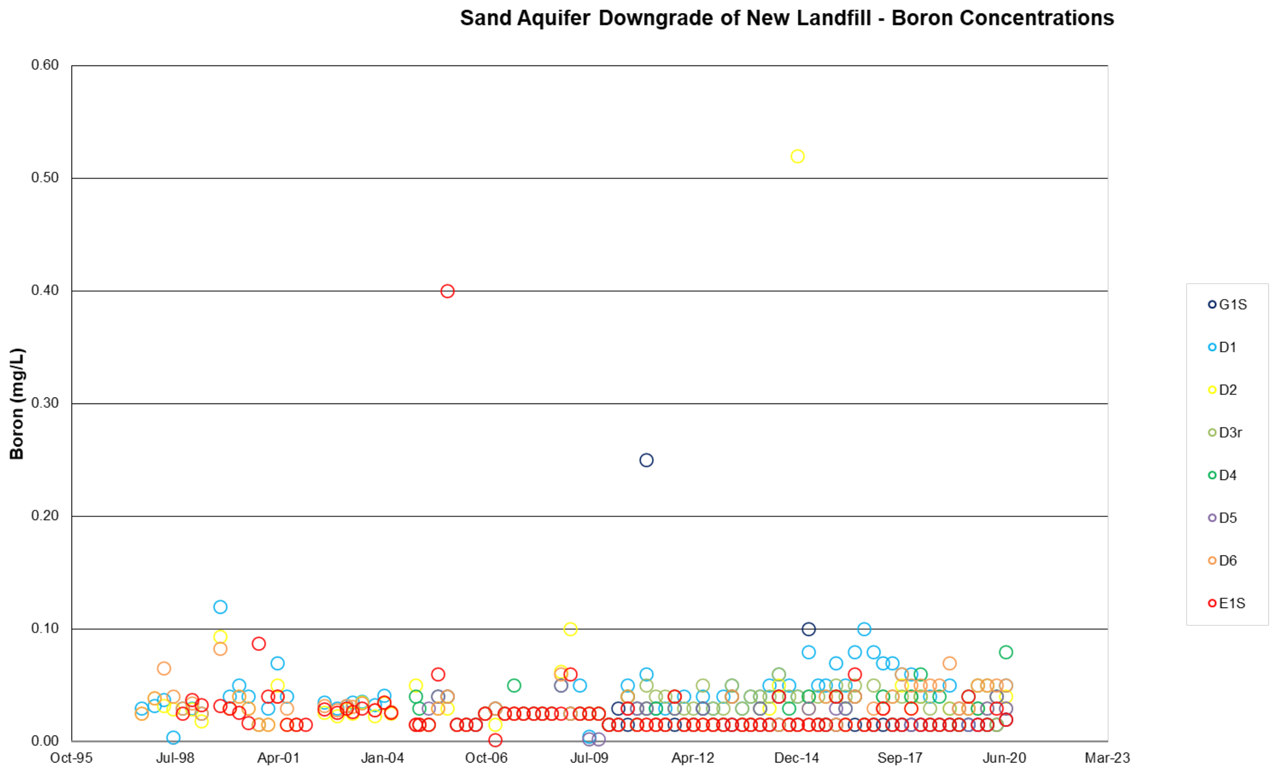
Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
pH		6 to 9	7.3	7.8	7.450	7.1	7.7	7.8	7.2	7.3	7.2	7.4	7.2	7.4	7.4	7.5	7.2	7.3	7.7	7.7	7.3	7.3	6.7	7.4
Suspended Solids	mg/l		18.5	2160	75.00	284	14	131	19	6	26	8	3	8	2160	3	3	27	29	13	18	194	35	16
Phenol	mg/L		0.025	0.025		0.025																		
VFA	mg/L		6	6		6																		
TOC	mg/L		23.8	23.8		23.8																		
Alkalinity	mg CaCO3/L		151	151		151																		
Conductivity	mS/m		81	103	59.50	55.7	91.1	63.3	52.4	93.2	73.7	83.1	85.3	89	103	87.0	31.9	52.9	92.5		76.2	77.5		
COD	mg/L		97	889	100.50	75	92	124	109	271	43	152	49	28	889	70	83	114	72	342	101	123	59	80
BOD (scBOD frm Apr'20)	mg/L		8	41	10.0000	3	21	17	3	3	3	12	8	9	41	3	1.5	12	21	8	3	25	7	6
Faecal C (Ecoli frm Apr'20)	col/100ml	100	380	2000	315.00	140	380	250	380	2000														
Chloride	mg/L		103	172	70.80	69.3	101	72.3	69.2	172	79.3	103	119	112	105	111	42.1	79.4	96.6	149	105		123	107
Nitrate-N	mg/L	90.3	0.56	5.99	0.2250	0.0050	5.99	0.26	0.19	0.57	0.65	3.63	4.58	0.54	0.24	1.59	0.27	0.35	0.93	1.33	0.13	1.33	0.005	1.17
Sulphate	mg/L	1000	6.71	6.71	6.710	6.71																		
Ammonia-N	mg/L		8.6	25.6	5.5050	4.61	10.9	6.4	3.6	4.2	10.3	7.6	8.0	12.3	19.1	11.2	1.2	1.5	7.2	25.6	11.8	11.6	9.2	17.1
Hardness	mg CaCO3/L		115	115	115.000	115																		
Calcium	mg/L	1000	21.1	21.1	21.10	21.1																		
Magnesium	mg/L		15	15	15.00000	15.0																		
Potassium	mg/L		15.5	15.5	15.50	15.5																		
Sodium	mg/L		51.3	51.3	51.30	51.3																		
D.R. Phosphorus	mg/L		0.024	0.024	0.0240	0.024																		
Aluminium	mg/L	5	0.0090	0.009	0.0090	0.009																		
Arsenic	mg/L	0.5	0.001	0.001	0.0010	0.001																		
Boron	mg/L	5	0.180	0.18	0.180	0.18																		
Cadmium	mg/L	0.01	0.0001	0.0001	0.00010	0.0001																		
Chromium	mg/L	1	0.0005	0.0005	0.00050	0.0005																		
Copper	mg/L	0.4	0.00025	0.00025	0.000250	0.00025																		
Iron	mg/L		0.7975	1.83	1.190	1.26	0.26	1.12	1.49	0.57	0.50	0.45	0.28	0.37	1.14	1.16	0.91	1.12	0.27	0.685	1.02	0.34	1.15	0.59
Lead	mg/L	0.1	0.000250	0.0003	0.000250	0.00025																		
Manganese	mg/L		0.2	0.5	0.18950	0.200	0.179	0.446	0.117	0.0295	0.104	0.284	0.120	0.506	0.378	0.493	0.0564	0.0032	0.0402	0.522	0.368	0.0581	0.37	0.388
Mercury	mg/L		0.000250	0.0003	0.000250	0.00025																		
Nickel	mg/L	1	0.00090	0.0009	0.00090	0.0009																		
Zinc	mg/L	20	0.001	0.001	0.0010	0.001																		
TKN	mg/L		12	36	10.000		14.4	10.0	6.0	7.2	12.9	9.5	12.3	15.7	36.0	12.5	3.1	5.8	8.9	29	13	11.8	11.4	18.9
Nitrite-N	mg/L		0.09	0.59	0.030		0.59	0.03	0.03	0.07	0.11	0.25	0.08	0.05	0.16	0.09	0.02	0.11	0.11	0.11	0.03	0.1	0.005	0.09
Total Nitrogen	mg/L		13.1	31.2	8.790		18.80	8.79	6.70	7.49	11.8	13.1	13.4	14.2	31.2	14.8	3.3	5.75	10.7	30.9	13.3	16.2	9.8	20.7

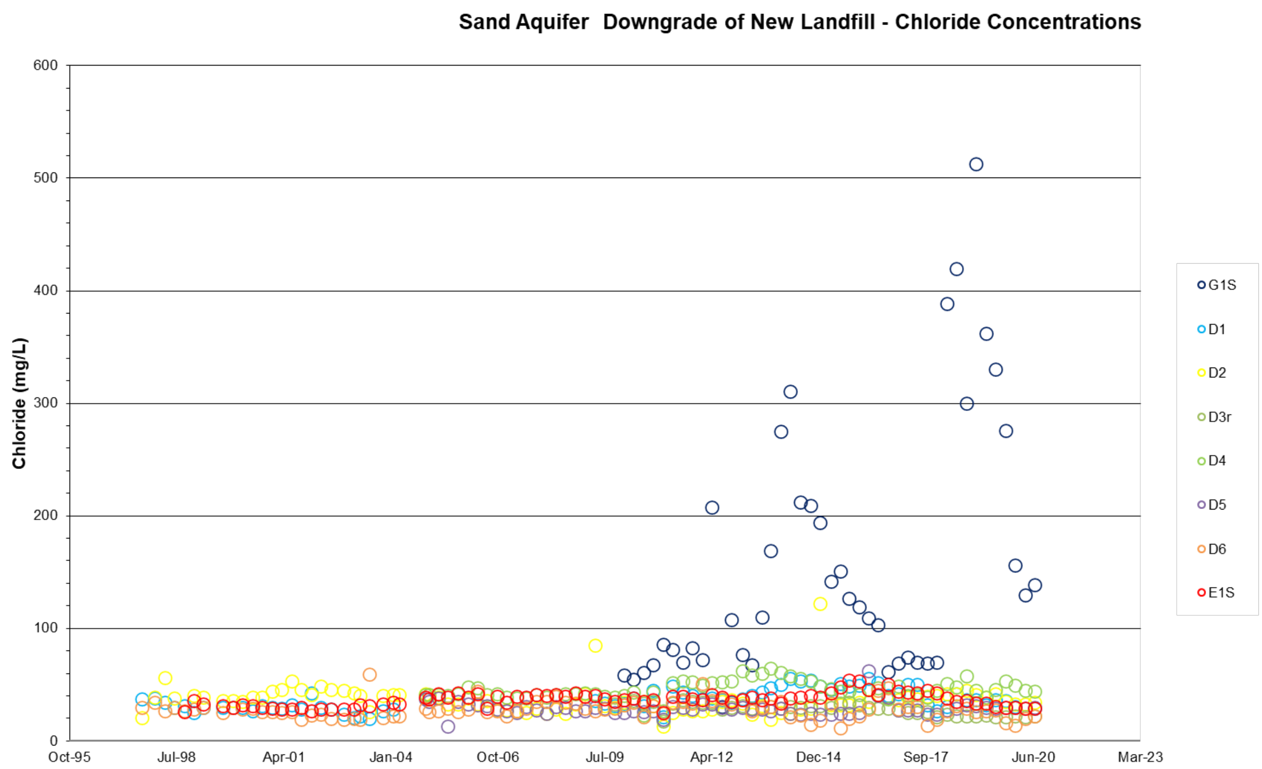
Tatana extra sampling SW4 (discontinued since Apr 2020)

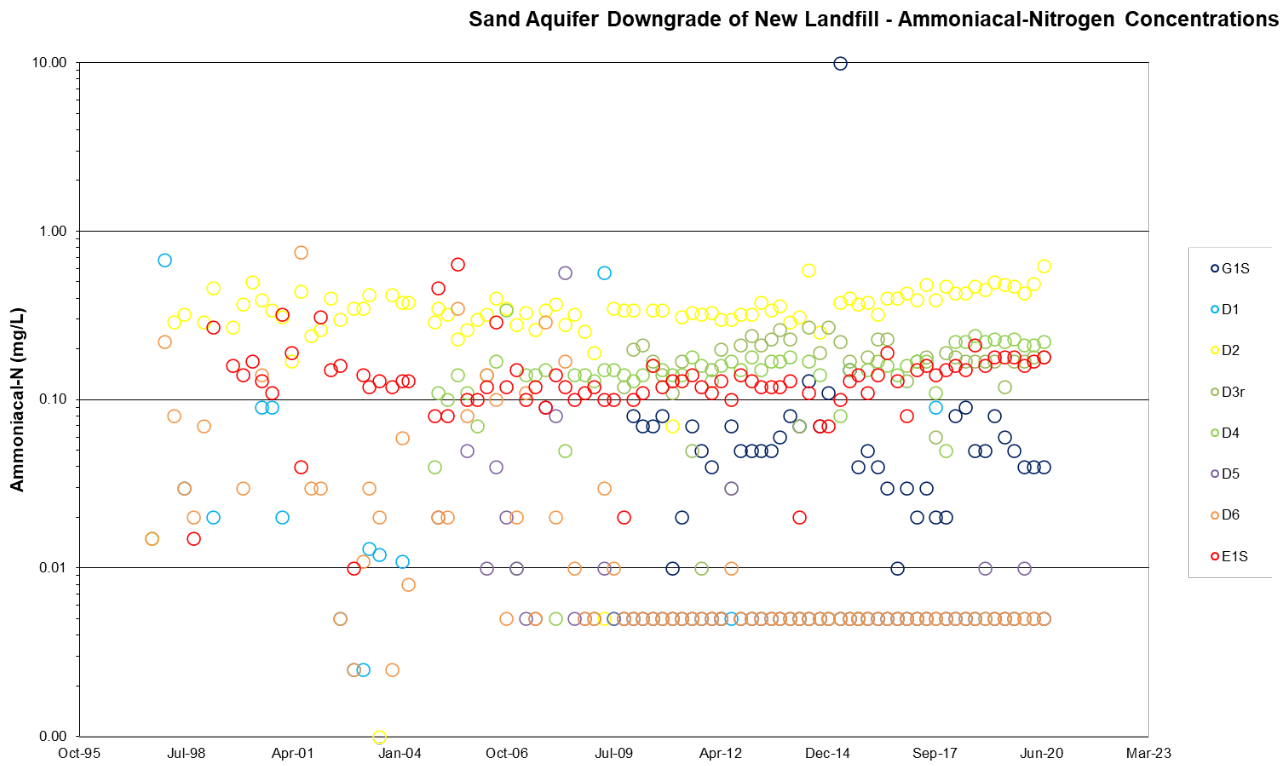
Determinand		ANZECC STOCK	Median	Maximum	Annual Median	Apr-20	Jan-20	Oct-19	Jul-19	Apr-19	Jan-19	Oct-18	Jul-18	Apr-18	Jan-18	Oct-17	Jul-17	Apr-17	Jan-17	Oct-16	Jul-16	Apr-16	Jan-16	Oct-15
pH		6 to 9	7.4	8	7.70		8	7.7	7.3	7.3	7.4	7.4	7.3	7.4	7.4	7.4	7.6	7.3	7.5	7.5	7.6	7.6	6.8	7.3
Faecal C (Ecoli frm Apr'20)	col/100ml	100	2625	4800	650.00		4600	650	44	4800														
Suspended Solids	mg/l		17	102	11.00		50	11	*3*	21	12	13	*3*	102	10	12	8	54	42	10	34	17	53	20
Conductivity	mS/m		83	161	82.90		103.0	82.9	58.1	84.6	77.3	78.3	83.4	85.1	161	93.2	64.3	58.0	99.1		76.9	66.8		
COD	mg/L		79	151	73.000		117	73	64	138	64	140	52	151	78	84	70	83	104	79	128	46	62	71
TKN	mg/L		10.1	17.1	10.40		12.1	10.4	5.8	9.6	12.5	8.4	7.4	12.2	17.1	13.8	8.3	4.7	9.3	10.1	11.2	9.6	7.6	11.9
BOD (scBOD frm Apr'20)	mg/L		3	41	3.00		*22*	*3*	*3*	11	*3*	*3*	*3*	9	*3*	7	*1.5*	*3*	22	*3*	13	12	*12*	*3*
Chloride	mg/L		96	141	88.10		97.9	88.1	65.7	98.4	81.7	93.3	116	98.6	141	123	75.3	70.9	96.3	98.8	90.5		96.2	81.8
Nitrite-N	mg/L		0.07	0.2	0.040		0.20	0.04	0.04	0.10	0.09	0.12	0.12	0.04	0.02	0.07	0.07	0.02	0.10	0.04	0.02	0.11	*0.005*	0.02
Nitrate-N	mg/L	90.3	0.27	3.64	0.400		1.02	0.40	0.18	0.21	0.16	1.89	3.64	0.27	*0.05*	0.57	0.42	0.06	0.28	0.08	0.07	1.37	*0.005*	0.12
Ammonia-N	mg/L		6.7	15.8	6.50		6.5	10.5	4.7	6.7	9.7	6.4	6.7	8.6	15.8	11.4	5.3	1.9	5.6	7.25	8.1	8.13	3.6	10.2
Total Nitrogen	mg/L		10.8	17.6	11.40		11.40	11.60	6.58	10.3	10.8	9.71	11.3	11.4	17.6	14.2	7.84	5.09	9.36	9.39	10.4	10.8	6.65	12.2
Iron	mg/L		0.5	1.3	0.460		0.19	0.46	0.90	0.43	0.29	0.43	0.38	0.56	0.27	0.43	0.46	0.56	0.10	1.24	1.28	0.49	1.27	0.54
Manganese	mg/L		0.491	1.740	0.5180		0.834	0.518	0.107	0.639	0.225	0.528	0.234	0.519	1.74	0.926	0.156	0.0502	0.223	0.329	0.688	0.0978	0.561	0.491

Appendix E Leachate Indicator Graphs

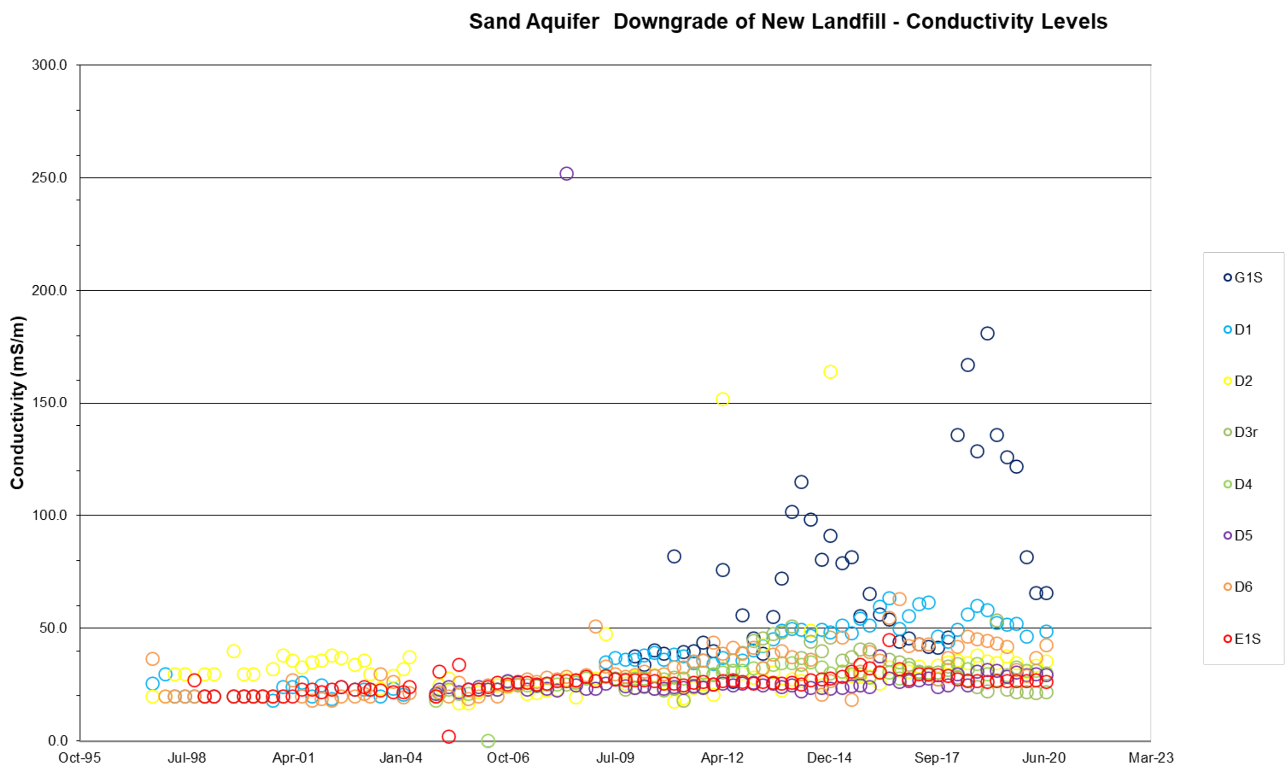
Sand aquifer bores, down-grade of New Landfill (G1S, D1, D2, D3R, D4, D5, D6, and E1S)



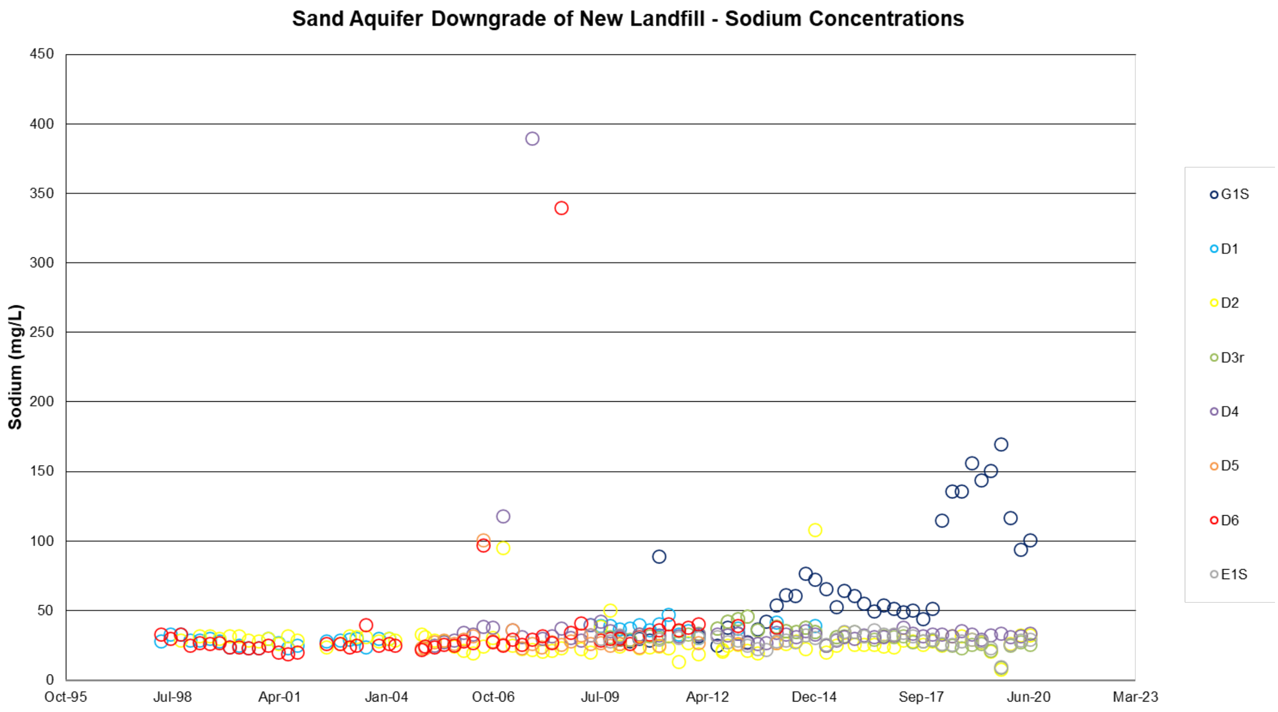




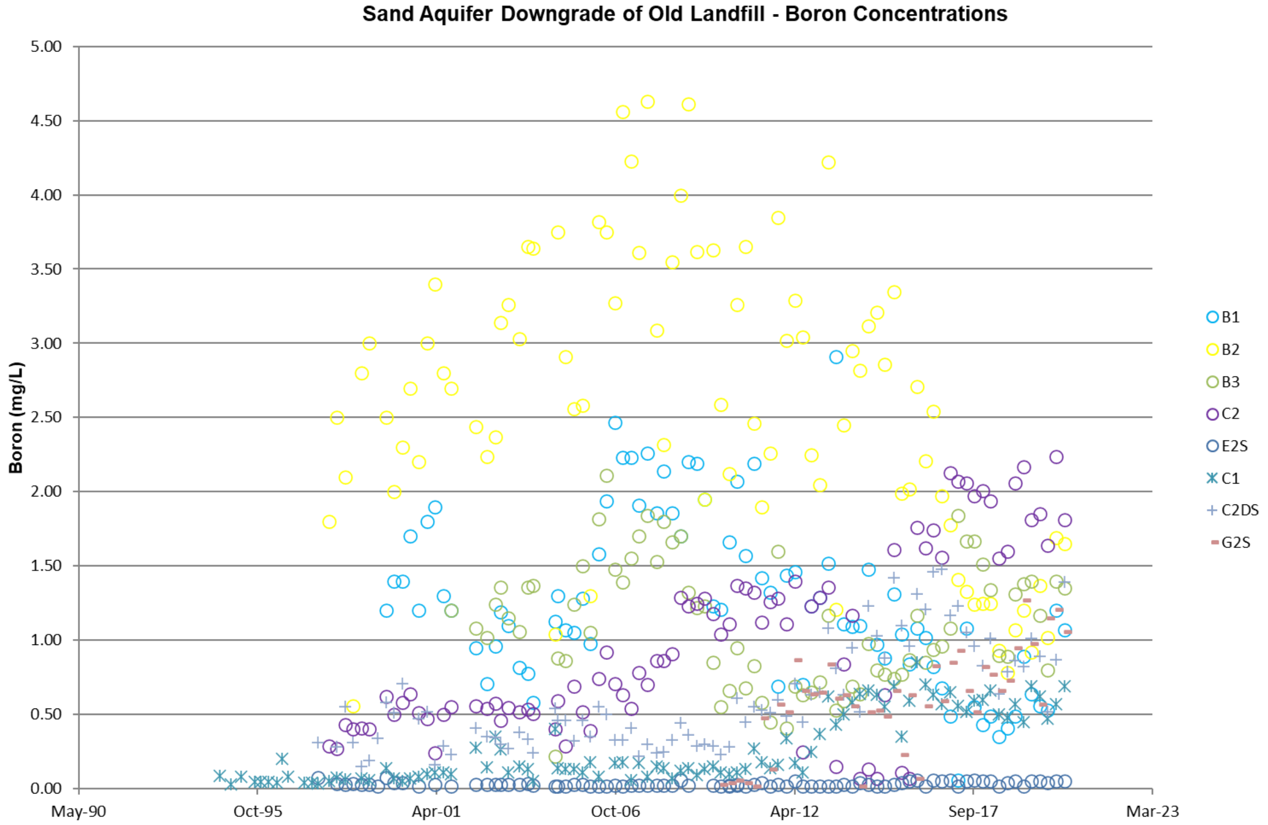
Sand Aquifer Downgrade of New Landfill - Ammoniacal-Nitrogen Concentrations
Ammoniacal-N (mg/L)
10.00
1.00
0.10
0.01
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
G1S
D1
D2
D3r
D4
D5
D6
E1S

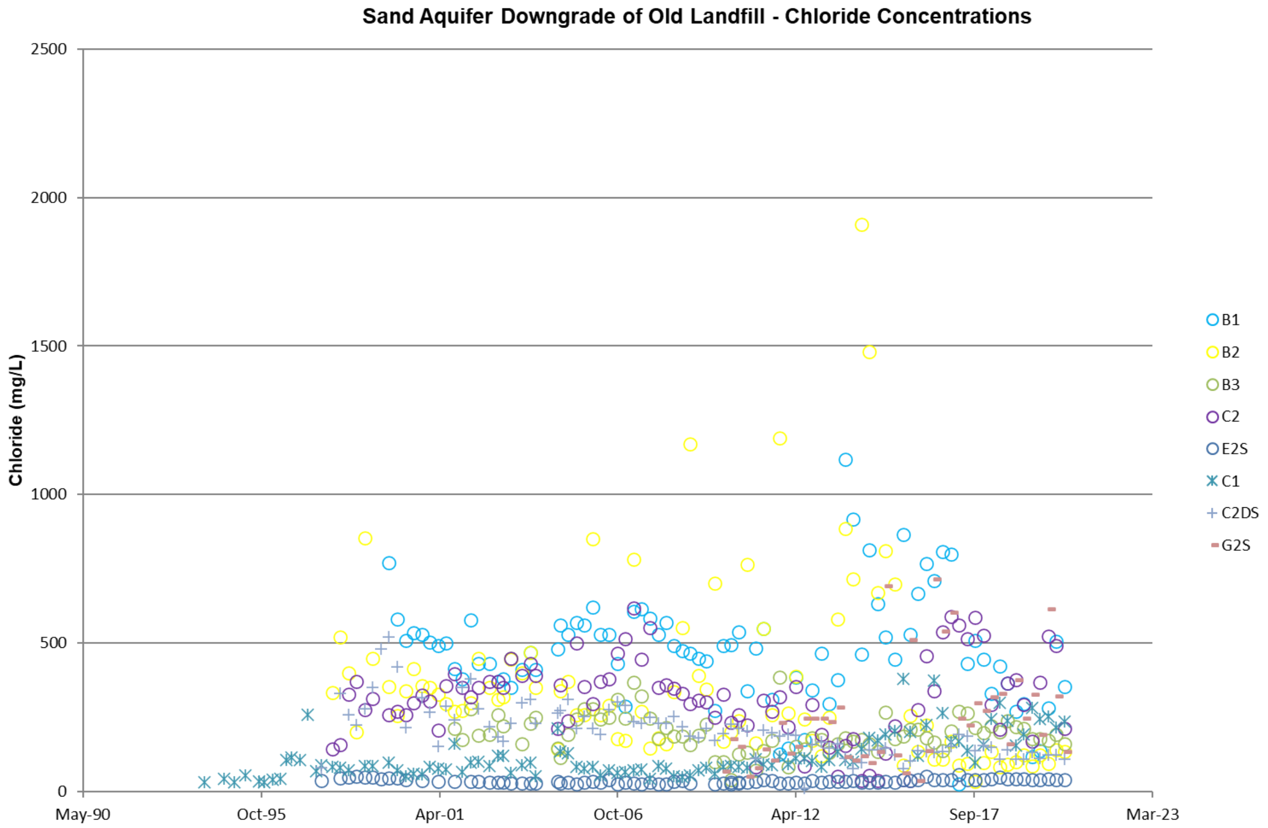


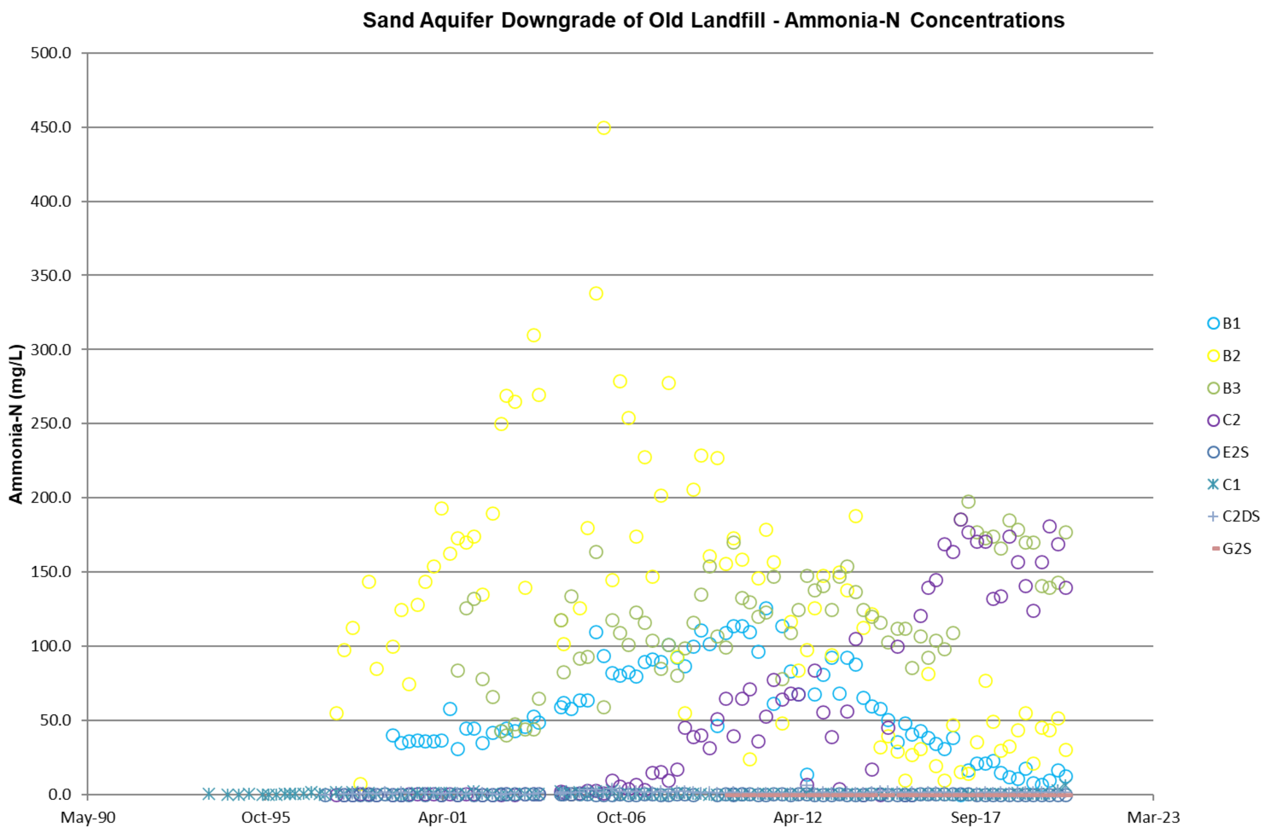
Sand Aquifer Downgrade of New Landfill - Conductivity Levels
Conductivity (mS/m)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
G1S
D1
D2
D3r
D4
D5
D6
E1S


Sand Aquifer Downgrade of New Landfill - Sodium Concentrations
Sodium (mg/L)
450
400
350
300
250
200
150
100
50
0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
G1S
D1
D2
D3r
D4
D5
D6
E1S

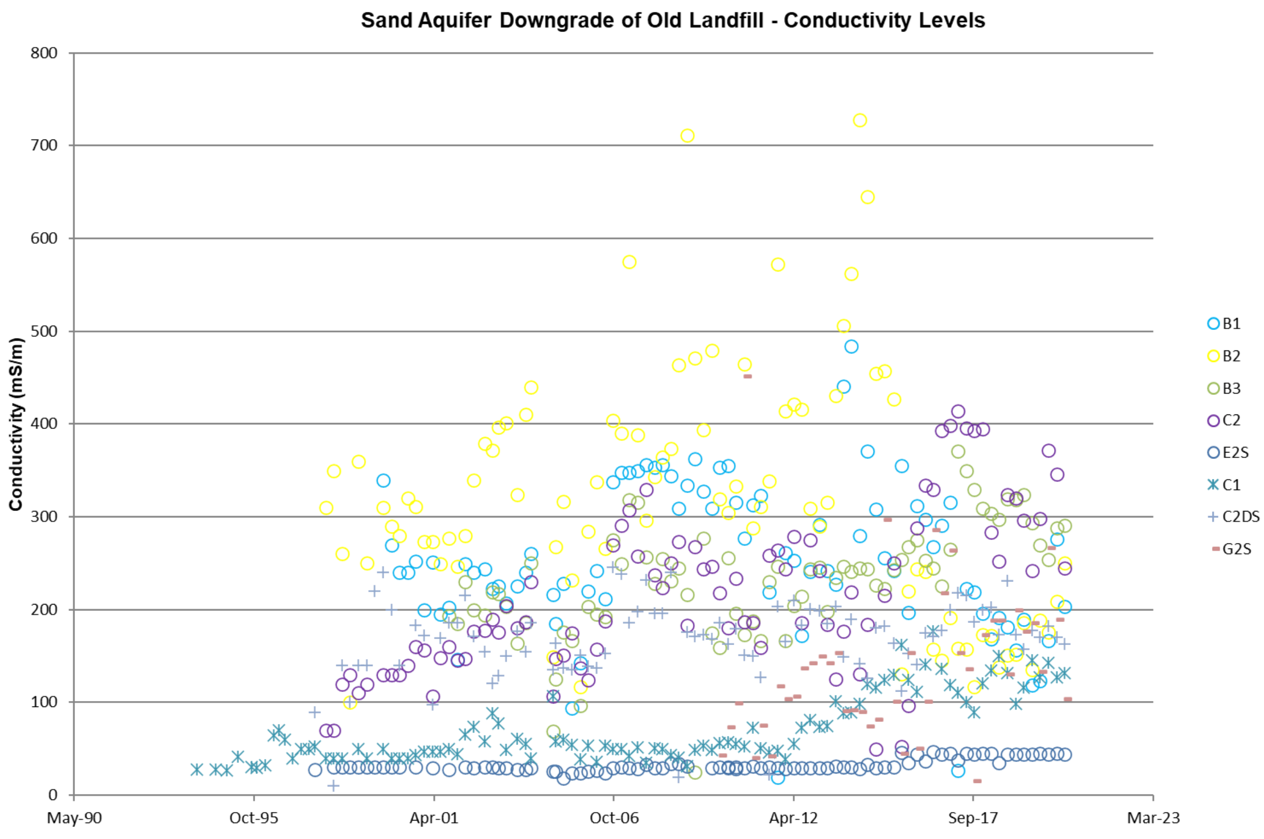
Sand aquifer bores, down-grade of Old Landfill (B1, B2, B3,C1, C2, C2DS, E2S and G2S)



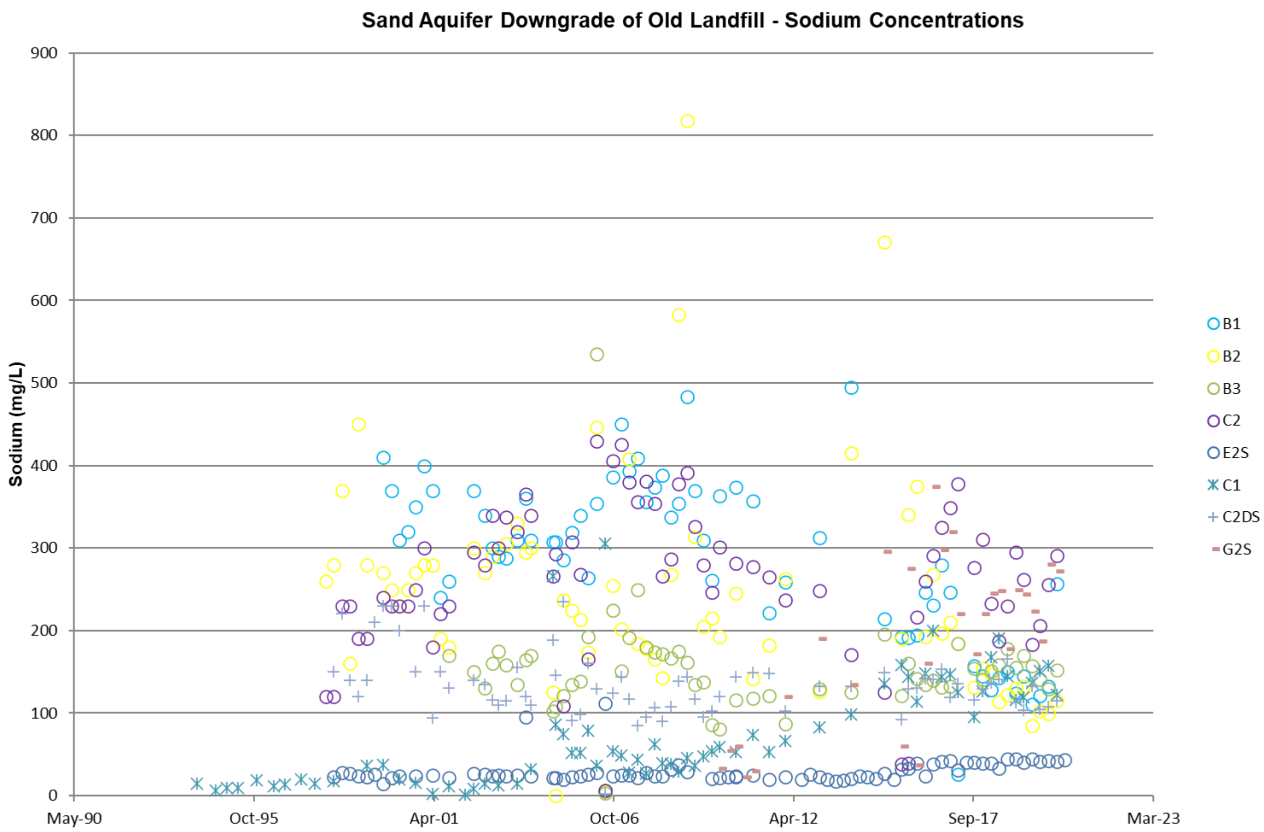




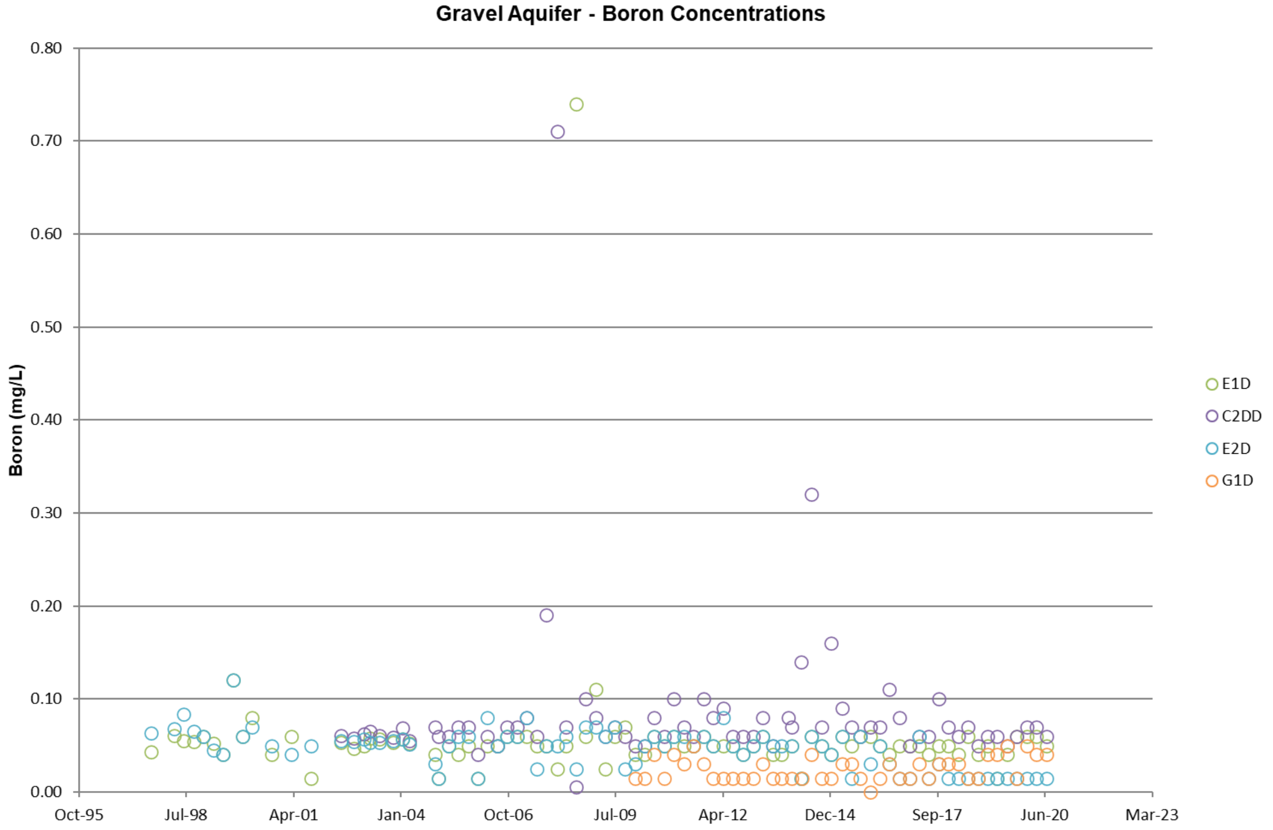
Sand Aquifer Downgrade of Old Landfill - Ammonia-N Concentrations
Ammonia-N (mg/L)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
May-90
Oct-95
Apr-01
Oct-06
Apr-12
Sep-17
Mar-23
B1
B2
B3
C2
E2S
C1
C2DS
G2S

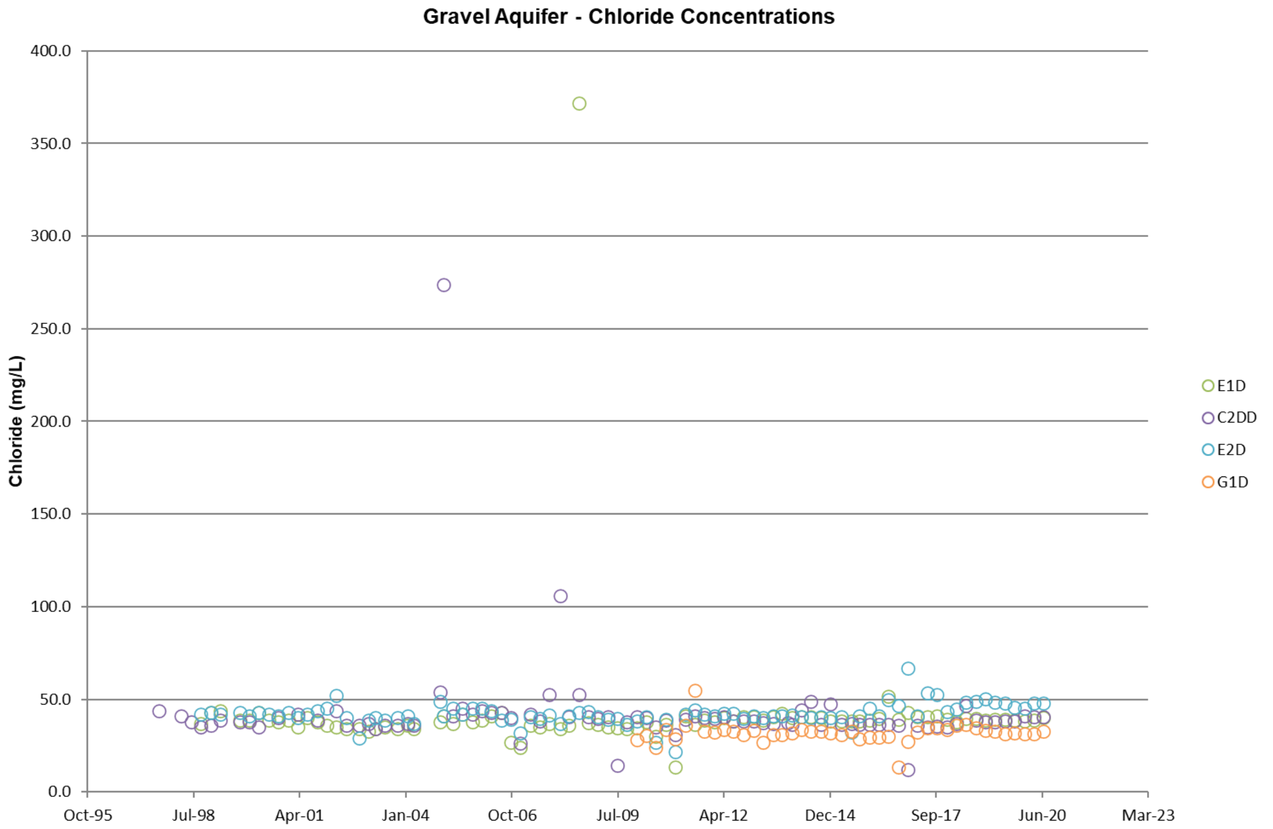


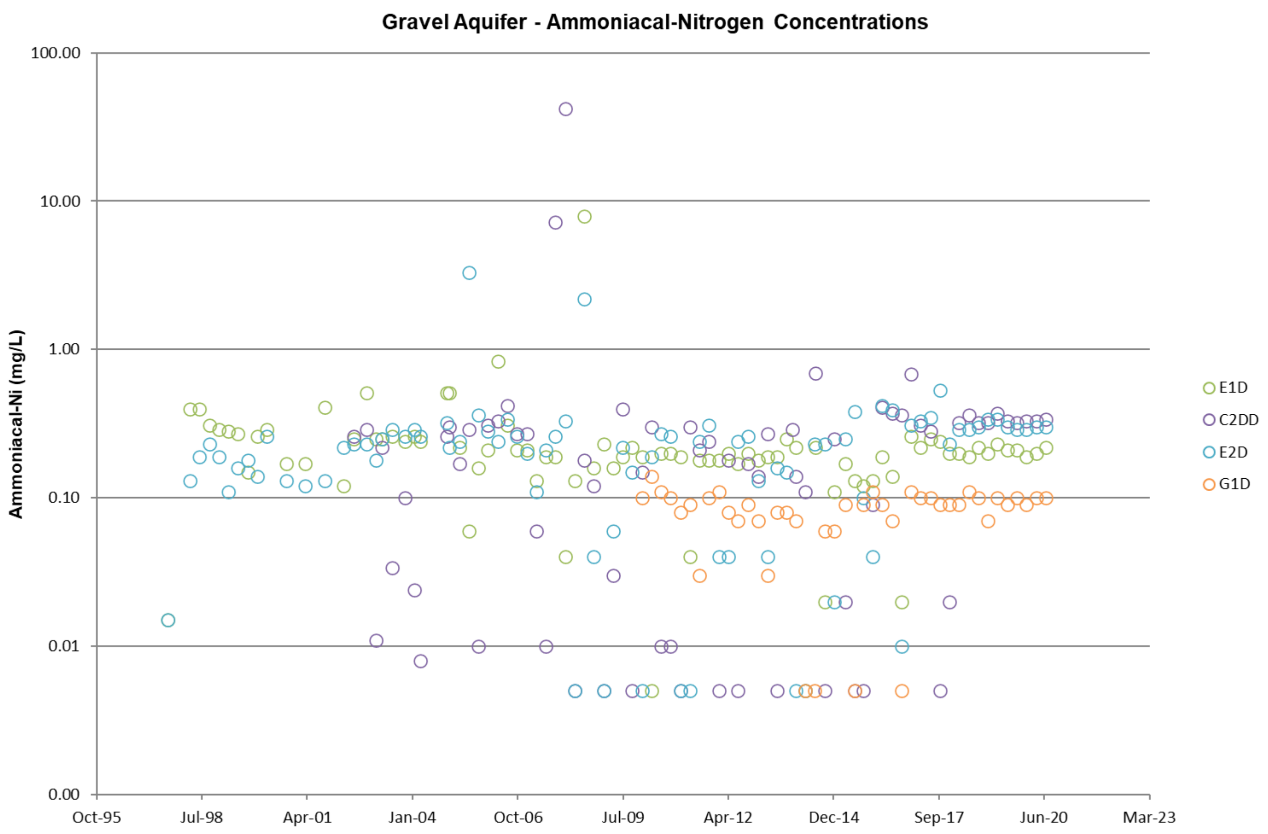
Sand Aquifer Downgrade of Old Landfill - Conductivity Levels
Conductivity (mS/m)
800
700
600
500
400
300
200
100
0
May-90
Oct-95
Apr-01
Oct-06
Apr-12
Sep-17
Mar-23
B1
B2
B3
C2
E2S
C1
C2DS
G2S

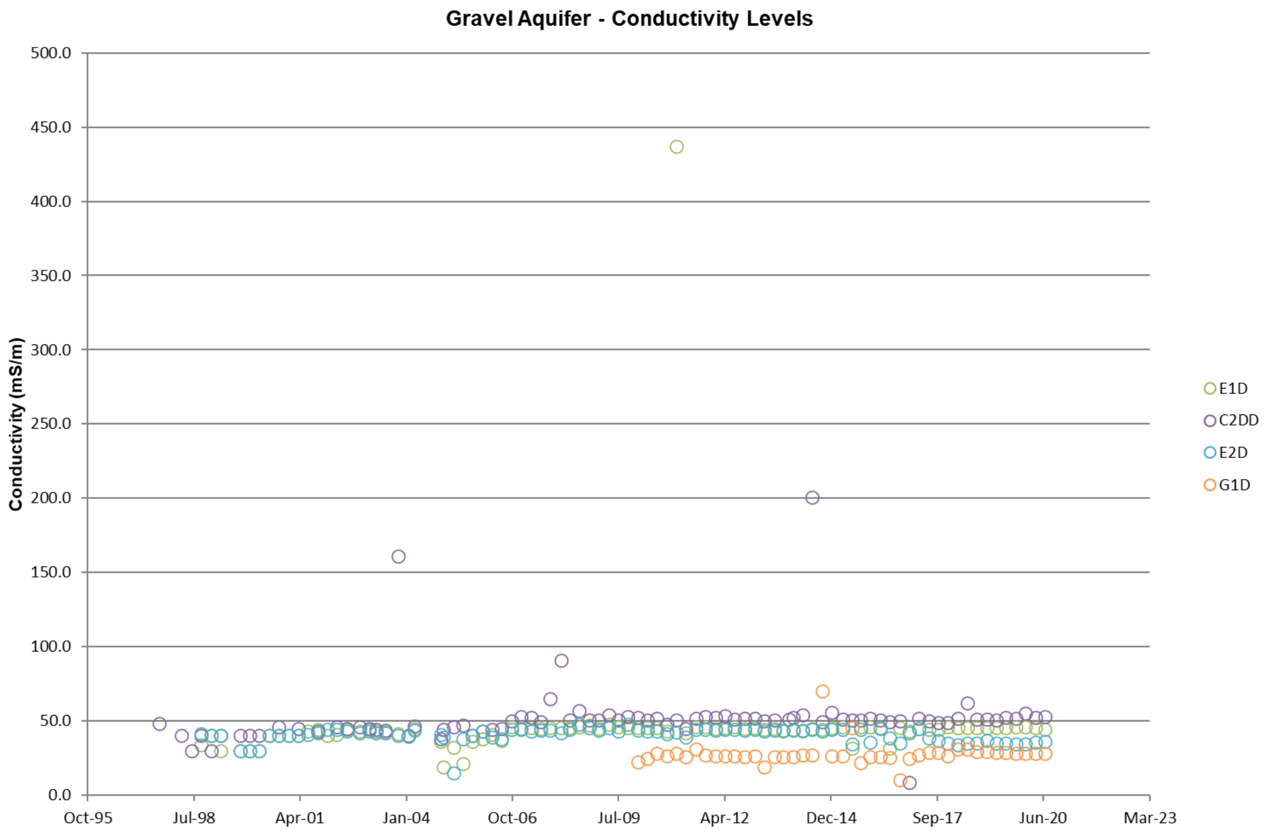

Sand Aquifer Downgrade of Old Landfill - Sodium Concentrations
Sodium (mg/L)
900
800
700
600
500
400
300
200
100
0
May-90
Oct-95
Apr-01
Oct-06
Apr-12
Sep-17
Mar-23
B1
B2
B3
C2
E2S
C1
C2DS
G2S

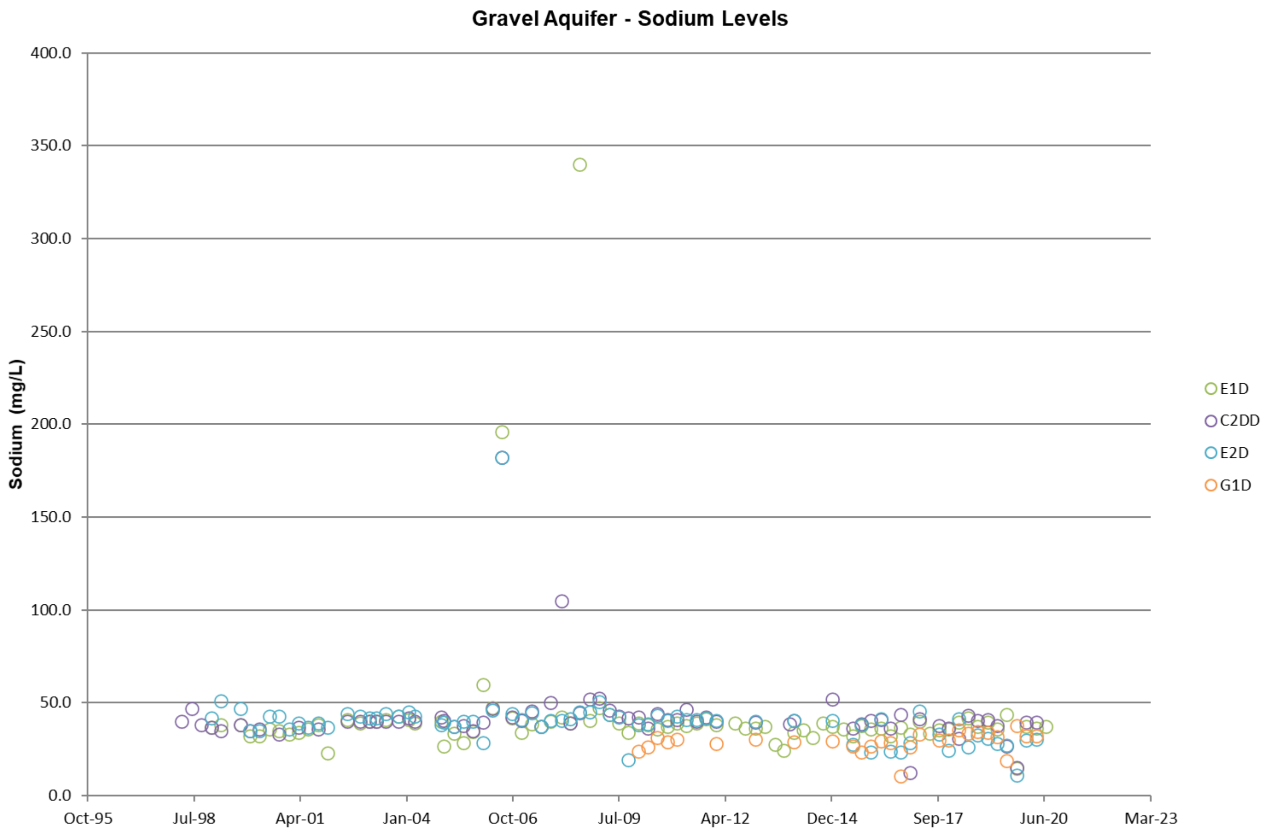
Gravel aquifer bores (E1D, C2DD, E2D, and G1D)



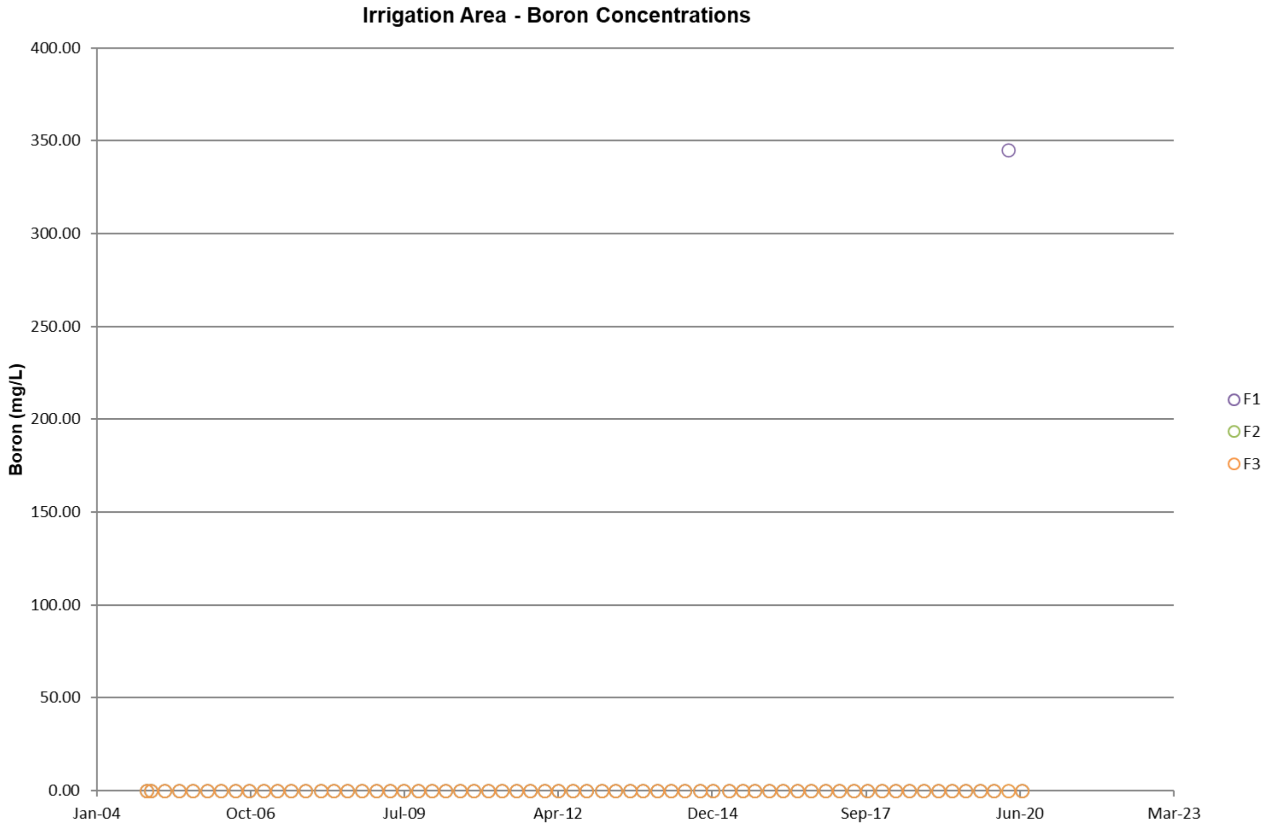


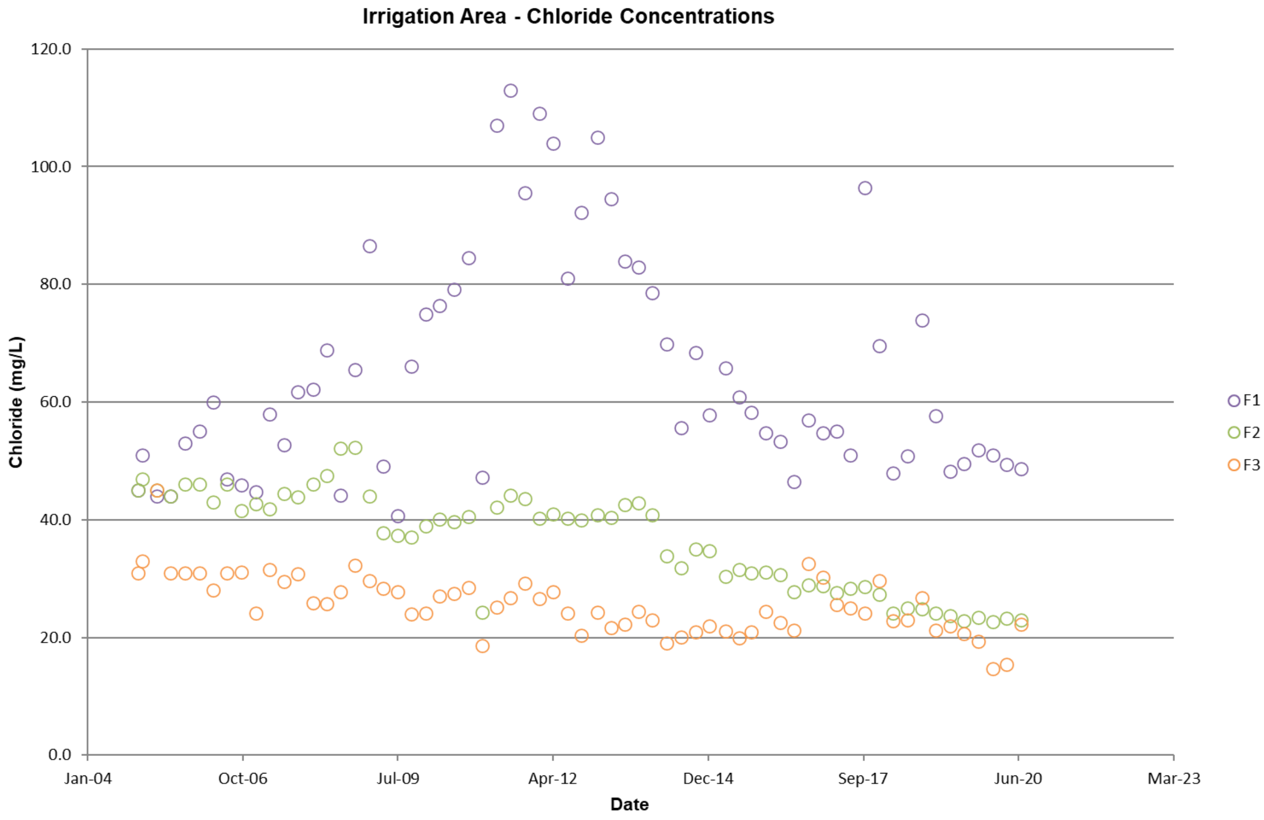

Gravel Aquifer - Ammoniacal-Nitrogen Concentrations
Ammoniacal-Ni (mg/L)
100.00
10.00
1.00
0.10
0.01
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

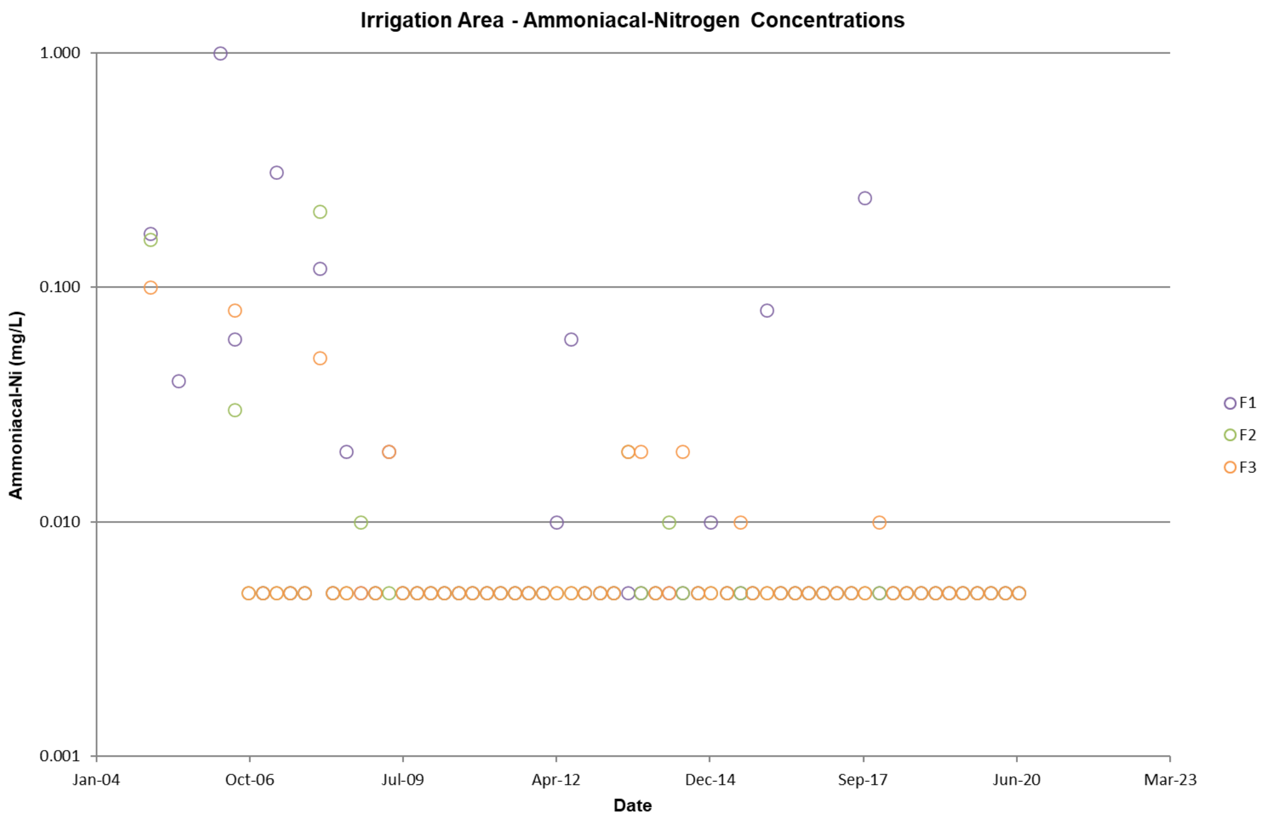

Gravel Aquifer - Conductivity Levels
Conductivity (mS/m)
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

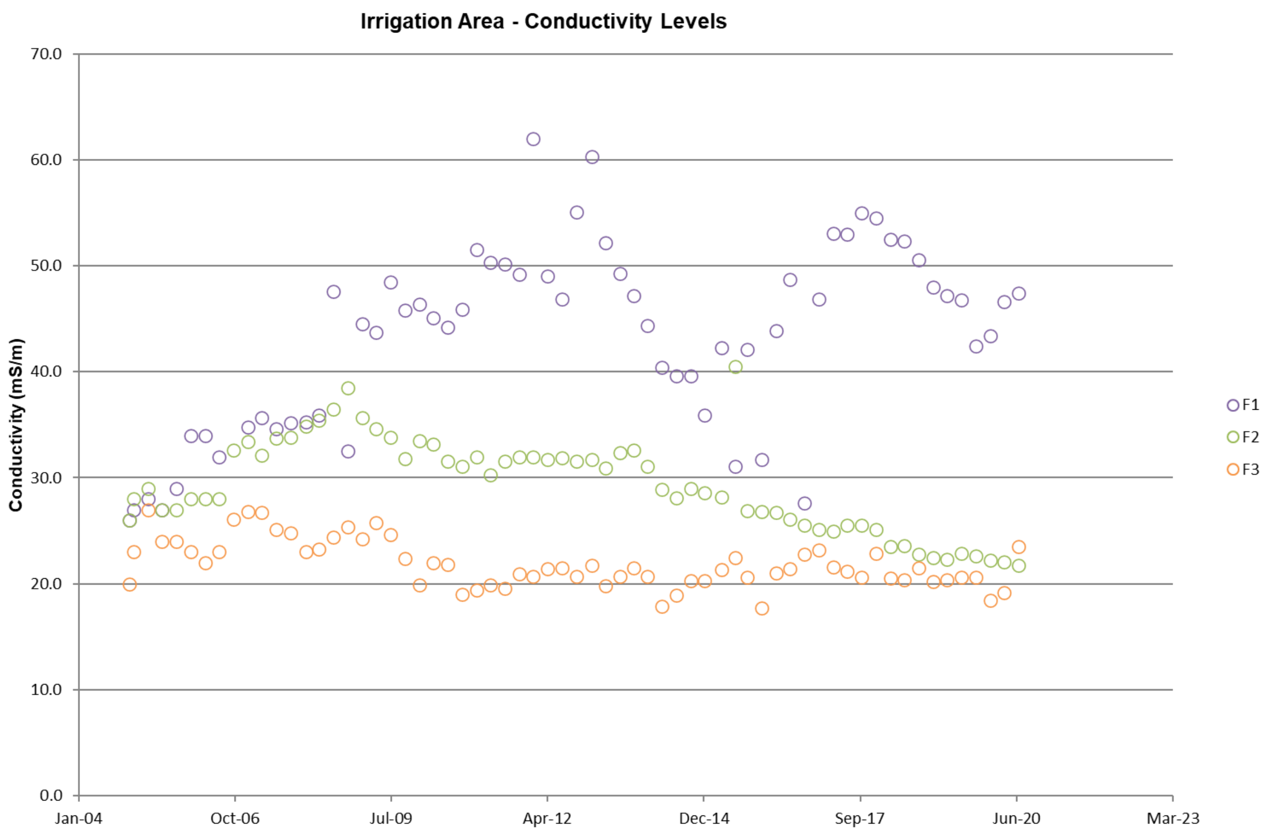

Gravel Aquifer - Sodium Levels
Sodium (mg/L)
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
E1D
C2DD
E2D
G1D

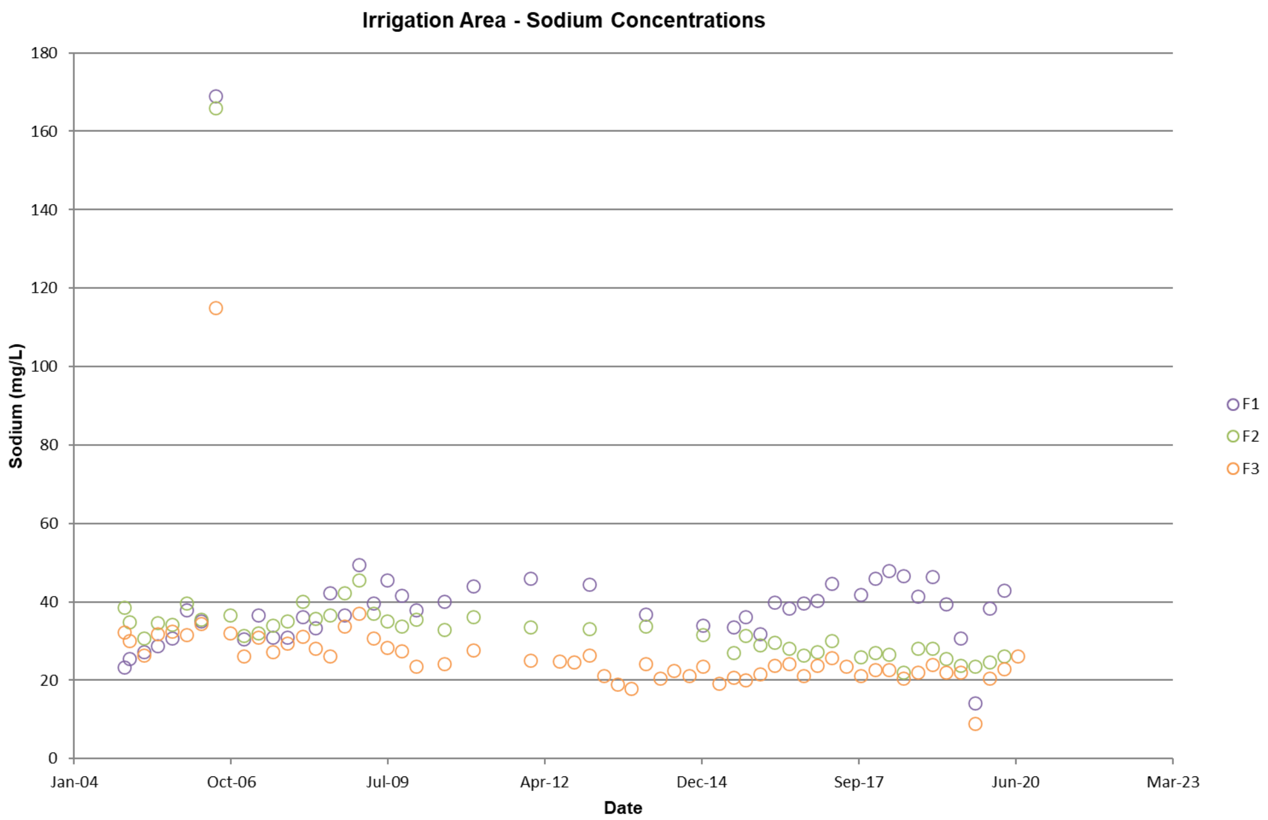
Irrigation area bores (F1, F2, and F3)



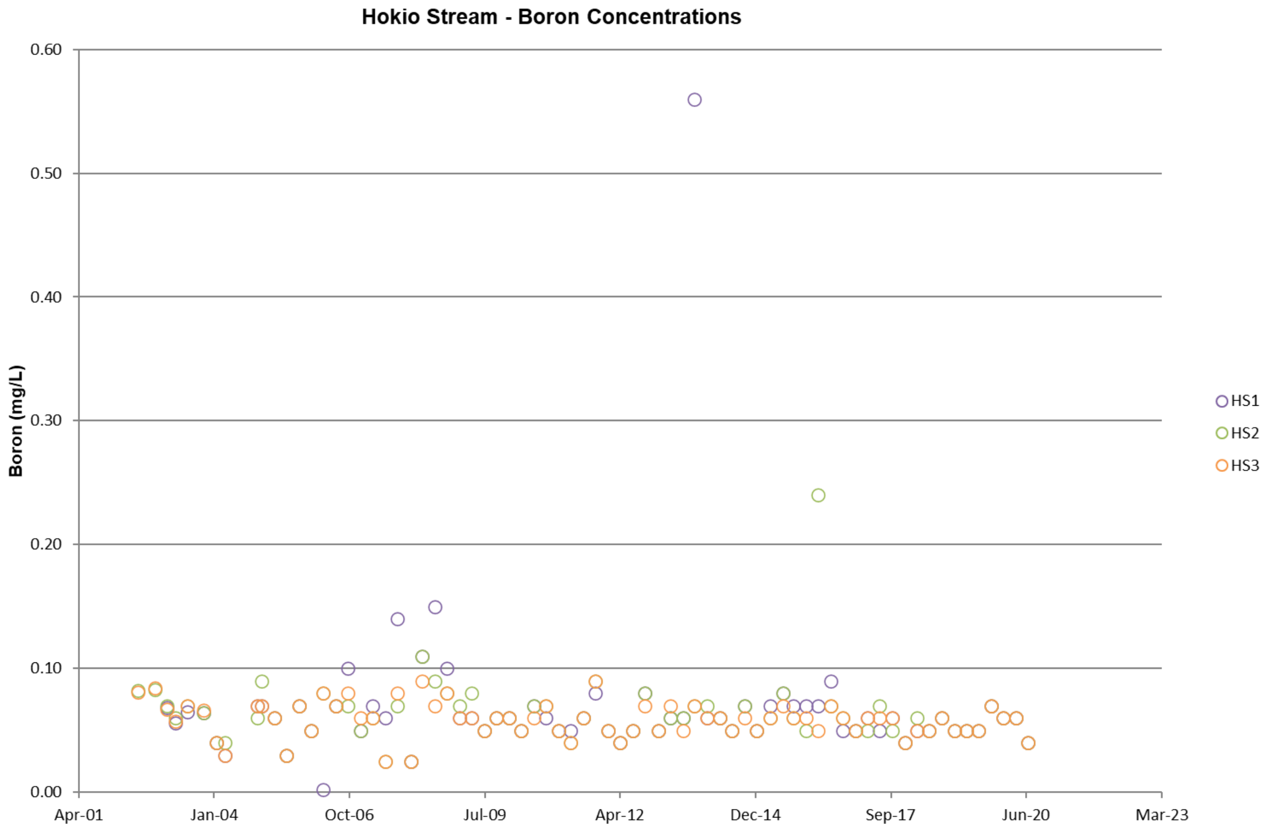


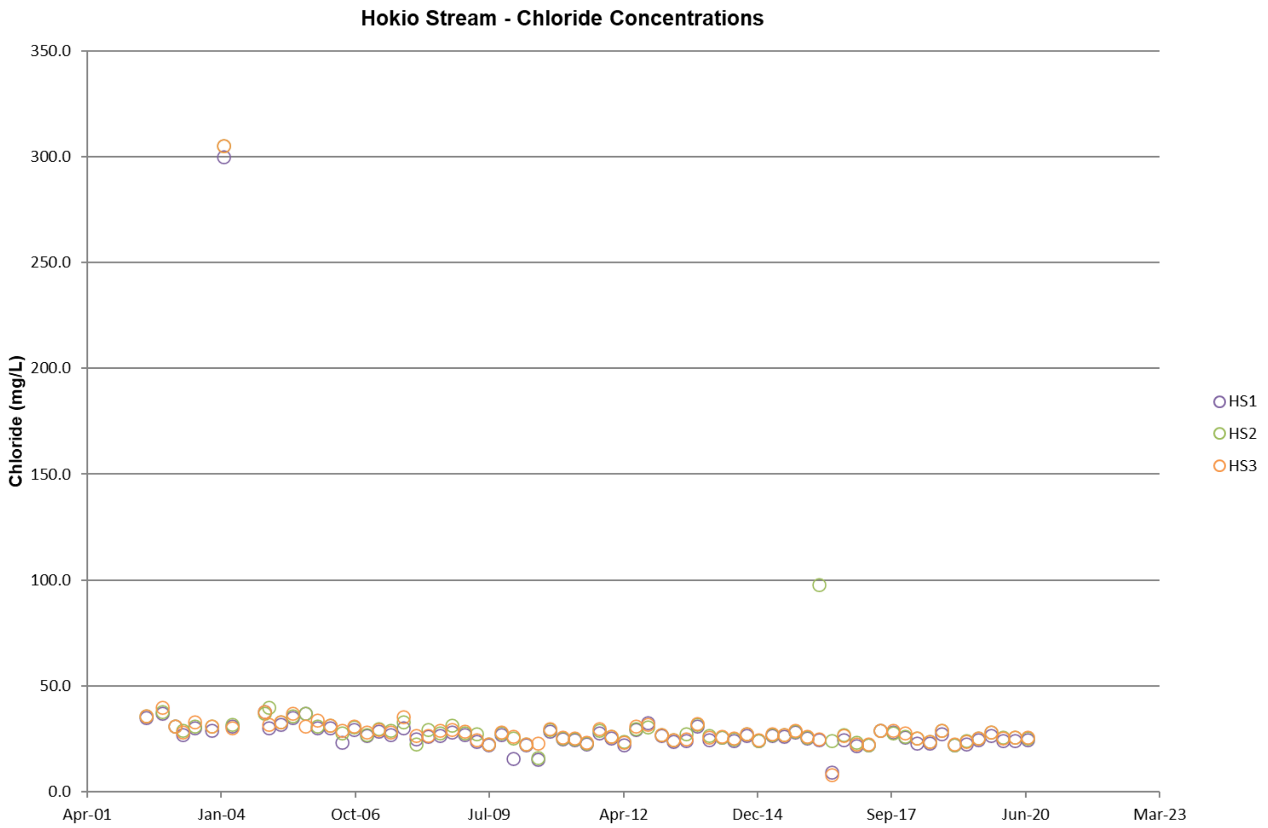

Irrigation Area - Ammoniacal-Nitrogen Concentrations
1.000
0.100
0.010
0.001
Ammoniacal-Ni (mg/L)
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
Date
F1
F2
F3

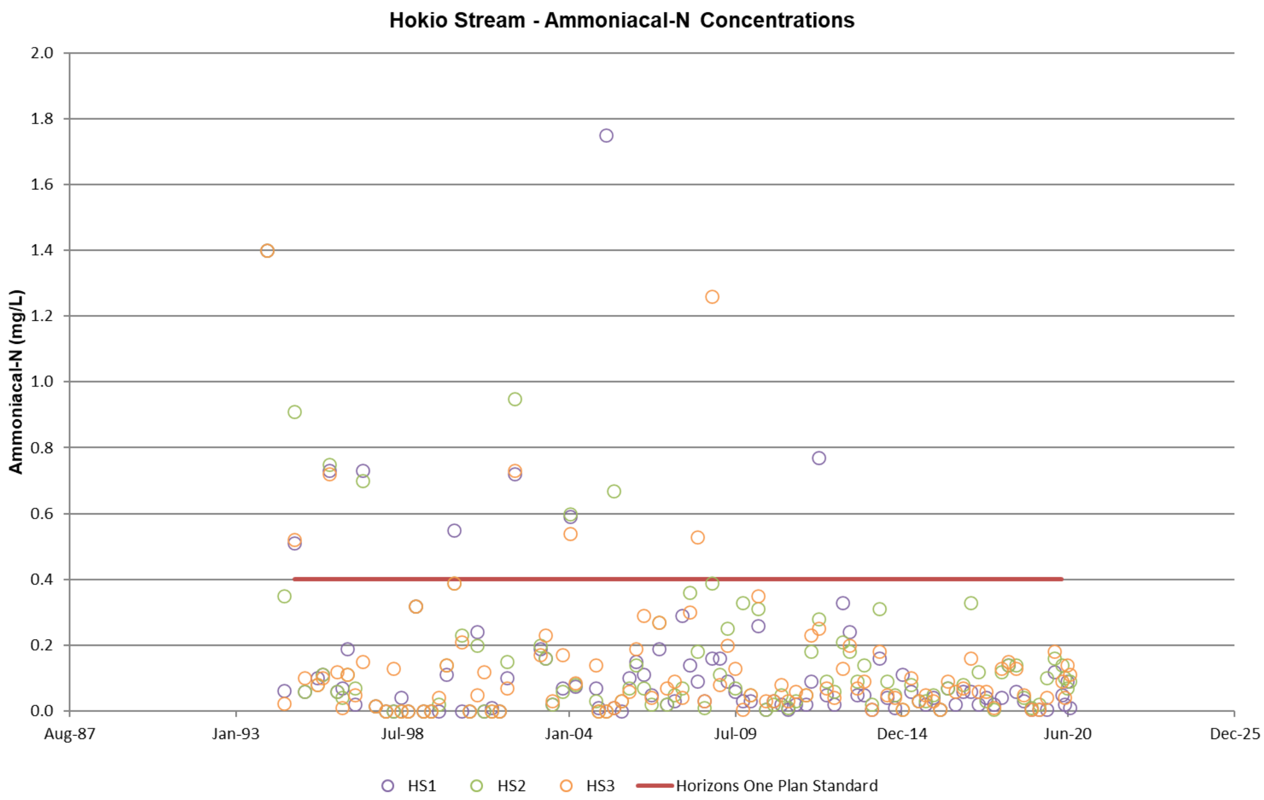

Irrigation Area - Conductivity Levels
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Conductivity (mS/m)
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
F1
F2
F3

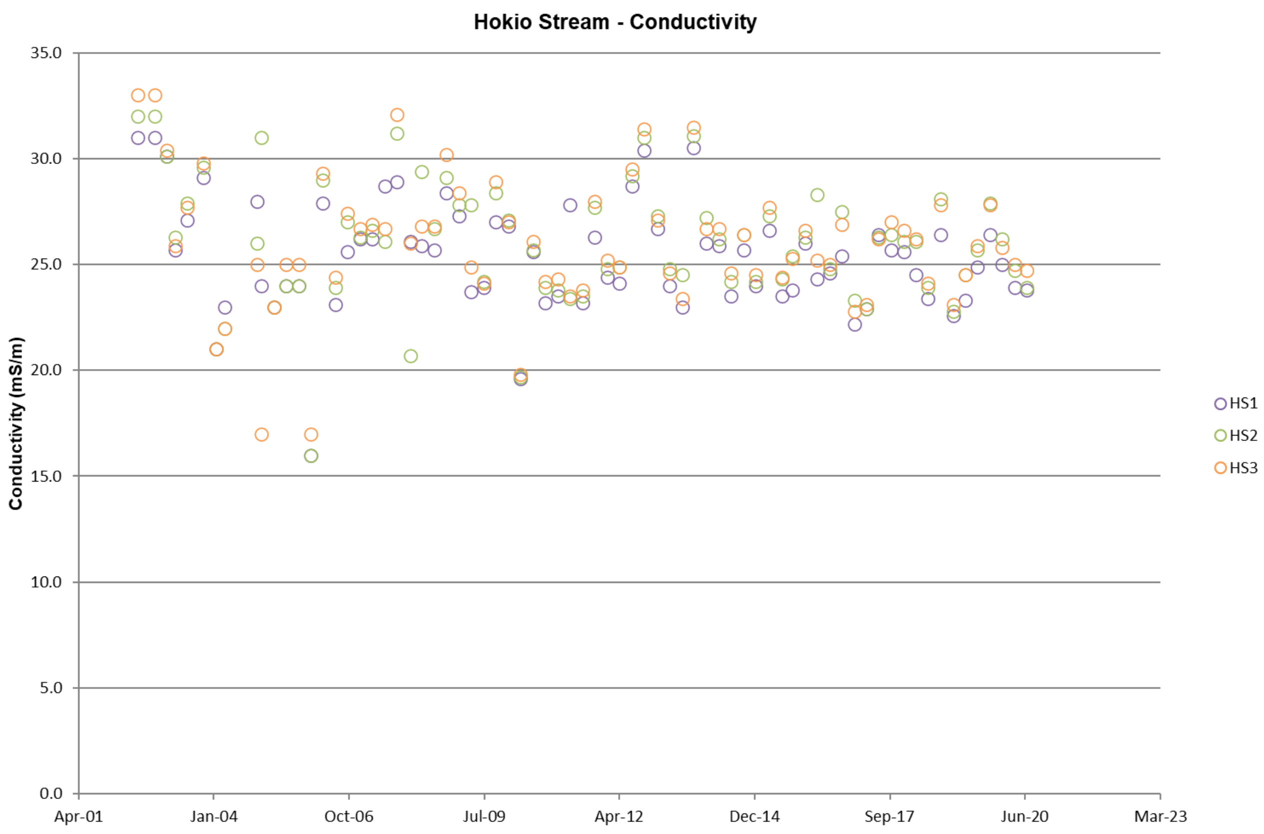

Irrigation Area - Sodium Concentrations
Sodium (mg/L)
180
160
140
120
100
80
60
40
20
0
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
Date
F1
F2
F3

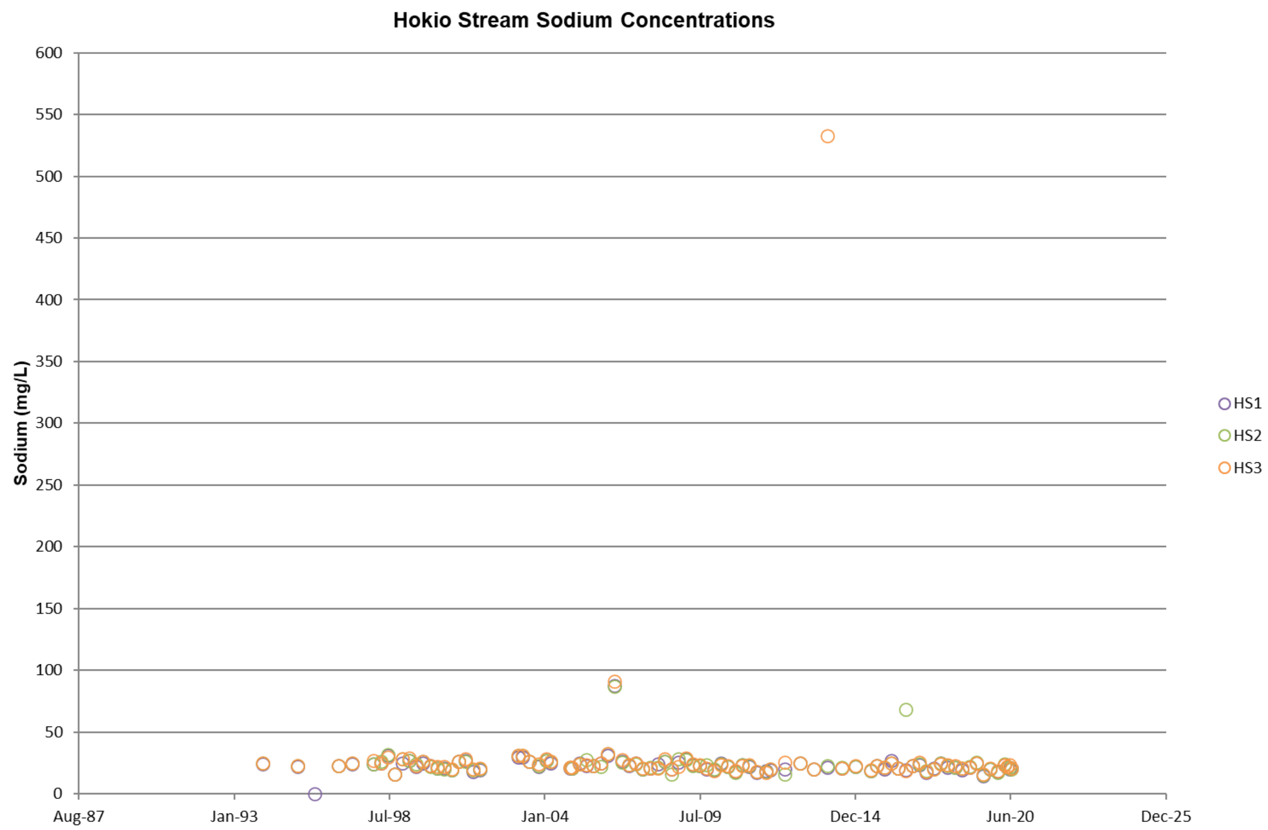
Hokio Stream – Surface water locations (HS1, HS2, and HS3)






Hokio Stream - Ammoniacal-N Concentrations
Ammoniacal-N (mg/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Aug-87
Jan-93
Jul-98
Jan-04
Jul-09
Dec-14
Jun-20
Dec-25
HS1
HS2
HS3
Horizons One Plan Standard


Hokio Stream - Conductivity
Conductivity (mS/m)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Mar-23
HS1
HS2
HS3



Hokio Stream Sodium Concentrations
Sodium (mg/L)
600
550
500
450
400
350
300
250
200
150
100
50
0
Aug-87
Jan-93
Jul-98
Jan-04
Jul-09
Dec-14
Jun-20
Dec-25
HS1
HS2
HS3

Appendix F Mass Contaminant Load Calculations

LEVIN LANDFILL MASS CONTAMINANT LOAD CALCULATIONS

DOWN-GRADIENT BORES

C1, C2, C2DS, G2S, B2, B3

Aquifer Thickness x Depth (W x D)

		Thickness (m)		
		5	10	15
Width (m	300	1500	3000	4500
	400	2000	4000	6000
	500	2500	5000	7500

Hydraulic Conductivity (K)

0.00002 m/s = 1.73 m/day — Assume range from 0.5 to 2m/day

0.5 1 2 — Based on field data collected July 2012

Hydraulic Gradient (i)

Assume = 0.0059

Concentration of Analytes in g/m3 (=C from C1, C2, C2DS, G2S, B2 and B3) - **including background**

	NH4 - N	Boron	Chloride	Sodium	Nitrate - N	DRP
Average of max. values last 5 years	78.36	1.732	400.2	279.7	11.7183	0.1165
Average of median values last 5 years	57.90	1.111	223.8	179.3	1.2442	0.0283

Discharge Volume (Q = W x D x K X i) in m3/day

W x D ↓		K→ 0.5	1	2
1500		4.4	8.9	17.7
4000		11.8	23.6	47.2
7500		22.1	44.3	88.5

Mass Load (Q x C) in kg/day

	W x D	C				
NH4-N	1500	78.36	Max.	0.35	0.69	1.39
		57.90	Med.	0.26	0.51	1.02
	4000	78.36	Max.	0.92	1.85	3.70
		57.90	Med.	0.68	1.37	2.73
	7500	78.36	Max.	1.73	3.47	6.93
		57.90	Med.	1.28	2.56	5.12
Boron	1500	1.732	Max.	0.008	0.015	0.031
		1.111	Med.	0.005	0.010	0.020
	4000	1.732	Max.	0.020	0.041	0.082
		1.111	Med.	0.013	0.026	0.052
	7500	1.732	Max.	0.038	0.077	0.153
		1.111	Med.	0.025	0.049	0.098
Chloride	1500	400.2	Max.	1.77	3.54	7.08
		223.8	Med.	0.99	1.98	3.96
	4000	400.2	Max.	4.72	9.44	18.89
		223.8	Med.	2.64	5.28	10.56
	7500	400.2	Max.	8.85	17.71	35.41
		223.8	Med.	4.95	9.90	19.81
Sodium	1500	279.7	Max.	1.24	2.48	4.95
		179.3	Med.	0.79	1.59	3.17
	4000	279.7	Max.	3.30	6.60	13.20
		179.3	Med.	2.12	4.23	8.46
	7500	279.7	Max.	6.19	12.38	24.75
		179.3	Med.	3.97	7.94	15.87
Nitrate N	1500	11.7183	Max.	0.05	0.10	0.21
		1.2442	Med.	0.01	0.01	0.02
	4000	11.7183	Max.	0.14	0.28	0.55
		1.2442	Med.	0.01	0.03	0.06
	7500	11.7183	Max.	0.26	0.52	1.04
		1.2442	Med.	0.03	0.06	0.11
DRP	1500	0.117	Max.	0.001	0.001	0.002
		0.028	Med.	0.000	0.000	0.001
	4000	0.117	Max.	0.001	0.003	0.005
		0.028	Med.	0.000	0.001	0.001
	7500	0.117	Max.	0.003	0.005	0.010
		0.028	Med.	0.001	0.001	0.003

SURFACE WATER (HOKIO STREAM) **Includes background**
HS1, HS2 and HS3

HS1 (values in g/m3)

	NH4 - N	Boron	Chloride	Sodium	Nitrate N	DRP
max. values last 5 years	0.14	0.090	29.1	26.8	3.5600	0.388
median values last 5 years	0.035	0.055	24.65	21.1	1.3750	0.022

HS3 (values in g/m3)

	NH4 - N	Boron	Chloride	Sodium	Nitrate N	DRP
max. values last 5 years	0.18	0.070	29.1	25.5	3.6400	0.391
median values last 5 years	0.06	0.060	25.8	21.5	1.4000	0.024

Hokio Stream Characteristics

Minimum flow = **q** = 174 L/s = 15034 m3/day

	Conc (upstream = u/s)	**q** x **C** (u/s) in kg/day
NH4-N	0.035	0.53
Boron	0.055	0.83
Chloride	24.65	370.58
Sodium	21.1	317.21
Nitrate N	1.375	20.67
DRP	0.022	0.33

Q + q = Combined Flow (m3/day)

W x D ↓ / K→		0.5	1	2
1500		15038.0	15042.5	15051.3
4000		15045.4	15057.2	15080.8
7500		15055.7	15077.9	15122.1

Calculated Concentration Downstream, in Hokio Stream
Accounting for background

NH4-N	1500	78.36		0.06	0.08	0.13
		57.90		0.05	0.07	0.10
	4000	78.36		0.10	0.16	0.28
		57.90		0.08	0.13	0.22
	7500	78.36		0.15	0.26	0.49
		57.90		0.12	0.20	0.37
Boron	1500	1.732		0.06	0.06	0.06
		1.111		0.06	0.06	0.06
	4000	1.732		0.06	0.06	0.06
		1.111		0.06	0.06	0.06
	7500	1.732		0.06	0.06	0.06
		1.111		0.06	0.06	0.06
Chloride	1500	400.2		24.76	24.87	25.09
		223.8		24.71	24.77	24.88
	4000	400.2		24.94	25.24	25.83
		223.8		24.81	24.96	25.27
	7500	400.2		25.20	25.75	26.85
		223.8		24.94	25.23	25.82
Sodium	1500	279.7		21.18	21.25	21.40
		179.3		21.15	21.19	21.29
	4000	279.7		21.30	21.51	21.91
		179.3		21.22	21.35	21.60
	7500	279.7		21.48	21.86	22.61
		179.3		21.33	21.56	22.03
Nitrate N	1500	11.7183		1.38	1.38	1.39
		1.2442		1.37	1.37	1.37
	4000	11.7183		1.38	1.39	1.41
		1.2442		1.37	1.37	1.37
	7500	11.7183		1.39	1.41	1.44
		1.2442		1.37	1.37	1.37
DRP	1500	0.1165		0.022	0.022	0.022
		0.0283		0.022	0.022	0.022
	4000	0.1165		0.022	0.022	0.022
		0.0283		0.022	0.022	0.022
	7500	0.1165		0.022	0.022	0.023
		0.0283		0.022	0.022	0.022

	Min	Max
NH4-N	0.05	0.49
Boron	0.06	0.06
Chloride	24.71	26.85
Sodium	21.15	22.61
Nitrate N	1.37	1.44
DRP	0.022	0.023

LEVIN LANDFILL MASS CONTAMINANT LOAD CALCULATIONS

DOWN-GRADIENT BORES
C1, C2, C2DS, G2S, B2 and B3

Aquifer Thickness x Depth (W x D)

		Thickness (m)		
		5	10	15
Width (m)	300	1500	3000	4500
	400	2000	4000	6000
	500	2500	5000	7500

Hydraulic Conductivity (K)

0.00002 m/s = 1.73 m/day — Assume range from 0.5 to 2m/day

0.5 1 2 — Based on field data collected July 2012

Hydraulic Gradient (i)

Assume = 0.0059

Concentration of Analytes in g/m3 (=C from C1, C2, C2DS, G2S, B2 and B3) - **excludes background**

	NH4 - N	Boron	Chloride	Sodium	Nitrate - N	DRP
Average of max. values last 5 years	78.35	1.695	358.1	248.4	8.5483	-0.030
Average of median values last 5 years	57.89	1.088	197.4	153.8	-0.16	-0.099

Discharge Volume (Q = W x D x K X i) in m3/day

W x D ↓		K→ 0.5	1	2
1500		4.4	8.9	17.7
4000		11.8	23.6	47.2
7500		22.1	44.3	88.5

DOWN-GRADIENT BORES
C1, C2, C2DS, G2S, B2 and B3
Excludes background

Mass Load (Q x C) in kg/day

	W x D	C				
NH4-N	1500	78.35		0.35	0.69	1.39
		57.89		0.26	0.51	1.02
	4000	78.35		0.92	1.85	3.70
		57.89		0.68	1.37	2.73
	7500	78.35		1.73	3.47	6.93
		57.89		1.28	2.56	5.12
Boron	1500	1.695		0.008	0.015	0.030
		1.088		0.005	0.010	0.019
	4000	1.695		0.020	0.040	0.080
		1.088		0.013	0.026	0.051
	7500	1.695		0.038	0.075	0.150
		1.088		0.024	0.048	0.096
Chloride	1500	358.1		1.58	3.17	6.34
		197.4		0.87	1.75	3.49
	4000	358.1		4.23	8.45	16.90
		197.4		2.33	4.66	9.32
	7500	358.1		7.92	15.84	31.69
		197.4		4.37	8.73	17.47
Sodium	1500	248.4		1.10	2.20	4.40
		153.8		0.68	1.36	2.72
	4000	248.4		2.93	5.86	11.72
		153.8		1.81	3.63	7.26
	7500	248.4		5.50	10.99	21.98
		153.8		3.40	6.81	13.61
Nitrate N	1500	8.5483		0.04	0.08	0.15
		-0.1592		-0.0007	-0.0014	-0.0028
	4000	8.5483		0.10	0.20	0.40
		-0.1592		-0.0019	-0.0038	-0.0075
	7500	8.5483		0.19	0.38	0.76
		-0.159167		-0.004	-0.007	-0.014
DRP	1500	-0.030		-0.0001	-0.0003	-0.0005
		-0.099		-0.0004	-0.0009	-0.0017
	4000	-0.030		-0.0004	-0.0007	-0.0014
		-0.099		-0.0012	-0.0023	-0.0046
	7500	-0.030		-0.0007	-0.0013	-0.0026
		-0.099		-0.0022	-0.0044	-0.0087

SURFACE WATER (HOKIO STREAM) **Without Background**
HS1, HS2 and HS3

From Results data spreadsheet
HS1

	NH4 - N	Boron	Chloride	Sodium	Nitrate N	DRP
max. values last 5 years	0.14	0.090	29.1	26.8	3.5600	0.388
median values last 5 years	0.04	0.055	24.7	21.1	1.3750	0.022

HS3

	NH4 - N	Boron	Chloride	Sodium	Nitrate N	DRP
max. values last 5 years	0.18	0.070	29.1	25.5	3.6400	0.391
median values last 5 years	0.06	0.060	25.8	21.5	1.4000	0.024

Hokio Stream Characteristics

Minimum flow = **q** = 174 L/s = 15034 m3/day

	Conc (u/s)	**q** x **C** (u/s)
NH4-N	0.035	0.53
Boron	0.055	0.83
Chloride	24.65	370.58
Sodium	21.1	317.21
Nitrate N	1.375	20.67
DRP	0.022	0.33

Q + q = Combined Flow

K→

W x D ↓		0.5	1	2
1500		15038.0	15042.5	15051.3
4000		15045.4	15057.2	15080.8
7500		15055.7	15077.9	15122.1

Calculated Concentration Downstream, in Hokio Stream

Without background

NH4-N	1500	78.35		0.06	0.08	0.13
		57.89		0.05	0.07	0.10
	4000	78.35		0.10	0.16	0.28
		57.89		0.08	0.13	0.22
	7500	78.35		0.15	0.26	0.49
		57.89		0.12	0.20	0.37
Boron	1500	1.695		0.06	0.06	0.06
		1.088		0.06	0.06	0.06
	4000	1.695		0.06	0.06	0.06
		1.088		0.06	0.06	0.06
	7500	1.695		0.06	0.06	0.06
		1.0875		0.06	0.06	0.06
Chloride	1500	358.1		24.75	24.85	25.04
		197.4		24.70	24.75	24.85
	4000	358.1		24.91	25.17	25.69
		197.4		24.79	24.92	25.19
	7500	358.1		25.14	25.63	26.60
		197.4		24.90	25.16	25.66
Sodium	1500	248.4		21.17	21.23	21.37
		153.8		21.14	21.18	21.26
	4000	248.4		21.28	21.46	21.81
		153.8		21.20	21.31	21.52
	7500	248.4		21.43	21.77	22.43
		153.8		21.30	21.49	21.88
Nitrate N	1500	8.5483		1.38	1.38	1.38
		-0.1592		1.37	1.37	1.37
	4000	8.5483		1.38	1.39	1.40
		-0.1592		1.37	1.37	1.37
	7500	8.5483		1.39	1.40	1.42
		-0.1592		1.37	1.37	1.37
DRP	1500	-0.030		0.022	0.022	0.022
		-0.099		0.022	0.022	0.022
	4000	-0.030		0.022	0.022	0.022
		-0.099		0.022	0.022	0.022
	7500	-0.030		0.022	0.022	0.022
		-0.099		0.022	0.022	0.021

NH4-N	Min	0.05
	Max	0.49
Boron	Min	0.06
	Max	0.06
Chloride	Min	24.70
	Max	26.60
Sodium	Min	21.14
	Max	22.43
Nitrate N	Min	1.37
	Max	1.42
DRP	Min	0.021
	Max	0.022

Appendix G Gas Sampling

Created	User	Borehole	Methane (CH_4)	Carbon Dioxide (CO_2)	Hydrogen Sulphide (H_2S)	Oxygen (O_2)	Weather conditions	Air temperature (°C)
11-07-19	Peter Giddins	Levin Landfill: Levin D4	0	0.05	0	20.5	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin F1	0.06	0.05	0	20.9	Overcast,dry and still	12
11-07-19	Peter Giddins	Levin Landfill: Levin G1s	0.01	0.04	0	20.5	Overcast,dry and still	12
11-07-19	Peter Giddins	Levin Landfill: Levin G1d	0.09	0.04	0	20.4	Overcast,dry and still	12
11-07-19	Peter Giddins	Levin Landfill: Levin D1	0	0.09	0	20.1	Overcast,dry and still	12
11-07-19	Peter Giddins	Levin Landfill: Levin D2	0	0.19	0	20	overcast,dry and still	12
11-07-19	Peter Giddins	Levin Landfill: Levin D6	0	0.04	0	20.2	Overcast,dry and still	13
11-07-19	Peter Giddins		0.01	0.02	0	21.2	Overcast,dry and still	13
11-07-19	Peter Giddins	Levin Landfill: Levin F3	0	0.05	0	20.1	Overcast,dry and still	14
11-07-19	Peter Giddins	Levin Landfill: Levin D3	0	0.09	0	20.2	Overcast,dry and still	14
11-07-19	Peter Giddins	Levin Landfill: Levin D5	0	0.07	0	20	Overcast,dry and still	14
11-07-19	Peter Giddins	Levin Landfill: Levin E1s	0	0.04	0	20.1	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin E1d	0	0.06	0	20.1	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin B1	0	0.28	0	19.8		
11-07-19	Peter Giddins	Levin Landfill: Levin E2d	0	0.12	0	20	Overcast,dry and still	14
11-07-19	Peter Giddins	Levin Landfill: Levin E2s	0	0.07	0	20	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin C2ds	0	0.2	0	19.7	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin C2dd	0	0.13	0	19.8	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin C2	0	0.11	0	19.7	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin B3s	0	0.05	0	20	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin B2	0.01	2.68	0	19	Overcast,dry and still	12
11-07-19	Peter Giddins	Levin Landfill: Levin C1	0	0.05	0	19.9	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin G2s	0.02	0.31	0	19.4	Overcast,dry and still	15
11-07-19	Peter Giddins	Levin Landfill: Levin F2	0	0.05	0	20.1	Overcast,dry and still	14
03-10-19	Peter Giddins	Levin Landfill: Levin F1	0	0	0	21	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin G1d	0	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin G1s	0	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin D2	1	0	0	20.9	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin D1	0	0	0	21	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin Landfill I	0	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin D6	0	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin D6	0	0	0	21	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin F2	0	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin F3	0	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin D3	2	0	0	20.3	Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin D5	1	0	0	21.1	Fine and sunny	13
03-10-19	Peter Giddins	Levin Landfill: Levin D4	0	0	0	20.9	Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin E1s	0	0	0	20.9	Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin E1d	0	0	0	20.9	Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin B1	1	0	0	20.6	Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin C1		Bore full to top of pipe.			Fine and sunny.	15
03-10-19	Peter Giddins	Levin Landfill: Levin G2s	2	0	0		Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin C2	7	0	0	15.9	Fine and sunny	14
03-10-19	Peter Giddins	Levin Landfill: Levin C2dd	2	0	0	20.6	Fine and sunny	15
03-10-19	Peter Giddins	Levin Landfill: Levin C2ds	2	0	0	20.7	Fine and sunny	15
03-10-19	Peter Giddins	Levin Landfill: Levin E2d	0	0	0	21	Fine and sunny	15
03-10-19	Peter Giddins	Levin Landfill: Levin E2s	0	0	0	20.9	Fine and sunny	15
03-10-19	Peter Giddins	Levin Landfill: Levin B3s	2	0	0	19.8	Fine and sunny	15
03-10-19	Peter Giddins	Levin Landfill: Levin B2	3	0	0	19	Fine and sunny	15
03-10-19	Peter Giddins	Levin Landfill: Levin G2s				20.7		
07-01-20	Paul Hayward	Levin Landfill: Levin G2s	0	0.06	0	21	Fine , still	
07-01-20	Paul Hayward	Levin Landfill: Levin C1	0	0.05	0	21	Fine , still	16
07-01-20	Paul Hayward	Levin Landfill: Levin E2d	0	0.05	0	20.8	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin E2s	0	0.06	0	20.7	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin C2	0	0.06	0	20.5	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin C2dd	0	0.15	0	20.7	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin C2dd	0	0.1	0	20.9	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin B3s	0	0.03	0	20.9	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin B2	0	0.07	0	20.8	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin B1	0	0.13	0	20.6	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin E1d	0	0.03	0	20.6	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin E1s	0.01	0.03	0	20.6	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin D4	0.08	0.03	0	20.8	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin D5	0	0.04	0	20.9	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin D3r	0.08	0.01	0	20.1	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin F3	0	0.05	0	21.08	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin F2	0	0.05	0	22	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin F2	0	0.05	0	22	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin F1	0	0.02	0	21.1	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin D2	0.05	0.11	0	20.6	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin D1	0	0.04	0	20.8	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin D6	0	0.03	0	20.7	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin G1s	0	0.04	0	21.2	Fine , still	17
07-01-20	Paul Hayward	Levin Landfill: Levin G1d	0	0.05	0	21	Fine , still	17

31-03-20	Paul Hayward	Levin Landfill: Levin G1d	0	0.03	0	20.9	Sunny , dry	15
31-03-20	Paul Hayward	Levin Landfill: Levin G1s	0	0.05	0	21	Sunny , dry	15
31-03-20	Paul Hayward	Levin Landfill: Levin F1	0	0.03	0	21.2	Sunny , dry	15
31-03-20	Paul Hayward	Levin Landfill: Levin D2	0	0.07	0	20.9	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin D1	0	0.08	0	20.7	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin D6	0	0.04	0	20.6	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin D3	0	0.03	0	20.7	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin F3	0	0.02	0	21	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin F2	0	0.05	0	21.3	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin E1d	0	0.04	0	21.5	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin E1s	0	0.03	0	21.6	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin D4	0	0.08	0	21.6	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin D5	0	0.06	0	21.5	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin E2d	0	0.04	0	21.1	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin E2s	0	0.04	0	21.2	Sunny , dry	16
31-03-20	Paul Hayward	Levin Landfill: Levin B3s	0	0.04	0	21.5	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin C2	0	0.05	0	21.5	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin C2dd	0	0.08	0	21.4	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin C2ds	0	0.18	0	21.2	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin B2	0	0.13	0	21.3	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin B1	0	0.08	0	21.2	Sunny , dry	
31-03-20	Paul Hayward	Levin Landfill: Levin C1	0	0.07	0	20.7	Sunny , dry	17
31-03-20	Paul Hayward	Levin Landfill: Levin G2s	0	0.03	0	20.6	Sunny , dry	15

Appendix H Survey Plan

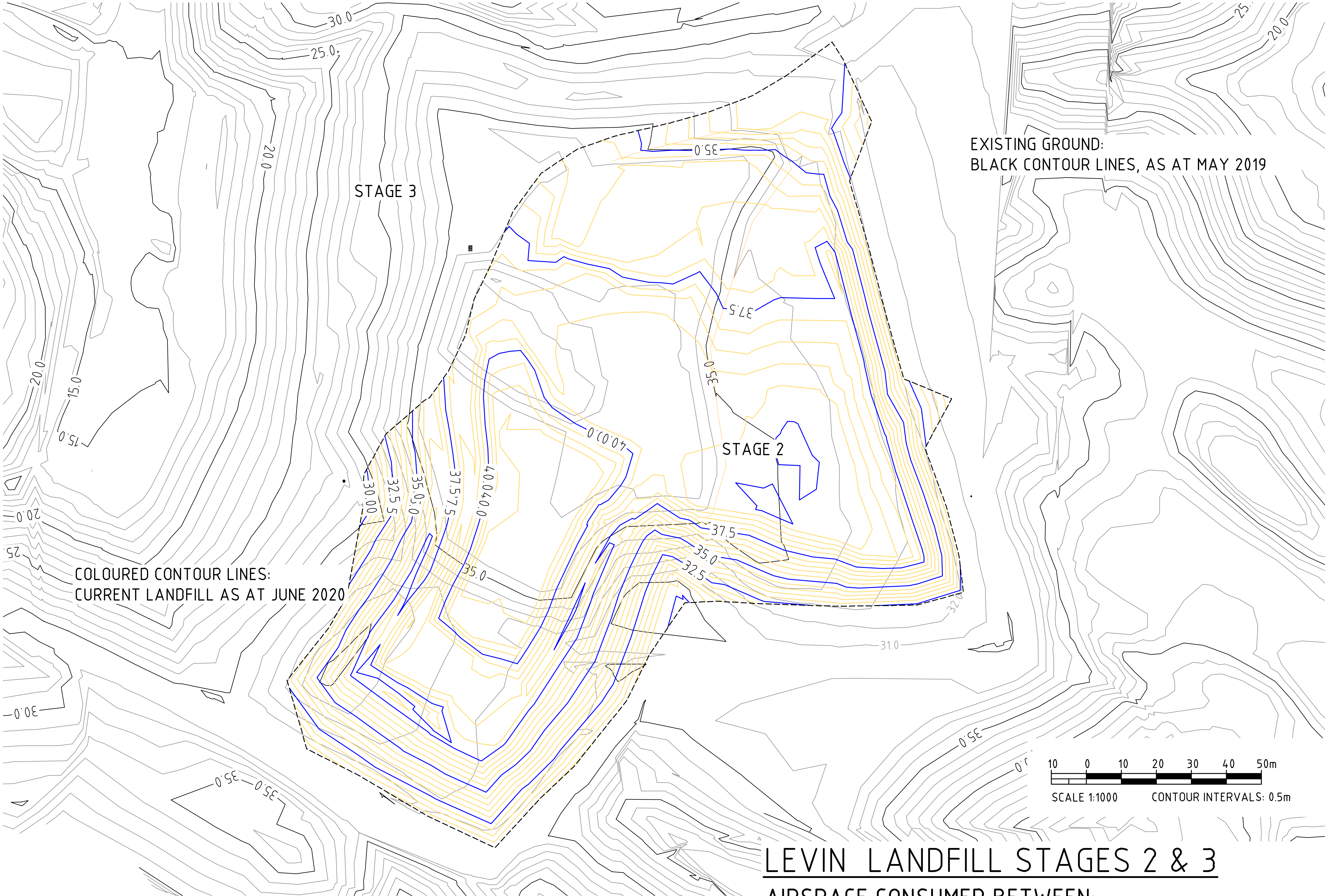
Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Borrow Area May 2019 v June 2020	**1.00**	**1.00**	4723.7sq.m	4886 Cu. M.	523 Cu. M.	4364 Cu. M.<Cut>
Borrow Area May 2019 v June 2020.1	**1.00**	**1.00**	4357.8sq.m	4863 Cu. M.	458 Cu. M.	4405 Cu. M.<Cut>

AREA OF VOLUME AT TOP OF BORROW CUT

LEVIN LANDFILL – BORROW AREA

VOLUME EXTRACTED FROM BORROW AREA BETWEEN MAY 2019 SURVEY TO LATEST SURVEY JUNE 2020

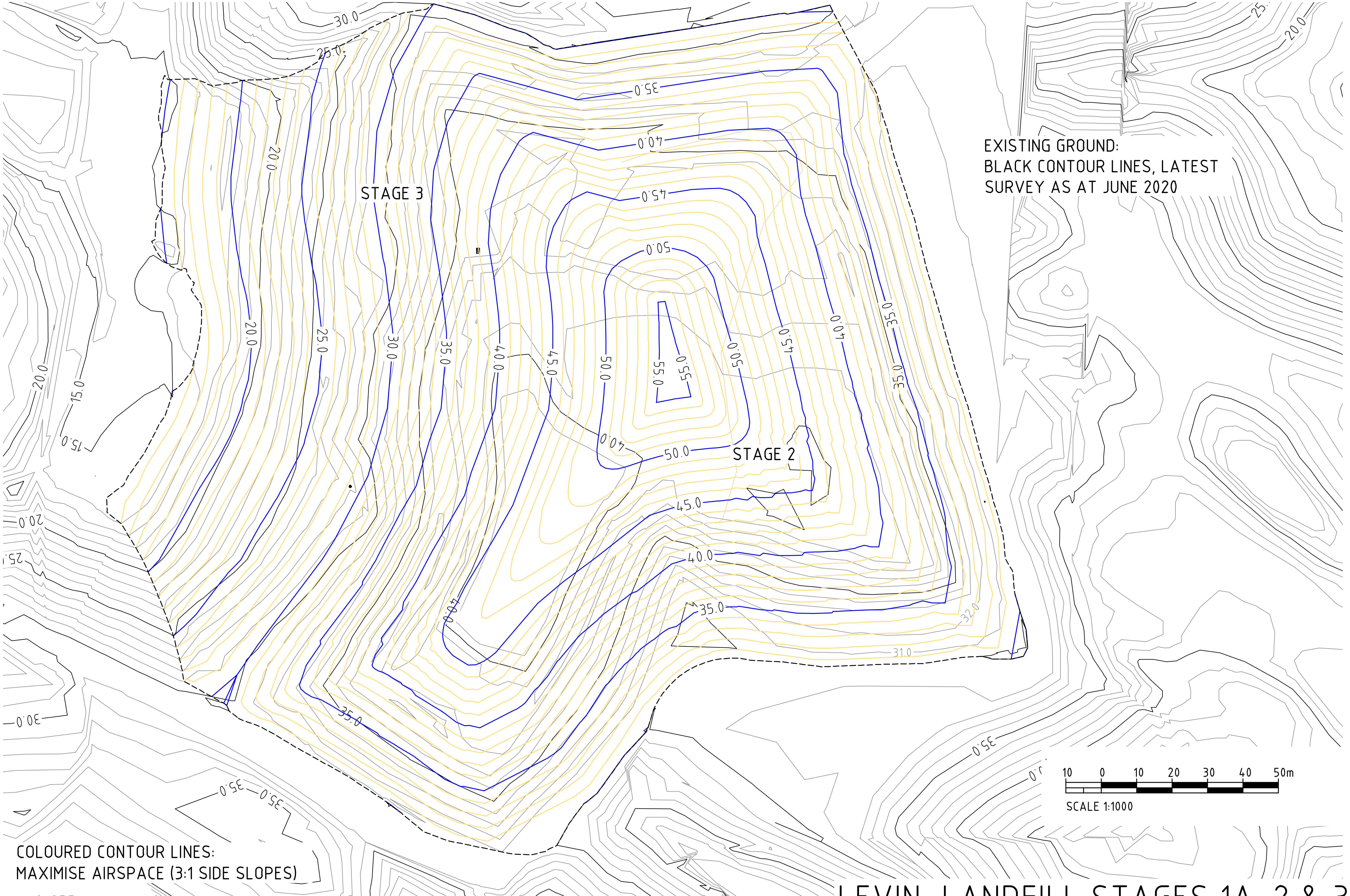


LEVIN LANDFILL STAGES 2 & 3

AIRSPACE CONSUMED BETWEEN:
STAGES 2 & 3 MAY 2019 & LATEST JUNE 2020 SURVEY.

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Stage 2 and 3 May 2019 to June 2020 Airspace consumed	**1.00**	**1.00**	23681.8sq.m	780 Cu. M.	63449 Cu. M.	62669 Cu. M.<Fill>
Totals			23681.8sq.m	780 Cu. M.	63449 Cu. M.	62669 Cu. M.<Fill>



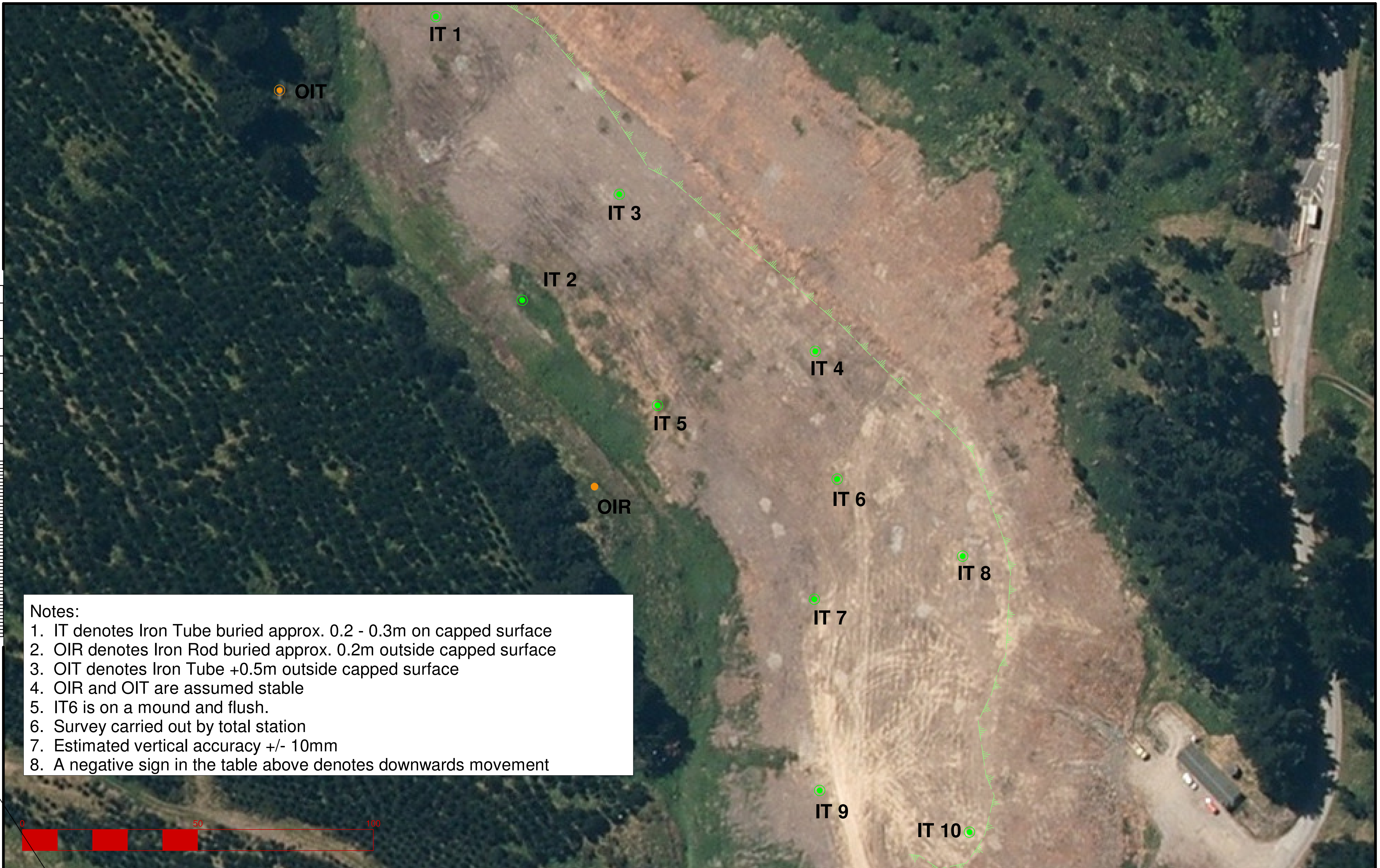
Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
EG June 2020 V FG Maximise (3:1 Slopes)	**1.00**	**1.00**	43719.4sq.m	3701 Cu. M.	132667 Cu. M.	128966 Cu. M.<Fill>
Totals			43719.4sq.m	3701 Cu. M.	132667 Cu. M.	128966 Cu. M.<Fill>

LEVIN LANDFILL STAGES 1A, 2 & 3

MAXIMISING AIRSPACE (3:1 SLOPES)

Appendix I Settlement Monitoring Points



ORIGINAL SIZE A3

0 10 20 30 40 50 60 70 80 90 100

DO NOT SCALE - IF IN DOUBT, ASK

Notes:
1. IT denotes Iron Tube buried approx. 0.2 - 0.3m on capped surface
2. OIR denotes Iron Rod buried approx. 0.2m outside capped surface
3. OIT denotes Iron Tube +0.5m outside capped surface
4. OIR and OIT are assumed stable
5. IT6 is on a mound and flush.
6. Survey carried out by total station
7. Estimated vertical accuracy +/- 10mm
8. A negative sign in the table above denotes downwards movement

CAD Ref :
Old Levin Landfill 30 June 2015 - Settlement Plan

REV	AMENDMENTS	DATE	INIT

SCALES 1:1000

FIELDBOOK	BY	DATE
SURVEYED	RLB	14-15
DESIGNED		
DRAWN	RLB	7/15
CHECKED		
APPROVED		

MWH

OLD LEVIN LANDFILL SETTLEMENT MONITORING

Status Stamp: FOR REVIEW

Date Stamp: 11/08/2016

Job No.	Sheet No.	Rev.
80500724	1 of 1	0

CLOSED LANDFILL SETTLEMENT MONITORING POINTS: July 2014 - June 2020

01-07-14

276456.677	659519.166	99.545	IT 1
276481.279	659438.353	99.473	IT 2
276508.959	659468.520	101.087	IT 3
276564.804	659423.807	102.079	IT 4
276519.814	659408.359	100.738	IT 5
276571.031	659387.368	104.176	IT 6
276564.514	659353.123	101.346	IT 7
276606.806	659365.397	102.689	IT 8
276566.047	659298.621	101.190	IT 9
276608.720	659286.741	101.843	IT 10
276501.879	659385.207	100.000	OIR
276412.147	659498.175	105.026	OIT

30-06-15

276456.676	659519.163	99.530	IT 1
276481.284	659438.344	99.461	IT 2
276508.958	659468.520	101.063	IT 3
276564.806	659423.787	102.053	IT 4
276519.828	659408.358	100.722	IT 5
276571.031	659387.368	104.106	IT 6
276564.517	659353.127	101.304	IT 7
276606.804	659365.397	102.671	IT 8
276566.051	659298.632	101.159	IT 9
276608.740	659286.750	101.813	IT 10
276501.884	659385.209	100.000	OIR
276412.129	659498.162	105.031	OIT

Movement: 30/06/2015 - 1/7/2014

dmE	dmN	dmZ	Code	Notes
-0.001	-0.003	-0.015	IT 1	
0.005	-0.009	-0.012	IT 2	
-0.001	0.000	-0.024	IT 3	
0.002	-0.020	-0.027	IT 4	
0.014	-0.001	-0.017	IT 5	
0.000	0.000	-0.070	IT 6	On mound
0.003	0.004	-0.042	IT 7	
-0.002	0.000	-0.018	IT 8	
0.004	0.011	-0.031	IT 9	
0.020	0.009	-0.031	IT 10	
0.005	0.002	0.000	OIR	Fixed
-0.018	-0.013	0.004	OIT	Check

10-08-16

276456.669	659519.151	99.511	IT 1
276481.288	659438.342	99.444	IT 2
276508.955	659468.512	101.035	IT 3
276564.806	659423.784	102.021	IT 4
276519.829	659408.352	100.700	IT 5
276571.031	659387.368	104.062	IT 6
276564.517	659353.135	101.253	IT 7
276606.804	659365.401	102.639	IT 8
276566.071	659298.642	101.125	IT 9
276608.755	659286.756	101.770	IT 10
276501.891	659385.209	100.000	OIR
276412.131	659498.158	105.021	OIT

Movement: 10/08/2016 - 30/06/2015

dmE	dmN	dmZ	Code	Notes
-0.007	-0.012	-0.018	IT 1	
0.004	-0.002	-0.016	IT 2	
-0.003	-0.008	-0.028	IT 3	
0.000	-0.003	-0.031	IT 4	
0.001	-0.006	-0.021	IT 5	
0.000	0.000	-0.044	IT 6	On mound
0.000	0.008	-0.051	IT 7	
0.000	0.004	-0.031	IT 8	
0.020	0.010	-0.034	IT 9	
0.015	0.006	-0.043	IT 10	
0.007	0.000	0.000	OIR	Fixed
0.002	-0.004	-0.009	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Movement: 10/08/2016 - 01/07/2014

dmE	dmN	dmZ	Code	Notes
-0.008	-0.015	-0.033	IT 1	
0.009	-0.011	-0.029	IT 2	
-0.004	-0.008	-0.052	IT 3	
0.002	-0.023	-0.058	IT 4	
0.015	-0.007	-0.038	IT 5	
0.000	0.000	-0.114	IT 6	On mound
0.003	0.012	-0.093	IT 7	
-0.002	0.004	-0.049	IT 8	
0.024	0.021	-0.065	IT 9	
0.035	0.015	-0.073	IT 10	
0.012	0.002	0.000	OIR	Fixed
-0.016	-0.017	-0.005	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

22-05-17

276456.685	659519.175	99.5	IT 1
276481.294	659438.36	99.433	IT 2
276508.961	659468.522	101.012	IT 3
276564.814	659423.795	101.999	IT 4
276519.833	659408.369	100.684	IT 5
276571.031	659387.368	104.026	IT 6
276564.515	659353.121	101.225	IT 7
276606.802	659365.4	102.627	IT 8
276566.06	659298.634	101.094	IT 9
276608.748	659286.734	101.743	IT 10
276501.902	659385.216	100	OIR
276412.172	659498.185	105.03	OIT

Movement: 22/05/2017 - 10/08/2016

dmE	dmN	dmZ	Code	Notes
-0.016	-0.024	-0.011	IT 1	
-0.006	-0.018	-0.011	IT 2	
-0.006	-0.010	-0.023	IT 3	
-0.008	-0.011	-0.022	IT 4	
-0.004	-0.017	-0.016	IT 5	
0.000	0.000	-0.036	IT 6	On mound
0.002	0.014	-0.028	IT 7	
0.002	0.001	-0.012	IT 8	
0.011	0.008	-0.031	IT 9	
0.007	0.022	-0.027	IT 10	
-0.011	-0.007	0.000	OIR	Fixed
-0.041	-0.027	0.009	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Movement: 22/05/2017 - 01/07/2014

dmE	dmN	dmZ	Code	Notes
0.008	0.009	-0.045	IT 1	
0.015	0.007	-0.040	IT 2	
0.002	0.002	-0.075	IT 3	
0.010	-0.012	-0.080	IT 4	
0.019	0.010	-0.054	IT 5	
0.000	0.000	-0.150	IT 6	On mound
0.001	-0.002	-0.121	IT 7	
-0.004	0.003	-0.062	IT 8	
0.013	0.013	-0.096	IT 9	
0.028	-0.007	-0.100	IT 10	
0.023	0.009	0.000	OIR	Fixed
0.025	0.010	0.004	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

04-07-18

276456.6931	659519.173	99.4892	IT 1
276481.2812	659438.351	99.4209	IT 2
276508.9587	659468.515	100.9909	IT 3
276564.8021	659423.781	101.9763	IT 4
276519.82	659408.359	100.6719	IT 5
276571.0249	659387.36	103.9822	IT 6
276564.5037	659353.119	101.1788	IT 7
276606.7903	659365.392	102.5772	IT 8
276566.0485	659298.638	101.0667	IT 9
276608.7314	659286.738	101.7143	IT 10
			OIR
276412.1367	659498.17	105.035	OIT

Movement: 04/07/2018 - 22/05/2017

dmE	dmN	dmZ	Code	Notes
-0.008	0.003	-0.011	IT 1	
0.013	0.009	-0.012	IT 2	
0.002	0.007	-0.021	IT 3	
0.012	0.015	-0.023	IT 4	
0.013	0.010	-0.012	IT 5	
0.006	0.008	-0.044	IT 6	On mound
0.011	0.002	-0.046	IT 7	
0.012	0.008	-0.050	IT 8	In Puddle
0.012	-0.003	-0.027	IT 9	
0.017	-0.004	-0.029	IT 10	
			OIR	Setup point
0.035	0.015	0.005	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Movement: 04/07/2018 - 01/07/2014

dmE	dmN	dmZ	Code	Notes
0.016	0.007	-0.056	IT 1	
0.002	-0.002	-0.052	IT 2	
0.000	-0.005	-0.096	IT 3	
-0.002	-0.027	-0.103	IT 4	
0.006	0.000	-0.066	IT 5	
-0.006	-0.008	-0.194	IT 6	On mound
-0.010	-0.004	-0.167	IT 7	
-0.016	-0.005	-0.112	IT 8	
0.001	0.016	-0.123	IT 9	
0.011	-0.003	-0.129	IT 10	
			OIR	Setup point
-0.010	-0.005	0.009	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Notes 04-07-2018

Heights surveyed by Total station

Position of monitoring points surveyed by Total Station (OIR - Setup Point)

30-04-19

276456.681	659519.172	99.497	IT 1
276481.279	659438.353	99.424	IT 2
276508.953	659468.517	100.989	IT 3
276564.803	659423.781	101.975	IT 4
276519.821	659408.362	100.669	IT 5
276571.026	659387.357	103.965	IT 6
276564.506	659353.111	101.16	IT 7
276606.8	659365.362	102.554	IT 8
276566.046	659298.625	101.061	IT 9
276608.717	659286.742	101.693	IT 10
			OIR
276412.124	659498.171	105.042	OIT

Movement: 30/05/2019 - 04/07/2018

dmE	dmN	dmZ	Code	Notes
-0.012	0.000	0.008	IT 1	
-0.002	0.002	0.003	IT 2	
-0.006	0.002	-0.002	IT 3	
0.001	0.000	-0.001	IT 4	
0.001	0.003	-0.003	IT 5	
0.001	-0.003	-0.017	IT 6	On mound
0.002	-0.008	-0.019	IT 7	
0.010	-0.030	-0.023	IT 8	In Puddle
-0.003	-0.012	-0.006	IT 9	
-0.014	0.004	-0.021	IT 10	
			OIR	Setup point
-0.013	0.001	0.007	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Movement: 30/05/2019 - 01/07/2014

dmE	dmN	dmZ	Code	Notes
0.004	0.006	-0.048	IT 1	
0.000	0.000	-0.049	IT 2	
-0.006	-0.003	-0.098	IT 3	
-0.001	-0.026	-0.104	IT 4	
0.007	0.003	-0.069	IT 5	
-0.005	-0.011	-0.211	IT 6	On mound
-0.008	-0.012	-0.186	IT 7	
-0.006	-0.035	-0.135	IT 8	
-0.001	0.004	-0.129	IT 9	
-0.003	0.001	-0.150	IT 10	
			OIR	Setup point
-0.023	-0.004	0.016	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Notes 30-05-2019
Heights surveyed by Total station
Position of monitoring points surveyed by Total Station (OIR - Setup Point)

30-06-20

276456.653	659519.157	99.483	IT 1
276481.274	659438.347	99.41	IT 2
276508.943	659468.512	100.963	IT 3
276564.782	659423.79	101.95	IT 4
276519.824	659408.362	100.654	IT 5
276571.022	659387.363	103.934	IT 6
276564.504	659353.117	101.132	IT 7
276606.788	659365.387	102.506	IT 8
276566.051	659298.643	101.035	IT 9
276608.742	659286.75	101.668	IT 10
			OIR
276412.113	659498.15	105.042	OIT

Movement: 30/06/2020 - 30/05/2019

dmE	dmN	dmZ	Code	Notes
-0.028	-0.015	-0.014	IT 1	
-0.005	-0.006	-0.014	IT 2	
-0.010	-0.005	-0.026	IT 3	
-0.021	0.009	-0.025	IT 4	
0.003	0.000	-0.015	IT 5	
-0.004	0.006	-0.031	IT 6	On mound
-0.002	0.006	-0.028	IT 7	
-0.012	0.025	-0.048	IT 8	In Puddle
0.005	0.018	-0.026	IT 9	
0.025	0.008	-0.025	IT 10	
			OIR	Setup point
-0.011	-0.021	0.000	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Movement: 30/06/2020 - 01/07/2014

dmE	dmN	dmZ	Code	Notes
-0.024	-0.009	-0.062	IT 1	
-0.005	-0.006	-0.063	IT 2	
-0.016	-0.008	-0.124	IT 3	
-0.022	-0.017	-0.129	IT 4	
0.010	0.003	-0.084	IT 5	
-0.009	-0.005	-0.242	IT 6	On mound
-0.010	-0.006	-0.214	IT 7	
-0.018	-0.010	-0.183	IT 8	
0.004	0.022	-0.155	IT 9	
0.022	0.009	-0.175	IT 10	
			OIR	Setup point
-0.034	-0.025	0.016	OIT	Check

Note: Vertical Accuracy approximately +/- 10mm

Notes 30-06-2020
Heights surveyed by Total station
Position of monitoring points surveyed by Total Station (OIR - Setup Point)

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