TOITŪ TE WHENUA

LAND INFORMATION NEW ZEALAND

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146 TE MAWHAI ROAD,
FORMER TOKANUI
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AWAMUTU

TOKANUI CLOSED LANDFILL, WHAREKORINO STREAM & BORE WATER SAMPLING, WATER QUALITY ANNUAL REPORT - 2022

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TOKANUI CLOSED LANDFILL, WHAREKORINO STREAM & BORE WATER SAMPLING QUALITY ANNUAL REPORT - 2022

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Status	Final	Signature	
Authors	B. Laing-Mcconnell		
Reviewer	S Finnigan	Date	19/12/2022

Fraser Thomas Limited
Consulting Engineers, Licensed Surveyors
Planners & Resource Managers
Level 1, 21 El Kobar Drive, East Tamaki, Auckland, 2025
PO Box 204006, Highbrook, Auckland, 2025
Auckland, New Zealand
Tel : +64 9 278-7078 : Fax : +64 9 278-3697
Email: sfinnigan@ftl.co.nz

TOKANUI CLOSED LANDFILL, TE AWAMUTU
WHAREKŌRINO STREAM & BORE WATER SAMPLING
WATER QUALITY ANNUAL REPORT – 2022

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1 INTRODUCTION AND PURPOSE

The Tokanui Closed Landfill resource consent (102269) includes several monitoring conditions that must be met each year. LINZ have commissioned Fraser Thomas Ltd (FTL) to assist with fulfilment of the Site Management and Aftercare section.

The purpose of this report is to provide the annual results from the two stream water and bore water sampling rounds undertaken in July and October 2022. These sampling rounds were undertaken later than normal, due to a delay in getting the FTL contract signed off affecting the timing of the first round, and delaying the second round to coincide with separate landfill intrusive investigation work.

2 CONSENT CONDITIONS

This stream and bore water sampling report has been produced in order to satisfy condition 7 of the Site Management and Aftercare requirements of the Tokanui Closed Landfill resource consent RC102269.01.01 for Wharekōrino stream and bore water sampling, dated 17th April 2000. This condition requires the following:

The consent holder shall undertake a formal inspection of the surface and capping of the landfill site on at least an annual basis to check for the following;
I. Poor pasture establishment;
II. Vegetation die off;
III. Refuse protruding through the cap;
IV. Damage to capping materials;
V. Differential settlement and ponding;
VI. Subsidence or erosion;
VII. Leachate springs;
VIII. Visual surface water quality and
IX. Erosion at or near the Wharekōrino Stream bank.

Any defects noticed during the inspection shall be remedied immediately. A report on the inspection, including any remedial actions taken, shall be forwarded to the Waikato Regional Council within two months of inspection.

In addition, condition number 7 specifies the monitoring requirements detailed below.

The consent holder shall characterise the quality of the groundwater and the quality of the Wharekōrino Stream (upstream and downstream of the landfill) to the satisfaction of the Waikato Regional Council. To this end, the consent holder shall develop a monitoring plan in consultation with the Waikato Regional Council. This plan shall be lodged with the Waikato Regional Council for written approval within three months of the granting of this consent. The plan shall include the following sampling programme as a minimum:

Source	*Frequency*	*Location*	*Parameters*
Wharekōrino Stream	*At least twice a year to coincide with high and low groundwater levels (generally September and April). The samples shall be taken when no surface water runoff is occurring.*	*All parameters shall be taken at locations S1, S2 and S3 as shown in Figure 1 attached to this consent except for the PAHs which shall be taken from location S4.*	• *Estimate of stream flow* • *pH* • *conductivity* • *suspended solids* • *total boron·* • *total iron* • *total mercury* • *potassium* • *chloride* • *ammoniacal nitrogen* • *nitrate nitrogen* • *sulphate* • *Polycyclic Aromatic Hydrocarbons*
Groundwater	*At least twice a year to coincide with high and low groundwater levels (generally September and April)*	*Monitoring wells P2 and P7 as shown in Figure 1 attached to this consent.*	• *Water level* • *pH* • *Total Alkalinity* • *Conductivity* • *dissolved boron·* • *dissolved iron* • *dissolved mercury* • *chloride* • *ammoniacal nitrogen* • *nitrate nitrogen* • *sulphate* • *total organic carbon*

The consent holder shall undertake the monitoring programme specified in the monitoring plan or any amendment to the plan that has been made in consultation with, and with the written agreement of, the Waikato Regional Council. The consent holder shall forward the results of the monitoring to the Waikato Regional Council within two months of sampling.

3 BACKGROUND

The resource consent RC102269.01.01 allows for the discharge of leachate from the Tokanui Hospital landfill into land in circumstances that may result in contaminants entering groundwater. The "landfill" in this case refers to a number of areas close to the Wharekōrino Stream that were used for the landfilling of hospital waste over at least 40 years until the late 1990s. A large range of typical domestic and specific medical waste materials were deposited in these landfilling areas, with some refuse burnt and covered with hospital boiler ash. Some of the landfilling areas were also 'capped' with low permeability clay cover and topsoil and then grassed. The landfilled area is now part of a dairy farm and is understood to be used only for grazing.

The groundwater and stream water quality monitoring is undertaken twice yearly to check for potential leaching of contaminants from the landfilled materials into the underlying groundwater and hence into the nearby stream.

Visual checks are also undertaken of the landfill surface annually to check for a range of issues, including any refuse that may have come to the surface and any differential settlement issues, that may promote ponding on the landfill surface. Settlement of the ground may arise from consolidation of the deposited fill materials and from degradation of the waste itself. The latter depends on the nature of the waste materials. Organic waste materials degrade relatively quickly and decrease in volume faster, compared with materials that are more resistant to degradation such as metals, building rubble, treated timber and plastics.

4 METHODOLOGY

4.1 Stream and Bore Sampling

Stream flows were not measured during either 2022 sampling round, which is consistent with previous WSP reports.

The first round of water quality sampling was undertaken on 22nd July 2022 to collect water quality samples from Wharekōrino Stream and Borehole P2. Weather conditions were overcast with light rain.

The second round of water quality sampling was undertaken on 31st October 2022 to collect water quality samples from Wharekōrino Stream and Borehole P2. Weather conditions were mainly fine with no rain.

On both occasions, Bore P7 was found to be dry, which has been the case on all previous sampling occasions and as such no sample could be taken from this bore.

The sampling locations are shown in Figure 1.

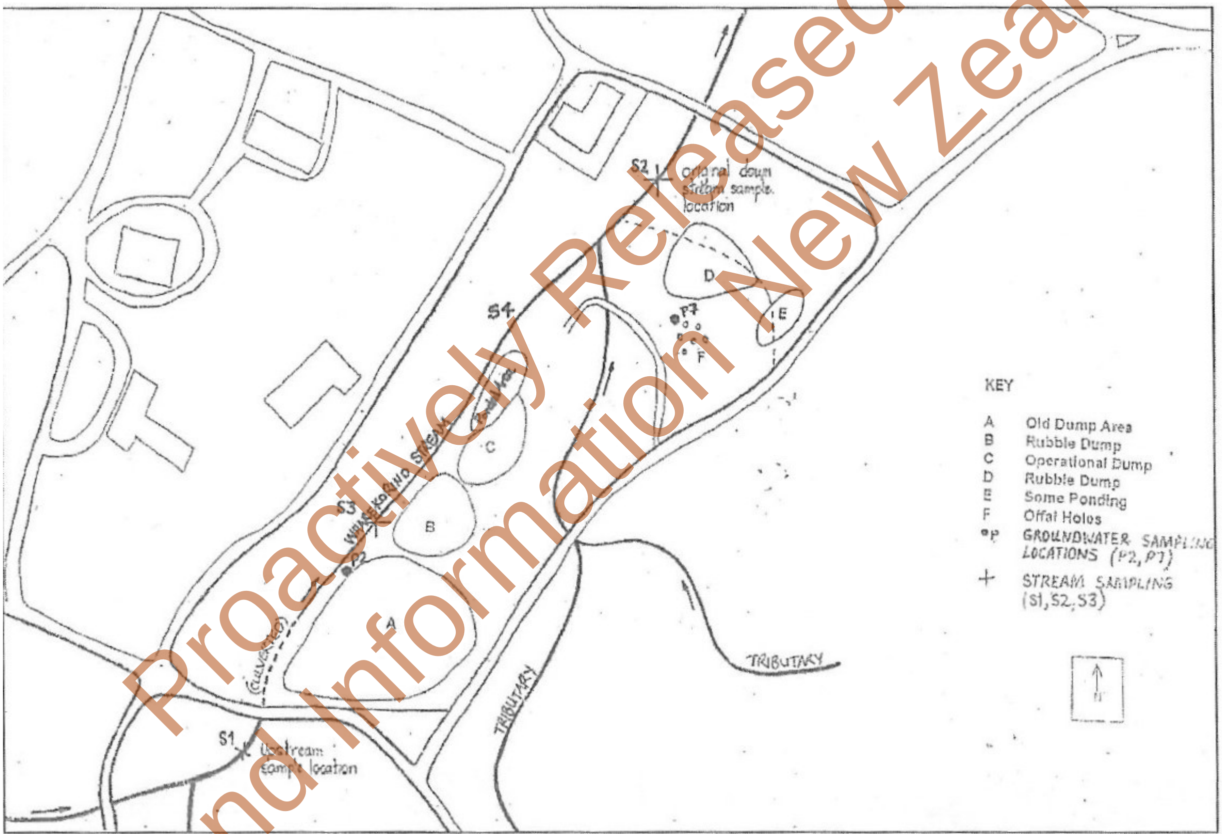


Figure 1: Location of stream and bore (groundwater) sampling sites and landfill areas.

Sampling was conducted at the bank of the stream at locations S1-S4 on both occasions, taking two large water sampling bottles to receive the direct flow from the centre of the stream. Sampling conducted from the borehole at P2 involved using a YRSI multimeter to measure pH, conductivity, DO (dissolved oxygen), ORP (oxidation reduction potential) and turbidity (first round only).

The groundwater level was approximately 0.74m higher during the July 2022 sampling round, compared with the October 2022 round, with this being attributed to July 2022 being very wet. Field measurements were fairly consistent between the July and October sampling events. Generally, Bore P2 had lower pH and conductivity and slightly higher ORP and DO during the July sampling compared with the October sampling.

Table 1: Field Measurements at P2 Borehole in July and October 2022

Field Measurements	July 2022	October 2022
Groundwater depth (m bgl)	2.45	3.19
Temperature (C°)	15.0	16.8
pH	5.93	6.65
DO (mg/L)	4.84	4.76
DO %	48.1	49.2
Specific Conductivity (µs/cm)	592	889
ORP (mV)	167.2	112.9
Turbidity (NTU)	5.28	Not measured[1]

[1] Different meter provided by supplier for second round

Water quality samples (S1-S4, P2) were sent to Hills Laboratories in a ruggedized chilly bin under standard chain of custody procedures for analysis.

4.2 Landfill Visual Assessment

A grid walkover was undertaken of the landfill on 2nd November 2022. Observations were made for each grid in accordance with the consent requirements. The grid plan used is included in Appendix A along with representative photos.

5 RESULTS

5.1 Stream and Bore Sampling

The stream sampling and borehole sampling results are appended to this report. Results from locations S1, S2, S3, S4 are given in Table 2 and the results from bore P2 are given in Table 3.

The results were compared to Australian and New Zealand Environmental and Conservation Council (ANZECC) 95% trigger level for freshwater, ANZECC livestock drinking water guidelines, ANZECC Irrigation long term (100 years) guidelines, ANZECC Irrigation long term (20 years), and Ministry of Health Drinking water Standards (Aesthetics, and Health). For ammonia, the trigger value varies with pH, and was adjusted from the default pH of 8.0 to the lab pH of 6.8, 6.5, and 6.4 respectively, using the formula in the ANZECC guidelines.

Table 2: Results of the Wharekōrino Stream water sampling – July and October 2022

SAMPLE TYPE	UNITS	S1 (July)	S1 (Oct)	S2 (July)	S2 (Oct)	S3 (July)	S3 (Oct)	S4 (July)	S4 (Oct)
pH	pH units	6.4	6.4	6.5	6.5	6.5	6.4	-	-
Electrical conductivity	mS/m	13.5	13.0	14.2	13.4	13.9	13.2	-	-
Total Suspended Solids		<3	< 3	4	< 3	<3	< 3	-	-
Boron		0.0174	0.0166	0.091	0.0680	0.079	0.0750		
Iron		0.194	*0.56*	*0.23*	*0.68*	*0.24*	*0.58*	-	-
Mercury		< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008		
Potassium		3.1	3.1	3.1	3.2	3.1	3.1	-	-
Chloride		18.5	17.6	18.7	17.4	18.4	17.5		
Ammoniacal - N		0.028	0.042	0.019	0.039	0.022	0.043	-	-
Nitrite	g/m^3	0.004	0.005	0.004	0.006	0.005	0.005	-	-
Nitrate		3.2	1.80	3.2	1.69	3.2	1.78	-	-
Nitrate + Nitrite		3.2	1.80	3.2	1.69	3.2	1.78	-	-
Sulphate		6.1	6.8	6.9	7.3	6.6	7.2	-	-
Benzo(a)pyrene			-		-		-	< 0.000008	< 0.000008
Napthalene			-		-		-	< 0.00004	< 0.0002

Key:

Underlined:	above ANZECC 95% Freshwater guideline values
Italicized	above ANZECC Irrigation Long Term 100 years
BLUE	above ANZECC Irrigation Short Term 20 years
BOLD	above ANZECC Livestock drinking water guidelines
RED:	exceeded Drinking water standards for health or Aesthetics (2005-2008)

Table 3: Results of the bore water sampling – July and October 2022

SAMPLE TYPE	UNITS	P2 – 19/07/22	P2 – 31/10/22
Groundwater depth	m (below ground level)	2.45	3.19
pH	pH units	6.4	6.8
Total Alkalinity	g/m³ as $CaCO_3$	161	340
Electrical Conductivity	mS/m	59.1	93.8
Boron	g/m³	***9.7***	***22***
Iron		< 0.02	< 0.02
Mercury		< 0.00008	< 0.00008
Chloride		15.4	14.1
Total Ammoniacal-N		< 0.010	0.013
Nitrite-N		< 0.002	< 0.002
Nitrate-N		7.1	3.00
Nitrate-N + Nitrite N		7.1	3.00
Sulphate		93	157.0
Total Organic Carbon		5.1	3.0

Note: P7 was dry on both occasions so not included in above table.

The latest boron levels in the landfill (P2) as well as upstream (S1), midstream (S3) and downstream (S2) were added to the long term monitoring data and the results are given in Figures 2-4 below. Similarly, the latest and long term nitrate monitoring results are given in Figure 5.

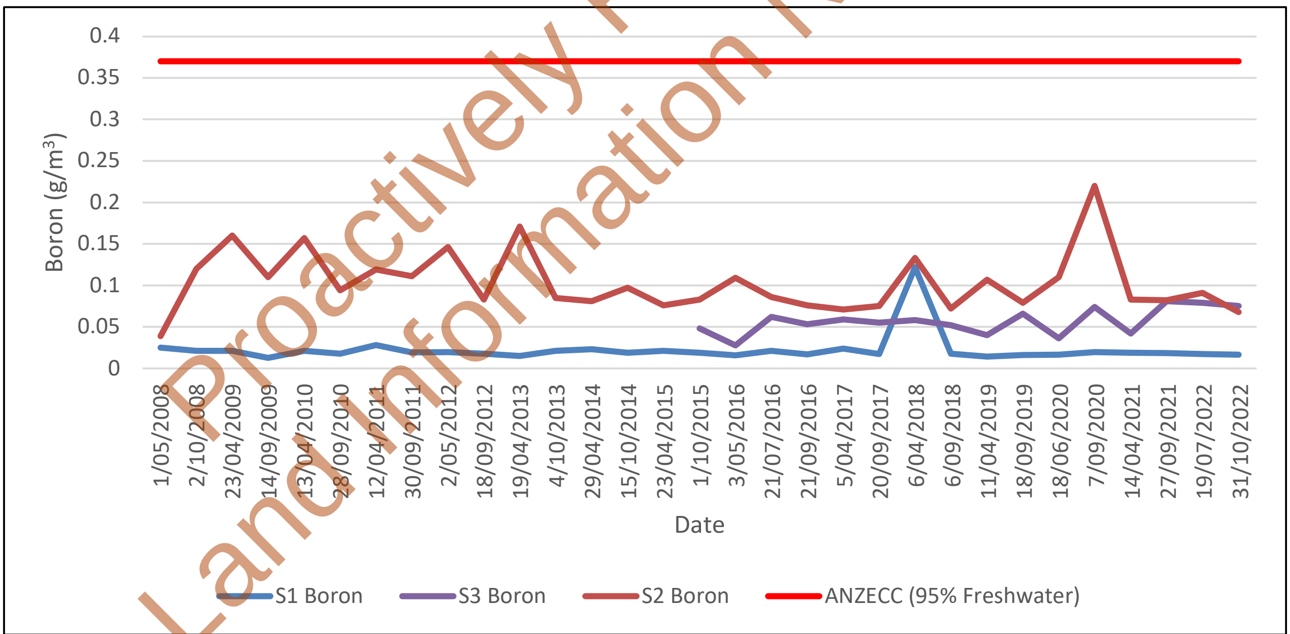


Figure 2: Long term boron levels (g/m³) upstream (S1), midstream (S3), and downstream (S2) of the landfill in comparison to ANZECC 95% protection trigger value for aquatic species.

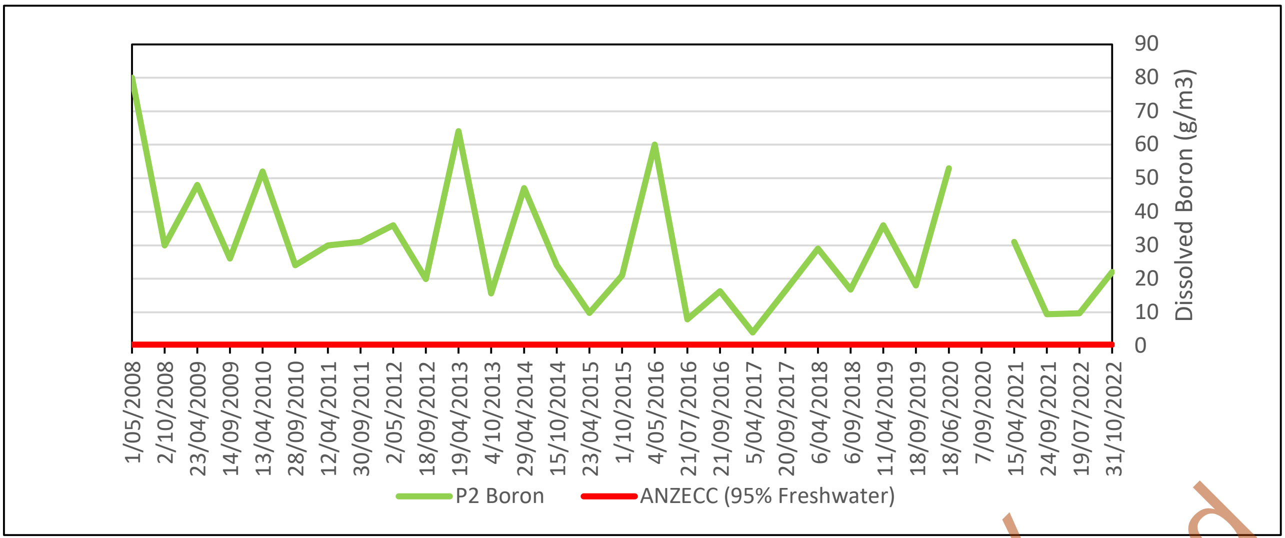


Figure 3: Long term dissolved boron levels (g/m³) within the landfill (P2).

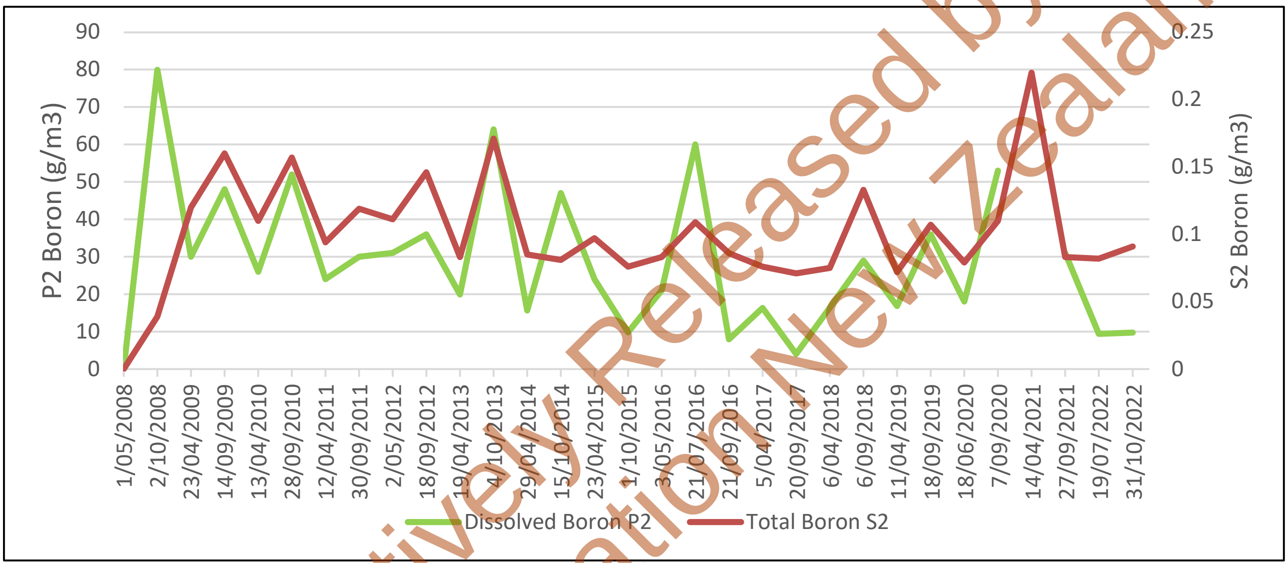


Figure 4: Relationship between boron levels (g/m³) at the downstream site (S2) and bore (P2). Stream (S2) boron values are shown on the right axis, bore (P2) values on the left axis.

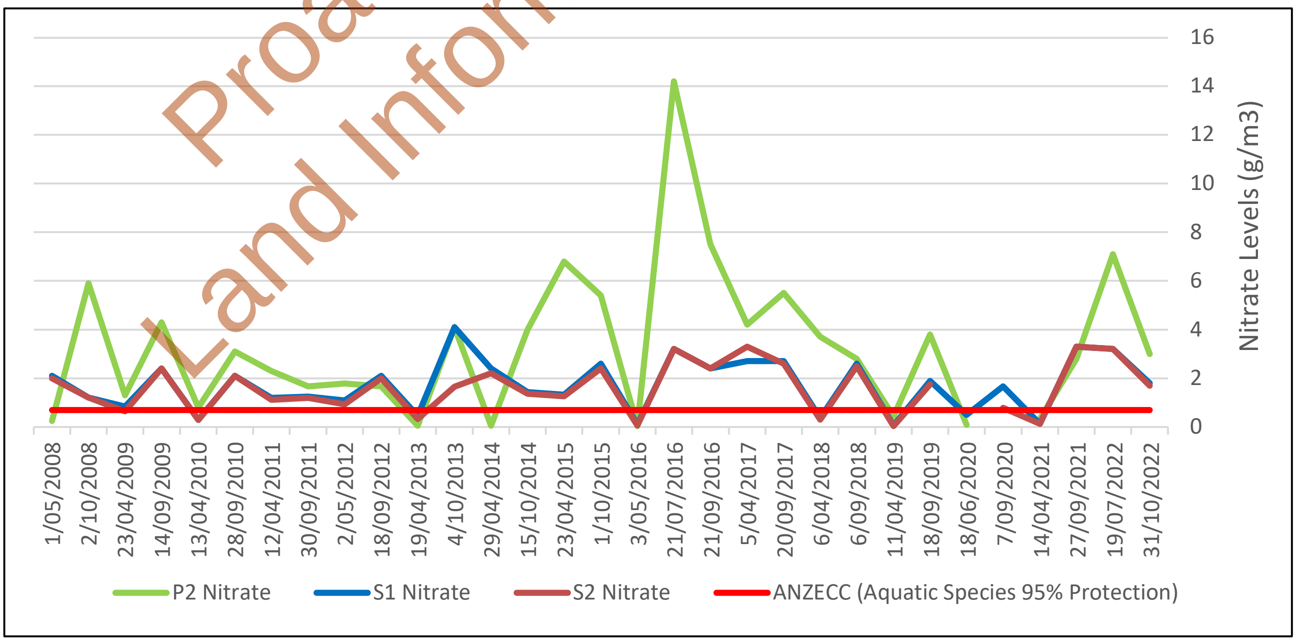


Figure 5: Long term nitrate levels (g/m³) in the landfill (P2) and upstream (S1) and downstream (S2) of the landfill. Note that the P2 bore was dry during the sampling period of September 2020.

5.2 Landfill Walkover Observations

Landfill walkover observations are summarised in Table 4 (below), with reference to grid locations for each item, where relevant.

Table 4: Landfill walkover site observations summary

Item	Description	Grid Ref
Pasture Establishment	Generally good, except patchy in specified locations	A1, B1, E6, E7, F6, G5, J5
Vegetation Die-off	No noticeable vegetation die off other than patchy pasture	H4
Refuse protruding through landfill cap	Consistently positioned near the extents of the landfill.	A3, B3, B4, D4, E4, H6, H7, L5, M6, N6
Damage to capping materials	Minor (couple) of noticeable instances	B3, N8
Differential settlement and ponding	Generally good, minor ponding mostly near stream and extents	B2, D7, E4, H4, I7, K4, K5,
Subsidence or erosion	Subsidence generally occurring along extents of landfill, and in the centre of area D	A3, E4, I5, J8, K6, N7, N8,
Leachate Springs	None found	-
Visual surface water quality	No visual changes observed	-
Erosion at or near Wharekōrino Stream bank	None noted	-

5.2.1 Pasture Establishment

The pasture appeared mostly lush, with some localized areas of patchiness or die off.

Figure 6: Pasture growth, showing examples of limited growth/patchiness (Left A3, Right F6)

5.2.2 Vegetation die off

Overall, the vegetation on the banks of the Wharekōrino stream and areas surrounding the landfill appeared to be healthy. Small amount of kanuka dieback was observed bordering area A, B and C.

Figure 7: Kanuka trees showing minor signs of die-back (Kanuka trees located at grid H4)

5.2.3 Refuse protruding through the cap

There were various instances of individual pieces of refuse protruding through the cap, consistently near the extents of the landfill.

Figure 8: Refuse protrusion across the site (ceramic pipe (B3), wooden post (E4), brick (D4, concrete (D4))

5.2.4 Damage to capping materials

Overall, only one area of note showing damage to capping materials was found – this was also mentioned in previous WSP reports).


Figure 9: Evidence of damage to landfill cap in Area E and extent of Area A (Left N7, Right A3)

5.2.5 Differential settlement and ponding

Ponding was observed across much of the site, exacerbated during periods of heavy rainfall and unlikely to be reflective of normal weather conditions in some areas. Area C has shown consistent ponding since the 2017 WSP field visit, and therefore is a likely frequent ongoing ponding problem.




Figure 10: Areas of ponding observed across the landfill site (Top Left H4, Top right D7, Bottom Left K4, Bottom Right I7)

5.2.6 Subsidence or erosion

There was no erosion noted across the landfill areas. Minor subsidence was observed around the site, resulting in an uneven profile across the landfill areas. It is unclear whether this is naturally occurring or a result of subsidence influenced by the landfill. There have been no new instances since the previous inspection, based on comparison with photos in the WSP 2021 report.

Figure 11: Instances of subsidence visible on site at areas E and A respectively (Left N7, Right E4)

5.2.7 Leachate Springs

No leachate springs were observed during the inspection.

5.2.8 Visual Surface water quality

The Wharekōrino Stream had a reasonably high flow rate and was mostly clear with slight clouding during the July visit consistent with recent heavy rainfall at that time. It had a moderate, clear flow during the October visit.

Figure 12: Visual surface water quality at S1 (Upstream) and S2 (Downstream) respectively.

5.2.9 Erosion at or near the Wharekōrino Stream Bank

No significant erosion was observed along the stream bank of the Wharekōrino stream. Debris build-up at the fence line and ponding in the paddock (more evident during July visit) suggests that when flows are high, the capacity of the stream banks is exceeded and the overflow spills and ponds into low lying pasture.

6 CONCLUSIONS

6.1 Wharekōrino Stream

Generally, stream water samples had neutral to slightly acidic pH, low suspended solids and electrical conductivity, low boron and low chloride levels. Heavy metal concentrations were typically considerably lower than all ANZECC criteria assessed.

Iron concentrations were found to be very slightly in exceedance of the ANZECC long term Irrigation (100 years), and the Drinking water standards for Aesthetics (2005-2008) at locations S2 and S3 during the first sampling event 19/07/22, and in exceedance of these guidelines at all locations tested (S1-S3) during the second sampling event 31/10/22. Levels were consistent across all locations tested, with only a 0.046 g/m^3 variation in values during the first sampling event, and a 0.12 g/m^3 variation in values during the second sampling event respectively. These exceedances in Iron levels are only considered cause for concern in situations where the water is used for continuous long-term irrigation (100 years +). As noted in the 2021 WSP monitoring report, The Report to Hearings Committee (2000) states that due to the low flows in the vicinity of the site, the Wharekōrino Stream is highly unlikely to be used for irrigation purposes; therefore, these elevated iron levels are not a cause for concern.

Nitrate levels in stream samples from both sampling events (S1-S3) were elevated above ANZECC 95% Freshwater guidelines for aquatic species protection, as has consistently been the case for samples taken in the second half of the year since 2015. Nitrate levels were consistent across all stream sampling locations tested, with no variation between sites during the July sampling event, and only a 0.11 g/m^3 variation in values during the October sampling event. Nitrate levels from the July sampling event were approx. 90% higher than during the October sampling event. Nitrate levels were consistent but slightly lower at the downstream location (S2) than at other locations during the October sampling, which may be an indication that the elevated levels are the result of an upstream input (e.g. fertiliser) rather than the result of leaching from the landfill.

Historical nitrate levels in the Wharekōrino stream have fluctuated from <0.10 to 3.3 g/m^3. These levels tend to be lower during low water levels (first half of the year) and higher during high water levels (second half of the year). Because the criteria for ANZECC 95% Freshwater guidelines for aquatic species protection is 0.7 g/m^3, this may mean that it is likely that samples taken in the first half of the year will have nitrate levels within guidelines, and samples taken in the second half of the year will exceed guidelines into the future.

All stream site samples recorded boron levels below the ANZECC 95% Freshwater guidelines for aquatic species protection (Appendix B). Historical data and the 2022 samples show that boron levels are consistently higher downstream of the landfill (Figure 2). It is worth noting that during the October sampling event, location S3 (mid-stream) had a higher boron concentration than locations S1 (upstream) and S2 (downstream). This may indicate that boron leaching is primarily coming from landfill areas A or B, as the S3 sampling location borders these areas, and the value for S1 which is upstream of the landfill is significantly lower than the S3 and S2 samples. The S2 boron levels are similar to S3, but slightly lower, which may support the previous statement. While this is a consistent trend and could suggest possible leaching of contaminants from the landfill where boron levels are much higher; the difference is minor (0.0166-0.0750 g/m^3) and all values have remained within the ANZECC 95% Freshwater guidelines for aquatic species protection.

PAHs were not detected above the lab limit of detection, which is consistent with all previous sampling rounds over the period 2016-2021. Mercury was also not detected, consistent with long term trends.

Overall, the water quality results indicate in our opinion that the historic landfilling activity is not affecting the surface water quality in the stream, other than for boron.

6.2 Bore Water

Bore P7 has been observed as dry and no sampling was able to take place. This is consistent with previous sampling events.

Nitrate levels in borewater samples from Bore location P2 were elevated above the ANZECC 95% freshwater guidelines for aquatic species, with a value of 7.1g/m^3 (July) and 3.00g/m^3 (October) compared with the guideline value of 0.7 g/m^3.

Historical nitrate levels for the P2 Bore site have been highly variable, fluctuating from 0.0039-14.2 g/m^3. Values over 0.7 g/m^3 exceed the thresholds for aquatic species protection (95%). Therefore, it is possible that these values will exceed ANZECC guidelines in the future, as was found to be the case in this sampling round.

The P2 bore site has consistently higher and more variable nitrate levels than the stream sites. The results from this sampling event support this trend. As the downstream sampling site (S2) typically has lower nitrate levels than the upstream site (S1), there is no indication that nitrate is leaching into the stream from the landfill area around the bore.

Water from Bore P2 produced a level of 9.7g/m^3 of dissolved boron during the first sampling event of 2022 (19/07/22), and a level of 22g/m^3 during the second sampling event (31/10/22). These results are reasonably consistent overall, but historic results indicate that sampling during the first half of the year has had more than double the average dissolved boron levels than samples taken during the second half of the year, since 2015. Generally, historical data shows a regular seasonal fluctuation of dissolved boron levels and a possible overall decline over time.

Historic data indicates a possible relationship between boron levels at the bore (P2) and downstream (S2) sites (Figure 4). This relationship along with the higher boron levels downstream (S2) compared with upstream (S1) suggests possible contamination from groundwater seepage through the landfill into the stream. However, as stated above all contaminant levels in the stream have remained below ANZECC Freshwater guidelines for aquatic species 95% protection.

6.3 Landfill Assessment

There were various areas showing minor localised patchiness/die off. Some kanuka trees adjacent to the landfill also showed signs of dieback. There were various instances of individual refuse pieces protruding through the cap at the extents of the landfill. There was one area which showed small localised damage to the cap of the landfill. There appears to be minor to moderate settlement and ponding in some areas, which has appeared largely unchanged from previous investigations. Area C has continued to show frequent ponding conditions.

Some subsidence was observed around the site, forming an uneven ground profile. No erosion was observed. There was no obvious evidence of contaminant leaching at any of the landfill sites. Wharekōrino Stream had an overall clear and slightly cloudy appearance, with debris build-up at the fence line and ponding in the paddock indicative of stream bank overtopping during periods of high stream flows.

7 RECOMMENDATIONS

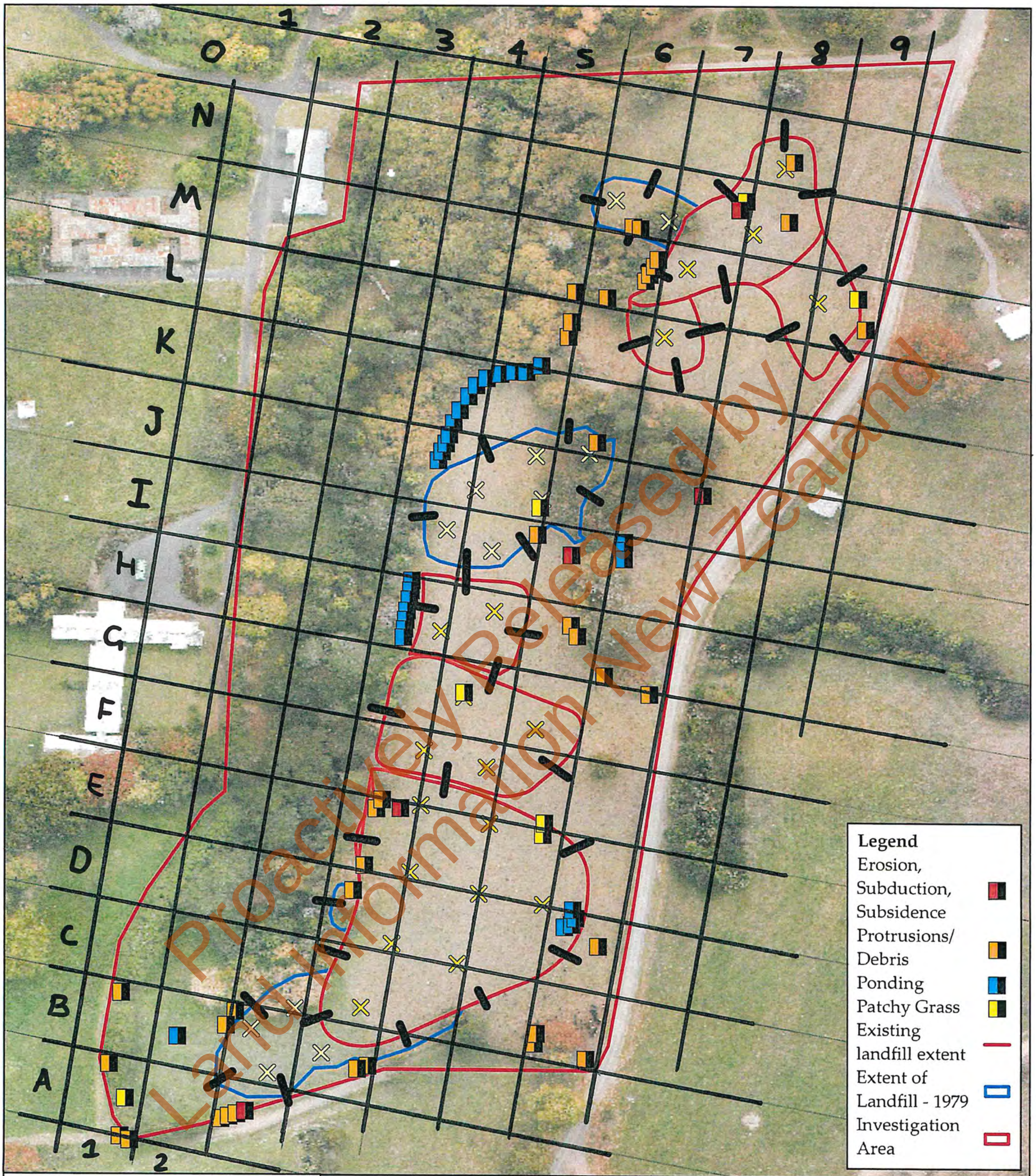
Long term monitoring data appears to show that boron is leaching from the landfill into the stream. The likely source is coal ash, which is understood to have been used as a cover material in some landfilling areas.

Water quality test parameters should be reviewed and discussed with WRC, as some parameters have consistently not been detected for many sampling rounds (e.g. mercury, PAHs). Similarly, some consent requirements, such as stream flow measurement, should be discussed with WRC, as these have never been reported on to our knowledge and never been raised as an issue by WRC.

Grid walkover survey findings were similar to previous WSP inspections. Intrusive landfill investigations have recently been undertaken by Fraser Thomas (Oct-Nov 2022) into the content and extent of the landfilled area. No immediate landfill remedial works are considered necessary. Instead, it is considered better to wait for the results of the Fraser Thomas intrusive investigation, which will address any remedial works considered necessary in a more coordinated and systematic manner, than based on the site walkover.

Appendix A

Landfill Grid Walkover Survey



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Appendix A: Site Features Plan

Toitū Te Whenua - Land Information New Zealand

Tokanui Closed Landfill, Te Awamutu
Wharekorino Stream & Bore Water Sampling
Water Quality Annual Report - 2022

Date:	19/12/2022
Figure Reference:	33097/WQR/002
Drawn by:	EB
Reviewed by:	SF
Job Number:	33097

N

0 18 36 72 108 144 Meters

Landfill Area	Grid	Description – November 2022
-	A1	Patches of dead grass, cement and wooden post debris
-	A2	-
Extent of A	A3	Large concrete block, small subsidence/erosion near fence, cement protrusion
-	B1	Wooden planks, cement, cement piping debris, patchy grass growth
Extent of A	B2	Previous ponding – lily's growing
Extent of A	B3	2 ceramic pipes protruding
A	B4	Loose rock, brick, cement along fence boundary gully. Single cement block protruding
-	C1	-
-	C2	-
A	C4	-
A	C5	-
A	C6	-
-	C7	Mixed cement blocks, water trough?
A	D4	Concrete block protruding at surface
	D5	-
	D7	Trough, ponding
	E4	Subsidence – ground has sunken, wooden post protruding, rock/concrete protruding, patches of dying pasture, another sunken part, stumps protruding
	E5	
	E6	Patchy pasture
	E7	Patchy pasture
A & B	F4	-
	F5	-
	F6	Patchy pasture throughout
-	F7	
B	G4	
	G5	Patchy vegetation growth
	G6	-
-	G7	-
C	H4	Ponding at fence boundary
	H5	-
-	H6	Bricks, wooden post protruding
-	H7	Cement, wooden post protrusion
Extent of C	I4	-
	I5	Erosion, subduction at boundary fence
-	I7	Minor ponding
Extent of C	J4	-
	J5	Patchy pasture
	J6	-
-	J7	-
-	J8	erosion
-	K4	ponding
Extent of C	K5	ponding
	K6	Small subsidence
-	K7	

-	K8	
-	L5	Concrete, ceramic protrusion
F	L6	
	L7	
E	L8	
D	M6	Rock, concrete blocks, scrap metal, metal piping, wooden posts
	M7	-
E	M8	-
	M9	Patchy pasture
D	N6	Brick, metal pipe protruding
	N7	Subsidence
	N8	
-	O5	-
-	O6	-
D	O8	Old stump protrusion
-	O9	-
-	P7, P8, P9	-

Supplementary notes; based on landfill area

Area A: Area A was largely observed as lush pasture, with some fill protrusion and one instance of ponding and subsidence/erosion.

Patchy pasture was noted within grids B1, B2, and B3 stretching west through the extent of area A, and areas E4, E6, E7 and F6 along the northern boundary of Area A and southern boundary of Area B.

Protrusion of wooden posts and planks were visible at A1 and B1, which is reasonably far from the extent of the landfill in 1979, and at E4 at the edge of area A, which is more likely associated with filling activities. Cement blocks protrude at A1 and B1 which is reasonably far from the extent of Area A1 and likely dumped. They were also found protruding at A3, B4, D4, and E4 along the boundary fenceline and western extent of Area A. 2 Ceramic posts were also noted to protrude at grid B3, at the extent of Area A.

Ponding was observed at Grid D7, surrounding a permanent water trough. Subsidence/Erosion was visible at grid A3 at the fenceline boundary.

Area B: Area B was observed as having no features of note, and some minor localized instances of patchy pasture in grids F6 and G5.

Area C: Area C was observed as mostly lush pasture, with large portions of ponding some visible subduction and subsidence. Grid J5 was the only portion of Area C where patchy pasture was observed, at the extent. Significant ponding was observed at H4 and minor ponding at K5, both located between the extent of area C and the Wharekorino stream. Ponding at both locations has been noted in previous years, and high stream flow is likely a large contributor. Localized subduction is observable at I5 at the extent of area near the fencline. Subsidence was noted at K6 at the north-eastern extent of area C.

Area D: Area D was mostly lush pasture, with very uneven topography including patches of subduction and some instances of protruding debris. Grid M6 contained a large amount of protruding debris including concrete blocks, scrap metal, piping and wooden posts at the boundary of Area D where the land slopes down toward the Wharekorino stream tributary. N6 had similarly exposed debris at the extent of Area D, near M6. Significant subsidence was observed at grid N7

Area E: Area E was primarily in good condition. The only feature of note was general sloping subduction of the land. Previous visits have noted ponding filling this subducted area, but none was observed during 2022.

Area F: No Features of note. Offal pits were located in this area but no visible features related to this.

A1

A1

A1

A1

A1 – Patchy pasture

A1 – Patchy pasture

A2

A2

A2

A2

A3 – large cement block

A3

A3 – Subsidence/erosion

A3

B1

B1 – patchy pasture

B1 – wooden debris

B1 – cement blocks

B1 – cement block/piping debris

B1 – manhole

B1

B1

B2

B2

B2 – previous ponding

B2

B3 – Ceramic pipe protrusion

B3 – Ceramic pipe protrusion

B3

B3

B3

B3

B4

B4

B4 – loose brick debris

B4 – cement block protruding

B4

B4 – cement block protruding

B4

B4

C1

C1

C4

C4

C4

C4

C4

C5

C5

C5

C5

C6

C6

C6

C6

C7

C7

C7

C7

C7

C7 – mixed cement blocks

D4

D4

D4

D4

D4 – concrete block protruding

D5

D5

D5

D5

D5

D7

D7

D7

D7

D7 – ponding

E4 - subsidence

E4 – wooden post protruding

E4 – concrete protrusion

E4 – patchy pasture

E4

E5

E5

E5

E5

E6

E6

E6

E6

E7 – patchy pasture

E7

E7

E7

F4

F4

F4

F4

F4

F5

F5

F5

F5

F6

F6

F6 – patchy pasture

F6

F6

F7

F7

F7

F7

G4

G5 – patchy pasture

G5

G5

G5

G6

G6

G6

G6

G7

G7

G7

G7

G7

H4 – ponding extent

H4

H4 – Ponding at fence boundary

H4

H4

H5

H5

H6

H6

H6

H6 – debris protruding

H6 – debris protruding

H7

H7

H7

H7 – debris protruding

H7

I4

I4

I4

I4

I5

I5 – erosion/subduction

I5

I5

I5

I7

I7 – minor ponding

I7

I7

J4

J4

J4

J4

J5

J5

J5 – patchy pasture

J5

J6

J6

J6

J6

J7

J7

J7

J7

J8 - erosion

J8

J8

J8

J8

K4

K4

K4 - ponding

K4 - ponding

K5

K5

K5 - ponding

K5

K5

K6

K6

K6 – minor subsidence

K7

K7

K8

K8

L5

L5 – concrete/ceramic protrusion

L5

L5 – concrete protrusion

L6

L6

L7

L7

L7

L7

L7

L8

L8

L8

M6 – concrete block, scrap metal, metal piping debris

M6 – concrete debris

M6

M6

M7

M8

M9

M9 – patchy pasture

M9

N6 – metal pipe protruding

N6 – brick protruding

N6

N6


N7


N7 – patchy pasture


N7


N7 - subsidence

O5

O8 – stump protruding

O8

09

O9

O9

P7, P8, P9

P7, P8, P9

Appendix B

Sampling Results and Lab Transcripts

Tokanui Landfill Monitoring: GW & SW Results															
Sample Date		**ANZECC (2000)**				**Drinking Water Standards (2005-2008) (Revised 2018)**		19-Jul-22				2-Nov-22			
Sample Name								S1	S2	S3	S4	S1	S2	S3	S4
Sample Depth (m)								Surface Water							
Lab Number								3036950.1	3036950.2	3036950.3	3036950.4	3108551.1	3108551.2	3108551.3	3108551.5
Individual Tests	**Unit of measurement**	**95% Freshwater**	**Livestock**	**Irrigation Long term 100 years**	**Irrigation short term 20 years**	**Health**	**Aesthetics**								
pH	**pH Units**						7-8.5	6.4	6.5	6.5	-	6.4	6.5	6.4	-
Electrical Conductivity	**mS/m**							13.5	14.2	13.9	-	13.0	13.4	13.2	-
Total Suspended Solids	**g/m³**						1,000	<3	4.0000	<3	-	< 3	< 3	< 3	-
Total Boron		0.37	5.0	0.50		1.4		0.0174	0.0910	0.0790	-	0.0166	0.0680	0.0750	-
Total Iron		ID		0.20	10.00		0.2	*0.19*	*0.23*	*0.24*	-	*0.56*	*0.68*	*0.58*	-
Total Mercury		0.0006	0.002	0.002	0.002	0.007		< 0.00008	< 0.00008	< 0.00008	-	< 0.00008	< 0.00008	< 0.00008	-
Total Potassium								3.1	3.1	3.1	-	3.1	3.2	3.1	-
Chloride							250.0	18.5	18.7	18.4	-	17.6	17.4	17.5	-
Total Ammoniacal-N		5.944 @ 6.8pH 6.295 @ 6.5 pH 6.373 @ 6.4pH						0.028	0.019	0.022	-	0.042	0.039	0.043	-
Nitrite-N						3.0		0.004	0.004	0.005	-	0.005	0.006	0.005	-
Nitrate-N		0.7				50.0		3.20	3.20	3.20	-	1.80	1.69	1.78	-
Nitrate-N + Nitrite N								3.20	3.20	3.20	-	1.80	1.69	1.78	-
Sulphate							250.0	6.1	6.9	6.6	-	6.8	7.3	7.2	-
PAHs	**g/m³**														
BaP (BAP)		ID						-	-	-	< 0.000008	-	-	-	< 0.000008
Naphthalene		0.016						-	-	-	< 0.00004	-	-	-	< 0.0002

Note:

Underlined: above ANZECC 95% Freshwater guideline values

Italicized above ANZECC Irrigation Long Term 100 years

BLUE above ANZECC Irrigation Short Term 20 years

BOLD above ANZECC Livestock drinking water guidelines

RED : exceeded Drinking water standards for health or Aesthetics (2005-2008)

ND not detected

- : not tested for

Tokanui Landfill Monitoring: GW & SW Results									
Sample Date		**ANZECC (2000)**				**Drinking Water Standards (2005-2008) (Revised 2018)**		2-Nov-22	19-Jul-22
Sample Name								P2	P2
Sample Depth (m)									
Lab Number								3108551.6	3036950.5
Individual Tests	**Unit of measurement**	**95% Freshwater**	**Livestock**	**Irrigation Long term 100 years**	**Irrigation short term 20 years**	**Health**	**Aesthetics**		
pH	**pH Units**						7-8.5	6.8	6.4
Total Alkalinity	**g/m³ as $CaCO_3$**							340	161
Electrical Conductivity	**mS/m**							93.8	59.1
Dissolved Boron	**g/m3**	0.37	5.0	0.50		1.4		<u>*22*</u>	<u>*10*</u>
Dissolved Iron				0.20	10.00		0.2	< 0.02	< 0.02
Dissolved Mercury		0.0006	0.002	0.002	0.002	0.007		< 0.00008	< 0.00008
Chloride							250.0	14.1	15.4
Total Ammoniacal-N		5.944 @ 6.8pH						0.013	< 0.010
Nitrite-N						3.0		< 0.002	< 0.002
Nitrate-N		0.7				50.0		<u>3.00</u>	<u>7.10</u>
Nitrate-N + Nitrite N								3.00	7.10
Sulphate							250.0	157.0	93.0
Total Organic Carbon								3.0	5.1

Note:

<u>Underlined:</u>	above ANZECC 95% Freshwater guideline values
Italicized	above ANZECC Irrigation Long Term 100 years
BLUE	above ANZECC Irrigation Short Term 20 years
BOLD	above ANZECC Livestock drinking water guidelines
RED :	exceeded Drinking water standards for health or Aesthetics (2005-2008)
ND	not detected
- :	not tested for

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

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Certificate of Analysis

SPv1

Client:	Fraser Thomas Limited	**Lab No:**	3036950
Contact:	Elliot Bish	**Date Received:**	19-Jul-2022
	C/- Fraser Thomas Limited	**Date Reported:**	27-Jul-2022
	PO Box 204006	**Quote No:**	117021
	Highbrook	**Order No:**	Required
	Auckland 2161	**Client Reference:**	33097
		Submitted By:	Elliot Bish

Sample Type: Aqueous

Sample Name:		S1 19-Jul-2022 12:00 pm	S2 19-Jul-2022 12:30 pm	S3 19-Jul-2022 11:40 am	S4 19-Jul-2022 12:15 pm	P2 19-Jul-2022 1:30 pm
Lab Number:		3036950.1	3036950.2	3036950.3	3036950.4	3036950.5
Individual Tests						
pH	pH Units	6.4	6.5	6.5	-	6.4
Total Alkalinity	g/m³ as $CaCO_3$	-	-	-	-	161
Electrical Conductivity (EC)	mS/m	13.5	14.2	13.9	-	59.1
Total Suspended Solids	g/m³	< 3	4	< 3	-	-
Dissolved Boron	g/m³	-	-	-	-	9.7
Total Boron	g/m³	0.0174	0.091	0.079	-	-
Dissolved Iron	g/m³	-	-	-	-	< 0.02
Total Iron	g/m³	0.194	0.23	0.24	-	-
Dissolved Mercury	g/m³	-	-	-	-	< 0.00008
Total Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	-	-
Total Potassium	g/m³	3.1	3.1	3.1	-	-
Chloride	g/m³	18.5	18.7	18.4	-	15.4
Total Ammoniacal-N	g/m³	0.028	0.019	0.022	-	< 0.010
Nitrite-N	g/m³	0.004	0.004	0.005	-	< 0.002
Nitrate-N	g/m³	3.2	3.2	3.2	-	7.1
Nitrate-N + Nitrite-N	g/m³	3.2	3.2	3.2	-	7.1
Sulphate	g/m³	6.1	6.9	6.6	-	93
Total Organic Carbon (TOC)	g/m³	-	-	-	-	5.1
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	-	-	-	< 0.000008	-
Acenaphthylene	g/m³	-	-	-	< 0.000008	-
Anthracene	g/m³	-	-	-	< 0.000008	-
Benzo[a]anthracene	g/m³	-	-	-	< 0.000008	-
Benzo[a]pyrene (BAP)	g/m³	-	-	-	< 0.000008	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	-	-	-	< 0.000008	-
Benzo[g,h,i]perylene	g/m³	-	-	-	< 0.000008	-
Benzo[k]fluoranthene	g/m³	-	-	-	< 0.000008	-
Chrysene	g/m³	-	-	-	< 0.000008	-
Dibenzo[a,h]anthracene	g/m³	-	-	-	< 0.000008	-
Fluoranthene	g/m³	-	-	-	< 0.000008	-
Fluorene	g/m³	-	-	-	< 0.000008	-
Indeno(1,2,3-c,d)pyrene	g/m³	-	-	-	< 0.000008	-
Naphthalene	g/m³	-	-	-	< 0.00004	-
Phenanthrene	g/m³	-	-	-	< 0.000008	-
Pyrene	g/m³	-	-	-	< 0.000008	-

This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised.
The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Analyst's Comments

Sample 5 Comment:
Please note that the level of Uncertainty of Measurement (UOM) for the TOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS analysis. In-house based on US EPA 8270.	0.000005 g/m³	4
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3, 5
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-3
pH	pH meter. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3, 5
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m³ as $CaCO_3$	5
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	1-3, 5
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) 23rd ed. 2017.	3 g/m³	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23rd ed. 2017.	-	5
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.005 g/m³	5
Total Boron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0053 g/m³	1-3
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m³	5
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m³	1-3
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	5
Total Mercury	Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m³	1-3
Total Potassium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.053 g/m³	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m³	1-3, 5
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m³	1-3, 5
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m³	1-3, 5
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m³	1-3, 5
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m³	1-3, 5
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m³	1-3, 5
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC.The uncertainty of the calculated result is a combination of the uncertainties of the two analytical determinands in the subtraction calculation. Where both determinands are similar in magnitude, the calculated result has a significantly higher uncertainty than would normally be achieved if one of the results was significantly less than the other. In such cases, the elevated uncertainty should be kept in mind when interpreting the data. APHA 5310 C (modified) 23rd ed. 2017.	0.5 g/m³	5

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 21-Jul-2022 and 27-Jul-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Kim Harrison MSc
Client Services Manager - Environmental

Hill Laboratories
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R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Fraser Thomas Limited	**Lab No:**	3108551	SPv1
Contact:	Dr S Finnigan	**Date Received:**	02-Nov-2022	
	C/- Fraser Thomas Limited	**Date Reported:**	10-Nov-2022	
	PO Box 204006	**Quote No:**	117021	
	Highbrook	**Order No:**	PO000793	
	Auckland 2161	**Client Reference:**	33097	
		Submitted By:	Elliot Bish	

Sample Type: Aqueous

Sample Name:		S1	S2	S3	S4	P2
Lab Number:		3108551.1	3108551.2	3108551.3	3108551.5	3108551.6
Individual Tests						
pH	pH Units	6.4	6.5	6.4	-	6.8
Total Alkalinity	g/m³ as $CaCO_3$	-	-	-	-	340
Electrical Conductivity (EC)	mS/m	13.0	13.4	13.2	-	93.8
Total Suspended Solids	g/m³	< 3	< 3	< 3	-	-
Dissolved Boron	g/m³	-	-	-	-	22
Total Boron	g/m³	0.0166	0.068	0.075	-	-
Dissolved Iron	g/m³	-	-	-	-	< 0.02
Total Iron	g/m³	0.56	0.68	0.58	-	-
Dissolved Mercury	g/m³	-	-	-	-	< 0.00008
Total Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	-	-
Total Potassium	g/m³	3.1	3.2	3.1	-	-
Chloride	g/m³	17.6	17.4	17.5	-	14.1
Total Ammoniacal-N	g/m³	0.042	0.039	0.043	-	0.013
Nitrite-N	g/m³	0.005	0.006	0.005	-	< 0.002
Nitrate-N	g/m³	1.80	1.69	1.78	-	3.0
Nitrate-N + Nitrite-N	g/m³	1.80	1.69	1.78	-	3.0
Sulphate	g/m³	6.8	7.3	7.2	-	157
Total Organic Carbon (TOC)	g/m³	-	-	-	-	3.0
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq						
Acenaphthene	g/m³	-	-	-	< 0.000008	-
Acenaphthylene	g/m³	-	-	-	< 0.000008	-
Anthracene	g/m³	-	-	-	< 0.000008	-
Benzo[a]anthracene	g/m³	-	-	-	< 0.000008	-
Benzo[a]pyrene (BAP)	g/m³	-	-	-	< 0.000008	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	-	-	-	< 0.000008	-
Benzo[g,h,i]perylene	g/m³	-	-	-	< 0.000008	-
Benzo[k]fluoranthene	g/m³	-	-	-	< 0.000008	-
Chrysene	g/m³	-	-	-	< 0.000008	-
Dibenzo[a,h]anthracene	g/m³	-	-	-	< 0.000008	-
Fluoranthene	g/m³	-	-	-	< 0.000008	-
Fluorene	g/m³	-	-	-	< 0.000008	-
Indeno(1,2,3-c,d)pyrene	g/m³	-	-	-	< 0.000008	-
Naphthalene	g/m³	-	-	-	< 0.0002	-
Phenanthrene	g/m³	-	-	-	< 0.000008	-
Pyrene	g/m³	-	-	-	< 0.000008	-

Analyst's Comments
Sample 6 Comment: Please note that the level of Uncertainty of Measurement (UOM) for the TOC result is significantly greater than that usually reported for this analyte (>300% at the 95% confidence level).

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous

Test	Method Description	Default Detection Limit	Sample No
Polycyclic Aromatic Hydrocarbons Trace in Water, By Liq/Liq	Liquid / liquid extraction, GC-MS analysis. In-house based on US EPA 8270.	0.000005 g/m^3	5
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3, 6
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-3
pH	pH meter. APHA 4500-H^+ B 23rd ed. 2017. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3, 6
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) 23rd ed. 2017.	1.0 g/m^3 as $CaCO_3$	6
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B 23rd ed. 2017.	0.1 mS/m	1-3, 6
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) 23rd ed. 2017.	3 g/m^3	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23rd ed. 2017.	-	6
Dissolved Boron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.005 g/m^3	6
Total Boron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.0053 g/m^3	1-3
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	6
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m^3	1-3
Dissolved Mercury	0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	6
Total Mercury	Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005.	0.00008 g/m^3	1-3
Total Potassium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.053 g/m^3	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-3, 6
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-3, 6
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-3, 6
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-3, 6
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-3, 6
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) 23rd ed. 2017.	0.5 g/m^3	1-3, 6
Total Organic Carbon (TOC)	Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC.The uncertainty of the calculated result is a combination of the uncertainties of the two analytical determinands in the subtraction calculation. Where both determinands are similar in magnitude, the calculated result has a significantly higher uncertainty than would normally be achieved if one of the results was significantly less than the other. In such cases, the elevated uncertainty should be kept in mind when interpreting the data. APHA 5310 C (modified) 23rd ed. 2017.	0.5 g/m^3	6

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 05-Nov-2022 and 10-Nov-2022. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental