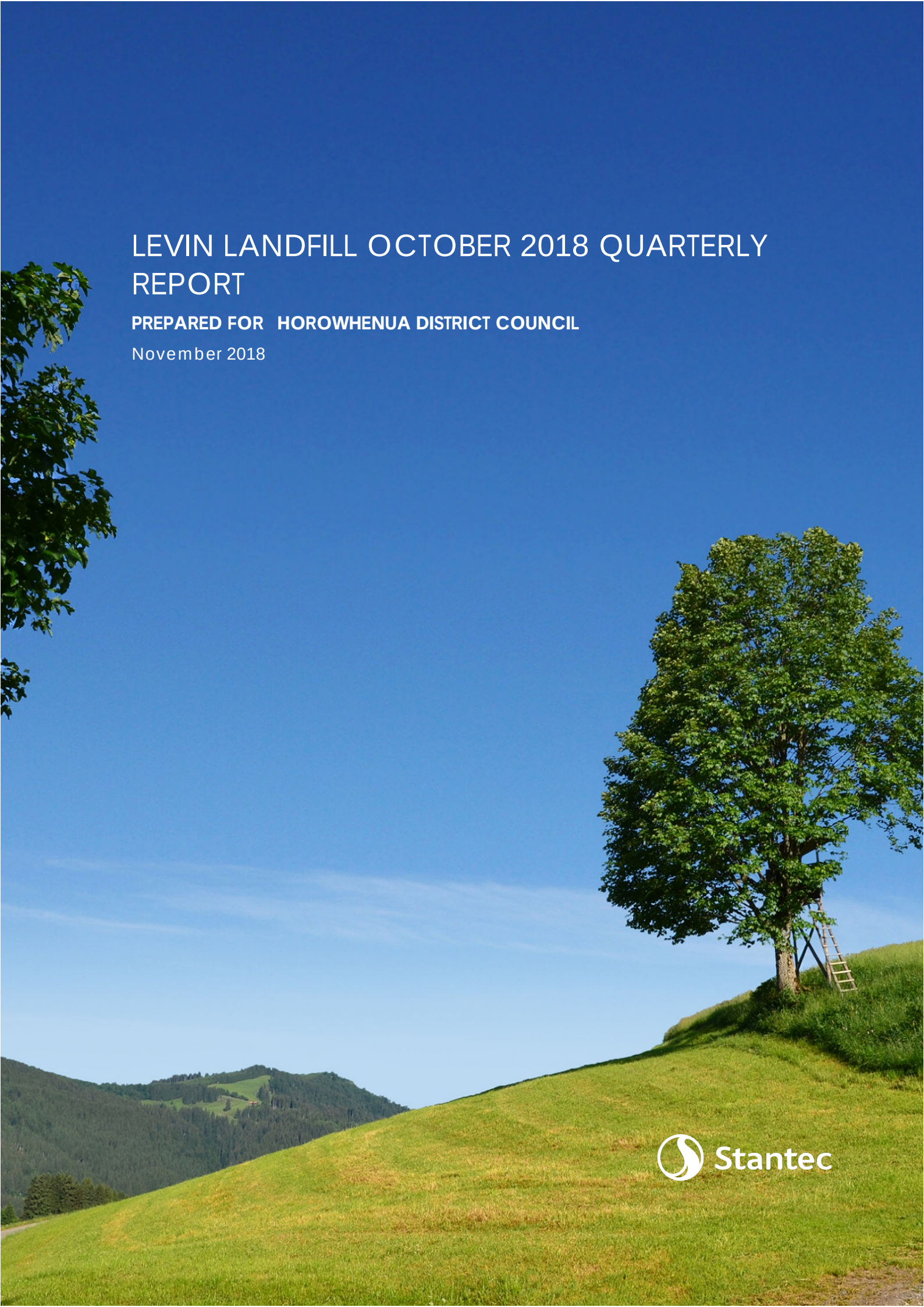
LEVIN LANDFILL OCTOBER 2018 QUARTERLY REPORT

PREPARED FOR HOROWHENUA DISTRICT COUNCIL

November 2018



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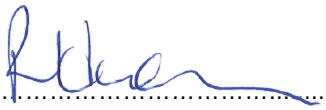
Roger Hulme		29/11/2018

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
01	28/11/2018	Draft for Comment	Matthew Chung	Fiona Styles (data entry)	Phil Landmark	Roger Hulme
02	29/11/2018	Final	Matthew Chung	Fiona Styles (data entry)	Phil Landmark	Roger Hulme

Executive Summary

Samples from 23 groundwater bores, the leachate effluent and 7 surface water sites were collected during October 2018 from around the Levin Landfill and were analysed for parameters as set out in Discharge Permit 6010. Stantec New Zealand, on behalf of Horowhenua District Council, reviewed the results of this monitoring.

Quality Control and Assurance

- Workshop training for compliant sampling procedures was conducted in March 2018 for all sampling personnel.

Natural Background Groundwater

- Results from the background water samples appear to be showing impact from activities unrelated to the landfill operations.

Groundwater Quality Hydraulically Down-Gradient of the New Landfill

- Water quality from shallow bores located hydraulically down-gradient of the new landfill (D-series bores) were all below the ANZECC Livestock Drinking Water Trigger Values, and therefore comply with the resource consent conditions.
- Water quality from the deep bore located hydraulically down-gradient of new landfill (E1D) was below the DWSNZ, and therefore complies with the resource consent conditions.
- Leachate indicator parameters in samples from deep bore E1D is close to background concentrations.

Impact of Old Landfill on Groundwater

- Water quality from shallow bores located hydraulically down-gradient of the old landfill (B-series and C-series bores) were all below the ANZECC Livestock Drinking Water Trigger Values, and therefore comply with the resource consent conditions.
- There was one non-compliance with respect to the resource consent condition for the deep-water quality where the manganese concentration at bore C2DD was marginally above the DWSNZ MAV. The concentration of manganese at this bore is consistent with historical results and is representative of ground water quality in the area.
- Bores located immediately down-gradient hydraulically to the old unlined landfill show elevated concentrations of leachate indicators above background concentrations.
- The leachate plume appears to have a confined northwards radius and is not extending to the north-west and the north-east. The estimate of plume width is 300-500m, which has been used since 2014.

Groundwater Quality Down-Gradient of the Irrigation Area

- Water quality from shallow bores located immediately down-gradient of the leachate irrigation area were below the ANZECC Livestock Drinking Water Trigger Values, and therefore comply with the resource consent conditions.

Leachate Effluent

- Results from the leachate effluent sample are within the range of data obtained from previous rounds and are well below that recorded at typical Class 1 landfills.
- An increasing trend is noted in nitrate nitrogen and conductivity levels in bores located hydraulically up- and down-gradient of the leachate pond. It is recommended that further investigations be carried out to identify the possible cause (or causes) of the elevated levels.

Tatana's Property Drain (surface water sampling locations)

- Several sampling locations along the Tatana Property Drain recorded their highest nitrite, nitrate and pH concentrations since monitoring began. Close monitoring of these paramters during the January 2019 monitoring round is recommended to confirm if it is an anomaly or indicative of an increasing trend.
- The results obtained from samples where the Tatana's drain discharges into Hokio Stream did not show any impact from the discharge of the drain.

Hokio Stream (surface water sampling locations)

- Water quality from surface sampling along Hokio Stream was below the ANZECC Livestock Drinking Water Trigger Values, and therefore comply with the resource consent conditions.
- Current observations indicate that leachate from the landfill is not having a detrimental effect on the Hokio Stream.

Horowhenua District Council

Levin Landfill October 2018 Quarterly Report

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1. Introduction

Horowhenua District Council (HDC) commissioned Stantec New Zealand to carry out environmental reporting for the discharge consent monitoring around the Levin Landfill site. Monitoring is carried out every three months at 27 locations, as required under the resource consent conditions. There are 23 boreholes penetrating the sand and gravel aquifers, 3 surface water sampling locations and a leachate sampling point as shown in the Site Plan in Appendix A. In addition, HDC has agreed to undertake voluntary surface water monitoring at four locations along the Tatana's Property drain.

The Levin Landfill site is made up of two landfills, one old, closed and unlined landfill and the new, lined and active landfill. The new landfill footprint is being developed in stages. The current operational landfill area is Stage 3C which was developed in 2017.

The Levin Landfill site is located above two identified aquifers, a shallow sand aquifer and a deeper gravel aquifer. The shallow aquifer is considered to be unconfined, has a low to moderate permeability, and flows in a northerly direction. The deeper gravel aquifer is considered to be a confined to semi-confined aquifer. Horizons Regional Council hydrology staff advised that '*the general confined groundwater flow direction is towards the west*'. Groundwater quality in the area is highly variable because of interaction with peat deposits that are prevalent in the area, localised effects such as from grazing activities, droppings from scavenging birds and from nitrogen-fixing plants such as gorse.

Since July 2010 water from the boreholes has been tested for dissolved nutrients and metals rather than total concentrations. For simplicity, results from monitoring prior to July 2010 (which were tested for total metal and nutrient concentrations) have not been compared to the results from July 2010 onwards.

This report presents the results from the October 2018 monitoring round which have been compared with the Drinking Water Standards for New Zealand 2008 (DWSNZ), and the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 Livestock Drinking Water Trigger Values as per Discharge Consent 6010.

Note that the resource consent is currently under review and changes have been proposed to the consent conditions that define the environmental monitoring requirements. However, the outcome of the review hearing has been appealed and so the new consent conditions have not been finalised. Until this is done, the requirements of the existing consent conditions are being complied with.

2. Groundwater and Surface Water Monitoring

2.1 Sample Analysis

Samples were collected progressively by Downer between 2 and 17 October 2018. Collected samples were couriered overnight and analysed by Eurofin ELS Ltd in Lower Hutt, Wellington, the following day.

The sampling programme for 2017-2020 is summarised in the schedule in Appendix B. The timing of the samples is slightly different from that outlined in the consent, but this change has been approved by the Regional Council. The main difference is that annual comprehensive monitoring is now undertaken in the January sampling round rather than during the October monitoring round. Additional analysis for sodium and iron is undertaken on some groundwater samples for the monitoring requirements of the Stormwater Discharge Consent 102259.

Groundwater samples taken from the boreholes, surface water samples from Hokio Stream and the leachate effluent were analysed for the indicator suite of parameters which are outlined in Table 1-1. The Tatana's Property samples were analysed based on a specific parameter list agreed to by Horizons Regional Council as detailed in Section 2.7.

Table 1-1: Indicator Parameters

Type	Parameters
Characteristics	pH Electrical Conductivity (EC)
Oxygen demand	COD
Nutrients*	NO_3-N, NH_4-N
Metals*	Al, Fe**, Pb, Mn, Ni
Other elements	B, Cl, Na**

Note: *Analyses performed for nutrients and metals are for dissolved rather than total concentrations.
**Selected bores as per stormwater consent 102559 (see Appendix B)

2.2 Background Groundwater Quality

Water quality from the natural **background water up-gradient from the landfill site is not subjected to any consenting conditions**. However, for comparison purposes, both the ANZECC Livestock Drinking Water Trigger Values and the DWSNZ guidelines were used to benchmark the quality of water up-gradient from the landfill site.

Groundwater is collected from two background bores situated hydraulically up-gradient from both the new and old landfills to the southeast of the site (bores G1S and G1D, Site Plan, Appendix A). These two bores were constructed in late 2009 to sample background water quality from the two main hydrogeological units. The first sampling round from these two bores was in July 2010.

The results are presented in Table 1-2. Bore F3 is also included in the background table as it is near the south boundary of the landfill site but further west and is unlikely to be impacted by landfill activities. The full laboratory report is presented in Appendix C.

Table 1-2: Background Monitoring Results for October 2018

Determinant	Units	DWSNZ MAV	ANZECC STOCK	G1S	G1D	F3
Water level	mBGL			14.13	14.68	5.19
pH		7 to 8.5*	6 to 9	**6.2**	7.0	7.0
Conductivity	mS/m			129	29.6	21.5
COD	mg/L			61	28	*29.0*
Chloride	mg/L	250*		**300**	34.6	26.8
Nitrate-N	mg/L	11.3	90.3	0.26	*0.005*	0.97
Ammonia-N	mg/L	1.17		0.05	0.10	*0.005*
Sodium	mg/L	200*		136	34.4	22.0
Aluminium	mg/L	0.1*	5	0.018	0.003	*0.001*
Boron	mg/L	1.4	5	*0.015*	*0.015*	*0.015*
Iron	mg/L	0.2*		**9.4**	**0.22**	*0.005*
Lead	mg/L	0.01	0.1	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	0.4		0.212	0.0688	*0.00025*
Nickel	mg/L	0.08	1	0.0008	*0.00025*	*0.00025*

Note: *denotes guideline values for aesthetic determinants (G.V.). **Bold** – denotes an exceedance of the relevant DWSNZ (2008) standard. Underlined – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

The result in Table 1-2 indicate that all background bores (G1S, G1D and F3) are within the ANZECC guidelines.

There were some exceedances of the DWSNZ limits during the October 2018 monitoring round:

- pH in bore G1S was below the DWSNZ GV
- Chloride concentration in bore G1S was above the DWSNZ GV
- Iron concentration in bores G1S and G1D were above the DWSNZ GV.

2.3 Groundwater Quality Hydraulically Down-Gradient of the New Landfill

Monitoring is carried out within the two main hydrogeological units for bores hydraulically up-gradient of the old landfill and hydraulically down-gradient of the new landfill.

2.3.1 Shallow Aquifer

Bores D1, D2, D3(r), D4, D5, D6 and E1S (Refer to Site Plan, Appendix A) are located hydraulically up-gradient of the old landfill, but down-gradient of the new one. This means they are uninfluenced by potential leaching from the old landfill and can act as a warning system for any leaching from the new landfill. Borehole D4 is likely to show any leaching from the new landfill, while borehole D5 is unlikely to be influenced by either landfill. It is unlikely that leachate from the new landfill will significantly affect groundwater quality due to a leachate collection system which is in place in the new landfill, but these bores would give early warning of potential problems. Bore D5 is at the south western corner of the site so also indicates shallow background groundwater quality in that part of the site.

The results from the October 2018 monitoring round for these bores are presented in Table 1-3 along with the shallow background bore results (G1S). The results have been compared with the ANZECC Livestock Drinking Water Trigger Values as per the consent conditions. The full laboratory report is included in Appendix C.

There were no exceedances of the ANZECC Livestock Drinking Water Trigger Values during the October 2018 monitoring round and so the **results comply with the resource consent conditions**.

Table 1-3: D-Series and E1S Monitoring Bores for October 2018

Determinant	Units	ANZECC STOCK	D1	D2	D3(r)	D4	D5	D6	E1S	G1S
Water level	mBGL		16.615	21.235	4.62	7.985	9.665	16.21	11.235	14.13
pH		6 to 9	6.6	6.4	6.7	6.8	7.1	6.7	6.8	6.2
Conductivity	mS/m		60.2	38.2	24.3	34.4	31.1	45.5	26.9	129
COD	mg/L		37	58	40	20	*55.0*	45	*7.5*	61
Chloride	mg/L		36.6	44.9	22.2	58.0	32.2	28.8	35.6	300
Nitrate-N	mg/L	90.3	20.9	*0.005*	0.27	*0.005*	0.97	23.8	*0.005*	0.26
Ammonia-N	mg/L		*0.005*	0.47	0.17	0.24	*0.005*	*0.005*	0.21	0.05
Sodium	mg/L		44.9	31.6	23.3	35.6	27.6	40.9	28.2	136
Aluminium	mg/L	5	*0.001*	0.015	*0.001*	*0.001*	0.003	*0.001*	0.003	0.018
Boron	mg/L	5	*0.015*	*0.015*	*0.015*	0.04	*0.015*	0.05	*0.015*	*0.015*
Iron	mg/L		*0.005*	10.3	2.90	0.91	0.07	*0.005*	3.79	9.4
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0008	*0.00025*
Manganese	mg/L		*0.00025*	0.335	0.228	0.211	0.0203	*0.00025*	0.208	0.212
Nickel	mg/L	1	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	0.0008

Note: **Bold** – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

2.3.2 Deep Aquifer

Bores E1D, C2DD, E2D and G1D all penetrate the deeper gravel aquifer. Boreholes E2D and C2DD are located to the north-northwest of both the landfills. Borehole E1D is located to the southwest of the old landfill. Borehole G1D is located hydraulically up-gradient from both landfills and is assumed to represent background water quality. Deep groundwater flow is assumed to be towards the west and therefore E1D should also not be affected by leachate from the old landfill (refer to Site Plan, Appendix A).

Results for the October 2018 consent monitoring round are presented in Table 1-4. The results have been compared with the DWSNZ as per the discharge consent 6010. The full laboratory report is included in Appendix C.

Table 1-4: Monitoring Bores within the Deep Aquifer for October 2018

Determinant	Units	DWSNZ MAV	E1D	C2DD	E2D	G1D
Water level	mBGL		11.135	2.47	5.62	14.68
pH		7 to 8.5*	7.6	7.4	7.5	7.0
Conductivity	mS/m		45.5	51.1	35.2	29.6
COD	mg/L		38	47	41	28
Chloride	mg/L	250*	39.6	39.0	49.0	34.6
Nitrate-N	mg/L	11.3	*0.005*	*0.005*	*0.005*	*0.005*
Ammonia-N	mg/L	1.17	0.22	0.32	0.30	0.10
Sodium	mg/L	200*	37.3	40.6	32.5	34.4
Aluminium	mg/L	0.1*	*0.001*	0.006	*0.001*	0.003
Boron	mg/L	1.4	0.04	0.05	*0.015*	*0.015*
Iron	mg/L	0.2*	0.05	0.03	0.06	**0.22**
Lead	mg/L	0.01	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L	0.4	0.256	**0.580**	0.237	0.0688
Nickel	mg/L	0.08	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Faecal coliform	cfu/100ml	NIL	n/r	*2*	n/r	n/r

Note: * denotes guideline values for aesthetic determinants (G.V.). **Bold** – denotes an exceedance of the relevant DWSNZ (2008) standard. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. n/r – not required to be tested during this monitoring period.

There was **one exceedance of the resource consent conditions** in samples from the deep gravel aquifer during the October 2018 sampling round:

- Manganese concentration in bore C2DD exceeded the DWSNZ MAV.

2.4 Impact of Old Unlined Landfill on Groundwater Quality

Water sampling is carried out to characterise the groundwater quality in a series of shallow bores situated hydraulically down-gradient from the old unlined landfill. The series B boreholes are located within 50m of the old landfill in a line along its northern edge. The series C boreholes are located further down the hydraulic gradient from the old landfill towards Hokio Beach Road to detect whether leachate is moving off site. Borehole E2S is located northwest of the old landfill to detect any leachate moving directly towards the nearest house down-stream of the site. Bore G2S was installed in late 2009 and is located to the north of the landfill site, hydraulically down-gradient of the old landfill by Hokio Road and the entrance road to the landfill (See Site Plan, Appendix A).

The results from the October 2018 consent monitoring round for these bores are presented in Table 1-5 and have been compared with the ANZECC Livestock Drinking Water Trigger Values as per the discharge consent 6010. The full laboratory report is included in Appendix C.

There were no exceedances of the ANZECC Livestock Drinking Water Trigger Values during the October 2018 monitoring round and so the **results comply with the resource consent conditions**.

Table 1-5: Results from Shallow Boreholes Down-Gradient from the Old Landfill for October 2018

Determinant	Units	ANZECC STOCK	E2S	B1	B2	B3	C1	C2	C2DS	G2S
Water level	mBGL		4.665	0.96	1.3	0.15	0.12	0.33	2.2	2.26
pH		6 to 9	7.4	6.9	7.0	6.8	6.7	6.8	6.6	6.7
Conductivity	mS/m		44.6	181	151	319	132	324	231	131
COD	mg/L		*7.5*	71	81	310	51	145	115	60
Chloride	mg/L		42.0	366	90.6	238	239	366	142	160
Nitrate-N	mg/L	90.3	*0.005*	4.32	18.4	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Ammonia-N	mg/L		0.26	11.9	32.6	185	0.27	174	1.18	*0.005*
Sodium	mg/L		45.0	150	122	178	145	230	166	178
Aluminium	mg/L	5	*0.001*	0.004	0.018	0.004	0.007	0.006	*0.001*	0.004
Boron	mg/L	5	0.04	0.41	0.78	0.89	0.48	1.60	0.79	0.73
Iron	mg/L		0.09	0.02	0.09	1.11	4.50	0.48	17.1	0.05
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L		0.406	9.85	2.06	2.68	0.388	0.0923	4.53	0.0586
Nickel	mg/L	1	*0.00025*	0.0016	0.0027	0.0131	0.0010	0.0054	0.0037	0.0040

Note: **Bold** – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics. n/a = no dipped levels recorded by sampler.

2.5 Groundwater Quality Down-Gradient of the Irrigation Area

The F-series boreholes sample from the shallow aquifer down-gradient to the leachate irrigation area. The F1 borehole is in the area where leachate from the new landfill was irrigated during the period 2004 to October 2008. F2 and F3 boreholes are in areas previously considered for future leachate irrigation. All leachate is now pumped to the Levin Wastewater Treatment Plant. The shallow groundwater at the irrigation area was also compared to that from the background bore (G1S).

The results from the F series boreholes are presented in Table 1-6 and have been compared with the ANZECC Livestock Drinking Water Trigger Values as per the discharge consent 6010. The full laboratory report is included in Appendix C.

Table 1-6: Results from the Irrigation Area for October 2018

Determinant	Units	ANZECC STOCK	F1	F2	F3	G1S
Water level	mBGL		7.71	2.74	5.19	14.13
pH		6 to 9	6.8	7.0	7.0	6.2
Conductivity	mS/m		50.6	22.8	21.5	129
COD	mg/L		40	33	*29.0*	61
Chloride	mg/L		74.0	24.9	26.8	300
Nitrate-N	mg/L	90.3	1.96	1.00	0.97	0.26
Ammonia-N	mg/L		*0.005*	*0.005*	*0.005*	0.05
Sodium	mg/L		41.5	28.2	22.0	136
Aluminium	mg/L	5	0.003	0.003	*0.001*	0.018
Boron	mg/L	5	*0.015*	*0.015*	*0.015*	*0.015*
Iron	mg/L		*0.005*	0.01	*0.005*	9.4
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L		0.0028	0.0036	*0.00025*	0.212
Nickel	mg/L	1	*0.00025*	*0.00025*	*0.00025*	0.0008

Note: **Bold** – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

There were no exceedances of the ANZECC Livestock Drinking Water Trigger Values during the October 2018 monitoring round and so the **results comply with the resource consent conditions**.

2.6 Leachate Effluent Results

The sampling result for leachate effluent is **not subjected to any water quality consenting conditions**. However, for comparison purposes, typical leachate characteristics for landfills published by the Waste Management Institute New Zealand (*Technical Guidelines for Disposal to Land*, August 2018, WasteMINZ) have been compared against the leachate quality (Table 1-7). The full laboratory report is included in Appendix C.

Table 1-7: Results from Leachate Effluent for October 2018

Determinant	Units	Typical Leachate Characteristics* (range)	Leachate Effluent
pH		5.9 - 8.5	7.8
Conductivity	mS/m	264 - 27900	1290
COD	mg/L	84 - 5090	2220
Chloride	mg/L		834
Nitrate-N	mg/L	0.1 - 50*	*0.05*
Ammonia-N	mg/L		1140
Sodium	mg/L	50 - 4000*	799

Determinant	Units	Typical Leachate Characteristics* (range)	Leachate Effluent
Aluminium	mg/L		0.461
Boron	mg/L		5.50
Iron	mg/L	1.6 – 220	4.10
Lead	mg/L	0.001 - 0.42	0.0019
Manganese	mg/L	0.3 - 65*	0.893
Nickel	mg/L	20 - 2050*	0.0952

Note: Data taken from Table 5-5, p82 for Class 1-type landfills, Technical Guidelines for Disposal to Land, WasteMINZ August 2018. *Data taken from Table 5-4, p81 of the same guideline.

The October 2018 monitoring round results for the leachate effluent were with the typical leachate composition range for Class 1 landfills published in the WasteMINZ 2018 Technical Guidelines for Disposal to Land.

2.7 Tatana's Property Drain

Four sampling points were selected to represent upstream (SW1), midstream (SW2 and SW3) and downstream (SW4) flows at the Tatana property (see Site Plan in Appendix A). Results from the October 2018 sampling round are presented in Table 1-8 and have been compared with the ANZECC Livestock Drinking Water Trigger Values because the water is most reflective of shallow groundwater. **Results from the Tatana's Property drain sampling points are presently not subjected to any consenting conditions.**

Table 1-8: Tatana's Drain Results for October 2018

Determinant	Units	ANZECC STOCK	SW1	SW2	SW3	SW4
pH		6 to 9	7.2	8.0	7.4	7.4
Total Suspended Solids	mg/L		254	26	8	13
Conductivity	mS/m		212	155	83.1	78.3
COD	mg/L		228	186	152	140
Total Kjeldahl Nitrogen	mg/L		77.4	30.1	9.5	8.4
BOD5-Total	mg/L		87	17	12	*3*
Chloride	mg/L		229	177	103	93.3
Nitrite-N	mg/L		0.16	0.43	0.25	0.12
Nitrate-N	mg/L	90.3	2.44	8.67	3.63	1.89
Ammonia-N	mg/L		73.2	27.1	7.6	6.4
Total-N	mg/L		82.2	41.2	13.1	9.71
Iron	mg/L		0.74	0.47	0.45	0.43
Manganese	mg/L		0.586	0.532	0.284	0.528

Note: **Bold** – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

For comparison purposes, the suite of parameters tested complies with the ANZECC Livestock Drinking Water Trigger Values and therefore meets the resource consent requirements for quality of shallow groundwater near Levin Landfill.

2.8 Hokio Stream

Stream monitoring is carried out by grab sampling at sites HS1, HS2 and HS3 (refer to Appendix A) to investigate if groundwater containing leachate is having an adverse environmental impact on the stream. Site HS1 is situated up-stream of the old landfill, HS2 is situated alongside the old landfill and up-stream of the Tatana's Property Drain discharge, and HS3 is located approximately 50m down-stream of the landfill site property boundary and the Tatana's Property Drain discharge. Indicator parameter analysis, as required in the monitoring schedule, is done every six months.

Results from the October 2018 sampling round are presented in Table 1-9 and have been compared with the ANZECC Livestock Drinking Water Trigger Values as per the discharge consent 6010.

Table 1-9: Hokio Stream Results for October 2018

Determinant	Units	ANZECC STOCK	HS1	HS2	HS3
pH		6 to 9	7.7	7.5	7.4
Conductivity	mS/m		24.5	26.1	26.2
COD	mg/L		100	92	82
Chloride	mg/L		22.9	25.3	25.5
Nitrate-N	mg/L	90.3	1.32	1.32	1.34
Ammonia-N	mg/L		0.06	0.14	0.13
Sodium	mg/L		19.1	20.6	20.9
Aluminium	mg/L	5	0.011	0.012	0.013
Boron	mg/L	5	0.05	0.06	0.05
Iron	mg/L		0.05	0.06	0.06
Lead	mg/L	0.1	*0.00025*	*0.00025*	*0.00025*
Manganese	mg/L		0.0259	0.0466	0.0494
Nickel	mg/L	1	*0.00025*	*0.00025*	*0.00025*

Note: **Bold** – denotes an exceedance of the ANZECC Livestock Drinking Water Trigger Values. All `<' values have been reported as half the detection limit for statistical purposes and are expressed in italics.

There were no exceedances of the ANZECC Livestock Drinking Water Trigger Values in samples from the Hokio Stream monitoring during the October 2018 monitoring round and so the **results comply with the resource consent conditions**.

3. Discussion

3.1 Sampling Quality Control and Assurance

A sampling quality control workshop was conducted by Stantec in March 2018 to assist staff members to comply with standard sampling and recording protocols. The workshop was attended by HDC and Downers staff members involved in water quality monitoring.

3.2 Background Groundwater Quality

Water quality from the natural background water up-gradient from the landfill site is not subjected to any consenting conditions.

Results since 2010 from the background bores indicate that low pH values are representative of background water quality in the shallow sand aquifer (G1S). The deeper gravel aquifer (G1D) has pH levels that are slightly higher but occasionally dip below the DWSNZ lower guideline of 7.

Iron concentrations have fluctuated considerably at both the G1S and G1D bores since monitoring began and is occasionally above the DWSNZ GV. During the October 2018 sampling round, iron concentration at G1S and G1D were 9.4mg/L and 0.22mg/L respectively, higher than the DWSNZ GV of 0.2mg/L but within the historical result ranges recorded at these bores. Elevated iron concentrations in groundwater is likely to be related to hydrogeological conditions found at the site and are common in groundwater in this area.

Chloride concentrations have also fluctuated considerably at the G1S bore and are occasionally above the DWSNZ GV. During the October 2018 sampling round, chloride concentration at G1S was 300mg/L, higher than the DWSNZ GV of 250 mg/L but within the historical result range recorded at this bore.

The recent monitoring result suggests that the background groundwater is being impacted by local ground conditions and/or activities up-gradient of the landfill.

3.3 Shallow Aquifer Groundwater Quality

3.3.1 Hydraulically Up-gradient from the Old landfill

Sampling results from the October 2018 monitoring round show that water quality from the shallow monitoring bores hydraulically up-gradient from the old landfill complies with the discharge consent conditions

In general, historical trends of leachate indicators chloride, boron and ammoniacal nitrogen in the D-series and E1S bores are like the concentrations in the background bore G1S. However, nitrate nitrogen is elevated in bores D1 and D6 when compared to background (G1S) as shown in

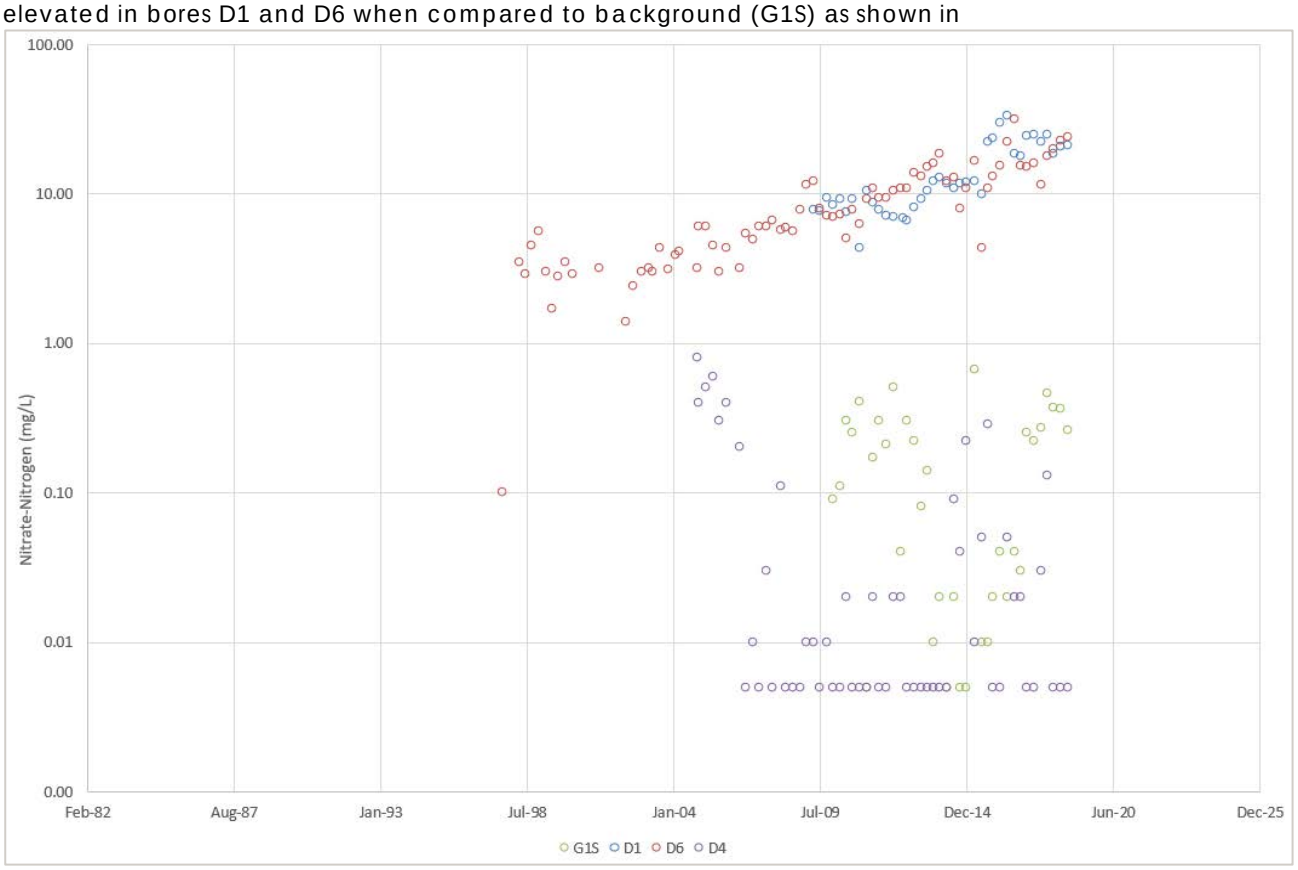


Figure 1-1 and has appeared to be increasing in recent sampling rounds. These bores are both located down gradient of the new landfill, with bore D1 located hydraulically up-gradient of the leachate effluent pond and bore D6 located down gradient of the leachate pond. Other leachate indicators such as boron, chloride and ammoniacal nitrogen are all consistent with background concentrations and historical record.

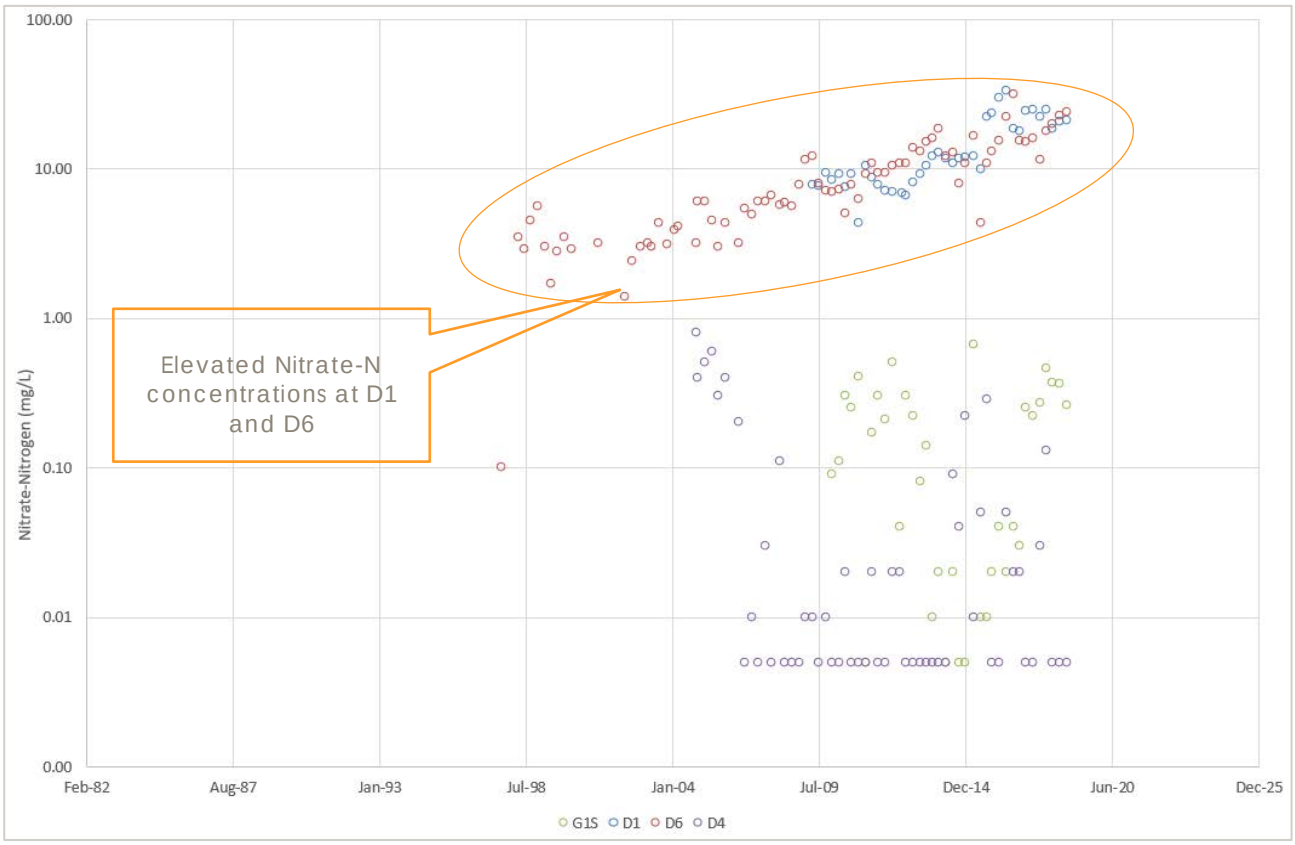


Figure 1-1: Nitrate Nitrogen Concentration in the D-Series Bores

Ammoniacal nitrogen is not elevated in either of these bores; however, conductivity also shows an increasing trend in recent sampling rounds. In previous quarterly reports, it was recommended that further investigations be carried out to identify the possible cause (or causes) of the elevated levels of nitrate nitrogen and conductivity in bores D1 and D6.

Such investigations should include for regular monitoring of groundwater levels to be undertaken in all the bores monitored for the 2018-2019 monitoring period so that groundwater flow and the depth of the unsaturated zone can be assessed. This will enable more conclusions to be drawn as to the source of the elevated nitrate nitrogen and conductivity values.

3.3.2 Irrigation area

Sampling results from all shallow bores located hydraulically down-gradient of the irrigation area (F series bores) is consistent with historical results and complies with the discharge consent conditions.

Historical trends of leachate indicators chloride, boron and ammoniacal nitrogen in the F-series bores are generally stable and did not show any indication of an increasing trend.

3.3.3 Hydraulically Down-gradient from the Old landfill

Sampling results from the shallow bores located hydraulically down-gradient of the old landfill complies with the discharge consent conditions (ANZECC Livestock Drinking Water Trigger Values).

Historical trends of leachate indicators in these bores show some elevation in the concentration of ammoniacal nitrogen above the background bore (G1S), particularly in bore C2. However, the concentration of ammoniacal nitrogen remains much lower than the shallow bores screened within the leachate plume and therefore it appears that the leachate plume from the old landfill is having a minimal effect on deeper groundwater.

Bores C1 and G2S are located down gradient of the old landfill to the east. These bores have consistently recorded low concentrations of ammoniacal nitrogen, with G2S often recording concentrations below detection limit. These bores are likely to be located beyond the eastern edge of the leachate plume.

Bores B1, B2, B3 and C2 all appear to be located and screened within the leachate plume and have significantly elevated concentrations of ammoniacal nitrogen. All four bores are plotted in Figure 1-2 below, along with the background bore, G1S. It is noted that the concentration of ammoniacal nitrogen in

bore C2 has been increasing since 2009. It is possible that the leachate plume has shifted resulting in the different spatial pattern from five years ago. The regular monitoring of the groundwater levels in the bores over the 2018-2019 monitoring period will allow further conclusions to be drawn in the next annual report.

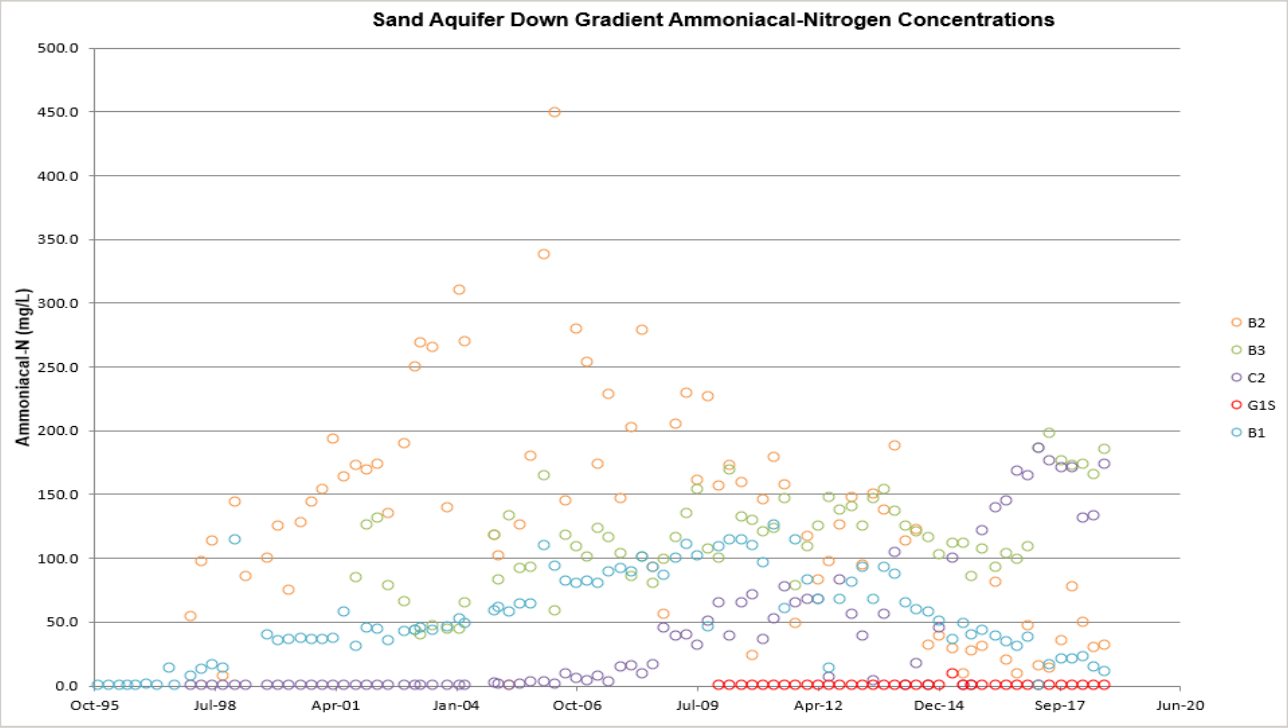


Figure 1-2: Shallow Bores Screened in the Leachate Plume

Given the apparent shift in the leachate plume, it is appropriate to assess the overall trend for all bores located and screened in the leachate plume. The overall trend indicates that the concentration of ammoniacal nitrogen has been declining over time since 2006. Other key leachate indicators, boron, conductivity and chloride are also all elevated within the bores that are located and screened in the leachate plume as would be expected.

The leachate plume appears to have a confined radius northward and is not extending to the north-west and the north-east. The estimate of plume width is 300-500m, which has been used since 2014.

3.4 Deep Aquifer Groundwater Quality

There was one exceedance to the resource consent condition for the deep gravel aquifer during the October 2018 sampling round where the manganese concentration at C2DD exceeded the DWSNZ MAV. Manganese concentration at C2DD (0.580mg/L) was however consistent with historical results and representative of ground water quality in the area.

3.5 Leachate Effluent

Monitoring results from the leachate effluent samples are not required to meet either the ANZECC or DWSNZ standards. Results from the October 2018 monitoring round were all within the typical leachate composition range for Class 1 landfills published in the WasteMINZ 2018 Technical Guidelines for Disposal to Land.

3.6 Tatana's Property Drain

Monitoring results from the Tatana's Property drain samples are not required to meet either the ANZECC or DWSNZ standards.

Historical results indicate concentrations of COD, TKN, chloride, ammonia-N, nitrate and Total-N to fluctuate significantly, particularly at the upstream end of Tatana's drain. This implies localised impact upstream of the drain, possibly from farming activities, but also from the shallow groundwater.

During the October 2018 sampling period, there were several locations that recorded the highest concentrations since monitoring began in 2015:

- Nitrite concentration at SW1(0.16mg/L), SW2 (0.43mg/L), SW3 (0.25mg/L) and SW4 (0.12mg/L),
- Nitrate concentration at SW1 (2.44mg/L) and SW2 (8.67mg/L), and
- pH at SW2 (pH 8).

Nitrate concentrations decreased along the drain (SW3, 3.63mg/L) and was at 1.89mg/L prior to discharge to the Hokio Stream (SW4). pH level was 7.4 at SW4.

Close monitoring of nitrite, nitrate and pH concentrations during the January 2019 monitoring round is recommended to confirm if it is an anomaly or indicative of an increasing trend.

The results obtained from samples where the Tatana's drain discharges into Hokio Stream did not show any impact from the discharge of the drain.

3.7 Hokio Stream

Sampling results at Hokio Stream during the October 2018 sampling round complies with the discharge consent conditions (ANZECC Livestock Drinking Water Trigger Values).

Historical results indicate concentrations of COD, chloride, nitrate, ammonia-N, sodium and manganese to fluctuate, particularly at the upstream of the Hokio Stream sampling location (HS1). This implies localised impact upstream of the landfill site, possibly from farming activities. The October 2018 results are consistent with historical results.

Current observations indicate that leachate from the landfill is not having an adverse environmental effect on the Hokio Stream.

3.8 Consent Compliance

Discharge permit 6010 states that quarterly and annual monitoring results should comply with the ANZECC Livestock Drinking Water Trigger Values in the shallow groundwater aquifer (sand aquifer) and surface water bodies. Samples from the deep groundwater (gravel aquifer) should comply with DWSNZ. Should any parameters be more than these guidelines, the permit holder shall report to the Regional Council as soon as practicable on the significance of the results and, where the change can be attributed to landfill leachate, consult with the Regional Council to determine if further investigation or remedial measures are required.

Shallow sand aquifer

There were **no exceedances** of the resource consent conditions during the October 2018 sampling round.

Deeper gravel aquifer

There was **one exceedance** of the resource consent conditions in samples from the deep gravel aquifer during the October 2018 sampling round:

- Manganese concentration in bore C2DD exceeded the DWSNZ MAV.

Hokio stream

There were **no exceedances** of the resource consent conditions during the October 2018 sampling round monitoring the Hokio Stream:

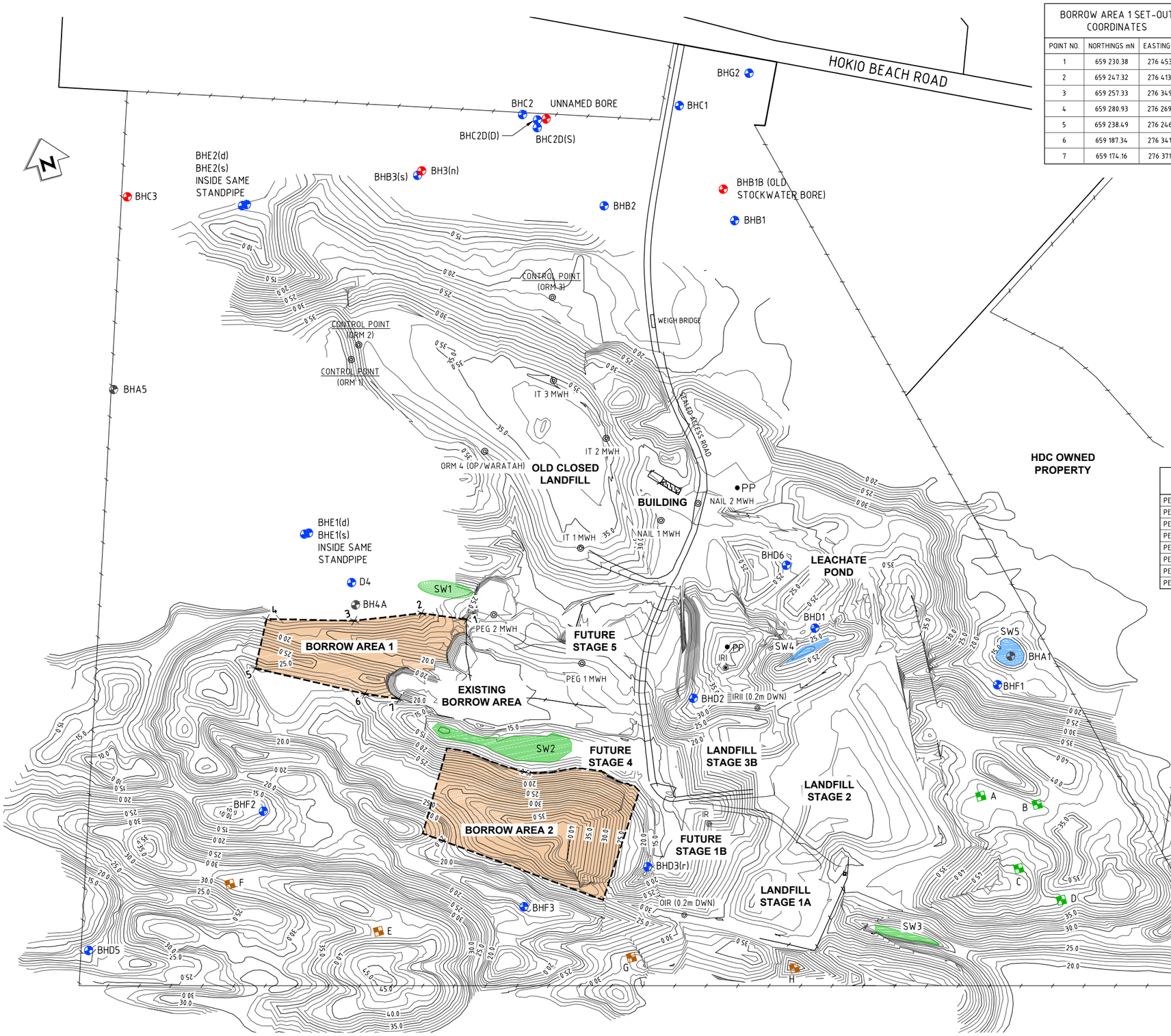
4. Conclusions

Current monitoring results suggests that the background groundwater is being impacted by local ground conditions, the old unlined landfill and/or activities up-gradient of the landfill.

During the October 2018 monitoring period there was one exceedance of the resource consent conditions.

Appendices

Appendix A Site Plans



DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A1

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	659 187.34	276 341.04
7	659 174.16	276 371.33

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	276 022.4	20.50	17.0		SHALLOW AQUIFER
D5	659 020.80	276 356.60	17.8	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						

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

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	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

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

FOR INFORMATION ONLY

REV	REVISIONS	DRN	CHK	APP	DATE
A	FOR INFORMATION	BCJ	PSL	PEL	17.10.17

SURVEYED	MWH	
DESIGNED	N/A	-
DRAWN	Brent James	10.2017
CAD REVIEW	Brent James	16.10.17
DESIGN CHECK	Matthew Chung	16.10.17
DESIGN REVIEW	Phil Landmark	16.10.17
APPROVED	Phil Landmark	16.10.17
PROF REGISTRATION:		

MWH

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: 17.10.17
Scales:
Drawing No.: 80500724-17-001-G001
Rev.: A

pw:\\asiavpwint04.mwhglobal.com:AP_PROJECTS\Documents\New Zealand Clients\Horowhenua District Council\80500724 - Levin Landfill Volumes\2017\General\80500724-17-001-G001

Hokio Stream (“HS”) and Tatana’s Property Drain (“SW”) Monitoring Locations

Appendix B Sampling Schedule

LEVIN LANDFILL - SUMMARY OF SURFACE AND GROUNDWATER MONITORING REQUIREMENTS (July 2017 - April 2020).

(The testing regime is based on Consent Conditions following the May 2010 Resource Consent Review. It takes no account of changes proposed for the 2016/2017 Review, or of the additional testing done by HDC on adjoining Tatana Property

Reports		Month	Table A (Condition 3, DP 6010)				Table B (Condition 3, DP 6010)																			Table C (Condition 3, DP 6010)			
			Deep Aquifer Bores*				Shallow Aquifer Bores*														Irrigation Bores*				Hokio Stream			Leachate Pond
Annual	Quarterly		C2dd	E1d	E2d	G1d	C1	C2	C2ds	D4	B1	B2	B3s	E1s	E2s	D1#	D2#	D3r#	D6#	G1s	G2s	D5@	F1@	F2@	F3@	HS1	HS2	HS3	
☑	☑	**Jul-17**	I + FC	I + SW	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 + SW	C	C	C	C
	☑	**Oct-17**	I + FC	I + SW	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 + SW	I	I	I	I
	☑	**Jan-18**	C	C	C	C	C	C + A	C + A	C	C + A	C + A	C + A	C	C	C	C	C	C	C	C + A	C	C	C	C	C	C	C	C + A
	☑	**Apr-18**	I + FC	I + SW	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 + SW	I	I	I	I
☑	☑	**Jul-18**	I + FC	I + SW	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 + SW	C	C	C	C
	☑	**Oct-18**	I + FC	I + SW	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 + SW	I	I	I	I
	☑	**Jan-19**	C	C	C	C	C	C + A	C + A	C	C + A	C + A	C + A	C	C	C	C	C	C	C	C + A	C	C	C	C	C	C	C	C + A
	☑	**Apr-19**	I + FC	I + SW	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 + SW	I	I	I	I
☑	☑	**Jul-19**	I + FC	I + SW	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 + SW	C	C	C	C
	☑	**Oct-19**	I + FC	I + SW	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 + SW	I	I	I	I
	☑	**Jan-20**	C	C	C	C	C	C + A	C + A	C	C + A	C + A	C + A	C	C	C	C	C	C	C	C + A	C	C	C	C	C	C	C	C + A
	☑	**Apr-20**	I + FC	I + SW	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 + SW	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 3a of DP 6011)

Notes:

C Comprehensive list see below
I Indicator list see below
A Additional VOC and SVOC analysis
SW Add sodium and iron analysis (for stormwater consent 102559)
FC Add faecal coliform test
* Additional parameters (pesticides and semi-VOC) to be analysed for if any leachate indicator parameters show leachate influence over 3 consecutive sampling rounds (Table B, Condition 3 of DP 6010).
@ 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) .

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.

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 - F, 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.

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

I. Completion of the initial 2 year monitoring program;
J. Good consistency of water sample analysis results, or a clearly identified reason for inconsistent results that excludes the contaminant source being landfill operations, stored waste or leachate;
K. No decline in water quality between monitoring sites HS1 and HS3 as determined from indicator parameter trends over a period of four consecutive sampling rounds;
L. If the Hokio Stream monitoring locations are being sampled on a conditional frequency and become non-compliant with condition K, the monitoring frequency for all three monitoring locations should return to the base case intensive monitoring until conditions J and K are again being fulfilled.

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 BOD
Nutrients*	NO3-N, NH4-N, DRP and SO_4
Metals*	Al, As, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn
Other elements	B, Ca, Cl, K and Na
Organics	Total organic carbon, total phenols, volatile acids
Biological	Faecal coliforms

* 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
Nutrients*	NO3-N and NH4-N
Metals*	AL, Mn, Ni and Pb
Other elements	B and Cl

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

Appendix C Analytical Results

eurofins | ELS

Eurofins ELS Limited

Analytical Report

Downer EDI Levin - Landfill
P O Box 642
LEVIN 5540
Attention: Bruce Marshall

Report Number: 18/36572
Issue: 1
30 October 2018

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-01	Levin B1		17/10/2018 00:00	17/10/2018 16:37	0

Notes: 78860-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.9		Jennifer Mont KTP
0055	Conductivity at 25°C	181	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	71	g/m³	Gordon McArthur KTP
0602	Chloride	366	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	4.32	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	11.9	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.004	g/m³	Tracy Morrison KTP
6707	Boron - Dissolved	0.41	g/m³	Tracy Morrison KTP
6717	Iron - Dissolved	0.02	g/m³	Tracy Morrison KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Tracy Morrison KTP
6721	Manganese - Dissolved	9.85	g/m³	Tracy Morrison KTP
6724	Nickel - Dissolved	0.0016	g/m³	Tracy Morrison KTP
6731	Sodium - Dissolved	150	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-02	Levin Leachate Pond		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.8		Gordon McArthur KTP
0055	Conductivity at 25°C	1,290	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	2,220	g/m³	Marylou Cabral KTP
0602	Chloride	834	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.10	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	1,140	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.461	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	5.50	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	4.10	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	0.0019	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.893	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0952	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	799	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-03	Levin B2		17/10/2018 00:00	17/10/2018 16:37	0

Notes: 78873-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Jennifer Mont KTP
0055	Conductivity at 25°C	151	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	81	g/m³	Gordon McArthur KTP
0602	Chloride	90.6	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	18.4	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	32.6	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.018	g/m³	Tracy Morrison KTP
6707	Boron - Dissolved	0.78	g/m³	Tracy Morrison KTP
6717	Iron - Dissolved	0.09	g/m³	Tracy Morrison KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Tracy Morrison KTP
6721	Manganese - Dissolved	2.06	g/m³	Tracy Morrison KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-03	Levin B2		17/10/2018 00:00	17/10/2018 16:37	0

Notes: 78873-0 Levin Landfill

	Test	Result	Units	Signatory
6724	Nickel - Dissolved	0.0027	g/m³	Tracy Morrison KTP
6731	Sodium - Dissolved	122	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-04	Levin B3s		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78874-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	319	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	310	g/m³	Marylou Cabral KTP
0602	Chloride	238	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	185	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.004	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.89	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	1.11	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	2.68	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0131	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	178	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-05	Levin C1		17/10/2018 00:00	17/10/2018 16:37	0

Notes: 78875-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Jennifer Mont KTP
0055	Conductivity at 25°C	132	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	51	g/m³	Gordon McArthur KTP
0602	Chloride	239	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.27	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.007	g/m³	Tracy Morrison KTP
6707	Boron - Dissolved	0.48	g/m³	Tracy Morrison KTP
6717	Iron - Dissolved	4.50	g/m³	Tracy Morrison KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Tracy Morrison KTP
6721	Manganese - Dissolved	0.388	g/m³	Tracy Morrison KTP
6724	Nickel - Dissolved	0.0010	g/m³	Tracy Morrison KTP
6731	Sodium - Dissolved	145	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-06	Levin C2		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78876-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	324	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	145	g/m³	Marylou Cabral KTP
0602	Chloride	366	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	174	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.006	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	1.60	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.48	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0923	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0054	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-06	Levin C2		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78876-0 Levin Landfill

	Test	Result	Units	Signatory
6731	Sodium - Dissolved	230	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-07	Levin C2dd		10/10/2018 00:00	10/10/2018 14:33	0

Notes: 78877-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Gordon McArthur KTP
0055	Conductivity at 25°C	51.1	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	47	g/m³	Marylou Cabral KTP
0602	Chloride	39.0	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.32	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.006	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.03	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.580	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	40.6	g/m³	Shanel Kumar KTP
M0102	Faecal Coliforms	< 4	cfu/100ml	Maria Norris KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-08	Levin C2ds		17/10/2018 00:00	17/10/2018 16:37	0

Notes: 78878-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.6		Jennifer Mont KTP
0055	Conductivity at 25°C	231	mS/m	Jennifer Mont KTP
0081	Chemical Oxygen Demand	115	g/m³	Gordon McArthur KTP
0602	Chloride	142	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	1.18	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Tracy Morrison KTP
6707	Boron - Dissolved	0.79	g/m³	Tracy Morrison KTP
6717	Iron - Dissolved	17.1	g/m³	Tracy Morrison KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Tracy Morrison KTP
6721	Manganese - Dissolved	4.53	g/m³	Tracy Morrison KTP
6724	Nickel - Dissolved	0.0037	g/m³	Tracy Morrison KTP
6731	Sodium - Dissolved	166	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-09	Levin D1		11/10/2018 00:00	12/10/2018 09:56	0

Notes: 78879-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.6		Gordon McArthur KTP
0055	Conductivity at 25°C	60.2	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	37	g/m³	Marylou Cabral KTP
0602	Chloride	36.6	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	20.9	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-09	Levin D1		11/10/2018 00:00	12/10/2018 09:56	0

Notes: 78879-0 Levin Landfill

	Test	Result	Units	Signatory
6731	Sodium - Dissolved	44.9	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-10	Levin D2		11/10/2018 00:00	12/10/2018 09:56	0

Notes: 78880-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.4		Gordon McArthur KTP
0055	Conductivity at 25°C	38.2	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	58	g/m³	Marylou Cabral KTP
0602	Chloride	44.9	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.47	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.015	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	10.3	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.335	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	31.6	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-11	Levin D3r		11/10/2018 00:00	12/10/2018 09:56	0

Notes: 78881-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Gordon McArthur KTP
0055	Conductivity at 25°C	24.3	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	40	g/m³	Marylou Cabral KTP
0602	Chloride	22.2	g/m³	Amit Kumar KTP
0605	Nitrate - Nitrogen	0.27	g/m³	Amit Kumar KTP
0760	Ammonia Nitrogen	0.17	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	2.90	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.228	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	23.3	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-12	Levin D4		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78882-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	34.4	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	20	g/m³	Marylou Cabral KTP
0602	Chloride	58.0	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.24	g/m³	Tracy Morrison KTP
1819	Iron - Dissolved	0.830	g/m³	Shanel Kumar KTP
1834	Sodium - Dissolved	35.2	g/m³	Shanel Kumar KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.91	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.211	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-12	Levin D4		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78882-0 Levin Landfill

	Test	Result	Units	Signatory
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	35.6	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-13	Levin D5		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.1		Gordon McArthur KTP
0055	Conductivity at 25°C	31.1	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	55	g/m³	Marylou Cabral KTP
0602	Chloride	32.2	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.97	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.07	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0203	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	27.6	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-14	Levin D6		11/10/2018 00:00	12/10/2018 09:56	0

Notes: 78884-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Gordon McArthur KTP
0055	Conductivity at 25°C	45.5	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	45	g/m³	Marylou Cabral KTP
0602	Chloride	28.8	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	23.8	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	40.9	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-15	Levin E1d		10/10/2018 00:00	11/10/2018 14:35	0

Notes: 78885-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.6		Gordon McArthur KTP
0055	Conductivity at 25°C	45.5	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	38	g/m³	Marylou Cabral KTP
0602	Chloride	39.6	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.22	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.256	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-15	Levin E1d		10/10/2018 00:00	11/10/2018 14:35	0

Notes: 78885-0 Levin Landfill

	Test	Result	Units	Signatory
6731	Sodium - Dissolved	37.3	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-16	Levin E1s		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78886-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	26.9	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Marylou Cabral KTP
0602	Chloride	35.6	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.21	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	3.79	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	0.0008	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.208	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	28.2	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-17	Levin E2d		10/10/2018 00:00	11/10/2018 14:35	0

Notes: 78887-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.5		Gordon McArthur KTP
0055	Conductivity at 25°C	35.2	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	41	g/m³	Marylou Cabral KTP
0602	Chloride	49.0	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.30	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.06	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.237	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	32.5	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-18	Levin E2s		15/10/2018 00:00	16/10/2018 10:04	0

Notes: 78888-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Gordon McArthur KTP
0055	Conductivity at 25°C	44.6	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	< 15	g/m³	Marylou Cabral KTP
0602	Chloride	42.0	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.26	g/m³	Tracy Morrison KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.04	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.09	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.406	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	45.0	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-19	Levin F1		10/10/2018 00:00	10/10/2018 14:33	0

Notes: 78889-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.8		Gordon McArthur KTP
0055	Conductivity at 25°C	50.6	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	40	g/m³	Marylou Cabral KTP
0602	Chloride	74.0	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	1.96	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0028	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	41.5	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-20	Levin F2		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Gordon McArthur KTP
0055	Conductivity at 25°C	22.8	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	33	g/m³	Marylou Cabral KTP
0602	Chloride	24.9	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	1.00	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0036	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	28.2	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-21	Levin F3		10/10/2018 00:00	10/10/2018 14:33	0

Notes: 78891-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Gordon McArthur KTP
0055	Conductivity at 25°C	21.5	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	29	g/m³	Marylou Cabral KTP
0602	Chloride	26.8	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.97	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	< 0.002	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	< 0.01	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	22.0	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-22	Levin G1S		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.2		Gordon McArthur KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-22	Levin G1S		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0055	Conductivity at 25°C	129	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	61	g/m³	Marylou Cabral KTP
0602	Chloride	300	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.26	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.05	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.018	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	9.41	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.212	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0008	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	136	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-23	Levin G1D		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.0		Gordon McArthur KTP
0055	Conductivity at 25°C	29.6	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	28	g/m³	Marylou Cabral KTP
0602	Chloride	34.6	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.10	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.003	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	< 0.03	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.22	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0688	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	34.4	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-24	Levin G2s		09/10/2018 00:00	10/10/2018 08:50	0

Notes: 78861-0Levin Landfill

	Test	Result	Units	Signatory
0001	pH	6.7		Gordon McArthur KTP
0055	Conductivity at 25°C	131	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	60	g/m³	Marylou Cabral KTP
0602	Chloride	160	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	< 0.01	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	< 0.01	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.004	g/m³	Shanel Kumar KTP
6707	Boron - Dissolved	0.73	g/m³	Shanel Kumar KTP
6717	Iron - Dissolved	0.05	g/m³	Shanel Kumar KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Shanel Kumar KTP
6721	Manganese - Dissolved	0.0586	g/m³	Shanel Kumar KTP
6724	Nickel - Dissolved	0.0040	g/m³	Shanel Kumar KTP
6731	Sodium - Dissolved	178	g/m³	Shanel Kumar KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-25	Levin HS1		02/10/2018 00:00	02/10/2018 16:24	0

Notes: 78895-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.7		Jennifer Mont KTP
0055	Conductivity at 25°C	24.5	mS/m	Gordon McArthur KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-25	Levin HS1		02/10/2018 00:00	02/10/2018 16:24	0

Notes: 78895-0 Levin Landfill

	Test	Result	Units	Signatory
0081	Chemical Oxygen Demand	100	g/m³	Gordon McArthur KTP
0602	Chloride	22.9	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	1.32	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.06	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.011	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	0.05	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	0.05	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.0259	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	19.1	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-26	Levin HS3		02/10/2018 00:00	02/10/2018 16:24	0

Notes: 78896-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Jennifer Mont KTP
0055	Conductivity at 25°C	26.2	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	82	g/m³	Gordon McArthur KTP
0602	Chloride	25.5	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	1.34	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.13	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.013	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	0.05	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	0.06	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.0494	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	20.9	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-27	Levin HS2		02/10/2018 00:00	02/10/2018 16:24	0

Notes: 78897-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.5		Jennifer Mont KTP
0055	Conductivity at 25°C	26.1	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	92	g/m³	Gordon McArthur KTP
0602	Chloride	25.3	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	1.32	g/m³	Shanel Kumar KTP
0760	Ammonia Nitrogen	0.14	g/m³	Divina Lagazon KTP
6701	Aluminium - Dissolved	0.012	g/m³	Sharon van Soest KTP
6707	Boron - Dissolved	0.06	g/m³	Sharon van Soest KTP
6717	Iron - Dissolved	0.06	g/m³	Sharon van Soest KTP
6718	Lead - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.0466	g/m³	Sharon van Soest KTP
6724	Nickel - Dissolved	< 0.0005	g/m³	Sharon van Soest KTP
6731	Sodium - Dissolved	20.6	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-28	Levin Landfill quarterly SW1		02/10/2018 00:00	02/10/2018 16:24	0

Notes: 78909-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.2		Jennifer Mont KTP
0002	Suspended Solids - Total	254	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	212	mS/m	Gordon McArthur KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-28	Levin Landfill quarterly SW1		02/10/2018 00:00	02/10/2018 16:24	0

Notes: 78909-0 Levin Landfill

	Test	Result	Units	Signatory
0081	Chemical Oxygen Demand	228	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	77.4	g/m³	Gordon McArthur KTP
0085	BOD5 - Total	87	g/m³	Marylou Cabral KTP
0602	Chloride	229	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.16	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	2.44	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	73.2	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	82.2	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.74	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.586	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-29	Levin Landfill quarterly SW2		02/10/2018 00:00	02/10/2018 16:25	0

Notes: 78910-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	8.0		Jennifer Mont KTP
0002	Suspended Solids - Total	26	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	155	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	186	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	30.1	g/m³	Gordon McArthur KTP
0085	BOD5 - Total	17	g/m³	Marylou Cabral KTP
0602	Chloride	177	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.43	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	8.67	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	27.1	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	41.2	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.47	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.532	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-30	Levin Landfill quarterly SW3		02/10/2018 00:00	02/10/2018 16:25	0

Notes: 78911-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Jennifer Mont KTP
0002	Suspended Solids - Total	8	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	83.1	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	152	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	9.5	g/m³	Gordon McArthur KTP
0085	BOD5 - Total	12	g/m³	Marylou Cabral KTP
0602	Chloride	103	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.25	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	3.63	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	7.6	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	13.1	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.45	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.284	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-31	Levin Landfill quarterly SW4		02/10/2018 00:00	02/10/2018 16:25	0

Notes: 78912-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.4		Jennifer Mont KTP
0002	Suspended Solids - Total	13	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	78.3	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	140	g/m³	Gordon McArthur KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-31	Levin Landfill quarterly SW4		02/10/2018 00:00	02/10/2018 16:25	0

Notes: 78912-0 Levin Landfill

	Test	Result	Units	Signatory
0083	Total Kjeldahl Nitrogen	8.4	g/m³	Gordon McArthur KTP
0085	BOD5 - Total	< 6	g/m³	Marylou Cabral KTP
0602	Chloride	93.3	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.12	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	1.89	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	6.4	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	9.71	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.43	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	0.528	g/m³	Sharon van Soest KTP

Sample	Site	Map Ref.	Date Sampled	Date Received	Order No.
18/36572-32	Levin Landfill quarterly SW5		02/10/2018 00:00	02/10/2018 16:25	0

Notes: 78913-0 Levin Landfill

	Test	Result	Units	Signatory
0001	pH	7.5		Jennifer Mont KTP
0002	Suspended Solids - Total	13	g/m³	Marylou Cabral KTP
0055	Conductivity at 25°C	140	mS/m	Gordon McArthur KTP
0081	Chemical Oxygen Demand	152	g/m³	Gordon McArthur KTP
0083	Total Kjeldahl Nitrogen	13.9	g/m³	Gordon McArthur KTP
0085	BOD5 - Total	< 6	g/m³	Marylou Cabral KTP
0602	Chloride	126	g/m³	Shanel Kumar KTP
0603	Nitrite - Nitrogen	0.04	g/m³	Shanel Kumar KTP
0605	Nitrate - Nitrogen	0.26	g/m³	Shanel Kumar KTP
0719	Ammonia Nitrogen	11.2	g/m³	Divina Lagazon KTP
2127	Total Nitrogen	13.1	g/m³	Divina Lagazon KTP
6717	Iron - Dissolved	0.15	g/m³	Sharon van Soest KTP
6721	Manganese - Dissolved	1.96	g/m³	Sharon van Soest KTP

Comments:

Sampled by customer using ELS approved containers.

Test Methodology:

Test	Methodology	Detection Limit
pH	Dedicated pH meter following APHA Online Edition Method 4500 H.	0.1
Suspended Solids - Total	APHA Online Edition Method 2540 D	3 g/m³
Conductivity at 25°C	APHA Online Edition Method 2510 B.	0.1 mS/m
Chemical Oxygen Demand	APHA Online Edition Method 5220 D.	15 g/m³
Total Kjeldahl Nitrogen	APHA Online Edition 4500-N(org) B	0.8 g/m³
BOD5 - Total	APHA Online Edition Method 5210 B.	1 g/m³
Chloride	Ion Chromatography following USEPA 300.0 (modified).	0.02 g/m³
Nitrite - Nitrogen	Ion Chromatography following USEPA 300.0 (modified)	0.01 g/m³
Nitrate - Nitrogen	Ion Chromatography following USEPA 300.0 (modified).	0.01 g/m³
Ammonia Nitrogen	Discrete Analyser. In House method based on ISBN 0117516139.	0.01 g/m³
Ammonia Nitrogen	Flow Injection Autoanalyser following APHA Online Edition Method 4500 NH3-H.	0.01 g/m³
Iron - Dissolved	ICP-OES following APHA Online Edition Method 3120 B (modified).	0.005 g/m³
Sodium - Dissolved	ICP-OES following APHA Online Edition Method 3120 B (modified).	0.02 g/m³
Total Nitrogen	Flow Injection Autoanalyser following APHA Online Edition Method 4500-NO3 I. Persulphate digestion follows APHA Online Edition 4500-N C.	0.05 g/m³
Aluminium - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.002 g/m³
Boron - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.03 g/m³
Iron - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.01 g/m³

Test	Methodology	Detection Limit
Lead - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.0005 g/m³
Manganese - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.0005 g/m³
Nickel - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified).	0.0005 g/m³
Sodium - Dissolved	ICP-MS following APHA Online Edition method 3125 (modified)	0.01 g/m³
Faecal Coliforms	APHA 9222D:Online Edition	1 cfu/100ml

Unless otherwise stated, all tests are performed in Wellington.

"<" means that no analyte was found in the sample at the level of detection shown. Detection limits are based on a clean matrix and may vary according to individual sample.

g/m3 is the equivalent to mg/L and ppm.

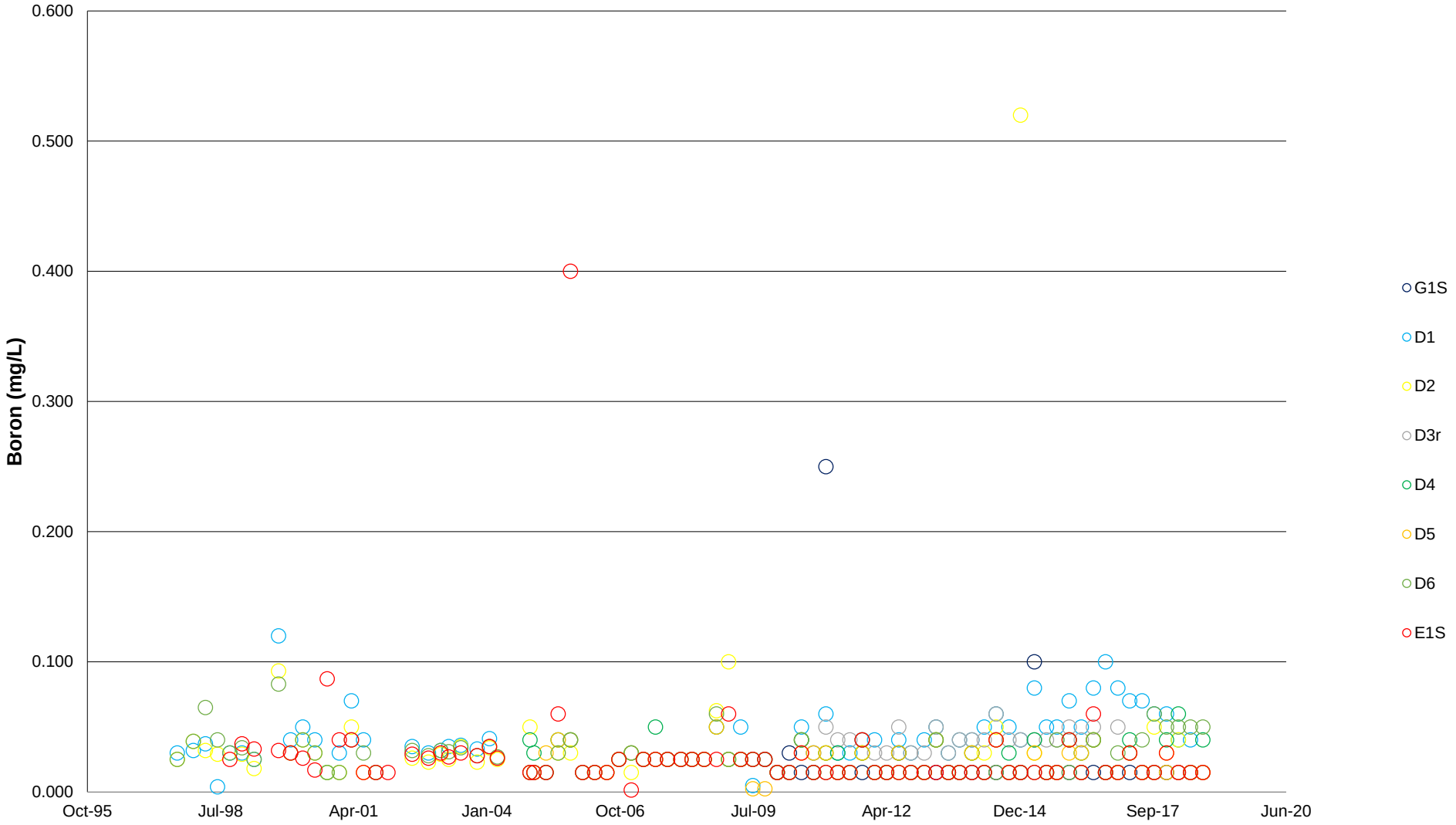
Samples will be retained for a period of time, in suitable conditions appropriate to the analyses requested.

Report Released By
Rob Deacon

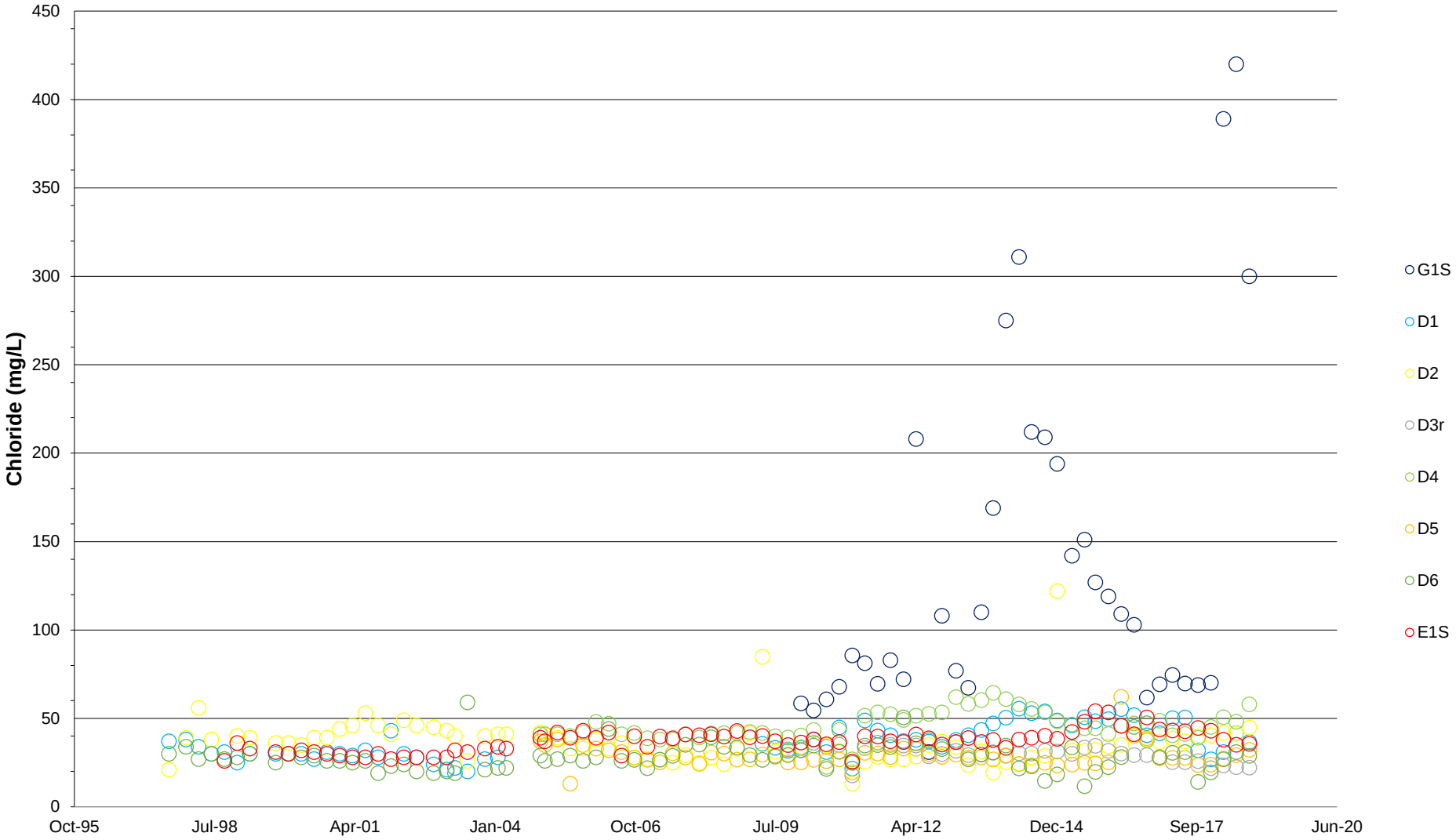
This laboratory is accredited by International Accreditation New Zealand and its reports are recognised in all countries affiliated to the International Laboratory Accreditation Co-operation Mutual Recognition Arrangement (ILAC-MRA). The tests reported have been performed in accordance with our terms of accreditation, with the exception of tests marked "not IANZ", which are outside the scope of this laboratory's accreditation.

Appendix D Historical Result Graphs

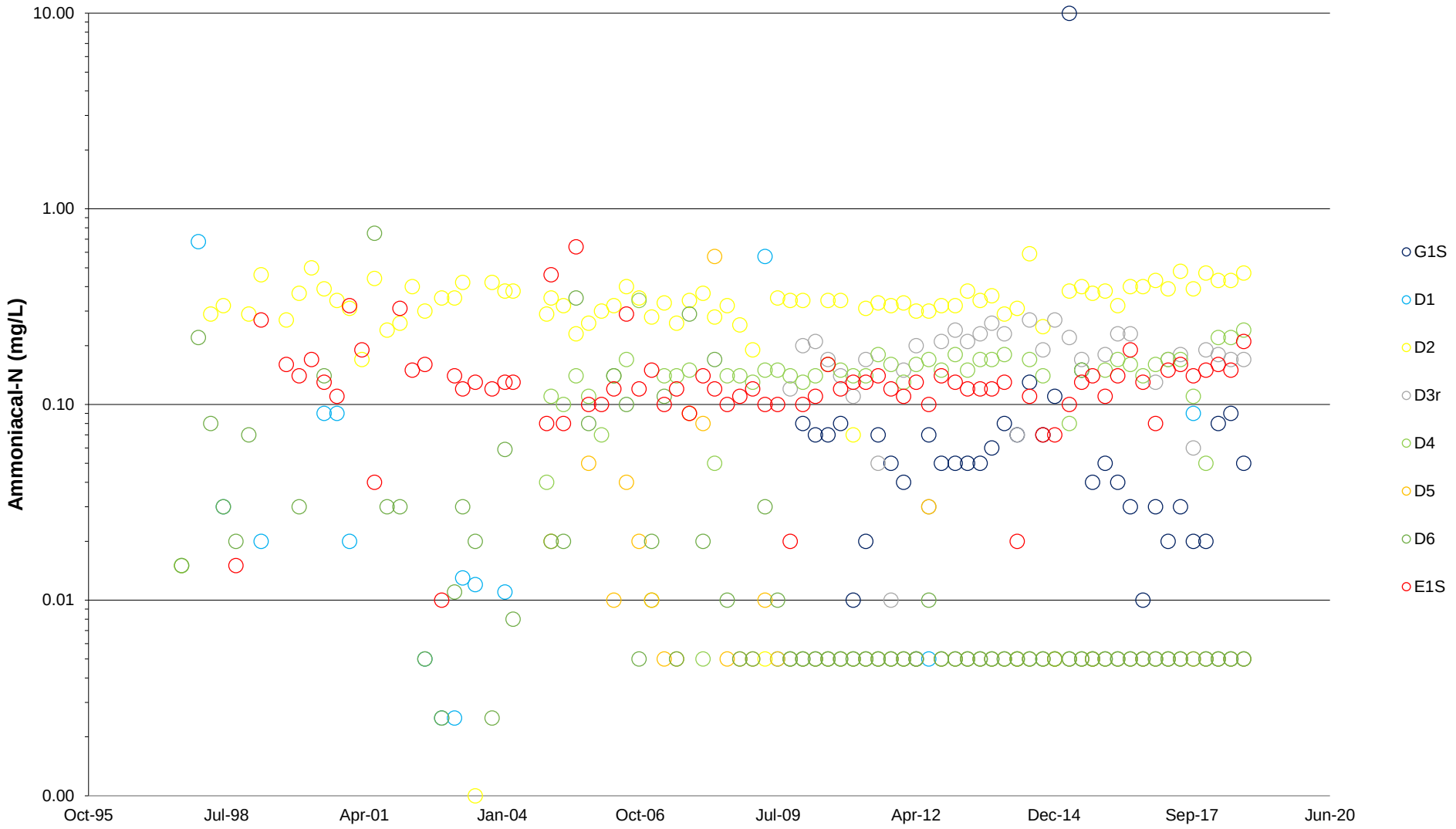
Sand Aquifer Boron Concentrations



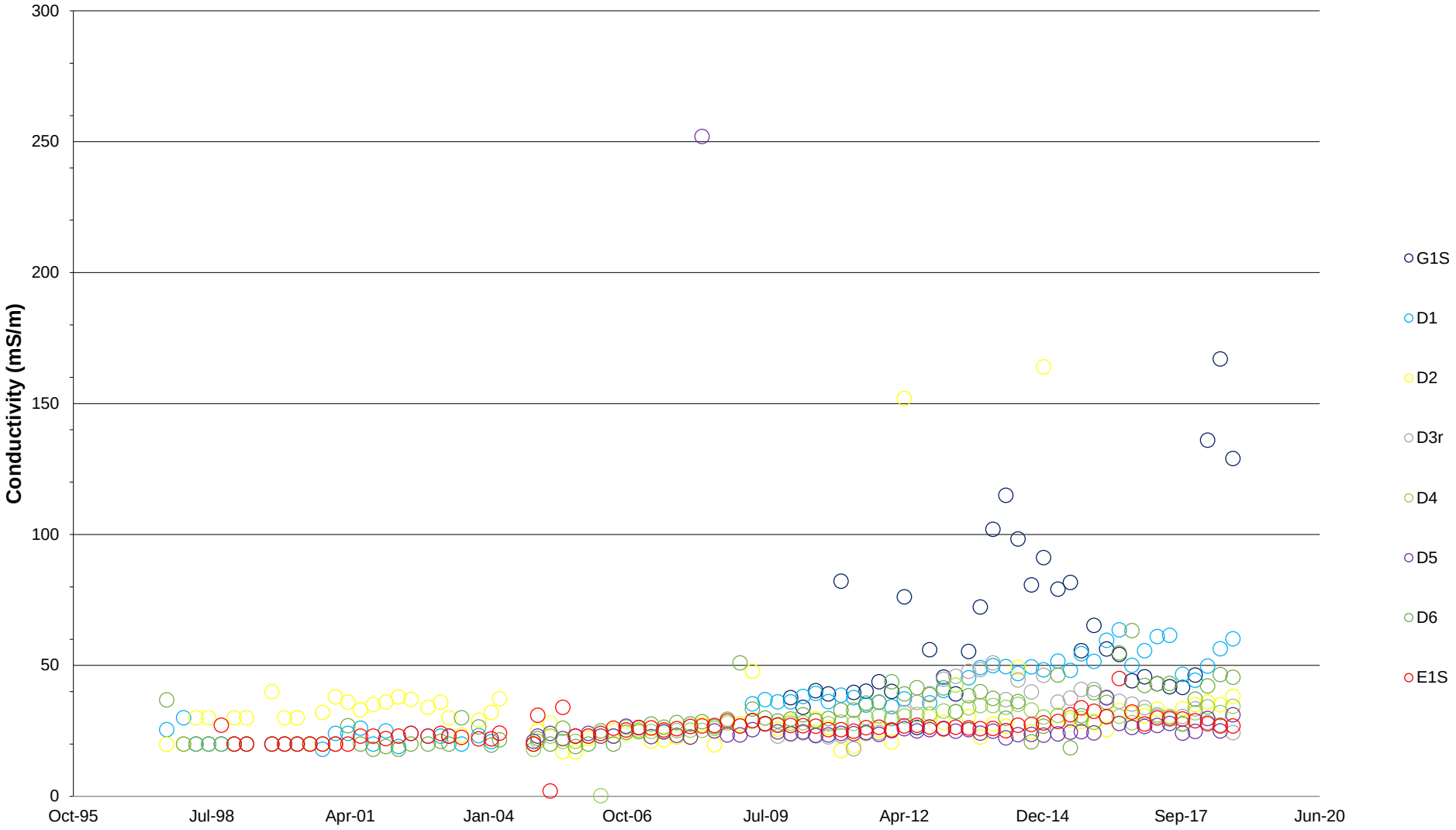
Sand Aquifer Chloride Concentrations

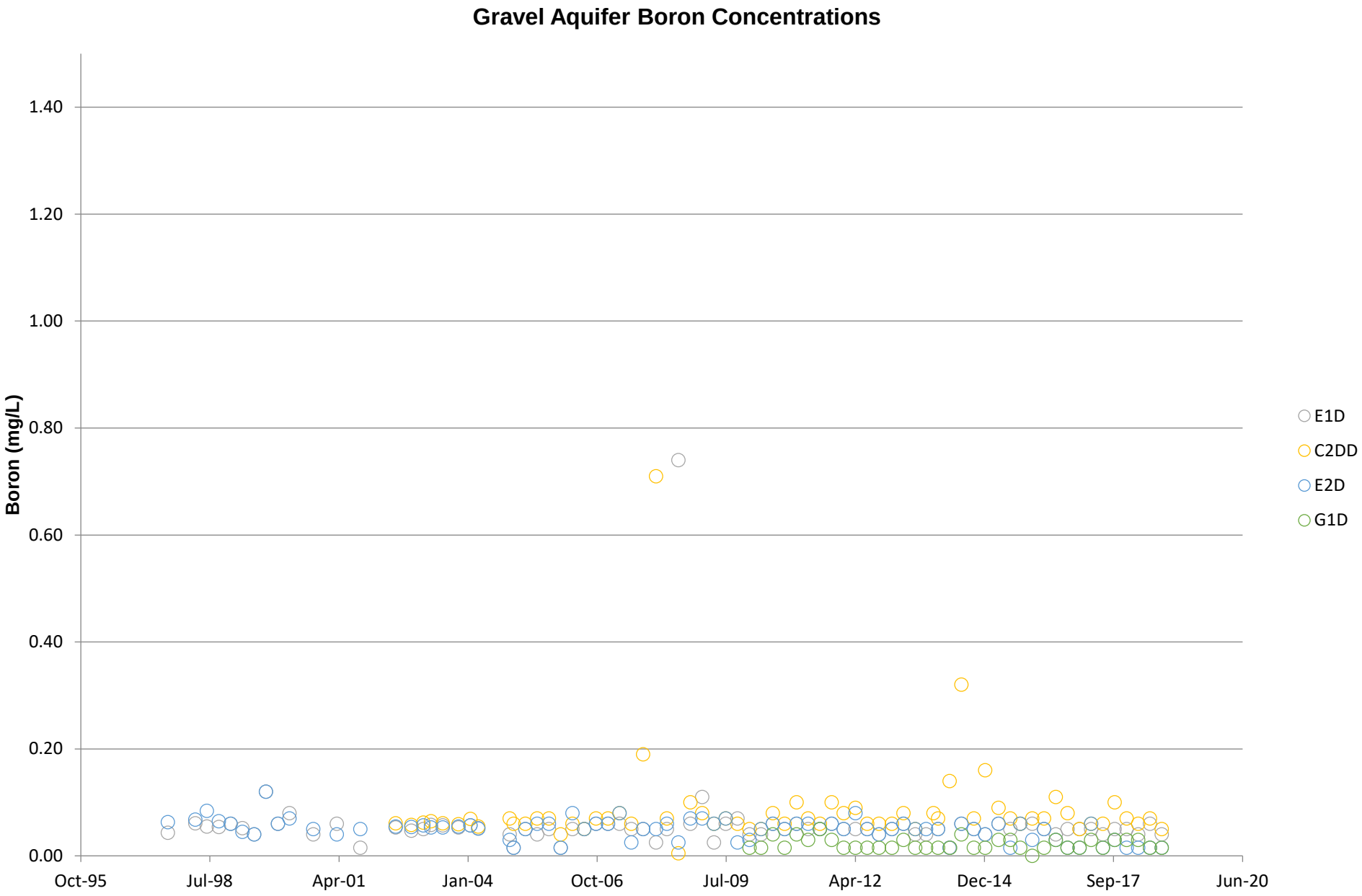


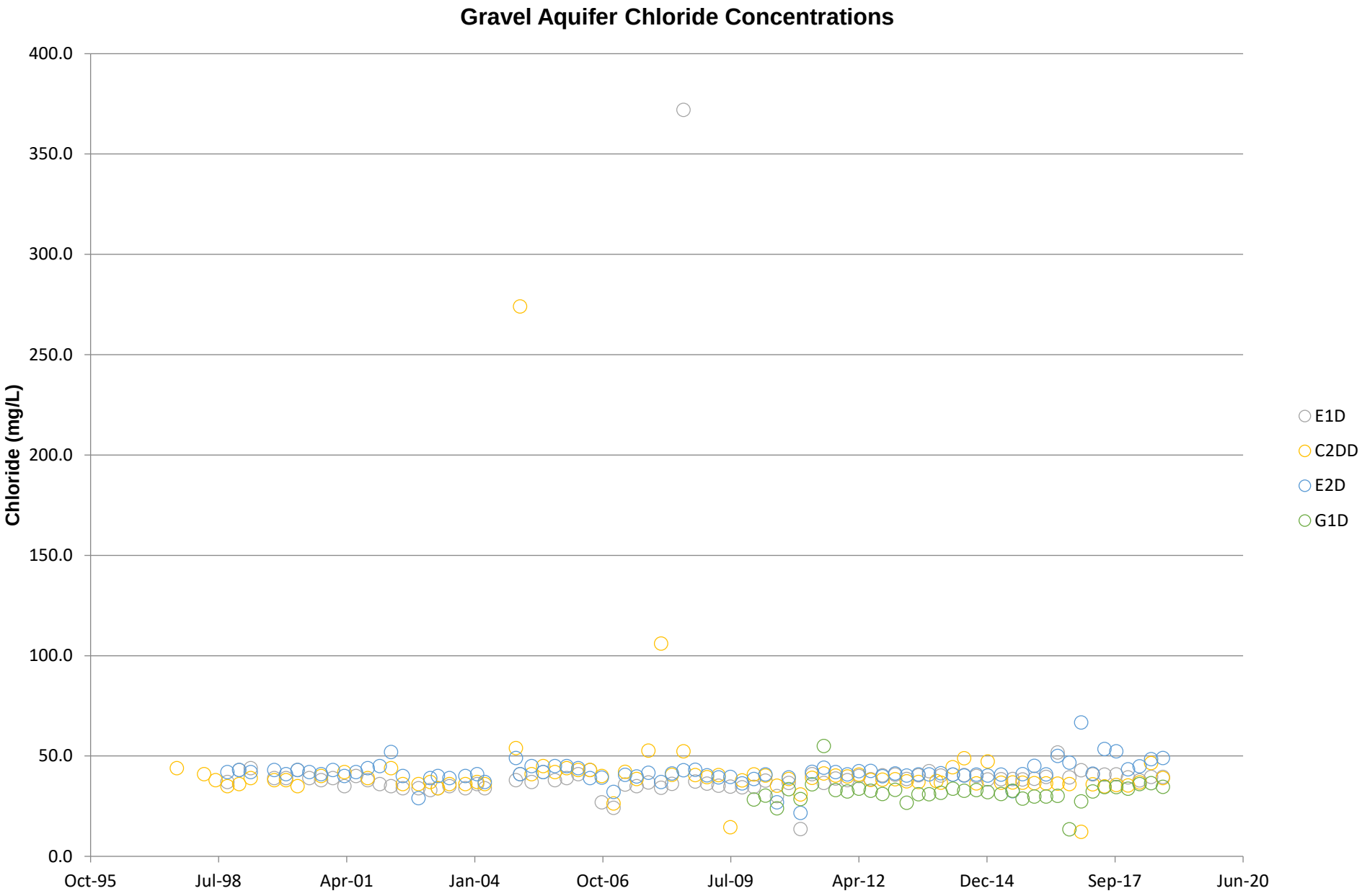
Sand Aquifer Ammoniacal-Nitrogen Concentrations

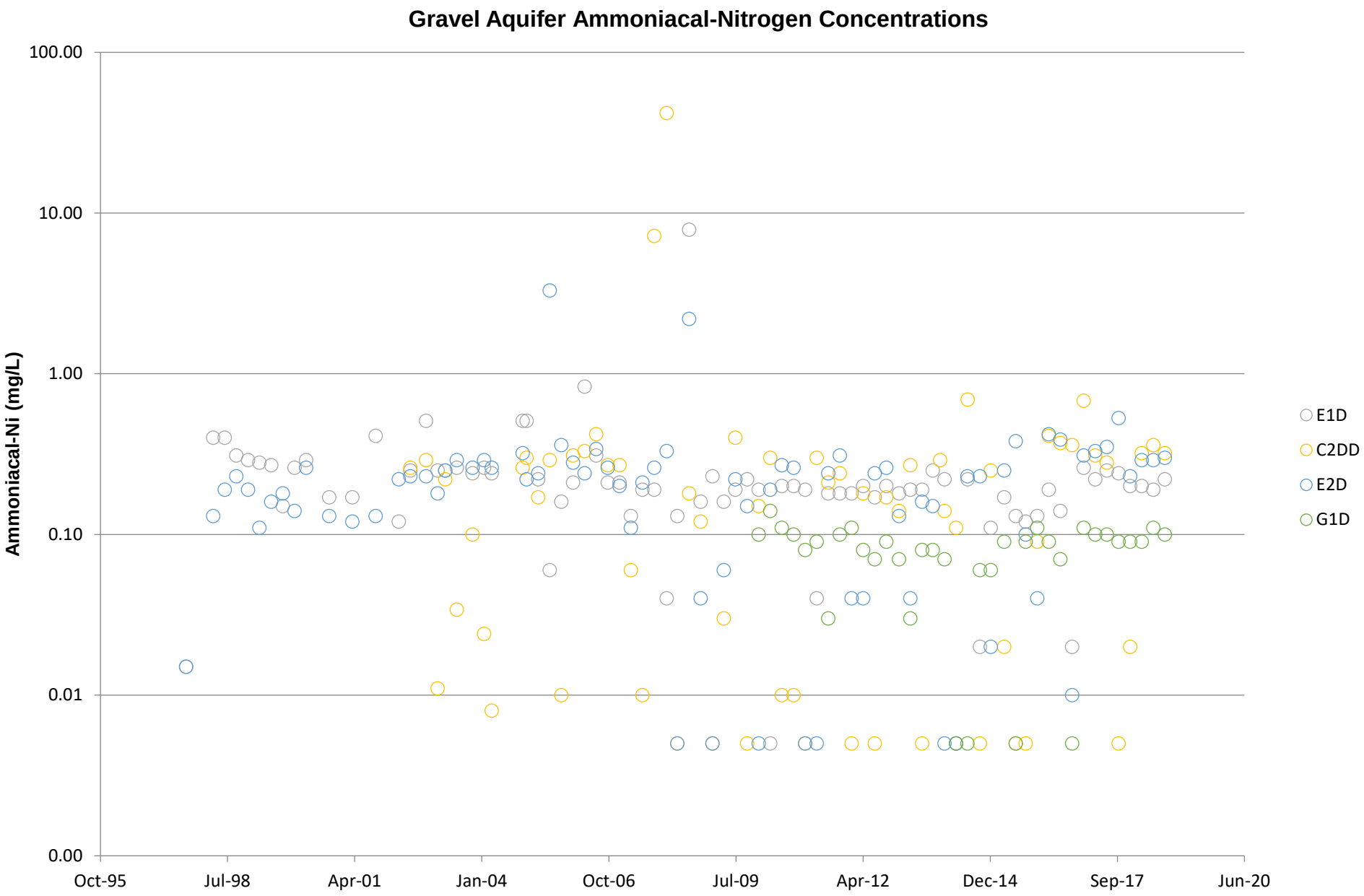


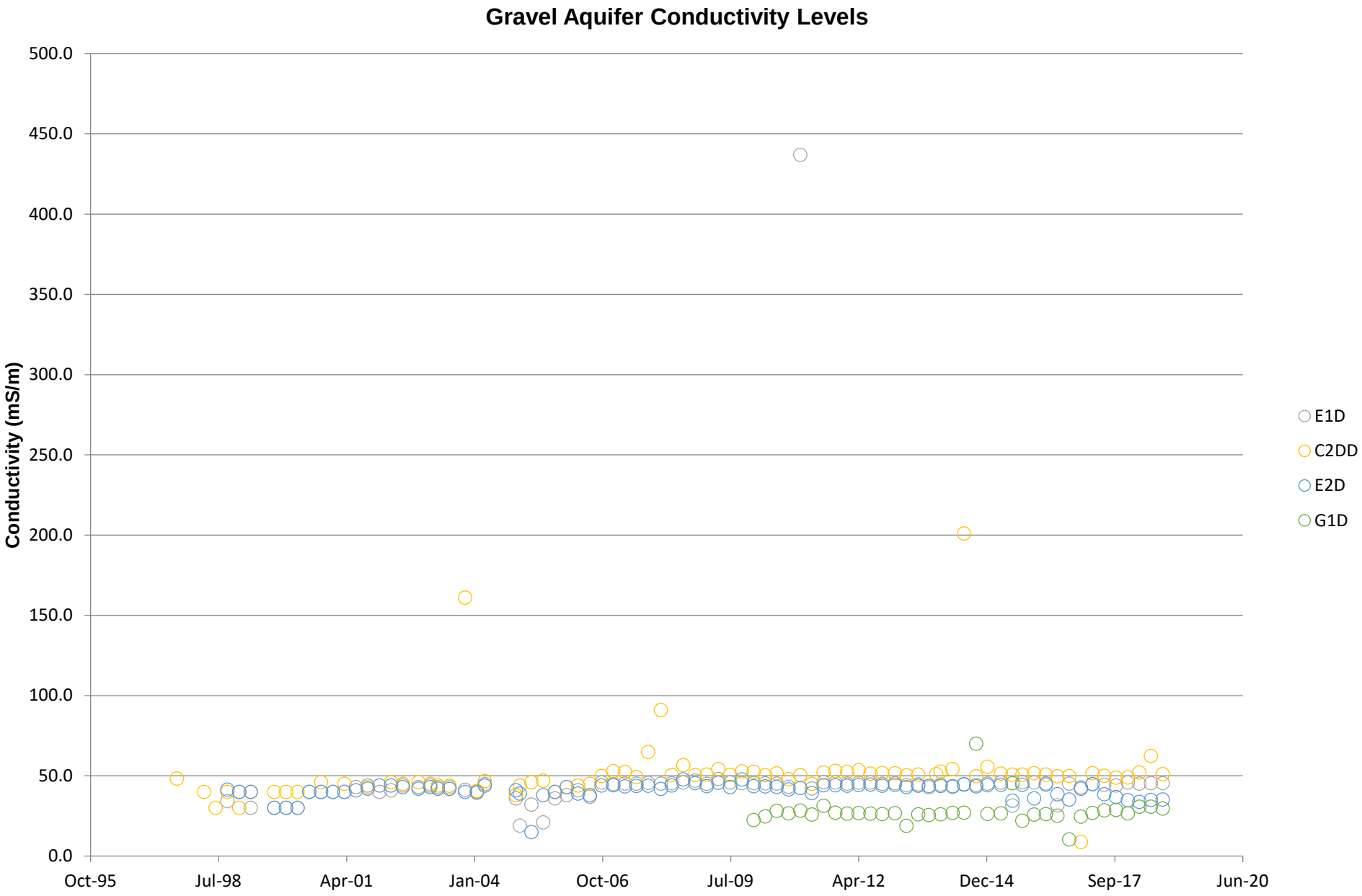
Sand Aquifer Conductivity Levels

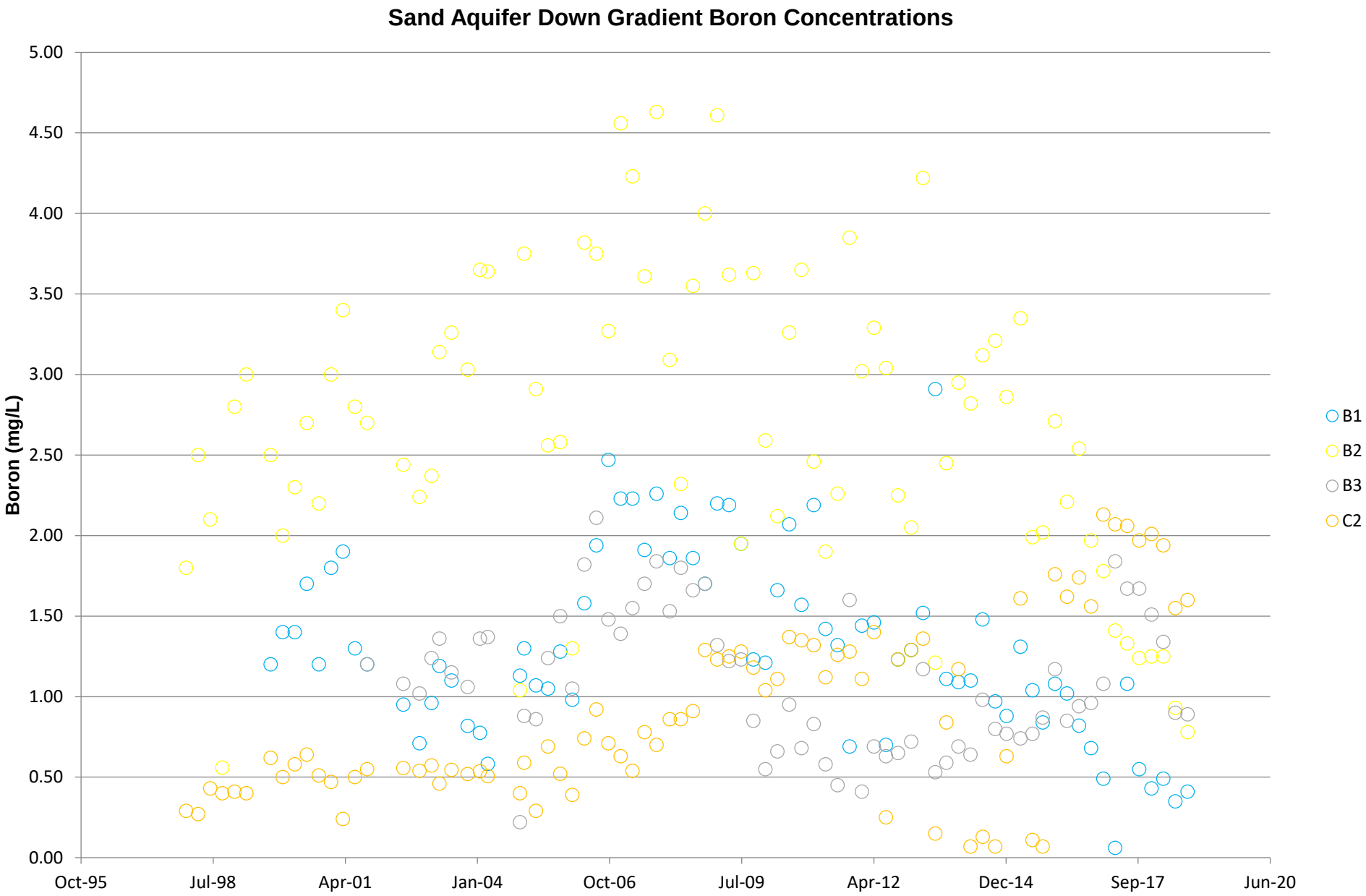



Gravel Aquifer Boron Concentrations
Boron (mg/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
E1D
C2DD
E2D
G1D

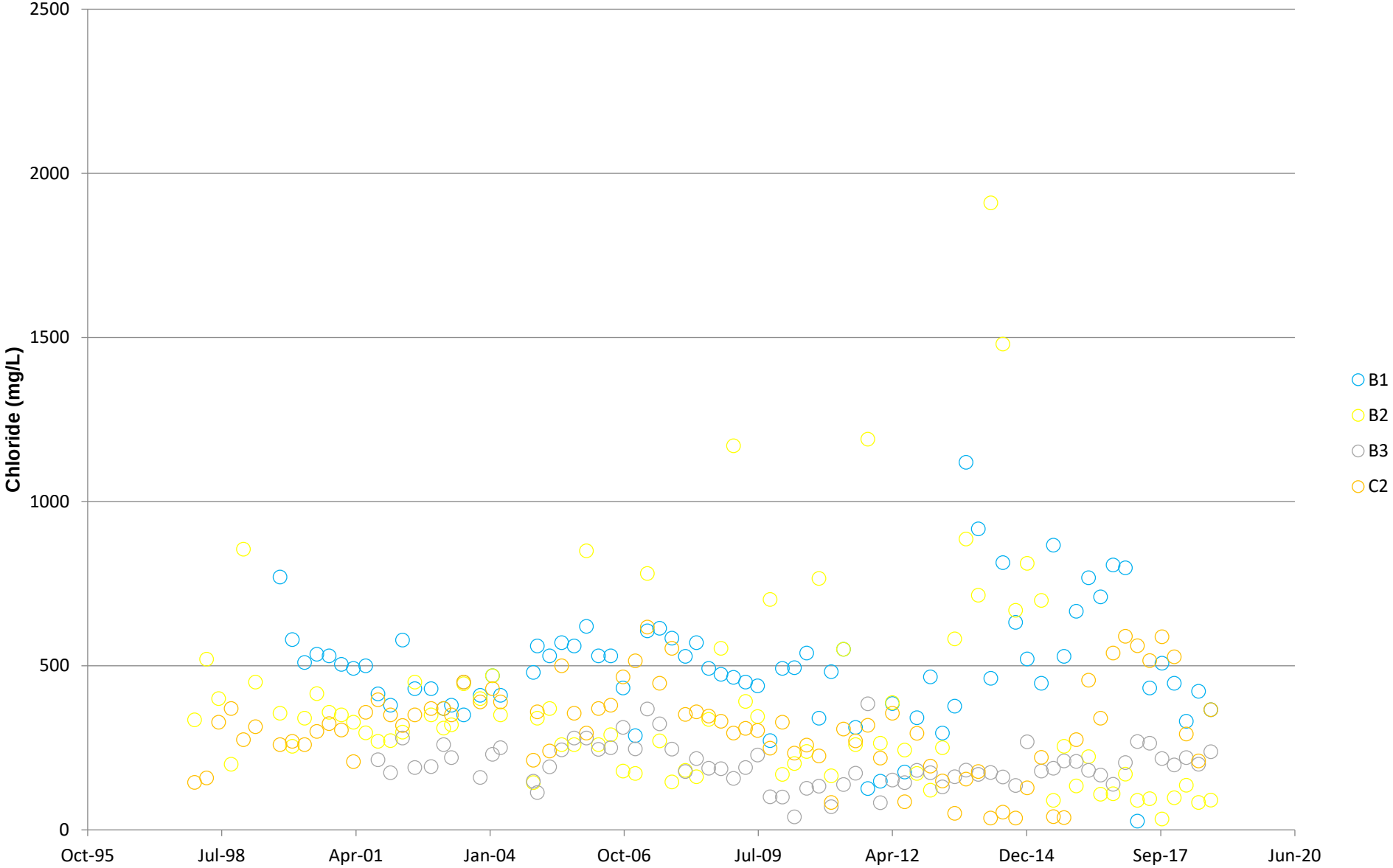

Gravel Aquifer Chloride Concentrations
Chloride (mg/L)
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
E1D
C2DD
E2D
G1D

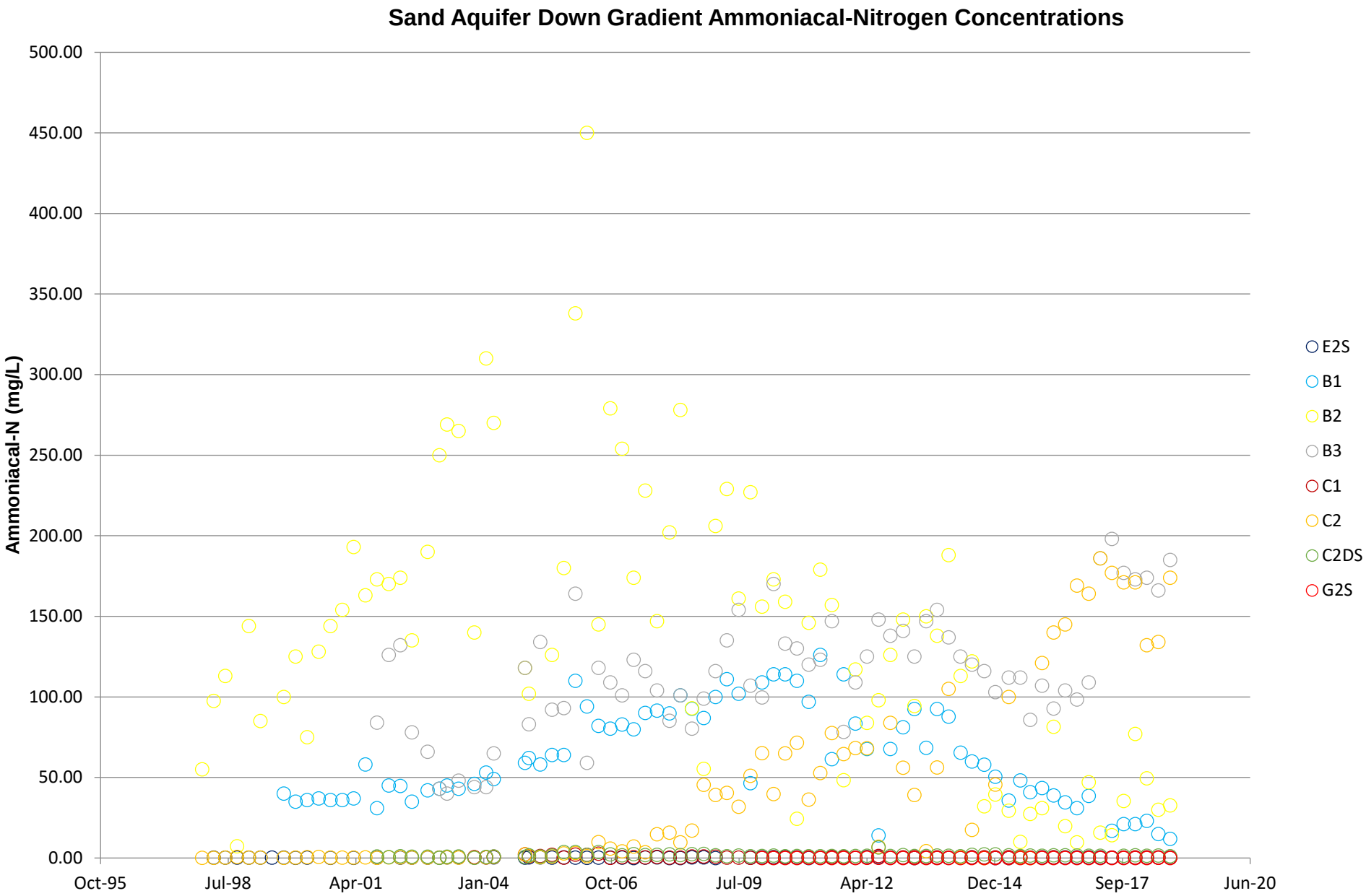

Gravel Aquifer Ammoniacal-Nitrogen Concentrations
Ammoniacal-Ni (mg/L)
100.00
10.00
1.00
0.10
0.01
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
E1D
C2DD
E2D
G1D


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
E1D
C2DD
E2D
G1D

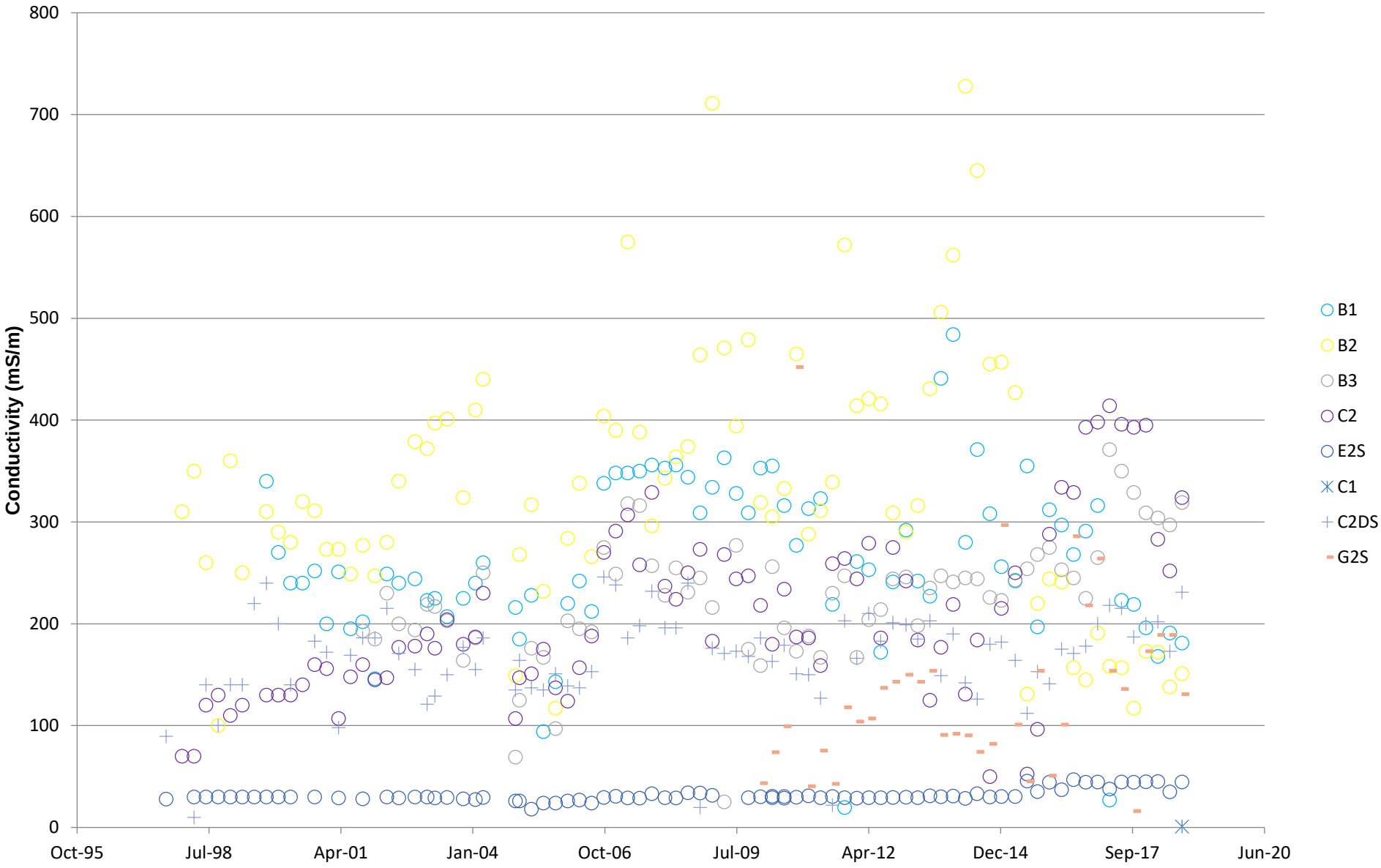

Sand Aquifer Down Gradient Boron Concentrations
Boron (mg/L)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
B1
B2
B3
C2

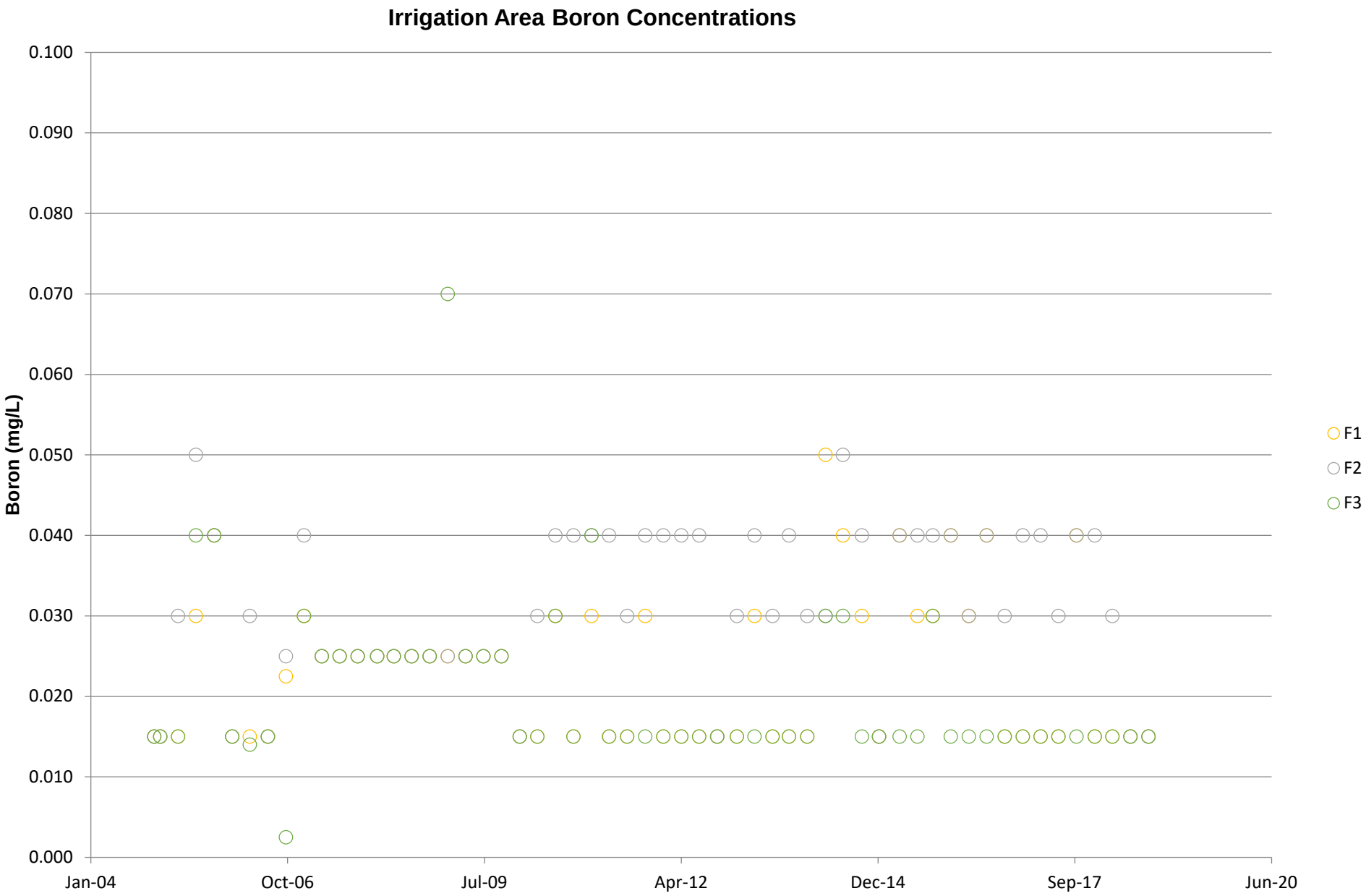
Sand Aquifer Down Gradient Chloride Concentrations

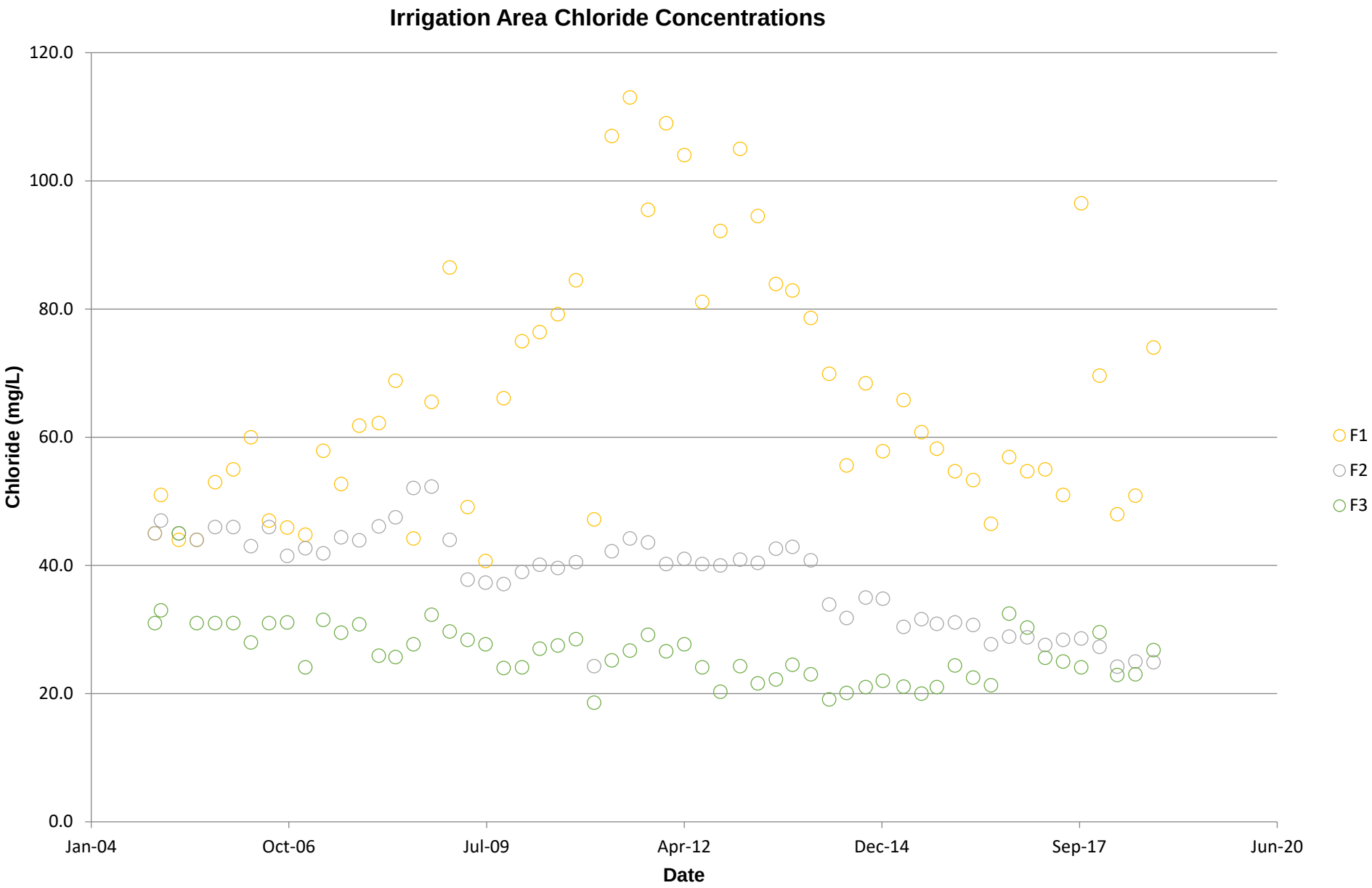


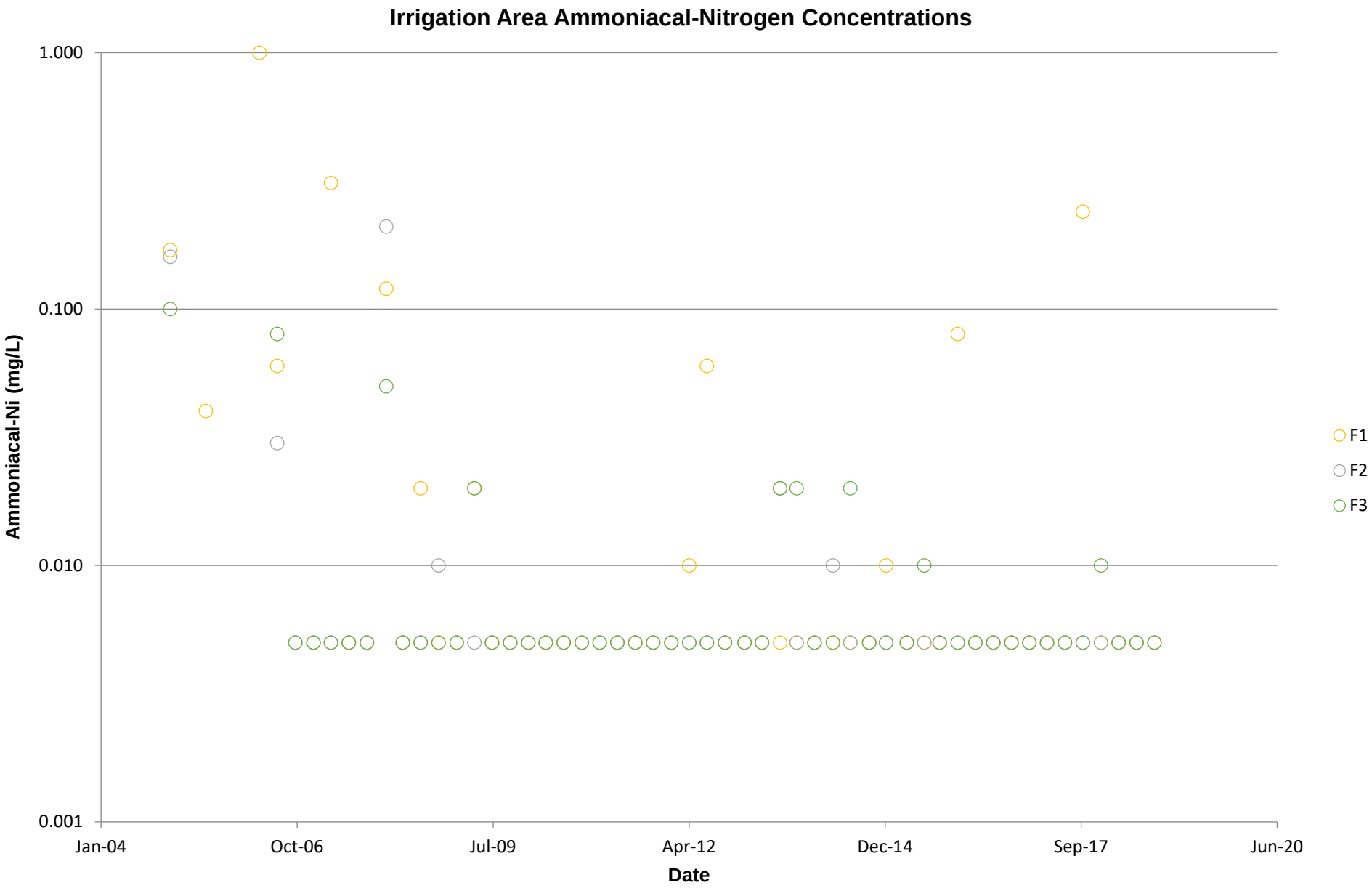

Sand Aquifer Down Gradient Ammoniacal-Nitrogen Concentrations
Ammoniacal-N (mg/L)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Oct-95
Jul-98
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
E2S
B1
B2
B3
C1
C2
C2DS
G2S

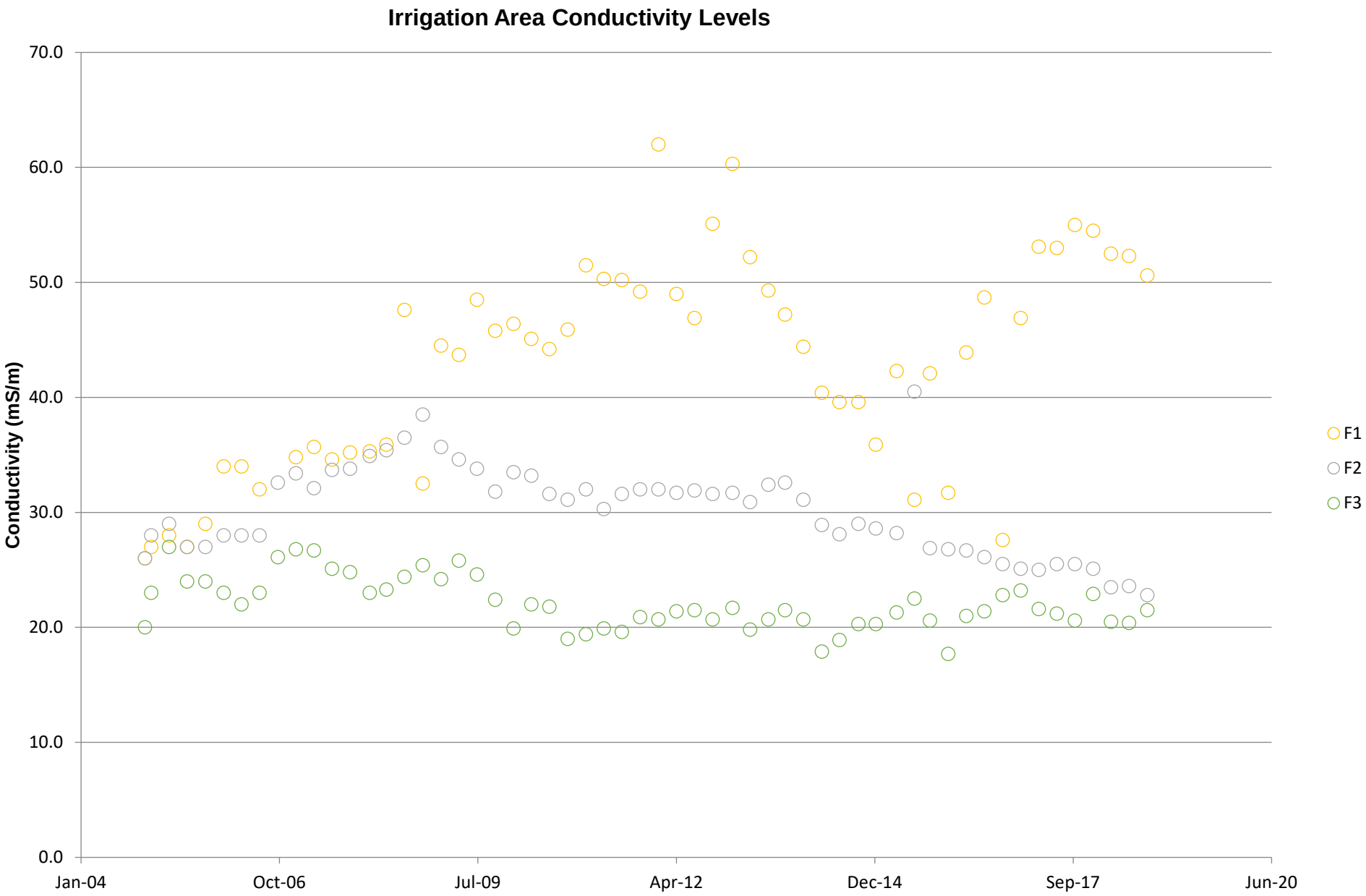
Sand Aquifer Down Gradient Conductivity Levels

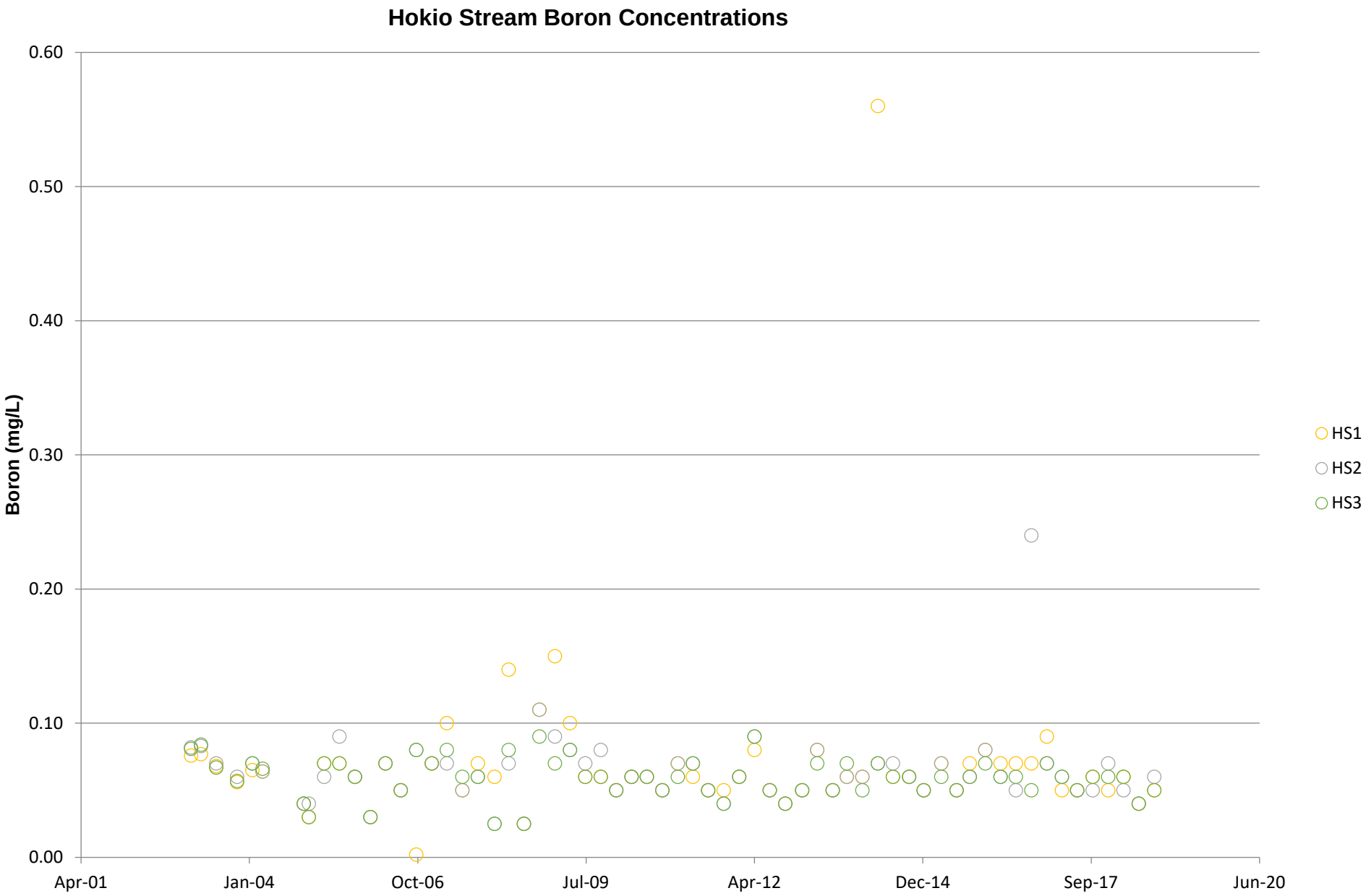


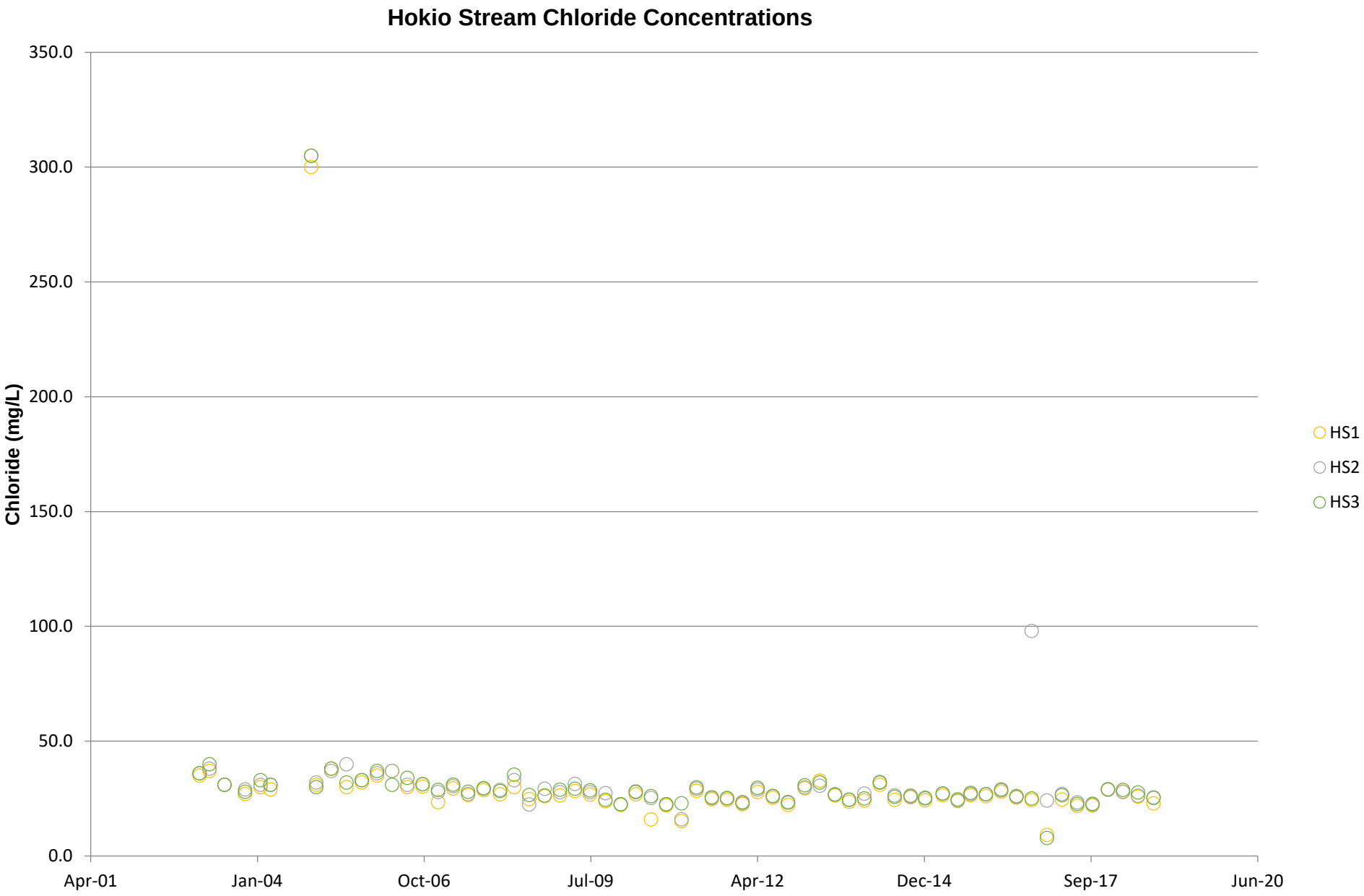

Irrigation Area Boron Concentrations
Boron (mg/L)
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
F1
F2
F3

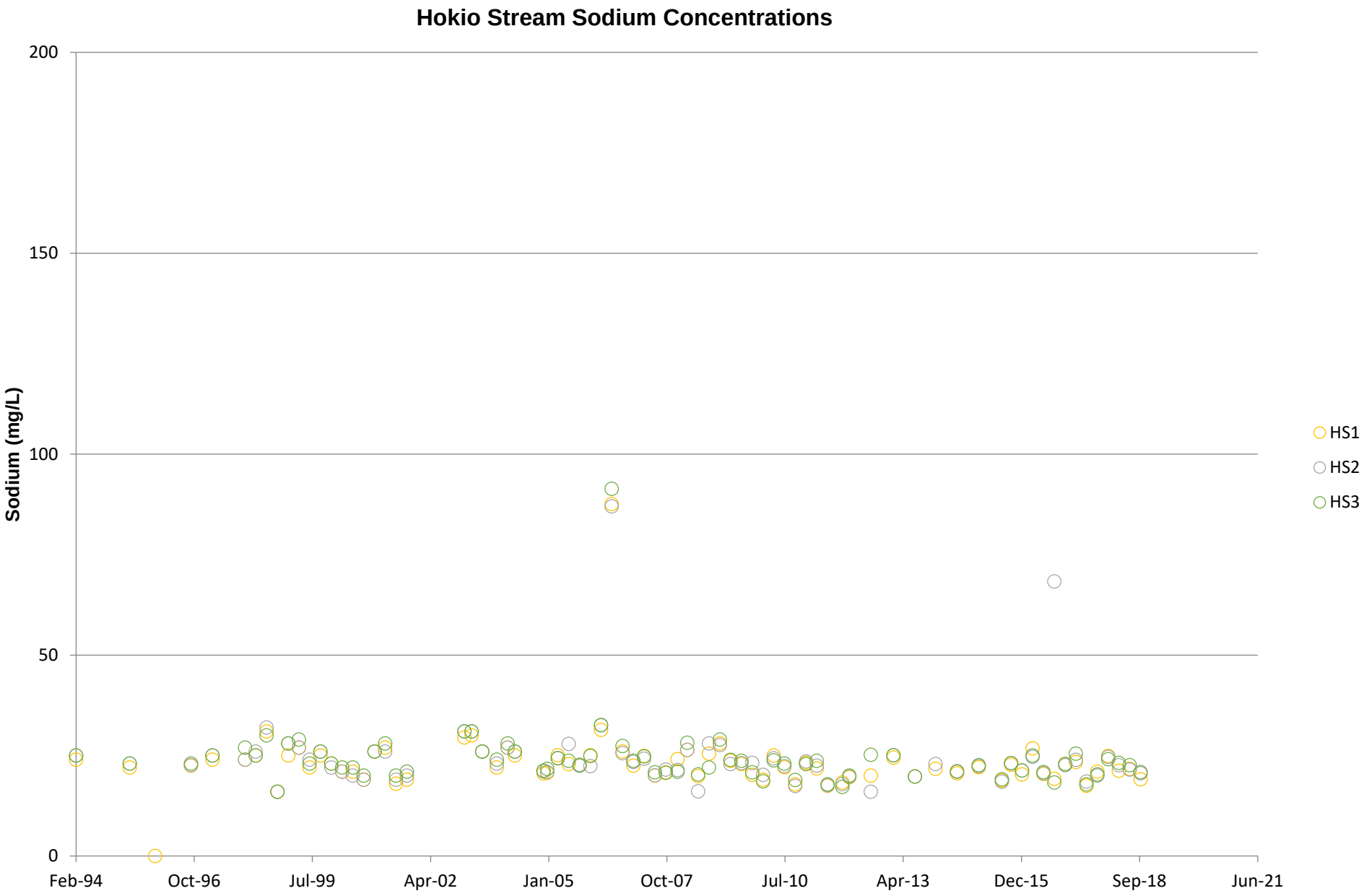

Irrigation Area Chloride Concentrations
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Chloride (mg/L)
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Date
F1
F2
F3

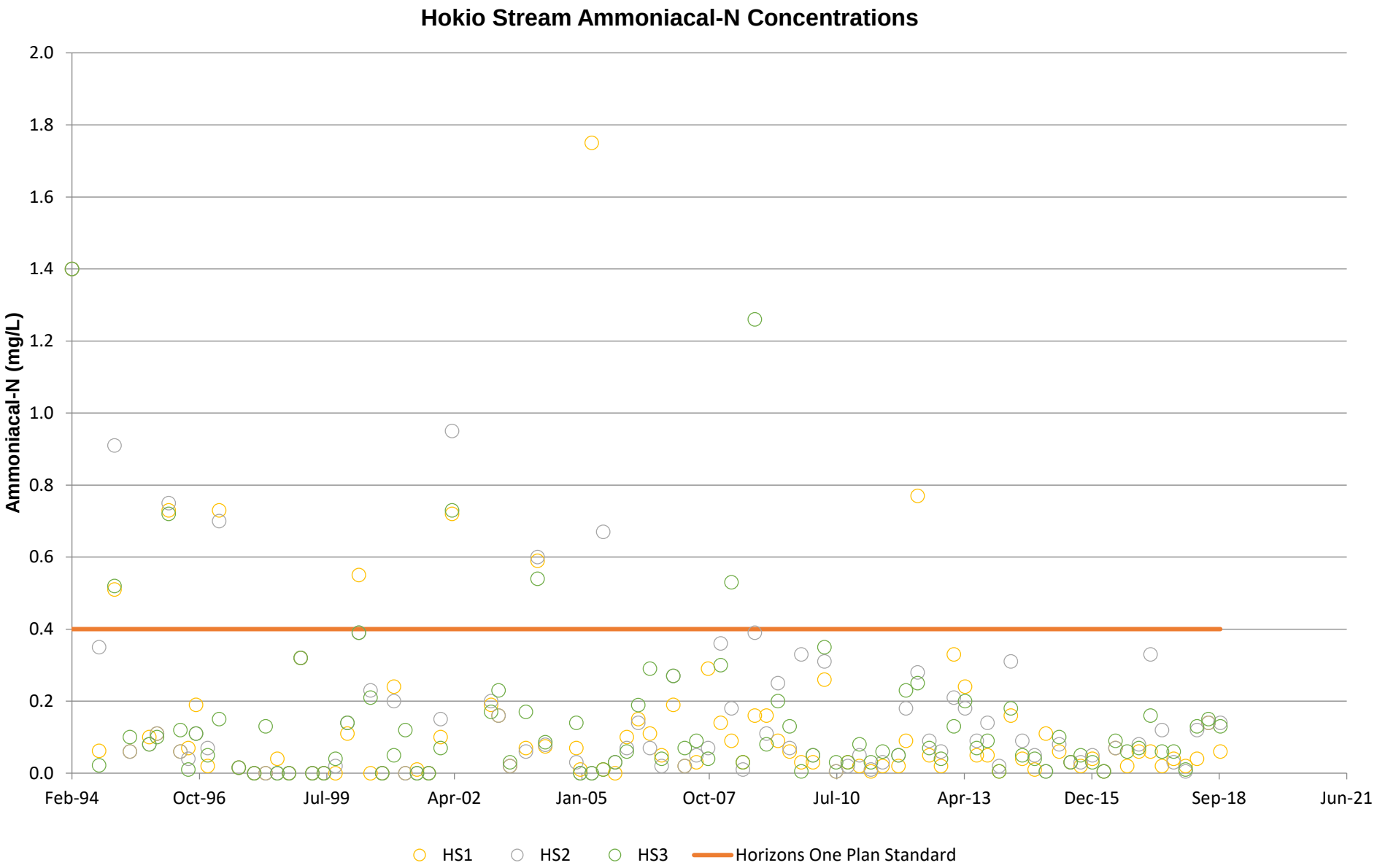

Irrigation Area Ammoniacal-Nitrogen Concentrations
1.000
0.100
0.010
0.001
Ammoniacal-Ni (mg/L)
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
Date
F1
F2
F3

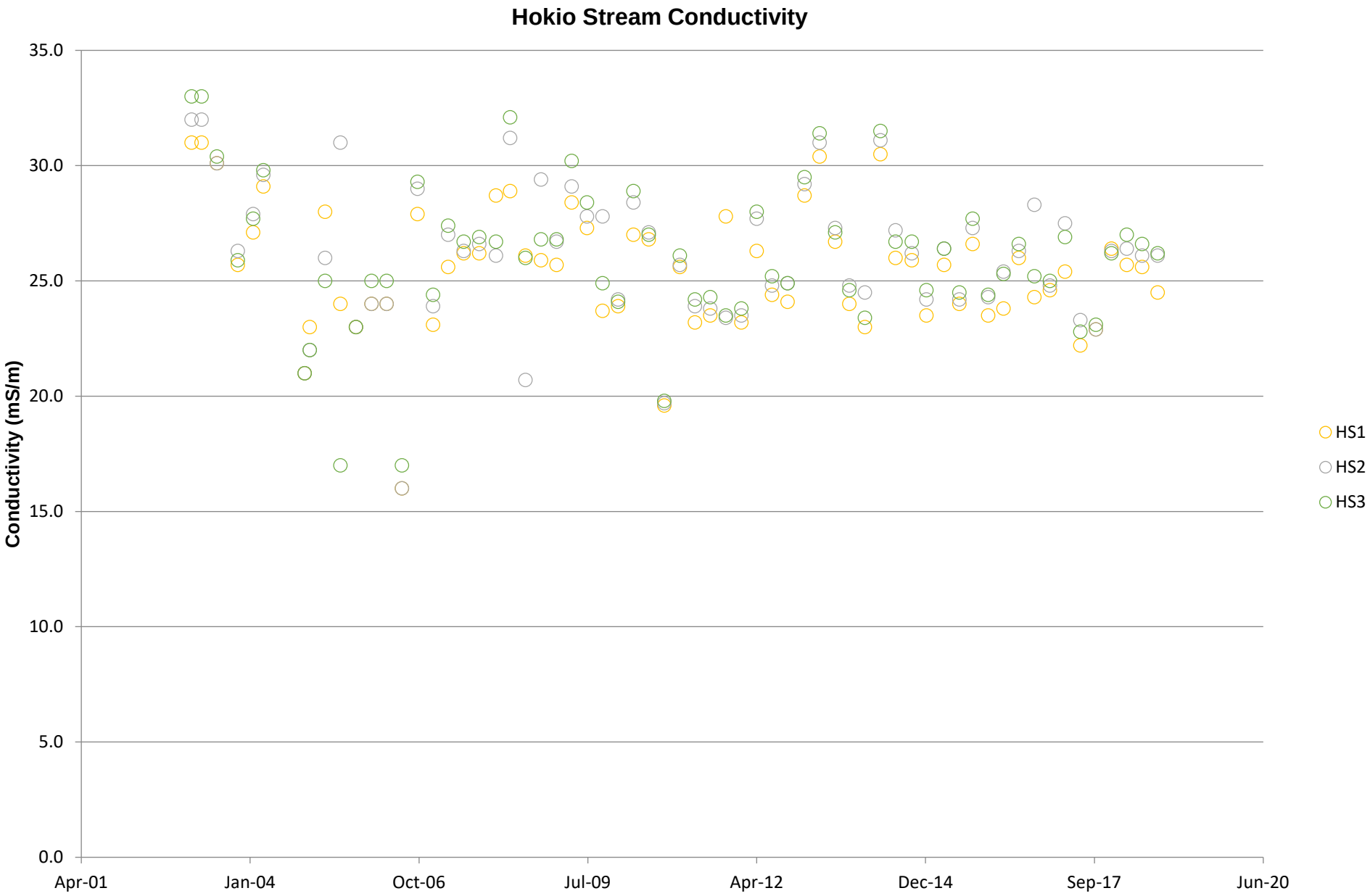

Irrigation Area Conductivity Levels
Conductivity (mS/m)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
F1
F2
F3


Hokio Stream Boron Concentrations
Boron (mg/L)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
HS1
HS2
HS3


Hokio Stream Chloride Concentrations
Chloride (mg/L)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Apr-01
Jan-04
Oct-06
Jul-09
Apr-12
Dec-14
Sep-17
Jun-20
HS1
HS2
HS3


Hokio Stream Sodium Concentrations
Sodium (mg/L)
200
150
100
50
0
Feb-94
Oct-96
Jul-99
Apr-02
Jan-05
Oct-07
Jul-10
Apr-13
Dec-15
Sep-18
Jun-21
HS1
HS2
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
Feb-94
Oct-96
Jul-99
Apr-02
Jan-05
Oct-07
Jul-10
Apr-13
Dec-15
Sep-18
Jun-21
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
HS1
HS2
HS3

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