Wollongong City Council

Helensburgh Waste Disposal Depot
Annual Report

Period 01 June 2012 – 31 May 2013

Reference: Z13 / 131621

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ABBREVIATIONS

ANZECC	Australian and New Zealand Environment Conservation Council
Ca	Calcium
$CaCO_3$	Calcium Carbonate
CFU	Colony Forming Units
CH_4	Methane
Cl	Chloride
Cr	Chromium
DC	Development Consent
DO	Dissolved Oxygen
EPL	Environmental Protection Licence
K	Potassium
LEMP	Landfill Environmental Management Plan
Mg	Magnesium
Na	Sodium
NH_3	Ammonia
OEH	The Office of Environment & Heritage
Ppm	Parts per Million
SO_4	Sulfate
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
Zn	Zinc

1 INTRODUCTION

1.1 BACKGROUND

The City of Wollongong is located 80 kilometres south of Sydney and is Australia's 9th largest city. The Wollongong City Council (Council) governance area occupies a relatively narrow coastal strip bordered by the Royal National Park to the north, the Windang Bridge and Yallah to the south, the Tasman Sea to the east and the escarpment to the west.

Council ceased accepting waste at the Helensburgh Waste Disposal Depot (the site) after 30 June 2012. Subsequent to closure the site has been capped with no less than 300mm of cover material in anticipation of a full site rehabilitation construction commencing in late 2013. The rehabilitation construction will incorporate an impervious liner into the site cap reduce leachate infiltration levels and to aid the speed at which the sites waste contamination levels stabilise.

The site is located Nixon Place, Helensburgh on NSW Department of Lands titled land for which Council holds a licence agreement. The site is situated at the northern extent of Council's governance area and is located on approximately 6.4 hectares of land extending across portions of Lots 621 and 915 of DP 752033.

Council holds an Environmental Protection Licence (EPL) number 5861, for 'Waste Disposal – Application to Land' for the site. Despite the sites closure on 30 June 2012, Council still operates in accordance with the sites Landfill Environmental Management Plan (LEMP) in accord with the requirements of the sites EPL and Development Consent (DC).

1.2 SITE HISTORY

The site has operated for over forty years. Prior to the establishment of waste disposal operations, the site was vacant bushland. In the initial years of operation, the site functioned as a trench and fill operation, with a significant amount of waste incinerated within the trenches. It is understood that from the 1960's until approximately the early 1990's, the site operated as a sanitary depot accepting mainly nightsoil and putrescible wastes. Limited environmental controls were in-place at this time. The site continued to accept these types of waste until 1991, when putrescible waste ceased to be accepted. From 1991 to 2012, the site was only permitted by Council to accept "General Solid Non Putrescible" style wastes e.g. furniture, wood, paper, plastics etc. (although the EPL allows the site to accept putrescible wastes if required). In regard to the sites landform, following completion of the trench and fill operations, landfilling operations shifted to land raise operations which

involved the construction of a small mound created from the deposited waste materials. Final land raising operations were completed in the site's central and southern area towards the end of the sites functional life.

In its final year of operation, the site received approximately 7,463 tonnes of waste, of which approximately 2,222 tonnes was sent to landfill (excluding cover material). The remainder (approximately 5,241 tonnes) was recycled. Material used for daily covering of the waste was mainly obtained from a combination of clean fill materials delivered to the site and material sourced on the site. Council also used landfill lids on the site in order to reduce the amount of daily cover required. The lids comprised a portable rigid steel frame covered by heavy duty fabric, which were be lifted on and off partly filled areas of waste at the end of each day's operations, reducing daily cover requirements at this site by approximately half. Since closure the lids have been transferred to Whytes Gully for continued beneficial use.

1.3 OBJECTIVES OF THE ANNUAL REPORT

Condition R1.10 of the EPL specifies that Council must provide an Annual Report to accompany the Annual Return for the site. The objective of this report is to provide this review.

1.4 RELEVANT DOCUMENTS

This annual report refers to information and data from the following documents;

- Helensburgh Waste Disposal Depot – Annual Return for Period 01 June 2011 to 31 May 2012. By Wollongong City Council July 2012.
- Helensburgh Waste Disposal Depot – Annual Return for Period 01 June 2010 to 31 May 2011. By Wollongong City Council July 2011.
- Helensburgh Waste Disposal Depot – Annual Report for Period 01 June 2009 to 31 May 2010. By GHD July 2010.

2 KEY LICENCE ISSUES

2.1 ENVIRONMENTAL PROTECTION LICENCE ANNUAL RETURNS

The Environment Protection Agency NSW (EPA) has issued an ***Environmental Protection Licence*** (Licence No. 5861) for the landfill and recycling operations on site. The licence, issued under the ***Protection of the Environment Operations Act 1997,*** requires an annual return to be submitted to the EPA, detailing;

a) Statement of compliance; and

b) Monitoring and complaints summary, including responses.

c) Tabulated results of all monitoring data required by the licence.

d) A graphical presentation of the data for at least three years (if available).

e) Notations made regarding any statistically significant variations or anomalies.

f) An analysis and interpretation of all monitoring data.

g) Identification of any deficiencies in environmental performance and action taken.

h) Recommendations on improving the sites environmental performance.

The EPL Annual Returns for the 2009 to 2012 reporting periods were reviewed to provide a background to this report. The Annual Returns can be summarised as follows:

01 June 2009 to 31 May 2010

B1. Pollution complaints - One.
B2. Concentration monitoring summary – Complete.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – Ten non compliances
C2. Details of non-compliance

1. ***Three missed conductivity measurements***
2. ***One round of groundwater monitoring missed***
3. ***Two missed ammonia measurements***
4. ***One round of groundwater monitoring missed***
5. ***Two missed ammonia measurements***
6. ***One round of groundwater monitoring missed***
7. ***Two missed ammonia measurements***
8. ***One round of surface water monitoring missed***
9. ***Two missed ammonia, faecal coliforms and dissolved oxygen tests***
10. ***Four missed potassium tests***

01 June 2010 to 31 May 2011
B1. Pollution complaints - Four.
B2. Concentration monitoring summary – Complete.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – Nil non compliances.
C2. Details of non-compliance – N/A

01 June 2011 to 31 May 2012
B1. Pollution complaints - Eleven.
B2. Concentration monitoring summary – Complete.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – Nil non compliances.
C2. Details of non-compliance – N/A

A potential problem existed prior to 2011 with seemingly regular missed analytical testing regimes over the previous 2 years. Subsequently, Council formally tendered for the environmental testing at the site, which now ensures regular testing routines are in place under contract performance requirements.

The EPL has had several variations applied to it in recent years. These changes include:

- Incorporation of additional ground water monitoring wells, gas migration monitoring wells and final closure capping profile on 20 May 2013.

- Scheduled Activity and Waste Classification structure altered on 17 October 2008.

- Environmentally sensitive or inappropriate landfilling classification removed from licence on 12 June 2008.

- Environmentally sensitive or inappropriate landfilling classification added to licence on 18 March 2008.

- Clarification of noise appropriated operating hours on 16 May 2006.

- Slag and asphalt chippings added to appropriate cover materials list on 17 May 2005

3 REVIEW OF LANDFILL MONITORING DATA

3.1 GROUND WATER MONITORING

3.1.1 Tabulated Results

Analyte	Units	23 August 2011							
		BH1	BH4	BH5	BH6	LGMB1	LGMB2	LGMB3	LGMB4
Alkalinity	mg/L	65	<1	<1	2	21	<1	7	8
Calcium	mg/L	19	<1	3	<1	9	12	3	11
Chloride	mg/L	42	154	49	43	17	73	36	11
Magnesium	mg/L	14	6	5	4	8	13	2	5
Nitrogen	mg/L	4.44	0.04	0.04	0.03	0.09	0.06	2.84	0.2
Potassium	mg/L	2	<1	2	1	5	5	7	32
Sodium	mg/L	38	117	27	48	25	36	20	12
Water Level	m	3.63	3.53	5.6	3.18	2.98	3.24	3.18	2.82
Sulfate	mg/L	80	95	24	69	63	79	29	86
TDS	mg/L	242	356	127	176	132	204	96	171
TOC	mg/L	<1	<1	<1	<1	<1	<1	<1	2
pH	pH	6.1	4.2	4.6	4.6	5.3	4.4	5.2	5

Table 3.1.1(a) Quarterly analyte testing results for August 2012

Analyte	Units	02 November 2011							
		BH1	BH4	BH5	BH6	LGMB1	LGMB2	LGMB3	LGMB4
Alkalinity	mg/L	94	<1	2	<1	16	<1	13	8
Calcium	mg/L	19	<1	4	<1	7	7	3	8
Chloride	mg/L	105	113	59	52	21	68	42	12
Magnesium	mg/L	15	5	6	5	6	9	3	4
Nitrogen	mg/L	4.87	0.02	<0.01	0.01	0.01	0.03	2.63	0.03
Potassium	mg/L	2	1	1	1	6	5	6	28
Sodium	mg/L	56	101	26	48	34	40	22	11
Water Level	m	4.44	5.55	7.36	3.81	3.3	4.43	4.38	3.64
Sulfate	mg/L	19	98	23	64	75	54	24	65
TDS	mg/L	286	338	124	226	400	218	137	178
TOC	mg/L	4	<1	<1	2	<1	<1	<1	5
pH	pH	6.2	4.5	5.1	4.8	5.2	4.7	5.3	5.1

Table 3.1.1(b) Quarterly analyte testing results for November 2012

Analyte	Units	07 February 2013							
		BH1	BH4	BH5	BH6	LGMB1	LGMB2	LGMB3	LGMB4
Alkalinity	mg/L	56	<1	<1	124	30	<1	14	7
Calcium	mg/L	28	<1	2	28	10	6	6	7
Chloride	mg/L	111	95	49	38	20	39	11	12
Magnesium	mg/L	22	5	5	14	7	7	3	3
Nitrogen	mg/L	5.34	0.38	0.38	<0.01	<0.01	<0.01	0.06	<0.01
Potassium	mg/L	2	2	<1	6	<1	3	2	27
Sodium	mg/L	62	87	24	34	32	30	10	10
Water Level	m	4.17	2.88	6.8	3.71	2.85	3.28	2.2	3.84
Sulfate	mg/L	88	106	16	23	68	41	16	58
TDS	mg/L	376	296	116	256	180	180	88	167
TOC	mg/L	7	13	1	9	1	2	<2	3
pH	pH	6	4.3	4.7	6.4	5.3	4.6	5.5	4.9

Table 3.1.1(c) Quarterly analyte testing results for February 2013

Analyte	25 May 2013							
	BH1	BH4	BH5	BH6	LGMB1	LGMB2	LGMB3	LGMB4
Alkalinity	5	<1	3	134	111	14	26	2
Calcium	24	<1	4	34	36	12	8	6
Chloride	102	110	46	21	13	63	12	10
Magnesium	48	5	5	15	14	9	4	3
Nitrogen	0.32	0.04	<0.01	<0.01	<0.01	0.02	0.03	0.06
Potassium	2	1	<1	3	2	3	3	25
Sodium	48	101	26	26	26	39	15	8
Water Level	3.26	2.6	4.63	3.28	2.59	1.81	1.94	2.23
Sulfate	101	85	16	24	42	40	22	36
TDS	432	440	158	318	330	296	128	162
TOC	3	2	<1	10	4	2	2	5
pH	5.3	4.2	4.4	6.8	6	5	5.6	4.7

Table 3.1.1(d) Quarterly analyte testing results for May 2013

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Analyte	Units	23 August 2012							
		BH1	BH4	BH5	BH6	LGMB1	LGMB2	LGMB3	LGMB4
Aluminium	mg/L	0.3	3.03	2.29	1.56	16.7	23.6	0.26	1.37
Arsenic	mg/L	0.002	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Barium	mg/L	0.018	0.018	0.016	0.007	0.048	0.018	0.012	0.007
Benzene	µg/L	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium	mg/L	<0.0001	0.0006	0.0013	0.0003	<0.0001	<0.0001	0.0003	0.0002
Chromium (hex.)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium (total)	mg/L	<0.001	<0.001	0.007	0.005	0.023	0.037	0.002	0.003
Cobalt	mg/L	<0.001	0.001	0.004	0.012	0.003	<0.001	0.022	<0.001
Copper	mg/L	0.003	0.004	0.006	0.004	0.014	0.004	0.003	0.007
Ethyl Benzene	µg/L	<2	<2	<2	<2	<2	<2	<2	<2
Fluoride	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	mg/L	0.002	0.002	0.001	0.001	0.037	0.007	<0.001	<0.001
Manganese	mg/L	0.093	0.046	0.174	0.049	0.014	0.017	0.08	0.061
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nitrate	mg/L	<0.01	0.59	0.26	0.09	0.2	0.02	0.02	0.77
Nitrite	mg/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Organochlorine Pesticides	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Organophosphate Pesticides	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Polycyclic Aromatic Hydrocarbons	µg/L	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	<2	<2	<2	<2	<2	<2	<2	<2
Total Phenolics	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Petroleum Hydrocarbons	µg/L	<50	<50	<50	<50	<50	<50	<50	<50
Xylene	µg/L	<2	<2	<2	<2	<2	<2	<2	<2
Zinc	mg/L	0.102	0.069	0.039	0.015	0.013	0.018	0.015	0.034

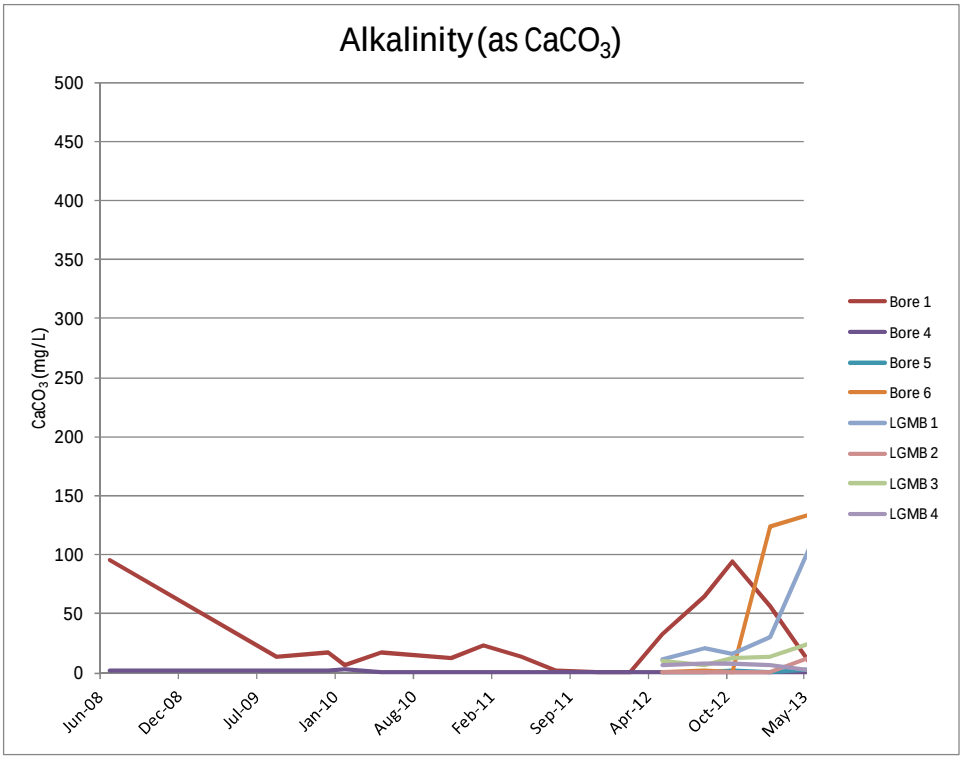
Table 3.1.1(e) Annual analyte testing August 2012 results

Pursuant to the recommendations contained in Helensburgh's 2010/2011 Annual Environmental Management Report, six additional groundwater monitoring bores were installed during the reporting period whose data is analysed throughout this Section 3. Please note that due to the infancy of these installations the history of available data is small.

Site investigations by GHD in 2011 have confirmed a predominant approximate west to east groundwater flow direction towards the adjacent Hacking River. The groundwater flow direction should be used to contextualise monitoring bore locations and elevated results, please refer to the sites Environmental Monitoring Locations located in Annexure A of this document

3.1.2 Data Presentation – Quarterly Monitoring

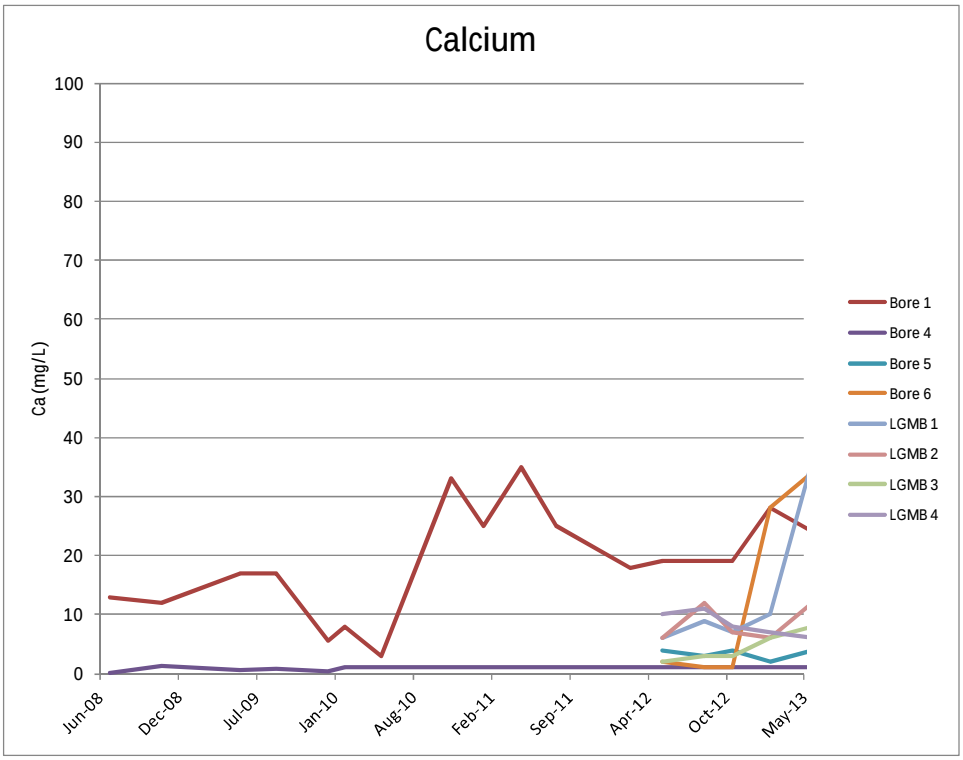
Alkalinity results presentation.



Increased alkalinity levels can be caused by many chemical processes including the denitrification process common in landfill leachate. Denitrification is the anaerobic biological reduction of nitrate (NO_3) to nitrogen (N_2) in its gaseous form. Under anoxic conditions microorganisms consume the oxygen in the nitrate and liberate the nitrogen. This process produces calcium carbonate as a by-product.

Bore 6 and LGMB 1 are potentially displaying early signs of elevating trends. Further monitoring of these points should be closely scrutinised to determine if a trend is emerging. It should however be noted that LGMB 1 is indicative of the groundwater that enters the landfill site and is not indicative of groundwater leaving the site.

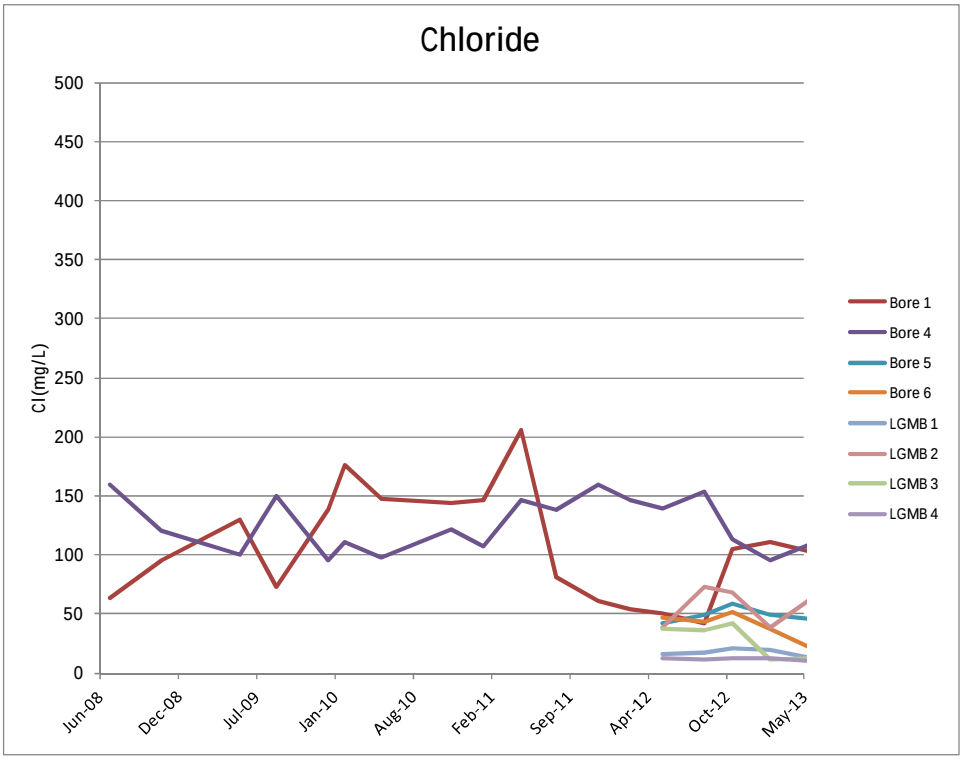
Calcium results presentation.



The groundwater monitoring wells show a consistent stable trend for calcium levels. The calcium levels sampled would be considered 'soft' in the 0-60mg/L area. 'Hard' water would be considered in the region of 120-180mg/L.

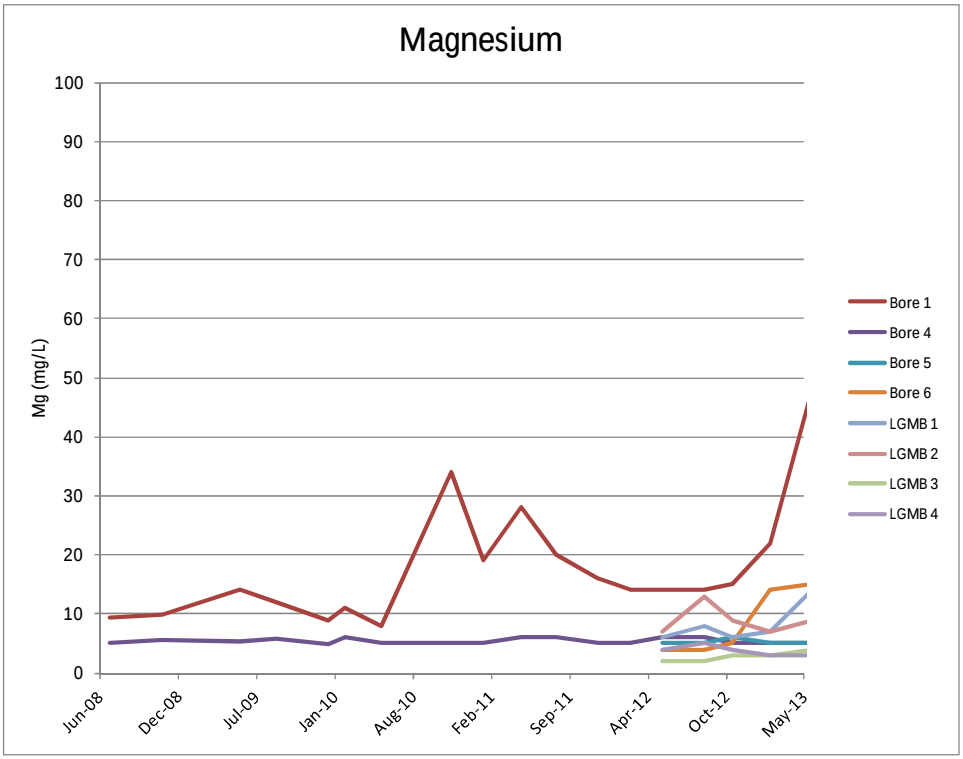
Bore 6 and LGMB 1 should be closely monitored in subsequent tests to ensure concentration elevation does not continue.

Chloride results presentation.



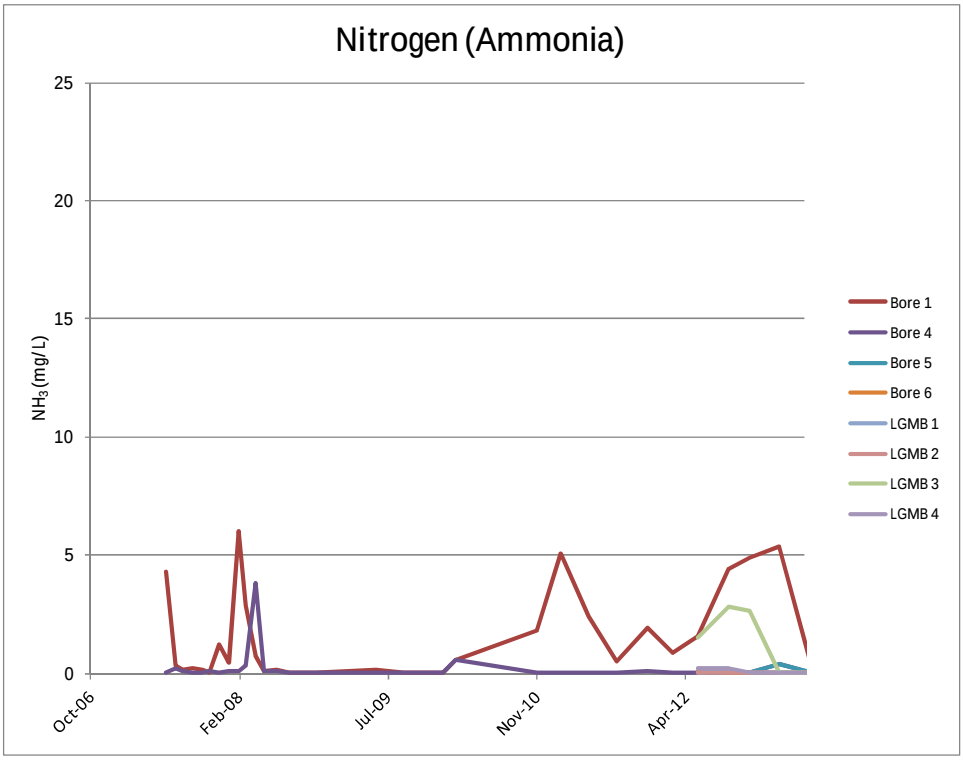
The trends for chloride monitoring have been in line with the historical levels over the data range available. Large quantities of inorganic ions such as chloride can be an indicator of leachate contamination of groundwater. A sudden increase in these ions can act as early warning system. The sampling history for chloride suggests that it does not indicate leachate presence in the groundwater. In fact the chloride levels are below the 250mg/L aesthetic criteria that are described in the ***2011 Australian Drinking Water Guidelines 6***.

Magnesium results presentation.



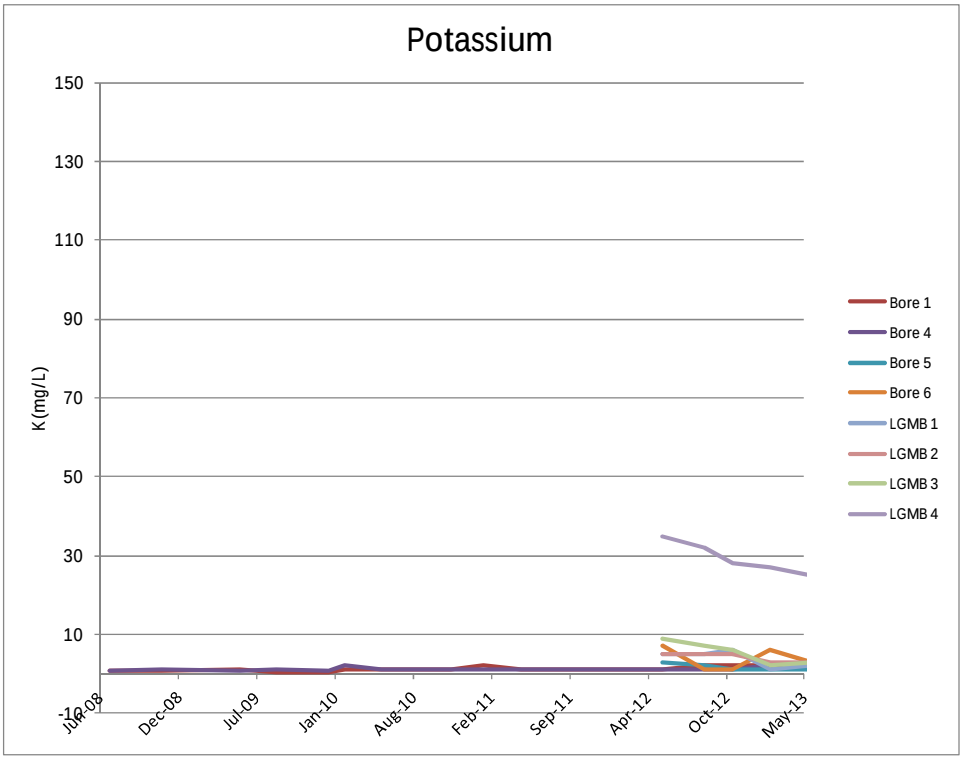
Groundwater monitoring well results are in line with historical levels and have maintained consistent levels with the exception of Bore 1, which is located up gradient of the site but is however still at relative low levels. The magnesium levels sampled would be considered 'soft' in the 0-60mg/L area. 'Hard' water would be considered in the region of 120-180mg/L

Nitrogen as ammonia results presentation.



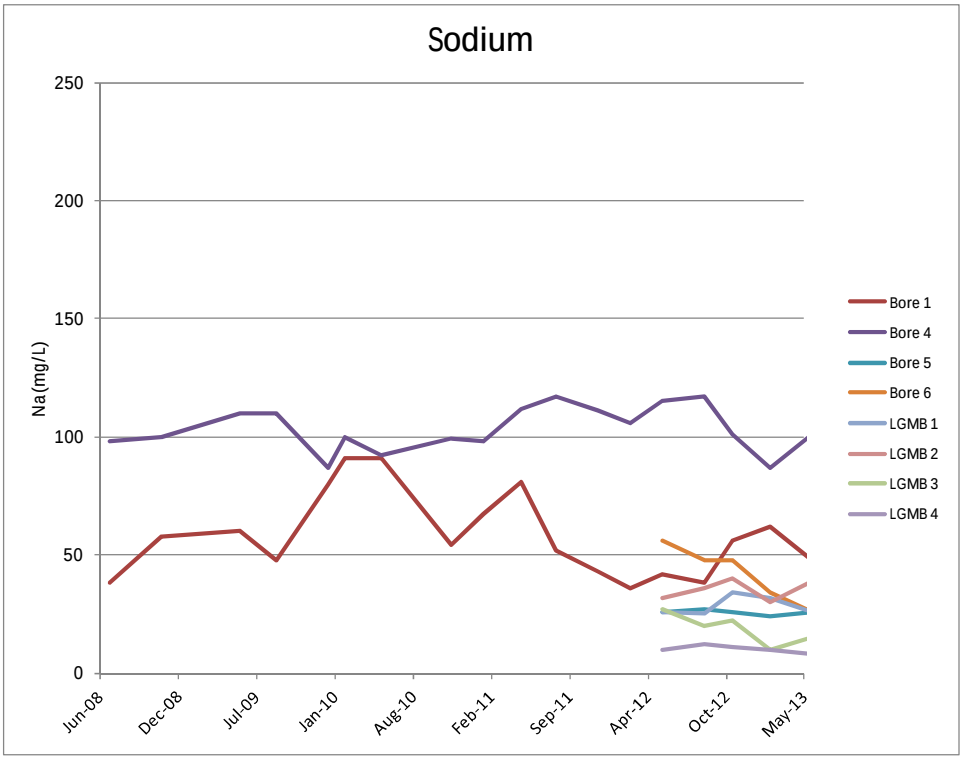
The groundwater monitoring wells indicate that ammonia levels in the groundwater are consistent over a long results period with the exception of seemingly anomalous rounds of testing in March 2008 and May 2012 derived from Bore 1, located up gradient from the site and indicative of the groundwater coming into the site. The relatively low results for ammonia in down gradient Bores 4, 6 and LGMB 4 indicate that the groundwater departing the site is not affected by Ammonia, which is perhaps the clearest signature of leachate.

Potassium results presentation.



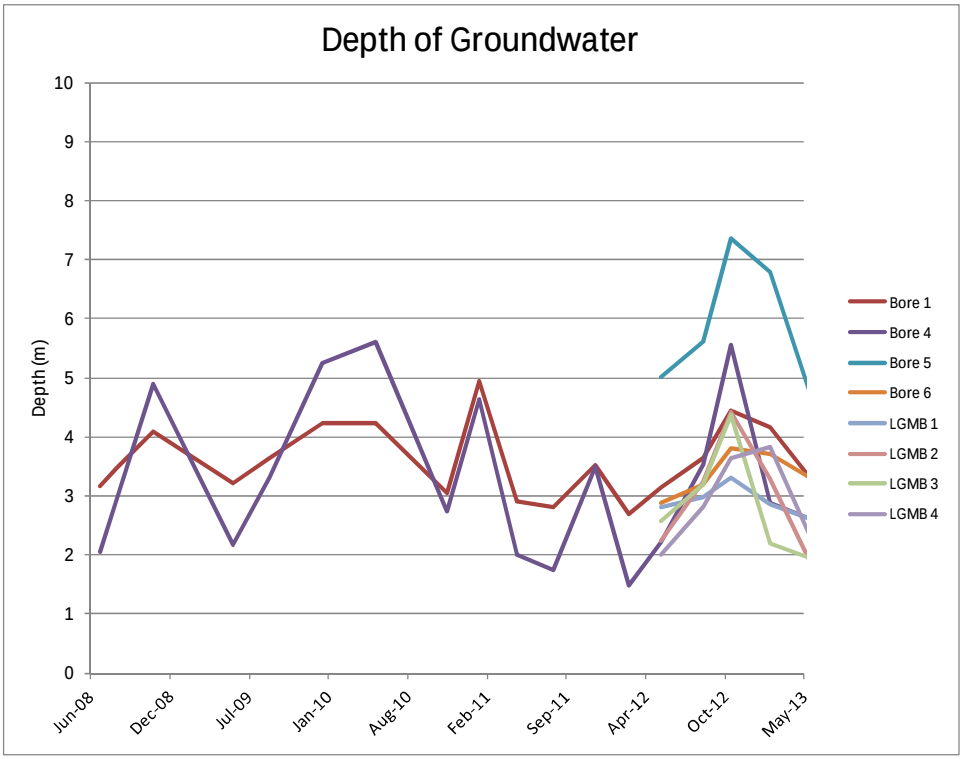
Potassium is present in groundwater systems outside coastal areas generally through weathering of clays and agricultural purposes (leaching of fertiliser). Potassium may also be present in the breakdown of glass and especially cathode ray tubes. Groundwater monitoring wells indicate that potassium levels in the ground water have not increased relative to historic levels over the available results period. The breakdown of clay materials on the down gradient slope towards the Hacking River may be the reason for the relative elevation of potassium in LGMB 4.

Sodium results presentation.



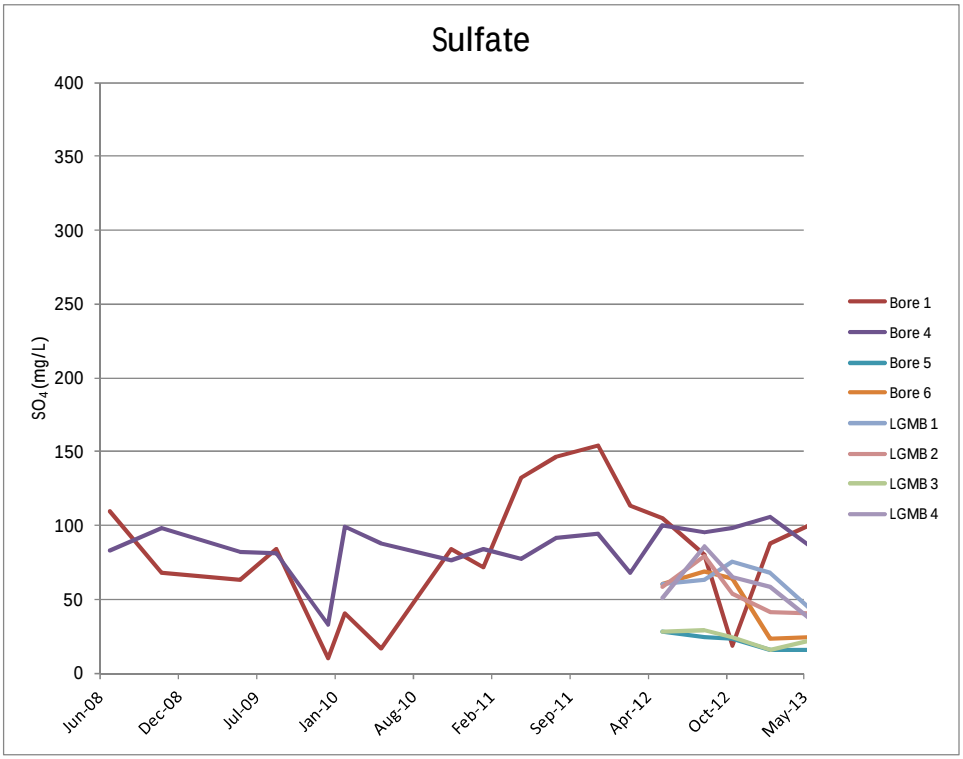
The trend for sodium has been stable over the history of available results. High sodium levels are another indicator of leachate infiltrating the groundwater. The ***2011 Australian Drinking Water Guidelines 6*** set a maximum level of sodium in drinking water at 180mg/L for aesthetic reasons. The sodium results experienced in the groundwater at Helensburgh indicate that the groundwater is not contaminated by leachate.

Standing water level presentation.



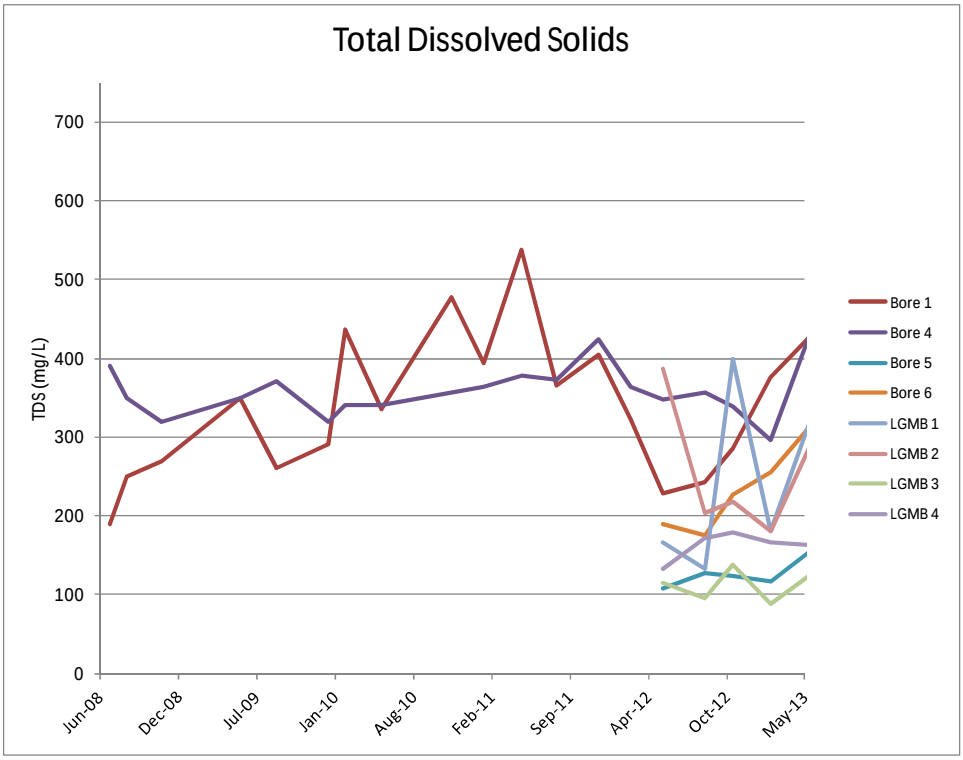
Groundwater level trends have been fairly stable, with the fluctuation over the 5 year testing period being a maximum of about 3.6m in Bore 4.

Sulfate results presentation.



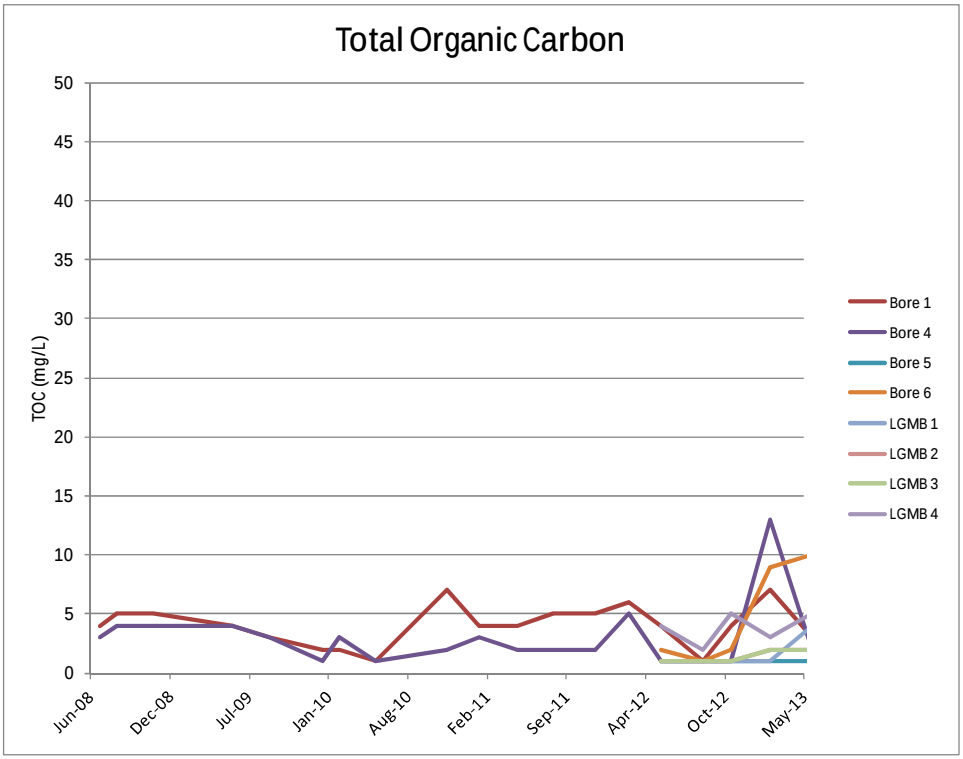
The ***2011 Australian Drinking Water Guidelines 6*** sets maximum sulfate levels in drinking water as 500mg/L. The sulfate levels in the groundwater monitoring wells are in line with the historical levels and are below the drinkable water maximum standard. Inorganic ions such as sulfate provide a good indication of groundwater contamination by landfill leachate. A sudden increase in these ions can act as early warning system.

Total dissolved solids results presentation.



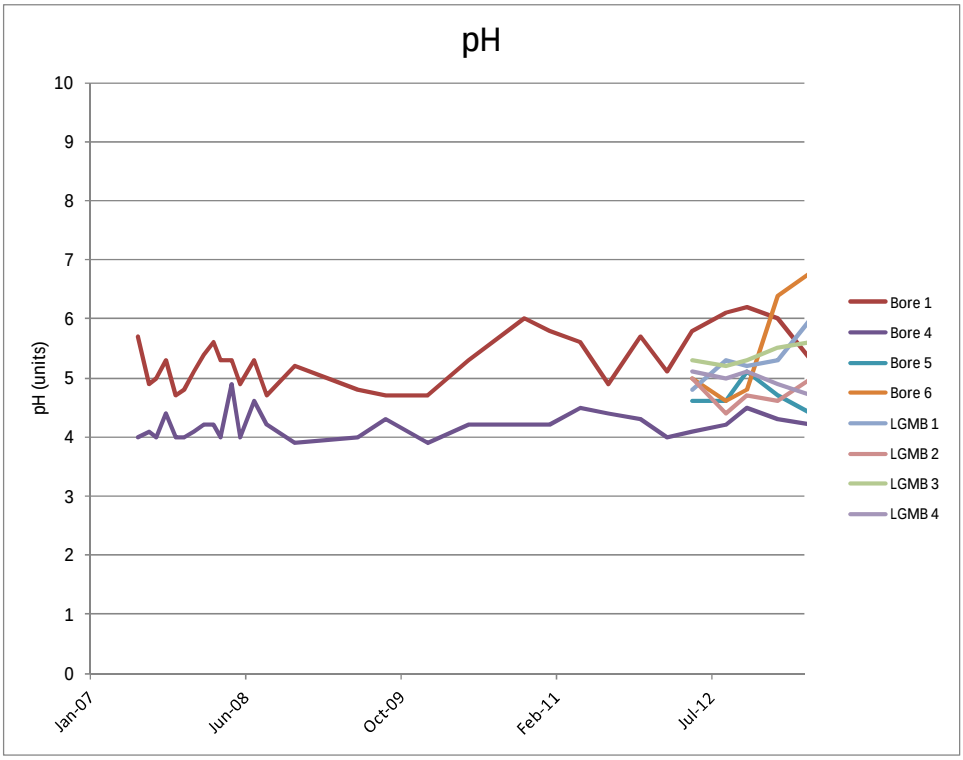
The ***2011 Australian Drinking Water Guidelines 6*** states that total dissolved solids levels of less than 600mg/L indicate good quality drinking water. The dissolved solids levels in the groundwater monitoring wells are in line with historical trends. High levels of dissolved solids can be sourced from salts derived from leachate infiltration.

Total organic carbon results presentation.



Microbial degradation of organic matter can increase the total organic carbon content in water and may provide evidence of groundwater contamination by organic compounds derived from the landfilling of organic matter. The amount of total organic carbon has remained consistently stable over the 5 year results period. The relatively higher incidental level in Bore 4 returned to normal after the November 2012 sample was taken. The relatively low results for TOC in down gradient bores indicate that organic matter is not entering the groundwater. It should also be noted that organic materials have not been landfilled at the Helensburgh site since 1991.

pH results presentation



The pH levels indicated in the groundwater monitoring wells have been extremely stable over the six year sample period. The fluctuations have been very small except with minor anomalies that invariably return to a stable trend. The groundwater monitoring wells indicate that the historical pH of the groundwater has been maintained over the six year sample period. The relatively low pH found naturally in the groundwater on site give an increased propensity for heavy metals to breakdown and travel through the system.

Bore 6 should be closely monitored upon the receipt of future samples to ensure that an upward (basic) trend does not develop.

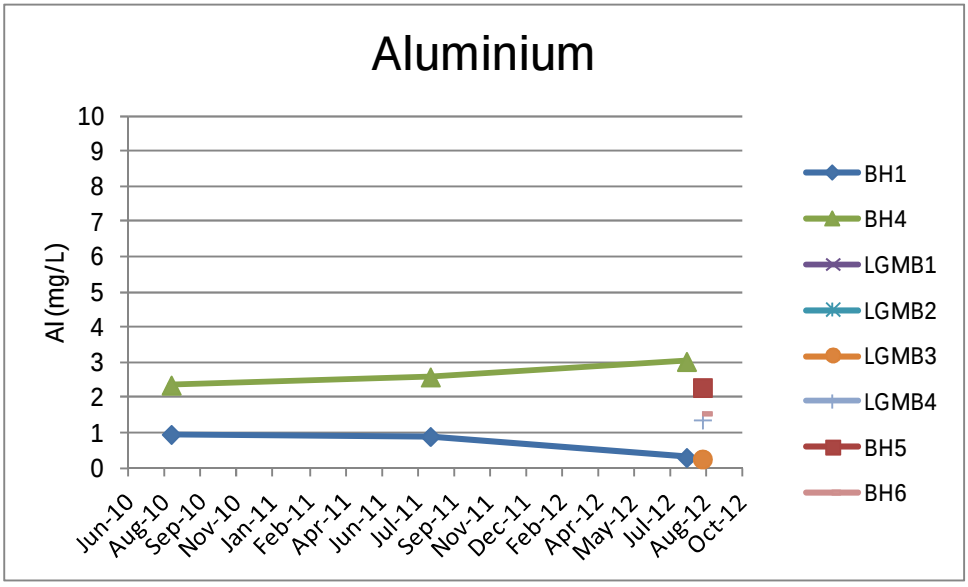
3.1.3 Data Presentation – Annual Monitoring

There is three years worth of annual groundwater regime sampling data available. Many of the sampled analytes over the three year sampling period have displayed such low contamination levels that the results have been near or below detectable limits. There is little sense in graphically displaying analytes that hover on or below laboratory detectable limits. These analytes are:

- Arsenic
- Benzene
- Cadmium
- Chromium (hexavalent)
- Chromium (total)
- Cobalt
- Copper
- Ethyl benzene
- Fluoride
- Lead
- Mercury
- Nitrite
- Organochlorine pesticides
- Organophosphate pesticides
- Polycyclic aromatic hydrocarbons
- Toluene
- Total phenolics
- Total petroleum hydrocarbons
- Xylene

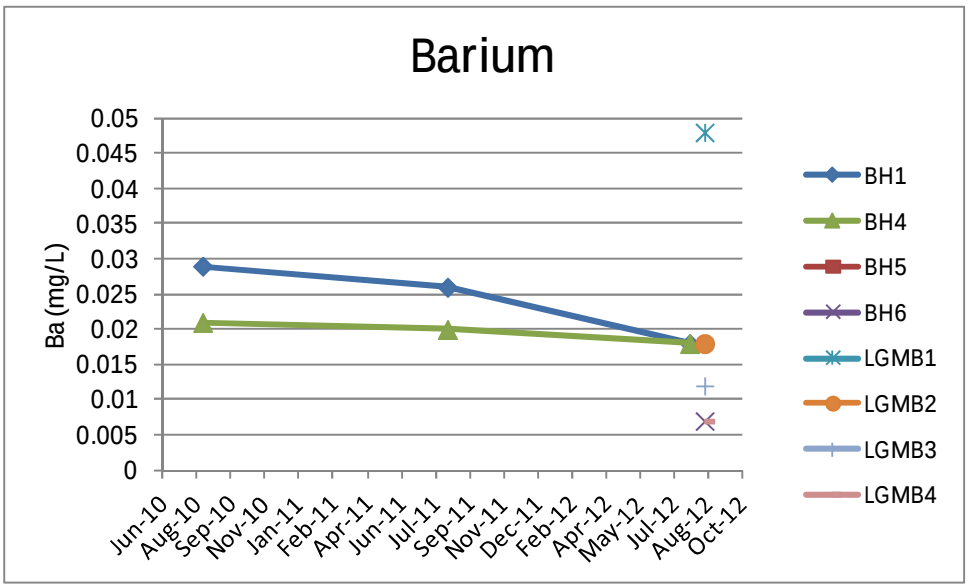
There is therefore little to gain from modelling aforementioned analytes. Only analytes with tangible results are modelled.

Aluminium results presentation.



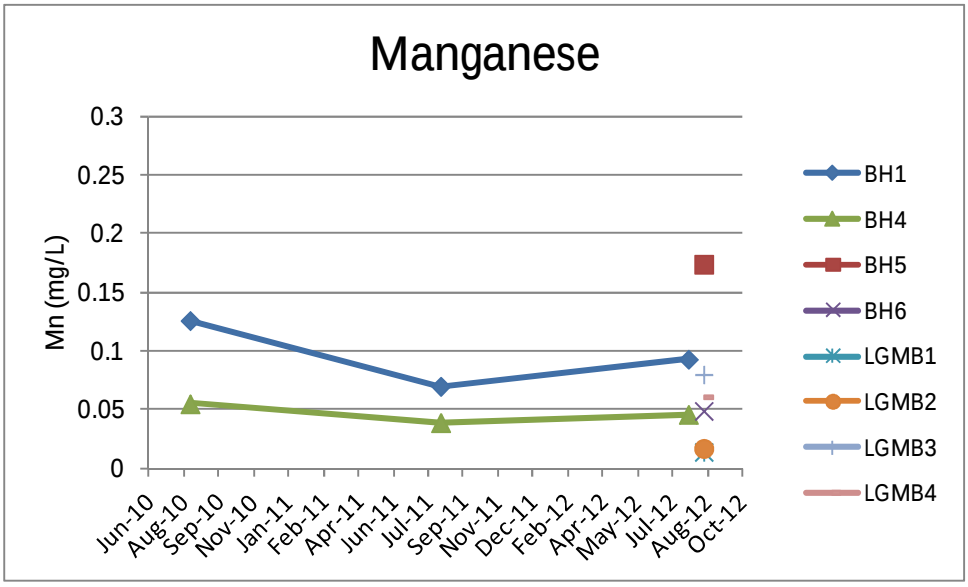
Aluminium levels in the sampled groundwater monitoring wells have been maintained at a consistent low level throughout the reporting period. Anthropogenic sources of aluminium in groundwater are generally related to low pH runoff and colliery based leachate.

Barium results presentation



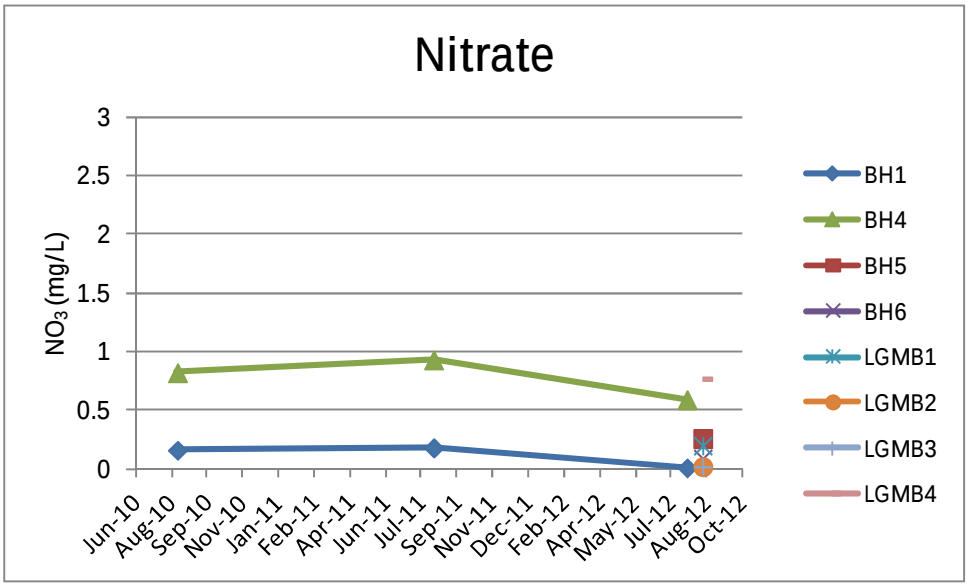
The ***2011 Australian Drinking Water Guidelines 6*** states that a maximum of 2 mg/L of barium is safe for consumption. Anthropogenic sources of barium in groundwater include bleaches, dyes and drillers mud. Barium levels are therefore extremely low and stable in the sites groundwater.

Manganese results presentation



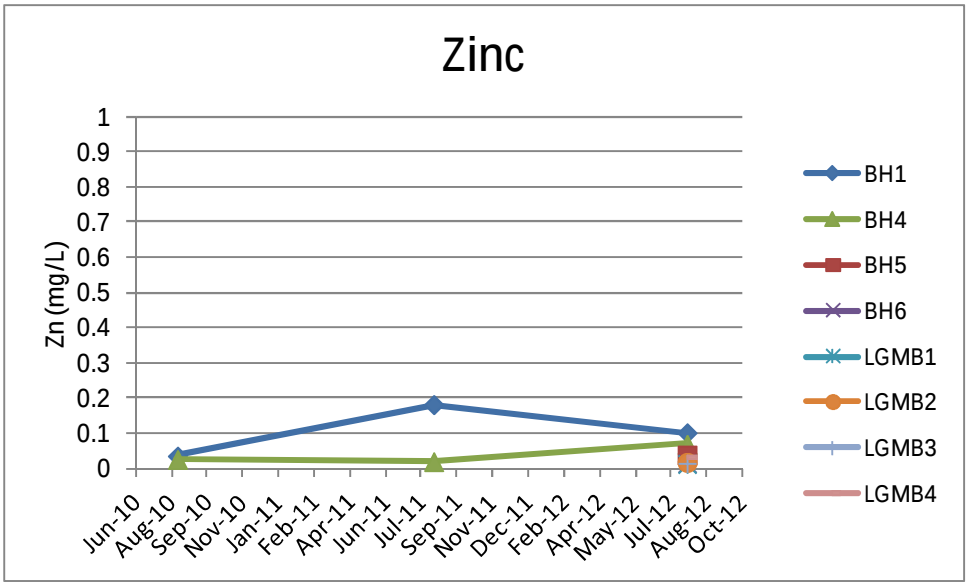
The ***2011 Australian Drinking Water Guidelines 6*** states that a maximum of 0.5 mg/L of manganese is safe for consumption. Manganese can be a strong indicator of landfill leachate in groundwater leached from hazardous waste sites and often derived from battery disposal. The extremely low manganese results provide that leachate infiltration into the surrounding groundwater is unlikely.

Nitrate results presentation



The ***2011 Australian Drinking Water Guidelines 6*** states that a maximum of 50 mg/L of nitrate is safe for consumption. Denitrification is a process common in leachate treatment where he anaerobic biological reduction of nitrate (NO_3) to nitrogen (N_2) in its gaseous form. Under anoxic conditions microorganisms consume the oxygen in the nitrate and liberate the nitrogen. The relatively low levels of nitrate sampled, indicate that landfill leachate is not present in the groundwater.

Zinc results presentation



The ***2011 Australian Drinking Water Guidelines 6*** states that for aesthetic reasons a maximum of 3 mg/L of zinc is desirable for consumption. Landfill sites can be an anthropogenic source of zinc in groundwater, however the extremely low levels of zinc detected indicate that landfill leachate is not intercepting the groundwater system around the site.

Unfortunately for all annually sampled analytes, trends have not been established as yet due to the lack of historical data available.

3.1.4 Groundwater Testing Results Interpretation

Results indicate that there has been no definitive increase in concentration levels for any of the analytes detailed when compared to the historical results and trends (where available). The following table indicates the analytes that should be closely monitored for developing trends over the next twelve months:

Analyte	Bore Number	Regime	Next Sample
Alkalinity	6, LGMB1	Quarterly	August 2013
Calcium	6, LGMB1	Quarterly	August 2013
pH	6	Quarterly	August 2013

On reflection, key indicators of landfill leachates potential ingress into ground water including ammonia, nitrate, nitrite levels and other less poignant indicators as tested do not conclude that that landfill leachate is entering the surrounding ground water system.

3.2 SURFACE WATER MONITORING

3.2.1 Tabulated Results

As per the sites EPL, stormwater overflow events and the Pony Club stormwater detention pond were monitored with the following results:

Analyte	Nil Overflows
Suspended Solids	n/a
pH	n/a

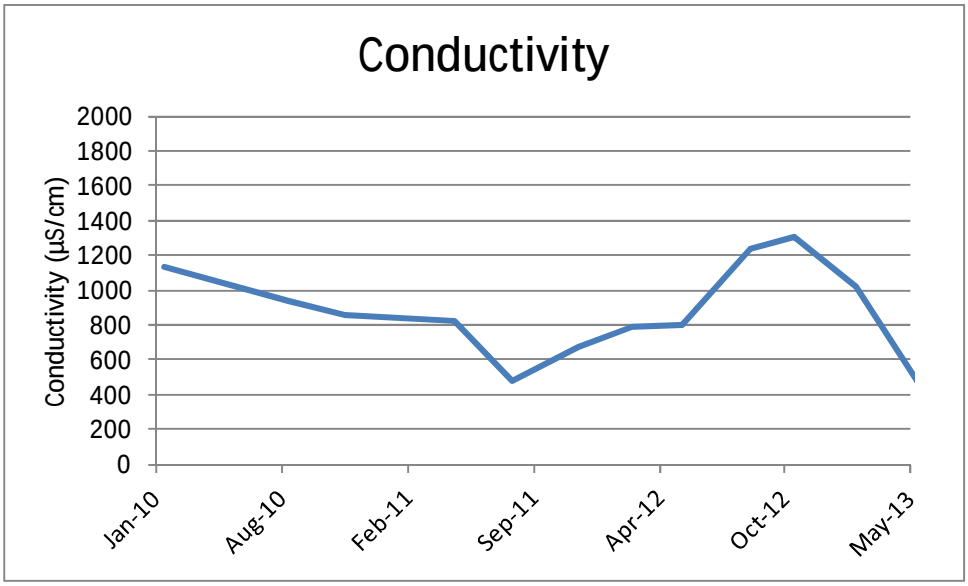
Table 3.2.1(a) Showing stormwater overflow monitoring results

Analyte	Unit	Aug-12	Nov-12	Feb-13	May-13
Conductivity	µS/cm	1240	1300	1020	436
Dissolved Oxygen	mg/L	7.22	6.31	6.21	8.28
Faecal Coliforms	CFU/100mL	8	230	900	8600
Nitrogen (Ammonia)	mg/L	16.2	15.9	11.8	1.02
Potassium	mg/L	34	34	25	8
Redox Potential	mV	29	153	22	23
Total Dissolved Solids	mg/L	616	716	506	362
Total Organic Carbon	mg/L	11	29	20	12
pH	pH	7.2	7.4	7.1	6.8

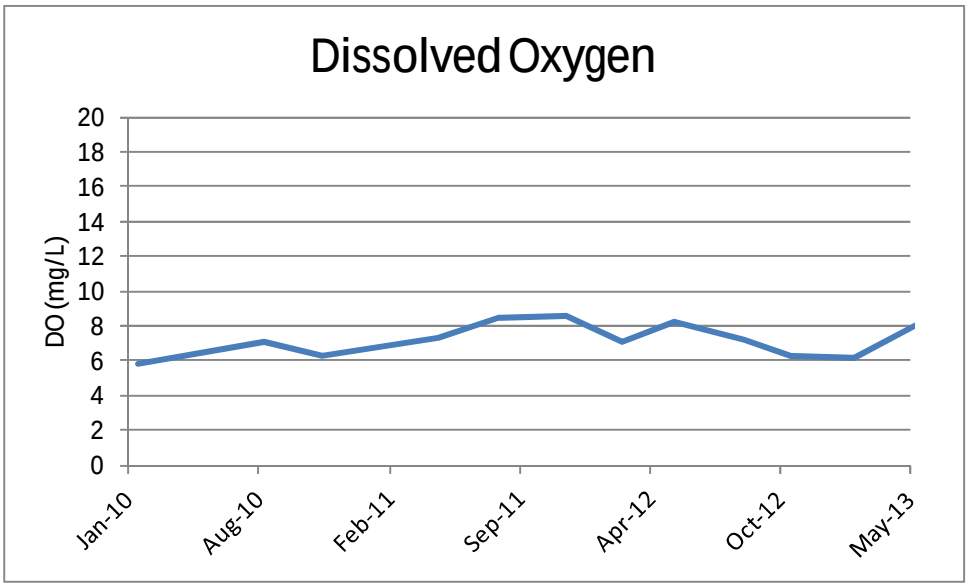
Table 3.2.1(b) Showing quarterly stormwater quality in the pony club pond

3.2.2 Data Presentation

Conductivity and dissolved oxygen in Pony Club Pond data presentation.

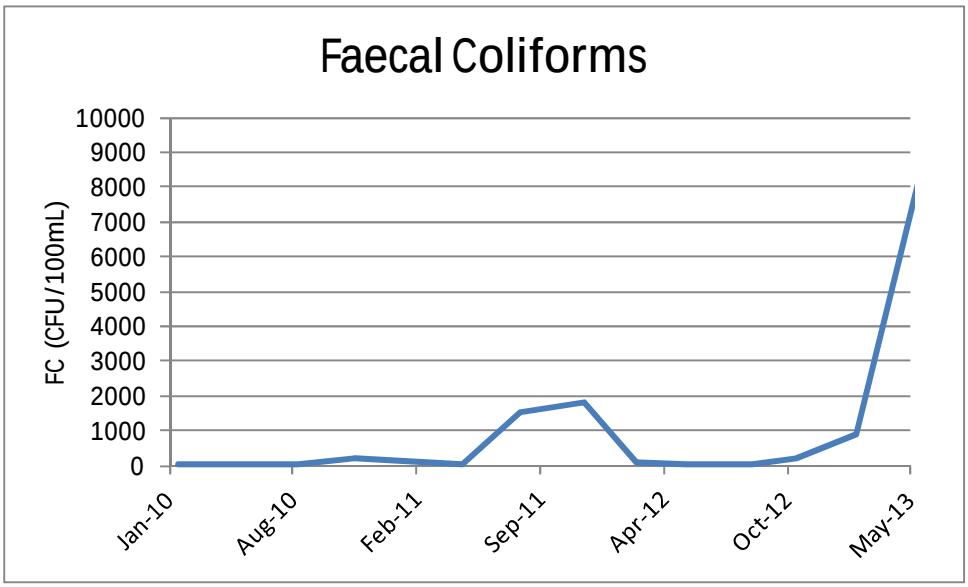


Conductivity is a measure of the waters ability to pass electrical current, usual though positively or negatively charged inorganic dissolved solids (e.g. sodium, magnesium, calcium, iron). The conductivity results for the Pony Club pond have been stable and trending downwards.



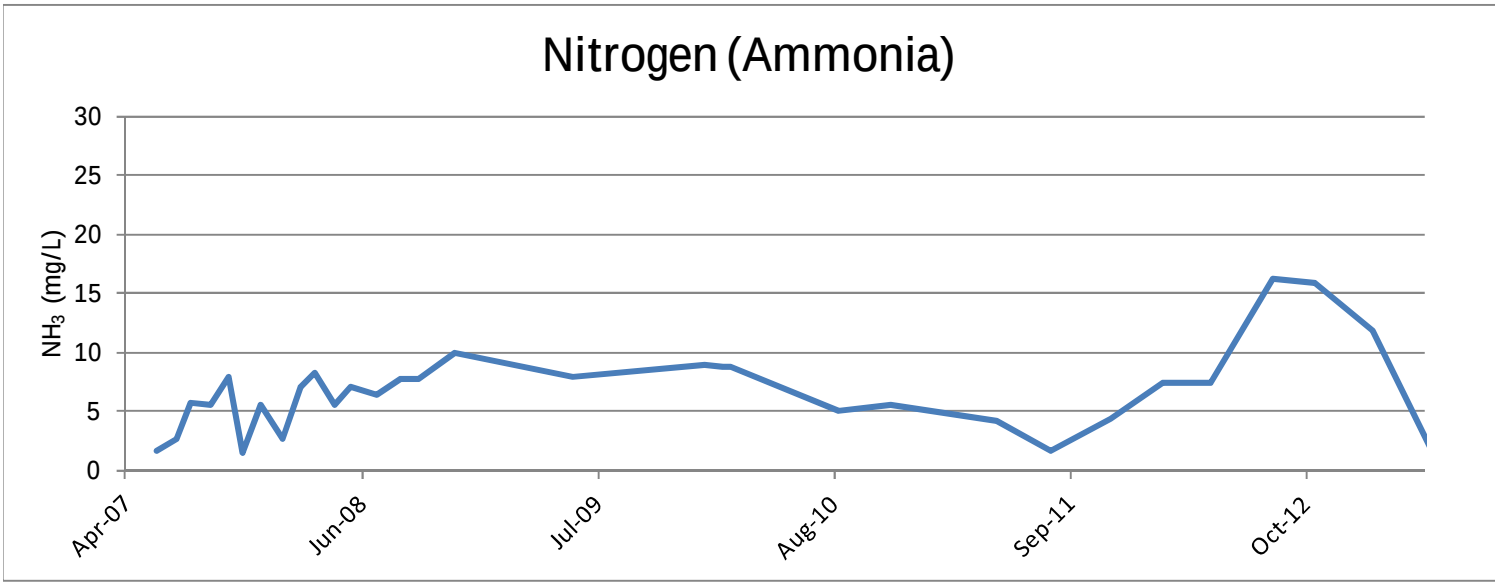
Dissolved oxygen levels can be depleted by biological activity associated with the nitrification process (common in leachate). The dissolved oxygen levels have been stable over the history of available results indicating leachate is not entering the Pony Club stormwater pond.

Faecal coliforms data presentation.



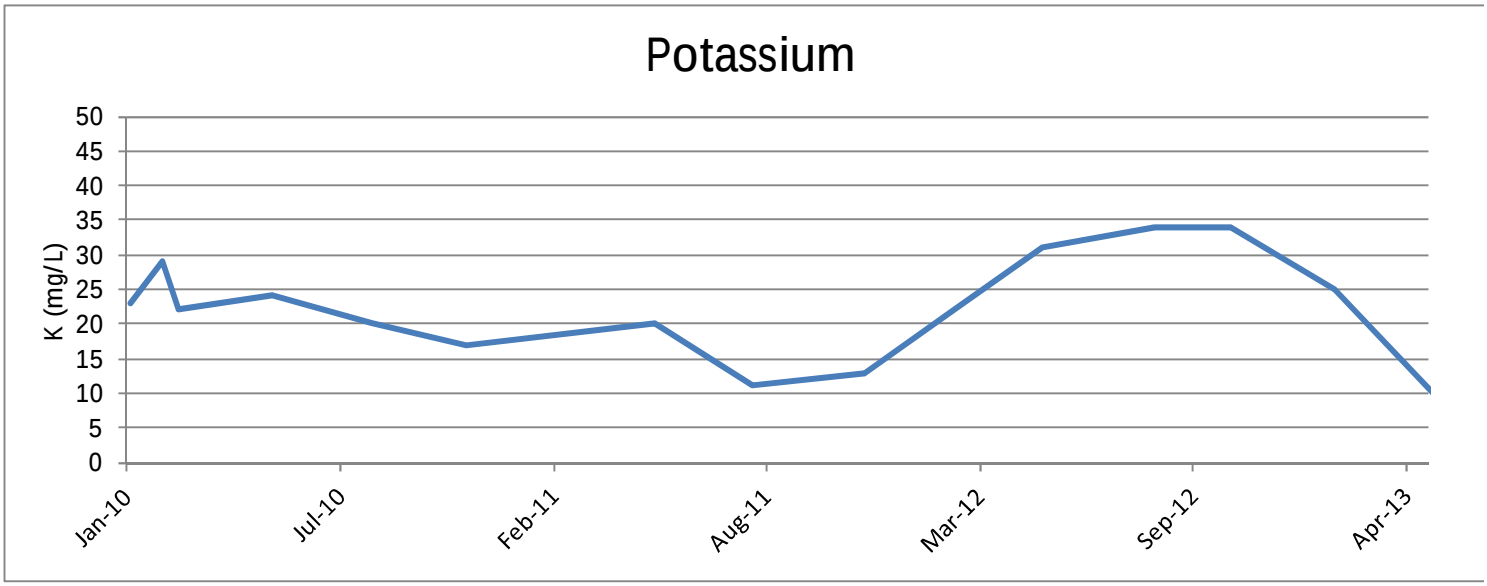
Coliforms are bacteria that live in animal intestines that can be found in excrement. The results displayed indicate that animal excrement may have been present in the pond in late 2011 and again in May 2013. The site is exposed to off leash dogs, horses (as a Pony Club) and deer.

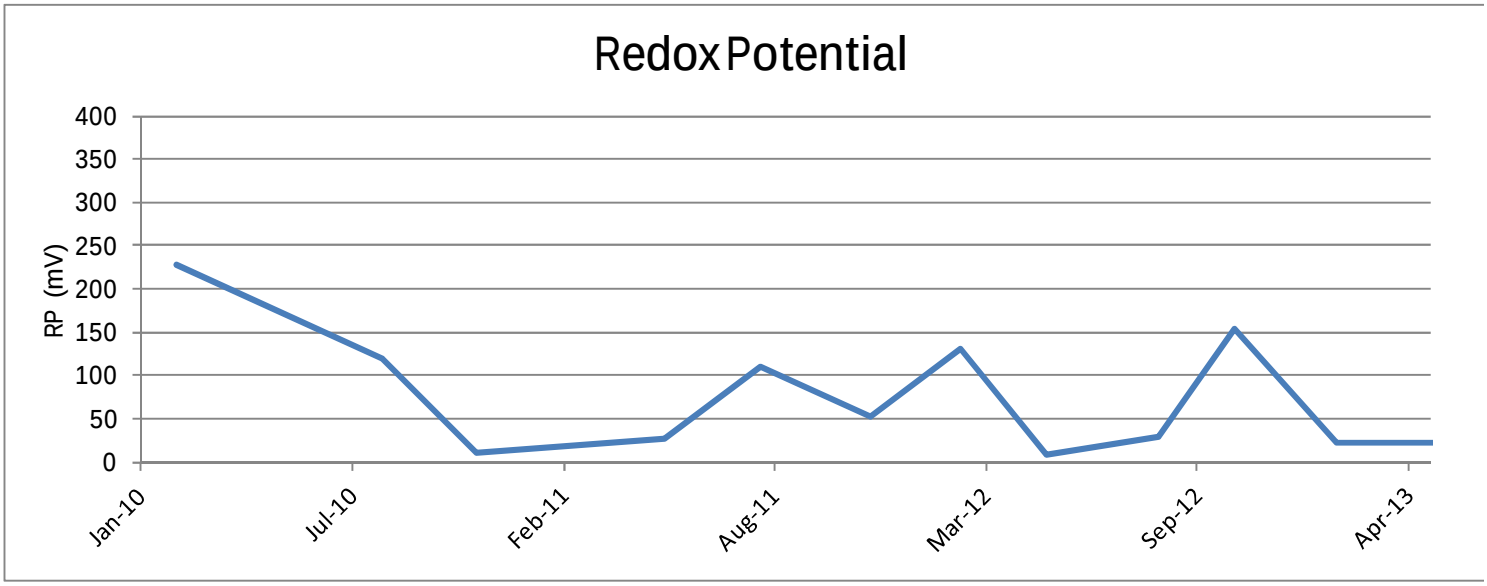
Nitrogen as ammonia data presentation.



Nitrogen (as Ammonia) has a relatively long history available for comparison. The trend has been ultimately stable over time fluctuating at a maximum between 2 and 17 mg/L. There is no indication that leachate is entering the Pony Club pond.

Potassium and redox potential in Pony Club Pond data presentation.





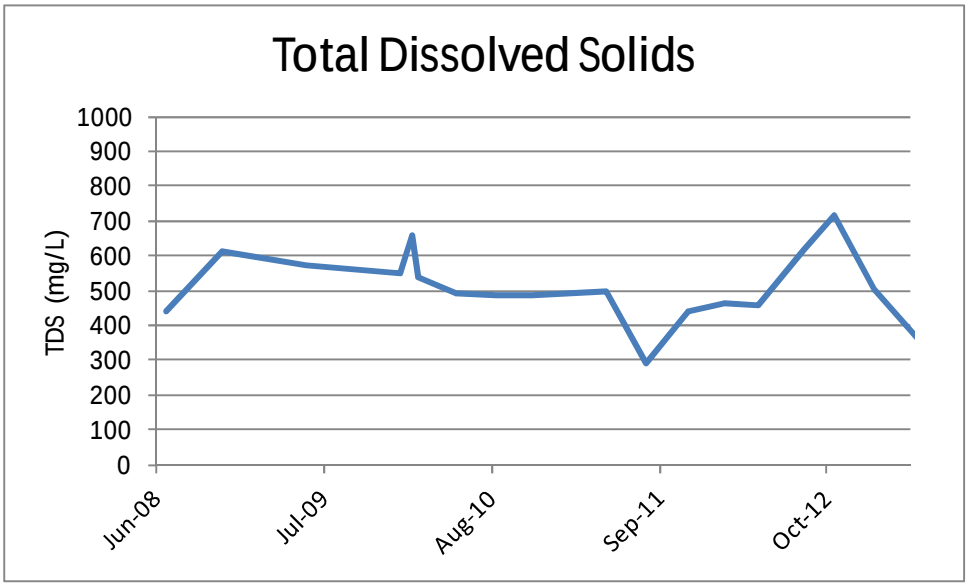
Both potassium and redox potential trends have been generally in line with historical trends.

Potassium is present in bodies of water outside coastal areas generally through weathering of clays and agricultural purposes (leaching of fertiliser).

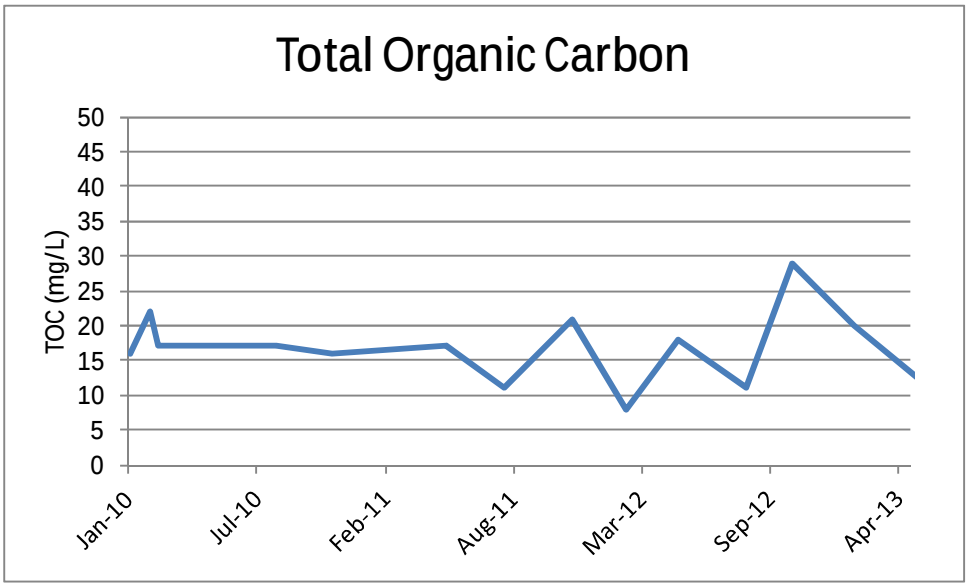
Redox reactions involve the transfer of electrons from a donor to a receptor and can be useful in determining if aerobic or anaerobic activity is occurring in a system.

Both potassium and redox potential levels sampled are considered to be within normal historical ranges.

Total dissolved solids and total organic carbon in Pony Club Pond data presentation.

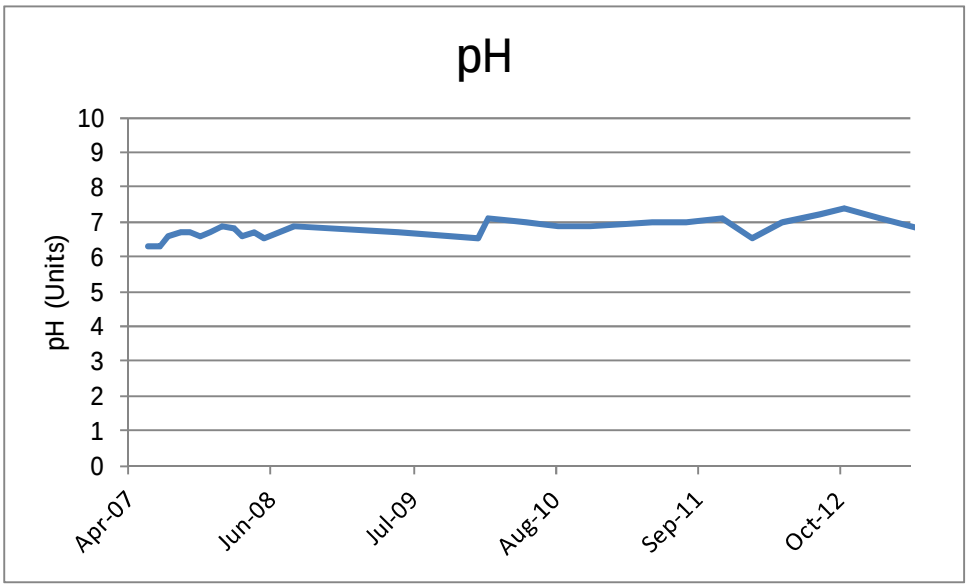


The ***2011 Australian Drinking Water Guidelines 6*** states that total dissolved solids levels of less than 600mg/L indicate good quality drinking water. The dissolved solids in the Pony Club pond are in line with historical trends and at levels considered good for consumption (although not recommended). High levels of dissolved solids can be sourced from salts derived from leachate infiltration.



Microbial degradation of organic matter can increase the total organic carbon content in water and may provide evidence of contamination by natural compounds derived from the landfilling of organic matter. The amount of total organic carbon has remained consistently stable over the results period. It should also be noted that organic materials have not been landfilled at the Helensburgh site since 1991. The results displayed are similar to the TOC results found in the sites groundwater

pH levels in Pony Club Pond data presentation.



Over relatively long history of data presented (6 years) the pH levels in the Pony Club pond have been ultimately stable and within optimal levels for the natural environment.

3.2.3 Stormwater Results Interpretation

From the data analysed for the Pony Club stormwater pond, all results are stable over the time period of available data. Despite the exhaustive list of analytes required to be tested in this ultimately minor stormwater pond, no abnormal results have been encountered. Therefore, the leachate system on site is not considered to be affecting the stormwater quality in the nearby Pony Club stormwater detention pond. Further, it can be accordingly demonstrated that the sites sediment and stormwater pond infrastructure is performing adequately and as desired.

3.3 LEACHATE POND MONITORING

3.3.1 Tabulated Results

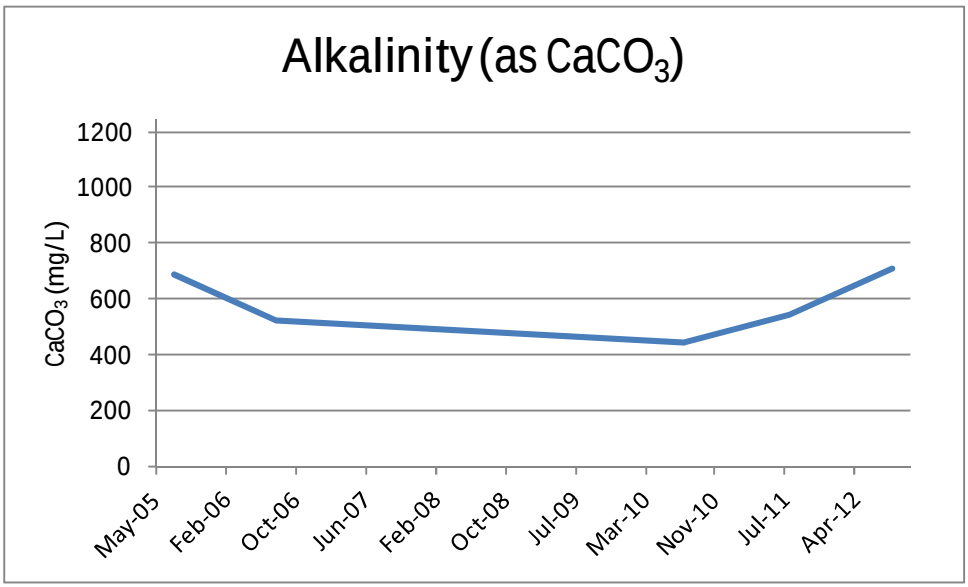
As per the EPL, the leachate pond was monitored with the following results:

Analyte	Units	Aug 2012
Alkalinity (as Calcium Carbonate	mg/L	710
Aluminium	mg/L	0.03
Arsenic	mg/L	0.002
Barium	mg/L	0.212
Benzene	µg/L	<1
Cadmium	mg/L	<0.0001
Calcium	mg/L	96
Chloride	mg/L	112
Chromium (Hexavalent)	mg/L	<0.01
Chromium (Total)	mg/L	0.002
Cobalt	mg/L	0.001
Conductivity	µS/cm	1590
Copper	mg/L	0.004
Ethyl Benzene	µg/L	<2
Fluoride	mg/L	0.1
Lead	mg/L	<0.001
Magnesium	mg/L	43
Manganese	mg/L	0.205
Mercury	mg/L	<0.0001
Nitrate	mg/L	3.61
Nitrite	mg/L	0.33
Nitrogen (Ammonia)	mg/L	23.2
Organochlorine pesticides	µg/L	<0.05
Organophosphate pesticides	µg/L	<0.05
Phosphorus (Total)	mg/L	0.2
Polycyclic Aromatic Hydrocarbons	µg/L	<1
Potassium	mg/L	48
Sodium	mg/L	151
Sulfate	mg/L	23
Toluene	µg/L	<2
Total Phenolics	mg/L	<0.05
Total Dissolved Solids	mg/L	900
Total Organic Carbon	mg/L	15
Total Petroleum Hydrocarbons	µg/L	50
Total Suspended Solids	mg/L	27
Xylene	µg/L	<2
Zinc	mg/L	0.013
pH	pH	7.6

3.3.2 Data Presentation

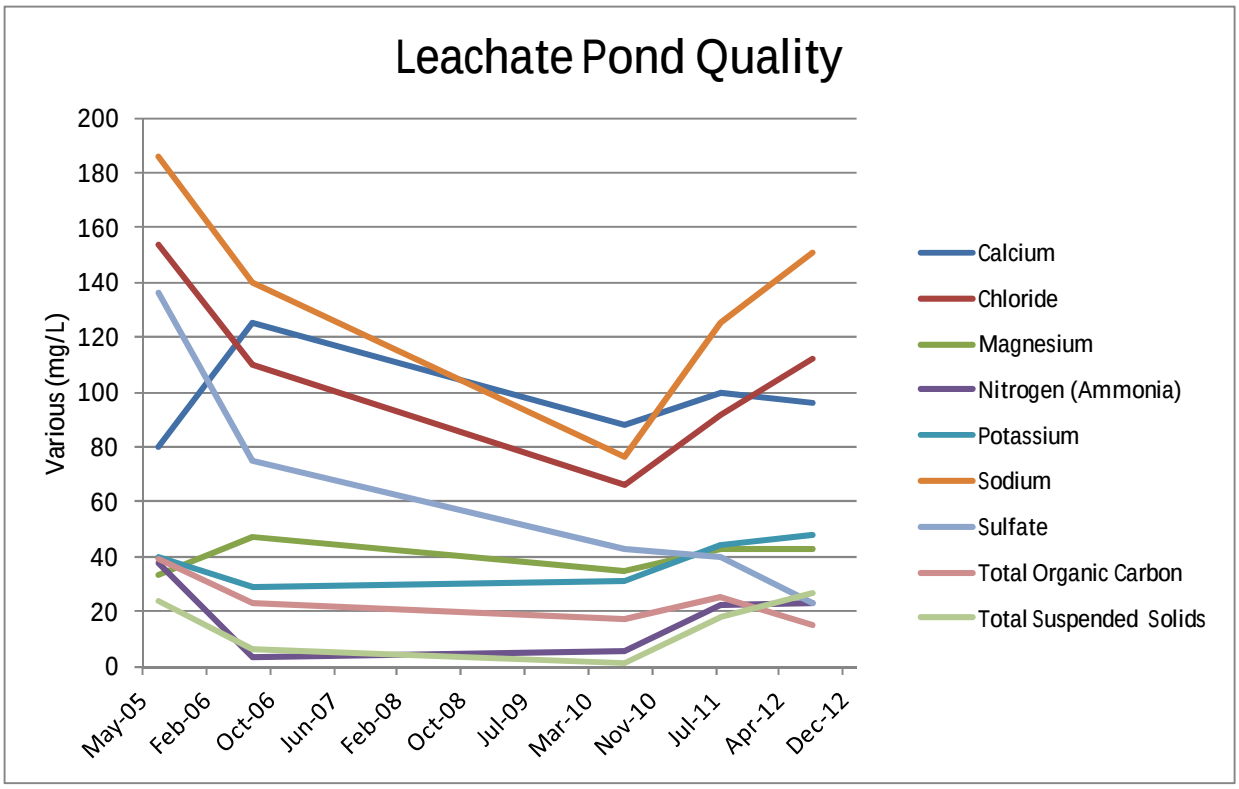
There is minimal history available for many of the analytes tested in the leachate dam at the Helensburgh Waste Disposal Depot. The data presented is only where there is a documented history of any results to draw comparisons to. All analytes that are sampled but not modelled are either near or below testable laboratory limits or isolated results that do not have historical data with which to compare.

Alkalinity as Calcium Carbonate results presentation.



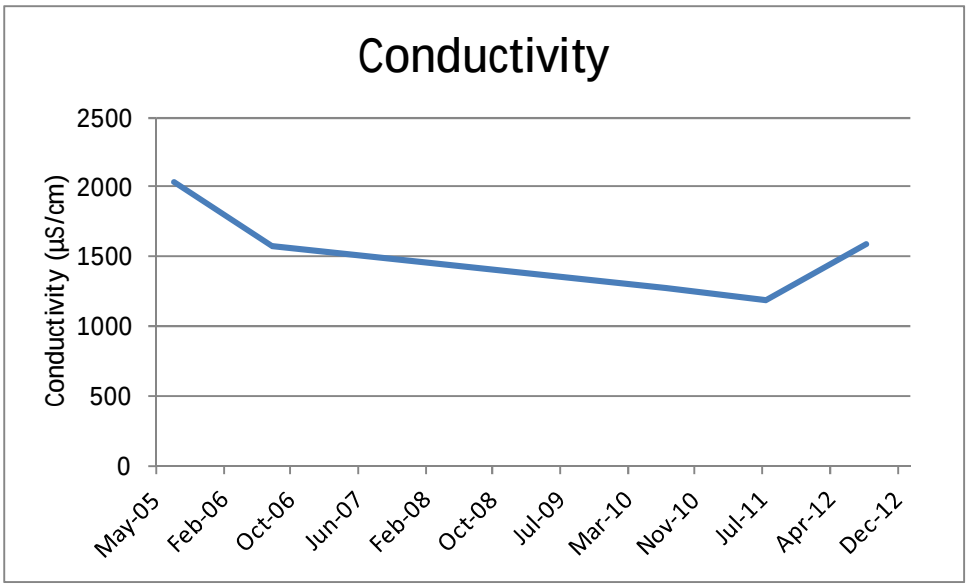
Alkalinity levels in the sites leachate are approximately 4 times higher than the highest groundwater result. Therefore indicating that leachate is probably not escaping the storage pond.

Multiple analytes results presentation



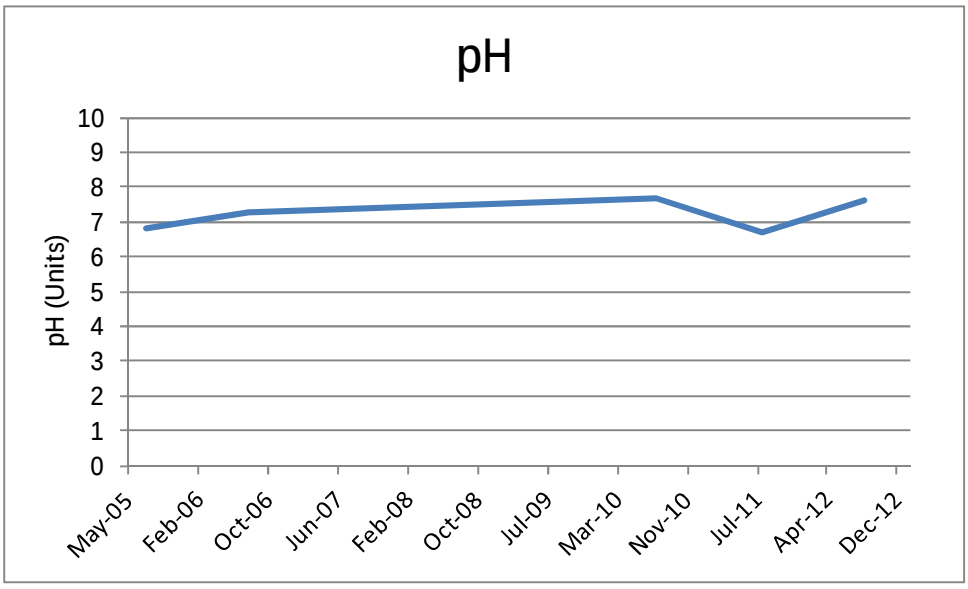
Data history for the plotted analytes shows either consistent or downward trends. Calcium, magnesium, potassium, sodium, total organic carbon and total suspended solids are all found at levels higher than the surrounding groundwater or the surface water pond, suggesting that leachate is being effectively contained and treated.

Conductivity results presentation.



Electrical conductivity levels are higher than the surrounding stormwater pond, suggesting that leachate is being effectively contained and treated.

pH results presentation.



pH levels in the leachate pond have remained stable over a relatively long sample period. The pH averages around 7.5 which would foster the aerobic nitrification process in the leachate.

3.3.3 Leachate Pond Results Interpretation

The results for the leachate pond water shows that the composition of the leachate may have improved slightly in regard to environmental consequence over the last 6 years. This would reflect the increased environmental controls implemented on site and the ban on putrescible waste types many years prior. However, the lack of background data makes it difficult to draw any definitive conclusion. Further, the benefits of sampling leachate quality in a leachate pond are minimal aside from potential comparison to surrounding stormwater pond quality. But even in this instance, the extent of the analytes tested is far more onerous than would be used to indicate cross contamination.

3.4 AIR EMISSIONS MONITORING

3.4.1 Tabulated Results

Table 3.4.1(a) Methane monitoring results.

Date	Results Above Recommended Threshold 500ppm	Accumulation Above Recommended Threshold 1250ppm
Aug-12	0	0

Presented results are the numbers of individual results derived from monthly sampling that are above the EPA Benchmark Technique recommended threshold levels for further action regarding surface emissions (500 ppm) and accumulation levels (1,250 ppm).

Table 3.4.1(b) Methane monitoring results in Migration Monitoring Assets

August 2012 - Landfill Gas Migration Monitoring Bores	
Bore Reference	Methane Concentration (ppm)
LGMB1	0.6
LGMB2	<0.1
LGMB3	70.6
LGMB4	1.7

Presented results are the methane concentration measured in the strategically placed gas migration monitoring bores.

3.4.2 Data Presentation

No data has been presented due to the fact that no emissions above EPA threshold levels for recommended further investigation were found on the site, nor have any results above these thresholds ever been found despite monthly testing completed voluntarily in past years.

3.4.3 Air Emissions Monitoring Results Interpretation

The site does not seem to be producing significant amounts of landfill gas, which is as expected for a non putrescible site. Resultant of the methane levels reported in the 2010-2011 Annual Environmental Management Report, Council now only sample the site annually as prescribed in the sites EPL.

To address a potential problem identified in the 2010-2011 Annual Environmental Management Report regarding a lack of data able to be ascertained from properties within 250 m of the landfill footprint due to refused entry, Council has installed four gas monitoring bores. The bores are

strategically positioned as directed by GHD's landfill gas expert team and will provide evidence of the migration of landfill gas offsite towards residences. Testing completed indicates that gas migration is not evident.

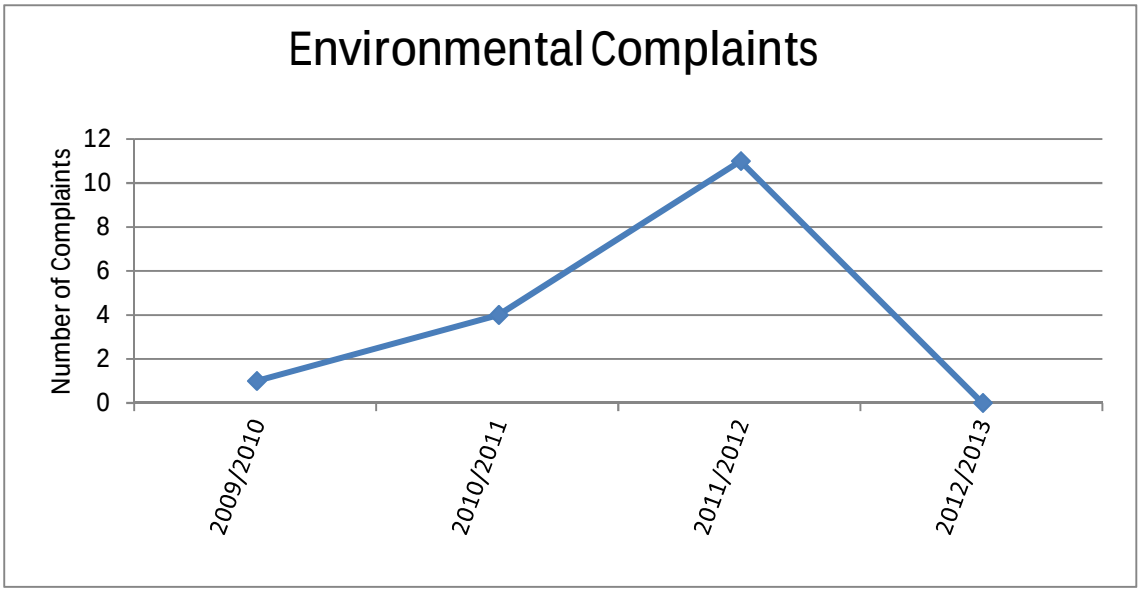
3.5 *ENVIRONMENTAL COMPLAINTS*

3.5.1 Tabulated Results

Year	Environmental Complaints
2009/2010	1
2010/2011	4
2011/2012	11
2012/2013	0

Table 3.5.1 Tabulated complaints for the reporting period and historically

3.5.2 Environmental Complaints Results Interpretation



There were no environment related complaints that were attributed to the site in the reporting period. This is as expected due to the site being closed for all but two months of the reporting period.

4 SITE SUMMATION

4.1 DEFICIENCY IDENTIFICATION & REMEDIATION

No deficiencies were identified in the presented Annual Environmental Management Report. However, some further observations are recommended.

4.1.1 Boreholes Indicating Potentially Imperfect Trend Stability

As discussed in Section 3.1.4, two borehole locations have provided individual and incidental analytical results that require an increased level of scrutiny upon future measurements to ensure negative trends are not establishing. Whilst it is common for individual analytical results to vary from time to time, the prudent course of action is to provide an increased level of vigilance for these analyte and borehole combinations until such time the results return to historic levels or further action is required.

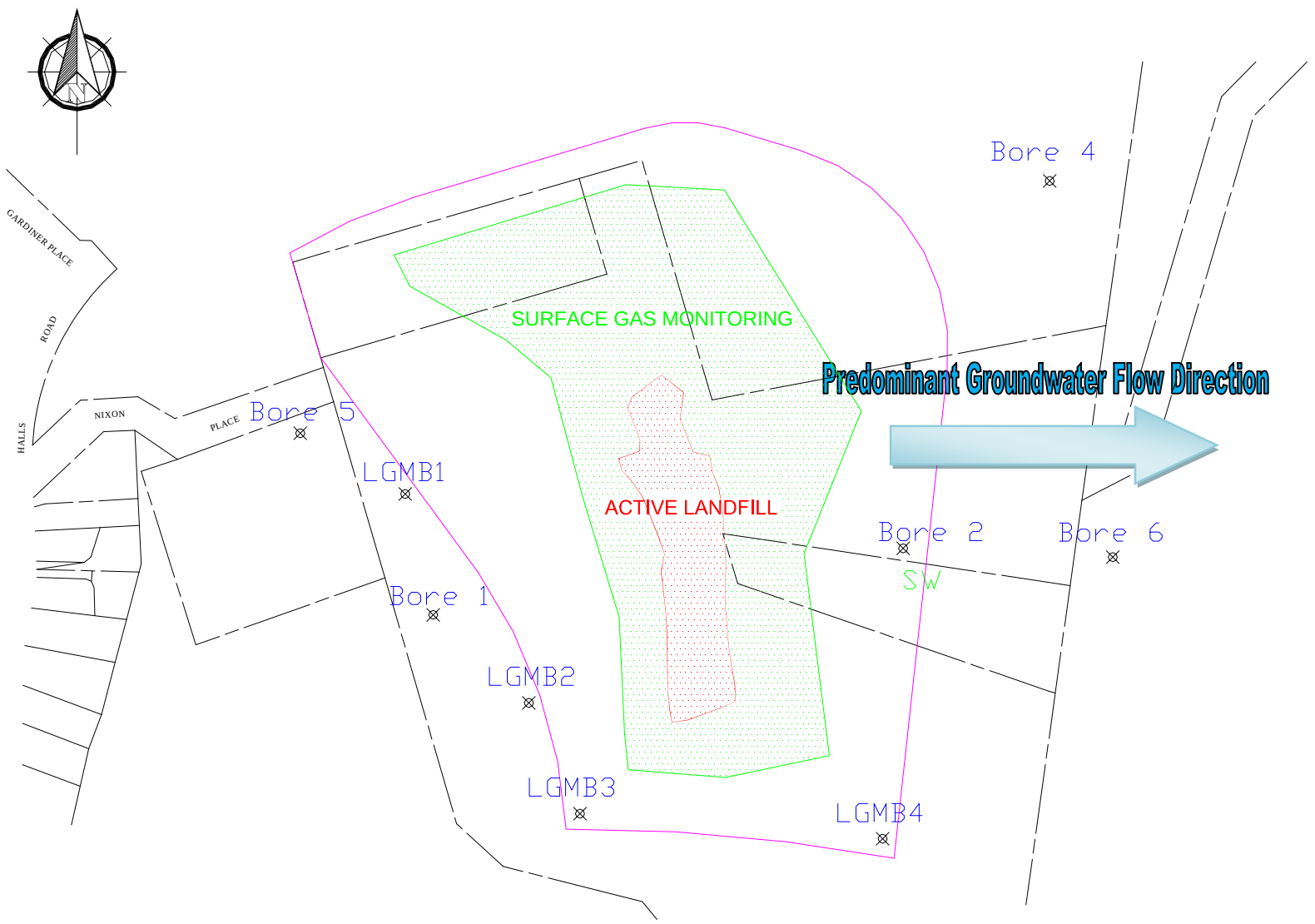
4.2 CONCLUSION

The site is performing adequately within the individual criteria and limits assigned to it in regard to environmental performance. The lack of deficiencies and nil non compliance's in conjunction with low levels of environmentally disruptive pollutants shows that Council has maintained good environmental performance considering the fact that the landfill is unlined. Council will continue to monitor the site in accordance with the sites EPL despite the fact that the site is now closed.

Annexure A

A.1.1 Environmental Monitoring Locations

Environmental Monitoring Locations



Helensburgh Waste Disposal Depot
Environmental Monitoring Locations