



Northern Beaches Health Service Redevelopment
A new wave in healthcare

Northern Beaches Hospital

Stage 1: Concept Design, Site Clearance & Preparatory Works

Appendix M

Groundwater Factual Report

Northern Beaches Hospital Groundwater Factual Report

Prepared for Health Infrastructure

Date | 2 September 2013



Project Name:	Northern Beaches Hospital EIS
Project Number:	30011256
Report for:	Johnstaff

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- A Field sheets for groundwater sampling rounds (March 2013 and June 2013)
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1 INTRODUCTION

1.1 Overview

This report has been prepared by SMEC Australia Pty Ltd (SMEC) for NSW Health Infrastructure (HI) for the proposed Northern Beaches Hospital, at Frenchs Forest. The purpose of this report is to:

- characterise the existing groundwater conditions on the hospital site
- identify any groundwater management issues with regard to development of the site, particularly in relation to any significant excavation
- support the environmental assessment for the proposed hospital.

The hospital site is located in Frenchs Forest on the corner of Wakehurst Parkway and Warringah Road (Figure 1). The locations of the groundwater monitoring bores are also identified on this figure.

1.2 Background

All site drilling activities including installation of monitoring bores were undertaken by the project geotechnical consultant, Douglas Partners Pty Ltd (DP). SMEC provided input to the design and location of bores. All drilling and bore construction information contained in this report was provided by DP while all water level and quality information was collected by SMEC.

Currently, the Northern Beaches Hospital site is mainly covered by native and exotic vegetation. There are also a number of sites of former residences and a former community mental health facility (demolished in March 2013), adjoining Bantry Bay Road. Drilling activities have been restricted to the fringes of the vegetation areas and previously disturbed areas.

1.3 Site geology

The site is underlain by Ashfield Shales or similar units to around eight metres depth which overly Hawkesbury Sandstone. As the site is located on the top of a broad ridge there are no transported soils on site. At surface the shales have weathered to stiff clays with the depth of weathering extending to between one metre and 3.5 metres. The underlying sandstone is fresh to weakly weathered.

1.4 Objectives

The objectives of the groundwater assessment are to:

- provide an assessment of natural groundwater levels
- provide an assessment of background groundwater quality
- present the monitoring data with assessment and review of potential impacts of excavation as part of site development.



DATE 02/09/2013

0 20 40 80
1:2,500 Metres

PAGE SIZE A4

COORDINATE SYSTEM
GDA 1994 MGA Zone 56

FIG NO. 1

FIGURE TITLE Bore Locations

PROJECT NO. 30011256

PROJECT TITLE Northern Beaches Hospital Project

CREATED BY D. Gunn

SOURCES Vector backdrop © MDS 2012;



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Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

1.5 Scope of work

The scope of work undertaken comprised:

- water level measurement using manual electronic dip meter and download installed electronic data loggers
- two groundwater quality sampling and analysis rounds
- sample analysis, review and assessment of the monitoring and water quality data
- assessment of groundwater levels, flow direction and potential contaminants of concern.

1.6 Limitations of reporting

This report was prepared taking due care and with the usual thoroughness of the consulting profession. All information provided in this report is considered valid and up to date at the time of reporting. This report presents the groundwater level monitoring and rainfall data collected to date. The assessment is based on the data collected from the installed monitoring bores only and rainfall records obtained from the Bureau of Meteorology.

Conclusions in this report are based on site observations, testing and other information obtained by SMEC, and on the assumption that these data are representative and reliable. These conclusions must be read in conjunction with the assumptions and uncertainties noted in the report.

2 FIELD INVESTIGATIONS

2.1 Groundwater

Installation of the groundwater monitoring network was initially undertaken by Douglas Partners Pty Ltd (DP), the project geotechnical contractor, in June 2012 and extended in March 2013 (Douglas Partners; 2012, 2013). The network comprises nine monitoring bores and location details are provided in Table 1. The monitoring bores installed in June 2012 were not developed following installation and those installed in March 2013 were developed only by flushing with fresh water and hand bailing the day after installation. The March 2013 installed bores were not supervised by a geotechnical engineer; as such the drilling and construction details cannot be verified by SMEC.

Table 1 Bore location and drilling details

Bore ID	Easting (MGA)	Northing (MGA)	Surface RL (mAHD)	Monitoring point RL (mAHD) [#]	Method [^]	Date installed
PZ01	336183.2	6263994.3	158.5*	158.5	Unknown	Unknown
PZ06	336323.4	6264052.1	159.0	159.0	SFA/Coring	18/06/2012
PZ09	336410.5	6264009.1	160.0	160.0	SFA/Coring	19/06/2012
PZ24	336437.2	6264147.2	154.8	154.8	SFA/Coring	20/06/2012
PZ31	336221.2	6264192.4	160.8	160.8	SFA/Coring	21/06/2012
PZ112	336411.0	6264008.0	159.8	160.3	SFA/Rotary	4/03/2013
P107	336340.0	6264039.0	158.0	158.5	SFA/Rotary	5/03/2013
P102	336208.0	6264149.0	161.0	161.5	SFA/Rotary	4/03/2013
P103	336201.0	6264099.0	160.7	161.2	SFA/Rotary	6/03/2013

* Elevation interpreted from site survey plan, # Interpreted from elevation data and stick measurements

[^] SFA- solid flight auger, Coring – diamond cored borehole, Rotary – rotary washboring

mAHD – metres Australian Height Datum, MGA- Map Grid of Australia 1984

The site experienced vandalism of monitoring bores PZ01 and PZ31. PZ01 was redrilled by DP however no construction information has been made available. PZ31 was rehabilitated by SMEC. SMEC began groundwater monitoring in November 2012.

The groundwater investigation was conducted in general accordance with the *National Environment Protection Measure (Assessment of Site Contamination)* 1999 (NEPC, 1999) and *Australian Standard Guide to the Sampling and Investigation of Potentially Contaminated Soil* (Standards Australia 1999 & 2005). The methods and procedures for fieldwork, decontamination procedures and sample handling were consistent with current industry practices.

Fieldwork was conducted on the following dates: 21 November 2012, 12 December 2012, 7 February 2013, 4 March 2013, 18 March 2013, 27 March 2013, 17 May 2013, and 19 June 2013. During each fieldwork round the groundwater level at the available monitoring bores was measured using an electronic dip meter to the top of the PVC

casing. Groundwater samples were collected for analysis on 27 March 2013 and 19 June 2013. Groundwater loggers were installed in six of the nine monitoring bores.

On 4 March 2013 SMEC personnel were present at the drilling of one of the new monitoring piezometers by DP. The work was undertaken by Ground Test and SMEC observed the drillers used hydrocarbon-based grease on the drilling rod. No representative from DP was present for geological logging of the borehole or recording the installation. SMEC is unable to verify the geological conditions noted on the borehole logs from the March 2013 drilling. Table 2 presents the piezometer construction details and interpreted screened lithology collated from the DP reports.

Table 2 Bore construction details and interpreted lithology

Bore ID	Total depth (mbgl)	Screen interval (mbgl)	Gravel pack interval (mbgl)	Bentonite seal (mbgl)	Interpreted screened geology
PZ01	16.5	13.5–16.5	13.5–16.5*	Unknown^	Sandstone
PZ06	9.8	6.8–9.8	6.8–9.8*	Unknown^	Laminate/Sandstone
PZ09	10.3	7.3–10.3	7.3–10.3*	Unknown^	Laminate
PZ24	7.8	4.8–7.8	4.8–7.8*	Unknown^	Sandstone
PZ31	8.0	5.0–8.0	5.0–8.0*	Unknown^	Shale
PZ102	8.0	5.0–8.0	4.5–8.0	3.5–4.5	Shale
PZ103	11.9	8.9–11.9	8.5–11.9	7.5–8.5	Shale
PZ107	8.1	5.1–8.1	4.5–8.5	3.5–4.5	Shale
PZ112	15.1	12.1–15.1	11.5–15.1	10.5–11.5	Shale

* Gravel pack unknown assumed minimum of screen interval

^ bentonite seal not known assume minimum half metre about gravel pack

mbgl – metres below ground level

2.2 Monitoring piezometer development

During the November 2012 fieldwork the existing monitoring bores PZ06, PZ09, PZ24, PZ31 and PZ01 were developed and purged using a wattera foot valve to clean out mud from the bottom of the bores. Due to the thick mud remaining from drilling (cored boreholes) additional potable water was added to the bore to assist. All bores were purged dry. Lockable road box monuments were installed on PZ06, PZ09, PZ24 and PZ31. This required the PVC pipe to be cut down to ground level, with the exception of PZ31 which was already at ground level following vandalism. During this round a void was noticed around the annulus casing of PZ24 of around 0.65m deep. This was backfilled with bentonite.

During the December 2012 round PZ06, PZ09, PZ31 and PZ01 were purged for a second time, though PZ24 underwent additional bailing. All bores with the exception of PZ01 were purged dry. A lockable road box monument was installed on PZ01.

Following the installation of additional monitoring bores PZ102, PZ103, PZ107 and PZ107 in March 2013, SMEC undertook purging on 18 March 2013. Purging is designed to

remove left over drilling mud fines from boreholes, develop the gravel pack and induce inflow of clean undisturbed groundwater. Groundwater bores with low yields are often purged dry and may require several purging rounds to remove fines from the gravel pack to allow collection of representative samples. Higher yielding bores are purged until the mud is removed.

During the May 2013 round, purging of PZ31, PZ102, PZ103 and PZ01 was undertaken. The bores were purged dry with the exception of PZ01 which underwent purging for 40 minutes.

2.3 Groundwater level monitoring

Groundwater levels were monitored between November 2012 and June 2013. The results are presented in Table 3 and Table 4. Hydrographs of groundwater level with rainfall are presented in Figures 2 to 8.

Table 3 Manually recorded groundwater levels (metres below top of casing)

Date	Bore ID								
	PZ01	PZ06	PZ09	PZ24	PZ31	PZ102	PZ103	PZ107	PZ112
TD	16.5	10.1	10.4	7.9	8	8.6	12.4	8.7	15.6
RL	158.5	159	160	154.8	160.8	161	160.7	158	159.8
21/11/2012	5.8	6.16	8.31	2.93	4.66				
12/12/2012		7.05	8.79	2.98	5.22				
7/02/2013	5.96	7.09	8.65	2.98	5.35				
4/03/2013	4.30	7.13	7.90	3.05	3.42				
18/03/2013	4.66	7.12	8.09	3.06	5.43	6.94	7.01	6.74	10.32
27/03/2013	5.58	7.10	8.34	3.03	5.47	6.94	7.13	6.74	10.29
17/05/2013	5.22	7.01	8.41	2.95	5.28	6.77	5.70	6.66	10.20
19/06/2013	5.27	7.08	8.37	3.05	5.38	6.72	5.62	6.93	10.26

TD- Total Depth

RL – Relative Level in mAHD

Table 4 Manually recorded groundwater levels (mAHD)

Date	Bore ID								
	PZ01	PZ06	PZ09	PZ24	PZ31	PZ102	PZ103	PZ107	PZ112
TD	16.5	10.1	10.4	7.9	8	8.6	12.4	8.7	15.6
RL	158.5	159	160	154.8	160.8	161	160.7	158	159.8
21/11/2012	152.7	152.8	151.6	151.8	156.1				
12/12/2012		151.9	151.2	151.8	155.8				
7/02/2013	152.5	151.9	151.3	151.8	155.4				
4/03/2013	154.2	151.8	152.1	151.7	157.3				
18/03/2013	152.8	151.8	151.9	151.7	155.3	153.4	153.3	153.3	150.0
27/03/2013	152.9	151.9	151.6	151.7	155.3	153.4	153.2	153.2	150.0
17/05/2013	153.2	151.9	151.5	151.8	155.5	153.5	154.6	154.6	150.1
19/06/2013	153.2	151.9	151.6	151.7	155.4	153.6	154.7	154.7	150.0

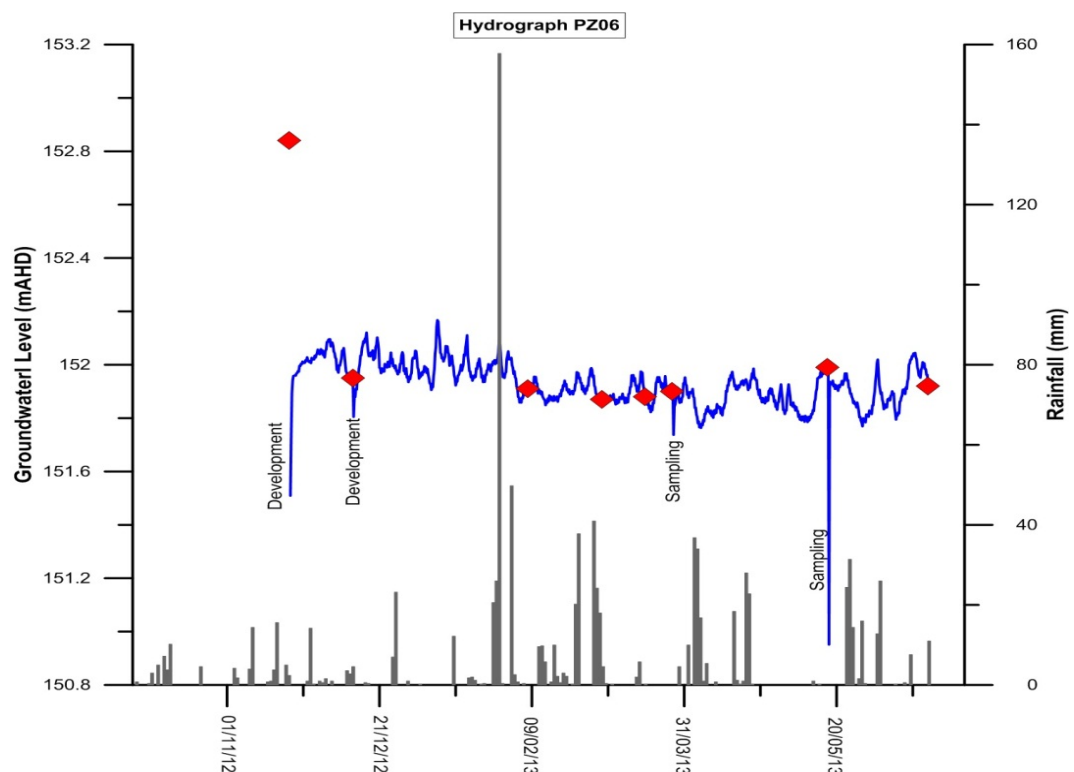


Figure 2 Piezometer hydrograph for PZ06 showing logger trace (blue line) and manual measurements (red diamonds)

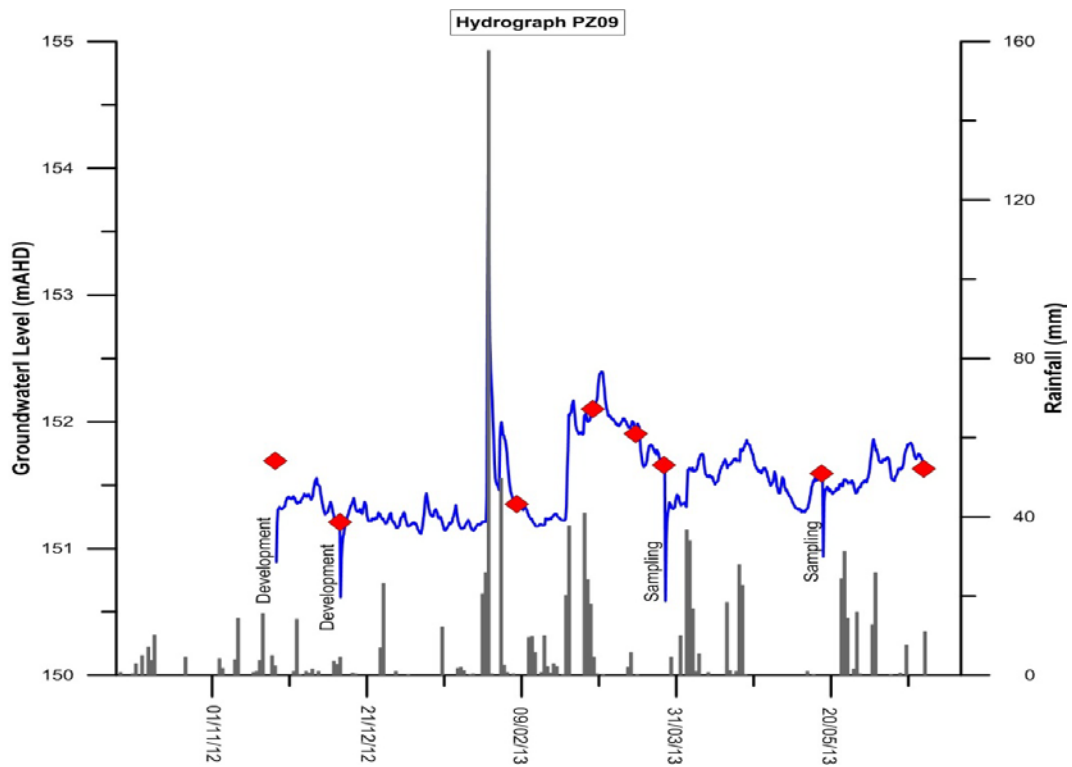


Figure 3 Piezometer hydrograph for PZ09 showing logger trace (blue line) and manual measurements (red diamonds)

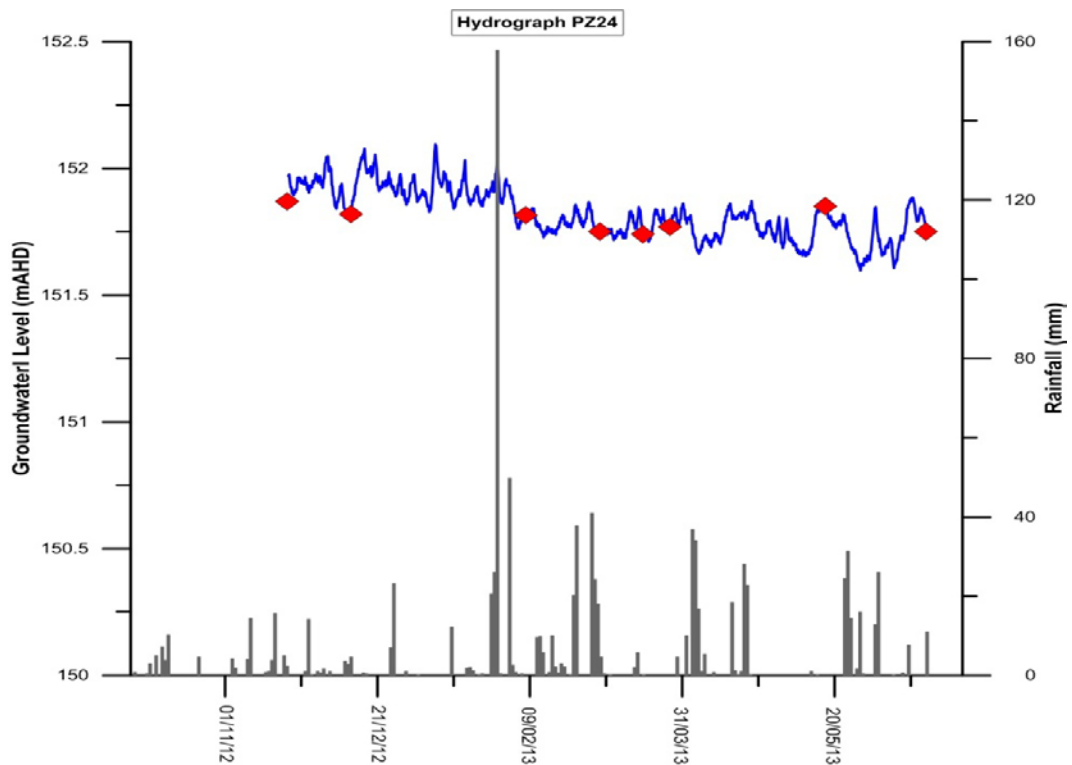


Figure 4 Piezometer hydrograph for PZ24 showing logger trace (blue line) and manual measurements (red diamonds)

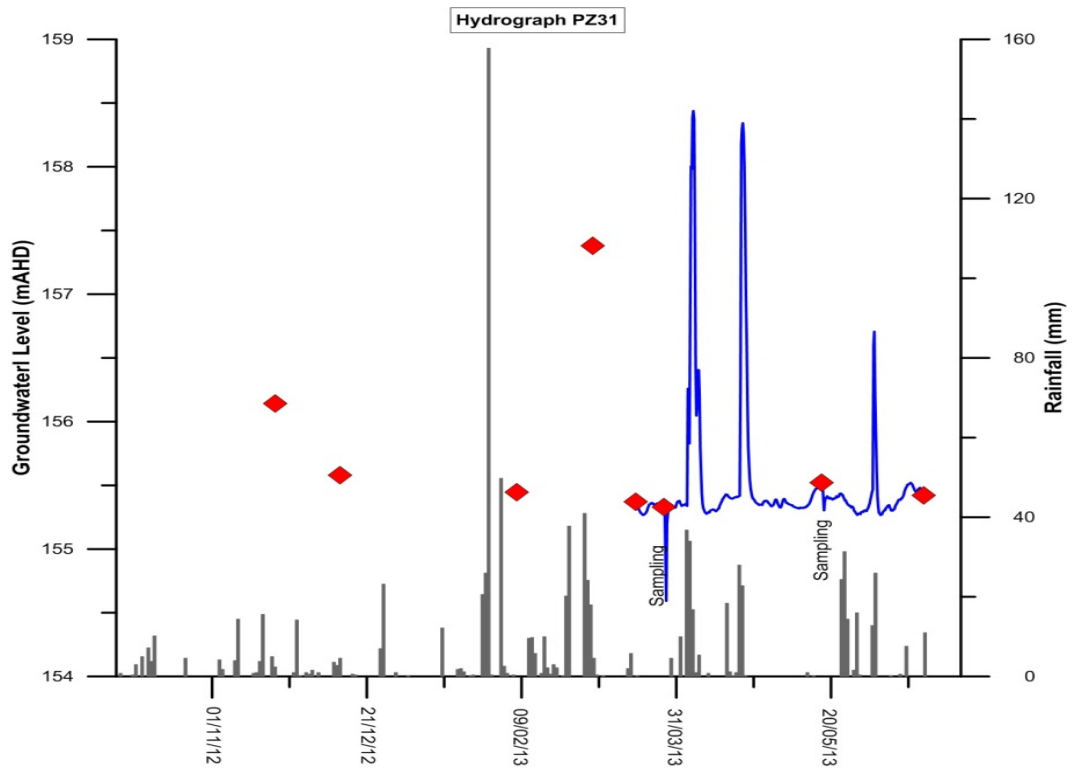


Figure 5 Piezometer hydrograph for PZ31 showing logger trace (blue line) and manual measurements (red diamonds)

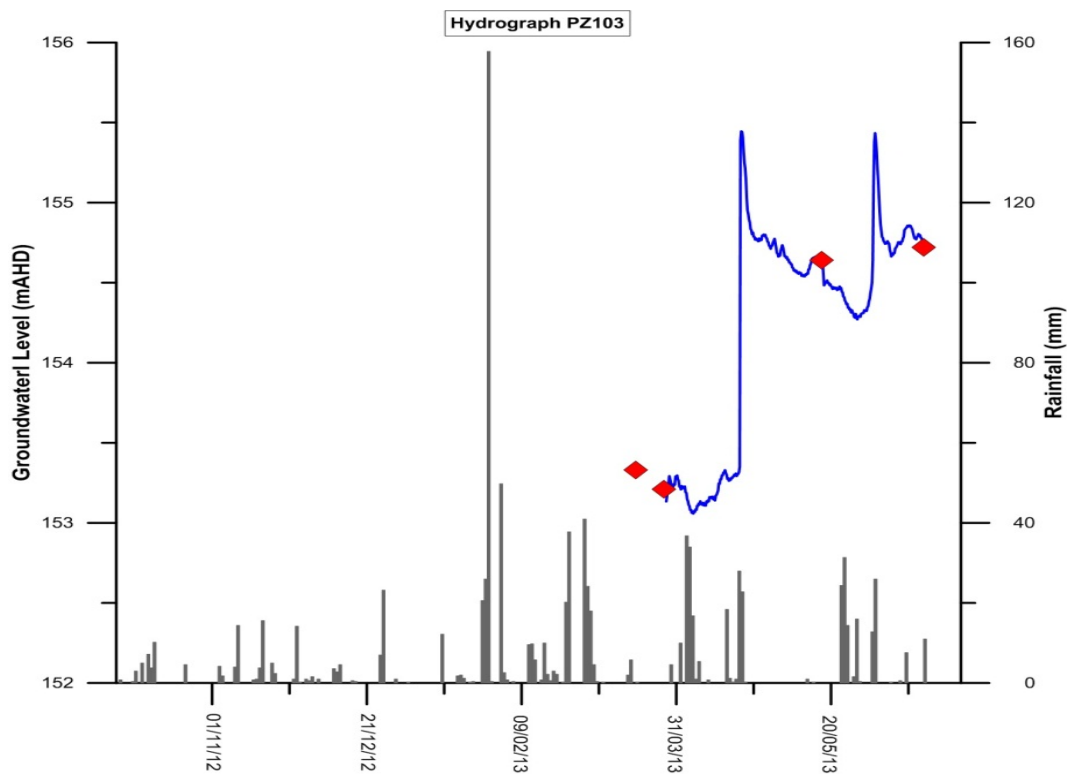


Figure 6 Piezometer hydrograph for PZ103 showing logger trace (blue line) and manual measurements (red diamonds)

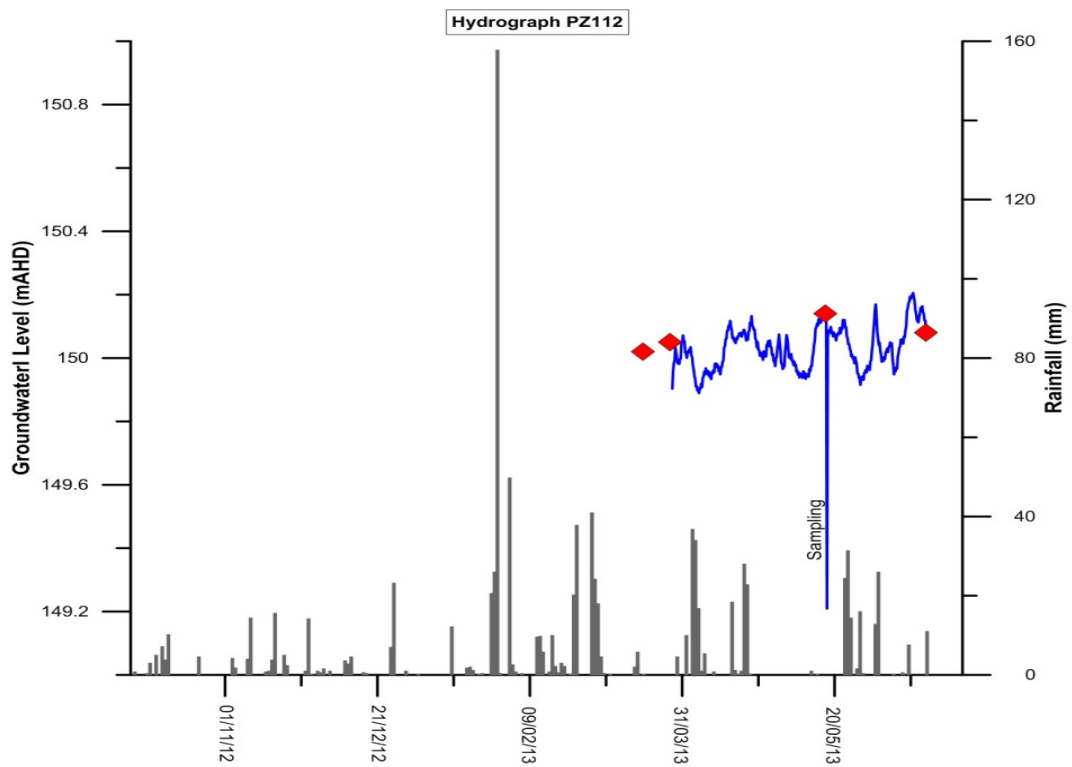


Figure 7 Piezometer hydrograph for PZ112 showing logger trace (blue line) and manual measurements (red diamonds)

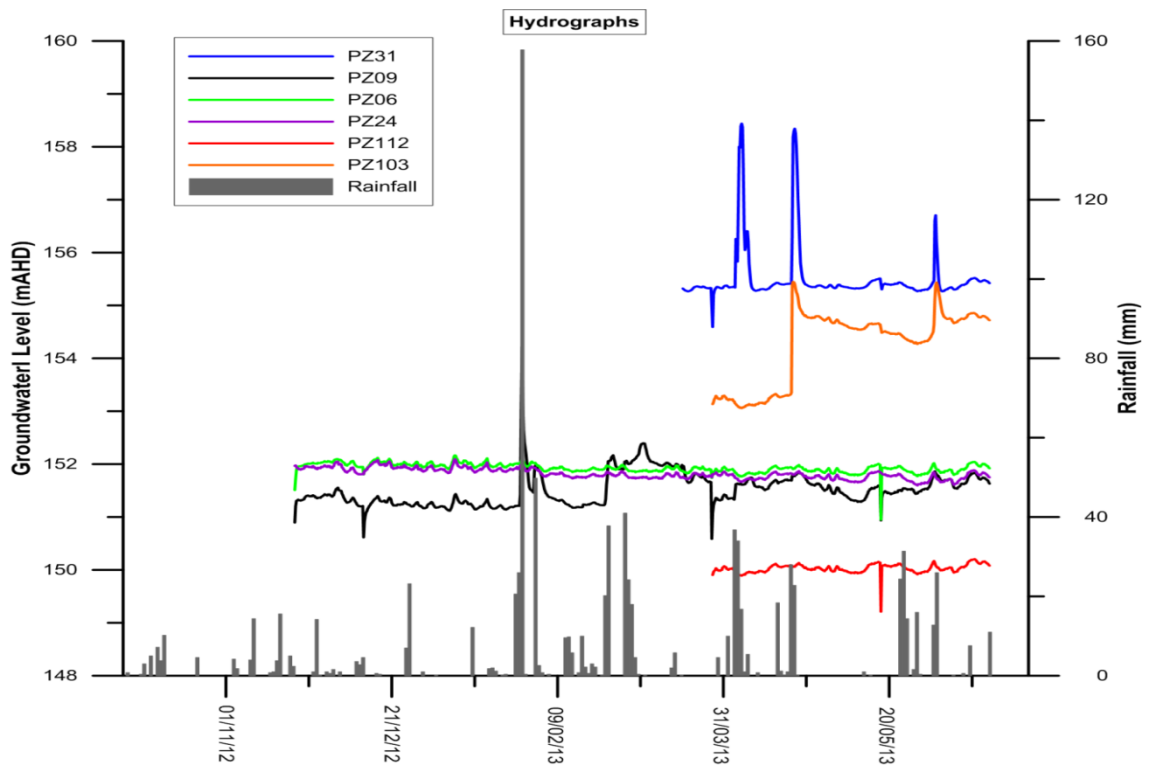


Figure 8 Piezometer hydrograph for all logger traces with daily rainfall (Station No 66188)

2.4 Groundwater field quality

Field groundwater quality indicators pH, Electrical Conductivity (EC) and Temperature (°C) were measured during the December 2012, March 2013, May 2013 and June 2013 fieldwork rounds and are provided in Tables 5 to Table 7. Field sheets for the two water quality sampling rounds are provided in Appendix A.

Table 5 Field measurements of pH

Date	Bore ID								
	PZ01	PZ06	PZ09	PZ24	PZ31	PZ102	PZ103	PZ107	PZ112
12/12/2012	5.96	5.88	4.03	4.02	5.61				
27/03/2013	5.66	4.71	3.75	3.45	5.98	4.31	5.85	3.63	4.07
17/05/2013	5.52	4.95	3.73	3.49	5.90	5.07	5.70	3.47	3.60
19/06/2013	5.86	4.93	3.79	3.57	3.77	5.46	6.17	3.51	3.78

Table 6 Field measurements of electrical conductivity (µS)

Date	Bore ID								
	PZ01	PZ06	PZ09	PZ24	PZ31	PZ102	PZ103	PZ107	PZ112
12/12/2012	3400	5170	1312	6130	6050				
27/03/2013	2900	7210	997	6300	1043	5030	2232	7200	5180
17/05/2013	2590	6550	1294	6150	682	1055	1282	7310	5120
19/06/2013	2258	6570	1209	6150	1505	630	687	7210	4790

Table 7 Field measurements of temperature (°C)

Date	Bore ID								
	PZ01	PZ06	PZ09	PZ24	PZ31	PZ102	PZ103	PZ107	PZ112
12/12/2012	19.0	17.8	17.9	17.4	19.0				
27/03/2013	19.0	17.6	17.8	18.5	19.0	17.9	17.9	17.9	17.9
17/05/2013	18.6	17.5	18.0	18.7	18.6	18.1	18.0	18.1	17.7
19/06/2013	18.4	17.6	18.0	18.4	18.4	18.1	18.1	18.1	17.8

2.5 Laboratory results

The analytical laboratory results for March 2013 and June 2013 for heavy metals and selected physical parameters are provided in Tables 8 to 10. The laboratory certificates of analysis are provided in Appendix B. No pesticides, PCBs or hydrocarbons were detected in the sampling rounds with the exception of PZ01 where 22 µg/L of Total Recoverable

Hydrocarbons C₆-C₁₀ was detected in March 2013. The June 2013 sample in PZ01 did not detect any hydrocarbons and the detection is likely due to contamination from hydrocarbon-based grease used during drilling. Some analytes were removed from the June 2013 testing as they were either non-detectable (ie below the lower limit of detection) in the March 2013 round or not required a second time (eg fluoride) for this assessment.

Table 8 Groundwater analysis results for PZ06, PZ09 and PZ24 and PZ31

Analyte	LOR	Units	Bore ID					
			PZ06 (Mar 2013)	PZ06 (Jun 2013)	PZ09 (Mar 2013)	PZ09 (Jun 2013)	PZ24 (Mar 2013)	PZ24 (Jun 2013)
Dissolved Heavy Metals								
Arsenic	1	µg/L	5	6	<1	<1	1	1
Cadmium	0.1	µg/L	0.4	<0.1	0.3	0.2	1.7	1.8
Chromium	1	µg/L	<1	<1	<1	1	3	4
Copper	1	µg/L	3	<1	100	85	3	4
Lead	1	µg/L	<1	<1	<1	<1	4	4
Mercury	0.05	µg/L	<0.05	<0.05	0.11	0.2	<0.05	<0.05
Nickel	1	µg/L	250	410	15	9	120	120
Zinc	1	µg/L	1100	1700	37	29	750	900
Selenium	1	µg/L	<1	NT	<1	NT	<1	NT
Total Metals								
Aluminum	10	µg/L	22000	4600	29000	10000	34000	33000
Iron	10	µg/L	140000	160000	14000	4100	46000	45000
Physical Parameters								
pH		pH	4.6	5.2	4.3	3.8	3.4	3.5
Acidity (CaCO ₃)	5	mg/L	280	600	340	94	390	590
Ammonia	0.005	mg/L	0.29	0.21	0.057	0.046	0.16	0.1
Total Dissolved Solids	5	mg/L	5200	4300	580	710	3600	3900
Electrical Conductivity	1	µS/cm	6500	6800	850	1200	6000	6300
Total Nitrogen	0.1	mg/L	2.1	1.3	3	1.2	0.9	0.8
TKN	0.1	mg/L	2.1	NT	2.5	NT	0.9	NT
Nitrate	0.005	mg/L	<0.005	0.009	0.55	0.31	0.012	<0.005
Nitrite	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	0.1	mg/L	0.28	NT	<0.1	NT	0.34	NT
Phosphate	0.005	mg/L	<0.005	NT	<0.005	NT	<0.005	NT
Total Phosphorus	0.05	mg/L	0.3	0.08	0.3	<0.05	<0.05	0.05
Calcium	0.5	mg/L	8.9	8.4	10	2.6	3	3.2
Potassium	0.5	mg/L	13	12	2.1	1.4	4.8	4.6
Sodium	0.5	mg/L	1100	1200	160	210	1000	1000
Magnesium	0.5	mg/L	200	170	12	13	160	150
Hydroxide Alkalinity	5	mg/L	<5	<5	<5	<5	<5	<5
Bicarbonate Alkalinity	5	mg/L	<5	<5	<5	<5	<5	<5
Carbonate Alkalinity	5	mg/L	<5	1100	<5	<5	<5	<5
Total Alkalinity	5	mg/L	<5	1100	<5	<5	<5	<5
Sulphate	1	mg/L	240	400	130	170	280	250
Chloride	1	mg/L	2200	2300	170	260	2100	2400

LOR – lower limit of detection

NT – Not Tested

Table 9 Groundwater analysis results for PZ01, PZ102 and PZ103

Analyte	LOR	Units	Bore ID					
			PZ01 (Mar 2013)	PZ01 (Jun 2013)	PZ102 (Mar 2013)	PZ102 (Jun 2013)	PZ103 (Mar 2013)	PZ103 (Jun 2013)
Dissolved Heavy Metals								
Arsenic	1	µg/L	<1	1	<1	1	1	2
Cadmium	0.1	µg/L	<0.1	<0.1	1.5	0.1	<0.1	<0.1
Chromium	1	µg/L	<1	<1	<1	2	<1	1
Copper	1	µg/L	<1	<1	230	260	<1	4
Lead	1	µg/L	<1	<1	<1	2	<1	1
Mercury	0.05	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	1	µg/L	110	66	200	12	63	14
Zinc	1	µg/L	260	87	790	990	250	270
Selenium	1	µg/L	<1	NT	<1	NT	<1	NT
Total Metals								
Aluminum	10	µg/L	870	200	38000	29000	1500	2300
Iron	10	µg/L	61000	46000	65000	16000	32000	9900
Physical Parameters								
pH		pH	5.5	6	4.4	5.7	5.8	6.6
Acidity (CaCO ₃)	5	mg/L	210	120	230	110	200	33
Ammonia	0.005	mg/L	0.049	0.088	0.26	0.11	0.052	0.081
Total Dissolved Solids	5	mg/L	1800	1300	3200	390	1200	630
Electrical Conductivity	1	µS/cm	3000	2200	4500	650	2100	770
Total Nitrogen	0.1	mg/L	1	0.7	0.9	8.1	1.8	1.2
TKN	0.1	mg/L	1	NT	0.9	NT	1.8	NT
Nitrate	0.005	mg/L	0.019	0.037	0.035	0.019	0.014	0.073
Nitrite	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride	0.1	mg/L	0.24	NT	0.48	NT	0.47	NT
Phosphate	0.005	mg/L	<0.005	NT	<0.005	NT	<0.005	NT
Total Phosphorus	0.05	mg/L	<0.05	<0.05	0.4	0.5	0.7	0.3
Calcium	0.5	mg/L	9.9	8.5	16	4.7	3.6	5.3
Potassium	0.5	mg/L	8.8	6.7	12	3.2	5	2.5
Sodium	0.5	mg/L	600	410	900	120	450	130
Magnesium	0.5	mg/L	68	38	110	5	32	7.9
Hydroxide Alkalinity	5	mg/L	<5	<5	<5	<5	<5	<5
Bicarbonate Alkalinity	5	mg/L	32	92	<5	530	91	110
Carbonate Alkalinity	5	mg/L	<5	<5	<5	<5	<5	<5
Total Alkalinity	5	mg/L	32	92	<5	530	91	110
Sulphate	1	mg/L	260	220	120	43	290	100
Chloride	1	mg/L	830	550	1500	150	440	110

Table 10 Groundwater Analysis Results for PZ07 and PZ112

Analyte	LOR	Units	Bore ID			
			PZ107 (Mar 2013)	PZ107 (Jun 2013)	PZ112 (Mar 2013)	PZ112 (Jun 2013)
Dissolved Heavy Metals						
Arsenic	1	µg/L	10	3	<1	<1
Cadmium	0.1	µg/L	0.6	0.5	2	2.1
Chromium	1	µg/L	3	2	<1	2
Copper	1	µg/L	1000	430	130	220
Lead	1	µg/L	<1	<1	11	7
Mercury	0.05	µg/L	<0.05	<0.05	<0.05	<0.05
Nickel	1	µg/L	84	64	110	210
Zinc	1	µg/L	650	230	330	620
Selenium	1	µg/L	<1	NT	<1	NT
Total Metals						
Aluminum	10	µg/L	60000	60000	28000	31000
Iron	10	µg/L	5400	6000	20000	9600
Physical Parameters						
pH		pH	4	3.5	4.3	3.9
Acidity (CaCO ₃)	5	mg/L	390	400	170	210
Ammonia	0.005	mg/L	0.26	0.15	0.11	0.11
Total Dissolved Solids	5	mg/L	4300	4600	3400	2600
Electrical Conductivity	1	µS/cm	6900	7400	4600	4900
Total Nitrogen	0.1	mg/L	2.8	2	2	1.5
TKN	0.1	mg/L	2.8	NT	1.9	NT
Nitrate	0.005	mg/L	<0.005	<0.005	0.049	0.031
Nitrite	0.005	mg/L	0.006	<0.005	0.008	<0.005
Fluoride	0.1	mg/L	0.26	NT	0.39	NT
Phosphate	0.005	mg/L	<0.005	NT	<0.005	NT
Total Phosphorus	0.05	mg/L	0.1	0.1	0.1	0.1
Calcium	0.5	mg/L	5	2	33	11
Potassium	0.5	mg/L	11	6.6	6.3	4.4
Sodium	0.5	mg/L	1300	1300	970	900
Magnesium	0.5	mg/L	180	160	100	92
Hydroxide Alkalinity	5	mg/L	<5	<5	<5	<5
Bicarbonate Alkalinity	5	mg/L	<5	<5	<5	<5
Carbonate Alkalinity	5	mg/L	<5	<5	<5	<5
Total Alkalinity	5	mg/L	<5	<5	<5	<5
Sulphate	1	mg/L	320	420	200	340
Chloride, Cl	1	mg/L	2400	2500	1400	1600

3 RESULTS

3.1 Groundwater level

The groundwater levels onsite have generally remained relatively consistent (Figure 8), with the exception of PZ103 which shows an increasing groundwater level. The rising groundwater level in PZ103 may indicate the screen interval is across both the shale and sandstone units, i.e. interlinking two aquifers.

The monitoring bores show increased groundwater levels in association with rainfall events. The magnitude of the response to rainfall is generally low with the exception of PZ103 and PZ31 which have significant spikes in water level assumed to be associated with surface water inflow to the monitoring bore.

Groundwater levels range from approximately 155 mAHD to 150 mAHD with two separate aquifers, a shallow perched shale and deeper sandstone system. The water level elevation in the shale is above the sandstone indicating a downward pressure gradient. It is likely the overlying shale has very low vertical permeability resulting in limited recharge to the underlying sandstone and development of an “under drained” system.

3.2 Groundwater quality

The groundwater quality results (Tables 8 to 10) were reasonably consistent between the two rounds. All samples are sodium–chloride type water reflecting the dominance of the shales as the host rock and recharge path for the sandstone. The Piper diagram (Figure 9) shows PZ102 and PX103 as having a higher carbonate/bicarbonate concentration. These two bores are screened in the shale and may reflect recent recharge either as a result of drilling or possible ingress of surface water during rainfall events.

The Durov diagram (Figure 10) shows a spread in pH from less than 4 to nearly 7 indicating slightly acidic to acidic groundwater conditions. The PZ103 sample for 19 June 2013 has the highest pH suggesting recent recharge. The TDS of the samples form a mixing line as opposed to separate distinct groups suggesting a common source and increasing TDS and EC with depth/age.

The groundwater on site would pose an issue for concrete and steel structures with high chloride and low pH. However, sulphate is generally low. Iron and aluminium are variable to high and would likely require treatment before discharge of groundwater.

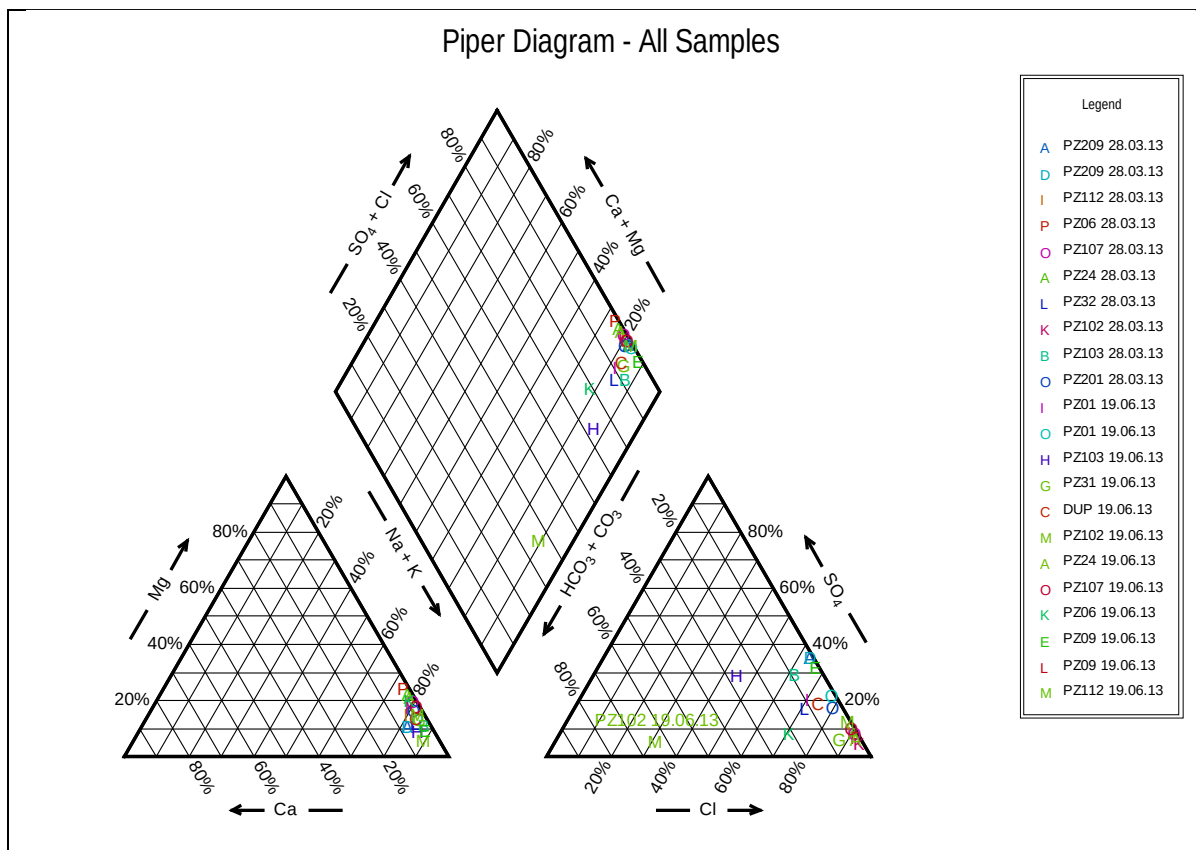


Figure 9 Piper Diagram, all samples

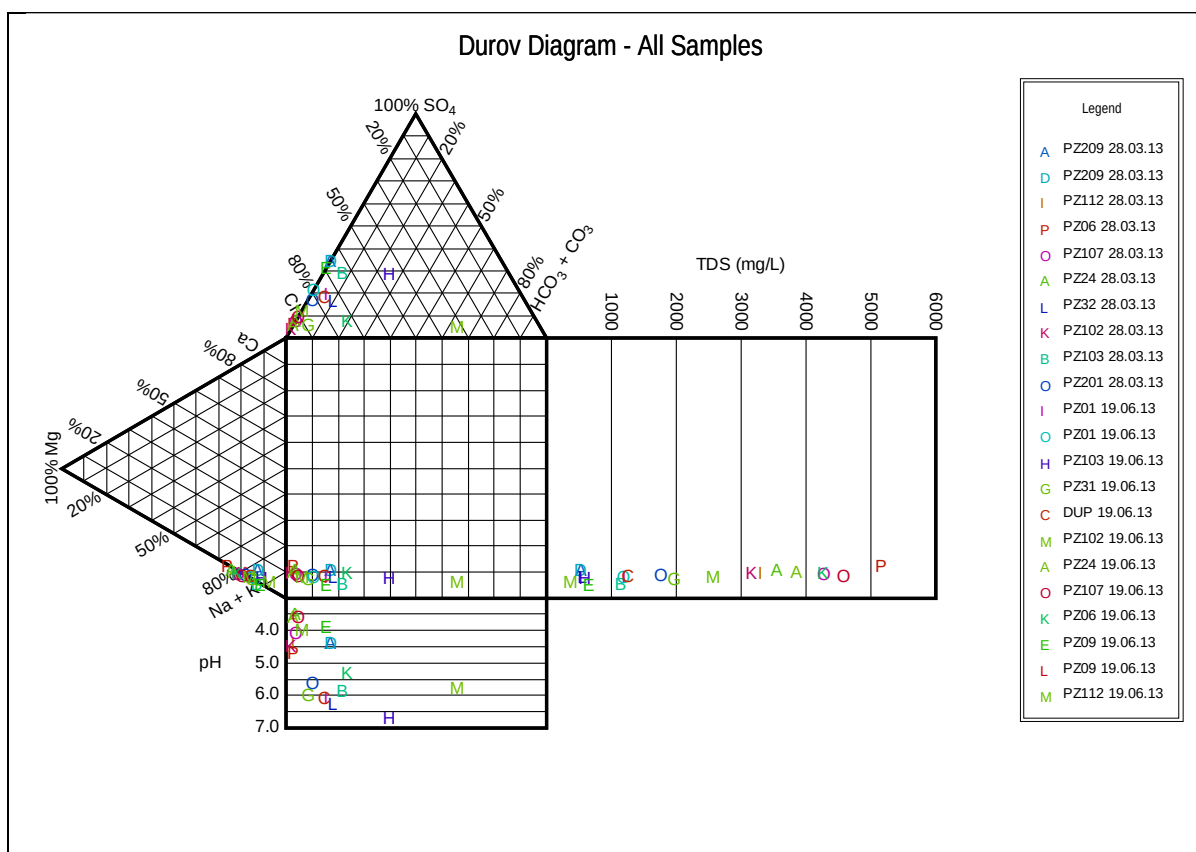


Figure 10 Durov Diagram, all samples

No significant contaminants of concern were detected (ie hydrocarbons, pesticides, PCBs). The levels of heavy metals such as copper, nickel, zinc, aluminium and iron are within the natural ranges anticipated for the geology. Nutrient and phosphorus levels are considered to be low.

3.3 Groundwater flow direction

Based on the May 2013 monitoring round water levels the groundwater flow direction is south-east towards Middle Harbour and Manly Dam (Figure 11). It can also be seen that there are two distinct water table elevations, one in the shale and another in the sandstone, which are separated by around two metres.

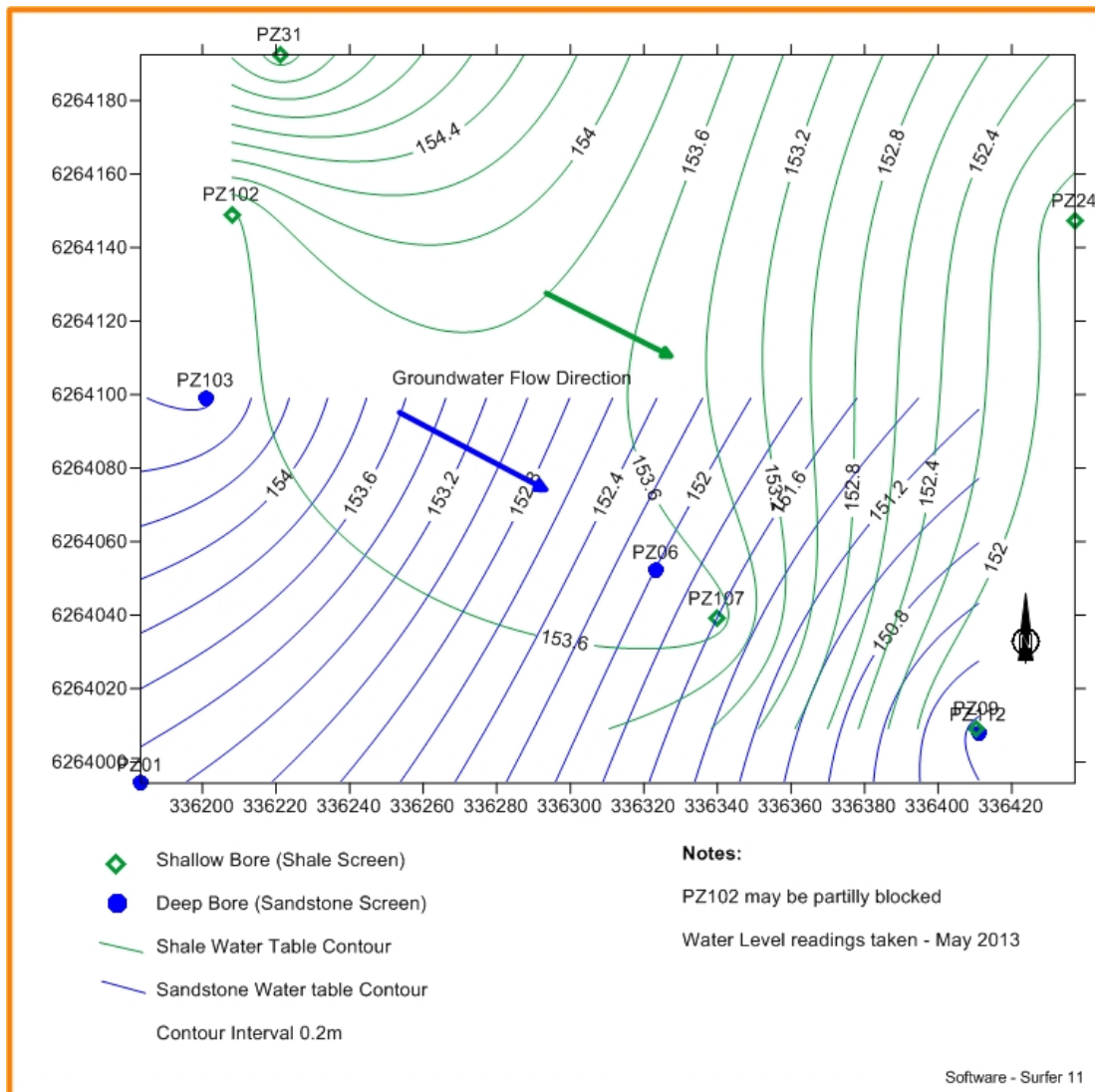


Figure 11 Water level contours for shale and sandstone bores

The groundwater level in the sandstone is lower than the shale indicating a vertical downwards hydraulic gradient. The shale forms a low vertical permeability aquitard resulting in low levels of recharge to the sandstone. The high permeability of the sandstone allows the groundwater recharge to drain away more quickly. The rate of leakage from the shale to the sandstone is less than the rate of groundwater movement.

The groundwater gradient in the shale is estimated at 0.013 and the groundwater gradient in the sandstone is estimated at 0.019.

4 CONCLUSIONS AND RECOMMENDATION

The following conclusions have been drawn:

- there are two water tables on site, one perched within the weathered overburden/shale, and the other regional water table within the sandstone
- the difference in head between the two water tables ranges from 1.6–2 metres
- the vertical hydraulic gradient on the site is downwards
- the flow direction in both aquifers is to the south-east with gradients of 0.13 and 0.19 for the shale and sandstone respectively
- no contaminants of concern have been observed
- groundwater quality is likely to impact any underground structures due to:
 - o high chloride
 - o low pH.
- any pumped water for an excavation would likely require treatment and/or dilution before discharge due to high iron, aluminium, chloride and low pH.

Recommendation:

Additional groundwater assessments for potential inflows should be undertaken, including but not limited to aquifer permeability testing and groundwater modelling of inflows, to reduce risk and maximize design efficiency for any substantial excavations.

5 REFERENCES

Douglas Partners (2012) *Report on Preliminary Geotechnical Investigation, Proposed Northern Beaches Hospital, Corner of Wakehurst Parkway and Warringah Road, Frenchs Forest*, report prepared for Health Infrastructure, July 2012.

Douglas Partners (2013) *Report on Standpipe Piezometer Installation, Proposed Northern Beaches Hospital, Corner of Wakehurst Parkway and Warringah Road, Frenchs Forest*, report prepared for Health Infrastructure, April 2013.

Appendix A

Field sheets for groundwater sampling rounds (March 2013 and June 2013)



DATE: 27/3/13

LOCATION:

PROJECT:

NSH 70011256

Bore Name	p21	Stickup (m)
Standing Water Level	558	Ref Point m TOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID
PZ01	X	X

Sample ID	Sample ID	Sample ID
mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point		

: Stickup is the height of the top of monument / top of casing / measuring point above ground level



GROUNDWATER SAMPLING RECORD SHEET

DATE: 27/3/13 LOCATION: NBHS PROJECT: 30011256

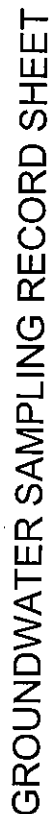
Bore Name	P206	Stickup (m)
Standing Water Level	7.1	Ref Point (mTOM) / mBMP
Sampling Method	Bailer / DPump / Other	

Volume (L)	Time	pH	EC	EC Units	Temp (°C)	DO	EH	Observation/Comments (e.g. colour, clarity, odour)
1	8.05	5.29	2.55	mS	17.9		86mV	Subs. cloudy, odour slight.
2	8.50	5.29	2.87	mS	17.9		82mV	
3	8.52	5.40	2.47	mS	17.9		11mV	
4	8.55	5.47	2.17	mS	17.6		-7mV	
5	8.57	5.42	2.29	mS	17.6		-13mV	
6	8.59	5.37	3.04	mS	17.5		-5mV	becoming cloudy
7	9.00	5.21	3.93	mS	17.5		6mV	
8	9.02	5.10	5.16	mS	17.4		25mV	V. turbid, light green
9	9.05	5.09	5.57	mS	17.5		43mV	
10	9.07	4.01	5.80	mS	17.6		61mV	
11	9.09	4.80	6.57	mS	17.5		88mV	
12	9.11	4.74	6.98	mS	17.5		107mV	
13	9.13	4.71	7.08	mS	17.5		119mV	
14	9.15	4.70	7.03	mS	17.6		150mV	
15	9.17	4.71	7.21	mS	17.5		125mV	

Sample ID	P206	Duplicate ID	X	Triplicate ID	X
-----------	------	--------------	---	---------------	---

*mTOM = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 09/30/13 LOCATION: NBS PROJECT: 3001256

LOCATION: NB HS

DATE: 08/30/30

PROJECT: 3001256

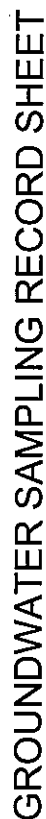
Bore Name	P-209	Stickup (m)	
Standing Water Level	8.54	Ref Point	mTOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other		

[illegible]

Sample ID	Duplicate ID	Triplicate ID
10209	X	X

Sample ID	Duplicate ID	Duplicate ID	Implicate ID
mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point			

* Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 27/3/13

LOCATION: NBHS

PROJECT: 3001256

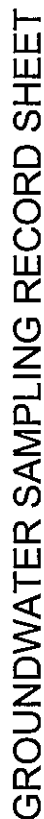
Bore Name	PZ102	Stickup (m)
Standing Water Level	5.94	Ref Point (mTOC) / mTOM / mBMP
Sampling Method	(Bailey) / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID
PZ102	X	X

*mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 27/3/13

LOCATION: NBHS

PROJECT:

HSN 30011256

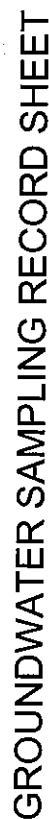
Bore Name	P2103	Stickup (m)
Standing Water Level	1.13	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailed / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID
PZ103	X	X

mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 27/3/13 LOCATION: NBHS PROJECT: 3001125%

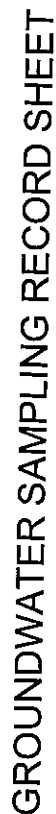
Bore Name	1207	Stickup (m)
Standing Water Level	6.34	Ref Point (mTOM / mBMP)
Sampling Method	(Bailer / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID
Z107	X	X

	DATE	SAMPLE ID	TRIPlicate ID
mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point			

Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 27/3/13 LOCATION: NBHS PROJECT: 30011256

LOCATION: NR H 2

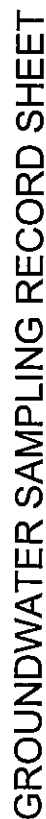
Bore Name	PZ 112	Stickup (m)
Standing Water Level	10.29	Ref Point (mTOC) / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	PZ12	Duplicate ID	Triplicate ID
		X	X

DATE	TIME	DEPTH (m)	TEMPERATURE (°C)	SPEED (cm/min)	DIRECTION	REMARKS
						mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 27/3/13

LOCATION: NBH3

PROJECT:

3001256

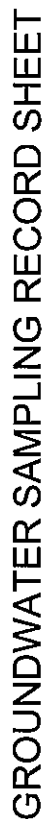
Bore Name	P224	Stickup (m)
Standing Water Level	3-03	Ref Point <u>mTOC</u> mTOM / mBMP
Sampling Method	Bailer Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID
P224	X	X

Sample ID	Duplicate ID	Duplicate ID	Duplicate ID
mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point			

* Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 27/3/13 LOCATION: NBHS PROJECT: 30011256

Bore Name	P732	Stickup (m)
Standing Water Level	5.47	Ref Point (mTOC) / mTOM / mBMP
Sampling Method	(Bailey) / Pump / Other	

[illegible]

Sample ID	P Z 3 Z	Duplicate ID	Triplicate ID
		X	X

mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

Stickup is the height of the top of monument / top of casing / measuring point above ground level

Note this is actually P231



LOCATION: VBHS

PROJECT: 3001256

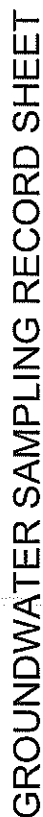
Bore Name	P201	Stickup (m)
Standing Water Level	5.27	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID	Lab Sent To
230	Dup		Envirolab

Sample ID	Depth (m)	Depth (ft)	Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point
1	0.0	0.0	
2	0.5	1.6	
3	1.0	3.3	
4	1.5	4.9	
5	2.0	6.6	
6	2.5	8.2	
7	3.0	9.8	
8	3.5	11.5	
9	4.0	13.1	
10	4.5	14.8	
11	5.0	16.4	
12	5.5	18.0	
13	6.0	19.7	
14	6.5	21.3	
15	7.0	23.0	
16	7.5	24.6	
17	8.0	26.2	
18	8.5	27.9	
19	9.0	29.5	
20	9.5	31.2	
21	10.0	32.8	
22	10.5	34.4	
23	11.0	36.1	
24	11.5	37.7	
25	12.0	39.4	
26	12.5	41.0	
27	13.0	42.6	
28	13.5	44.3	
29	14.0	45.9	
30	14.5	47.6	
31	15.0	49.2	
32	15.5	50.8	
33	16.0	52.5	
34	16.5	54.1	
35	17.0	55.8	
36	17.5	57.4	
37	18.0	59.1	
38	18.5	60.7	
39	19.0	62.3	
40	19.5	64.0	
41	20.0	65.6	
42	20.5	67.2	
43	21.0	68.9	
44	21.5	70.5	
45	22.0	72.1	
46	22.5	73.8	
47	23.0	75.4	
48	23.5	77.0	
49	24.0	78.7	
50	24.5	80.4	
51	25.0	82.0	
52	25.5	83.6	
53	26.0	85.3	
54	26.5	86.9	
55	27.0	88.6	
56	27.5	90.2	
57	28.0	91.8	
58	28.5	93.5	
59	29.0	95.1	
60	29.5	96.7	
61	30.0	98.4	
62	30.5	100.0	
63	31.0	101.7	
64	31.5	103.3	
65	32.0	104.9	
66	32.5	106.6	
67	33.0	108.2	
68	33.5	109.9	
69	34.0	111.5	
70	34.5	113.1	
71	35.0	114.8	
72	35.5	116.4	
73	36.0	118.1	
74	36.5	119.7	
75	37.0	121.3	
76	37.5	122.9	
77	38.0	124.6	
78	38.5	126.2	
79	39.0	127.9	
80	39.5	129.5	
81	40.0	131.2	
82	40.5	132.8	
83	41.0	134.4	
84	41.5	136.1	
85	42.0	137.7	
86	42.5	139.4	
87	43.0	141.0	
88	43.5	142.6	
89	44.0	144.3	
90	44.5	145.9	
91	45.0	147.6	
92	45.5	149.2	
93	46.0	150.8	
94	46.5	152.5	
95	47.0	154.1	
96	47.5	155.8	
97	48.0	157.4	
98	48.5	159.1	
99	49.0	160.7	
100	49.5	162.3	
101			

Stickup is the height of the top of monument / top of casing / measuring point above ground level



LOCATION: VBHS

PROJECT: 3001256

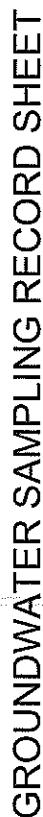
Bore Name	03112	Stickup (m)
Standing Water Level	10.26	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID	Lab Sent To
02112			EnviroLab

mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 19/6/13

LOCATION: NBHS

PROJECT: 30011256

Bore Name	P2107	Stickup (m)
Standing Water Level	6.93	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID	Lab Sent To
P7107			EnviroLab

mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

Stickup is the height of the top of monument / top of casing / measuring point above ground level

The boiler volume was removed before water was added.



DATE: 10/6/13

LOCATION: N645

PROJECT: 3001256

Bore Name	2224	Stickup (m)
Standing Water Level	3.05	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	PZ107	Duplicate ID		Triplicate ID		Lab Sent To	Envirolas
-----------	-------	--------------	--	---------------	--	-------------	-----------

mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 1968

LOCATION: USHS

PROJECT: 3001256

Bore Name	P2102	Stickup (m)
Standing Water Level	6.72	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailer/Pump / Other	

[illegible]

Sample ID	92102	Duplicate ID		Triplicate ID		Lab Sent To	Envirolab
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*mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level

9/9/79 Heller → very muddy water



LOCATION: NBHS

PROJECT: 3001256

Bore Name	PZ103	
Standing Water Level	5.62	Ref Point mTOC / mTOM / mBMP
Sampling Method	Bailer / Pump / Other	

[illegible]

Sample ID	Duplicate ID	Triplicate ID	Lab Sent To
P2103			EnviroLab

*mTOM = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level

Box



DATE: 9/6/83 LOCATION: NBHS PROJECT: 3001256

Bore Name		P206	Stickup (m)
Standing Water Level		7.08	Ref Point mTOG / mTOM / mBMP
Sampling Method		Bailed	Pump / Other

[illegible]

Sample ID	P206	Duplicate ID		Triplicate ID		Lab Sent To	Envirolabs
-----------	------	--------------	--	---------------	--	-------------	------------

mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level



DATE: 19/6/13 LOCATION: NBHS PROJECT: 3001256

[illegible]

Sample ID	P709	Duplicate ID	Triplicate ID	Lab Sent To	Envirolab
-----------	------	--------------	---------------	-------------	-----------

*mTOC = meters Top Of Casing, mTOM = meters Top Of Monument, mBMP = meters Below Measuring Point

* Stickup is the height of the top of monument / top of casing / measuring point above ground level

Appendix B

Laboratory certificates of analysis

CERTIFICATE OF ANALYSIS

88098

Client:

SMEC Australia
Level 6, 76 Berry St
North Sydney
NSW 2060

Attention: Bradley Tucker

Sample log in details:

Your Reference:	30011256	
No. of samples:	9 waters	
Date samples received / completed instructions received	27/03/13	/ 27/03/13

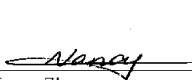
Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

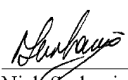
Report Details:

Date results requested by: / Issue Date: 5/04/13 / 5/04/13
Date of Preliminary Report: Not issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:


Nancy Zhang
Chemist


Rhian Morgan
Reporting Supervisor


Nick Sarlamis
Inorganics Supervisor


Jeremy Faircloth
Chemist

vTRH in Water (C6-C9) NEPM Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-2 PZ112 Water	88098-9 PZ201 Water
Date extracted	-	27/03/2013	27/03/2013
Date analysed	-	28/03/2013	28/03/2013
TRHC ₆ - C ₉	µg/L	<10	<10
TRHC ₆ - C ₁₀	µg/L	<10	22
Surrogate Dibromofluoromethane	%	89	126
Surrogate toluene-d8	%	80	118
Surrogate 4-BFB	%	100	92

svTRH (C10-C40) in Water			
Our Reference:	UNITS	88098-2	88098-9
Your Reference	-----	PZ112	PZ201
Type of sample	-----	Water	Water
Date extracted	-	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013
TRHC ₁₀ - C ₁₄	µg/L	<50	<50
TRHC ₁₅ - C ₂₈	µg/L	<100	<100
TRHC ₂₉ - C ₃₆	µg/L	<100	<100
TRH>C ₁₀ - C ₁₆	µg/L	<50	<50
TRH>C ₁₆ - C ₃₄	µg/L	<100	<100
TRH>C ₃₄ - C ₄₀	µg/L	<100	<100
Surrogate o-Terphenyl	%	107	92

PAHs in Water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-2 PZ112 Water	88098-9 PZ201 Water
Date extracted	-	28/03/2013	28/03/2013
Date analysed	-	05/04/2013	05/04/2013
Naphthalene	µg/L	<1	<1
Acenaphthylene	µg/L	<1	<1
Acenaphthene	µg/L	<1	<1
Fluorene	µg/L	<1	<1
Phenanthrene	µg/L	<1	<1
Anthracene	µg/L	<1	<1
Fluoranthene	µg/L	<1	<1
Pyrene	µg/L	<1	<1
Benzo(a)anthracene	µg/L	<1	<1
Chrysene	µg/L	<1	<1
Benzo(b+k)fluoranthene	µg/L	<2	<2
Benzo(a)pyrene	µg/L	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5
Surrogate p-Terphenyl-d14	%	113	92

OCP in water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-1 PZ209 Water	88098-2 PZ112 Water	88098-3 PZ06 Water	88098-4 PZ107 Water	88098-5 PZ24 Water
Date extracted	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
HCB	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
alpha-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
beta-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
delta-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Aldrin	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor Epoxide	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-Chlordane	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
alpha-Chlordane	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan I	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
pp-DDE	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Dieldrin	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
pp-DDD	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan II	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
pp-DDT	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin Aldehyde	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan Sulphate	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Methoxychlor	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Surrogate TCMX	%	87	96	86	83	83

OCP in water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-6 PZ32 Water	88098-7 PZ102 Water	88098-8 PZ103 Water	88098-9 PZ201 Water
Date extracted	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
HCB	µg/L	<0.2	<0.2	<0.2	<0.2
alpha-BHC	µg/L	<0.2	<0.2	<0.2	<0.2
gamma-BHC	µg/L	<0.2	<0.2	<0.2	<0.2
beta-BHC	µg/L	<0.2	<0.2	<0.2	<0.2
Heptachlor	µg/L	<0.2	<0.2	<0.2	<0.2
delta-BHC	µg/L	<0.2	<0.2	<0.2	<0.2
Aldrin	µg/L	<0.2	<0.2	<0.2	<0.2
Heptachlor Epoxide	µg/L	<0.2	<0.2	<0.2	<0.2
gamma-Chlordane	µg/L	<0.2	<0.2	<0.2	<0.2
alpha-Chlordane	µg/L	<0.2	<0.2	<0.2	<0.2
Endosulfan I	µg/L	<0.2	<0.2	<0.2	<0.2
pp-DDE	µg/L	<0.2	<0.2	<0.2	<0.2
Dieldrin	µg/L	<0.2	<0.2	<0.2	<0.2
Endrin	µg/L	<0.2	<0.2	<0.2	<0.2
pp-DDD	µg/L	<0.2	<0.2	<0.2	<0.2
Endosulfan II	µg/L	<0.2	<0.2	<0.2	<0.2
pp-DDT	µg/L	<0.2	<0.2	<0.2	<0.2
Endrin Aldehyde	µg/L	<0.2	<0.2	<0.2	<0.2
Endosulfan Sulphate	µg/L	<0.2	<0.2	<0.2	<0.2
Methoxychlor	µg/L	<0.2	<0.2	<0.2	<0.2
Surrogate TCMX	%	92	82	97	88

OP Pesticides in water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-1 PZ209 Water	88098-2 PZ112 Water	88098-3 PZ06 Water	88098-4 PZ107 Water	88098-5 PZ24 Water
Date extracted	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Diazinon	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos-methyl	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Ronnel	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Fenitrothion	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Bromophos ethyl	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Ethion	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Surrogate TCMX	%	87	96	86	83	83

OP Pesticides in water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-6 PZ32 Water	88098-7 PZ102 Water	88098-8 PZ103 Water	88098-9 PZ201 Water
Date extracted	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Diazinon	µg/L	<0.2	<0.2	<0.2	<0.2
Dimethoate	µg/L	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos-methyl	µg/L	<0.2	<0.2	<0.2	<0.2
Ronnel	µg/L	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos	µg/L	<0.2	<0.2	<0.2	<0.2
Fenitrothion	µg/L	<0.2	<0.2	<0.2	<0.2
Bromophos ethyl	µg/L	<0.2	<0.2	<0.2	<0.2
Ethion	µg/L	<0.2	<0.2	<0.2	<0.2
Surrogate TCMX	%	92	82	97	88

PCBs in Water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-1 PZ209 Water	88098-2 PZ112 Water	88098-3 PZ06 Water	88098-4 PZ107 Water	88098-5 PZ24 Water
Date extracted	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Arochlor 1016	µg/L	<2	<2	<2	<2	<2
Arochlor 1221	µg/L	<2	<2	<2	<2	<2
Arochlor 1232	µg/L	<2	<2	<2	<2	<2
Arochlor 1242	µg/L	<2	<2	<2	<2	<2
Arochlor 1248	µg/L	<2	<2	<2	<2	<2
Arochlor 1254	µg/L	<2	<2	<2	<2	<2
Arochlor 1260	µg/L	<2	<2	<2	<2	<2
Surrogate TCLMX	%	87	96	86	83	83

PCBs in Water Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-6 PZ32 Water	88098-7 PZ102 Water	88098-8 PZ103 Water	88098-9 PZ201 Water
Date extracted	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Arochlor 1016	µg/L	<2	<2	<2	<2
Arochlor 1221	µg/L	<2	<2	<2	<2
Arochlor 1232	µg/L	<2	<2	<2	<2
Arochlor 1242	µg/L	<2	<2	<2	<2
Arochlor 1248	µg/L	<2	<2	<2	<2
Arochlor 1254	µg/L	<2	<2	<2	<2
Arochlor 1260	µg/L	<2	<2	<2	<2
Surrogate TCLMX	%	92	82	97	88

HM in water - dissolved Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-1 PZ209 Water	88098-2 PZ112 Water	88098-3 PZ06 Water	88098-4 PZ107 Water	88098-5 PZ24 Water
Date prepared	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Arsenic-Dissolved	µg/L	<1	<1	5	10	1
Cadmium-Dissolved	µg/L	0.3	2.0	0.4	0.6	1.7
Chromium-Dissolved	µg/L	<1	<1	<1	3	3
Copper-Dissolved	µg/L	110	130	3	1,000	3
Lead-Dissolved	µg/L	<1	11	<1	<1	4
Mercury-Dissolved	µg/L	0.11	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	15	110	250	84	120
Zinc-Dissolved	µg/L	37	330	1,100	650	750
Selenium-Dissolved	µg/L	<1	<1	<1	<1	<1

HM in water - dissolved Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-6 PZ32 Water	88098-7 PZ102 Water	88098-8 PZ103 Water	88098-9 PZ201 Water
Date prepared	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Arsenic-Dissolved	µg/L	3	<1	1	<1
Cadmium-Dissolved	µg/L	<0.1	1.5	<0.1	<0.1
Chromium-Dissolved	µg/L	1	<1	<1	<1
Copper-Dissolved	µg/L	2	230	<1	<1
Lead-Dissolved	µg/L	<1	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	19	200	63	110
Zinc-Dissolved	µg/L	280	790	250	260
Selenium-Dissolved	µg/L	<1	<1	<1	<1

Miscellaneous Inorganics Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-1 PZ209 Water	88098-2 PZ112 Water	88098-3 PZ06 Water	88098-4 PZ107 Water	88098-5 PZ24 Water
Date prepared	-	02/04/2013	02/04/2013	02/04/2013	02/04/2013	02/04/2013
Date analysed	-	02/04/2013	02/04/2013	02/04/2013	02/04/2013	02/04/2013
pH	pH Units	4.3	4.3	4.6	4.0	3.4
Acidity as CaCO ₃	mg/L	340	170	280	390	390
Ammonia as N in water	mg/L	0.055	0.11	0.29	0.26	0.16
Total Dissolved Solids (grav)	mg/L	580	3,400	5,200	4,300	3,600
Electrical Conductivity	µS/cm	800	4,600	6,500	6,900	6,000
Total Nitrogen in water	mg/L	3.0	2.0	2.1	2.8	0.9
TKN in water	mg/L	2.5	1.9	2.1	2.8	0.9
Nitrate as N in water	mg/L	0.55	0.049	<0.005	<0.005	0.012
Nitrite as N in water	mg/L	<0.005	0.008	<0.005	0.006	<0.005
Fluoride, F	mg/L	<0.1	0.39	0.28	0.26	0.34
Phosphate as P in water	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Phosphorus - Total	mg/L	0.3	0.1	0.3	0.1	<0.05

Miscellaneous Inorganics Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-6 PZ32 Water	88098-7 PZ102 Water	88098-8 PZ103 Water	88098-9 PZ201 Water
Date prepared	-	02/04/2013	02/04/2013	02/04/2013	02/04/2013
Date analysed	-	02/04/2013	02/04/2013	02/04/2013	02/04/2013
pH	pH Units	6.2	4.4	5.8	5.5
Acidity as CaCO ₃	mg/L	35	230	200	210
Ammonia as N in water	mg/L	0.11	0.26	0.052	0.049
Total Dissolved Solids (grav)	mg/L	610	3,200	1,200	1,800
Electrical Conductivity	µS/cm	990	4,500	2,100	3,000
Total Nitrogen in water	mg/L	1.6	0.9	1.8	1.0
TKN in water	mg/L	1.6	0.9	1.8	1.0
Nitrate as N in water	mg/L	<0.005	0.035	0.014	0.019
Nitrite as N in water	mg/L	0.01	<0.005	<0.005	<0.005
Fluoride, F	mg/L	<0.1	0.48	0.47	0.24
Phosphate as P in water	mg/L	<0.005	<0.005	<0.005	<0.005
Phosphorus - Total	mg/L	<0.05	0.4	0.7	<0.05

HM in water - total	UNITS	88098-1	88098-2	88098-3	88098-4	88098-5
Our Reference:	-----	PZ209	PZ112	PZ06	PZ107	PZ24
Your Reference	-----	Water	Water	Water	Water	Water
Type of sample						
Date prepared	-	28/3/2013	28/3/2013	28/3/2013	28/3/2013	28/3/2013
Date analysed	-	28/3/2013	28/3/2013	28/3/2013	28/3/2013	28/3/2013
Aluminium-Total	µg/L	29,000	28,000	22,000	60,000	34,000
Iron-Total	µg/L	14,000	20,000	140,000	5,400	46,000

HM in water - total	UNITS	88098-6	88098-7	88098-8	88098-9
Our Reference:	-----	PZ32	PZ102	PZ103	PZ201
Your Reference	-----	Water	Water	Water	Water
Type of sample					
Date prepared	-	28/3/2013	28/3/2013	28/3/2013	28/3/2013
Date analysed	-	28/3/2013	28/3/2013	28/3/2013	28/3/2013
Aluminium-Total	µg/L	690	38,000	1,500	870
Iron-Total	µg/L	3,500	65,000	32,000	61,000

Ion Balance Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-1 PZ209 Water	88098-2 PZ112 Water	88098-3 PZ06 Water	88098-4 PZ107 Water	88098-5 PZ24 Water
Date prepared	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Calcium - Dissolved	mg/L	10	33	8.9	5.0	3.0
Potassium - Dissolved	mg/L	2.1	6.3	13	11	4.8
Sodium - Dissolved	mg/L	160	970	1,100	1,300	1,000
Magnesium - Dissolved	mg/L	12	100	200	180	160
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Carbonate Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Sulphate, SO ₄	mg/L	130	200	240	320	280
Chloride, Cl	mg/L	170	1,400	2,200	2,400	2,100
Ionic Balance	%	6.1	8.2	-1.1	-2.4	-5.0

Ion Balance Our Reference: Your Reference Type of sample	UNITS ----- -----	88098-6 PZ32 Water	88098-7 PZ102 Water	88098-8 PZ103 Water	88098-9 PZ201 Water
Date prepared	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Date analysed	-	28/03/2013	28/03/2013	28/03/2013	28/03/2013
Calcium - Dissolved	mg/L	5.9	16	3.6	9.9
Potassium - Dissolved	mg/L	2.9	12	5.0	8.8
Sodium - Dissolved	mg/L	200	900	450	600
Magnesium - Dissolved	mg/L	16	110	32	68
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO ₃	mg/L	57	<5	91	32
Carbonate Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	57	<5	91	32
Sulphate, SO ₄	mg/L	78	120	290	260
Chloride, Cl	mg/L	230	1,500	440	830
Ionic Balance	%	4.9	4.9	5.4	5.1

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 draft Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 draft Guideline on Investigation Levels for Soil and Groundwater.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM draft B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+.
Inorg-005	Acidity - determined titrimetrically in accordance with APHA 22nd ED, 2320-B.
Inorg-057	Ammonia - determined colourimetrically based on EPA350.1 and APHA 22nd ED 4500-NH3 F, Soils are analysed following a KCl extraction.
Inorg-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-5oC.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA 22nd ED 2510 and Rayment & Lyons.
Inorg-055/062	Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen.
Inorg-062	TKN - determined colourimetrically based on APHA 22nd ED 4500 Norg.
Inorg-055	Nitrate - determined colourimetrically based on EPA353.2 and APHA 22nd ED NO3- F. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on EPA353.2 and APHA 22nd ED NO2- B. Soils are analysed following a water extraction.
Inorg-026	Fluoride determined by ion selective electrode (ISE) in accordance with APHA 22nd ED, 4500-F-C.
Inorg-060	Phosphate determined colourimetrically based on EPA365.1 and APHA 22nd ED 4500 P E. Soils are analysed following a water extraction.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA 22nd ED, 2320-B.

Method ID	Methodology Summary
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110-B.
Inorg-041	Gravimetric determination of the total solids content of water using APHA 22nd ED 2540B.

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
vTRH in Water (C6-C9) NEPM						Base II Duplicate II %RPD		
Date extracted	-			27/03/2013	[NT]	[NT]	LCS-W1	27/03/2013
Date analysed	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
TRHC ₆ - C ₉	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	118%
TRHC ₆ - C ₁₀	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	118%
Surrogate Dibromofluoromethane	%		Org-013	98	[NT]	[NT]	LCS-W1	116%
Surrogate toluene-d8	%		Org-013	96	[NT]	[NT]	LCS-W1	95%
Surrogate 4-BFB	%		Org-013	92	[NT]	[NT]	LCS-W1	99%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
svTRH (C10-C40) in Water						Base II Duplicate II %RPD		
Date extracted	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Date analysed	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
TRHC ₁₀ - C ₁₄	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	118%
TRHC ₁₅ - C ₂₈	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	121%
TRHC ₂₉ - C ₃₆	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	96%
TRH>C ₁₀ - C ₁₆	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	118%
TRH>C ₁₆ - C ₃₄	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	121%
TRH>C ₃₄ - C ₄₀	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	96%
Surrogate o-Terphenyl	%		Org-003	88	[NT]	[NT]	LCS-W1	104%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
PAHs in Water						Base II Duplicate II %RPD		
Date extracted	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Date analysed	-			05/04/2013	[NT]	[NT]	LCS-W1	05/04/2013
Naphthalene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	78%
Acenaphthylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	81%
Phenanthrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	76%
Anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	81%
Pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	82%
Benzo(a)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
PAHs in Water						Base II Duplicate II %RPD		
Chrysene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	72%
Benzo(b+k)fluoranthene	µg/L	2	Org-012 subset	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	92%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene TEQ	µg/L	5	Org-012 subset	5	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	109	[NT]	[NT]	LCS-W1	100%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
OCP in water						Base II Duplicate II %RPD		
Date extracted	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Date analysed	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
HCB	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
alpha-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	78%
gamma-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
beta-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	80%
Heptachlor	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	81%
delta-BHC	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
Aldrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	78%
Heptachlor Epoxide	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	83%
gamma-Chlordane	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
alpha-Chlordane	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
Endosulfan I	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
pp-DDE	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	80%
Dieldrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	82%
Endrin	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	75%
pp-DDD	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	87%
Endosulfan II	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
pp-DDT	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	LCS-W1	84%
Methoxychlor	µg/L	0.2	Org-005	<0.2	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%		Org-005	84	[NT]	[NT]	LCS-W1	92%

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
OP Pesticides in water						Base II Duplicate II %RPD		
Date extracted	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Date analysed	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Diazinon	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NR]	[NR]
Dimethoate	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NR]	[NR]
Chlorpyrifos-methyl	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NR]	[NR]
Ronnel	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NR]	[NR]
Chlorpyrifos	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	LCS-W1	72%
Fenitrothion	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	LCS-W1	75%
Bromophos ethyl	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	[NR]	[NR]
Ethion	µg/L	0.2	Org-008	<0.2	[NT]	[NT]	LCS-W1	67%
Surrogate TCMX	%		Org-008	84	[NT]	[NT]	LCS-W1	80%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
PCBs in Water						Base II Duplicate II %RPD		
Date extracted	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Date analysed	-			28/03/2013	[NT]	[NT]	LCS-W1	28/03/2013
Arochlor 1016	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Arochlor 1221	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Arochlor 1232	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Arochlor 1242	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Arochlor 1248	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Arochlor 1254	µg/L	2	Org-006	<2	[NT]	[NT]	LCS-W1	86%
Arochlor 1260	µg/L	2	Org-006	<2	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%		Org-006	84	[NT]	[NT]	LCS-W1	78%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
HM in water - dissolved						Base II Duplicate II %RPD		
Date prepared	-			28/03/2013	88098-1	28/03/2013 28/03/2013	LCS-W1	28/03/2013
Date analysed	-			28/03/2013	88098-1	28/03/2013 28/03/2013	LCS-W1	28/03/2013
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	<1 <1	LCS-W1	97%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	88098-1	0.3 0.3 RPD: 0	LCS-W1	96%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	<1 <1	LCS-W1	88%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	110 100 RPD: 10	LCS-W1	89%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	<1 <1	LCS-W1	87%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	100	88098-1	0.11 0.11 RPD: 0	LCS-W1	96%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	15 15 RPD: 0	LCS-W1	92%

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
HM in water - dissolved						Base II Duplicate II %RPD		
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	37 35 RPD: 6	LCS-W1	87%
Selenium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	88098-1	<1 <1	LCS-W1	95%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Miscellaneous Inorganics						Base II Duplicate II %RPD		
Date prepared	-			02/04/2013	88098-1	02/04/2013 02/04/2013	LCS-W1	02/04/2013
Date analysed	-			02/04/2013	88098-1	02/04/2013 02/04/2013	LCS-W1	02/04/2013
pH	pH Units		Inorg-001	[NT]	88098-1	4.3 4.3 RPD: 0	LCS-W1	101%
Acidity as CaCO ₃	mg/L	5	Inorg-005	<5	88098-1	340 330 RPD: 3	LCS-W1	107%
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	88098-1	0.055 0.057 RPD: 4	LCS-W1	96%
Total Dissolved Solids (grav)	mg/L	5	Inorg-018	<5	88098-1	580 570 RPD: 2	LCS-W1	96%
Electrical Conductivity	µS/cm	1	Inorg-002	<1	88098-1	800 850 RPD: 6	LCS-W1	112%
Total Nitrogen in water	mg/L	0.1	Inorg-055/062	<0.1	88098-1	3.0 2.9 RPD: 3	LCS-W1	99%
TKN in water	mg/L	0.1	Inorg-062	<0.1	88098-1	2.5 2.3 RPD: 8	LCS-W1	99%
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	88098-1	0.55 0.55 RPD: 0	LCS-W1	101%
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	88098-1	<0.005 <0.005	LCS-W1	101%
Fluoride, F	mg/L	0.1	Inorg-026	<0.1	88098-1	<0.1 <0.1	LCS-W1	103%
Phosphate as P in water	mg/L	0.005	Inorg-060	<0.005	88098-1	<0.005 <0.005	LCS-W1	87%
Phosphorus - Total	mg/L	0.05	Metals-020 ICP-AES	<0.05	88098-1	0.3 0.3 RPD: 0	LCS-W1	93%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results		
HM in water - total						Base II Duplicate II %RPD		
Date prepared	-			[NT]	88098-1	28/3/2013 28/3/2013		
Date analysed	-			[NT]	88098-1	28/3/2013 28/3/2013		
Aluminium-Total	µg/L	10	Metals-022 ICP-MS	<10	88098-1	29000 29000 RPD: 0		
Iron-Total	µg/L	10	Metals-022 ICP-MS	<10	88098-1	14000 14000 RPD: 0		
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Ion Balance						Base II Duplicate II %RPD		
Date prepared	-			28/03/2013	88098-1	28/03/2013 28/03/2013	LCS-W1	28/03/2013
Date analysed	-			28/03/2013	88098-1	28/03/2013 28/03/2013	LCS-W1	28/03/2013
Calcium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	88098-1	10 10 RPD: 0	LCS-W1	101%
Potassium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	88098-1	2.1 2.1 RPD: 0	LCS-W1	109%
Sodium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	88098-1	160 160 RPD: 0	LCS-W1	104%
Magnesium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	88098-1	12 12 RPD: 0	LCS-W1	101%

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Ion Balance						Base Duplicate %RPD		
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	5	Inorg-006	<5	88098-1	<5 <5	[NR]	[NR]
Bicarbonate Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	88098-1	<5 <5	[NR]	[NR]
Carbonate Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	88098-1	<5 <5	[NR]	[NR]
Total Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	88098-1	<5 <5	LCS-W1	101%
Sulphate, SO ₄	mg/L	1	Inorg-081	<1	88098-1	130 130 RPD: 0	LCS-W1	103%
Chloride, Cl	mg/L	1	Inorg-081	<1	88098-1	170 170 RPD: 0	LCS-W1	94%
Ionic Balance	%		Inorg-041	[NT]	88098-1	6.1 5.9 RPD: 3	[NR]	[NR]

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	88098-2	28/03/2013
Date analysed	-	[NT]	[NT]	88098-2	28/03/2013
Arsenic-Dissolved	µg/L	[NT]	[NT]	88098-2	96%
Cadmium-Dissolved	µg/L	[NT]	[NT]	88098-2	94%
Chromium-Dissolved	µg/L	[NT]	[NT]	88098-2	80%
Copper-Dissolved	µg/L	[NT]	[NT]	88098-2	87%
Lead-Dissolved	µg/L	[NT]	[NT]	88098-2	100%
Mercury-Dissolved	µg/L	[NT]	[NT]	88098-2	96%
Nickel-Dissolved	µg/L	[NT]	[NT]	88098-2	87%
Zinc-Dissolved	µg/L	[NT]	[NT]	88098-2	87%
Selenium-Dissolved	µg/L	[NT]	[NT]	88098-2	100%
QUALITY CONTROL Ion Balance	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	88098-2	28/03/2013
Date analysed	-	[NT]	[NT]	88098-2	28/03/2013
Calcium - Dissolved	mg/L	[NT]	[NT]	88098-2	#
Potassium - Dissolved	mg/L	[NT]	[NT]	88098-2	116%
Sodium - Dissolved	mg/L	[NT]	[NT]	88098-2	#
Magnesium - Dissolved	mg/L	[NT]	[NT]	88098-2	#
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	[NT]	[NT]	[NR]	[NR]
Bicarbonate Alkalinity as CaCO ₃	mg/L	[NT]	[NT]	[NR]	[NR]
Carbonate Alkalinity as CaCO ₃	mg/L	[NT]	[NT]	[NR]	[NR]
Total Alkalinity as CaCO ₃	mg/L	[NT]	[NT]	[NR]	[NR]
Sulphate, SO ₄	mg/L	[NT]	[NT]	[NR]	[NR]
Chloride, Cl	mg/L	[NT]	[NT]	[NR]	[NR]
Ionic Balance	%	[NT]	[NT]	[NR]	[NR]

Report Comments:

ION_BALANCE: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Asbestos ID was analysed by Approved Identifier:
Asbestos ID was authorised by Approved Signatory:

Not applicable for this job
Not applicable for this job

INS: Insufficient sample for this test
NA: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batched of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

CERTIFICATE OF ANALYSIS

92553

Client:

SMEC Australia
Level 6, 76 Berry St
North Sydney
NSW 2060

Attention: Cara Jacques

Sample log in details:

Your Reference:	30011256	
No. of samples:	10 waters	
Date samples received / completed instructions received	19/06/13	/ 19/06/13

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	26/06/13	/	26/06/13
Date of Preliminary Report:	Not issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:



Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	92553-1	92553-2	92553-3	92553-4	92553-5
Your Reference	-----	PZ01	PZ103	PZ31	DUP	PZ102
Date Sampled	-----	19/06/2013	19/06/2013	19/06/2013	19/06/2013	19/06/2013
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	19/06/2013	19/06/2013	19/06/2013	19/06/2013	19/06/2013
Date analysed	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
TRHC ₆ - C ₉	µg/L	<10	<10	<10	<10	<100
TRHC ₆ - C ₁₀	µg/L	<10	<10	<10	<10	<100
TRHC ₆ - C ₁₀ less BTEX (F1)	µg/L	<10	<10	<10	<10	[NA]
Benzene	µg/L	<1	<1	<1	<1	<10
Toluene	µg/L	<1	<1	<1	<1	<10
Ethylbenzene	µg/L	<1	<1	<1	<1	<10
m+p-xylene	µg/L	<2	<2	<2	<2	<20
o-xylene	µg/L	<1	<1	<1	<1	<10
Naphthalene	µg/L	<1	<1	<1	<1	<10
Surrogate Dibromofluoromethane	%	107	107	107	108	107
Surrogate toluene-d8	%	101	101	101	101	101
Surrogate 4-BFB	%	99	96	97	100	98

svTRH (C10-C40) in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	92553-1 PZ01 19/06/2013 Water	92553-2 PZ103 19/06/2013 Water	92553-3 PZ31 19/06/2013 Water	92553-4 DUP 19/06/2013 Water	92553-5 PZ102 19/06/2013 Water
Date extracted	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Date analysed	-	21/06/2013	21/06/2013	21/06/2013	21/06/2013	21/06/2013
TRHC ₁₀ - C ₁₄	µg/L	<50	<50	<50	<50	<50
TRHC ₁₅ - C ₂₈	µg/L	<100	<100	<100	<100	<100
TRHC ₂₉ - C ₃₆	µg/L	<100	<100	<100	<100	<100
TRH>C ₁₀ - C ₁₆	µg/L	<50	<50	<50	<50	<50
TRH>C ₁₀ - C ₁₆ less Naphthalene (F2)	µg/L	<50	<50	<50	<50	[NA]
TRH>C ₁₆ - C ₃₄	µg/L	<100	<100	<100	<100	<100
TRH>C ₃₄ - C ₄₀	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	104	93	96	83	61

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	92553-1 PZ01 19/06/2013 Water	92553-2 PZ103 19/06/2013 Water	92553-3 PZ31 19/06/2013 Water	92553-4 DUP 19/06/2013 Water	92553-5 PZ102 19/06/2013 Water
Date extracted	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Date analysed	-	21/06/2013	21/06/2013	21/06/2013	21/06/2013	21/06/2013
Naphthalene	µg/L	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Surrogate p-Terphenyl-d14	%	93	95	105	80	61

HM in water - dissolved						
Our Reference:	UNITS	92553-1	92553-2	92553-3	92553-4	92553-5
Your Reference	-----	PZ01	PZ103	PZ31	DUP	PZ102
Date Sampled	-----	19/06/2013	19/06/2013	19/06/2013	19/06/2013	19/06/2013
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Date analysed	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Arsenic-Dissolved	µg/L	1	2	2	1	1
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Chromium-Dissolved	µg/L	<1	1	1	<1	2
Copper-Dissolved	µg/L	<1	4	3	<1	260
Lead-Dissolved	µg/L	<1	1	<1	<1	2
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	66	14	28	66	12
Zinc-Dissolved	µg/L	87	270	20	91	990

HM in water - dissolved						
Our Reference:	UNITS	92553-6	92553-7	92553-8	92553-9	92553-10
Your Reference	-----	PZ24	PZ107	PZ06	PZ09	PZ112
Date Sampled	-----	19/06/2013	19/06/2013	19/06/2013	19/06/2013	19/06/2013
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Date analysed	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Arsenic-Dissolved	µg/L	1	3	6	<1	<1
Cadmium-Dissolved	µg/L	1.8	0.5	<0.1	0.2	2.1
Chromium-Dissolved	µg/L	4	2	<1	1	2
Copper-Dissolved	µg/L	4	430	<1	85	220
Lead-Dissolved	µg/L	4	<1	<1	<1	7
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	0.20	<0.05
Nickel-Dissolved	µg/L	120	64	410	9	210
Zinc-Dissolved	µg/L	900	230	1,700	29	620

Miscellaneous Inorganics						
Our Reference:	UNITS	92553-1	92553-2	92553-3	92553-4	92553-5
Your Reference	-----	PZ01	PZ103	PZ31	DUP	PZ102
Date Sampled	-----	19/06/2013	19/06/2013	19/06/2013	19/06/2013	19/06/2013
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Date analysed	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
pH	pH Units	6.0	6.6	5.9	6.0	5.7
Electrical Conductivity	µS/cm	2,200	770	3,500	2,200	650
Total Dissolved Solids (grav)	mg/L	1,300	630	2,000	1,300	390
Acidity as CaCO ₃	mg/L	120	33	110	96	110
Ammonia as N in water	mg/L	0.088	0.081	0.25	0.089	0.11
Total Nitrogen in water	mg/L	0.7	1.2	1.6	0.6	8.1
Nitrate as N in water	mg/L	0.037	0.073	<0.005	0.043	0.019
Nitrite as N in water	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Phosphorus - Total	mg/L	<0.05	0.3	<0.05	<0.05	0.5

Miscellaneous Inorganics						
Our Reference:	UNITS	92553-6	92553-7	92553-8	92553-9	92553-10
Your Reference	-----	PZ24	PZ107	PZ06	PZ09	PZ112
Date Sampled	-----	19/06/2013	19/06/2013	19/06/2013	19/06/2013	19/06/2013
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Date analysed	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
pH	pH Units	3.5	3.5	5.2	3.8	3.9
Electrical Conductivity	µS/cm	6,300	7,400	6,800	1,200	4,900
Total Dissolved Solids (grav)	mg/L	3,900	4,600	4,300	710	2,600
Acidity as CaCO ₃	mg/L	590	400	600	94	210
Ammonia as N in water	mg/L	0.10	0.15	0.21	0.046	0.11
Total Nitrogen in water	mg/L	0.8	2.0	1.3	1.2	1.5
Nitrate as N in water	mg/L	<0.005	<0.005	0.009	0.31	0.031
Nitrite as N in water	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Phosphorus - Total	mg/L	0.05	0.1	0.08	<0.05	0.1

HM in water - total Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	92553-1 PZ01 19/06/2013 Water	92553-2 PZ103 19/06/2013 Water	92553-3 PZ31 19/06/2013 Water	92553-4 DUP 19/06/2013 Water	92553-5 PZ102 19/06/2013 Water
Date prepared	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Date analysed	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Aluminium-Total	µg/L	200	2,300	1,400	200	29,000
Iron-Total	µg/L	46,000	9,900	29,000	47,000	16,000

HM in water - total Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	92553-6 PZ24 19/06/2013 Water	92553-7 PZ107 19/06/2013 Water	92553-8 PZ06 19/06/2013 Water	92553-9 PZ09 19/06/2013 Water	92553-10 PZ112 19/06/2013 Water
Date prepared	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Date analysed	-	20/6/2013	20/6/2013	20/6/2013	20/6/2013	20/6/2013
Aluminium-Total	µg/L	33,000	60,000	4,600	10,000	31,000
Iron-Total	µg/L	45,000	6,000	160,000	4,100	9,600

Ion Balance Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	92553-1 PZ01 19/06/2013 Water	92553-2 PZ103 19/06/2013 Water	92553-3 PZ31 19/06/2013 Water	92553-4 DUP 19/06/2013 Water	92553-5 PZ102 19/06/2013 Water
Date prepared	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Date analysed	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Calcium - Dissolved	mg/L	8.5	5.3	3.7	8.6	4.7
Potassium - Dissolved	mg/L	6.7	2.5	3.3	6.7	3.2
Sodium - Dissolved	mg/L	410	130	280	400	120
Magnesium - Dissolved	mg/L	38	7.9	25	38	5.0
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO ₃	mg/L	92	110	120	77	530
Carbonate Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	92	110	120	77	530
Sulphate, SO ₄	mg/L	220	100	120	210	43
Chloride, Cl	mg/L	550	110	1,100	580	150
Ionic Balance	%	-1.2	-3.6	-40	-2.4	-45

Ion Balance Our Reference: Your Reference Date Sampled Type of sample	UNITS ----- -----	92553-6 PZ24 19/06/2013 Water	92553-7 PZ107 19/06/2013 Water	92553-8 PZ06 19/06/2013 Water	92553-9 PZ09 19/06/2013 Water	92553-10 PZ112 19/06/2013 Water
Date prepared	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Date analysed	-	20/06/2013	20/06/2013	20/06/2013	20/06/2013	20/06/2013
Calcium - Dissolved	mg/L	3.2	2.0	8.4	2.6	11
Potassium - Dissolved	mg/L	4.6	6.6	12	1.4	4.4
Sodium - Dissolved	mg/L	1,000	1,300	1,200	210	900
Magnesium - Dissolved	mg/L	150	160	170	13	92
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as CaCO ₃	mg/L	<5	<5	1,100	<5	<5
Carbonate Alkalinity as CaCO ₃	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	<5	<5	1,100	<5	<5
Sulphate, SO ₄	mg/L	250	420	400	170	340
Chloride, Cl	mg/L	2,400	2,500	2,300	260	1,600
Ionic Balance	%	-12	-5.9	-18	-1.8	-4.0

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA 22nd ED 2510 and Rayment & Lyons.
Inorg-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-5oC.
Inorg-005	Acidity - determined titrimetrically in accordance with APHA 22nd ED, 2320-B.
Inorg-057	Ammonia - determined colourimetrically based on EPA350.1 and APHA 22nd ED 4500-NH3 F, Soils are analysed following a KCl extraction.
Inorg-055/062	Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen.
Inorg-055	Nitrate - determined colourimetrically based on EPA353.2 and APHA 22nd ED NO3- F. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on EPA353.2 and APHA 22nd ED NO2- B. Soils are analysed following a water extraction.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA 22nd ED, 2320-B.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110-B.
Inorg-041	Gravimetric determination of the total solids content of water using APHA 22nd ED 2540B.

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
vTRH(C6-C10)/BTEXN in Water						Base II Duplicate II %RPD		
Date extracted	-			19/06/2013	[NT]	[NT]	LCS-W1	19/06/2013
Date analysed	-			20/06/2013	[NT]	[NT]	LCS-W1	20/06/2013
TRHC ₆ - C ₉	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	107%
TRHC ₆ - C ₁₀	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	107%
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	108%
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	108%
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	106%
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	LCS-W1	106%
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	105%
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	101	[NT]	[NT]	LCS-W1	103%
Surrogate toluene-d8	%		Org-016	101	[NT]	[NT]	LCS-W1	100%
Surrogate 4-BFB	%		Org-016	104	[NT]	[NT]	LCS-W1	98%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
svTRH (C10-C40) in Water						Base II Duplicate II %RPD		
Date extracted	-			20/06/2013	[NT]	[NT]	LCS-W1	20/06/2013
Date analysed	-			21/06/2013	[NT]	[NT]	LCS-W1	21/06/2013
TRHC ₁₀ - C ₁₄	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	113%
TRHC ₁₅ - C ₂₈	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	128%
TRHC ₂₉ - C ₃₆	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	114%
TRH>C ₁₀ - C ₁₆	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	113%
TRH>C ₁₆ - C ₃₄	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	128%
TRH>C ₃₄ - C ₄₀	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	114%
Surrogate o-Terphenyl	%		Org-003	108	[NT]	[NT]	LCS-W1	113%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
PAHs in Water						Base II Duplicate II %RPD		
Date extracted	-			20/06/2013	[NT]	[NT]	LCS-W1	20/06/2013
Date analysed	-			21/06/2013	[NT]	[NT]	LCS-W1	21/06/2013
Naphthalene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	85%
Acenaphthylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	91%
Phenanthrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	79%

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
PAHs in Water						Base II Duplicate II %RPD		
Anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	82%
Pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	88%
Benzo(a)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	79%
Benzo(b+k)fluoranthene	µg/L	2	Org-012 subset	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	97%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	104	[NT]	[NT]	LCS-W1	83%
QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
HM in water - dissolved						Base II Duplicate II %RPD		
Date prepared	-			20/06/2013	92553-9	20/6/2013 20/6/2013	LCS-W2	20/06/2013
Date analysed	-			20/06/2013	92553-9	20/6/2013 20/6/2013	LCS-W2	20/06/2013
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	92553-9	<1 <1	LCS-W2	95%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	92553-9	0.2 0.2 RPD: 0	LCS-W2	99%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	92553-9	1 1 RPD: 0	LCS-W2	91%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	92553-9	85 85 RPD: 0	LCS-W2	83%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	92553-9	<1 <1	LCS-W2	104%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	92553-9	0.20 [N/T]	LCS-W2	96%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	92553-9	9 9 RPD: 0	LCS-W2	87%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	92553-9	29 29 RPD: 0	LCS-W2	89%

QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Miscellaneous Inorganics						Base II Duplicate II %RPD		
Date prepared	-			20/06/2013	92553-1	20/06/2013 20/06/2013	LCS-W1	20/06/2013
Date analysed	-			20/06/2013	92553-1	20/06/2013 20/06/2013	LCS-W1	20/06/2013
pH	pH Units		Inorg-001	[NT]	92553-1	6.0 [N/T]	LCS-W1	101%
Electrical Conductivity	µS/cm	1	Inorg-002	<1	92553-1	2200 [N/T]	LCS-W1	105%
Total Dissolved Solids (grav)	mg/L	5	Inorg-018	<5	92553-1	1300 [N/T]	LCS-W1	95%
Acidity as CaCO ₃	mg/L	5	Inorg-005	<5	92553-1	120 100 RPD: 18	LCS-W1	105%
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	92553-1	0.088 0.088 RPD: 0	LCS-W1	88%
Total Nitrogen in water	mg/L	0.1	Inorg-055/062	<0.1	92553-1	0.7 0.6 RPD: 15	LCS-W1	109%
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	92553-1	0.037 0.039 RPD: 5	LCS-W1	100%
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	92553-1	<0.005 <0.005	LCS-W1	101%
Phosphorus - Total	mg/L	0.05	Metals-020 ICP-AES	<0.05	92553-1	<0.05 <0.05	LCS-W1	90%
QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
HM in water - total						Base II Duplicate II %RPD		
Date prepared	-			20/06/2013	92553-4	20/06/2013 20/06/2013	LCS-W1	20/06/2013
Date analysed	-			20/06/2013	92553-4	20/06/2013 20/06/2013	LCS-W1	20/06/2013
Aluminium-Total	µg/L	10	Metals-022 ICP-MS	<10	92553-4	200 200 RPD: 0	LCS-W1	115%
Iron-Total	µg/L	10	Metals-022 ICP-MS	<10	92553-4	47000 49000 RPD: 4	LCS-W1	99%
QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Ion Balance						Base II Duplicate II %RPD		
Date prepared	-			20/06/2013	92553-1	20/06/2013 20/06/2013	LCS-W1	20/06/2013
Date analysed	-			20/06/2013	92553-1	20/06/2013 20/06/2013	LCS-W1	20/06/2013
Calcium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	92553-1	8.5 8.5 RPD: 0	LCS-W1	95%
Potassium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	92553-1	6.7 6.6 RPD: 2	LCS-W1	108%
Sodium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	92553-1	410 400 RPD: 2	LCS-W1	104%
Magnesium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	92553-1	38 37 RPD: 3	LCS-W1	92%
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	5	Inorg-006	<5	92553-1	<5 [N/T]	[NR]	[NR]
Bicarbonate Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	92553-1	92 [N/T]	[NR]	[NR]
Carbonate Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	92553-1	<5 [N/T]	[NR]	[NR]
Total Alkalinity as CaCO ₃	mg/L	5	Inorg-006	<5	92553-1	92 [N/T]	LCS-W1	113%

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Ion Balance						Base Duplicate %RPD		
Sulphate, SO ₄	mg/L	1	Inorg-081	<1	92553-1	220 220 RPD: 0	LCS-W1	115%
Chloride, Cl	mg/L	1	Inorg-081	<1	92553-1	550 550 RPD: 0	LCS-W1	96%
Ionic Balance	%		Inorg-041	[NT]	92553-1	-1.2 [N/T]	[NR]	[NR]
QUALITY CONTROL	UNITS	Dup. Sm#		Duplicate		Spike Sm#	Spike % Recovery	
HM in water - dissolved				Base + Duplicate + %RPD				
Date prepared	-	92553-1		20/6/2013 20/6/2013		92553-2	20/6/2013	
Date analysed	-	92553-1		20/6/2013 20/6/2013		92553-2	20/6/2013	
Mercury-Dissolved	µg/L	92553-1		<0.05 <0.05		92553-2	88%	
QUALITY CONTROL	UNITS	Dup. Sm#		Duplicate		Spike Sm#	Spike % Recovery	
Miscellaneous Inorganics				Base + Duplicate + %RPD				
Date prepared	-	92553-2		20/6/2013 20/6/2013		92553-2	20/6/2013	
Date analysed	-	92553-2		20/6/2013 20/6/2013		92553-2	20/6/2013	
pH	pH Units	92553-2		6.6 6.6 RPD: 0		[NR]	[NR]	
Electrical Conductivity	µS/cm	92553-2		770 770 RPD: 0		[NR]	[NR]	
Total Dissolved Solids (grav)	mg/L	92553-2		630 630 RPD: 0		[NR]	[NR]	
Ammonia as N in water	mg/L	92553-2		0.081 [N/T]		92553-2	100%	
Total Nitrogen in water	mg/L	92553-2		1.2 [N/T]		92553-2	116%	
Nitrate as N in water	mg/L	92553-2		0.073 [N/T]		92553-2	82%	
Nitrite as N in water	mg/L	92553-2		<0.005 [N/T]		92553-2	120%	
Phosphorus - Total	mg/L	92553-2		0.3 [N/T]		92553-2	98%	
QUALITY CONTROL	UNITS	Dup. Sm#		Duplicate		Spike Sm#	Spike % Recovery	
Ion Balance				Base + Duplicate + %RPD				
Date prepared	-	92553-2		20/6/2013 20/6/2013		92553-2	20/6/2013	
Date analysed	-	92553-2		20/6/2013 20/6/2013		92553-2	20/6/2013	
Calcium - Dissolved	mg/L	92553-2		5.3 [N/T]		92553-2	89%	
Potassium - Dissolved	mg/L	92553-2		2.5 [N/T]		92553-2	117%	
Sodium - Dissolved	mg/L	92553-2		130 [N/T]		92553-2	#	
Magnesium - Dissolved	mg/L	92553-2		7.9 [N/T]		92553-2	84%	
Hydroxide Alkalinity (OH ⁻) as CaCO ₃	mg/L	92553-2		<5 <5		[NR]	[NR]	
Bicarbonate Alkalinity as CaCO ₃	mg/L	92553-2		110 110 RPD: 0		[NR]	[NR]	
Carbonate Alkalinity as CaCO ₃	mg/L	92553-2		<5 <5		[NR]	[NR]	
Total Alkalinity as CaCO ₃	mg/L	92553-2		110 110 RPD: 0		[NR]	[NR]	
Sulphate, SO ₄	mg/L	92553-2		100 [N/T]		92553-2	105%	
Chloride, Cl	mg/L	92553-2		110 [N/T]		92553-2	90%	

Report Comments:

Total Recoverable Hydrocarbons in water:(BTEX) PQL has been raised due to the sample matrix requiring dilution (sediment)

ION_BALANCE: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Ion misbalance for samples 3 and 5 due to other ions not measured in Ion balance.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.



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