Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Six Monthly Groundwater Monitoring Event – December 2014 (E4)

11 – 19 Centenary Road
Merrylands

Prepared for
St Vincent de Paul Society

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Report on Six Monthly Groundwater Monitoring Event – December 2014 (E4)
11 – 19 Centenary Road, Merrylands

1. Introduction

This report documents the results of the fourth groundwater monitoring event that was undertaken at 11 - 19 Centenary Road, Merrylands (the site). The assessment was undertaken by Douglas Partners Pty Ltd (DP) and was commissioned by the St Vincent de Paul Society (SVDPS). The site location and property boundaries are presented on Drawing 1, Appendix A.

It is understood that SVDPS intends to continue using the site as a retail outlet (commercial/industrial land use) until at least 2016. Previous assessments by DP in 2009 and 2010 identified the presence of hydrocarbon impacted soil and groundwater associated with leaks from two underground storage tanks (USTs) in the central part of the site. Further, in 2010, DP also undertook a groundwater assessment to evaluate whether groundwater conditions at the site were conducive to natural attenuation. In this regard, no light phase non-aqueous phase liquid (LNAPL) has been identified at the site and the total recoverable hydrocarbon (TRH) and benzene, toluene, ethylbenzene and xylene (BTEX) contamination is understood to be in the dissolved phase. Based on the 2009 and 2010 results, DP prepared a remediation action plan (*Report on Remediation Action Plan*, *11-19 Centenary Road, Merrylands*, January 2011, 71184.01-3 (DP, 2011), refer Section 4) for the site. The RAP was based on a two staged remedial approach wherein the first stage comprised removal of the USTs and grossly impacted soils (to the extent practicable) followed by validation of the remedial excavation, and bi-annual monitored natural attenuation assessments for a period of at least three years to assess whether the contamination at the site was attenuating naturally. The second stage of the remedial approach focussed on the systematic sampling and validation of the site when the site becomes accessible for a detailed investigation.

In 2012, the first stage of remediation works including the removal of two underground storage tanks (USTs) and some of the surrounding hydrocarbon contaminated soil was completed. Given the operational nature and associated access constraints at the site, residual soil contamination was identified to remain on-site beyond the extent of the remedial excavation. Consequently, an interim environmental management plan (*Interim Environmental Management Plan, 11 – 19 Centenary Road, Merrylands*, April 2013, 71184.02 (DP 2013b), refer Section 4) was prepared for the site which also recommended the commencement of the monitored natural attenuation (MNA) groundwater monitoring events (GMEs).

In view of the above, the GMEs were commenced in June 2013 and the current assessment is the fourth GME. The main objective of the GME is to evaluate, on the basis of both field and laboratory results, whether the groundwater conditions at the site are supporting the natural attenuation process, and to identify the presence or otherwise of signs and by-products that would indicate the occurrence of natural attenuation in the groundwater.

2. Scope of Works

The groundwater monitoring programme has been developed broadly in accordance with the seven step data quality objective process, as defined in Australian Standard (AS) *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and Semi-volatile Compounds* (AS 4482.1 – 2005). The DQO process is outlined in the AS and defined by:

- Stating the Problem;
- Identifying the Decision;
- Identifying Inputs to the Decision;
- Defining the Boundary of the Assessment;
- Developing a Decision Rule;
- Specifying Acceptable Limits on Decision Errors;
- Optimising the Design for Obtaining Data.

Data quality objectives have been established for the project and are summarised in Table 1 and detailed in s.7.

Table 1: Data Quality Objectives

Data Quality Objective	Report section where addressed
State the Problem	S1 Introduction
Identify the Decision	S8 Site Assessment Criteria S11 Discussion S12 Conclusions and Recommendations
Identify inputs into the decision	S3 Site Description S4 Background S5 Geology and Hydrogeology S6 Potential For Contamination S8 Site Assessment Criteria S9 Field Results S10 Laboratory Testing
Define the Boundary of the Assessment	S3 Site Description Appendix A Drawing 1
Develop a Decision Rule	S8 Site Assessment Criteria
Specify Acceptable Limits on Decision Errors	Appendix E
Optimise the Design for Obtaining Data	S7 Fieldwork Methods

The scope of works is discussed in the following sections and was as follows:

- The measurement of standing water level and thickness of LNAPL, if any, in monitoring wells 201, 202, 203, 301, 302 and 303 using a multi-phase, interface dip-meter;
- Development of the six monitoring wells via removal of at least three bore volumes or till dry. An initial bail was utilised to visually confirm the absence (or otherwise) of a free product layer. To avoid cross contamination, reusable sampling equipment was not utilised and the bores were sampled "against the contamination gradient", i.e. from the (perceived) least contaminated to the most contaminated (to reduce the risk of cross-contamination);
- Following bore recovery, physical parameters (pH, dissolved oxygen, electrical conductivity and redox potential) were measured using a pre-calibrated multi-parameter probe until stable groundwater parameters were obtained;
- The wells were then sampled using low flow sampling equipment. Samples collected were decanted into laboratory prepared sample bottles (including acid preserved BTEX vials);
- Laboratory analysis was conducted on six groundwater samples (plus QA/QC samples) as per the following schedule:
    - Metals;
    - Total recoverable hydrocarbons (TRH);
    - Monoaromatic hydrocarbons (benzene, toluene, ethylbenzene and xylenes – BTEX);
    - Polycyclic aromatic hydrocarbons (PAH);
    - Volatile organic compounds (VOC – 54 analytes);
    - Ammonia – N (nitrogen as ammonia);
    - O-phosphate;
    - Nitrate;
    - Nitrite;
    - Sulphate;
    - Sulphide;
    - Dissolved methane;
    - Dissolved carbon dioxide;
    - Fe(III);
    - Fe(II); and
    - Total alkalinity
- Analysis of the following QA/QC samples:
    - 1 Intra-laboratory and 1 Inter-laboratory QA/QC sample (metals and TRH);
    - 1 Trip spike and 1 trip blank (TRH and BTEX).
- Preparation of this report detailing the findings of the current half yearly monitoring.

3. Site Identification and Description

The site is identified as part of Lots 19 – 24 in Deposited Plan 2020 and Lot 1 in Deposited Plan 597975 in the Parish of St John, County of Cumberland and the local government area of Holroyd City Council. The street address is 11 - 19 Centenary Road, Merrylands. The site covers an area of approximately 0.28 ha (See Drawing 1, Appendix A).

The site is bordered by Alderney Road and Centenary Road to the north and west respectively. Residential properties border the site to the east and south. Adjacent to the southern boundary is unused land that forms part of the adjacent residential property. This residential property is used by the SVDPS as an office.

The majority of the north-eastern section of the site is occupied by a single-storey, slightly dilapidated warehouse building of timber, steel and corrugated iron construction with concrete flooring. During remediation works (see Section 4), two USTs were removed from the external south-western corner of this building. Subsequent to validation, the remedial pit was reinstated with clean virgin excavated natural material (VENM) and the ground surface was sealed with asphalt. The far north-eastern corner of the site comprises a vegetated area with some mature trees.

The western section of the site is occupied by a two-storey building that is used for retail purposes. The ground level of the building is of brick construction and the second storey is of lightweight construction with external concrete column supports. The ground level flooring comprises concrete and wooden floors which have been carpeted.

The area between the two buildings is paved with asphalt and used as a car park with vehicle access via Alderney and Centenary Roads. The site boundaries are typically covered with grass and scattered mature trees. The ground surface within the site falls gently to the west.

4. Previous Reports and Background

The following relevant site specific reports have previously been produced by DP in relation to contamination issues at the site:

- *Report on Phase 1 Contamination Assessment with Limited Sampling, Proposed Building Additions, 11-19 Centenary Road, Merrylands*, June 2009, DP Ref: 71184 (DP, 2009a);
- *Report on Phase 2 Contamination Assessment, 11-19 Centenary Road, Merrylands,* September 2009, DP Ref: 71184.01 (DP, 2009b);
- *Report on Groundwater Monitoring Event, Assessment of Contamination and Natural Attenuation Parameters*, 11-19 Centenary Road, Merrylands, January 2010, 71184.01-2, (DP, 2010);
- *Report on Remediation Action Plan*, *11-19 Centenary Road, Merrylands*, January 2011, 71184.01-3 (DP, 2011);
- *Report on Tank Pit Validation Assessment, 11 – 19 Centenary Road, Merrylands,* January 2013, 71184.02 (DP, 2013a);

- *Interim Environmental Management Plan, 11 – 19 Centenary Road, Merrylands*, April 2013, 71184.02 (DP 2013b);
- *Report on Six Monthly Groundwater Monitoring Event – June 2013 (E1), 11 – 19 Centenary Road, Merrylands*, August 2013, 71184.02 (DP 2013c);
- *Report on Six Monthly Groundwater Monitoring Event – December 2013 (E2), 11 – 19 Centenary Road, Merrylands*, March 2014, 71184.02 (DP 2014a); and
- *Report on Six Monthly Groundwater Monitoring Event – June 2014 (E3), 11 – 19 Centenary Road, Merrylands*, July 2014, 71184.03 (DP 2014b).

The results of DP (2009a, 2009b and 2010) indicated the presence of TRH C_6-C_9 and BTEX impacted soil and groundwater associated with USTs at the site. Consequently, the site owner (i.e., St Vincent DePaul Society) took a proactive approach wherein it voluntarily notified the NSW EPA under Section 60 of the *Contaminated Land Management Act 1997* (CLM Act 1997) of the identified contamination at the site. Subsequently, DP reports 2009a, 2009b, 2010 and 2011 were submitted to the NSW EPA.

In addition to the above, it is noted that DP (2010) comprised a GME to evaluate whether groundwater conditions at the site were conducive to monitored natural attenuation (MNA). The assessment involved a review of the previous results, sampling of the three groundwater monitoring wells from DP (2009b) (i.e, Bores 201 – 203) plus the construction and sampling of four additional groundwater wells (301 – 304), two of which were located off site (303 and 304). It is noted that the locations of the off-site wells were restricted by the presence of both buried services and overhead electrical cables along both sides of Centenary Road. Consequently, BH303 and BH304 were placed in close proximity to each other at a location immediately up-gradient of the identified sensitive receptors (i.e. the residential properties across Centenary Road). The results of DP (2010) showed the following:

- Light non-aqueous phase liquid (LNAPL) was not detected by the interface probe, although a thin oily sheen was observed in two of the bores i.e., Bores 203 and 302, which are located adjacent to the UST and cross-gradient to UST, respectively (see Drawing 1, Appendix A);
- Strong hydrocarbon odours were noted to be present in the groundwater from the wells adjacent to the UST, i.e. Bores 203 and 302, whilst slight hydrocarbon odours were noted at Bores 201 and 202;.
- The analytical results for the primary contaminants of concern (i.e., TRH, BTEX and PAH) indicated that the groundwater up-gradient of the UST (301) did not show any discernible signs of hydrocarbon associated contamination;
- Substantially elevated TRH C_6-C_9 (11000 – 35000 µg/L), benzene (830 - 10000 µg/L), toluene (5100 – 19000 µg/L), ethylbenzene (1000 – 1300 µg/L) and total xylenes (3580 – 5000 µg/L) concentrations, in exceedance of the adopted groundwater investigation levels (GIL), were however, recorded in the groundwater samples retrieved from Bores 203 and 302. The concentrations of medium to heavy chain hydrocarbons (TRH C_{10} – C_{36}) and PAH (naphthalene) also exceeded the adopted GILs in these two bores. A review of the chromatograms for Bores 203 and 302 indicated that the chemical "signature" of the TRH was similar to petrol. Furthermore, elevated concentrations of a number of petroleum related, non-halogenated volatile organic compounds (VOC), in particular, cyclohexane, n-propylbenzene, 1,2,4 trimethylbenzene and 1,3,5 trimethylbenzene were also detected in Bores 203 and 302. In summary, the analytical results from DP (2010) indicated that the groundwater in the vicinity of the USTs is significantly impacted by petroleum hydrocarbons;

- Samples collected at the down-gradient site boundary (Bores 201 and 202) recorded elevated TRH C_6–C_9 and BTEX concentrations. The recorded concentrations were significantly lower than recorded at Bores 203 and 302 (adjacent to the source of the contamination). The only primary contaminant of concern that exceeded the adopted GIL was TRH C_6–C_9 in Bore 201 (530 µg/L). Bore 202 recorded minor concentrations of TRH C_6–C_9 and BTEX were detected which were also below the adopted GIL;
- Samples collected from the off-site, down-gradient bores (Bores 303 and 304) recorded lower TRH contaminant concentrations than those detected at the site boundaries. Whilst detectable concentrations of TRH C_6 – C_9 (Bores 303 and 304), BTEX (Bores 303 and 304) and VOC (Bore 303) were recorded in the off-site, down-gradient bores, the concentrations were well within the adopted GIL;
- The field parameters indicated that the recorded values of both dissolved oxygen and redox potential were indicative of the occurrence of natural attenuation through oxidation of petroleum hydrocarbons;
- The presence of increased concentrations of dissolved CO_2 along the flow path of the plume, and the presence of elevated methane concentrations within the plume further suggested that natural attenuation is occurring (at least partially) with the petroleum hydrocarbons breaking down under aerobic conditions to form methane;
- Relatively low nutrient concentrations i.e., ammonia and phosphorous were detected in the analysed samples. In this regard DP 2010 noted that the efficiency of the process may be further enhanced by appropriately introducing nutrients to the groundwater;
- With respect to electron receptors, sulphate concentrations in the three most contaminated bores (Bores 203, 302 and 201) showed significantly lower sulphate concentrations than the baseline bore (BH301) and the fringe bore (BH303). Similarly, the recorded concentrations of ferrous iron (the product of reduced ferric iron) were greatest in the bores with the highest concentrations of petroleum hydrocarbon contaminants (Bores 203 and 302). Therefore, there was evidence of both sulphate and ferric iron reduction which would support the oxidation and biodegradation of petroleum related hydrocarbons. In addition to the above, there appeared to be some signs of an increased alkalinity trend along the flow path of the contamination plume, which further supported the inference that natural attenuation was occurring at the site.

Based on the results of DP (2009 and 2010), a Remediation Action Plan (RAP) (DP, 2011) was prepared with a view to remediate soil and groundwater contamination. The proposed remediation strategy comprised a phased approach. DP (2009a, 2009b, 2010, 2011) were the subject of an audit by a NSW Environment Protection Authority (EPA) accredited auditor, Mr Philip Mulvey of Environmental Earth Sciences Pty Ltd (EES). Based on the auditor's comments on the reports, the DP (2011) RAP was finalised and submitted to the NSW EPA.

DP (2011) documented a two stage remediation process. Phase 1 of the remediation works which were completed in 2012 included removal of the USTs, excavation and disposal of contaminated soil, backfilling the excavated area with validated virgin excavated natural material (VENM) and implementing six monthly groundwater monitoring events. Phase 2 of the remediation works (to be completed in the future) involves further sampling to characterise the site and appropriate remediation of any additional and residual areas of contamination.

An air monitoring event (AME) was also undertaken in the process of finalising the RAP. The purpose of the AME was to confirm whether the detected petroleum hydrocarbon contamination in the

subsurface had intruded into the building and resulted in unacceptable health impacts on the air quality of the site, such that corresponding remedial action/management could be incorporated. Based on the findings of the AME, it was considered that the site was not impacted by vapour intrusion from the volatile contaminants in soil/groundwater at the time of sampling and at the sampling locations. Further details on the AME are provided in DP (2011).

Between July and September 2012, the first phase of remediation comprising the removal of two USTs and disposal of some of the surrounding contaminated soil was completed. However, the GMEs had not yet commenced. DP (2013a) reported on the remediation that had been undertaken including the removal of two USTs and excavation and disposal of surrounding hydrocarbon contaminated soil. The extent of the excavations to remove contaminated soil was limited so as to maintain the structural integrity of the existing operational building structures and underground services. The validation results suggested that TRH C_6-C_9 and BTEX soil contamination remains at depths of more than 2 m below the current ground level which was identified within the weathered sandstone, particularly at the base of the remedial excavations.

In view of the residual soil and groundwater contamination, an interim environmental management plan (IEMP) was prepared for the site (DP, 2013b). The IEMP detailed interim management strategies for the maintenance of the existing ground surfaces and also recommended commencement of the current six monthly GME of the groundwater monitoring wells. In this regard, given that BH303 and BH304 were placed in close proximity to each other, BH304 was excluded from the GMEs as BH303 was considered to provide data that would be representative of the off-site sampling locations.

In June 2013, the first GME (E1) was carried out and the results were reported in DP (2013c). The results of DP (2013c) indicated that whilst the concentration of the contaminants of concern had marginally increased since the January 2010 monitoring event, the increased concentrations were likely to be associated with the recent remedial works that had temporarily altered the groundwater conditions and geochemical processes at the site. Therefore, DP (2013c) concluded that "….*the elevated contaminant concentrations detected during the current monitoring round may not necessarily be indicative of deteriorating groundwater conditions and are more likely to be associated with stabilisation of groundwater conditions at the site. As such, robust trend analysis cannot be conducted at this stage until the data set is expanded through/by additional rounds of monitoring. Therefore further rounds of groundwater monitoring will be required to evaluate a trend in the contaminant plume*."

In December 2013, the second GME (E2) was carried out and the results were reported in DP (2014a). The results indicated that contaminant concentrations during the second GME "*were generally lower than those detected during the June 2013 monitoring round (E1), and in some cases were lower than those recorded during DP (2010). However, anomalous variations in contaminant concentrations can occur due to natural fluctuations in groundwater quality which are affected by many factors including climatic influence. As such, in order to evaluate whether there is a sustained trend of contaminant depletion in the plume, further rounds of groundwater monitoring as per the RAP and IEMP will be required to carry out a more detailed trend analysis of the contaminant plume.*"

In June 2014, the third GME (GME E3) was carried out and the results were reported in DP (2014b). The results indicated that during the third GME "*with the exception of BH203 (located adjacent to the former USTs), contaminant concentrations in the remainder of the bores (where hydrocarbons were previously detected) were generally lower than those detected during the December 2013 (E2) and June 2013 (E1) monitoring rounds, and in some cases were lower than those recorded during DP*

(2010). Whilst the concentrations of the petroleum hydrocarbon contaminants in BH203 (located adjacent to the former USTs) increased when compared to E2, these increased concentrations may not necessarily be indicative of deteriorating groundwater conditions. Furthermore, as the concentrations of benzene, toluene and ethylbenzene in the down-gradient site boundary bores are now below the laboratory's detection limits, these results suggest that the plume may be shrinking. However, anomalous variations in contaminant concentrations can occur due to natural fluctuations in groundwater quality which are affected by many factors including climatic influence. As such, in order to evaluate whether there is a sustained trend of contaminant depletion in the plume, further rounds of groundwater monitoring as per the RAP and IEMP will be required to carry out a more detailed trend analysis of the plume."

The updated schedule for the GMEs is provided in Table 2 below.

Table 2: Schedule for Six Monthly Groundwater Monitoring Events.

Event	Status
Event 1 (E1) Six Monthly groundwater monitoring round and provision of letter report detailing the findings of the assessment. Groundwater wells 301, 201, 202, 203, 302 and 303.	Completed
Event 2. (E2) **December 2013** Six Monthly groundwater monitoring round and provision of report detailing the findings of the assessment. Groundwater wells 301, 201, 202, 203, 302 and 303.	Completed.
Event 3. (E3) **June 2014** Six Monthly groundwater monitoring round and provision of report detailing the findings of the assessment. Groundwater wells 301, 201, 202, 203, 302 and 303.	Completed
Event 4. (E4) **December 2014** Six Monthly groundwater monitoring round and provision of report detailing the findings of the assessment. Groundwater wells 301, 201, 202, 203, 302 and 303.	Completed and reported herein
Event 5. (E5) **June 2015** Six Monthly groundwater monitoring round and provision of report detailing the findings of the assessment. Groundwater wells 301, 201, 202, 203, 302 and	To be completed

Event	Status
303.	
Event 6. (E6) **December 2015** Six Monthly groundwater monitoring round and provision of report detailing the findings of the assessment. Groundwater wells 301, 201, 202, 203, 302 and 303.	To be completed
Summary Report – January 2016 Preparation of a summary report detailing the results and implications of the data sourced from the three years of monitoring.	To be completed

5. Geology and Hydrogeology and Climate

Reference to the 1: 100 000 Series Geological Sheet for Sydney indicates that the site is underlain by Bringelly Shale which typically comprises shale, carbonaceous claystone and fine to medium grained lithic sandstone. Bringelly Shale typically weathers to form residual clayey soils of moderate to high reactivity.

The geological mapping was confirmed by the previous investigations with fine to medium grained sandstone and laminite encountered in all bores.

A groundwater bore search of the (former) Department of Water and Energy website database (this function has now been incorporated into NSW Office of Water) was conducted as part of DP (2009a). There was no record of any groundwater wells within a 500 m radius of the site. Additionally, no groundwater was observed during augering at any of the sample locations. Coring techniques precluded observations of the depth to the groundwater table in all groundwater bores. During the current GME, groundwater levels, were recorded to be between 1.85 m below ground level (bgl) (36.5 m relative to Australian Height Datum (AHD)) and 3.96m bgl (33.44m AHD), mainly within the bedrock horizon.

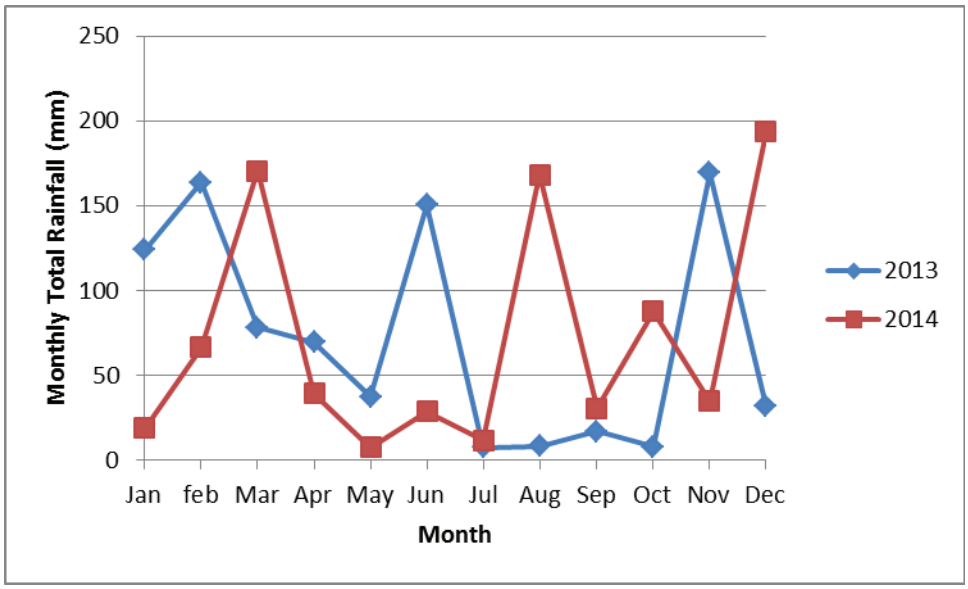
Stormwater runoff would be expected to infiltrate into the soils (in unpaved areas) or be collected at drains located around the site. The nearest water body is the Prospect Creek located approximately 3 km south-west of the site. The ground surface falls to the west at an average slope of approximately 3 degrees, with ground surface Reduced Levels (RL) ranging from about RL 39.5 m AHD at the north-east corner to RL36.6 m AHD at the north-west corner. The off-site sample locations (BH303 and BH304) had RLs of 36.75 m AHD and 36.8 m AHD respectively. Based on groundwater level data, the general groundwater gradient at the site groundwater is expected to be in a south-westerly direction.

5.1 Climate

Monthly rainfall statistics for the nearest weather station (i.e. the Greystanes – Bathurst Street weather station located 4.8km from the site) were sourced from the Bureau of Meteorology (BOM) website and

the "monthly total" rainfall figures for 2013 and 2014 are presented in Figure 1 below. The data indicated that between May and December 2014, precipitation levels ranged between 7.6 mm (May 2014) – 193.6 mm[1] (December 2014). In this regard, between 1 December and 8 December 2014 (sampling date), a total of 126 mm of rainfall was received. Accordingly, it is anticipated that the recent rain events could potentially have an impact on groundwater levels and contaminant concentrations in the groundwater.

Figure 1: Monthly Total Rainfall for 2013 and 2014.



6. Potential for Contamination

The main contaminants of concern which were identified during the previous investigations at the site are TRH, BTEX, VOC and PAH that are associated with leaks from the former USTs.

The ongoing groundwater monitoring, therefore, focuses on the contaminants of concern listed above as well as inorganic analytes used to assess the potential for natural attenuation to occur.

7. Fieldwork Methods

7.1 Groundwater Sampling Methods

Prior to sampling, the groundwater levels were measured on 1 December 2014 using an interface dip meter. The wells were subsequently developed by removing a minimum of three bore volumes of water or until all standing water was removed, using a submersible pump and subsequently a

[1]Source:http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_stn_num=067017

disposable bailer (to remove an residual water that was not extractable by the pump). The wells were allowed to recharge over a period of seven days and groundwater levels re-measured.

Groundwater sampling which was carried out on 8 December 2014, was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. Prior to sampling, an initial bail was obtained by means of a bore-dedicated bailer with a view to identifying the presence of any light non-aqueous phase liquid (LNAPL). Subsequently, the wells were micro-purged using a low flow pump until field parameters (pH, temperature, dissolved oxygen, conductivity, turbidity and redox) had stabilised as per the criteria in Table 3, (from *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* by Douglas Yeskis and Bernard Zavala 2002). Field parameters were measured using a calibrated 90FLMV water quality meter. Redox levels were measured using a standard Ag/AgCl Redox probe which was attached to the water quality meter. Groundwater samples were collected using a low flow Geopump in order to minimise aeration of the sample and disturbance to the water column, thus increasing accuracy of field parameters and minimising volatile losses.

Table 3: Stabilised Criteria with Reference for Water-Quality-Indicator Parameters

Parameter	Stabilisation Criteria
pH	+/- 0.1
Electrical Conductivity	+/- 3%
Oxidation/reduction potential	+/- 10 millivolts
Turbidity	+/- 10% (when turbidity is greater than 10 NTUs)
Dissolved Oxygen	+/- 0.3 mg/L

Once field parameters had stabilised the samples were collected using a low flow Geopump in order to minimise aeration of the sample and disturbance to the water column, thus increasing accuracy of field parameters and minimising volatile losses. Samples were placed (with minimum aeration) into appropriately prepared bottles/containers supplied by the NATA accredited laboratory (containing preservatives –see below).

For analysis of iron (Fe^{2+} and Fe^{3+}) the relevant sample fraction was field filtered using a sterilized 0.45 μm filter prior to placement in appropriately laboratory prepared bottles.

To avoid cross contamination, reusable sampling equipment was not utilised and the bores were sampled "against the contamination gradient", i.e. from the (perceived) least contaminated to the most contaminated (to reduce the risk of cross-contamination). The use of a new length of sample tubing (the only point of contact with the water) prior to collection of groundwater samples from each well, precluded the need for the collection of a rinsate sample.

Sample handling and transport were as set out below:

- Sample containers, supplied by the laboratory (listed below), were labelled with individual and unique identification, including project number and sample number. Appropriate containers and preservative were used as below:
    - TRH C_6- C_9, BTEX and volatile organic compounds (VOCs) - 2 x 40 ml hydrochloric acid (HCl) preserved glass vial cooled to 4°C;

- TRH C_{10}-C_{36} and PAH – 1 L Amber glass bottle;
- Nitrate – 20 ml plastic or glass cooled to 4°C;
- Nitrite – 20 ml plastic or glass cooled to 4°C;
- Ammonia - 20 ml plastic sulphuric acid (H_2SO_4) preserved cooled to 4°C;
- Iron (Fe2+) – 100 ml plastic HCl preserved, no headspace;
- Iron (Fe3+) – 50 ml plastic nitric acid (HNO_3) preserved, cooled to 4°C;
- Sulphate – 100 ml plastic cooled to 4°C;
- Chloride – 100 ml plastic;
- Methane - 2 x 40 ml HCl preserved glass vials cooled to 4°C; and
- Total alkalinity – 100 ml plastic cooled to 4°C.

- Collecting 10% replicate samples for QA/QC purposes. In addition laboratory prepared trip spikes and blanks were taken into the field unopened as additional QA/QC samples;
- Samples were placed in insulated coolers and maintained at a temperature of approximately 4°C until transported to the analytical laboratory, and
- Chain of custody documentation was maintained at all times and countersigned by the receiving laboratory on transfer of samples.

Primary samples for chemical analysis were dispatched to Envirolab Services Pty Ltd and inter-laboratory samples were analysed at Eurofins Mgt Pty Ltd. Both laboratories are NATA accredited for analysis.

7.2 Sampling and Analytical Rationale

The sampling and analytical rationale for the GMEs are provided in Table 4.

Table 4: Groundwater Sampling and Analytical Rationale

Bore ID	Bore Location	Rationale	Date Sampled	Analytical Scheme	Analytical Rationale	QA/QC Samples
BH201	South-western portion of site (adjacent to site boundary)	Obtain data on groundwater quality at the site boundary directly down-gradient to the former UST locations	8 December 2014	TRH, BTEX, VOCs, PAH, Ammonia-N, o-phosphate, sulphate, nitrate, nitrite, anions, cations, methane, CO2, Fe(II), Fe(III), total alkalinity	Assess contaminant concentrations and MNA parameters at the down-gradient site boundary	
BH202	North-western portion of site (adjacent to site boundary)	Obtain data on the groundwater quality at the site boundary down-gradient to the former UST locations	8 December 2014	TRH, BTEX, VOCs, PAH, Ammonia-N, o-phosphate, sulphate, nitrate, nitrite, anions, cations, methane, CO2, Fe(II), Fe(III), total alkalinity	Assess contaminant concentrations and MNA parameters at the site boundary	BD1/081214 (Intra-laboratory Sample) and BD2/081214 (inter-laboratory sample)
BH203	Adjacent to former USTs	Obtain groundwater data at the location of known petroleum hydrocarbon hotspot so as to assess the impact of the hydrocarbon contamination on the groundwater.	8 December 2014	TRH, BTEX, VOCs, PAH, Ammonia-N, o-phosphate, sulphate, nitrate, nitrite, anions, cations, methane, CO2, Fe(II), Fe(III), total alkalinity	Assess contaminant concentrations and MNA parameters at the source of the hydrocarbon contamination	
BH301	North-eastern portion of the site	Located up-gradient to the USTs to obtain baseline groundwater data	8 December 2014	TRH, BTEX, VOCs, PAH, Ammonia-N, o-phosphate, sulphate, nitrate, nitrite, anions, cations, methane, CO2, Fe(II), Fe(III), total alkalinity	Obtain baseline groundwater data pertaining to contaminant concentrations and MNA parameters	
BH302	Southern portion of site	Located cross-gradient to the hydrocarbon hotspot location to delineate extent of the plume and to obtain data on the cross-gradient groundwater quality	8 December 2014	TRH, BTEX, VOCs, PAH, Ammonia-N, o-phosphate, sulphate, nitrate, nitrite, anions, cations, methane, CO2, Fe(II), Fe(III), total alkalinity	Obtain cross-gradient groundwater data pertaining to contaminant concentrations and MNA parameters	
BH303	Offsite - pavement across Centenary Road	Delineate the extent of the contaminant plume and obtain data on the offsite and down gradient groundwater quality.	8 December 2014	TRH, BTEX, VOCs, PAH, Ammonia-N, o-phosphate, sulphate, nitrate, nitrite, anions, cations, methane, CO2, Fe(II), Fe(III), total alkalinity	Assess contaminant concentrations and MNA parameters at offsite, down-gradient location	Trip Spike and Trip Blank

7.3 Data Quality Objectives

The scope of the works was devised generally in accordance with the seven step data quality objective (DQO) process, as defined in Australian Standard *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 2005). The DQO process is discussed in the following sections.

7.3.1 State the Problem

The groundwater at the site has been impacted by TRH and BTEX contamination as a result of leaks from two former USTs. The results of previous assessments have shown that no LNAPL has been identified at the site. The purpose of the current investigation is to undertake groundwater monitoring as part of a long-term monitoring programme and to assess the trends and changes therein.

7.3.2 Identify the Decision

Environmental data, including groundwater characteristics, is required to evaluate whether the TRH and BTEX contaminated plume is attenuating naturally.

7.3.3 Identify Inputs into the Decision

Inputs into the decision are as follows:

- Previous soil and groundwater data collected from the site and off-site sampling locations;
- Soil data collected from the site, included analytical results for the contaminants of concern (COC);
- Groundwater data collected from the site, including analytical results for the COC;
- Geochemical indicators and breakdown products of the primary contaminants to evaluate whether MNA is occurring at the site;
- The trend of contaminant concentrations (i.e. whether contaminant concentrations are increasing or decreasing); and
- Field and laboratory QA/QC data to assess the suitability of the environmental data for the assessment.

7.3.4 Define the Assessment Boundaries

For the purpose of the GMEs, the site is defined 11- 19 Centenary Road, Merrylands and is shown in Drawing 1, Appendix A. In this regard, it is noted that BH303 is located off-site and its location has been selected to act as a down-gradient sentinel well with a view to providing information on whether the plume is impacting upon the closest down-gradient sensitive receptors (i.e. residential properties).

7.3.5 Develop a Decision Rule

The information obtained through the assessment will be used to evaluate whether MNA is occurring at the site. The decision rule in evaluating whether MNA is occurring at the site will comprise:

- Primary lines of evidence namely analytical data for the primary contaminants of concern that will be sourced from the previous assessments and the data from the ongoing six monthly GMEs, will be assessed to evaluate whether contaminant concentrations in the groundwater are reducing over time and to develop a trend for the groundwater contaminants;
- Secondary lines of evidence, namely geochemical indicators and breakdown products of the primary contaminants that will be sourced from the previous assessments and the ongoing six monthly GMEs to evaluate whether natural attenuation is occurring at the site and whether groundwater conditions are conducive to natural attenuation;
- The groundwater screening criteria (GSC) will be the NSW EPA produced and/or endorsed criteria, as specified in Table 5. Where such criteria are not available, other recognised national or international standards will be used. In this regard, the primary purpose of the six monthly GMEs is to evaluate the trend of the hydrocarbon based groundwater contaminants, and to ascertain whether MNA is occurring at the site. Given that the previous investigations have shown that the groundwater at the site has been impacted by petroleum based hydrocarbon contamination, it is considered that comparison of the groundwater contaminant concentrations against the GSC are less relevant when compared to the overall trend of the contaminants (i.e. whether contaminant concentrations are increasing or decreasing);
- The groundwater will not be considered to be impacted by a particular contaminant if there is no notable increase in primary contaminant concentrations in the groundwater between well locations (i.e. between hydraulic up-gradient wells and down-gradient wells) and/or there are no primary contaminant concentrations in the groundwater samples exceeding the adopted GSC.

The air monitoring event undertaken as part of the RAP (DP, 2011) showed that the site was not impacted by vapour intrusion from the volatile contaminants in soil/groundwater at the time of sampling and at the sampling locations. However, based on the results of the ongoing groundwater monitoring programme:

- If there is an increasing concentration trend in the groundwater at two or more monitoring points sustained over two monitoring events (three in total, the initial event and the two consecutive events showing an increase), the need for an increase in monitoring frequency and/or soil vapour monitoring will be assessed;
- If the trend is maintained over a further two monitoring events and confirmed by statistical analysis, additional monitoring points may be added and a reliable relationship between dissolved phase concentrations would be established; and
- If there is a continued rising trend, a contingency action plan will be developed and initiated, with the urgency of that action dependent upon the analyte of concern and the analysis of the trend.

Additionally, laboratory test results will be accepted and considered useable for the assessment under the following conditions:

- All laboratories used are accredited by NATA for the analyses undertaken. DP has used Envirolab Services as the primary laboratory and MGT Eurofins as the secondary laboratory;

- All practical quantitation limits (PQL) set by the laboratories fall below the GSC or indicate across the board lack of detection (i.e. it is noted that some of the water assessment criteria are difficult to achieve at PQL);
- The differences between the reported concentrations of analytes in the intra- and inter-laboratory replicate samples and the corresponding original samples are within adopted acceptance limits; and
- The quality assurance / quality control (QA/QC) protocols and results reported by the laboratories comply with the requirements of the *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)* (NEPM 2013) "*Guideline on Laboratory Analysis of Potentially Contaminated Soils*".

7.3.6 Specify Limits on the Decision Error

In order to maintain the quality of the groundwater data, appropriate and adequate quality assurance and quality control (QA/QC) measures and evaluations have been incorporated into the sampling and analysis regime.

A field and laboratory QA/QC regime, comprising the collection and analysis of intra- and inter-laboratory replicate samples was implemented to meet the requirements associated with the following data quality indicators (DQIs):

- Conformance with specified holding times;
- Accuracy of spiked samples within the laboratory's acceptable range (typically 70-130% for inorganic contaminants and greater for some organic contaminants);
- Field and laboratory duplicates and replicates samples will have a precision average of +/- 30% relative percentage difference (RPD) for inorganic analytes and +/- 50% RPD for organic analytes; and
- Field replicates were collected at a frequency of at least 10% of all samples.

Other limits on decision errors for the assessment have been as follows:

- The analyte selection based on the available site history, past site activities, site features and the previous findings. The potential for contaminants other than those proposed to be analysed is considered to be low;
- The GSC are adopted from established and NSW EPA produced and/or endorsed guidelines listed in Sections 8. Where not available, recognised national and international guidelines have been used. The GSC have risk probabilities already incorporated;
- The acceptance limits for laboratory QA/QC parameters are based on the laboratory reported acceptance limits and those stated in the NEPM (2013) "*Guideline on Laboratory Analysis of Potentially Contaminated Soils*" and ANZECC (1996) "*Guidelines for the Laboratory Analysis of Contaminated Soils*".

7.3.7 Optimise the Design for Obtaining Data

The monitoring points measured during the current round are targeted to assess the groundwater conditions at the site and adjacent to the most sensitive receptors that being the residential properties.

8. Assessment Criteria

8.1 Groundwater Screening Criteria

As previously mentioned, the primary purpose of the six monthly GMEs is to evaluate the trend of the hydrocarbon based groundwater contaminants, and to ascertain whether MNA is occurring at the site. Further, given that the previous investigations have shown that the groundwater at the site has been impacted by petroleum based hydrocarbon contamination, it is considered that comparison of the groundwater contaminant concentrations against threshold criteria for hydrocarbon based contaminants are less relevant when compared to the overall trend of the contaminants (i.e. whether contaminant concentrations are increasing or decreasing). Nevertheless, a set of groundwater screening criteria (GSC) have been developed to provide an indication of the groundwater quality at the site. Hence, on the basis of potential receptors, the guidelines to be used for the GSC are as follows:

- The groundwater investigation levels as provided in the National Environment Protection Council, *National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999, as amended 2013* (NEPC 2013);
- For contaminants where no NEPC (2013) guidance is provided, *Australian and New Zealand Guidelines for Fresh and Marine Waters,* (2000), published by the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), will be adopted for assessing water quality (ANZECC, 2000);
- In order to evaluate whether the groundwater may impact on aquatic life within the fresh water aquatic ecosystems associated with Prospect Creek, the groundwater analytical results will be screened against the available Trigger Values for slightly / moderately disturbed fresh water systems, at a general protection level of protection of 95% of species from the abovementioned guidelines. For contaminants such as toluene, ethylbenzene and xylenes where no NEPC (2013 and ANZECC high reliability trigger values are available, low reliability trigger values will be sourced from ANZECC 2000;
- Groundwater health screening levels (HSLs) for vapour intrusion into commercial/industrial sites, sourced from the National Environment Protection Council, *National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999, as amended 2013* (NEPC 2013), will be used as an additional screening criteria for TRH C_6-C_{10}, TRH >C_{10}-C_{16}, BTEX and naphthalene. Given that the previous investigations have shown that the subsoils at the site comprise clays and sandstone, the HSLs for clay have been adopted. In this regard it is noted that the groundwater HSLs provided in the NEPC (2013) apply to sites where groundwater is between approximate depths of 2 – 4m bgl, and during the current assessment, groundwater at the site has been recorded at depths ranging between 1.85 – 3.96 m bgl (average of 2.66m bgl). Given the variation in groundwater levels at the site, the NEPC (2013) groundwater HSLs have been adopted as preliminary screening criteria only;

- For VOCs, where no Australian standard exists, the USEPA *Regional Screening Levels for Chemical Contamination at Superfund Sites* (updated May 2013) will be used as screening criteria.

The adopted GSC for the analytes to be included in the assessment, and the corresponding source documents, are shown in Table 5.

Table 5: Groundwater Screening Criteria (ANZECC 2000[a] and NPEC 2013[b])

Compound	Groundwater Screening Criteria (GSC) (µg/L)
TRH: C_6-C_9	150 [d]
TRH C_6 – C_{10} less BTEX	Not Limiting [b,g]
TRH: C_{10}-C_{36}	600 [d]
TRH C_{10}-C_{40}	Not Limiting [b,g]
Benzene	950 [a, c] 30000 [b,g]
Toluene	180 [e] Not Limiting [b, g]
Ethylbenzene	80 [e] Not Limiting [b,g]
Xylene	625[e] Not Limiting [b,g]
PAH-total	not available
Naphthalene	16[a, c] Not Limiting [b,g]
Phenanthrene	2 [a,e]
Total phenols	320 [c]
1,2-dichloroethane	1900 [e]
Cyclohexane	1300[f]
Trichloroethene	330 [e]
Styrene	1100 [f]
Isopropylbenzene	30 [e]
n-propylbenzene	210 [f]
1,3,5 trimethylbenzene	87 [f]
1,2,4 trimethylbenzene	15[f]
sec-butylbenzene	160 [f]
4-isopropyl toluene	Not available
n-butyl benzene	780 [f]

Notes for Table 5:

a) Australian and New Zealand Environment and Conservation Council '*Australian and New Zealand Guidelines for Fresh and Marine Water Quality – October 2000'*. Trigger Values for a 95% Level of Protection of Species in Fresh Water (Table 3.4.1).

b) National Environment Protection Council, *National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999, as amended 2013* (NEPC 2013);

c) Trigger Values for a 95% Level of Protection of Species in Fresh Water (Table 3.4.1) sourced from NEPC 2013 and ANZEC 2000

d) ANZECC 2000 and NEPC 2013 threshold not available. It is noted there is a 'low reliability' Interim Working Value (Section 8.3.7) final chronic value of 7 µg/L for petroleum hydrocarbon but that commercial laboratories are not generally able to achieve the necessary limits of reporting to demonstrate compliance. For reference purposes, DP has referred to other available Australian guidelines for TPH *viz. Airport (Environment Protection) Regulations* (1997), Schedule 2 Water Pollution Accepted Limits: Table 1.03 – Accepted limits of contamination. It should be noted however that these have not been endorsed by NSW EPA and are used as 'screening levels' only.

e) Low reliability trigger values for Freshwater species sourced from ANZECC (2000) have been used in the absence of high reliability trigger values;

f) *USEPA Regional Screening Levels for Chemical Contamination at Superfund Sites (updated May 2013)* threshold criteria for tap water.

g) Groundwater health screening levels (HSLs) for vapour intrusion into commercial/industrial sites, sourced from the Schedule B1 of National Environment Protection Council, *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1)* (NEPM 2013). Used as screening criteria only.

8.2 MNA Parameters

In order to assess whether the groundwater conditions are conducive to natural attenuation, and to ascertain whether natural attenuation is occurring, geochemical indicators or breakdown products of the primary contaminants have been assessed. The aerobic breakdown of petroleum based hydrocarbons follows a fairly predictable path wherein carbon dioxide (CO_2) and water (H_2O) are the eventual end products. Other products such as methane (CH_4) may be present as an intermediate product. Therefore, the presence of these analytes in the groundwater would provide evidence that natural attenuation is taking place (i.e. if they are found to be present at elevated concentrations down-gradient of the plume, relative to the up-gradient locations).

There are also a number of geochemical indicators that can be analysed to determine if the conditions are suitable for monitored natural attenuation. Natural attenuation of petroleum hydrocarbons will occur most effectively under aerobic conditions that will promote the oxidation of the contaminants (i.e. oxidising conditions). The best indicators of aerobic conditions are dissolved oxygen and redox potential. Aerobic conditions typically have a dissolved oxygen concentration in the range of 3 to 5 ppm (while anaerobic conditions are typically less than 1 ppm). Aerobic degradation also typically occurs where the redox potential is highly positive.

Another limiting factor is nutrient availability, particularly ammonia and phosphate which is required to promote microbial growth. Depletion of these nutrients, as compared to control wells outside of the contaminated area can be indicators of biodegradation activity within the contaminated area.

It is also important to determine if other electron acceptors are being utilised as they will affect the rate of biodegradation. The presence or absence of certain species relative to background levels can be indicative of ongoing biodegradation processes. For example nitrate depletion in the presence of nitrite may indicate nitrate reduction. Similarly, sulphate depletion in the presence of sulphide can be indicative of sulphate reduction. In the process of iron reduction the Fe(III) is reduced to Fe(II). Therefore, elevated Fe(II) may indicate microbial iron reduction.

Given the absence of NSW EPA endorsed guidelines for MNA, Table 6, below is taken from the Western Australia Department of the Environment, *Use of Natural Attenuation For Groundwater Remediation* 2004. The table summarises the indicators of the dominant electron acceptors involved with degradation reactions.

Table 6: Indicators of Dominant Electron Acceptors Involved with Degradation Reactions

Dominant Electron Acceptor	Indicator (on incoming water)
Dissolved oxygen reduction (i.e. aerobic groundwater)	Dissolved oxygen (DO) > 0.5 mg/L
Nitrate reduction	DO > 0.5 mg/L Nitrate > 1 mg/L as N
Ferric iron reduction	Ferrous iron (Fe^{2+}) > 0.5 mg/L DO < 0.5 mg/L Nitrate < 0.5 mg/L as N Aquifer sediments may have a "bleached" appearance due to loss of iron oxides
Sulphate reduction	Sulphate > 1 mg/L DO, nitrate and Fe^{2+} <0.5 mg/L Sulphides < 0.5 mg/L Groundwater may have a strong "rotten egg" smell due to dissolved hydrogen sulphide

For the purpose of the current investigation monitoring well 203 can be viewed as being in or near the main contaminant plume. Monitoring wells 201 and 202 can be viewed as down-gradient wells that are associated with the main contaminant plume. BH301 is considered to be the up-gradient/baseline monitoring well. BH303 is the off-site monitoring well that is considered to be down-gradient of the plume and is considered to be a "warning well" at the nearest down-gradient sensitive receptors (i.e., the residential properties).

9. Fieldwork Results

9.1 Groundwater Field Parameters

Measurements of groundwater field parameters were collected during sampling from Bores 201 to 303. The stabilised field parameters are summarised in Table 7, below. The field data sheets are included in Appendix C.

Table 7: Stabilised Field Parameters

Bore	Bore RL (m)	Water Depth (m)	Water RL (m)	Dissolved Oxygen (mg/L)	SHE Redox (Ag/AgCl) (mV)	Temp (°C)	pH	Comments
201	37.4	3.96	33.44	0.3	-27	22.2	6.52	No visible or detectable separate phase. Hydrocarbon odour detected
202	36.9	2.9	34	0.7	438	23.8	6.88	No visible or detectable separate phase. Hydrocarbon/ phenolic odour detected
203	38.3	1.97	36.33	0.43	41	22.9	6.79	No visible or detectable separate phase Hydrocarbon odour detected
301	39.1	2.34	36.76	2.13	327	20.8	6.79	No visible or detectable separate phase No odour detected
302	38.35	1.85	36.5	0.31	49	24	6.46	No detectable separate phase. Oily sheen observed Hydrocarbon odour detected
303	36.75	2.94	33.81	2.21	298	22.8	6.78	No visible or detectable separate phase No odour detected

10. Laboratory Results

10.1 Groundwater Analytical Results

A summary of the analytical results from the current round of groundwater testing is presented in Tables 8 and 9. It is noted that the groundwater results of DP (2009b), DP (2010) and the previous GMEs have also been included in Table 8 to provide background information on the primary contaminants of concern. The laboratory certificates are presented in Appendix B. Laboratory and field QA/QC is discussed in Appendix E.

Table 8: Analytical Results for Primary Contaminants of Concern (All Results Reported in µg/L unless otherwise specified)

Sample ID	PAH							TRH							VOCs																	Phenols (mg/L)	Hardness by calculation (mgCaCO3/L)
	B(a)P	Naphthalene	acenaphthene	acenaphthylene	fluorene	phenanthrene	Total +ve PAH	C6-C9	C6-C10 Less BTEX (F1)	C10-C36	TRH >C10 - C16	TRH >C10 - C16 (F2)	TRH >C16 - C34	TRH >C34 - C40	Benzene	Toluene	Ethylbenzene	Total Xylene	1,2-dichloroethane	cyclohexane	Trichloroethene	Styrene	Isopropylbenzene	n-propyl benzene	1,3,5-trimethyl benzene	1,2,4-trimethyl benzene	sec-butyl benzene	4-isopropyl toluene	n-butyl benzene		
DP 2009 Assessment																																	
BH201	<0.1	3.9	-	-	-	-	3.9	790	-	360	-	-	-	-	240	400	15	124	-	-	-	-	-	-	-	-	-	-	-	-	<0.05	2,400
BD1/300809 4	-	-	-	-	-	-	-	920	-	282	-	-	-	-	220	530	19	164	-	-	-	-	-	-	-	-	-	-	-	-	-	2,400
BH202	<0.1	<0.1	-	-	-	-	<0.1	1300	-	<250	-	-	-	-	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	<0.05	1,300
BH203	<0.1	52	-	-	-	-	52	29000	-	2420	-	-	-	-	7100	14000	850	3700	-	-	-	-	-	-	-	-	-	-	-	-	0.23	280
nsate Sample /2008	<1	<1	-	-	-	-	<1	<10	-	<250	-	-	-	-	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Spike/ 310809	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.85	0.95	0.95	0.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Blank/ 310809	-	-	-	-	-	-	-	<10	-	-	-	-	-	-	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010 Assessment																																	
BH201	<1	2.1	-	-	-	-	2.1	530	-	310	-	-	-	-	140	170	<10	95	-	<10	-	-	-	<10	<10	<10	-	-	-	-	-	2014.3
BH202	<1	<1	-	-	-	-	<1	130	-	<250	-	-	-	-	62	71	4	15.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH203	<1	120	-	-	-	-	120	35000	-	4420	-	-	-	-	10000	19000	1300	5000	-	170	-	-	-	<100	120	440	-	-	-	-	-	1740.94
BH301	<1	<1	-	-	-	-	<1	<10	-	<250	-	-	-	-	<1	<1	<1	<3	-	<1	-	-	-	<1	<1	<1	-	-	-	-	-	2896.6
BH302	<1	69	-	-	-	-	69	11000	-	2220	-	-	-	-	830	5100	1000	3580	-	60	-	-	-	86	160	500	-	-	-	-	-	1980.57
BD1/011209			-	-	-			9600	-	2200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH303	<1	<1	-	-	-	-	<1	140	-	<250	-	-	-	-	45	71	4.2	17.6	-	1.2	-	-	-	<1	<1	1.5	-	-	-	-	-	1255.54
BH304	<1	<1	-	-	-	-	<1	80	-	<250	-	-	-	-	30	50	3.6	13.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TB/011209	-	-	-	-	-	-	-	<10	-	<250	-	-	-	-	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TS/011209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.66	0.96	0.97	101% and 99%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June 2013 Monitoirng Round (E1)																																	
201	<0.1	6.7	<0.1	<0.1	<0.1	<0.1	6.7	690	670	300	70	60	<100	<100	35	17	15	112	<1	4	<1	<1	<1	2	8	17	<1	<1	<1	<1	1800
BD1/060613	-	-	-	-	-	-	-	600	-	200	110	-	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/060613*	-	-	-	-	-	-	-	280	150	<100	<50	<50	<100	<100	37	18	<10	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	1400	1600	164	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1500
203	<0.1	94	<0.1	<0.1	<0.1	<0.1	94	78000	36000	4430	3100	2800	520	<100	14000	26000	2900	8000	17	290	2	31	68	230	270	1300	6	4	10	10	1600
301	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	3300
302	<0.1	220	0.2	<0.1	0.4	0.3	220	20000	12000	4000	1600	1400	<100	<100	290	2200	3800	5370	<1	250	<1	<1	99	330	320	1100	9	4	15	15	4400
303	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<1	12	12	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1300
Trip Spike	-	-					-	-	-	-	-	-	-	-	0.97	0.99	1.02	102% &103%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trip Blank	-	-					-	<10	<10	-	-	-	-	-	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December 2013 (Monitoirng Round E2)																																	
201	<0.5	23	<0.1	<0.1	<0.1	<0.1	23	350	270	540	280	260	<100	<100	21	9	35	119	2	10	<1	<1	3	7	13	17	<1	<1	<1	-	1800
202	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	88	88	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1400
BD1/021213 [6]	-	-	-	-	-	-	-	76	-	255	<50	-	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD1/021213 [7]	-	-	-	-	-	-	-	110	110	<100	<50	<50	<100	<100	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203	<0.5	92	<0.1	<0.1	0.2	<0.1	92	37000	20000	3230	1700	1600	<100	<100	4100	11000	1500	5100	4	110	2	14	30	120	170	670	4	3	7	-	680
301	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	3400
302	<0.5	160	0.2	<0.1	0.5	0.4	160	9100	5400	3410	1700	1500	<100	<100	72	830	3300	1430	<1	140	<1	2	57	240	190	750	9	5	15	-	4700
303	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1500
Trip Spike	-	-	-	-	-	-	-								93.00%	102.00%	107.00%	109%														
Trip Blank	-	-	-	-	-	-	-	<10	<10						<1	<1	<1	<3														
June 2014 (Monitoirng Round E3)																																	
201	<0.1	0.8	<0.1	<0.1	<0.1	<0.1	0.84	32	25	<250	<50	<50	<100	<100	<1	<1	<1	11	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1600
BD2/020614 [7]	-	-	-	-	-	-	-	<20	<20	<100	<50	<50	<100	<100	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
202	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	110	110	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1400
203	<0.1	250	<0.1	<0.1	0.2	0.1	250	65000	20000	7370	4800	4500	<100	<100	13000	29000	2400	6400	<1	160	3	18	51	160	230	980	5	3	8	-	2000
301	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	3300
BD1/020614 [6]	-	-	-	-	-	-	-	<10	-	<250	<50	-	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
302	<0.1	95	0.3	0.1	0.8	0.8	97	5500	3600	3630	2200	2100	<100	<100	66	320	2500	650	<1	78	<1	1	52	200	170	510	7	4	16	-	4300
303	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1300
TS	-	-	-	-	-	-	-	-	-	<250	-	-	-	-	102.00%	96.00%	102.00%	101.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TB	-	-	-	-	-	-	-	<10	<10	-	-	-	-	-	<1	<1	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December 2014 (Monitoirng Round E4)																																	
201	<0.1	3.4	<0.1	<0.1	<0.1	<0.1	3.4	200	160	294	68	64	<100	<100	4	4	14	74	<1	<1	<1	<1	<1	2	5	5	<1	<1	<1	-	1600
202	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	82	82	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1200
BD1/081214	-	-	-	-	-	-	-	110	110	279	<50	-	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/081214	-	-	-	-	-	-	-	110	110	410	110	110	<100	<100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
203	<0.1	71	<0.1	<0.1	0.3	0.2	72	3900	2100	2300	1200	1100	<100	<100	35	200	1800	379	<1	<1	<1	<1	50	130	54	190	6	1	6	-	4200
301	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NIL (+)VE	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	3200
302	0.3	240	0.1	0.1	0.3	0.4	240	81000	22000	9300	6000	5800	190	<100	14000	40000	2900	8700	<10	<10	<10	25	59	170	280	1100	<10	<10	<10	-	1300
303	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	<10	<10	<250	<50	<50	<100	<100	<1	<1	<1	<3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	1400
TS										<250					118.00%	107.00%	107.00%	109.00%												-		
TB								<10	<10	-					<1	<1	<1	<3												-		
GSC	Not specified	16 [1] NL [3]	-	-	-	2 [4]	Not specified	150 [2]	NL [3]	600 [2]	NL [3]	NL [3]	NL	NL [3]	950 [1] 30000 [3]	180 [4] NL [3]	80 [4] NL [3]	550 [4] NL [3]	1900 [4]	1300 [5]	330 [4]	1100 [5]	30 [4]	210 [5]	87 [5]	15 [5]	160 [5]	-	780 [5]	320	-

Notes:

1 ANZECC 2000 - b) Trigger Values for a 95% Level of Protection of Species in Fresh Water (Table 3.4.1).

2 ANZECC threshold not available. It is noted there is a 'low reliability' Interim Working Value (Section 8.3.7) final chronic value of 7 µg/L for petroleum hydrocarbon but that commercial laboratories are not generally able to achieve the necessary detection limits to demonstrate compliance. For reference purposes, DP has referred to other available Australian guidelines for TRH viz. Airport (Environment Protection) Regulations (1997), Schedule 2 Water Pollution Accepted Limits: Table 1.03 – Accepted limits of contamination. It should be noted however that these have not been endorsed by NSW EPA and are used as 'screening levels' only

3 Groundwater health screening levels (HSLs) for vapour intrusion into commercial/industrial sites, sourced from the Schedule B1 of National Environment Protection Council, National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1) (NEPM 2013). Used as screening criteria only.

4 Low reliability trigger values for Freshwater species sourced from ANZECC 2000 have been used in the absence of high reliability trigger values

5 USEPA Regional Screening Levels for Chemical Contamination at Superfund Sites (updated May 2013) threshold criteria for tap water used as screening criteria in the absence of NSW EPA and national standards

6 Intra-laboratory sample collected from monitoring well reported directly above

7 Inter-laboratory sample collected from monitoring well reported directly above

TS Trip spike

TB Trip blank

300 Exceedance of GSC

POL Practical quantitation limits

Table 9: Analytical Results for MNA Parameters

Analyte	Baseline (up-gradient)	Within Plume				Down Gradient Off-site well (Fringe of Plume)
	301	203	302	201	202	303
Methane (µg/L)	<5	<5	330	<5	<5	<5
Carbon dioxide (mg/L)	120	140	180	130	97	90
Ammonia as N (mg/L)	<0.09	<0.07	<0.1	0.008	0.029	0.054
Phosphate as P (mg/L)	0.012	<0.005	<0.08	<0.005	<0.005	0.010
Nitrate as N (mg/L)	0.095	<0.03	<0.03	<0.005	<0.02	0.048
Nitrite as N (mg/L)	<0.005	<0.005	<0.025	<0.005	<0.005	<0.005
Sulphate (mg/L)	610	160	57	290	95	480
Sulphide (mg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ferrous Iron (mg/L)	<0.05	0.28	4.3	0.06	<0.05	<0.05
Ferric Iron (mg/L)	<0.05	0.25	3.3	<0.05	<0.05	<0.05
Iron – dissolved (µg/L)	<10	3700	11000	130	<10	-
Total Alkalinity $CaCO_3$ (mg/L)	1000	1200	840	1000	900	960
Chloride (mg/L)	6900	9000	3500	3900	3800	3400

11. Discussion

11.1 Field Observations

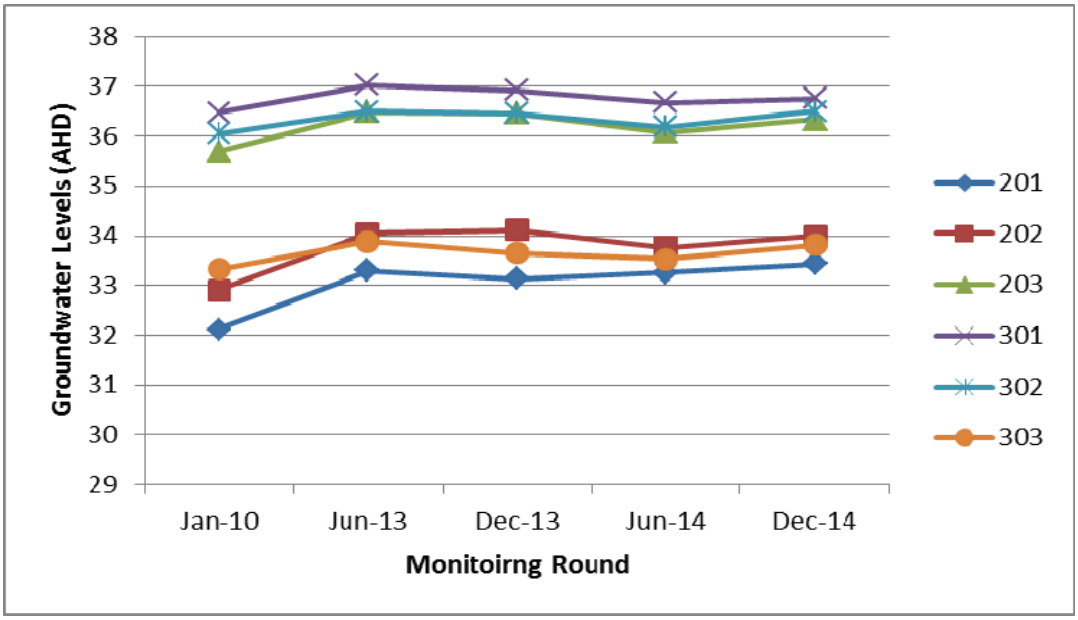
Field data pertaining parameters such as dissolved oxygen and redox potential are discussed in Section 11.2.2.

11.1.1 Groundwater Levels

During the current monitoring round, groundwater levels were measured prior to sampling of the groundwater monitoring wells. With the exception of BH201, groundwater levels during the current

monitoring round were marginally higher (ranging between 0.09m – 0.25m higher) than the levels recorded during the June 2014 monitoring event (E3). The trend of the groundwater levels is shown in Figure 2, below. Groundwater level data obtained during the current monitoring round confirmed that groundwater flow is generally in a south-westerly direction. Further, as mentioned in Section 5.1, groundwater levels appear to be fluctuating marginally in conjunction with rainfall events experienced during the preceding months.

Figure 2. Comparison of Groundwater Levels (AHD) with Previous Monitoring Rounds



11.2 Discussion of Analytical Results

11.2.1 Primary Contaminants of Concern (TRH, BTEX and PAH)

11.2.1.1 TRH C_6 – C_9

The concentration of TRH C_6 – C_9 recorded in sample BH301 (up-gradient/baseline well) was below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site.

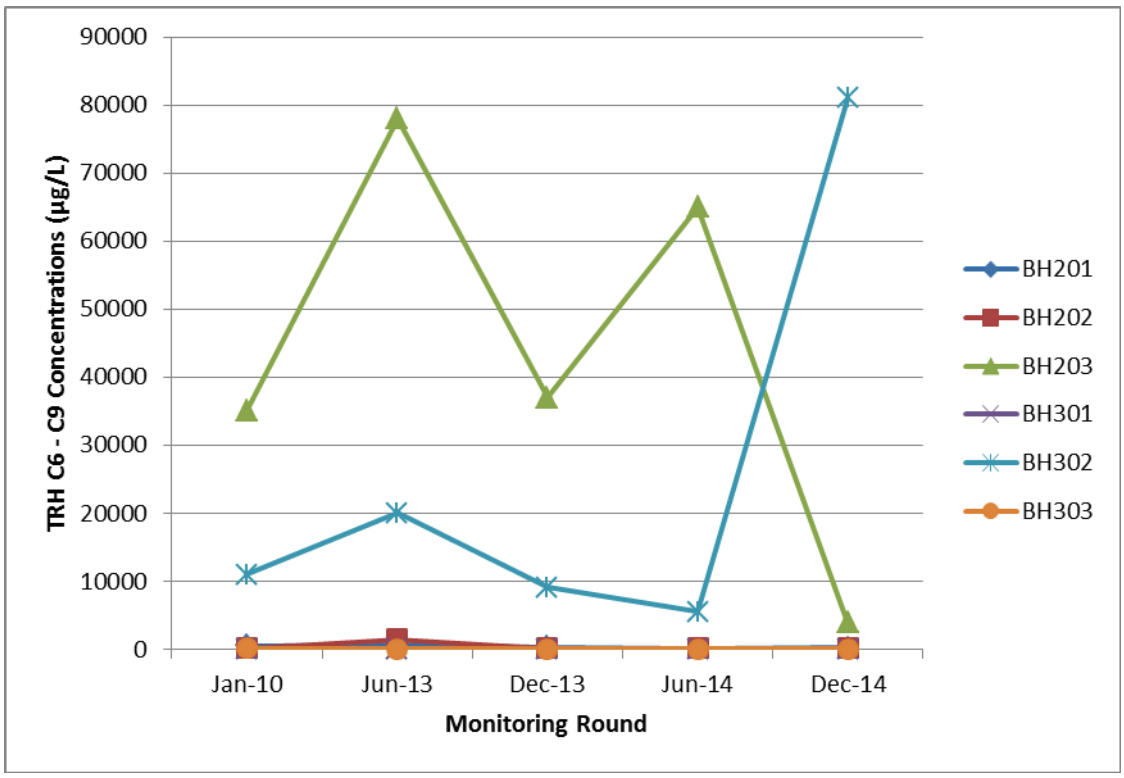
The highest concentrations were recorded in BH203 (3,900 µg/L) and BH302 (81,000 µg/L) which exceed the adopted GSC (150 µg/L). These wells are located adjacent to and cross-gradient to the source of the plume (i.e. the UST area) respectively, and are considered to be within the plume.

TRH C_6-C_9 concentrations dropped off quite significantly in BH201 (200 µg/L) and BH202 (82 µg/L). In this regard, whilst the recorded concentration at BH202 was within the adopted GSC, the concentration at BH201 marginally exceeded the GSC, suggesting that the site boundary wells could be located close to the fringe of the plume.

The concentration of TRH C_6 – C_9 in BH303 was recorded below the laboratory's limit of reporting and was therefore, within the adopted GSC. In this regard, BH303 is an off-site monitoring well and a comparison of the detected TRH C_6-C_9 concentration in this off-site monitoring well against the concentrations detected in the nearest down-gradient well at the site boundary (BH201) shows that the concentration of TRH C_6 – C_9 reduces significantly between the western site boundary and the off-site location.

Comparison of the data obtained during the current monitoring round with the results of the June 2014 monitoring round (E3) showed that at BH202 and BH203, TRH C_6 – C_9 concentrations have reduced considerably and concentrations appear to be lower than the all previous monitoring rounds including January 2010 concentrations i.e. prior to remediation (Refer Figure 3 below). At BH201, the TRH C_6 – C_9 concentrations were marginally higher than the E3 results but were still lower than the January 2010, E1 and E2 results. However, at BH302, the concentration of TRH C_6 – C_9 concentration has increased considerably during the current monitoring round. Notwithstanding, the lower concentrations recorded in BH202 and BH203 could be indicative of a shrinking plume and an associated reduction of contaminant mass within the source of the plume. Furthermore, the results also indicate that contaminant concentrations in the core of the plume, specifically in BH203 (the previously worst affected bore located adjacent to the former source), may be pulsing, as spikes in TRH C_6-C_9 concentrations were observed during the E1 and E3 (June 2013 and June 2014) GMEs and reduced concentrations were recorded in BH203 during the E2 and E4 (December 2013 and December 2014) GMEs. The spikes observed in BH203 during E1 and E3 are likely to be associated with flushing of residual contaminants from the vadose zone during the preceding wet months.

Figure 3. Comparison of TRH C_6-C_9 Concentrations with Previous Monitoring Rounds



11.2.1.2 Medium to Heavy Chain TRH $C_{10} – C_{36}$

The concentration of TRH $C_{10} – C_{36}$ recorded in sample BH301 (up-gradient/baseline well) was below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site.

The highest concentrations were recorded in BH203 (2,300 µg/L) and BH302 (9,300 µg/L) which exceeded the adopted GSC (600 µg/L). These wells are located adjacent to and cross-gradient to the source of the plume (i.e. the UST area) respectively, and are considered to be within the plume.

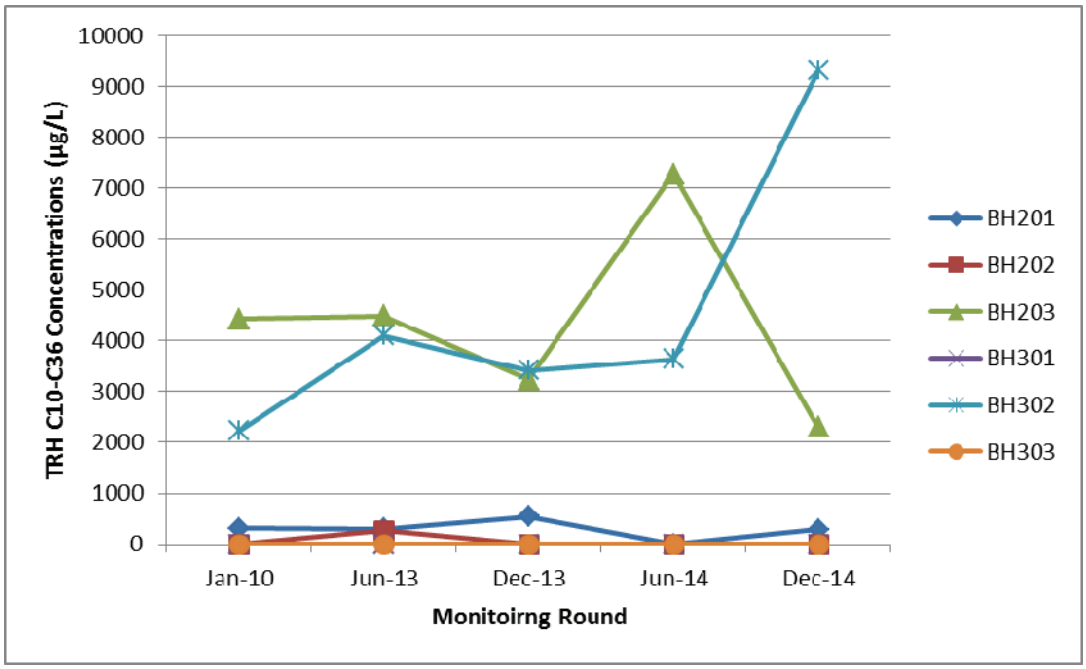
TRH C_{10}-C_{36} concentrations dropped off quite significantly in BH201 and BH202 (below the laboratory's limit of reporting at BH202 and within the GSC at both wells) on the western boundary, suggesting that the wells could be located close to the fringe of the plume.

The concentration of TRH $C_{10} – C_{36}$ in BH303 was recorded below the laboratory's limit of reporting and was therefore within the adopted GSC.

In this regard it is noted that the majority of the elevated concentrations were recorded in the TRH C_{10}-C_{16} fraction suggesting that the detected medium chain exceedances in BH203 and BH302 are most probably attributable to petrol, which also contributed to the high TRH $C_6 – C_9$ concentrations recorded in these samples. The low detected concentrations at the down-gradient site boundaries (which were recorded below the GSC) and off site well (below the laboratory's limit of reporting) suggest the depletion of TRH C_{10} - C_{36} within the plume.

Comparison of the data obtained during the current monitoring round and the previous monitoring rounds (refer Figure 4 below) showed that the concentration of TRH C_{10}-C_{36} in BH203 (i.e. the bore directly adjacent to the source) has reduced considerably and is now lower than all previous monitoring rounds i.e, E3, E2, E1 and the January 2010 monitoring rounds. At BH302 (cross-gradient to the UST area), the concentration increased considerably above the E3 concentration. Whilst at BH201 (down-gradient site boundary well), the concentration of TRH C_{10}-C_{36} marginally increased above E3 concentrations, the recorded concentrations were still lower than the E2, E1 and January 2010 concentrations. At BH202 (at the north-western site boundary), the concentration has been below the laboratory's limit of reporting during E4, E3, E2 and January 2010. The lower recorded concentrations at BH201 (i.e. at the down-gradient site boundary) suggests that TRH C_{10}-C_{36} attenuation is taking place and could be indicative of a shrinking plume. Furthermore, the results also indicate that contaminant concentrations in the core of the plume, specifically in BH203 (the previously worst affected bore located adjacent to the former source), may be pulsing as spikes in TRH C_{10}-C_{36} concentrations were observed during the E1 and E3 (June 2013 and June 2014) GMEs and reduced concentrations were recorded in BH203 during the E2 and E4 (December 2013 and December 2014) GMEs. The spikes observed in BH203 during E1 and E3 are likely to be associated with flushing of residual contaminants from the vadose zone during the preceding wet months.

Figure 4. Comparison of TRH C_{10} - C_{36} Concentrations with Previous Monitoring Rounds



11.2.1.3 Benzene

The concentration of benzene recorded in sample BH301 (up-gradient/baseline well) was below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site.

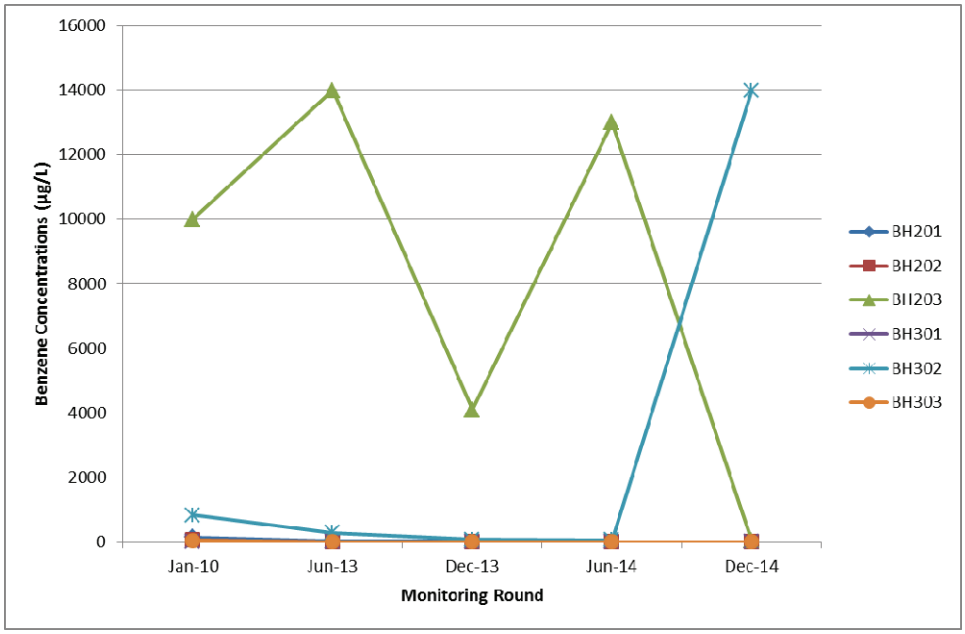
The highest concentration was recorded in BH302 (14,000 µg/L) which exceeds the adopted GSC (950 µg/L). This well is located cross-gradient to the source of the plume (i.e. the UST area) and is considered to be within the plume. BH203 located adjacent to the former source of the plume recorded a concentration of 35 µg/L (which was within the adopted GSC).

A low concentration of benzene (4 µg/L) was recorded in sample BH201 (down-gradient site boundary), but was below the adopted GSC. Furthermore, the concentration of benzene in samples BH202 (north-western site boundary) and BH303 (off-site down-gradient location) were below the laboratory's limit of reporting and were therefore below the adopted GSC.

The data obtained during the current monitoring round indicates that at the previously worst affected bore i.e., BH203 (adjacent to the source of the plume) the concentration of benzene has reduced significantly to the lowest concentration recorded to date (refer Figure 5 below). However, at BH302 (cross-gradient to the source area but within the plume), the concentration of benzene has spiked. Whilst at BH201 the benzene concentration marginally increased when compared to E3, the recorded concentration was still significantly lower than GMEs E2, E1 and January 2010 which suggests that benzene concentration in this well (located on the down-gradient site boundary) is following a downward trend. In this regard, benzene concentrations in BH202 (north-western site boundary) and

BH303 (off-site down-gradient well) were below the laboratory's limit of reporting. It is noted that the concentration of benzene in the plume appears to reduce significantly between the source and the down-gradient wells at the site boundary (BH201 and BH202) and the off-site well (BH303) suggesting the plume may be shrinking and the impacts associated with benzene are relatively limited in extent. Furthermore, the results also indicate that contaminant concentrations in the core of the plume, specifically in BH203 (the previously worst affected bore located adjacent to the former source), may be pulsing as spikes in benzene concentrations were observed during the E1 and E3 (June 2013 and June 2014) GMEs and reduced concentrations were recorded in BH203 during the E2 and E4 (December 2013 and December 2014) GMEs. The spikes observed in BH203 during E1 and E3 are likely to be associated with flushing of residual contaminants from the vadose zone during the preceding wet months.

Figure 5. Comparison of Benzene Concentrations with Previous Monitoring Rounds



11.2.1.4 Toluene

The concentration of toluene recorded in sample BH301 (up-gradient/baseline well) was below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site.

The highest concentrations were recorded in BH302 (40,000 µg/L) and BH203 (200 µg/L) which exceed the adopted GSC (180 µg/L). These wells are located cross-gradient and adjacent to the source of the plume (i.e. the UST area) respectively, and are considered to be within the plume.

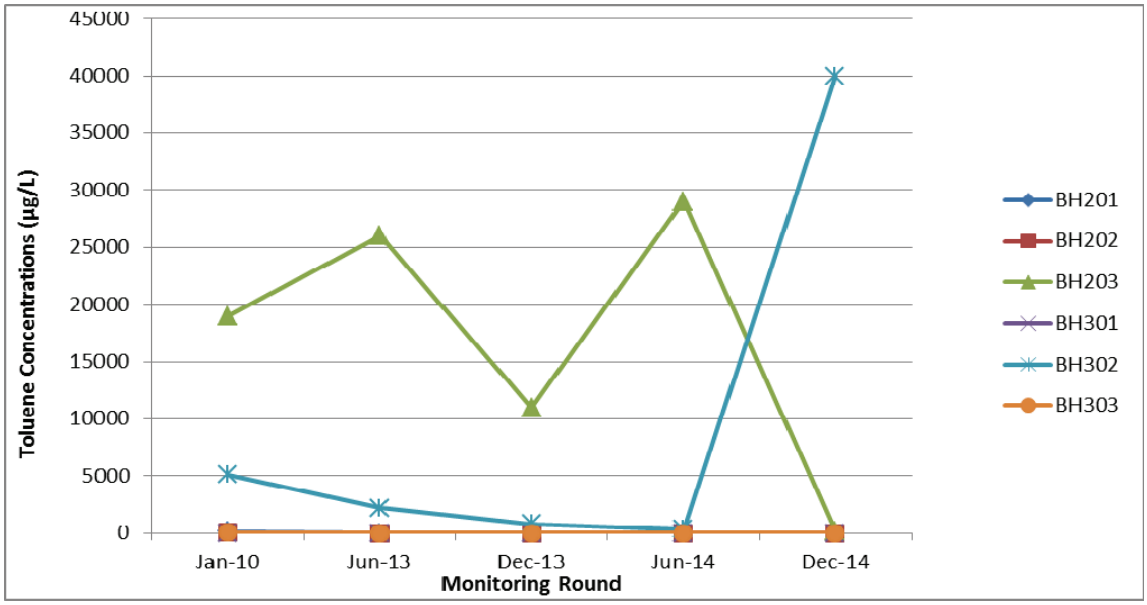
Toluene concentrations dropped off quite significantly in BH201 (4 µg/L) and BH202 (<1 µg/L) on the western boundary and were below the adopted GSC at these locations. This suggests either a limited extent of the plume or substantial depletion of toluene is occurring within the plume.

Additionally, the concentration of toluene in BH303 (off-site well) was recorded below the laboratory's limit of reporting and was therefore, within the adopted GSC.

Therefore, the results of the current monitoring round suggest that whilst the concentrations of toluene near the source of the contamination (i.e. BH203 and BH302) exceed the GSC, at the western (down-gradient) site boundaries, the concentration reduces considerably and is within the adopted GSC.

Comparison of the data from the current monitoring round with the previous rounds indicates that with the exception of BH302 (cross-gradient to the source of the plume), substantial reduction in toluene concentrations (refer Figure 6 below) has occurred in all other bores where toluene was previously detected. Conversely, at BH302, the toluene concentration has increased from 320 µg/L in E3, 830 µg/L in E2 and 5,100 µg/L in January 2010 to 40,000 µg/L during the current round. However, at BH203 (adjacent to the former source) the concentration reduced considerably from 26,000 µg/L in E1, 11,000 µg/L in E2 and 29,000 µg/L in E3 to 200 µg/L during the current round. Furthermore, at the bores located on the down-gradient site boundaries, the toluene concentrations were below the adopted GSC and in the case of BH202 was also below the laboratory's limit of reporting. The significant reduction of toluene concentrations in the bore adjacent to the source and at the down-gradient bores during the current monitoring round is most likely indicative of a reduction in contaminant mass and progressive natural attenuation of the contaminants within the plume. Furthermore, the results also indicate that contaminant concentrations in the core of the plume, specifically in BH203 (the previously worst affected bore located adjacent to the former source), may be pulsing, as spikes in toluene concentrations were observed during the E1 and E3 (June 2013 and June 2014) GMEs and reduced concentrations were recorded in BH203 during the E2 and E4 (December 2013 and December 2014) GMEs. The spikes observed in BH203 during E1 and E3 are likely to be associated with flushing of residual contaminants from the vadose zone during the preceding wet months.

Figure 6. Comparison of Toluene Concentrations with Previous Monitoring Rounds



11.2.1.5 Ethylbenzene

The concentration of ethylbenzene recorded in sample BH301 (up-gradient/baseline well) was below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site.

The highest concentrations were recorded in BH302 (2,900 µg/L) and BH203 (1,800 µg/L) which exceed the adopted GSC (80 µg/L). These wells are located cross-gradient to and adjacent to the source of the plume (i.e. the UST area) respectively, and are considered to be within the plume.

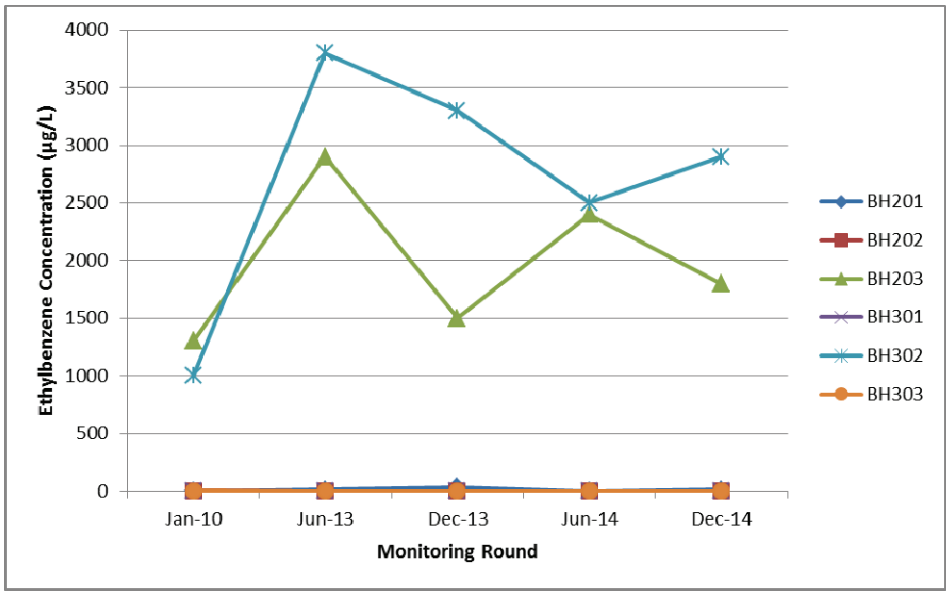
Ethylbenzene concentrations dropped off quite significantly in BH201 (14 µg/L) and BH202 (<1 µg/L) and were within the adopted GSC on the western boundary.

The concentration of ethylbenzene in BH303 (off-site well) was also recorded below the laboratory's limit of reporting and was therefore, within the adopted GSC.

In summary, the analytical results of the current round showed that whilst ethylbenzene concentrations at BH203 and BH302 (within the plume) exceeded the GSC, the concentration of ethylbenzene at the site boundaries and the offsite sampling locations reduced significantly and were within the adopted GSC at and beyond the site boundaries. The reduction in ethylbenzene concentrations at the site boundaries and off-site wells suggest either a limited extent of the plume or substantial depletion of ethylbenzene within the plume.

Comparison of the data sourced from the current and previous sampling rounds (refer Figure 7 below) indicates that at the down-gradient site boundary (BH201), the concentration of ethylbenzene increased marginally from <1 µg/L during E3 to 14 µg/L during the current round, but was still within the GSC. Given that the recorded ethylbenzene concentrations at the site boundary are within the adopted GSC, the marginal increase at this location is not considered to be significant. At BH203 (previously worst affected bore located adjacent to former UST area), the recorded ethylbenzene concentration decreased from 2400 µg/L in E3 to 1800 µg/L during the current round, and was still below E1 concentrations (2,900 µg/L). Conversely at BH302, the recorded ethylbenzene concentration increased from 2500 µg/L in E3 to 2900 µg/L during the current round, but was still below E1 concentrations (3,800 µg/L).

Figure 7. Comparison of Ethylbenzene Concentrations with Previous Monitoring Rounds



11.2.1.6 Xylene

The concentration of xylene recorded in sample BH301 (up-gradient/baseline well) was below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site.

The highest concentration was recorded in BH302 (8700 µg/L) which exceed the adopted GSC (550 µg/L). At BH203 (previously worst affected bore located adjacent to the former source), a xylene concentration of 379 µg/L was recorded, which was within the adopted GSC. These wells are located cross-gradient to and adjacent to the source of the plume (i.e. the UST area) respectively, and are considered to be within the plume.

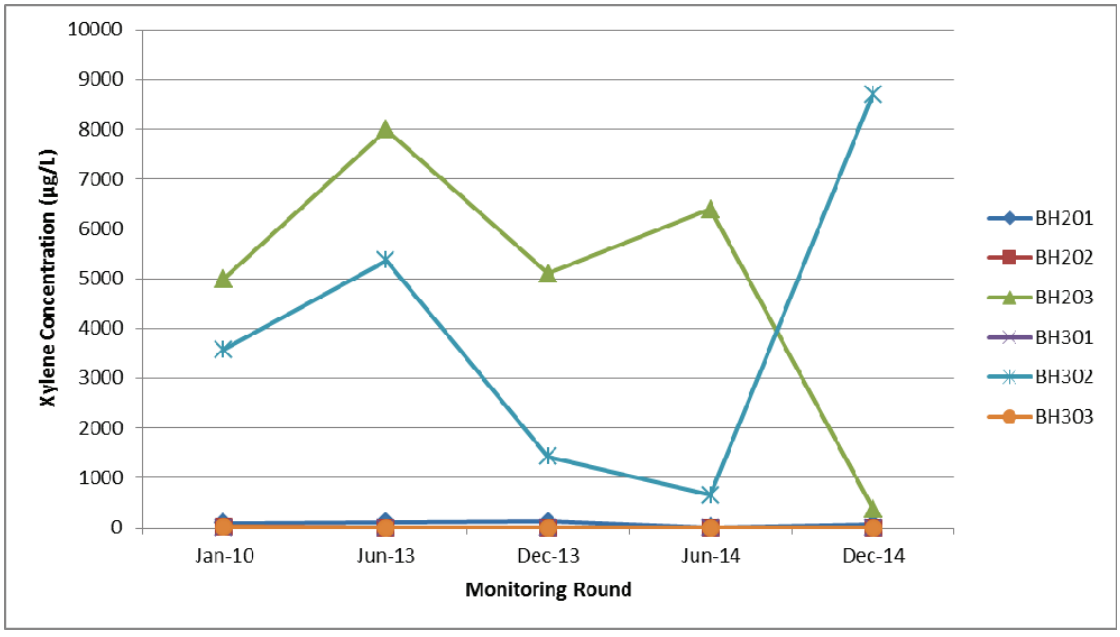
Xylene concentrations dropped off quite significantly in BH201 (74 µg/L below the GSC) and BH202 (below the laboratory's limit of reporting) on the western boundary, suggesting that the wells could be located close to the fringe of the plume.

The concentration of xylene in BH303 (off-site well) was recorded below the laboratory's limit of reporting and was therefore, within the adopted GSC.

In summary the results indicated that whilst xylene concentrations at BH203 and BH302 (in the core of plume) were elevated, the concentrations reduced rapidly at the site boundaries and were well within the adopted GSC at the site boundaries.

Comparison of the data sourced from the current and previous sampling rounds indicated that with the exception of BH302 (located cross-gradient to the source), a substantial reduction in xylene concentrations (refer Figure 8 below) has occurred in all other bores where xylene was previously detected. However, at BH302, the xylene concentrations have increased from 650 µg/L in E3 to 8,700 µg/L during the current monitoring round. However, at BH203 (previously worst affected bore located adjacent to the former source), the concentration reduced considerably from 6,400 µg/L in E3 to 375 µg/L during the current monitoring round, and was the lowest recorded concentration at this location to date. At BH201 (down-gradient bore on the south-western boundary), the xylene concentration marginally increased from 11 µg/L in E3 to 74 µg/L during the current monitoring round, but was still well below the January 2010 and E1 concentrations. At BH202 (down-gradient north-western boundary), the xylene concentration was below the laboratory's limit of reporting, which is comparable to the results of E3 and E2, and lower than the concentrations recorded during the E1 (120 µg/L) and January 2010 (15.9 µg/L) monitoring rounds. The significant reduction of xylene concentration in the bore adjacent to the source is suggestive of a reduction in contaminant mass and attenuation of contaminants at this location. Furthermore, although a minor increase in xylene concentration was observed during the current GME in BH201 (down-gradient site boundary), in overall terms there appears to be a down-ward trend in contaminant concentrations at the site boundaries. As such, these results are suggestive of a shrinking plume. In this regard, the results to date also indicate that contaminant concentrations in the core of the plume, specifically in BH203 (the previously worst affected bore located adjacent to the former source), may be pulsing, as spikes in xylene concentrations were observed during the E1 and E3 (June 2013 and June 2014) GMEs and reduced concentrations were recorded in BH203 during the E2 and E4 (December 2013 and December 2014) GMEs. The spikes observed in BH203 during E1 and E3 are likely to be associated with flushing of residual contaminants from the vadose zone during the preceding wet months.

Figure 8. Comparison of Xylene Concentrations with Previous Monitoring Rounds



11.2.1.7 PAH

With the exception of naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene and phenanthrene all other PAHs were recorded to be below the laboratory's limit of reporting during the current round of sampling.

The concentrations of all PAHs including naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene and phenanthrene recorded in sample BH301 (up-gradient/baseline well) were below the laboratory's limit of reporting confirming that the source of the hydrocarbon contamination is located within the site. Furthermore, at BH202 (down-gradient north-western boundary) recorded PAH concentrations were below the laboratory's limit of reporting. However, detectable PAH concentrations were recorded in the other bores as follows:

- Naphthalene concentrations were recorded in BH203 (71 µg/L), BH302 (240 µg/L), BH201 (3.4 µg/L) and BH303 (0.1 µg/L). In this regard, the recorded concentrations at BH203 and BH302 exceeded the GSC of 16 µg/L;
- Low concentrations of acenaphthene were recorded in BH302 (0.1 µg/L). It noted that there is currently no NSW EPA endorsed GSC for acenaphthene. In this regard, the laboratory's reporting limit for acenaphthene was <0.1 µg/L;
- A low concentration of acenaphthylene was only recorded in BH302 (0.1 µg/L). It is noted that there is currently no NSW EPA endorsed GSC for acenaphthylene. In this regard, the laboratory's reporting limit for acenaphthylene was <0.1 µg/L;
- Low concentrations of fluorene were recorded in BH203 (0.3 µg/L) and BH302 (0.3 µg/L). It is noted that there is currently no NSW EPA endorsed GSC for fluorene. In this regard, the laboratory's reporting limit for fluorene was <0.1 µg/L; and
- Low concentrations of phenanthrene were recorded in BH203 (0.2 µg/L) and BH302 (0.4 µg/L). The recorded concentrations were however, below the GSC (2 µg/L).

In summary, the highest concentrations were recorded in BH203 and BH302. These wells are located adjacent to and cross-gradient to the source of the plume (i.e. the UST area) respectively, and are considered to be within the plume.

However, PAH concentrations dropped off quite significantly in BH201 and BH202 on the western boundary, suggesting that the wells could be located close to the fringe of the plume.

Furthermore, the concentration of PAH in BH303 (off-site well) were either recorded at, or below the laboratory's limit of reporting.

11.2.1.8 VOCs

As discussed above, exceedances of the benzene, toluene, ethylbenzene and xylene GSC were detected in the core of the plume.

In addition to the above listed VOCs, detectable concentrations of a number of petroleum related non-halogenated VOCs were recorded as follows:

- Whilst the concentration of 1,2-dichloroethane, cyclohexane and tichloroethene in all analysed samples was below the laboratory's limit of reporting, it is noted that at BH203 and BH302, the limit of reporting was raised from <1 µg/L to <10 µg/L due to interference with the sample matrix. Notwithstanding, the recorded concentrations were within the adopted GSC;
- A styrene concentration of 25 µg/L was recorded at BH302, which was below the adopted GSC;
- The recorded concentration of isopropylbenzene at BH203 (50 µg/L) and BH302 (59 µg/L) exceeded the adopted GSC (30 µg/L), but were lower than that recorded during E1;
- The recorded concentration of n-propylbenzene in samples BH203 (130 µg/L), BH302 (170 µg/L) and BH201 (2 µg/L) were below the GSC (210 µg/L), and in the case of BH203 and BH302 were also lower than that recorded during E1;
- 1,3,5 trimethylbenzene was recorded in samples BH201, BH203 and BH302 at concentrations of 5 µg/L, 54 µg/L and 280 µg/L, respectively. In this regard, the recorded concentration at BH302 exceeded the GSC of 87 µg/L;
- 1,2,4 trimethylbenzene was recorded in samples BH203 (190 µg/L) and BH302 (1100 µg/L) and exceeded the GSC of 15 µg/L. Additionally a low concentration was also detected in sample BH201 (5 µg/L) which was within the adopted GSC;
- The recorded sec-butyl benzene concentration in sample BH203 (6 µg/L) was within the adopted GSC (160 µg/L). Furthermore, the limit of reporting for sample BH302 was raised from <1 µg/L to <10 µg/L due to interference with the sample matrix;
- A low concentration of 4-isopropyl toluene was recorded in sample BH203 (1 µg/L). Furthermore, the limit of reporting for sample BH302 was raised from <1 µg/L to <10 µg/L due to interference with the sample matrix. It is noted that there is currently no NSW EPA endorsed GSC for 4-isopropyl toluene; and
- The recorded n-butyl benzene concentration in sample BH203 (6 µg/L) was within the adopted GSC. Furthermore, the limit of reporting for sample BH302 was raised from <1 µg/L to <10 µg/L due to interference with the sample matrix. It is noted that there is currently no NSW EPA endorsed GSC for n-butyl benzene.

11.2.2 Natural Attenuation Parameters

As previously mentioned in Section 7, in addition to the primary contaminants of concern, samples from BH201, BH202, BH203, BH301, BH302 and BH303 were also analysed for a range of natural attenuation parameters to identify potential indicators for natural attenuation. As the analytical results showed that the concentrations of the contaminants of concern in BH301 (up-gradient well) were recorded below the laboratory's limits of reporting, the concentrations of the natural attenuation parameters detected in BH301 were adopted as the baseline values.

BH203 (adjacent to the source of contamination), BH302 (cross-gradient to the source), BH201 (at the down-gradient site boundary) and BH202 (at the down-gradient western site boundary) are considered to represent the quality of groundwater at various stages within the plume. In this regard, BH203 and

BH302, which are located adjacent to and cross-gradient to the source, are considered to represent the conditions in the core of the plume.

Noting the low contaminant concentrations in the off-site down-gradient well, BH303 is considered to represent the off-site down-gradient condition.

11.2.2.1 Condition of Groundwater

Natural attenuation of petroleum hydrocarbons typically occurs more effectively in oxidising (i.e. aerobic) conditions, as indicated by the measured dissolved oxygen and redox potential values. Field measurements for dissolved oxygen and redox were taken using a calibrated 90FLMV water quality meter.

Concentrations of dissolved oxygen (DO) were recorded in the baseline bore i.e. BH301 at 2.13 mg/L. Depleted DO values recorded within the core of the plume, at BH203 (0.43 mg/L) and BH302 (0.31 mg/L) suggest that oxygen is being consumed within the core of the plume. The DO values then recovered at the off-site well at BH303 (2.21 mg/L). Whilst not clearly conclusive, the results suggest that there is an increase in DO away from the former source (i.e. the former UST) of the plume.

With respect to redox potential, the level is highly positive at the baseline bore (BH301 at 327 she mV). At the site boundary locations BH201 and BH202, redox potential levels of -27 she mV and 438 she mV were recorded, respectively. The elevated redox level at BH202 suggests a relatively higher oxidising potential at the north-western boundary and is likely to be associated with the low contaminant concentrations observed in this bore. Furthermore, at the off-site bore (BH303) a redox level of 298 she mV was recorded.

At BH203 and BH302 (within the plume), generally lower redox levels of 41 she mV and 49 she mV, were recorded, respectively. The results indicate that the groundwater has a relatively high oxidising potential when it enters the site. As natural attenuation (oxidation) is occurring within the contaminated plume, the redox potential reduces at the core of the plume and is showing signs of recovery at the north-western boundary where contaminant concentrations were low (i.e, BH202).

In this regard, the recorded values of redox levels and dissolved oxygen levels are generally indicative of the conditions necessary for natural attenuation through oxidation of petroleum hydrocarbons, and is indirect evidence that oxidation of the petroleum hydrocarbons is occurring. Furthermore, it is noted that the current monitoring round was the fourth since removal of the contamination source (USTs) in 2012. Consequently, it is expected that groundwater conditions at the site are now relatively stable and trends (if any) should become more apparent in future monitoring rounds.

11.2.2.2 Breakdown Products

Petroleum hydrocarbons follow a fairly predictable breakdown path to form the eventual end products of carbon dioxide (CO_2) and water (H_20), with methane (CH_4) as the common intermediary product. Elevated concentrations of these analytes relative to background concentrations can be indicative of biodegradation.

The analytical results indicated that the concentration of dissolved CO_2 in the groundwater was relatively consistent between the baseline bore (120 mg/L at BH301) and the south-western down-gradient site boundary bore (130 mg/L at BH201). The highest CO_2 concentrations were recorded in the bores where the highest contaminant concentrations were observed i.e, BH302 (180 mg/L, located cross-gradient to the former source) and BH203 (140 mg/L, located adjacent to the former source). The lowest CO_2 concentrations were recorded in BH202 (97 mg/L, located on the north-western site boundary) and at BH303 (90 mg/L, the down-gradient off-site bore).

With respect to dissolved methane, the concentration was recorded below the laboratory's limit of reporting (<5 µg/L) in the baseline bore (BH301). In contrast, the highest dissolved methane concentration was recorded in BH302 (330 µg/L) which recorded the highest contaminant concentrations during the current GME and is located cross-gradient to the source of the plume. This suggests that methane is being produced at this location as a result of breakdown of petroleum hydrocarbons. Further, dissolved methane concentrations at the remainder of the bores were below the laboratory's limit of reporting.

In overall terms, the presence of elevated methane and CO_2 concentrations in the worst affected bore (i.e. BH302 which is located cross-gradient to the former source of the plume) suggest that natural attenuation is occurring with the petroleum hydrocarbons breaking down under aerobic conditions to form methane and CO_2. Additionally, the reduced methane and CO_2 concentrations in BH201 and BH202 are also suggestive of a plume that may be shrinking. This inference is further supported by the observed reduction in petroleum hydrocarbon concentrations during the current monitoring round in BH203 (previously worst affected bore) and the down-gradient site boundary wells (BH201 and BH202) when compared to the results of E1 and E2.

11.2.2.3 Nutrient Availability

Nutrient availability, particularly ammonia and phosphate are limiting factors for microbial growth that promotes biodegradation. As such, the lack of sufficient nutrient concentrations can potentially inhibit the rate of natural attenuation. Laboratory analysis for ammonia and phosphate was therefore, conducted.

Phosphate concentrations in the baseline bore (BH301) were found to be 0.012 mg/L. In the bores with the highest petroleum hydrocarbon concentrations (i.e, BH302 and BH203), phosphate concentrations were found to be below the laboratory's limit of reporting. In this regard, for sample BH302 the laboratory's limit of reporting was raised from <0.005 mg/L to <0.08 mg/L due interference with the sample matrix. At the site boundary bores (i.e., BH201 and BH202), phosphate concentrations were below the laboratory's limit of reporting. However, at the off-site down-gradient well a phosphate concentration of 0.01 mg/L was recorded. Therefore, whilst not conclusive, the data may be indicative of phosphate consumption in the core of the plume (BH203 and BH302) and the down-gradient site boundaries with less depleted concentrations at the off-site bore where contaminant concentrations were generally found to be lower.

The recorded ammonia concentrations were also low in all wells (up-gradient and down-gradient wells) with values ranging between 0.008 mg/L to <0.1 mg/L, indicating a general lack of ammoniacal nitrogen in the groundwater. In this regard, the lowest ammoniacal nitrogen was recorded in the bores on down-gradient site boundary bores i.e. BH201 (0.008 mg/L) and BH202 (0.029 mg/L). At the off-

site down-gradient bore, an ammonia concentration of 0.054 mg/L was recorded. Conversely, at BH203 (adjacent to the former source) and BH302 (cross-gradient to the former source), ammonia concentrations were below the laboratory's limit of reporting. In this regard, for the sample collected from BH302, the laboratory's limit of reporting was raised from <0.07 mg/L to <0.1 due interference with the sample matrix.

On this basis, it appears that there could be a general lack of nutrients in the groundwater. Consequently, it is considered that the attenuation process may potentially be enhanced by adding nutrients to the groundwater to stimulate the biodegradation process. Furthermore, as previously mentioned, the current monitoring round was the fourth since removal of the contamination source (USTs) in 2012. Therefore, it is expected that groundwater conditions at the site are now relatively stable and trends (if any) should become more apparent in future monitoring rounds.

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11.2.2.4 Electron Receptors

In order for oxidation of hydrocarbon contaminants to proceed, electron receptors must be available. Groundwater samples were therefore analysed for nitrate, sulphate and ferric iron as well as their products of reduction (nitrite, sulphide and ferrous iron) with a view to evaluating the dominant electron receptors in the system. Dissolved oxygen is also an electron receptor and is discussed in Section 11.2.2.1.

The analytical results indicate that the nitrate and nitrite concentrations are relatively low with a recorded nitrate concentration of 0.095 mg/L at BH301 (baseline bore) and 0.048 mg/L at BH303 (off-site down-gradient bore). At the remainder of the bores, the nitrate concentrations were below the laboratory's limit of reporting. In this regard, the laboratory's limit of reporting at a number of bores was raised above from <0.005 mg/L (BH203 and BH302 <0.03 mg/L and BH202 <0.02 mg/L) due to interference with the sample matrix.

With the exception of BH302, nitrite concentrations at all bores were also below the laboratory's limit of reporting of <0.005 mg/L. At BH302, whilst the laboratory's limit of reporting for nitrite was raised from <0.005 mg/L to <0.025 due to interference with the sample matrix, the recorded concentration was nevertheless below the laboratory's reporting limit. Therefore, there is no strong evidence of nitrate reduction (to nitrite).

The sulphate concentration in the bores with the highest petroleum hydrocarbon contaminants (BH302 – 57 mg/L and BH203 - 160 mg/L) and the bores on the western boundaries (BH201 – 290 mg/L and BH202 – 95 mg/L) showed significantly lower sulphate concentrations than the baseline bore (BH301 – 610 mg/L) and the off-site well (BH303 – 480 mg/L). Further, sulphide concentrations in all bores were below the laboratory's limit of reporting (<0.5 mg/L). Whilst not conclusive, the reduced sulphate concentrations in the worst affected bores i.e. BH302 and BH203 when compared to the baseline (BH301) and the off-site well (BH303) suggests that sulphate in the worst affected bores is being depleted and/or reduced.

The ferrous iron concentrations in the groundwater seem to provide relatively more reliable evidence of conducive MNA conditions. In this regard, the recorded concentrations of ferrous iron (the product of reduced ferric iron) were greatest in the bores with the highest concentrations of petroleum

hydrocarbon contaminants (BH203 and BH302 with concentrations of 0.28 mg/L, and 4.3 mg/L respectively). Conversely, at the baseline bore (BH301 – <0.05 mg/L) and the off-site well (BH303 – <0.05 mg/L), ferrous iron concentrations were lower than those recorded in the core of the plume. At BH203 (0.25 mg/L) and BH302 (3.3 mg/L) ferric iron was also detected, thereby, confirming that ferric iron is available and is being reduced to ferrous iron in the groundwater.

Therefore, there is evidence of both sulphate and ferric iron reduction which would support oxidation and natural attenuation of the petroleum hydrocarbons.

11.2.2.5 Alkalinity

Changes in alkalinity within different stages of the plume can be indicative of aerobic degradation of hydrocarbons.

At the up-gradient, baseline well (BH301), an alkalinity level of 1000 mg/L was recorded. The alkalinity was increased marginally in BH203 (adjacent to the source), at a recorded level of 1200 mg/L, which could be indicative of a potential increase in alkalinity within the plume. However, at BH302 (cross-gradient of the plume) a lower alkalinity level of 840 mg/L was recorded, which could be associated with the former fuel leak. However, at the boundaries and the off-site well alkalinity levels ranging between 900 and 1000 mg/L were recorded.

Whilst the current results indicated that, for samples collected within the plume, an apparent trend of increasing alkalinity was noted, which is characteristic of breakdown of petroleum related hydrocarbons, there was also a noted reduction in alkalinity in the cross-gradient bore when compared with the baseline. The actual cause of this reduction is currently unknown.

11.3 Summary of Analytical Results and Natural Attenuation Parameters

The analytical results for chemical contaminants assessed during the current monitoring round (discussed in Section 11.2.1) indicate that with the exception of BH302 (located cross-gradient to the former source), hydrocarbon contaminant concentrations in the remainder of the wells within and close to the fringe of the plume (i.e. BH203, BH201 and BH202) appear to have reduced considerably when compared to the results of the December 2013 (E2) and June 2013 (E1) monitoring rounds, and in some instances (such as for TRH, benzene, toluene and xylenes), have even been recorded at concentrations below those detected during DP (2010). In this regard, during the current GME the reduction in TRH, benzene, toluene and xylene concentrations is most pronounced in BH203, which was previously the worst affected bore and is located adjacent to the former source. Furthermore, the benzene, toluene and xylene concentrations at the down-gradient site boundary wells (BH201 and BH202) are showing a trend of reduction in contaminant concentrations when compared to the results of the January 2010, E1 and E2 monitoring rounds.

However, at BH302 (adjacent to the former source), the concentrations of the hydrocarbon contaminants appear to have increased when compared to E3, E2, E1 and January 2010 concentrations. Furthermore, whilst at the site boundaries (BH201 and BH202) a marginal increase in contaminant concentrations was observed when compared to E3, the recorded contaminant

concentrations at these wells were nevertheless below E2, E1 and January 2010 concentrations. The increased contaminant concentrations at BH302 and to a lesser extent at the site boundary wells during this GME are not necessarily indicative of deteriorating groundwater conditions as the observed spike may be associated with recent rain events that could have resulted in flushing out of contaminants. As previously mentioned, the results to date also indicate that contaminant concentrations in the core of the plume, specifically in BH203 (the previously worst affected bore located adjacent to the former source), may be pulsing, as spikes in contaminant concentrations were observed during the E1 and E3 (June 2013 and June 2014) GMEs and reduced concentrations were recorded in BH203 during the E2 and E4 (December 2013 and December 2014) GMEs. Similarly, the spike observed in BH302 during the current monitoring round is likely to be associated with this seasonal fluctuation wherein contaminants from vadose zone are likely to have been released as a result of preceding rainfall events.

Notwithstanding the above, the reduced contaminant concentrations at the remainder of the bores (i.e. BH203, BH201, BH202 and BH303, which in some instances are below the laboratory's limit of reporting) when compared to E2, E1 and January 2010 GMEs are most likely indicative of a shrinking hydrocarbon plume and a reduction in contaminant mass. In this regard, whilst the reduction in hydrocarbon contaminant concentrations (except BH302) is generally suggestive of improving groundwater quality, it is noted that the current monitoring round is only the fourth round of a three year monitoring programme. As such, anomalous variations in contaminant concentrations can occur due to natural fluctuations in groundwater quality which are affected by many factors including climatic influence. Therefore, in order to evaluate whether there is a sustained trend of contaminant depletion, it is considered prudent to expand the existing data set through/by additional rounds of monitoring as per the current bi-annual monitoring programme.

The analytical results for the natural attenuation parameters (discussed in Section 11.2.2) generally indicate that even though relatively low nutrient concentrations (ammonia and phosphorous) were detected, there is evidence of both oxygen depletion in the plume and breakdown products of petroleum related hydrocarbons. There is also evidence of the presence of the electron receivers which would be required for oxidation of the petroleum related hydrocarbons to proceed. These results generally support the conclusion that the groundwater conditions at the site are conducive to natural attenuation. Furthermore, the favourable natural attenuation parameters coupled with the recorded lower contaminant concentrations in all bores other than BH302 (located cross-gradient to the source) also suggest that natural attenuation is occurring in the contaminated groundwater. However, the results do also indicate that the natural attenuation process may be further enhanced by increasing nutrient and oxygen concentrations in the groundwater.

11.4 Preliminary Trend Analysis

As previously mentioned, during the current monitoring round, with the exception of BH302 (located cross-gradient to the former USTs), contaminant concentrations in the remainder of the bores (where hydrocarbons were previously detected) were generally lower than those detected during the December 2013 (E2) and June 2013 (E1) monitoring rounds, and in the majority of the bores were lower than those recorded during DP (2010). Whilst the concentrations of the petroleum hydrocarbon contaminants in BH302 (located cross-gradient to the former USTs) have increased when compared to E3, these increased concentrations may not necessarily be indicative of deteriorating groundwater conditions. Furthermore, as the concentration of TRH, benzene, toluene, xylene and, to a lesser

extent, ethylbenzene in the down-gradient site boundary bores are typically showing a downward trend, these results suggest that the plume may be shrinking and a reduction in contaminant mass is occurring. The inference of a reduction in contaminant mass is further supported by the pronounced reduction in contaminant concentration during the current GME at BH203 (located adjacent to the former UST area) which was previously the worst affected bore. However, anomalous variations in contaminant concentrations can occur due to natural fluctuations in groundwater quality which are affected by many factors including climatic influence. As such, in order to evaluate whether there is a sustained trend of contaminant depletion in the plume, further rounds of groundwater monitoring as per the RAP and IEMP will be required to carry out a more detailed trend analysis of the plume.

12. Conclusion and Recommendations

This report presents the results of a GME for December 2014 undertaken at 11 – 19 Centenary Road, Merrylands.

The significance of the results and the recommendations are outlined in the preceding sections. Additional rounds of monitoring will be required as per the RAP and IEMP to assess trends in the data set and to determine if contingency groundwater remediation measures will be required in the future. However, the monitoring results do not support the need to engage contingency measures at this stage and continued monitoring as per the current bi-annual programme is therefore deemed appropriate.

13. Limitations

Douglas Partners (DP) has prepared this report for 11 – 19 Centenary Road, Merrylands in accordance with our proposal dated 7 May 2012 (proposal SYD120470) and acceptance received from Mr Stephen McCulloch of St Vincent de Paul Society (SVDPS). The work was carried out in accordance with an AS4122-2000 Consultancy Agreement with SVDPS. This report is provided for the exclusive use of SVDPS for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other sites or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget and time constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attachments and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the discussions section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the groundwater components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

Drawing

Notes About this Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

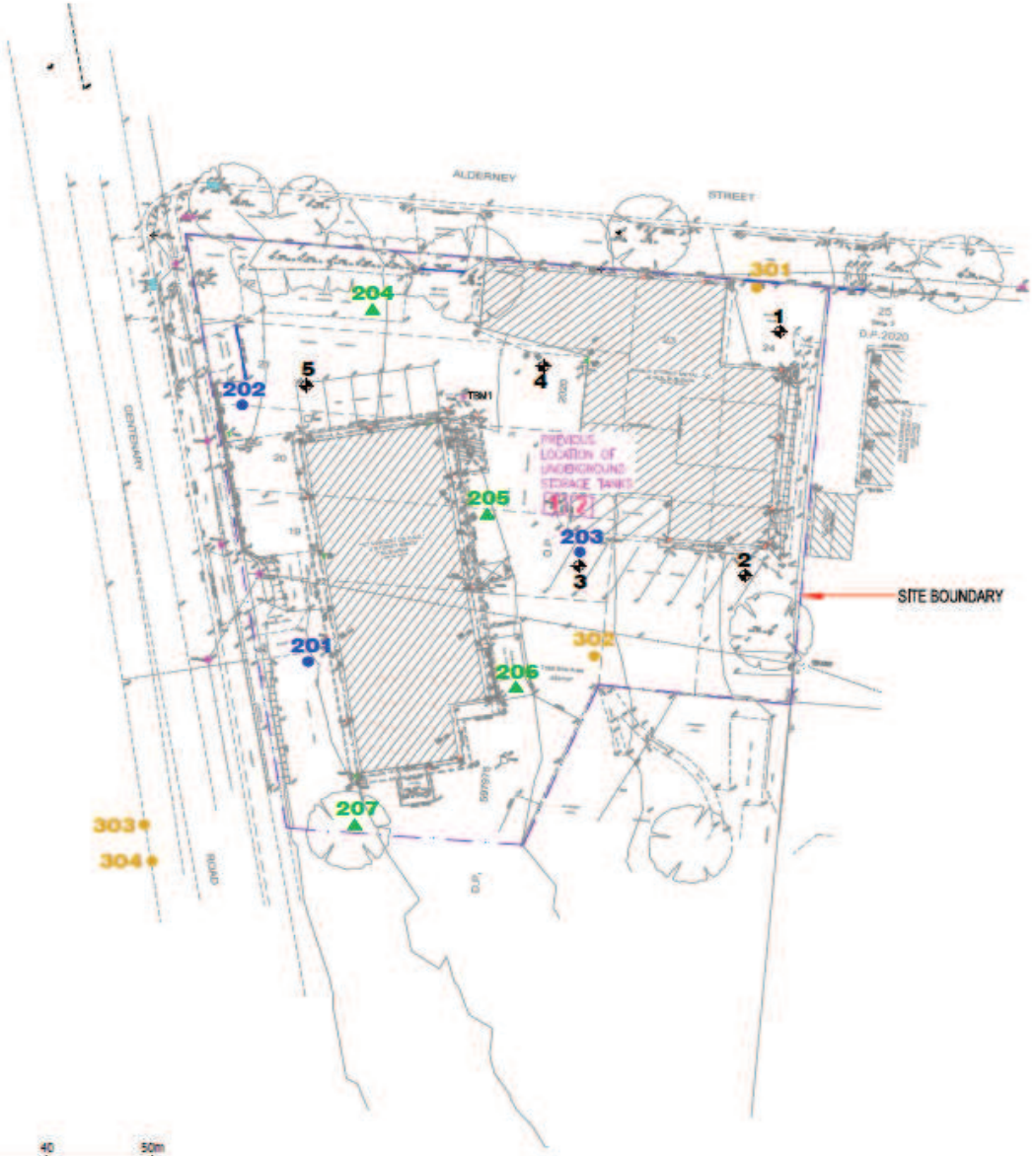
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

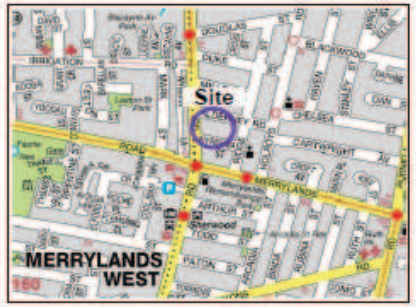
Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.





Locality Plan

LEGEND

- Test bore location (May 2009)
- Test bore location (Aug 2009)
- Ground water well (Aug 2009)
- Ground water well (Dec 2009)

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: St Vincent de Paul Society		TITLE:	**Site Location Plan and Locations of Monitoring Wells**	Project 71184.04 (E4)
	OFFICE: Sydney			**Six Monthly Groundwater Monitoring Event - December 2014 (E4)**	Drawing 1
	SCALE:As Shown	DATE: 08 January 2015		**11 - 19 Centenary Road, Merrylands**	Revision: 0

Appendix B

Laboratory Certificates

Douglas Partners
Geotechnics | Environment | Groundwater

ENVIROLAB

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

CHAIN OF CUSTODY DESPATCH SHEET

Job No: 120679

Date Received: 9.12.14
Time Received: 1.50pm
Received by: D.F.
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Project Name: Merrylands – Groundwater Monitoring
Project No: 71184.04
DP Contact Person: NSA/WFY (Standard TAT)
Prior Storage: esky / fridge / shelved (circle)
Do samples contain HBM? YES/NO

To: Envirolab Services
12 Ashley Street, Chatswood NSW 2068
Ph Phone: 02 9910 6200 Fax: 02 9910 6201
Attn: Tania Notaras

	Sample ID	Sample Type S-soil W-water Sampling Date	Lab ID	Analytes: HM	TRH/BTEX	PAH (low level)	Sulphate	VOC	Ammonia-N	o-phosphate	Nitrate-N	Nitrite-N	Sulphide	Carbon Dioxide	Fe (III)	Fe (II)	Cations, anions & hardness	Total Alkalinity	Methane
1.	201	W 08/12/14		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.	202	↓		↓		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
3.	203																		
4.	301																		
5.	302																		
6.	303																		
7.	BD1				TRH														
8.	TS				BTEX														
9.	TB				✓														

PQL = practical quantitation limit, *As per Laboratory Method Detection Limit

Date relinquished: 09/12/14
Total number of samples in container:
Results required by: WFY

SAMPLES RECEIVED
Please sign and date to acknowledge receipt of samples and return by e-mail

Signature:
Date: 9.12.14 Lab Ref:

Send results to:
Douglas Partners Pty Ltd
Postal Address:
PO Box 472 West Ryde NSW 1685

E-mail: wenfei.yuan@douglaspartners.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 120679

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: WenFei Yuan

Sample log in details:

Your Reference:	**71184.04, Merrylands - Groundwater Monitoring**
No. of samples:	9 waters
Date samples received / completed instructions received	09/12/14 / 09/12/14

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:	17/12/14 / 17/12/14
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:

Jacinta Hurst
Laboratory Manager

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-1 201 08/12/2014 water	120679-2 202 08/12/2014 water	120679-3 203 08/12/2014 water	120679-4 301 08/12/2014 water	120679-5 302 08/12/2014 water
Date extracted	-	12/12/2014	12/12/2014	12/12/2014	12/12/2014	12/12/2014
Date analysed	-	13/12/2014	13/12/2014	13/12/2014	13/12/2014	13/12/2014
Dichlorodifluoromethane	µg/L	<10	<10	<10	<10	<100
Chloromethane	µg/L	<10	<10	<10	<10	<100
Vinyl Chloride	µg/L	<10	<10	<10	<10	<100
Bromomethane	µg/L	<10	<10	<10	<10	<100
Chloroethane	µg/L	<10	<10	<10	<10	<100
Trichlorofluoromethane	µg/L	<10	<10	<10	<10	<100
1,1-Dichloroethene	µg/L	<1	<1	<1	<1	<10
Trans-1,2-dichloroethene	µg/L	<1	<1	<1	<1	<10
1,1-dichloroethane	µg/L	<1	<1	<1	<1	<10
Cis-1,2-dichloroethene	µg/L	<1	<1	<1	<1	<10
Bromochloromethane	µg/L	<1	<1	<1	<1	<10
Chloroform	µg/L	<1	<1	<1	<1	<10
2,2-dichloropropane	µg/L	<1	<1	<1	<1	<10
1,2-dichloroethane	µg/L	<1	<1	<1	<1	<10
1,1,1-trichloroethane	µg/L	<1	<1	<1	<1	<10
1,1-dichloropropene	µg/L	<1	<1	<1	<1	<10
Cyclohexane	µg/L	3	<1	44	<1	130
Carbon tetrachloride	µg/L	<1	<1	<1	<1	<10
Benzene	µg/L	4	<1	35	<1	14,000
Dibromomethane	µg/L	<1	<1	<1	<1	<10
1,2-dichloropropane	µg/L	<1	<1	<1	<1	<10
Trichloroethene	µg/L	<1	<1	<1	<1	<10
Bromodichloromethane	µg/L	<1	<1	<1	<1	<10
trans-1,3-dichloropropene	µg/L	<1	<1	<1	<1	<10
cis-1,3-dichloropropene	µg/L	<1	<1	<1	<1	<10
1,1,2-trichloroethane	µg/L	<1	<1	<1	<1	<10
Toluene	µg/L	4	<1	200	<1	40,000
1,3-dichloropropane	µg/L	<1	<1	<1	<1	<10
Dibromochloromethane	µg/L	<1	<1	<1	<1	<10
1,2-dibromoethane	µg/L	<1	<1	<1	<1	<10
Tetrachloroethene	µg/L	<1	<1	<1	<1	<10
1,1,1,2-tetrachloroethane	µg/L	<1	<1	<1	<1	<10
Chlorobenzene	µg/L	<1	<1	<1	<1	<10
Ethylbenzene	µg/L	14	<1	1,800	<1	2,900
Bromoform	µg/L	<1	<1	<1	<1	<10
m+p-xylene	µg/L	62	<2	290	<2	5,200
Styrene	µg/L	<1	<1	<1	<1	25
1,1,2,2-tetrachloroethane	µg/L	<1	<1	<1	<1	<10
o-xylene	µg/L	12	<1	89	<1	3,500
1,2,3-trichloropropane	µg/L	<1	<1	<1	<1	<10

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-1 201 08/12/2014 water	120679-2 202 08/12/2014 water	120679-3 203 08/12/2014 water	120679-4 301 08/12/2014 water	120679-5 302 08/12/2014 water
Isopropylbenzene	µg/L	<1	<1	50	<1	59
Bromobenzene	µg/L	<1	<1	<1	<1	<10
n-propyl benzene	µg/L	2	<1	130	<1	170
2-chlorotoluene	µg/L	<1	<1	<1	<1	<10
4-chlorotoluene	µg/L	<1	<1	<1	<1	<10
1,3,5-trimethyl benzene	µg/L	5	<1	54	<1	280
Tert-butyl benzene	µg/L	<1	<1	<1	<1	<10
1,2,4-trimethyl benzene	µg/L	5	<1	190	<1	1,100
1,3-dichlorobenzene	µg/L	<1	<1	<1	<1	<10
Sec-butyl benzene	µg/L	<1	<1	6	<1	<10
1,4-dichlorobenzene	µg/L	<1	<1	<1	<1	<10
4-isopropyl toluene	µg/L	<1	<1	1	<1	<10
1,2-dichlorobenzene	µg/L	<1	<1	<1	<1	<10
n-butyl benzene	µg/L	<1	<1	6	<1	<10
1,2-dibromo-3-chloropropane	µg/L	<1	<1	<1	<1	<10
1,2,4-trichlorobenzene	µg/L	<1	<1	<1	<1	<10
Hexachlorobutadiene	µg/L	<1	<1	<1	<1	<10
1,2,3-trichlorobenzene	µg/L	<1	<1	<1	<1	<10
Surrogate Dibromofluoromethane	%	103	103	101	103	98
Surrogate toluene-d8	%	99	99	100	100	96
Surrogate 4-BFB	%	108	104	113	107	110

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	120679-6 303 08/12/2014 water
Date extracted	-	12/12/2014
Date analysed	-	13/12/2014
Dichlorodifluoromethane	µg/L	<10
Chloromethane	µg/L	<10
Vinyl Chloride	µg/L	<10
Bromomethane	µg/L	<10
Chloroethane	µg/L	<10
Trichlorofluoromethane	µg/L	<10
1,1-Dichloroethene	µg/L	<1
Trans-1,2-dichloroethene	µg/L	<1
1,1-dichloroethane	µg/L	<1
Cis-1,2-dichloroethene	µg/L	<1
Bromochloromethane	µg/L	<1
Chloroform	µg/L	<1
2,2-dichloropropane	µg/L	<1
1,2-dichloroethane	µg/L	<1
1,1,1-trichloroethane	µg/L	<1
1,1-dichloropropene	µg/L	<1
Cyclohexane	µg/L	<1
Carbon tetrachloride	µg/L	<1
Benzene	µg/L	<1
Dibromomethane	µg/L	<1
1,2-dichloropropane	µg/L	<1
Trichloroethene	µg/L	<1
Bromodichloromethane	µg/L	<1
trans-1,3-dichloropropene	µg/L	<1
cis-1,3-dichloropropene	µg/L	<1
1,1,2-trichloroethane	µg/L	<1
Toluene	µg/L	<1
1,3-dichloropropane	µg/L	<1
Dibromochloromethane	µg/L	<1
1,2-dibromoethane	µg/L	<1
Tetrachloroethene	µg/L	<1
1,1,1,2-tetrachloroethane	µg/L	<1
Chlorobenzene	µg/L	<1
Ethylbenzene	µg/L	<1
Bromoform	µg/L	<1
m+p-xylene	µg/L	<2
Styrene	µg/L	<1
1,1,2,2-tetrachloroethane	µg/L	<1
o-xylene	µg/L	<1
1,2,3-trichloropropane	µg/L	<1
Isopropylbenzene	µg/L	<1

VOCs in water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	120679-6 303 08/12/2014 water
Bromobenzene	µg/L	<1
n-propyl benzene	µg/L	<1
2-chlorotoluene	µg/L	<1
4-chlorotoluene	µg/L	<1
1,3,5-trimethyl benzene	µg/L	<1
Tert-butyl benzene	µg/L	<1
1,2,4-trimethyl benzene	µg/L	<1
1,3-dichlorobenzene	µg/L	<1
Sec-butyl benzene	µg/L	<1
1,4-dichlorobenzene	µg/L	<1
4-isopropyl toluene	µg/L	<1
1,2-dichlorobenzene	µg/L	<1
n-butyl benzene	µg/L	<1
1,2-dibromo-3-chloropropane	µg/L	<1
1,2,4-trichlorobenzene	µg/L	<1
Hexachlorobutadiene	µg/L	<1
1,2,3-trichlorobenzene	µg/L	<1
Surrogate Dibromofluoromethane	%	102
Surrogate toluene-d8	%	100
Surrogate 4-BFB	%	105

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	120679-1	120679-2	120679-3	120679-4	120679-5
Your Reference	----------	201	202	203	301	302
Date Sampled	----------	08/12/2014	08/12/2014	08/12/2014	08/12/2014	08/12/2014
Type of sample		water	water	water	water	water
Date extracted	-	12/12/2014	12/12/2014	12/12/2014	12/12/2014	12/12/2014
Date analysed	-	13/12/2014	13/12/2014	13/12/2014	13/12/2014	13/12/2014
$TRHC_6$ - C_9	µg/L	200	82	3,900	<10	81,000
$TRHC_6$ - C_{10}	µg/L	260	82	4,500	<10	88,000
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	160	82	2,100	<10	22,000
Benzene	µg/L	4	<1	35	<1	14,000
Toluene	µg/L	4	<1	200	<1	40,000
Ethylbenzene	µg/L	14	<1	1,800	<1	2,900
m+p-xylene	µg/L	62	<2	290	<2	5,200
o-xylene	µg/L	12	<1	89	<1	3,500
Naphthalene	µg/L	4	<1	55	<1	260
Surrogate Dibromofluoromethane	%	103	103	101	103	98
Surrogate toluene-d8	%	99	99	100	100	96
Surrogate 4-BFB	%	108	104	113	107	110

vTRH(C6-C10)/BTEXN in Water					
Our Reference:	UNITS	120679-6	120679-7	120679-8	120679-9
Your Reference	----------	303	BD1/020614	TS	TB
Date Sampled	----------	08/12/2014	08/12/2014	08/12/2014	08/12/2014
Type of sample		water	water	water	water
Date extracted	-	12/12/2014	12/12/2014	12/12/2014	12/12/2014
Date analysed	-	13/12/2014	13/12/2014	13/12/2014	13/12/2014
$TRHC_6$ - C_9	µg/L	<10	110	[NA]	<10
$TRHC_6$ - C_{10}	µg/L	<10	110	[NA]	<10
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	<10	[NA]	[NA]	<10
Benzene	µg/L	<1	[NA]	118%	<1
Toluene	µg/L	<1	[NA]	107%	<1
Ethylbenzene	µg/L	<1	[NA]	107%	<1
m+p-xylene	µg/L	<2	[NA]	108%	<2
o-xylene	µg/L	<1	[NA]	109%	<1
Naphthalene	µg/L	<1	[NA]	[NA]	<1
Surrogate Dibromofluoromethane	%	102	101	99	100
Surrogate toluene-d8	%	100	97	101	101
Surrogate 4-BFB	%	105	98	103	100

svTRH (C10-C40) in Water						
Our Reference:	UNITS	120679-1	120679-2	120679-3	120679-4	120679-5
Your Reference	----------	201	202	203	301	302
Date Sampled	----------	08/12/2014	08/12/2014	08/12/2014	08/12/2014	08/12/2014
Type of sample		water	water	water	water	water
Date extracted	-	10/12/2014	10/12/2014	10/12/2014	10/12/2014	10/12/2014
Date analysed	-	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
TRHC$_{10}$ - C$_{14}$	µg/L	94	<50	2,100	<50	8,700
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100	500
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	68	<50	1,200	<50	6,000
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	64	<50	1,100	<50	5,800
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100	190
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	103	105	106	105	108

svTRH (C10-C40) in Water			
Our Reference:	UNITS	120679-6	120679-7
Your Reference	----------	303	BD1/020614
Date Sampled	----------	08/12/2014	08/12/2014
Type of sample		water	water
Date extracted	-	10/12/2014	10/12/2014
Date analysed	-	11/12/2014	11/12/2014
TRHC$_{10}$ - C$_{14}$	µg/L	<50	79
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$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	[NA]
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100
Surrogate o-Terphenyl	%	101	104

PAHs in Water - Low Level Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-1 201 08/12/2014 water	120679-2 202 08/12/2014 water	120679-3 203 08/12/2014 water	120679-4 301 08/12/2014 water	120679-5 302 08/12/2014 water
Date extracted	-	10/12/2014	10/12/2014	10/12/2014	10/12/2014	10/12/2014
Date analysed	-	10/12/2014	10/12/2014	10/12/2014	10/12/2014	10/12/2014
Naphthalene	µg/L	3.4	<0.1	71	<0.1	240
Acenaphthylene	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Acenaphthene	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Fluorene	µg/L	<0.1	<0.1	0.3	<0.1	0.3
Phenanthrene	µg/L	<0.1	<0.1	0.2	<0.1	0.4
Anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	0.1
Fluoranthene	µg/L	<0.1	<0.1	<0.1	<0.1	0.5
Pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	0.4
Benzo(a)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	0.3
Chrysene	µg/L	<0.1	<0.1	<0.1	<0.1	0.4
Benzo(b,j+k)fluoranthene	µg/L	<0.2	<0.2	<0.2	<0.2	0.6
Benzo(a)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	0.3
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1	<0.1	<0.1	<0.1	0.3
Dibenzo(a,h)anthracene	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1	<0.1	<0.1	<0.1	0.3
Benzo(a)pyrene TEQ	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	µg/L	3.4	NIL (+)VE	72	NIL (+)VE	240
Surrogate p-Terphenyl-d14	%	110	107	109	116	110

PAHs in Water - Low Level		
Our Reference:	UNITS	120679-6
Your Reference	----------	303
Date Sampled	----------	08/12/2014
Type of sample		water
Date extracted	-	10/12/2014
Date analysed	-	10/12/2014
Naphthalene	µg/L	0.1
Acenaphthylene	µg/L	<0.1
Acenaphthene	µg/L	<0.1
Fluorene	µg/L	<0.1
Phenanthrene	µg/L	<0.1
Anthracene	µg/L	<0.1
Fluoranthene	µg/L	<0.1
Pyrene	µg/L	<0.1
Benzo(a)anthracene	µg/L	<0.1
Chrysene	µg/L	<0.1
Benzo(b,j+k)fluoranthene	µg/L	<0.2
Benzo(a)pyrene	µg/L	<0.1
Indeno(1,2,3-c,d)pyrene	µg/L	<0.1
Dibenzo(a,h)anthracene	µg/L	<0.1
Benzo(g,h,i)perylene	µg/L	<0.1
Benzo(a)pyrene TEQ	µg/L	<0.5
Total +ve PAH's	µg/L	0.1
Surrogate p-Terphenyl-d14	%	115

HM in water - dissolved Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-1 201 08/12/2014 water	120679-2 202 08/12/2014 water	120679-3 203 08/12/2014 water	120679-4 301 08/12/2014 water	120679-5 302 08/12/2014 water
Date prepared	-	10/12/2014	10/12/2014	10/12/2014	10/12/2014	10/12/2014
Date analysed	-	10/12/2014	10/12/2014	10/12/2014	10/12/2014	10/12/2014
Arsenic-Dissolved	µg/L	<1	<1	2	<1	7
Cadmium-Dissolved	µg/L	<0.1	<0.1	<0.1	0.2	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	<1	<1	<1	3	<1
Lead-Dissolved	µg/L	<1	<1	3	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	0.06
Nickel-Dissolved	µg/L	<1	4	<1	11	5
Zinc-Dissolved	µg/L	3	4	13	16	26
Iron-Dissolved	µg/L	130	<10	3,700	<10	11,000

HM in water - dissolved Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-6 303 08/12/2014 water	120679-7 BD1/020614 08/12/2014 water
Date prepared	-	10/12/2014	10/12/2014
Date analysed	-	10/12/2014	10/12/2014
Arsenic-Dissolved	µg/L	2	<1
Cadmium-Dissolved	µg/L	0.4	<0.1
Chromium-Dissolved	µg/L	<1	<1
Copper-Dissolved	µg/L	3	<1
Lead-Dissolved	µg/L	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05
Nickel-Dissolved	µg/L	8	4
Zinc-Dissolved	µg/L	14	3
Iron-Dissolved	µg/L	<10	[NA]

Miscellaneous Inorganics						
Our Reference:	UNITS	120679-1	120679-2	120679-3	120679-4	120679-5
Your Reference	----------	201	202	203	301	302
Date Sampled	----------	08/12/2014	08/12/2014	08/12/2014	08/12/2014	08/12/2014
Type of sample		water	water	water	water	water
Date prepared	-	09/12/2014	09/12/2014	09/12/2014	09/12/2014	09/12/2014
Date analysed	-	09/12/2014	09/12/2014	09/12/2014	09/12/2014	09/12/2014
Ammonia as N in water	mg/L	0.008	0.029	<0.07	<0.09	<0.1
Phosphate as P in water	mg/L	<0.005	<0.005	<0.005	0.012	<0.08
Nitrate as N in water	mg/L	<0.005	<0.02	<0.03	0.095	<0.03
Nitrite as N in water	mg/L	<0.005	<0.005	<0.005	<0.005	<0.025
Sulphide	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Dioxide CO_2	mg/L	130	97	140	120	180
Ferric Iron (by calculation)	mg/L	<0.05	<0.05	0.25	<0.05	3.3
Ferrous Iron	mg/L	0.06	<0.05	0.28	<0.05	4.3

Miscellaneous Inorganics		
Our Reference:	UNITS	120679-6
Your Reference	----------	303
Date Sampled	----------	08/12/2014
Type of sample		water
Date prepared	-	09/12/2014
Date analysed	-	09/12/2014
Ammonia as N in water	mg/L	0.054
Phosphate as P in water	mg/L	0.010
Nitrate as N in water	mg/L	0.048
Nitrite as N in water	mg/L	<0.005
Sulphide	mg/L	<0.5
Carbon Dioxide CO_2	mg/L	90
Ferric Iron (by calculation)	mg/L	<0.05
Ferrous Iron	mg/L	<0.05

Ion Balance Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-1 201 08/12/2014 water	120679-2 202 08/12/2014 water	120679-3 203 08/12/2014 water	120679-4 301 08/12/2014 water	120679-5 302 08/12/2014 water
Date prepared	-	09/12/2014	09/12/2014	09/12/2014	09/12/2014	09/12/2014
Date analysed	-	09/12/2014	09/12/2014	09/12/2014	09/12/2014	09/12/2014
Calcium - Dissolved	mg/L	150	130	270	230	130
Potassium - Dissolved	mg/L	19	13	26	41	10
Sodium - Dissolved	mg/L	2,800	2,800	5,100	4,500	1,700
Magnesium - Dissolved	mg/L	300	220	850	630	240
Hardness	mgCaCO3 /L	1,600	1,200	4,200	3,200	1,300
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1,000	900	1,200	1,000	840
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	1,000	900	1,200	1,000	840
Sulphate, SO4	mg/L	290	95	160	610	57
Chloride, Cl	mg/L	3,900	3,800	9,000	6,900	3,500
Ionic Balance	%	7.1	7.7	4.0	7.1	-6.5

Ion Balance Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	120679-6 303 08/12/2014 water
Date prepared	-	09/12/2014
Date analysed	-	09/12/2014
Calcium - Dissolved	mg/L	150
Potassium - Dissolved	mg/L	15
Sodium - Dissolved	mg/L	2,600
Magnesium - Dissolved	mg/L	240
Hardness	mgCaCO3 /L	1,400
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	960
Carbonate Alkalinity as $CaCO_3$	mg/L	<5
Total Alkalinity as $CaCO_3$	mg/L	960
Sulphate, SO4	mg/L	480
Chloride, Cl	mg/L	3,400
Ionic Balance	%	6.2

Miscellaneous test in air						
Our Reference:	UNITS	120679-1	120679-2	120679-3	120679-4	120679-5
Your Reference	----------	201	202	203	301	302
Date Sampled	----------	08/12/2014	08/12/2014	08/12/2014	08/12/2014	08/12/2014
Type of sample		water	water	water	water	water
Date prepared	-	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
Date analysed	-	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
Methane	µg/L	5	<5	<5	<5	330

Miscellaneous test in air		
Our Reference:	UNITS	120679-6
Your Reference	----------	303
Date Sampled	----------	08/12/2014
Type of sample		water
Date prepared	-	11/12/2014
Date analysed	-	11/12/2014
Methane	µg/L	<5

Method ID	Methodology Summary
Org-013	Water samples are analysed directly by purge and trap GC-MS.
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-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 (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
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-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.
Inorg-060	Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.
Inorg-055	Nitrate - determined colourimetrically. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.
Inorg-051	Sulphide determined titrimetrically based on APHA latest edition 4500 S2- F.
APHA 4500-CO2	Dissolved CO_2-determined titrimetrically . Based on APHA , 4500-CO_2 D.
Inorg-076	A sample is determined colourimetrically by discrete analyser based on APHA latest edition 3500-Fe B.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.
Inorg-041	Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.
AT-006	Dissolved gases determined by GC-FID using method USEPA SOP RSK175

QUALITY CONTROL VOCs in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/12/2014	120679-1	12/12/2014 || 15/12/2014	LCS-W1	12/12/2014
Date analysed	-			13/12/2014	120679-1	13/12/2014 || 15/12/2014	LCS-W1	13/12/2014
Dichlorodifluoromethane	µg/L	10	Org-013	<10	120679-1	<10 || <10	[NR]	[NR]
Chloromethane	µg/L	10	Org-013	<10	120679-1	<10 || <10	[NR]	[NR]
Vinyl Chloride	µg/L	10	Org-013	<10	120679-1	<10 || <10	[NR]	[NR]
Bromomethane	µg/L	10	Org-013	<10	120679-1	<10 || <10	[NR]	[NR]
Chloroethane	µg/L	10	Org-013	<10	120679-1	<10 || <10	[NR]	[NR]
Trichlorofluoromethane	µg/L	10	Org-013	<10	120679-1	<10 || <10	[NR]	[NR]
1,1-Dichloroethene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Trans-1,2-dichloroethene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,1-dichloroethane	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	104%
Cis-1,2-dichloroethene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Bromochloromethane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Chloroform	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	104%
2,2-dichloropropane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2-dichloroethane	µg/L	1	Org-013	[NT]	120679-1	<1 || 1	LCS-W1	103%
1,1,1-trichloroethane	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	104%
1,1-dichloropropene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Cyclohexane	µg/L	1	Org-013	<1	120679-1	3 || 4 || RPD: 29	[NR]	[NR]
Carbon tetrachloride	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Benzene	µg/L	1	Org-013	<1	120679-1	4 || 6 || RPD: 40	[NR]	[NR]
Dibromomethane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2-dichloropropane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Trichloroethene	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	106%
Bromodichloromethane	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	103%
trans-1,3-dichloropropene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
cis-1,3-dichloropropene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,1,2-trichloroethane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Toluene	µg/L	1	Org-013	<1	120679-1	4 || 5 || RPD: 22	[NR]	[NR]
1,3-dichloropropane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Dibromochloromethane	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	103%
1,2-dibromoethane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Tetrachloroethene	µg/L	1	Org-013	[NT]	120679-1	<1 || <1	LCS-W1	104%
1,1,1,2-tetrachloroethane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Chlorobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Ethylbenzene	µg/L	1	Org-013	<1	120679-1	14 || 17 || RPD: 19	[NR]	[NR]
Bromoform	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
m+p-xylene	µg/L	2	Org-013	<2	120679-1	62 || 74 || RPD: 18	[NR]	[NR]
Styrene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,1,2,2-tetrachloroethane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
o-xylene	µg/L	1	Org-013	<1	120679-1	12 || 14 || RPD: 15	[NR]	[NR]

QUALITY CONTROL VOCs in water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
1,2,3-trichloropropane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Isopropylbenzene	µg/L	1	Org-013	<1	120679-1	<1 || 1	[NR]	[NR]
Bromobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
n-propyl benzene	µg/L	1	Org-013	<1	120679-1	2 || 2 || RPD: 0	[NR]	[NR]
2-chlorotoluene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
4-chlorotoluene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,3,5-trimethyl benzene	µg/L	1	Org-013	<1	120679-1	5 || 6 || RPD: 18	[NR]	[NR]
Tert-butyl benzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2,4-trimethyl benzene	µg/L	1	Org-013	<1	120679-1	5 || 7 || RPD: 33	[NR]	[NR]
1,3-dichlorobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Sec-butyl benzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,4-dichlorobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
4-isopropyl toluene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2-dichlorobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
n-butyl benzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2-dibromo-3-chloropropane	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2,4-trichlorobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Hexachlorobutadiene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
1,2,3-trichlorobenzene	µg/L	1	Org-013	<1	120679-1	<1 || <1	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-013	98	120679-1	103 || 104 || RPD: 1	LCS-W1	99%
Surrogate toluene-d8	%		Org-013	99	120679-1	99 || 99 || RPD: 0	LCS-W1	101%
Surrogate 4-BFB	%		Org-013	107	120679-1	108 || 108 || RPD: 0	LCS-W1	93%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/12/2014	120679-1	12/12/2014 || 15/12/2014	LCS-W1	12/12/2014
Date analysed	-			13/12/2014	120679-1	13/12/2014 || 15/12/2014	LCS-W1	13/12/2014
TRH C_6 - C_9	µg/L	10	Org-016	[NT]	120679-1	200 || 240 || RPD: 18	LCS-W1	102%
TRH C_6 - C_{10}	µg/L	10	Org-016	[NT]	120679-1	260 || 310 || RPD: 18	LCS-W1	102%
Benzene	µg/L	1	Org-016	[NT]	120679-1	4 || 6 || RPD: 40	LCS-W1	104%
Toluene	µg/L	1	Org-016	[NT]	120679-1	4 || 5 || RPD: 22	LCS-W1	105%
Ethylbenzene	µg/L	1	Org-016	[NT]	120679-1	14 || 17 || RPD: 19	LCS-W1	100%
m+p-xylene	µg/L	2	Org-016	[NT]	120679-1	62 || 74 || RPD: 18	LCS-W1	100%
o-xylene	µg/L	1	Org-016	[NT]	120679-1	12 || 14 || RPD: 15	LCS-W1	100%
Naphthalene	µg/L	1	Org-013	<1	120679-1	4 || 5 || RPD: 22	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	100	120679-1	103 || 104 || RPD: 1	LCS-W1	99%
Surrogate toluene-d8	%		Org-016	100	120679-1	99 || 99 || RPD: 0	LCS-W1	101%
Surrogate 4-BFB	%		Org-016	101	120679-1	108 || 108 || RPD: 0	LCS-W1	93%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/12/2014	[NT]	[NT]	LCS-W2	10/12/2014
Date analysed	-			11/12/2014	[NT]	[NT]	LCS-W2	11/12/2014
TRH C_{10} - C_{14}	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W2	113%
TRH C_{15} - C_{28}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	103%
TRH C_{29} - C_{36}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	101%
TRH >C_{10} - C_{16}	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W2	113%
TRH >C_{16} - C_{34}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	103%
TRH >C_{34} - C_{40}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	101%
Surrogate o-Terphenyl	%		Org-003	102	[NT]	[NT]	LCS-W2	83%

QUALITY CONTROL PAHs in Water - Low Level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/12/2014	[NT]	[NT]	LCS-W2	10/12/2014
Date analysed	-			10/12/2014	[NT]	[NT]	LCS-W2	10/12/2014
Naphthalene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	76%
Acenaphthylene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	78%
Phenanthrene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	74%

QUALITY CONTROL PAHs in Water - Low Level	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Anthracene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	73%
Pyrene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	86%
Benzo(a)anthracene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	70%
Benzo(b,j+k) fluoranthene	µg/L	0.2	Org-012 subset	<0.2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	LCS-W2	82%
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	0.1	Org-012 subset	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	104	[NT]	[NT]	LCS-W2	100%

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			10/12/2014	120679-7	10/12/2014 || 10/12/2014	LCS-W1	10/12/2014
Date analysed	-			10/12/2014	120679-7	10/12/2014 || 10/12/2014	LCS-W1	10/12/2014
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	120679-7	<1 || <1	LCS-W1	120%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	120679-7	<0.1 || <0.1	LCS-W1	104%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	120679-7	<1 || <1	LCS-W1	118%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	120679-7	<1 || <1	LCS-W1	118%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	120679-7	<1 || <1	LCS-W1	101%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	120679-7	<0.05 || [N/T]	LCS-W1	102%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	120679-7	4 || 4 || RPD: 0	LCS-W1	116%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	120679-7	3 || 3 || RPD: 0	LCS-W1	117%
Iron-Dissolved	µg/L	10	Metals-022 ICP-MS	<10	[NT]	[NT]	LCS-W1	114%

QUALITY CONTROL Miscellaneous Inorganics	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			09/12/2014	120679-1	09/12/2014 || 09/12/2014	LCS-W1	09/12/2014
Date analysed	-			09/12/2014	120679-1	09/12/2014 || 09/12/2014	LCS-W1	09/12/2014
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	120679-1	0.008 || 0.008 || RPD: 0	LCS-W1	103%
Phosphate as P in water	mg/L	0.005	Inorg-060	<0.005	120679-1	<0.005 || <0.005	LCS-W1	104%
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	120679-1	<0.005 || <0.005	LCS-W1	93%
Nitrite as N in water	mg/L	0.005	Inorg-055	<0.005	120679-1	<0.005 || <0.005	LCS-W1	108%
Sulphide	mg/L	0.5	Inorg-051	<0.5	120679-1	<0.5 || [N/T]	LCS-W1	110%
Carbon Dioxide CO_2	mg/L	0	APHA 4500-CO2	0.0	120679-1	130 || 130 || RPD: 0	LCS-W1	105%
Ferric Iron (by calculation)	mg/L	0.05		<0.05	120679-1	<0.05 || <0.05	[NR]	[NR]
Ferrous Iron	mg/L	0.05	Inorg-076	<0.05	120679-1	0.06 || 0.06 || RPD: 0	LCS-W1	101%

QUALITY CONTROL Ion Balance	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			09/12/2014	120679-1	09/12/2014 || 09/12/2014	LCS-1	09/12/2014
Date analysed	-			09/12/2014	120679-1	09/12/2014 || 09/12/2014	LCS-1	09/12/2014
Calcium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	120679-1	150 || [N/T]	LCS-1	97%
Potassium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	120679-1	19 || [N/T]	LCS-1	97%
Sodium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	120679-1	2800 || [N/T]	LCS-1	106%
Magnesium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	120679-1	300 || [N/T]	LCS-1	95%
Hardness	mgCaCO3/L	3		[NT]	120679-1	1600 || [N/T]	[NR]	[NR]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	120679-1	<5 || <5	[NR]	[NR]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	120679-1	1000 || 990 || RPD: 1	[NR]	[NR]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	120679-1	<5 || <5	[NR]	[NR]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	120679-1	1000 || 990 || RPD: 1	LCS-1	103%
Sulphate, SO4	mg/L	1	Inorg-081	<1	120679-1	290 || 290 || RPD: 0	LCS-1	101%
Chloride, Cl	mg/L	1	Inorg-081	<1	120679-1	3900 || 3900 || RPD: 0	LCS-1	92%
Ionic Balance	%		Inorg-041	[NT]	120679-1	7.1 || [N/T]	[NR]	[NR]

QUALITY CONTROL Miscellaneous test in air	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			11/12/2014	120679-5	11/12/2014 || 11/12/2014	LCS	11/12/2014
Date analysed	-			11/12/2014	120679-5	11/12/2014 || 11/12/2014	LCS	11/12/2014
Methane	µg/L	5	AT-006	<5	120679-5	330 || 360 || RPD: 9	LCS	95%

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	120679-1	10/12/2014 || 10/12/2014	120679-2	10/12/2014
Date analysed	-	120679-1	10/12/2014 || 10/12/2014	120679-2	10/12/2014
Mercury-Dissolved	µg/L	120679-1	<0.05 || <0.05	120679-2	#

QUALITY CONTROL Ion Balance	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	120679-2	09/12/2014 || 09/12/2014
Date analysed	-	120679-2	09/12/2014 || 09/12/2014
Calcium - Dissolved	mg/L	120679-2	130 || 130 || RPD: 0
Potassium - Dissolved	mg/L	120679-2	13 || 13 || RPD: 0
Sodium - Dissolved	mg/L	120679-2	2800 || 2800 || RPD: 0
Magnesium - Dissolved	mg/L	120679-2	220 || 220 || RPD: 0
Hardness	mgCaCO3/L	120679-2	1200 || 1200 || RPD: 0

Report Comments:

VOC_W:PQL has been raised due to the high concentration of analytes in the sample/s, resulting in the sample/s requiring dilution.

MISC_INORG: PQL has been raised due to negative results obtained.
These could be due to possible colorimetric interferences on the instrument due to the sample matrix.

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.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Douglas Partners (Syd)
96 Hermitage Road
West Ryde
NSW 2114

Attention: **Wen Fei Yuan**

Report **441984-W**
Project name MERRYLANDS - GROUNDWATER MONITORING 71184.03
Received Date Dec 10, 2014

Client Sample ID			**BD2**
Sample Matrix			**Water**
Eurofins | mgt Sample No.			**S14-De10172**
Date Sampled			**Dec 09, 2014**
Test/Reference	LOR	Unit	
Total Recoverable Hydrocarbons - 1999 NEPM Fractions			
TRH C6-C9	0.02	mg/L	0.11
TRH C10-C14	0.05	mg/L	0.41
TRH C15-C28	0.1	mg/L	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1
TRH C10-36 (Total)	0.1	mg/L	0.41
Total Recoverable Hydrocarbons - 2013 NEPM Fractions			
Naphthalene[N02]	0.02	mg/L	< 0.02
TRH C6-C10	0.02	mg/L	0.11
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	0.11
TRH >C10-C16	0.05	mg/L	0.11
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	0.11
TRH >C16-C34	0.1	mg/L	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1
Heavy Metals			
Arsenic (filtered)	0.001	mg/L	< 0.001
Cadmium (filtered)	0.0001	mg/L	< 0.0001
Chromium (filtered)	0.001	mg/L	< 0.001
Copper (filtered)	0.001	mg/L	< 0.001
Lead (filtered)	0.001	mg/L	< 0.001
Mercury (filtered)	0.0001	mg/L	< 0.0001
Nickel (filtered)	0.001	mg/L	0.004
Zinc (filtered)	0.005	mg/L	< 0.005

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Dec 12, 2014	7 Day
- Method: TRH C6-C36 - LTM-ORG-2010			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Dec 12, 2014	7 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Metals M8 filtered	Sydney	Dec 11, 2014	28 Day
- Method: E020/E030 Filtered Metals in Water & E026 Mercury			

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Melbourne
3-5 Kingston Town Close
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NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	Douglas Partners (Syd)	**Order No.:**		**Received:**	Dec 10, 2014 2:15 PM
Address:	96 Hermitage Road West Ryde NSW 2114	**Report #:** **Phone:** **Fax:**	441984 02 9809 0666	**Due:** **Priority:** **Contact Name:**	Dec 17, 2014 5 Day Wen Fei Yuan
Project Name:	MERRYLANDS - GROUNDWATER MONITORING 71184.03				

Eurofins | mgt Client Manager: Andrew Black

Sample Detail					Metals M8 filtered	Total Recoverable Hydrocarbons
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217					X	X
Brisbane Laboratory - NATA Site # 20794						
External Laboratory						
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
BD2	Dec 09, 2014		Water	S14-De10172	X	X

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

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Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.02			0.02	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH C6-C10 less BTEX (F1)	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Heavy Metals							
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0001			0.0001	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Copper (filtered)	mg/L	< 0.001			0.001	Pass	
Mercury (filtered)	mg/L	< 0.0001			0.0001	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	87			70-130	Pass	
TRH C10-C14	%	70			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	106			70-130	Pass	
TRH C6-C10	%	93			70-130	Pass	
TRH >C10-C16	%	83			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic (filtered)	%	110			70-130	Pass	
Cadmium (filtered)	%	111			70-130	Pass	
Chromium (filtered)	%	116			70-130	Pass	
Copper (filtered)	%	104			70-130	Pass	
Lead (filtered)	%	97			70-130	Pass	
Mercury (filtered)	%	91			70-130	Pass	
Nickel (filtered)	%	100			70-130	Pass	
Zinc (filtered)	%	105			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	S14-De08771	NCP	%	90			70-130	Pass	
TRH C10-C14	S14-De10976	NCP	%	71			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	S14-De08771	NCP	%	129			70-130	Pass	
TRH C6-C10	S14-De08771	NCP	%	94			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
TRH >C10-C16	S14-De10976	NCP	%	84			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic (filtered)	S14-De12407	NCP	%	105			70-130	Pass	
Cadmium (filtered)	S14-De12407	NCP	%	107			70-130	Pass	
Chromium (filtered)	S14-De12407	NCP	%	117			70-130	Pass	
Copper (filtered)	S14-De12407	NCP	%	102			70-130	Pass	
Lead (filtered)	S14-De12407	NCP	%	103			70-130	Pass	
Mercury (filtered)	S14-De12407	NCP	%	97			70-130	Pass	
Nickel (filtered)	S14-De12407	NCP	%	100			70-130	Pass	
Zinc (filtered)	S14-De12407	NCP	%	99			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	S14-De08779	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C10-C14	S14-De11723	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH C15-C28	S14-De11723	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	S14-De11723	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	S14-De08779	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C6-C10	S14-De08779	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C6-C10 less BTEX (F1)	S14-De08779	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH >C10-C16	S14-De11723	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH >C16-C34	S14-De11723	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH >C34-C40	S14-De11723	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic (filtered)	S14-De12406	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cadmium (filtered)	S14-De12406	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Chromium (filtered)	S14-De12406	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper (filtered)	S14-De12406	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead (filtered)	S14-De12406	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Mercury (filtered)	S14-De12406	NCP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel (filtered)	S14-De12406	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc (filtered)	S14-De12406	NCP	mg/L	< 0.005	< 0.005	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.

Authorised By

Andrew Black	Analytical Services Manager
Ivan Taylor	Senior Analyst-Metal (NSW)
Ryan Hamilton	Senior Analyst-Organic (NSW)
Ryan Hamilton	Senior Analyst-Volatile (NSW)

Glenn Jackson

National Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

Appendix C

Field Notes

Geotec... artners ...onment / Groundwater

Groundwater Field Sheet

Project and Bore Installation Details	
Bore / Standpipe ID:	201
Project Name:	Groundwater Monitoring
Project Number:	71184.04
Site Location:	11-19 Centenary Rd, Merryland
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Volume = casing volume + filter pack volume

Where $\pi = \pi d_c^2/4 - n(\pi h_f d_c^2/4 - \pi h_f d_f^2/4)$

n = porosity (0.3 assumed for filter pack material)

h_c = height of water column

d_c = diameter of annulus

h_f = length of filter pack

d_f = diameter of casing

Bore Vol Normally: 7.2*h

Bore Development Details	
Date/Time:	1/12/14
Purged By:	WFH / CB
GW Level (pre-purge):	3.96 m bgl
GW Level (post-purge):	4.90 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	10.05 m bgl
Estimated Bore Volume:	42 L ~125 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	12V Submersible pump

hydrocarbon odour

clear 10

4 / 6x7 x42 x 3 / 126

Micropurge and Sampling Details	
Date/Time:	08/12/14
Sampled By:	WFH
Weather Conditions:	Wet
GW Level (pre-purge):	3.95 m bgl
GW Level (post sample):	3.96 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	10.05 m bgl
Estimated Bore Volume:	~42 L
Total Volume Purged:	2.5 L
Equipment:	12 V peristaltic pump

hydrocarbon odour / no free product

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1 °C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10 mV**
13:08	22.6	0.94	5.34	6.45	-202
13:09	22.4	0.61	5.36	6.47	-211
13:10	22.3	0.46	5.36	6.49	-220
13:11	22.2	0.34	5.32	6.48	-223
13:12	22.2	0.30	5.29	6.52	-221
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS		

2.5L

4 / 6 / 10

Sample Details

Sampling Depth (rationale):	7 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	clear, H/C odour
Sample ID:	201
QA/QC Samples:	n/a
Sampling Containers and filtration:	• 4 x 40ml HCl glass vials • 1 x 500mL amber • 2 x 150ml H_2SO_4 plastic bottles • 1 x 500mL plastic bottle • 1 x 250 ml Nitric Acid plastic bottle
mments / Observations:	clear, H/C odour

Douglas Partners
Geotechnics | Environment | Groundwater

Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= $\pi h_c d_c^2/4 - n(\pi h_c d_c^2/4 - \pi h_f d_f^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_c = height of water column
d_c = diameter of annulus
h_f = length of filter pack
d_f = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	202
Project Name:	Groundwater Monitoring
Project Number:	71184.04
Site Location:	11-19 Centenary Rd, Merrylands
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	20 m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details	
Date/Time:	01/12/14
Purged By:	WF4/CB
GW Level (pre-purge):	2.59 m bgl
GW Level (post-purge):	9.70 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	10.13 m bgl
Estimated Bore Volume:	50. L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) ~150
Equipment:	12 V Submersible pump

9.70
2.60
7.10

7 x 7 = 49

50
x 3

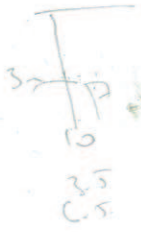
Micropurge and Sampling Details	
Date/Time:	08/12/14
Sampled By:	WF4
Weather Conditions:	Overcast
GW Level (pre-purge):	2.90 m bgl
GW Level (post sample):	6.27 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed: Slight phenolic odour
Observed Well Depth:	10.13 m bgl
Estimated Bore Volume:	~ 50 L
Total Volume Purged:	6.5 L
Equipment:	12 V peristaltic pump

- Slight phenolic odour during development
- Silty.

10

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1 °C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10 mV**
13:57	24.0	0.74	7.61	6.83	161
13:58	24.1	0.71	7.58	6.84	175
13:59	24.0	0.70	7.54	6.85	196
14:00	24.0	0.70	7.51	6.86	207
14:01	23.9	0.71	7.48	6.87	225
14:02	23.9	0.70	7.43	6.87	233
14:03	23.8	0.70	7.40	6.88	239
6.5L					
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS		



Sample Details

Sampling Depth (rationale):	6.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	Clear & slight phenolic odour
Sample ID:	202.
QA/QC Samples:	BD1 & BD2.
Sampling Containers and filtration:	• 8 x 40ml HCl glass vials • 3 x 500mL amber • 2 x 150 ml H_2SO_4 plastic bottles • 1 x 100 mL plastic bottle • 3 x 250mL nitric acid plastic bottle
Comments / Observations:	

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= πh.d.²/4 − n(πh.d.²/4−πh.d.²/4)
Where π = 3.14
n = porosity (0.3 for most filter pack material)
h = height of water column
d = diameter of annulus
h = length of filter pack
d = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	203
Project Name:	Groundwater Monitoring
Project Number:	71184.04
Site Location:	11-19 Centenary Rd, Merrylands
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details	
Date/Time:	01/12/14.
Purged By:	WFH/CB
GW Level (pre-purge):	1.95 m bgl
GW Level (post-purge):	7.10 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	8.33 m bgl
Estimated Bore Volume:	42 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) 7120L / pump until dry
Equipment:	

Micropurge and Sampling Details	
Date/Time:	08/12/14
Sampled By:	WFH
Weather Conditions:	Overcast
GW Level (pre-purge):	1.97 m bgl
GW Level (post sample):	5.20 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed:
Observed Well Depth:	8.33 m bgl
Estimated Bore Volume:	~42 L
Total Volume Purged:	5 L
Equipment:	12 V peristaltic pump

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10 mV**
14:51	25.1	0.66	16.0	6.77	-17
14:52	23.9	0.45	16.3	6.77	-45
14:53	23.3	0.36	16.3	6.77	-70
14:54	23.0	0.31	16.3	6.77	-105
14:55	22.8	0.21	16.3	6.78	-138
14:56	22.9	0.23	16.3	6.78	-160
14:57	22.8	0.22	15.0	6.78	-170
14:58	22.9	0.43	12.82	6.79	-158
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS		

Sample Details

Depth (rationale):	5.5 m bgl,
Appearance (e.g. Clearness, odour):	Clear, HC odour
	203
Samples:	n/a
Containers and	• 4 x 40ml HCl glass vials • 1 x 500ml amber • 2 x 150ml H_2SO_4 plastic bottles • 1 x 250ml nitric acid plastic bottle • 1 x 500ml plastic bottle
Observations:	TRH vials – silty. (due to low recharge)

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
$= \pi h_c d_c^2/4 + n(\pi h_c d_b^2/4 - \pi h_c d_c^2/4)$
Where: $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_c = height of water column
d_b = diameter of annulus
h_f = length of filter pack
d_c = diameter of casing
Bore Vol Normally: 7.2*h

Project and Bore Installation Details	
Bore / Standpipe ID:	301
Project Name:	Groundwater Monitoring
Project Number:	71124.04
Site Location:	11-19 Centenary Rd, Merrylands
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details	
Date/Time:	01/12/14
Purged By:	WFM / CB
GW Level (pre-purge):	2.33 m bgl
GW Level (post-purge):	7.42 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	8.36 m bgl
Estimated Bore Volume:	~4.2 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry) Pump not dry
Equipment:	Submersible Pump.

Micropurge and Sampling Details	
Date/Time:	8/12/14
Sampled By:	WFM
Weather Conditions:	Humid, overcast
GW Level (pre-purge):	2.34 m bgl
GW Level (post sample):	3.44 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed: no odour/sheen
Observed Well Depth:	8.36 m bgl
Estimated Bore Volume:	~4.2 L
Total Volume Purged:	5.5 L
Equipment:	12V Peristaltic Pump

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1 °C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10 mV**
11:38	20.8	2.42	13.05	6.81	137
11:39	25.0	2.05	13.06	6.78	133
11:40	22.4	2.03	13.13	6.78	130
11:41	21.0	2.12	13.05	6.79	129
11:42	20.8	2.13	12.95	6.79	128
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS		

Sample Details

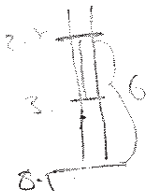
Sampling Depth (rationale):	5.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	no odour / no free product
Sample ID:	301
QA/QC Samples:	nil
Sampling Containers and filtration:	• 4 x 40ml HCl glass vials • 1 x 500ml amber • 2 x 150ml H_2SO_4 plastic bottles • 1 x 250ml nitric acid plastic bottle • 1 x 250 ml plastic bottle
Comments / Observations:	

8.36
2.33
6.03 x 2 = 12.1

Clear, no odour,

12.1 x 2 = 24.2 / 6 = 4.03 Purge vol

8.36
2.34
6.02



5.5

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= $\pi h_c d_c^2/4 + n(\pi h_f d_f^2/4 - \pi h_f d_c^2/4)$
Where $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h_c = height of water column
d_c = diameter of annulus
h_f = length of filter pack
d_c = diameter of casing
Bore Vol Normally: 7.2^*h

Project and Bore Installation Details

Bore / Standpipe ID:	302
Project Name:	Groundwater Monitoring
Project Number:	71184.04
Site Location:	11-19 Centenary Rd, Merrylands
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details

Date/Time:	01/12/14
Purged By:	WFY/CB
GW Level (pre-purge):	1.98 m bgl
GW Level (post-purge):	8.87 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	9.86 m bgl
Estimated Bore Volume:	56 L
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	12V Submersible pump

hydrocarbon odour
10
2
8 x 7 = 56
x 3

Micropurge and Sampling Details

Date/Time:	08/12/14
Sampled By:	WFY
Weather Conditions:	overcast
GW Level (pre-purge):	1.85 m bgl
GW Level (post sample):	3.54 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed:
Observed Well Depth:	9.86 m bgl
Estimated Bore Volume:	~56 L
Total Volume Purged:	2.5 L
Equipment:	12V peristaltic pump

- Slightly black silty water.

Water Quality Parameters

Time / Volume	Temp (°C)	DO (mg/L)	EC (µS or mS/cm)	pH	Redox (mV)
Stabilisation Criteria (3 readings)	**0.1° C**	**+/- 0.3 mg/L**	**+/- 3%**	**+/- 0.1**	**+/- 10 mV**
15:38	24.2	0.67	6.43	6.51	-116
15:39	24.0	0.46	6.45	6.50	-138
15:40	23.9	0.35	6.41	6.49	-148
15:41	24.0	0.31	6.35	6.45	-150
15:42					
15:43					

Additional Readings Following stabilisation:	DO % Sat	SPC	TDS		

Sample Details

Sampling Depth (rationale):	6 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	brown/black Silty water + H/C odour
Sample ID:	302
QA/QC Samples:	n/a
Sampling Containers and filtration:	• 4 x 40ml HCl glass vials • 1x 500ml amber • 2x 150ml H_2SO_4 plastic bottles • 1x 250ml nitric acid plastic bottle - 1x 500 ml plastic bottle
Comments / Observations:	

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Groundwater Field Sheet

Bore Volume = casing volume + filter pack volume
= $\pi h d^2/4 - n\pi h d^2/4 + \pi h d^2/4$
Where $\pi = 3.14$
n = porosity (0.3 for most filter pack material)
h = height of water column
d = diameter of annulus
h = length of filter pack
d = diameter of casing
Bore Vol Normally: 7.2^*h

Project and Bore Installation Details	
Bore / Standpipe ID:	303
Project Name:	Groundwater Monitoring
Project Number:	71184.04
Site Location:	11-19 Centenary Rd Merrylands
Bore GPS Co-ord:	
Installation Date:	
GW Level (during drilling):	m bgl
Well Depth:	m bgl
Screened Interval:	m bgl
Contaminants/Comments:	

Bore Development Details	
Date/Time:	01/12/14
Purged By:	WFM/CB.
GW Level (pre-purge):	2.99 m bgl
GW Level (post-purge):	2.78 m bgl
PSH observed:	Yes / No (interface / visual). Thickness if observed: Silty water & organic odour
Observed Well Depth:	10.13 m bgl
Estimated Bore Volume:	~4.9 L Pumped until dry.
Total Volume Purged:	(target: no drill mud, min 3 well vol. or dry)
Equipment:	12 V Submersible pump

Micropurge and Sampling Details	
Date/Time:	08/12/14
Sampled By:	WFM
Weather Conditions:	Overcast
GW Level (pre-purge):	2.94 m bgl
GW Level (post sample):	4.74 m bgl
PSH observed:	Yes / (No) (interface / visual). Thickness if observed: no odour/free product
Observed Well Depth:	10.13 m bgl
Estimated Bore Volume:	~4.9 L
Total Volume Purged:	3.5 L
Equipment:	12V peristaltic pump.

Water Quality Parameters ppt(TDS)

Time / Volume	Temp (°C)	DO (mg/L) ppm	EC (µS or mS/cm)	pH	Redox (mV)
Stabilisation Criteria (3 readings)	0.1° C	+/- 0.3 mg/L	+/- 3%	+/- 0.1	+/- 10 mV
12:22	23.1	2.68	6.72	6.74	169
12:23	23.5	2.72	6.71	6.74	178
12:24	22.6	2.75	6.60	6.73	179
12:25	22.9	2.45	6.58	6.71	146
12:26 (3.5L)	22.9	2.18	6.54	6.70	116
12:27	22.7	2.02	6.61	6.75	105
12:28	22.8	2.21	6.68	6.78	99
Additional Readings Following stabilisation:	DO % Sat	SPC	TDS		

Sample Details

Sampling Depth (rationale):	6.5 m bgl,
Sample Appearance (e.g. colour, siltiness, odour):	Strong H/C odour in the atmosphere due to recent accident
Sample ID:	303
QA/QC Samples:	nil
Sampling Containers and filtration:	• 4x 40ml HCl glass vials • 1x 500mL amber • 2x 150ml H_2SO_4 plastic bottles • 1x 500mL plastic bottle • 1x 250ml nitric acid plastic bottle
Comments / Observations:	

Appendix D

Calibration Records

ThermoFisher SCIENTIFIC

The world leader in serving science

RENTALS

Equipment Certification Report – TPS 90FLMV Water Quality Meter

This Water Quality Meter has been performance checked and calibrated as follows:

Sensor	Concentration	Span 1	Span 2	Traceability Lot #	Pass?
pH	pH 7.00 / pH 4.00	7,00 pH	4,00 pH	MB1697 / RL1670	☑
Conductivity	2.76mS/cm	0,00 mS/cm	2,76 mS/cm	MC1968	☑
TDS	36 ppk	0,0 ppk	36,0 ppk	LB1814	☑
Dissolved Oxygen	Sodium Sulphite / Air	0,00 ppm in Sodium Sulphite	8,63 ppm Saturation in Air	522	☑
Check only					
Redox (ORP) *	Electrode operability test	236mV ~~240mV~~ +/- 10%	232 mV	LH2225/6	☑

* This meter uses an Ag/AgCl ORP electrode. To convert readings to SHE (Standard Hydrogen Electrode), add 199mV to the mV reading.

☑ Battery Status 7,59 (min 7.2V)
☐ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 22,1 °C
☐ Electrodes Cleaned and checked

Tag No: TFNR080

Valid to: 05/03/2015

Date: 08/12/2014

Signed: Seppo Raposeina

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $30 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Returned	Item
☑	☐	90FLMV Unit. Ops check/Battery status: 7,90
☑	☐	pH sensor with wetting cap, 5m
☑	☐	Conductivity/TDS/Temperature K=10 sensor, 5m
☑	☐	Dissolved oxygen YSI5739 sensor with wetting cap, 5m
☑	☐	Redox (ORP) sensor with wetting cap, 5m
☑	☐	Turbidity sensor, 5m
☑	☐	Power supply 240V to 12V DC 200mA
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Syringe with storage solution for pH and ORP sensors
☑	☐	Carry Case
☑	☐	Check to confirm electrical safety (tag must be valid)

Date: 08/12/2014

Signed: Seppo Raposeina

TFS Reference	CS001817	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	90FLMV SG	Condition on return:	
Equipment Serial No.	51816		

Appendix E

Quality Assurance/Quality Control Procedures and Results

QA/QC PROCEDURES AND RESULTS

Q1. FIELD QUALITY ASSURANCE AND QUALITY CONTROL

The field QC procedures for sampling as prescribed in Douglas Partners' *Field Procedures Manual* were followed during the assessment.

Q1.1 Sampling Team

Field sampling was undertaken by DP's Environmental Scientist Wen-Fei Yuan who has over six years of experience in contamination assessments.

Q1.2 Sample Collection

Sample collection procedures and dispatch are reported in Section 7 of the report.

Q1.3 Chain-of-Custody

Chain-of-custody information was recorded on the Chain-of-Custody (COC) sheets and accompanied samples to the analytical laboratory. Signed copies of COC are presented in Appendix B, following the laboratory reports.

Q1.4 Sample Splitting Techniques

Replicate samples were collected in the field as a measure of accuracy, precision and repeatability of the results. Field replicate samples for groundwater were collected from the same location and an identical depth to the primary sample. Replicate samples were collected by decanting equal portions of groundwater into separately and uniquely labelled groundwater bottles. Sample bottles were filled directly from the pump outlet to minimise disturbance.

Q1.5 Duplicate Frequency

Field sampling comprised inter-laboratory and intra-laboratory replicate sampling, at a rate of approximately one duplicate sample for every ten original samples (groundwater) for intra-laboratory and inter-laboratory analysis.

Q1.6 Field Instrument Calibration

The groundwater water quality meter was calibrated by ThermoFischer Scientific prior to commencing fieldwork. Records of the calibration are presented in Appendix D. The water quality metre is also serviced regularly per the manufacturers recommendations.

Q1.7 Relative Percentage Difference

A measure of the consistency of results for field samples is derived by the calculation of relative percentage differences (RPDs) for duplicate samples. A RPD of +/- 30% is generally considered typically acceptable for inorganic analytes by NSW EPA, although in general a wider RPD range (50%) may be acceptable for organic analytes.

Q1.7.1 Intra-Laboratory Analysis

Intra-laboratory duplicate sampling was conducted as an internal check of the reproducibility within the primary laboratory (Envirolab Pty Ltd) and as a measure of consistency of sampling techniques. During the current assessment, one intra-laboratory sample was analysed at Envirolab. The comparative results of analysis between original and duplicate samples collected during the current assessment is summarised in the table below.

Table 1: Intra-laboratory Results Organics (µg/L)

Sample	C_6-C_9	C_{10}-C_{36}	C_{16}-C_{34}	C_{34}-C_{40}
BH202	82	<250	<100	<100
BD1/081214	110	279	<100	<100
Difference[1]	28	29	0	0
RPD	29	11	0	0

[1] **when concentrations are below the PQL values, the difference and RPD are computed using the PQL values**

The calculated RPD values for the groundwater samples samples were within the acceptable range of +/-50% for organic analytes. Based on the overall results, it is considered that the results indicate an acceptable consistency between the samples and their replicates and indicate that suitable field sampling methodology was adopted and laboratory precision was achieved.

Q1.7.2 Inter-Laboratory Analysis

Inter-laboratory duplicate sampling was conducted as a check of the reproducibility of results between the primary laboratory (Envirolab Pty Ltd) and the secondary laboratory (Eurofins MGT Pty Ltd) and as a measure of consistency of sampling techniques. During the current assessment, one inter-laboratory triplicate was analysed at Eurofins.

The comparative results of analysis between original and inter-laboratory duplicates are summarised in the table below. Note that where the laboratory PQLs are different and both samples are below the PQL (or one sample is below PQL and the other has a recorded detection below the other lab PQL) the difference and RPD has been given as zero (0).

Table 2: Inter-laboratory Results Organics (µg/L)

Sample	TRH C_6-C_9	TRH C_{10}-C_{36}	TRH C_{10}-C_{16}	TRH $C1_6$-C_{34}	TRH C_{34}-C_{40}
BD1/08122014	110	279	<50	<100	<100
BD2/08122014	110	410	110	<100	<100
Difference [1]	0	131	60	0	0
RPD	0	38	**75**	0	0

[1] **when concentrations are below the PQL threshold values, the difference and RPD are computed using the PQL values**

With the exception of TRH C_{10}-C_{36}, the calculated RPD values for the remainder of the analysed contaminants in the groundwater samples were within the acceptable range of +/-50% for organic analytes. However, this is not considered to be significant due to:

- The typically low actual differences in the concentrations of the replicate pairs where some RPD exceedances occurred;
- Replicates, rather than homogenised duplicates were used to avoid volatile loss, hence greater variability can be expected;
- The majority of RPDs within a replicate pair being within the acceptable limits; and
- All other QA/QC parameters met the DQI's.

Based on the overall results, it is considered that the results indicate an acceptable consistency between the samples and their replicates and indicate that suitable field sampling methodology was adopted and laboratory precision was achieved.

It is therefore considered that the results indicate an acceptable consistency between the samples and their duplicates and indicate that suitable field sampling methodology was adopted and laboratory precision was achieved.

Q1.8 Field Trip Spikes and Blanks

Q1.8.1 Field Trip Spikes

According to *the NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (1997)*, laboratory prepared trip spikes are to be taken into the field, subjected to the same preservation methods as the field samples, then analysed, for the purposes of determining the losses in volatile organics incurred prior to reaching the laboratory.

The practicalities of trip spikes are currently being debated and a standardized procedure is yet to be defined. One water based trip spikes was prepared by the laboratory. The laboratory prepared trip spike was preserved in the standard manner and taken into the field unopened. At this stage, the laboratory has no standard acceptance limits in recovery rates. The results (presented in Table 3)

indicated that the percentage loss for BTEX during the trip is generally within the expected range of recovery percentage.

Table 3: Trip Spike Results (% recovery)

Sample ID	Benzene	Toluene	Ethyl Benzene	Xylene
TS08012014	118%	107%	107%	109%

Q1.8.2 Trip Blanks

One water based trip blank (while groundwater sampling) was taken out to the field unopened, subjected to the same preservation methods as the field samples, then analysed, for the purposes of determining the transfer of contaminants into the blank sample incurred prior to reaching the laboratory. The results of the laboratory analysis for the trip blank are shown in the Table 4 below.

Table 4- Results of Laboratory Analysis of Trip Blank Analysis for TRH/BTEX

Sample ID	TRH C6-C9 Benzene	Toluene	Ethyl Benzene	Total Xylene
TB081214	<10 <0.5	<0.5	<1.0	<3.0

Levels of analytes were all found to be below detection limits, indicating that cross contamination of BTEX did not occur during the course of the round trip from laboratory to site.

Q2. LABORATORY QUALITY ASSURANCE AND QUALITY CONTROL

Q2.1 Chain-of-Custody

Chain-of-custody information was recorded on the Chain-of-Custody (COC) sheets and accompanied samples to the analytical laboratory. COC contained receipt date and time and the identity of samples. Signed copies of COC are presented in Appendix B, following the laboratory reports.

Q2.2 Analytical Laboratory

Samples were submitted to the following laboratories for analysis:

- Primary Laboratory: Envirolab Services Pty Ltd (Chatswood);
- Secondary Laboratory: Eurofins MGT Pty Ltd (Lane Cove).

Both laboratories are NATA accredited. Envirolab's accreditation number is 2901 and is accredited for compliance with ISO/IEC 17025. Envirolab tests comply with NATA and NEPM. In- house procedures are employed by Envirolab in the absence of documented standards.

Eurofins MGT's NATA accreditation number is 1261 and is accredited for compliance with ISO/IEC 17025.

Q2.3 Surrogate Spike

This sample is prepared by adding a known amount of surrogate, which behaves similarly to the analyte, prior to analysis to each sample. The recovery result indicates the proportion of the known concentration of the surrogate that is detected during analysis. These results are within acceptance limits as specified in Envirolab Services, indicating that the extraction technique was effective.

The laboratory acceptance criteria for surrogate samples is generally 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q2.4 Practical Quantitation Limits - PQLs

The PQL is the lowest quantity of an analyte which can be detected during the analysis. PQLs at different analytical laboratories can differ based on the analytical techniques.

Q2.5 Reference and Daily Check Sample Results – Laboratory Control Sample (LCS)

This sample comprises spiking either a standard reference material or a control matrix (such as a blank of sand or water) with a known concentration of specific analytes. The LCS is then analysed and results compared against each other to determine how the laboratory has performed with regard to sample preparation and analytical procedure. LCSs are analysed at a frequency of 1 in 20, with a minimum of one analysed per batch.

The laboratory acceptance criteria for LCS samples is generally 70-130% for inorganic/ metals; and 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q2.6 Laboratory Duplicate Results

These are additional portions of a sample which are analysed in exactly the same manner as all other samples. The laboratory acceptance criteria for duplicate samples is: in cases where the level is <5xPQL – any RPD is acceptable; and in cases where the level is >5xPQL – 0-50% RPD is acceptable.

Q2.7 Laboratory Blank Results

The laboratory blank, sometimes referred to as the method blank or reagent blank is the sample prepared and analysed at the beginning of every analytical run, following calibration of the analytical apparatus. This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, it can be determined by processing solvents and reagents in exactly the same manner as for samples. Laboratory blanks are analysed at a frequency of 1 in 20, with a minimum of one per batch.

Q2.8 Matrix Spike

This is a sample duplicate prepared by adding a known amount of analyte prior to analysis, and then treated exactly the same as all other samples. The recovery result indicates the proportion of the known concentration of the analyte that is detected during analysis. The laboratory acceptance criteria for matrix spike samples is generally 70-130% for inorganic/metals; and 60-140% for organics; and 10-140% for SVOC and speciated phenols.

Q2.9 Results of Laboratory QA

The laboratory QA for surrogate spikes, LCS, laboratory duplicate results, method blanks and matrix spikes were generally within the acceptance standards.

It was therefore considered that an acceptable level of laboratory precision and consistency was achieved and that surrogate spikes, LCS, laboratory duplicate results, method blanks and matrix spike results were of an acceptable level.