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19 October 2015

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Ryan Thoroughgood
Project Director
Health Infrastructure
Level 6, 77 Pacific Highway,
North Sydney, NSW, 2060

Dear Ryan

This letter presents a summary of findings and the current contamination status of the site located at 612-624 Pittwater Road, Brookvale NSW.

A number of historic investigations have been completed to characterise the extent of contamination in soil, groundwater and soil vapour at the site. The reports documenting this work are:

- SMEC 2014a, *Brookvale Community Health Centre Planning and Environmental Constraints Due Diligence Assessment*.
- SMEC 2014b, *Summary Of Findings Associated With New Supporting Environmental Information.*
- SMEC 2014c, *Targeted Environmental Site Assessment 612–624 Pittwater Road, Brookvale NSW.*
- SMEC 2014d, *Contamination Condition Review 614 – 624 Pittwater Road, Brookvale.*
- SMEC 2014e, *Summary of Preliminary Environmental Investigation and Review for 612-624 Pittwater Road, Brookvale*.
- SMEC 2014f, *Summary of Environmental Investigations and Findings for 612-624 Pittwater Road, Brookvale*.
- Solutions Engineering 2014g, *Asbestos Register 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100.*
- Solutions Engineering 2014h, *Asbestos management Plan 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100.*
- Handex Australia Pty Ltd (Handex) 1998, *Limited Environmental Site Assessment – 620 Pittwater Road, Brookvale NSW, Site No. No0263*
- PPK Environment and Infrastructure Pty Ltd (PPK, now Parsons Brinckerhoff) 1999, *Limited Environmental Site Assessment for 620 Pittwater Road, Brookvale NSW (lot adjacent to former Mobil Service Station).*
- PPK 2000a, *Remedial Action Plan, Former Mobil Service Station and Adjoining Properties, Cnr Williams and Pittwater Roads, Brookvale.*

- PPK 2003a, *Site Remediation and Validation Report, Former Service Station, Corner William Street and Pittwater Road, Brookvale, NSW (Site No. No0263.)*
- IT Environmental (Australia) Pty Ltd 2003b, *Summary Site Audit Report Former Mobil Service Station 612 Pittwater Road Brookvale NSW*
- Parsons Brinckerhoff 2010a, *Groundwater Monitoring Event August 2009 – 620 Pittwater Road, Brookvale NSW.*
- Parsons Brinckerhoff 2010b, *Post Phase 2 ESA – 620 Pittwater Rd, Brookvale, NSW*
- Parsons Brinckerhoff 2010c, *Groundwater Monitoring Event March 2010 – 620 Pittwater Road, Brookvale NSW.*
- Parsons Brinckerhoff 2011a, *Soil Validation Report 620 Pittwater Rd Brookvale, NSW 2100.*
- Parsons Brinckerhoff 2011b*, Soil Vapour Intrusion Assessment, 620 Pittwater Road, Brookvale NSW.*
- Parsons Brinckerhoff 2012a, *Site Risk Management Plan, 620 Pittwater Road, Brookvale, NSW*
- Parsons Brinckerhoff 2012b, *Environmental Report, 620 Pittwater Road, Brookvale, NSW, dated June 2012.*
- Parsons Brinckerhoff 2012c, *On site Human Health Risk Assessment - 620 Pittwater Road, Brookvale, NSW.*
- Parsons Brinckerhoff 2013a, *Letter Addendum to 'On site Human Health Risk Assessment Report, June 2012 .*
- Environ Australia Pty Ltd 2013b, *Site Audit Report – 620 Pittwater Road, Brookvale NSW.*

The reports listed above were used to develop an understanding of the contamination status of the site.

The site comprises the following individual properties:

- Number 612, comprising Lot A, Lot B and Lot C of deposit plan 375728, historically used as a Mobil service station and currently vacant
- Number 620, comprising Lot 1, DP 500541, historically used as a residence, and currently unused
- Number 624, comprising Lot 3 DP 539384, historically and currently used for commercial and light industrial activities.

A summary of the current status of the site is as follows:

- Number 612 was historically used as a Mobil service station containing seven underground storage tanks (USTs) and associated fuel infrastructure. The fuel infrastructure was removed in 1999 and the site was validated in 2000. Residual contamination was reported in soil at the northern boundary of the site. Concentrations of contaminants of concern in soil samples collected from the excavated material were reported below the adopted assessment criteria for re-use on site and the soil removed from the excavations was land farmed and backfilled on site. The concentrations of hydrocarbons in these historic soil samples were recently compared to the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM, as amended 2013) applicable health screening levels (HSLs) and TRH exceedances were identified in a number of samples.
- Residual hydrocarbon contamination was historically identified in soil at number 620. Number 620 was remediated and validated to the extent practical in 2011; however, residual contamination was reported

in soil at depths ranging from 2.7 mBGL to 3.0 mBGL on excavation surfaces at the western portion of number 620. Excavation was undertaken up to the boundary and the boundary of the onsite house structure, no further excavation was possible due to the risk of undermining the roadway and the house.

- A site audit statement completed by IT Environmental (2003) for number 612 had reported the review of previous investigations conducted at the site and certified the site appropriate for commercial/industrial land use. It was reported that groundwater was not to be used onsite (refer to Enclosure D)
- A site audit report (Environ Australia Pty Ltd 2013b), completed for number 620 concluded that hydrocarbon contamination in groundwater beneath number 620 was not considered likely to pose any unacceptable health risks to future users of number 620 and residual hydrocarbon contamination remaining near the surface of weathered sandstone bedrock may emit odours or be observed to be stained during excavation at number 620. The site was deemed suitable for commercial/industrial use (refer to Enclosure E)
- Investigations conducted by SMEC in 2014 of the entire site detected concentrations of contaminants of concern in soil and groundwater contamination at the western boundary of number 620 above the applicable criteria for commercial/industrial use which was consistent with the contamination discussed above. The investigation reports are provided in Enclosure A.
- Five groundwater monitoring wells were previously installed at the site by SMEC.
- A groundwater monitoring event was conducted for four accessible wells at the entire site by Parsons Brinckerhoff in May 2015. The investigation identified hydrocarbon contaminants at elevated levels in a monitoring well (MW2) located at the western boundary of number 620. The NEPM (2013) HSL criteria could not be applied as the guidance is only intended for groundwater depths greater than 2 m below ground level. A soil vapour assessment was recommended to assess vapour intrusion risk of that could result from the elevated groundwater concentrations. The groundwater monitoring report is provided in Enclosure B.
- The soil vapour assessment was conducted by Parsons Brinckerhoff in June 2015 targeting the historically backfilled land farmed soil at number 612 and contamination at the western boundary of number 620. The investigation identified vapour concentrations below the applicable HSLs. It was concluded that there were no unacceptable vapour intrusion risks to potential users of the community health facility from the contaminants of concern investigated as part of the previous groundwater monitoring event. The soil vapour report is provided in Enclosure C.
- Solutions Engineering completed an asbestos register for structures on-site in 2014 and identified asbestos in most structures onsite. This was followed by the preparation of an asbestos management plan to be applied during site works.
- Warehouse buildings at the entire site have been inspected and various contaminating activities have been identified. Contamination sampling has not been conducted below these structures. A soil investigation should be conducted below building footprints once on site structures have been removed.
- A site survey provided by HI identified one UST at the north-eastern portion of the site at number 624. The site is located within a UPSS regulation environmental sensitive zone, in accordance with the requirements for this regulation, the UPSS located onsite will require removal and remediation in accordance with the remedial action plan prepared for the site (Enclosure F).
- The acid sulfate soil (ASS) map sitting under the *Warringah local environmental plan* (LEP) (2011) identifies the general north-eastern portion of the sites as being Class 4 ASS which is the second lowest ASS risk classification. Clause 6.1 of the LEP (2011) specifics that for Class 4 soils, development consent is required for only for works more than 2 metres below the natural ground surface (unlikely for

the CHC development), or for works by which the water table is likely to be lowered more than 2 metres below the natural ground surface (unlikely for the CHC development).

In conclusion, recent investigations have been conducted by Parsons Brinckerhoff since May 2015, comprising a groundwater monitoring and soil vapour assessment at the site. Groundwater sampled at a total of four locations identified the requirement for a soil vapour investigation. A soil vapour assessment was conducted to address areas of concern and found that concentrations were not likely to pose a risk to future commercial site users.

It should be noted that there are areas at the site that have not been investigated, and dependent on the results of the proposed investigations at these areas, remediation at the site may be required. Further, the UST located at the north-east portion of the site is located within UPSS regulation environmental sensitive zone and requires remediation. Remaining areas of the site have been adequately investigated and do not require remediation.

Therefore, the site, with the exception of the building footprints and the UST at the north-eastern portion is suitable for the proposed use as a community health centre in general accordance with Department of Urban Affairs and Planning / NSW Environment Protection Authority Managing Land Contamination Planning Guidelines SEPP 55–Remediation of Land.

A soil investigation below all on-site building footprints and the removal and validation of the UST at the north-eastern portion of the site is required to be completed by Parsons Brinckerhoff. A draft remedial action plan (RAP) has been developed to address remediation required for the removal of the UST and potential remediation identified below building footprints on-site and provided as a part of the Environmental Impact Statement (EIS) (Enclosure F).

An Environmental Management Plan (EMP) will be prepared for the site to address areas of concern identified in historical investigations conducted at the site and provided as a part of the EIS. Following results from the final investigations at the site and remediation of required areas, the EMP will be updated to address the areas of concern in relation to the development of the site. The EMP will be written in accordance with Department of Infrastructure, Planning and Natural Resources 2004, *Guideline for the Preparation of Environmental Management Plans.*

In view of the low risk of ASS, no historic soil sampling has been undertaken to confirm the potential for ASS. It is recommended that field and confirmatory laboratory analysis for ASS is undertaken in the northern portion of the site, and beneath the building footprints during the additional soil investigations works. Subject to the findings of this analysis, an ASS management plan (ASSMP) may need to be prepared. The ASSMP would form part of the EMP and would provide a framework for managing any possible encounter with ASS during the excavation works and should be compiled in accordance with the Acid Sulfate Soils Management Advisory Council (ASSMAC) 1998, *Acid Sulfate Soils Assessment Guidelines action criteria*.

If you wish to discuss the information presented in this letter or require clarification on specific matters, please contact the undersigned on (02) 9272 1453.

Yours sincerely

Beejal Patel
Environmental Scientist
Parsons Brinckerhoff

Encl: SMEC investigation reports
Parsons Brinckerhoff GME report
Parsons Brinckerhoff soil vapour report
IT Environmental Site Audit Report
Environ Australia Site Audit Report
Parsons Brinckerhoff Remedial Action Plan

Enclosure A

SMEC investigation reports

Local People. Global Experience.

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23rd September 2014

Project Director - Lawrence Nethery
Health Infrastructure
Po Box 1060
NORTH SYDNEY NSW 2059

Dear Lawrence,

RE: Summary Of Environmental Investigations And Findings For 612-624 Pittwater Road, Brookvale.

Introduction

This letter presents the summary findings of existing environmental documentation and targeted environmental investigation conducted by SMEC on the proposed NBHS Southern site at 612-624 Pittwater Road, Brookvale (the Site). This letter supplements the summary letter issued to HI in August 2014 and presents new findings based on additional environmental monitoring and extensive site inspections conducted in September 2014. The environmental investigations conducted in September focused on closing the information gaps identified in previous understanding of the contaminated land associated with the Site. The information gaps identified were primarily relating to 'on site' contamination within 624 Pittwater Road and potential 'offsite' impacts on groundwater that may exist as a result of historical contaminating landuses. This letter is to be read in conjunction with the detailed supporting SMEC reports.

Sampling and analysis results from the focused environmental investigation were compared against the National Environment Protection Measures (NEPM) - Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater. The NEPM has been considered in the context of the future use of the site as a community health facility building and has adopted the commercial/industrial land use criteria for assessment.

Additional site environmental investigation and monitoring included the following:

- Internal inspection of building tenancies within 624 Pittwater Road (Fire door manufacturer and retail premises, formerly used as an automotive workshop).
- Installation of three additional strategically located monitoring wells (MW1, MW2, MW3).
- Intrusive soil sampling at six additional on site locations (SD1, BH1, BH2, BH3, BH4, BH5) and analysis for TRH, BTEX, PAH, Metals 8, OC, OP, PCB, Phenols, cyanide, asbestos, VOCs, SVOCs, VHCs.
- Installation of six on site passive gas sampling points (VP1, VP2, VP3, VP4, VP5, VP6) adjacent

to Pittwater Road.

- Assessment of recently 'imported' fill soil material applied to the surface of 620 Pittwater Road (VP1, VP2, VP3, VP4/0-0.1).
- Off site vapour assessment of air space in 50 service pits (Telstra, Optus, Electricity etc.) using a photoionisation detector (PID) to the sites perimeter boundary.
- Off site monitoring of two groundwater wells west of Pittwater Road, labelled MB2 (north) and MB3 (south) and analyse for TRH, BTEX, Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) and VOCs.
- Consultation with the incumbent EPA Licensed Contaminated Land Site Auditor for 620Pittwater Road to identify site characteristics of works conducted to date in addition to an historical account from the Auditor as to the works carried out on the previous service station site by Mobil upon closure of that facility in 1998

'Off Site' and 'On Site' Investigation Findings

'Off Site' Investigations

The offsite investigation conducted by SMEC commenced on the 9th of September 2014.

PID readings of the air space in fifty service pits located along both sides of Pittwater Road and both sides of William Street in the vicinity of the site indicated VOCs were all 0 ppmv.

Offsite depth to the sandstone interface seepage water was 2.3-2.4m below ground level (bgl) in the two existing offsite monitoring bores on the opposite side of Pittwater Road. Results of groundwater testing indicated TPH and VOCs were below laboratory limits of reporting (LOR). Metals were detected at background concentrations common to urban areas (i.e. slightly elevated zinc).

Anecdotal evidence suggests that a Caltex service station and a drycleaners facility may have operated at 451 Pittwater Road, Brookvale. These adjacent landuses are listed within SEPP 55 as potentially contaminating landuses and the offsite monitoring wells identified on the western side of Pittwater Road may be associated with historical remediation of those sites.

'On Site' Investigations

The onsite inspection and investigation conducted by SMEC commenced on the 12th September 2014. The internal tenancy inspections indicated that 624 Pittwater Road was historically used as an automotive show room with service hoists and an underground storage tank at the rear. The internal inspection areas are currently operational and contain storage of bulky goods preventing access to walls and provided limited inspection opportunities of the floor slabs.

The units at the rear of 624 Pittwater Road are currently used for fire door manufacturing. Historically, we understand, these rear units were used for motorcycle workshops, cabinetry workshops and bulk storage of blank doors as stock for the fire door business. The internal site inspection identified mobile storage vessels containing flammable liquid and hazardous chemicals. It is likely that these chemicals are associated with the bonding and weather proofing treatments applied to the fire doors in the spray booth area. The concrete floors appeared to be stained with the bonding and weather proofing agents corresponding to liquids held in storage.

The site inspection of 620 Pittwater Road indicated that 'imported' and 'non virgin' soil materials had been spread across the site and placed around the former residential property. This material covered previously installed groundwater wells and gas monitoring facilities and made earlier gas vapour models accepted by the Site Audit review in 2013 redundant. The anecdotal evidence suggests that the fill material was originally from site and spread out across 620 Pittwater Road during the demolition of the shed structure and during general site clean-up works occurring across the site. Whilst the material appears to be imported to the area, testing of this fill material did not indicate contamination issues.

On site soil results for 612-620 Pittwater Road obtained from the intrusive soil sampling indicate the hydrocarbon impact zone is consistent with existing understanding of the site. Access to surface soils at the rear of the former residence have been exposed since recent demolition and removal of shed structures associated with former market gardening activities known to site. Soil results indicate that surface soils in this location are impacted by heavy metals impacts. No indication of impact from the adjacent spray booth has been obvious in this location based on soil and water data collected.

On site soil gas vapour results for the front of 612-620 Pittwater Road indicate that volatiles are present within the previously identified seepage area. The four passive gas samplers installed provide lateral delineation for the known vapour impacted subsoils located 1 – 2 m below ground level. The presence of soil vapour has been confirmed at location VP3 (BH4/MW2), with trace levels of VOCs also detected. It is noteworthy that VP1 and VP2 are set back from the boundary and adjacent to the house (see attachment A) indicated VOCs were not detected. This monitoring confirms the hydrocarbon/ VOC impacted soil voids dissolving in seepage water are limited to pockets of soil near the boundary at the front of the former residence in a section approximately 20m wide.

Concentrated Hydrocarbon Seepage Area

The hydrocarbon impacted seepage area in 612-620 Pittwater Road (Attachment C) represents residual contamination that remains in the soil pores (soil particle gaps) as opposed to a primary source contamination plume. The soil pores in the seepage area have retained groundwater that has been impacted by residual levels of hydrocarbons and other fuel related compounds. The quality of the impacted seepage water fluctuates during seasonal changes in the local groundwater regime as drying and inundation occurs periodically. This seepage area has been attenuating since the primary source of the pollution was removed when the tank farm on 612 Pittwater Road was removed and remediation work occurred in 2003.

The environmental monitoring being conducted during this assessment is detecting the secondary source of hydrocarbons and its seasonal variation. SMEC does not consider this or previous data sufficient to establish or discount the presence of a plume. This notwithstanding, a limited soil vapour risk remains at the western site boundary. The costs associated with this have been incorporated with the Quantity Surveyor and is allowed for as a likely outcome for developing the site.

In addition to the remediation works conducted in 2003, the extent of hydrocarbon contamination in 620 Pittwater Road has been investigated and remediated by excavation and offsite disposal of contaminated soils in 2011. The Auditor considers that the hydrocarbon contamination associated with the former adjacent service station has been remediated to the extent practible and that the site has been remediated to a standard suitable for commercial / industrial landuse with respect to hydrocarbons. Some minor residual contamination remains mainly near the surface of the weathered rock at depth and odours and or staining may be present. The risk to human health is low in terms of direct contact is low given the remaining hydrocarbons seepage area is >2.0 m below ground level. Costs associated with soil vapour risk assessment have been incorporated into the remediation cost plan to address this concern.

Conclusion and recommended path forward

The site has environmental issues that require specific environmental monitoring and management of onsite/offsite water quality and air quality. Environmental monitoring would commence immediately on site possession to establish baseline data. Baseline data and detailed environmental risk assessment would inform the design of the proposed building and provide remediation management plans for the construction and operational phases as well as establishing baselining intelligence around communications to the community about the site.

The short term (starting with HI possession), long term and operational issues relating to management of soil and groundwater contamination have not changed significantly since the earlier recommendation made in August 2014. The information gap analysis associated with onsite issues relating to 624 Pittwater Road and offsite impacts associated with historical landuses at 612-624 Pittwater Road has improved understanding of site conditions. The current overall understanding of contamination issues on site indicates that the remediation methodology can be enhanced by providing additional onsite soil and groundwater to waste (ie offsite disposal) costings at the construction phase of the proposed development.

The possibility of offsite impacts on groundwater is reduced based on observations made at the site perimeter and limited offsite monitoring conducted, however the risk of offsite impacts associated with seepage water remains. It is noted that this risk is offset by the lack of sensitive receivers in the immediate down gradient location of the site. Pittwater Road is likely to act as both a distance buffer (being approximately 70 metres wide at this point) and a wide physical barrier that would limit the risk of offsite migration of seepage waters .This highly compacted and sealed road formation does not collect soil vapours and therefore there is limited risk of harm to road corridor users from erroneous gasses and/or seepage water.

Recommendations if the site is purchased

In the event that HI purchases the site and develops it as a proposed NBHS facility, SMEC concludes from its previous testing and this focused ‘gap analysis’ that the site can be made suitable for the proposed development subject to compliance with the additional contaminated land assessment required, continuation of the baseline monitoring and developing the management documents that can be verified by a Contaminated Land Act accredited Site Auditor. When requirements of the site audit process have been satisfied, the Site Auditor may issue a Site Audit Statement confirming the site is suitable for the proposed land use.

This summary letter report is to be read in conjunction with the full report titled *Targeted Environmental Site Assessment 612-624 Pittwater Road, Brookvale NSW* (SMEC, 2014) and the SSAR (2003) and SAS (2013).

Please let me know if you have any questions relating to these matters.

Yours sincerely,

Daniel Saunders
Team Leader - Environmental Site Services

Attachments

A – Monitoring locations developed in September 2014.

B – Combined monitoring events coverage.

C– Hydrocarbon impacted soil

D – Cost / risk curve for site remediation

Limitations

This letter report has been prepared for HI. The purpose of the report is to provide additional information in relation to the contamination previously identified at the sites located at 612-624 Pittwater Road, Brookvale, NSW, 2100.

This report does not provide a complete assessment of the contamination status of the site. The report is limited to the scope defined in this letter. In conducting this assessment, reliance has been placed on data and information provided by HI and other consultants, including the decommissioning, remediation and validation of the former service station site and adjacent residential block.

This document has been prepared in good faith and no responsibility can be accepted for inaccuracies contained in the information provided by HI or other consultants. The findings of this report are based on the data collected during the stated investigation period. SMEC performed the fieldwork in a manner consistent with the normal level of care and expertise exercised by members of the contaminated land management profession.

The findings of the report are based on the concentrations observed in the sampled groundwater at the time of the assessment. These conditions may change with time and space.No warranty, expressed or implied, is made as to the information and professional advice included in this report. The report shall only be used for the purposes as stated in this report and shall not be relied upon by any party other than the client for the project. Anyone using this document does so at their own risk and should satisfy themselves concerning the applicability of its application and where necessary should seek expert advice in relation to the particular situation. The client acknowledges that this report is for the exclusive use of the client.

DATE 19/09/2014

0 30 60 Metres

1:1,500

COORDINATE SYSTEM
GDA 1994 MGA Zone 56

FIG NO. Attachment A

IGURE TITLE September 2014 Current Site Sampling Plan

PAGE SIZE A4

PROJECT NO. 30011256

PROJECT TITLE Brookvale CHC

CREATED BY LR11993

SOURCES Vector backdrop data © MDS 2014

SMEC

Location: I:\projects\30011256 - Northern Beaches Hospital EIS\008 DATA\GIS\Maps\Brookvale CHC\Figure3_SeptemberSamplingPlan.mxd

Last updated by: LR11993 on 19/09/2014 at 10:24

LEGEND

- ● Passive Gas Sample Locations
- ✛ New Soil Bore Locations
- ✛ Existing Monitoring Well Location
- ✛ New Monitoring Well Location
- ☒ Stormwater Drain Sediment
- ✛ Groundwater Borehole Locations
- ✛ Environmental Borehole Locations
- ✛ Geotechnical and Environmental Borehole Locations
- ▭ Site
- ▭ Cadastre

DATE 19/09/2014

0 15 30 Metres

1:800

COORDINATE SYSTEM GDA 1994 MGA Zone 56

FIG NO. Attachment B

IGURE TITLE All Sampling Locations

PAGE SIZE A4

PROJECT NO. 30011256

PROJECT TITLE Brookvale CHC

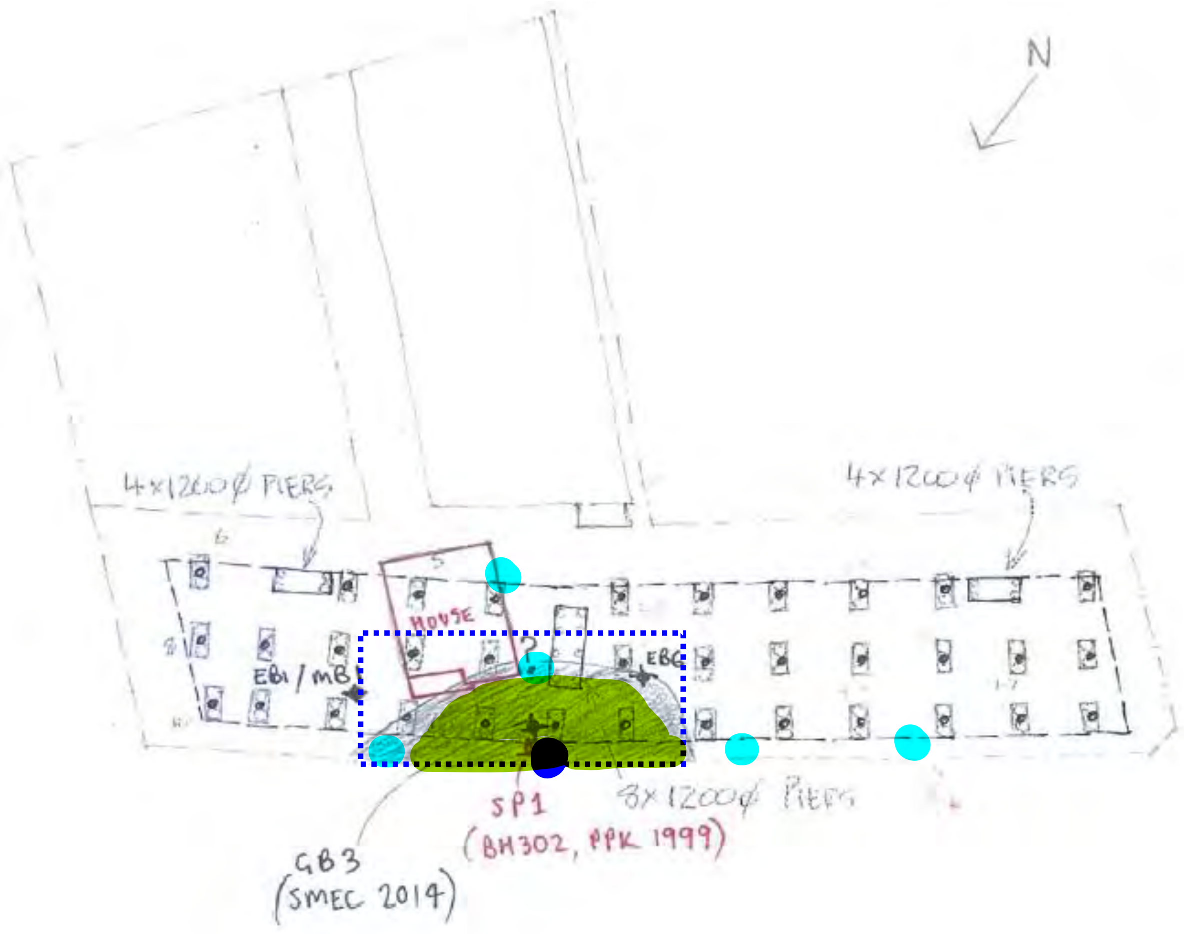
CREATED BY LR11993

SOURCES Vector backdrop data © MDS 2014

SMEC

Celebrating 40 years 1973 - 2013

Attachment C - Hydrocarbon imapcted soils



PRELIMINARY FOUNDATION DESIGN

PIERS – 2× 1200 ∅ + 2m SOCKET
INTO SANDSTONE.

PIER CAP – 3000×1500×600 Dp.

AVERAGE PILE DEPTH = 3.5m+2m.
= 5.5m

* ALLOW TO SLEEVE ALL PILES
AVERAGE LENGTH = 5.0m

⌖ STANDPIPE INSTALLED BY PPK (1999)

✦ SOIL BOREHOLE INSTALLED BY SMEC (2014)

▨ APPROX EXTENT OF SOIL/SEEPAGE CONTAMINATION

REMAINING HYDROCARBON IMPACT IN WEATHERED SANDSTONE LAYER BELOW IMPORTED FILL APPROX 2.0m bgl.

⬚ 529m2 area remediated by excavation of impacted soils, offsite disposal, validation sampling and re-instatement as summarised by Auditor in Environ SAR (2013). Minor "pockets" of hydrocarbon impacted soils remain below 2.0m.

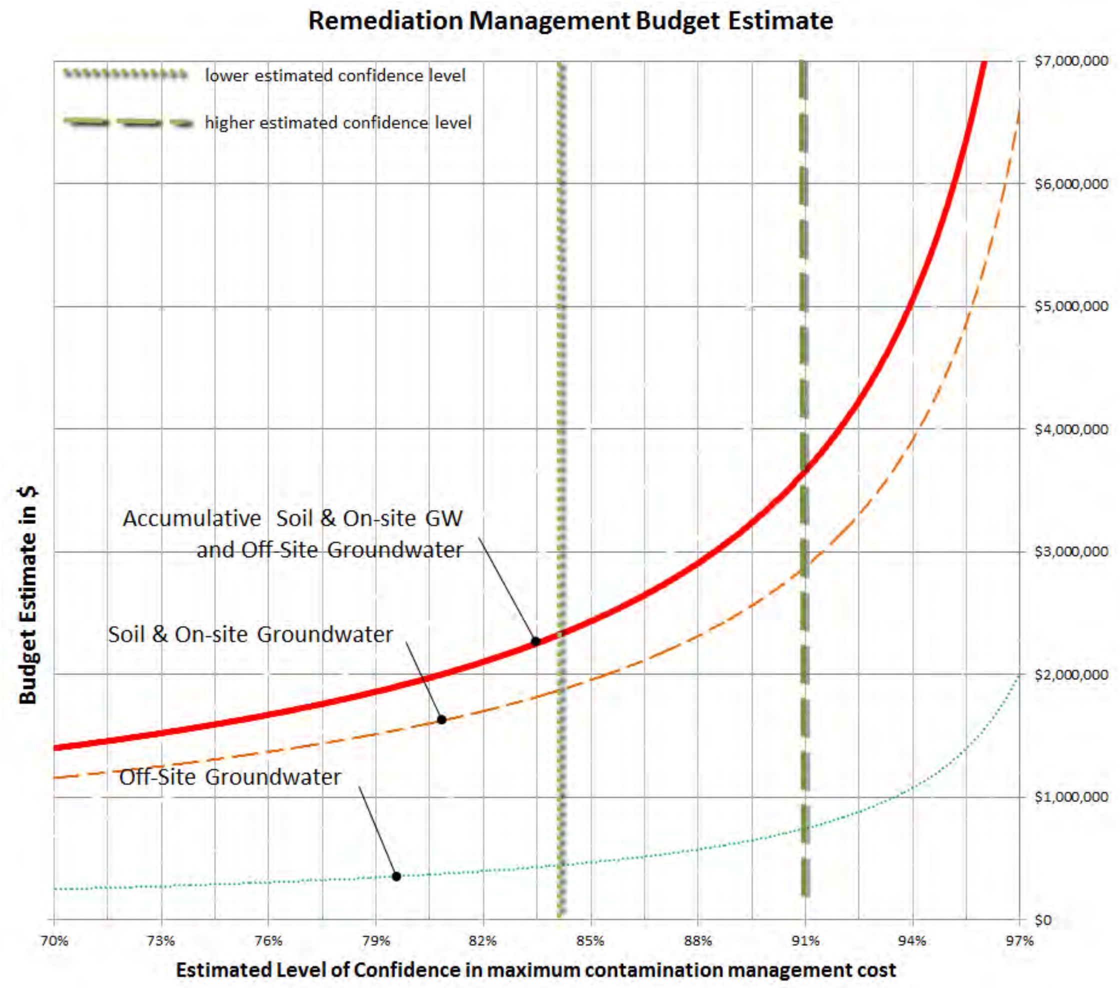
● SMEC 2014 Soil gas vapour points at 1.0m bgl. Non-detect results confirm lateral extent of remaining "pocket"

● HOTSPOT confirmed by SMEC 2014 - Hydrocarbon impacted soil and seepage water and elevated VOCs in passive gas samplers

🟩 Likely extent of hydrocarbon impacted soil at approximately 2.0m bgl, underlying imported backfill (clean) confirmed by SMEC 2014 investigations.

SOUTHERN COMMUNITY HEALTH CARE
121211 TTW
JUNE 2014 SK01

Attachment D



1. This graph indicates the estimated level of confidence that contamination remediation costs will not exceed a maximum cost.
Eg.: The level of confidence that all remediation costs do not exceed $1.7M is 75%, and the level of confidence that all remediation costs do not exceed $2.9M is 88%.
The graph indicates that the most likely maximum cost will be within the range of $2.3M and $3.8M and the cost plan includes this allowance range.

2. The estimate considers contamination remediation for "on-site" soil & groundwater and separately for "off-site" groundwater based on completed site investigations and analysis.

3. **Soil & "On-site" Groundwater** includes requirements for "on-site" soils [eg. excavation, disposal, retaining walls, risk assessments, designs, importation of soils, vapour barrier, etc.] and for "on-site" groundwater [eg. water quality monitoring, water treatment during construction, monitoring, etc.]

4. **"Off-site" Groundwater** includes potential management requirements for potential groundwater impacts outside the site boundaries [eg. monitoring, risk assessment, barriers, enhanced natural degradation].

5. The estimate is based on the level of knowledge regarding current and potential contamination, lower and upper cost estimates for various scenarios, and professional judgment regarding the likelihood of events occurring.

6. This budget/risk/confidence graph has been prepared in conjunction with R.L.B. and is a function of completed site investigations.

Targeted Environmental Site Assessment

612–624 Pittwater Road, Brookvale NSW

For: Health Infrastructure

AUGUST 2014

Project Name:	Targeted Environmental Site Assessment at 612–624 Pittwater Road, Brookvale, NSW
Project Number:	30011256
Report for:	Health Infrastructure

PREPARATION, REVIEW AND AUTHORISATION

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
0	13/06/14	Steven Shaw and Penelope Ford	Peter Horn	Chris Masters
01	30/06/14	Penelope Ford	Daniel Saunders	Chris Masters
02	12/08/14	Daniel Saunders	Penenlope Ford	Chris Masters

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EXECUTIVE SUMMARY

- Johnstaff Projects on behalf of Health Infrastructure (HI) engaged SMEC Australia Pty Ltd (SMEC) to conduct a Geotechnical and Contamination Targeted Environmental Site Assessment (TESA) at 612, 620 and 624 Pittwater Road, Brookvale NSW 2100 (the site).
- The TESA was required prior to HI entering a sale agreement with the owner of the site (Knarf Holdings Pty Ltd).
- The site comprises three properties with a total area of approximately 5,400 m^2 and includes a former service station site (vacant), former residence (vacant) and commercial retail outlet (currently operational). This TESA report presents the findings of the investigation conducted at the site by SMEC on 5–7 June 2014.
- The aim of the TESA was to assess geotechnical and contamination status of the subsurface associated with previous and current land use operations and past site remediation activities.
- This report presents the details of the desktop analysis of available environmental survey, field investigations, laboratory analysis results and provides interpretive comments for five geotechnical borehole locations drilled to top of rock profile (1.7–9.7 metres below ground level (mbgl)), seven environmental bore locations drilled to an approximate depth of 3-4 mbgl, one groundwater well location (installed to 7 mbgl) and two groundwater locations from existing/historic standpipe bores.
- Sampling and analysis results were compared against relevant the National Environment Protection Measures (NEPM) - Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater. The NEPM was first published in 1999, and updated in 2013 by the National Environment Protection Council (NEPC) and provides national standards for a variety of environmental issues, including the assessment of site contamination. The NEPM has been considered, in the context of the future use of the site as a community health facility and has adopted the commercial/industrial land use criteria for assessment.

Findings

- Previous remediation and validation works undertaken at the former service station site located at 612 Pittwater Road (612) summarised by PB (2003) indicated that residual total petroleum hydrocarbons (TPH) contamination was present in soil and groundwater in a band of soil between 2–3 m in the seepage zone at 620 Pittwater Road (620).
- A Site Audit Statement (SAS) for 612 was issued by David Lam from IT Environmental (2003) pertaining to site suitability for commercial/ industrial landuse, subject to a list of conditions to be implemented during site development. Conditions such as:

o Groundwater should not be used on site without assessment for the particular use.

  - Ideally the site should be built from ground level up, to avoid causing a basement level below periodic seepage level because any pumping in such conditions could cause any nearby contaminants to flow back towards the site.
  - If a car park is built below ground level such that seepage water could (without dewatering) enter the building basement, there should be a dewatering system designed such that seepage water in any weather conditions is prevented from entering the basement or any service lines. If contaminated, such water may require treatment prior to disposal.
  - In either of the above uses, it would be considered prudent to incorporate a combination of a membrane or vapour proof geofabric below the lower building slab and a passive venting system to allow any vapours/odorous air to escape slowly to atmosphere rather than potentially build up in a confined air space within the car park.
- Further remedial works were undertaken in the southwest corner of 620 and a SAS was issued by Environ (2013) post remediation/validation.
- PB (2003) reported in accordance with NEPM (1999), however this guidance document has since been updated and NEPM (2013) provides further guidance material in terms of risk associated with vapour intrusion and potential receptors.
- Current analytical soil results from recent environmental monitoring conducted by SMEC in June 2014 indicate:
  - Concentrations of TPH exceed the NEPM 2013 Health Screening Levels (HSLs) and Ecological Screening Levels (ESLs) for TPH fractions within soils sampled at one location (GB3) within the previously validated southwest corner of 620.
  - Concentrations of OCP, OPP, PCB and phenol concentrations were below laboratory limits of reporting (LOR) in all samples analysed.
  - Heavy metal and PAH concentrations were below the site assessment criteria (HILs and EILs) for all samples analysed.
  - Asbestos Containing Material (ACM) was identified in the shed structure at the rear of 620, however asbestos was not detected in near surface fill/soil material tested at three target locations.
- Current groundwater monitoring event (GME) analytical results indicate:
  - Concentrations of TPH and BTEX were below the laboratory LOR in all three groundwater samples during the first GME, however TPH and BTEX were above the laboratory LOR in SP1 during the second GME.
  - Toluene was above Groundwater Investigation Levels (GILs) in seepage water monitoring bore SP1 located 1 m from the footpath at 620.
  - Heavy metal concentrations (copper and zinc) were above the adopted GILs for protection of aquatic ecosystems in all groundwater samples.
- The depth of fill across the site varies from 0 mbgl to approximately 1.5 mbgl. The nature of the fill varies from gravel road base fill, ash fill, and clayey sand ‘land-farmed’ backfill material.

- The Dangerous Goods licences search results for the commercial property at 624 Pittwater Road (624) indicate two positions that a tank may be located. A record exists for the proposed location of a tank on the northern side of the building and a second record exists for inspection of the known tank on the eastern side of the building.

Conclusions and Recommendations

- A consequence of the remediation works occurring over a 16 year period has resulted in a remediation process encountering a progression of environmental guidance from environmental regulators. Over this period, regulations for remediation of former service station sites have required more technical assessment methodologies and remediation values have been reduced and validation documentation have become more extensive. The increasing conservative nature of environmental regulation can be demonstrated in the lowering of the trigger values associated with TPH in soils over this period. This progression of trigger values for TPH would suggest that there is likely to be some backfilled soils present on the site that would now present as exceedances.
- The source of TPH impacted soil in 620 is likely to be from pockets of ‘minor residual hydrocarbon contamination’ as reported by Environ (2013).
- The main issues relating to management of risks associated with existing site conditions are:
  - Potential Acid Sulphate Soil (PASS) is present on site and may be engaged during construction subject to final design of the proposed building.
  - Safe removal of asbestos containing materials and any other hazardous building materials in built structures and fill layers currently on site.
  - Installation of a lower slab vapour proof liner to prevent vapour intrusion through the slab or slab joints for the entire building footprint.
  - Design of barrier wall (and passive venting system if risk assessment requires) subject to the findings of the soil vapour risk assessment to allow any seepage water or odorous air to escape.
  - Implementing a Construction Environmental Management Plan (CEMP) that addresses requirements of the Remedial Action Plan (RAP) to manage contaminated soil / stockpile movement and tracking, use of capping material, road base fill and potential re-use of material sourced from the site.
- Given the presence of at least one underground storage tank (UST) and history of automotive workshop activities at 624, there is a potential for other currently unassessed environmental issues relating to automotive workshop activities. Environmental issues may include but not be limited to potential contaminating landuse activities associated with waste oil tanks, backfilled hoist pits, mechanical service bays, solvent benches associated with cleaning automotive parts and spray painting etc.
- While limited targeted investigation locations at 624 did not indicate gross contamination, a Detailed Site Investigation (DSI) for the combined sites is recommended prior to new works commencing.

- SMEC consider it prudent to conduct a vapour intrusion risk assessment to form part of the DSI.
- A site specific remediation action plan (RAP) will be required to address known contamination constraints to incorporate the proposed building design.
- A Site Validation Report (SVR) will establish that the RAP objectives have been achieved.
- A site specific Construction Environmental Management Plan (CEMP) detailing issues such as Unexpected Find Protocols (UFP) should be implemented during demolition and site development.
- An Operational Environmental Management Plan (OEMP) will be required for the post construction phase to demonstrate that suitable vapour protection has been achieved in the built environment and when the building is occupied.
- Potential Acid Sulfate Soil (PASS) present along the northern boundary of the site as identified in soil bores GB1 and GB2 require an Acid Sulfate Soil Management Plan (ASSMP) as part of the CEMP to provide oversight to civil works in dealing with ASS if and when it is engaged.
- Elevated TPH concentrations in the previously remediated 529m^2 area of 620 warrant a desktop review of previous vapour intrusion reports and further assessment to define the extent of potential vapour intrusion.
- The potential for vapour intrusion from shallow soils located in the southwest corner of 620 should be considered in light of future development plans and potential human receptors.
- Given TPH in GB3 exceeded ecological screening levels, in accordance with NEPM 2013 ecological receptors need to be considered for all land uses including commercial development sites. If ecological receptors are present, these may be the drivers for remediation and/or management plan implementation.
- The SSAR has identified concern with the potential of the seepage water containing some risk of environmental harm and it has identified that aesthetic impacts (principally visual and odour) are likely during construction. The SSAR does not provide information that Mobil or the former Land Owner have been in negotiation with EPA NSW to develop a resolution for offsite impacts relating to groundwater
- In addition to other relevant matters, the CEMP should address placement of the vapour proof concrete liner, barrier walls and venting systems (if risk assessment requires) to prevent soil vapour intrusion into the building. Trees and shrubs should be grown in planter boxes filled with clean imported soil to prevent the root zone penetrating potential pockets of hydrocarbon impacted soils.
- Conduct a hazardous material survey for all on site buildings, and review any existing asbestos registers prior to demolition works, with all ACM earmarked for removal to be documented in an asbestos removal control plan prepared by a licensed Class A or B removalist.

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ABBREVIATIONS

ANZECC	Australian and New Zealand Environment Conservation Council
B(a)P	Benzo(a)Pyrene
BGL	Below Ground Level
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CoC	Chain of Custody
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
GPR	Ground Penetrating Radar
HIL	Health-based Investigation Level
kg	kilogram
mbgl	metres below ground level
mg	milligrams
nd	Non-detect
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
PBILs	Phytotoxicity Based Investigation levels
PAH	Polycyclic Aromatic Hydrocarbons
PSH	Phase Separated Hydrocarbons
PQL	Practical Quantitation limits
PID	Photo Ionisation Detector
ppm	parts per million
PQL	Practical Quantitation Limits
QA/QC	Quality Assurance, Quality Control
RPD	Relative Percentage Difference
SAR	Site Audit Report
SMEC	Snowy Mountains Engineering Corporation
TESA	Targeted Environmental Site Assessment
TPH	Total Petroleum Hydrocarbons
UPSS	Underground Petroleum Storage System
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

1 INTRODUCTION

1.1 Background

SMEC Australia Pty Ltd (SMEC) was engaged by Health Infrastructure (HI) via Johnstaff Projects to conduct a Geotechnical and Contamination Targeted Environmental Site Assessment (TESA) at 612-624 Pittwater Road, Brookvale, NSW 2100 (the site).

Part of the site (612 Pittwater Road) historically operated as a Mobil Service Station until 1997. The service station site was subsequently decommissioned and demolished between 6–27 April 1998 and all infrastructure removed (PB 2003). The site was found to be impacted by hydrocarbon contamination (soil and perched groundwater) and remediation and validation works were conducted. Hydrocarbon impacted soils (approximately 1,105 m^3) were land-farmed on site and reused to backfill the tankpit excavations (PB 2003).

A Site Audit Statement (SAS) of 612 was issued by IT Environmental (2003) to achieve site validation for commercial/ industrial landuse, subject to a list of conditions to be implemented during site development.

During validation works it was found that hydrocarbon contamination had migrated north-west into the neighbouring residential property (620 Pittwater Road). Following further assessment, remediation works were conducted within the north-western section of 620 in October and November 2009 to achieve site validation. Remedial activities included excavation and offsite disposal of hydrocarbon impacted soils. A Site Audit Report (SAR) and SAS was issued by Environ (November 2013) for the 529.1 m^2 remediated north-western section of the site impacted by the former neighbouring Mobil site (approximately one third of the total area 620).

No previous environmental investigations appear to have been conducted at 624 Pittwater Road (624).

SMEC understands that HI currently has a purchase option on the site and that this report will form part to the due diligence process associated with that purchase option.

1.2 Project Objectives

The objectives of the TESA are to:

- Assist HI in identifying and managing risks associated with the site regarding the potential for contamination
- Assess existing documentation relating to past and present land-use and develop a sampling and analysis plan (SAP) to facilitate a targeted investigation of those portions of the site that may be contaminated
- Determine the nature and extent of soil and groundwater contamination (if any) at the site
- Determine geotechnical properties of site soils and substrata

- Assess the human health and environmental risks associated with any identified contamination by comparing contaminant concentrations to their NEPM (2013) and ANZECC/ARMCANZ(2000) assessment guidelines and established site assessment criteria
- Prepare a TESA Draft Report to submit for the client's revision
- Prepare a TESA Final Report.

1.3 Scope of Works

The scope of work for this TESA included the following:

- A review of relevant information from previous reports provided to SMEC
- Preparation of health & safety and quality plans for works undertaken
- Service location, comprising review of Dial-Before-You-Dig plans and the use of ground penetrating radar (GPR) with a qualified service locater
- Installation of one contamination monitoring well
- Assessing the presence of PSH using an interface probe (IP), at one newly installed and two existing well locations
- Documentation of groundwater levels and general conditions observed at a total of three monitoring well locations
- Collection of soil and groundwater samples (including QA/QC samples)
- Implementation of decontamination procedures in accordance with best industry practice
- Chemical testing of soil and groundwater samples collected for TPH, BTEX, PAH, OCP, OPP, PCB, phenols, metals (8) and asbestos
- Provide a geotechnical assessment of the surface soil and substrata
- Prepare a Draft TESA report documenting the works undertaken and the results and observations of the soil and groundwater sampling and analysis
- Prepare a Final Report.

1.4 Published Guidelines And Framework

This report has been prepared with reference to the following publications:

- DECC NSW Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Tanks) (2008)
- DECC NSW Contaminated Sites Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997 (2009)
- DECC NSW Contaminated Sites Guidelines for the NSW Site Auditor Scheme [2nd edition] (2006)
- DECC NSW Guidelines for the Assessment and Management of Groundwater Contamination (2006)

- NEPC National Environment Protection Council (Assessment of Site Contamination) Measure, Schedule B(1) Guidelines on Investigation Levels for Soil and Groundwater (1999) (Updated 2013)
- ANZECC/ARMCANZ Australian and New Zealand Guidelines for Marine Water Quality, 95% Trigger Values (2000).

1.5 Limitations

This report has been prepared for HI. The purpose of the report is to provide additional information in relation to the hydrocarbon contamination previously identified at the sites located at 612-624 Pittwater Road, Brookvale, NSW, 2100.

This report does not provide a complete assessment of the contamination status of the site. The report is limited to the scope defined in **Section 1.3**.

In conducting this assessment, reliance has been placed on data and information provided by HI and other consultants, including the decommissioning, remediation and validation of the former service station site and adjacent residential block.

This document has been prepared in good faith and no responsibility can be accepted for inaccuracies contained in the information provided by HI or other consultants. The findings of this report are based on the data collected during the stated investigation period. SMEC performed the fieldwork in a manner consistent with the normal level of care and expertise exercised by members of the contaminated land management profession.

The findings of the report are based on the concentrations observed in the sampled groundwater at the time of the assessment. These conditions may change with time and space.

No warranty, expressed or implied, is made as to the information and professional advice included in this report. The report shall only be used for the purposes as stated in **Section 1.2** and shall not be relied upon by any party other than the client for the project. Anyone using this document does so at their own risk and should satisfy themselves concerning the applicability of its application and where necessary should seek expert advice in relation to the particular situation.

The client acknowledges that this report is for the exclusive use of the client.

2 SITE INFORMATION

2.1 Site Location

The location of the site within a regional context is presented in **Figure 1** in **Appendix A.**

2.2 Site Description and Land Zoning

The site is located at 612-624 Pittwater Road, Brookvale, NSW, 2100 and comprises three properties with a total area of approximately 5,400m^2.

The site is located in the Warringah Local Government Area and is presently zoned *B5 Business Development* under the *Warringah Local Environmental Plan 2011*. **Table 1** summarises the legal descriptions and current ownership details of the site.

Table 1 Site legal description and ownership

Site	Legal description	Ownership
612 Pittwater Road [former service station (vacant)]	Lot A DP 375728 Lot B DP 375728 Lot C DP 375728	Knarf Holdings Pty Ltd
620 Pittwater Road [former residence (vacant)]	Lot 1 DP 500541	
624 Pittwater Road [commercial business (operational)]	Lot 3 DP 539384	

2.3 Surrounding Land Uses

The general surrounding land uses are as follows:

- North: commercial /light industrial
- East: commercial /light industrial
- South: William Street then low density residential
- West: Pittwater Road then Warringah Mall.

2.4 Surface Conditions

Site surface features and site conditions at the time of investigation are described as follows:

612 Pittwater Road	This parcel of land is presently unoccupied and has been cleared of structures. It appears to be used as a temporary storage area for construction and building materials. The site is bounded by temporary fencing along the southern and western frontages.

620 Pittwater Road	This parcel of land contains a vacant, dilapidated, unoccupied brick and tile residence. There are a number of smaller shed/carport structures at the rear of the property. There is extensive overgrown vegetation across the site. The site is bounded by temporary fencing along the western frontage (continuing from the adjacent property at 612 Pittwater Road).
624 Pittwater Road	This parcel of land is occupied by two commercial enterprises: • Barbecues Galore (624/1 Pittwater Road, front of property) • Fire door manufacturer (624/2 Pittwater Road, rear of property) The northern part of the site (parking area for Barbecues Galore customers) adjoins the access road to the commercial premises (Pet-O) at 626 Pittwater Road (at the rear of 624 Pittwater Road). There is no dividing barrier between these two properties.

Site features have been photographed and are presented in **Appendix H**.

2.5 Topography and Landforms

The general topography of the site and surrounding area slopes towards the north. The site is higher at the southern side near William Street. William Street itself rises to the east away from Pittwater Road.

2.6 Vegetation

The vegetation on site consists of small garden beds containing shrubs. Vegetation on and surrounding the site showed no obvious signs of distress.

2.7 Geology

Information on geology has been obtained through reference to the Sydney 1:100,000 Geological Map (DMR 1983). The site is located on Quaternary sediments. The mapping identifies the underlying lithology for the site as comprising ‘silty to peaty quartz sand, silt and clay; ferruginous and humic cementation in places; common shell layers’.

2.8 Soils

Information on soils has been sourced from *Soil Landscapes of the Sydney 1:100,100 sheet* (Chapman and Murphy 1989). Both sites are mapped as occurring on the soil landscape grouping ‘Disturbed Terrain’.

Table 2 summarises the information provided with regard to landscape, soil characteristics and potential limitations on development.

Table 2 Soil Landscape Series Sheet 9130 – Disturbed Terrain

Aspect	Description
Landscape	Level plain to hummocky terrain, extensively disturbed by human activity including complete disturbance, removal or burial of soil. Local relief <10 m, slopes <30%. Land fill includes soil, rock, building and waste materials. Original vegetation completely cleared, replaced with turf or grassland.
Soils	Turfed fill areas commonly capped with up to 40 cm of sandy loam or up to 60 cm of compacted clay over fill or waste materials.
Limitations	Dependant on nature of fill material. Mass movement hazard, unconsolidated low wet-strength materials, impermeable soil, poor drainage, localised very low fertility and toxic materials.

2.9 Hydrology and Hydrogeology

Surface water across the majority of the site is likely to flow to the north in accordance with the general topography of the site and general area. Up-gradient surface waters are likely to flow into the kerb and guttering on Williams Street and Pittwater Road.

Previous environmental studies contained within the Site Audit Report (Environ 2013) indicate a localised groundwater flow towards the north.

3 SITE HISTORY

3.1 Previous Reports

The following two environmental reports were provided to SMEC for review:

- Parsons Brinckerhoff, 11 March 2003, Summary of Site Conditions and Timing of Works, Former Mobil Service Station and Adjacent Property, Corner William Street and Pittwater Road, Brookvale.
- Environ Australia Pty Ltd, November 2013, Site Audit Report – 620 Pittwater Road, Brookvale NSW.

A timeline for previous environmental survey and reporting conducted since closure of the site as a service station in 1997 is located in Appendix I.

The following two Site Audit Statements (SAS) were provided to SMEC for review:

Site	**620 Pittwater Road, Brookvale NSW**
Date	18/11/2013
Site Audit Statement No.	GN 440
Auditor	Graeme Nyland
Company	ENVIRON Australia
Property Description	Part of Lot 1 DP 500541 (529.1m^2)
Prepared For	Mobil Oil Australia
Site Audit Report Title	Site Audit Report – 620 Pittwater Road, Brookvale NSW Report No. GN440 (ENVIRON Ref: AS121114) November 2013
Site	**612 Pittwater Road, Brookvale NSW**
Date	29/07/2003
Site Audit Statement No.	DL 001
Auditor	David Lam
Company	IT Environmental (Australia) Pty Ltd
Property Description	Lots A, B, C, DP 375728
Prepared For	Mobil Oil Australia
Site Audit Report Title	Summary Site Audit Report Former Mobil Service Station 612 Pittwater Road, Brookvale NSW 29 July 2003

Other environmental reports relating to works conducted at the site(s) (referenced in the Site Audit report) for review include:

- Limited Environmental Site Assessment – 620 Pittwater Road, Brookvale NSW, Site No. No0263 dated 8 December 1998 by Handex.
- Groundwater Monitoring Event August 2009 – 620 Pittwater Road, Brookvale NSW dated January 2010, Parsons Brinkerhoff.
- Post Phase 2 Environmental Site Assessment - 620 Pittwater Road, Brookvale NSW, dated August 2010, Parsons Brinkerhoff.
- Groundwater Monitoring Event March 2010 – 620 Pittwater Road, Brookvale NSW dated August 2010, Parsons Brinkerhoff.
- Soil Validation Report, 620 Pittwater Road, Brookvale NSW 2100, dated February 2011, Parsons Brinkerhoff.
- Soil Vapour Intrusion Assessment, 620 Pittwater Road, Brookvale NSW, dated February 2011, Parsons Brinkerhoff.
- Site Risk Management Plan, 620 Pittwater Road, Brookvale, NSW, dated March 2011, Parsons Brinkerhoff.
- Environmental Report, 620 Pittwater Road, Brookvale, NSW, dated March 2011, Parsons Brinkerhoff.
- Additional On site Human Health Risk Assessment Advice - 620 Pittwater Road, Brookvale, NSW, dated September 2011, Parsons Brinkerhoff.
- On site Human Health Risk Assessment Advice - 620 Pittwater Road, Brookvale, NSW, dated June 2012, Parsons Brinkerhoff.
- Environmental Report, 620 Pittwater Road, Brookvale, NSW, dated June 2012, Parsons Brinkerhoff.
- Letter Addendum to ‘On site Human Health Risk Assessment Report, June 2012’, dated 1 July 2013 by Parsons Brinkerhoff (2013).
- Limited Environmental Site Assessment for 620 Pittwater Road, Brookvale NSW (lot adjacent to former Mobil Service Station), 1999, PPK.
- Remedial Action Plan – Former Mobil Service Station and Adjoining Properties, Cnr Williams and Pittwater Roads, Brookvale, 2000, PPK
- Site Remediation and Validation Report, Former Service Station, Corner William Street and Pittwater Road, Brookvale, NSW (Site No. No0263), February 2000, PPK.

3.2 Summary of Previous Studies provided to SMEC

A timeline containing the sequence of environmental reporting from the closure of the site a service station is included in Appendix I.

3.2.1 Parsons Brinckerhoff, 11 March 2003, Summary of Site Conditions and Timing of Works, Former Mobil Service Station and Adjacent Property, Corner William Street and Pittwater Road, Brookvale.

A summary of PB's letter report is presented as follows:

- Site demolition works were conducted between 6–17 April 1998. All site features including buildings, slabs and fuel handling infrastructure were removed from the site.
- A total of eleven Underground Storage Tanks (UST) and one Above Ground Storage Tank (AST) and associated infrastructure were removed.
- At the completion of demolition works, as request by Mobil, no structures remained on site.
- The site was found to be impacted by hydrocarbon contamination (soil and perched groundwater) and remediation and validation works were conducted. Remediation works consisted of land-farming approximately 1,105 m^3 of hydrocarbon impacted soil on site and reusing that material to backfill the tankpit excavations on site.
- Validation works were conducted on the service station site in July–October 1998, October 2001 and November 2002.
- Validation works included, sampling tank pit excavations, sampling of land-farmed materials and validation of the site on an 8.5 m grid basis.
- Following validation works there remained a number of hydrocarbon soil sample exceedances along the northern boundary with 620 Pittwater Road and along the north-western portion of the excavation wall adjacent to Pittwater Road that couldn't be chased out due to the public footpath.
- Hydrocarbon impacted groundwater was considered to be restricted to a perched seepage zone overlying the weathered sandstone with a flow direction towards the north.
- PB considered that the contamination at 620 Pittwater road was limited to a band of soil between 2–3 m in the seepage zone within the north-western section of the property.
- PB recommended remedial works be conducted at 620 Pittwater Road to address the hydrocarbon impacted soil and perched groundwater.

PB concluded that:

- the former service station site required no further remedial activity
- remediation works were required at 620 Pittwater Road
- remediation works of contamination identified along the north-western boundary were not considered viable due to the proximity of Pittwater Road and major underground service corridors.

3.2.2 Environ Australia Pty Ltd, November 2013, Site Audit Report – 620 Pittwater Road, Brookvale NSW

Environ was commissioned to provide a Site Audit Report (SAR) for remedial works conducted at 620 Pittwater Road. The SAR relates to the 529.1 m^2 western third of the property only, ie the area where hydrocarbon contamination had previously been identified.

The Auditor concluded that based on the information provided that 'hydrocarbon contamination from the adjoining former service station has been remediated to the extent practicable and that the site has been remediated to a standard suitable for commercial/industrial land use with respect to petroleum hydrocarbons'.

The Auditor identified that 'some minor residual contamination remains on site and odours and/or staining may be encountered during excavations at the site'.

3.2.3 IT Environmental, July 2003, Site Audit Statement– 612 Pittwater Road, Brookvale NSW

The SAS written by David Lam concluded the site was suitable for continued commercial / industrial landuse, subject to the following conditions:

- Groundwater should not be used on site without assessment for the particular use.
- It is understood that the proposed development will include a car park at the lower level. Ideally the park should be built from ground level up, to avoid causing a basement level below periodic seepage level because any pumping in such conditions could cause any nearby contaminants to flow back towards the site. This condition could be avoided if all nearby seepage water impact could be shown to have attenuated and detailed risk assessment could show residual levels in groundwater on and near the site to not represent an unacceptable risk. This however may be practically impossible as wells in Pittwater Road are as the Auditor understands it unable to be permitted.
- If a car park is built below ground level such that seepage water could (without dewatering) enter the building basement, there should be a dewatering system designed such that seepage water in any weather conditions is prevented from entering the basement or any service lines. This would require a pumping system which a competent professional would need to design. Any water that was disposed from such a pumping system would need to be checked for compliance to be disposed to stormwater or sewer and appropriate approval obtained before any such operation was undertaken. If contaminated, such water may require treatment prior to disposal.
- In either of the above uses, it would be considered prudent to incorporate a combination of a membrane or vapour proof geofabric below the lower building slab and a passive venting system to allow any vapours/odorous air to escape slowly to atmosphere rather than potentially build up in a confined air space within the car park. This system should be designed by a competent professional and would conservatively extend over the northern part of the site above former seepage water impact and grass likely to contain backfilled odorous soils.

3.3 Dangerous Goods

Workcover NSW was contacted on 11th June 2014 to perform a search of licences to keep dangerous goods at the site. A record exists for the known tank onsite and a second record exists for a proposed tank at a location now covered with new carpark pavement. Therefore it is unknown if the proposed second tank was ever installed.

Copies of the communication received from Workcover NSW are provided in **Appendix G**.

3.4 Site Inspection

Following the review of existing data, a site inspection was undertaken on 5 June 2014 by a SMEC Environmental Scientist prior to intrusive investigation activities. The purpose of the site inspection was to ensure areas of potential environmental concern were identified and to field check the desktop information.

3.4.1 Purpose

The purpose of the site reconnaissance was to gather non-intrusive data to increase the confidence in the conceptual understanding of the spatial extent of historic activities and disturbed areas across the site.

3.4.2 Methodology

The site inspection was undertaken to identify the following:

- Disturbed ground possibly in the form of trenches or rectangular shapes
- Waste disposal, including domestic rubbish and building rubble, including asbestos (fragments and sheets)
- Stained or odorous soils
- Unnatural changes in vegetation (including evidence of cleared ground or vegetation potentially impacted by contamination)
- Scan the nominated testing areas using a Ground Penetrating Radar (GPR) the location of site structures, including evidence of potential underground structures
- Potential human and environmental receptors that could be exposed to contaminants
- Historical groundwater monitoring well locations at the site.

3.4.3 Site Observations

Notable site observations are presented in Table 3 The associated site photographs are provided in **Appendix H**.

Table 3 Field observations

Site	Observations
612 Pittwater Road	One standpipe was found to be suitable for testing groundwater
620 Pittwater Road	One standpipe was found to be suitable for testing groundwater. One vapour monitoring point was found installed in the 529.1m^2 area previously remediated. The dilapidated shed at the rear of the residential building comprised ‘fibro’ asbestos containing material (ACM). Abandoned vehicle (truck) located at rear of property.
624 Pittwater Road	One disused UST and associated vent pipe was located at the rear of the commercial building. A scan of the area with the GPR indicated that the tank was likely abandoned in situ and backfilled with gravelly sand.

4 POTENTIAL SOURCES AND CONTAMINANTS OF CONCERN

4.1 Potential Sources of Contamination

On the basis of historical records, previous reports conducted at the site and a site inspection, the most likely potential sources of contamination within the site include:

- Previously removed UST infrastructure from the former service station site (bowsers, USTs and associated infrastructure)
- Present (abandoned) UST and associated infrastructure located at the rear of the commercial building in 624 Pittwater Road.
- Potential use of fill across the site
- Building materials.

4.2 Potential Contaminants of Concern

Based on the desktop review and site inspection, potential chemicals of concern included:

- Metals (8) - arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn)
- Total Petroleum Hydrocarbons (TPH)
- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Asbestos.

4.3 Potential Receptors of Concern

Based on the information available, the potential receptors included:

- Transient users of the site
- Future users of the site
- Construction workers involved in the event of site redevelopment
- Flora and fauna in areas surrounding the site
- Aquatic ecosystems of Greendale Creek, Curl Curl Lagoon, located approximately 800m east of the site.

4.4 Persistence in the Environment

The potential contaminants of concern identified which have a relatively high degree of persistence in the environment are:

- Asbestos
- Lead
- Some PAHs

- Longer chain hydrocarbons (ie >C_{29}).

5 ASSESSMENT CRITERIA

5.1 Investigation Levels

Assessment criteria for the soil groundwater analytical results are discussed below. Evaluation against assessment criteria is used to identify levels of contamination that may pose ecological or health risks to future users or potential receptors of the site.

It is noted that a new, amended National Environment Protection (Assessment of Site Contamination) Measure (NEPM) has been approved by all Australian States. The NEPM was first published in 1999, and updated in 2013 by the National Environment Protection Council (NEPC) and provides national standards for a variety of environmental issues, including the assessment of site contamination in:

- Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater.

In terms of Groundwater Investigation Levels (GIL), the 2013 version of the NEPM references:

- Australian and New Zealand Guidelines for Fresh and Marine Waters, Australian and New Zealand Environment and Conservation Council /Agricultural and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ 2000).

5.2 Health Screening Levels for Organic and Inorganic Chemicals

In accordance with NEPM 2013, to determine whether the health-based screening levels (HSL) are applicable or whether a site specific determination was required the application checklist was considered.

HSL have been derived for petroleum hydrocarbons for different land uses, media, soil types and depths to contamination. The approach in the development of HSL has sought to set a combination of assumptions and parameters that correspond to the reasonable exposure that can be expected for the range of scenarios. If the subject site does not fall within the range of assumed conditions the HSL may not be protective and a more detailed consideration of the site specific situation should be carried out.

5.2.1 Soil

In view of the proposed land use as a commercial building, the adopted assessment criteria for assessing the soil contaminants have been sourced from:

- NEPM (2013) Soil HSLs for vapour intrusion for commercial /industrial (HSL D)
- NEPM (2013) Health Investigation Levels (HILs) for selected organic and inorganic chemicals for Commercial /Industrial (HIL D) sites
- NEPM (2013) Management Limits for TPH analytical results
- For analytes in which there are no listed criteria, the laboratory PQL will be taken as the trigger level, above which further assessment will be required.

5.2.2 Groundwater

HSL are not provided for groundwater less than 2 m below ground level, and so a site specific risk assessment should be considered. However, it is considered unnecessary to calculate site specific HSL for groundwater for the following reasons:

- The groundwater HSL for vapour intrusion for BTEX and TPH C_6-C_{10} and >C_{10}-C_{16} for commercial industrial (ie Table 1A(4)) are all ‘not limited’ (NL, ie cannot exist in concentrations high enough to cause unacceptable risk to health, for scenarios where groundwater is at a depth of 2 mbgl or greater apart from benzene and TPH C_6-C_{10} where the lowest HSLs are 5,000 µg/L (benzene) and 6,000 µg/L (C_6-C_{10})
- All of the chemical analytical results are below the laboratory estimated quantitation limit (EQL) for the HSL chemicals
- All of the hydrocarbon analytical results are below the EQL
- The primary sources of petroleum hydrocarbons (such as former USTs) in the vicinity of MB1, SP1 and SP2 have all been removed /remediated.

As there is no primary source and the analytical results are all reported as being below the EQL it is not considered that hydrocarbons could give rise to an unacceptable risk for the ongoing commercial industrial land use scenario. Other criteria have been determined for the assessment of groundwater as discussed in Section 5.7.

5.3 Ecological Screening Levels for Metals and Other Contaminants

5.3.1 EILs

- Analytical results will also be compared with the NEPM (2013) provisional phytotoxicity-based Ecological Investigation Levels (EILs) to determine potential risks to current and future ecological receptors at the site for select analytes (As, DDT, Pb, Napthalene, Cr, Cu, Ni, Zn).
- For other analytes potentially phytotoxic to plants, the NEPM 1999 provisional phytotoxicity based investigation levels (PBILs) have been referenced.
- The NEPM (2013) EIL values rely on site specific inputs and calculations, whereas the NEPM (1999) PBILs are indicative concentrations aimed at protecting plant health, and were derived specifically for sandy loam soils or soils of a closely similar texture with a pH in the range of 6 to 8. They are intended for assessment screening purpose only.
- Having consideration for site specific EIL calculation and known historical factors, soils present on site are considered ‘Aged’, ie >2yrs in current landform.

5.3.2 ESLs

- Ecological Screening Levels (ESLs) are relevant in terms of petroleum impacted soils where ecological receptors are present. The ESLs presented in Table 1B(6) of the NEPM (2013) are compared against various land uses for fine or coarse soil textures.

- For the purpose of this investigation TPH fractions will be compared to fine soil texture for commercial and industrial land use.

5.4 Guidelines for Protection of Aquatic Ecosystems

- Site specific considerations for selecting groundwater investigation levels for protection of aquatic ecosystems should be considered in terms of:

o Drinking Water (Australian Drinking Water Guidelines (NHMRC & NRMMC, 2004)

o Aquatic ecosystems (ANZECC & ARMCANZ, 2000).

- The nearest water body is Greendale Creek, Curl Curl Lagoon, located approximately 800 m east of the site.
- The trigger values applicable to the protection of aquatic ecosystems are the ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) for toxicants in freshwater for the protection of 95% of species.

5.5 Potential Groundwater Receptors

The receptors that could potentially be exposed to contaminated groundwater include:

- Persons using groundwater as drinking water - through the extraction of groundwater from offsite bores for human and/or livestock drinking water purposes. Note the area surrounding the site is commercial
- Persons using groundwater for irrigation purposes - through the extraction of groundwater from offsite bores
- Aquatic ecosystems in freshwater surface water bodies.

5.6 Adopted Soil Assessment Criteria

The adopted soil assessment criteria for the site are shown in **Table C1** of **Appendix C**, and are summarised as follows:

- NEPM (2013) HILs for organic and inorganic chemicals
- NEPM (2013) ESLs, HSLs and MLs for TPH
- NEPM EILs (2013) /PBILs (1999) for phytotoxicity.

5.7 Adopted Groundwater Investigation Levels

The adopted groundwater investigation levels (GILs) for the site are shown in **Table C2** of **Appendix C** and are summarised as follows:

- Laboratory EQLs as screening levels for hydrocarbons
- NEPM (2013) groundwater investigation levels for Freshwaters, sourced from ANZECC (2000) for typical slightly to moderately disturbed aquatic ecosystems (protection of 95% freshwater species) for lead, benzene, naphthalene and xylene
- ANZECC (2000) low reliability trigger value sourced from Table 8.3.14 (ANZECC 2000) for toluene and ethylbenzene.

6 SITE INVESTIGATION AND METHODOLOGY

6.1 Background

The principal question of the investigation is to assess the risks posed by potential contamination for the proposed land use of the site as a community health centre.

SMEC has undertaken the works in accordance with the following plan:

- The Job Safety and Environmental Analysis (JSEA) Plan to manage the potential risks to human health and safety associated with the fieldwork.

All fieldwork was undertaken by suitably qualified, trained and experienced personnel.

6.2 Sampling Design Requirements

The sampling design for the site was made to target specific areas of environmental concern on the basis of the existing information regarding the site layout and the location of former fuel storage tanks.

SMEC undertook drilling and sampling at 12 borehole locations to depths ranging between 0.5 m and 9.7 mbgl across the site. One monitoring bore was installed on 624 Pittwater Road, adjacent to the boundary of 620 Pittwater Road. The locations of the borehole and two existing monitoring standpipes are presented in **Figure 2** in **Appendix A.**

6.3 Sampling and Analysis Plan (SAP)

The SAP for site sampling and field activities is detailed in

Table 4**.**

Table 4 Sampling and Analysis Plan

Borehole ID	Type	Media	Number of Samples	Laboratory Analysis (selected samples)
GB1-GB5	Geotech/ Environmental	Soil	5	Total Petroleum Hydrocarbons (TPH), Benzene/Toluene/Ethylbenzene/Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs), Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) (M8)
EB1-EB7	Environmental	Soil	7	TPH, BTEX, PAHs, M8, organochlorine (OCP) and organophosphate (OPP) pesticides, Phenolics, Asbestos
QA/QC	Water Trip	Spike/ Blank	2	TPH C_6-C_9 and BTEX
	Duplicates	Soil	1	TPH, BTEX, PAHs, M8, Asbestos
		Groundwater	2	TPH, BTEX, M8.
First Round GME (7 June 2014)				
MB1	Newly installed	Groundwater	1	TPH, BTEX, M8.
SP1 & SP2	Existing (previous name unknown)	Groundwater	2	TPH, BTEX, M8.
Second Round GME (17 June 2014)				
MB1	New	Groundwater	1	TPH, BTEX
SP1	Existing	Groundwater	1	TPH, BTEX

6.4 Borehole Sampling Program

The drilling program was conducted between 5th and 7th June 2014. Bore locations were first screened using GPR to identify the presence of underground service(s). Borehole drilling was conducted using a push tube drilling rig mounted on a Geoprobe 7822DT provided by EPOCA Environmental. Borehole EB1 was extended to 7 m and converted to monitoring well MB1.

A SMEC Senior Environmental Scientist was present to supervise the drilling process and to log each bore in general accordance with the Unified Soil Classification System. SMEC undertook soil sampling within the site as described in **Table 3.**The borehole logs are presented in **Appendix B**.

6.5 Methods of Soil Sampling

Soil samples were collected from dedicated push tubes using new disposable nitrile gloves for each sample. The soil was transferred to the sample jar using a stainless steel hand auger or trowel, which was decontaminated with a phosphate free detergent between each sample location. A hand held photo ionisation detector (PID) was used to assess the potential for volatile organic compounds (VOCs) within soil samples. The calibration certificate for field equipment used is presented in **Appendix D**.

6.6 Groundwater Well Installation and Sampling

One groundwater monitoring well (MB1) was installed by EPOCA Environmental in borehole EB1.

A truck mounted drill rig was used to install the well to a depth of 7 mbgl.

- The new well was made of class 18 uPVC 50 mm, machine slotted screen and casing. A gattic flush cover was placed to protect the well.
- During the installation of the monitoring well, soil samples were collected from nominal depths according to the soil characteristics encountered during the drilling operations. The borehole was logged in general accordance with the Unified Soil Classification System.

At the completion of well installation, groundwater was purged (up to 3 well volumes) using a dedicated bailer. Purging allows soil residuals and drilling mud introduced into the well during drilling and well construction to be removed and also ensures that the well represents true surrounding aquifer conditions.

Groundwater levels and the potential presence of phase-separated hydrocarbons (PSH) were measured in the newly installed well using an interface probe. The potential presence of contamination was then further assessed using visual and olfactory techniques.

During two groundwater monitoring events (GME) dedicated disposable bailers were used to collect groundwater samples from the newly installed monitoring well at 624 Pittwater Road and two existing standpipes located at 612 Pittwater Road following level measuring and purging. The groundwater well locations assessed for this investigation are presented in **Figure 2, Appendix A.**

7 SITE ASSESSMENT

7.1 Field Observations – Soils

The site was generally underlain by fill up to approximately 1.5 m, then clayey sand and sandy clay to 3-4 m. Underlying firm sandstone bedrock was encountered at depths ranging between 0.5–4.6 mbgl across the site. The nature of the fill varied across the site and included gravel road base fill, ash fill, and clayey sand 'land-farm' backfill material.

During borehole drilling and sampling, the soil lithology was noted, along with any evidence of soil contamination such as soil discolouration and/or soil odour. A hand held photo ionisation detector (PID) was used to assess the potential for volatile organic compounds (VOCs) within soil samples. Calibration certificates for the PID are presented in **Appendix D**.

Table 5 presents typical conditions encountered in each borehole drilled on the site. Detailed geological conditions, borehole termination depths, sampling point depths, well construction and PID readings can be observed in borehole logs presented within **Appendix B**. Location of boreholes and groundwater monitoring wells across the site are presented in **Figure 2**, **Appendix A**.

Table 5 General geological conditions encountered in environmental boreholes

Borehole ID	Depth of Fill (mbgl)	Material	Highest PID (ppm)	Comments
Geotech boreholes GB1 to GB5, (labelled BH1 to BH5 in Appendix F)	Various - refer Appendix F		GB3 = 300 to 900 range (entire length of fill profile).	Strong odours detected entire length of profile. Refer Appendix F for logs.
EB1/MB1	0.4	Fill (dark grey sand) Residual (clayey sand)	0	No odours detected. Borehole terminated at 7m.
EB2	0.6	Fill (ash and slag) Residual (clayey sand)	0	No odours detected. Borehole terminated at 3m target depth reached.
EB3	0.6	Fill (ash and slag) Residual (clayey sand)	0	No odours detected. Borehole terminated at 3m target depth reached
EB4	0.3	Fill (clayey sandy gravel) Residual (sandstone)	0	No odours detected. Borehole terminated at 0.5m. Refusal on hard sandstone.
EB5	1.0	Fill (sandy clay and gravel) Residual (clayey sand)	63 (between 1.4m-1.5m)	Strong odour detected. Borehole terminated at 3.3m. Refusal on hard sandstone.

Borehole ID	Depth of Fill (mbgl)	Material	Highest PID (ppm)	Comments
EB6	0.4	Fill (reworked clayey sands) Residual (clayey sand)	245 (between 2.6m-2.7m)	Strong odour detected. Borehole terminated at 3.3m. Refusal on hard sandstone.
EB7	0.3	Fill (gravelly clayey sand with ash) Residual (clayey sand)	0	No odours detected. Borehole terminated at 3.6m. Refusal on hard sandstone.

During field work activities, hydrocarbon odours were not observed with the exception of strong odours in GB3, EB5 and EB6. PID and olfactory assessment of impacted soils produced comparative results to the visual assessment.

7.2 Soil Analytical Results

Soil analytical results were compared to the adopted site criteria. Results indicate the following exceedances for soils (and respective criteria):

- GB3 (1.5 m):
  - TPH C_6-C_{10}, 560 mg/kg (NEPM 2013 HSL D 1–2 m 370 mg/kg criterion for vapour intrusion)
  - TPH C_6-C_{10}, 560 mg/kg (NEPM 2013 ESL fine soil 215 mg/kg criterion)
  - TPH >C_{10}-C_{16}, 400 mg/kg (NEPM 2013 ESL fine soil 170 mg/kg criterion).

Other soil analytical results indicated that:

- Concentrations of TPH and BTEX were generally either below their PQL or below the adopted site criteria in all samples analysed
- Metals (8) concentrations were below the site assessment criteria for all samples analysed
- PAH, OCP, OPP, PCB and phenol concentrations were below PQLs in all samples analysed
- Asbestos was not detected in any of the soil samples analysed

Table C1, Appendix C presents soil analytical results with comparison to the adopted site assessment criteria.

Laboratory test results presented in **Table C1, Appendix C** suggest potential acid sulfate soil (PASS) present along the northern boundary of the site as identified in soil bores GB1 and GB2. Therefore this part of the site requires management to provide oversight to civil works in dealing with ASS if and when it is engaged.

7.3 Field Observations – Groundwater

Groundwater monitoring wells were gauged prior to groundwater monitoring events (GME) conducted on 7 and 17 June 2014. Groundwater level gauging indicated that standing water levels were:

- 7 June 2014 (rain event) - approximately 0.8 mbgl on 612 Pittwater Road in SP1 and SP2 and approximately 1.2 mbgl at 624 Pittwater Road in MB1; and
- 17 June 2014 (dry period) – approximately 1.27mbgl in SP1, 0.89 in SP2 and 1.26 in MB1.

During groundwater sampling, the groundwater colour was generally observed to be clear, however a milky colour during the first event and grey colour during the second event, was observed in SP1. No fuel odours were noted during sampling with the exception of hydrocarbon odours and sheen observed in SP1 during the second sampling event. SP2 purged dry during the second event and therefore was not sampled.

A summary of the well gauging data is provided in Table 6.

Table 6 Groundwater well gauging data

Well ID	Date	Well Depth (mbgl)	Standing Water Level (mbgl)	Odour	Observations
MB1	07/06/14	6.85	1.22	No	No odour, no sheen
MB1	17/06/14	6.85	1.26	No	No odour, no sheen QA2 sample collected
SP1	07/06/14	2.73	0.81	No	No odour, no sheen Slight milky colour
SP1	17/06/14	2.73	1.27	Yes	Hydrocarbon sheen and odour. Grey colour.
SP2	07/06/14	1.92	0.79	No	No odour, no sheen QA1 sample collected
SP2	17/06/14	1.92	0.89	No	Purged dry. No sample

7.4 Groundwater Analytical Results

Tabulated analytical results for groundwater analysis are presented within the laboratory summary tables (**Appendix C**) while the laboratory reports are presented in **Appendix E**.

7.4.1 First Groundwater Monitoring Event

Three groundwater samples (MB1, SP1 and SP2) were collected from the site. The pre-existing names of two existing standpipe located on 612 Pittwater Rd were unknown at the time of investigation, therefore SP1 and SP2 were allocated for the purpose of this investigation.

For screening purposes concentrations detected above laboratory EQLs, are listed as follows:

- Arsenic (2 µg/L) in SP1
- Cadmium (0.1 µg/L) in MB1
- Chromium (2 µg/L) in SP1
- Chromium (2 µg/L) in SP2
- Chromium (1 µg/L) in MB1
- Copper (6 µg/L) in SP1
- Copper (3 µg/L) in SP2
- Copper (3 µg/L) in MB1
- Lead (2 µg/L) in SP1
- Nickel (1 µg/L) in SP1

- Nickel (3 µg/L) in MB1
- Zinc (83 µg/L) in SP1
- Zinc (80 µg/L) in SP2
- Zinc (170 µg/L) in MB1.

Of the above listed samples, all three locations had concentrations exceeding GILs for copper (1.4 µg/L) and zinc (8 µg/L).

TPH, BTEX and mercury were not detected above laboratory EQLs. Phase separated hydrocarbon (PSH) was not detected (with the use of an interface probe) within any of the monitoring wells.

A site photograph of well location of MB1 is presented in **Appendix H**.

7.4.2 Second Groundwater Monitoring Event

Two groundwater samples (plus QAQC) were collected from a newly installed monitoring bore (MB1) and existing standpipe (SP1) previously referred to as BH302 (Environ 2013).

The “seepage water” samples were collected directly from the monitoring bores following purging and placed into laboratory supplied sample bottles.

The analytical results from the “seepage water” are presented within the laboratory summary table (**Appendix C**) and laboratory reports (**Appendix E**).

Comparison of the two groundwater sampling events indicates heavy rainfall may have diluted concentrations during the first sampling event. SMEC considers the second round of seepage water sampling to be more representative of actual ground conditions.

Concentrations in groundwater in the seepage zone overlying sandstone bedrock are summarised below:

- MB1 (located at the Barbeques Galore site) - TPH and BTEX concentrations were all below the laboratory LOR and therefore below the adopted assessment criteria;
- SP1 (located at the former residential site, 1m from the footpath) - TPH, toluene and xylene were detected above the laboratory LOR, with toluene (11.85ug/L) exceeding the adopted assessment criteria (6.3ug/L); and
- SP2 (located on the high side of the former service station site) – due to the presence of sandstone bedrock just below ground level, the standpipe was found to be dry and no sample was obtained.

Based on the results from this ground water sampling event, SMEC concludes the following:

1. Hydrocarbon concentration in the seepage water immediately adjacent to the footpath is above assessment criteria and therefore requires further investigation and/or management incorporating the new building design.

8 STATE ENVIONMENT PLANNING POLICY 55

8.1 Overview

The objective of *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55) is to provide for a consistent State-wide planning approach to the remediation of contaminated land. In particular, SEPP 55 aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment:

- by specifying when development consent is required, and when it is not required, for a remediation work
- by specifying certain considerations that are relevant in rezoning land and in determining development applications in general and development applications for consent to carry out a remediation work in particular
- by requiring that a remediation work meet certain standards and notification requirements.

SEPP 55 is supported by *Managing Land Contamination, Planning Guidelines SEPP 55 – Remediation of Land* (Dept of Urban Affairs and Planning 1998). The Guidelines facilitate the integration of land contamination management into the planning and development control process to:

- ensure that changes of land use will not increase the risk to health or the environment
- avoid inappropriate restrictions on land use
- provide information to support decision-making and to inform the community.

The Guidelines identify the information to be provided by a proponent to assist a planning authority to carry out its planning functions. The level of investigation required in this regard will depend on individual circumstances and may involve one or more of the following stages:

- Stage 1 – preliminary investigation
- Stage 2 – detailed investigation
- Stage 3 – remedial action plan
- Stage 4 – validation and monitoring.

The investigation undertaken for the proposed Southern Community Health Centre to date has comprised a data gaps analysis that has drawn on past investigations undertaken for the site (where made available to SMEC) and focussed assessments based on a limited program of test drilling, and sample collection and analysis. While these activities are consistent with and support the SEPP 55 process, it should be noted that further work may be required to address all relevant stages as noted above.

9 QUALITY CONTROL AND QUALITY ASSURANCE

9.1 Overview

All fieldwork was performed by experienced SMEC staff and suitably qualified subcontractors in accordance with SMEC's standard operating procedures.

All samples were collected directly into laboratory supplied sample bottles. To avoid potential cross-contamination a clean pair of nitrile gloves was worn prior to the collection of each sample. All equipment that came into contact with multiple well locations was decontaminated with Decon 90 and rinsed prior to use at each location.

All sample bottles were filled with sample directly from a dedicated bailer and immediately placed in an ice-filled esky to keep the samples below a temperature of approximately 4^{o}C.

A chain of custody form was completed with the sample names, sampling date and required analyses. The chain of custody form and the samples were then sent in a sealed esky to the laboratory for analysis; within the prescribed analyte holding times.

Samples were submitted to the NATA accredited laboratory: Envirolab (primary laboratory)

Analytical methods complied with NEPM and NSW EPA requirements.

The laboratory reports and certificates, sample receipt and Chain of Custody (COC) information are provided in **Appendix E**.

9.2 Blind Field Duplicates

A total of 12 soil samples were analysed for contaminants of concern by the primary laboratory. One intra–laboratory blind duplicate soil sample QC1 (EB2/0.5-0.6) was also analysed by the primary laboratory (Envirolab). All RPDs for replicate sample QC1 were within the recognised quality control interval of ±50% (see **Table C3, Appendix C**).

A total of three groundwater samples were analysed for contaminants of concern by the primary laboratory. One intra–laboratory blind duplicate groundwater sample QA1 (SP2) was also analysed by the primary laboratory (Envirolab). All RPDs for replicate sample QA1 (SP2) were zero (0) and therefore within the recognised quality control interval of ±50% (see **Table C4, Appendix C**).

9.3 Laboratory Control Spikes

Laboratory Control Spikes were used during the analysis to check the quality of laboratory preparation techniques. The target frequency of one (1) per analytical batch of 20 per analytical method with the laboratory acceptance criteria of generally:

- 70-130% for inorganics/metals
- 60–140% for organics
- 10 – 140% for speciated phenols.

The matrix spike recoveries for the batches relating to this project were within the acceptable criteria.

9.4 Laboratory Blanks

Laboratory blanks were used during the laboratory analysis to identify if contaminants of concern were introduced to the samples during laboratory analysis procedures.

Laboratory blanks are used to monitor unintentionally introduced contaminants to the sample in the laboratory, for example organic or inorganic residues contained on glassware or cleaning reagents. Laboratory method blanks are used as part of the precision process. The acceptance criteria of the method blank is not detected >95% of the reported EQL. No target analytes were detected in any of the laboratory blanks, indicating that the analytical method was satisfactory and no contamination occurred.

It is therefore considered that the field duplicate/laboratory QA/QC is adequate for the investigation.

10 DISCUSSION

10.1 Acid Sulfate Soils

Acid sulfate soil exist across the northern part of the site may require specialist disposal of excavated material and piling spoil and can be managed via the Construction Environmental Management Plan (CEMP).

Consideration therefore must be given to:

- Design of the new building to prevent vapour intrusion.
- Design of barrier liners and vents associated with footings and conduits.
- Implementing a CEMP that addresses requirements of the Remedial Action Plan (RAP) to manage soil/ stockpile movement and tracking, use of capping material, road base fill and potential re-use of material sourced from the site.

10.2 Geotechnical Assessment

More than 400mm of uncontrolled fill is present on the site and will require removal prior to redevelopment.

The fill materials encountered on the site does not appear to have been placed in a controlled manner, and therefore must not be relied upon for support. The loads will be transferred to the underlying weathered sandstone material using piles.

The piles will need to be sleeved to prevent collapse of foundation material into pile excavation.

10.3 Dangerous Goods Search Results

The archive documents received from WorkCover NSWs Stored Chemical Information Database (SICD) for 624 Pittwater Road indicate two positions that a tank may be located. A record exists for the proposed location of a tank on the northern side of the building and a second record exists for inspection of the known tank on the eastern side of the building.

The records relate to an application raised by Murphy Johnston Imported Cars in 1977 and an inspection carried out by the certifier in 1978. It is possible that only one tank was built, however at this stage the record is inconclusive to this point and the new carpark pavement on site has removed potential surface indicators of a tank location or associated infrastructure on the northern side of the building.

The presence of this tank or tanks, suggest that there may be other currently unassessed environmental issues relating to automotive workshop/showroom activities within the adjacent building. Environmental issues may include but not be limited to potential contaminating landuse activities associated with waste oil tanks, backfilled hoist pits, mechanical service bays, solvent benches associated with cleaning automotive parts and spray painting etc.

In summary, at least one decommissioned tank remains underground at the rear of the BBQ' Galore building and will require removal and remediation of the surrounding soil prior to site development.

10.4 Previous Remediation Works

10.4.1 Overview

Potential contaminants of concern include:

- Total Petroleum Hydrocarbons;
- Asbestos containing building materials; and
- Polycyclic Aromatic Hydrocarbons.

10.4.2 Previous Investigation Work

Previous remediation and validation works undertaken at the former service station site summarised by PB (2003) indicated that residual total petroleum hydrocarbons (TPH) contamination was present in soil and groundwater in a band of soil between 2–3 m in the seepage zone at 620 Pittwater Road.

It is anticipated that this impacted material will be removed from site and replaced with clean fill material.

Soil vapour intrusion assessment has previously been undertaken at the site and advice was provided on human health risk. Environ report (2013) summarises multiple lines of evidence (soil, groundwater and soil vapour concentrations), incorporated into a vapour intrusion model based on the existing site conditions.

10.5 Future Remediation Works

10.5.1 Overview

Future remedial work includes, but is not limited to:

- Installation of a vapour proof membrane under the entire building footprint slab to prevent hydrocarbon vapours from permeating into building zone.
- Installation of a temporary steel shoring wall for contaminated soil removal at the western boundary.
- Removal of decommissioned underground storage tank/s.

10.5.2 Hazardous Materials

Hazardous materials including bonded asbestos roof sheeting is present in the existing structures on site.

A hazardous materials assessment report is required prior to demolition. Safe removal of asbestos containing materials and any other hazardous building materials will be required by a suitably qualified contractor during demolition.

10.5.3 Further Assessment and Remedial Work

A Detailed Site Inspection (DSI) containing a vapour risk assessment and conceptual site model will be required for the combined sites prior to new works commencing.

A site specific remediation action plan (RAP) will be required to address known contamination constraints presented in the all existing environmental documentation to incorporate the proposed building design and building methodology. The RAP will determine how site validation is achieved.

A Site Validation Report (SVR) will establish that the RAP objectives have been achieved.

An EPA licensed auditor is likely to be commissioned by HI to provide independent advice to ensure a high level of environmental compliance around contaminated land issues is achieved throughout the project life.

Environmental monitoring of soil, groundwater and air will form the basis of the DSI, vapour risk assessment and conceptual site model on which the RAP will be designed to enable the compliance with the proposed end use of the site. Monitoring will occur throughout the project life cycle to demonstrate improvements, progress and compliance required to demonstrate potential risk has either been removed or mitigated.

10.5.4 Risk Assessment

To guide risk mitigation and site management under the new landuse scenario, having consideration for potential indoor air spaces associated with the new building design, a site specific human and/or environmental risk assessment is required.

A gap analysis of the previous model assumptions (Environ 2013) implies the vapour intrusion model requires adjustments to incorporate:

1. New lines of evidence including:
    a. Minor pockets of soil contamination exceed soil assessment criteria for potential vapour intrusion;
    b. Elevated VOCs were recorded with a PID in soil headspace samples up to 900 ppm;
    c. Contaminated seepage water exceeded site assessment criterion (6.3ug/L) for toluene (11.85ug/L) at the western site boundary; and
2. The size of the proposed new building footprint has increased since the previous model area of 400m^2 was inputted.

SMEC consider it prudent to conduct a vapour intrusion risk assessment to form part of the DSI report in terms of:

- the new building footprint;
- current soil vapour and seepage water criteria exceedances;

- the known contamination in the road verge at the front of the site;
- remaining underground tank/s at the rear of the site; and
- the history of other potentially contaminating land uses trading at 624 Pittwater Road.

It is possible that a vapour risk still applies to the former service station site (612). The DSI of 624 Pittwater Road and demolition of 624 may uncover new vapour risk issues resulting from tanks and related infrastructure which may impact on proposed at grade carpark provisions.

10.5.5 Construction and Operational Site Management Plans

For the interim period potential vapour and seepage water intrusions should be addressed in a site specific Construction Environmental Management Plan (CEMP) detailing issues such as Unexpected Find Protocols (UFP), dewatering, liquid waste disposal, waste classification, contaminated soil disposal and re-use options.

It is likely that an Operational Environmental Management Plan (OEMP) will be required for the post construction phase to demonstrate that suitable vapour protection has been achieved in the built environment and when the building is occupied. The OEMP will l incorporate a three year monitoring program to undertake indoor air monitoring of lift shafts etc.

The following scenarios apply to site construction:

1. <u>Topsoil/ fill removal</u>

Bulk excavation and removal of the top 500mm is related to dealing with the residual waste associated with former building footings and activities. This removal will typically deal with problematic localised fill layers, pesticide treated soil, pipes and localised asbestos impacted soil finds are not uncommon.

It should be noted that Lot A, B and C (612) has been filled over with Construction and Demolition (C&D) Waste and waste concrete (blowouts) by way of surface treatment for all weather access across the site. This tipped material will most likely require removal as part of this 500mm stripping of surface material.

2. <u>Underground Petroleum Storage System (UPSS) removal</u>

The underground storage tank/s (USTs) located at 624 Pittwater Road would need to be removed and tank pits validated to achieve compliance with *Guidelines for Implementing the Protection of the Environment Operations (UPSS) Regulations 2008*. Tank decommissioning and removal of UPSS and associated aboveground infrastructure to be conducted in accordance with NSW EPA (2010a) UPSS *Technical Note: Site Validation Reporting* and NSW EPA (2010b) *Technical Note: Decommissioning, Abandonment and Removal of UPSS.*

Several activities undertaken on site in the past including spray painting of fire proof doors, automotive workshop, chemical storage, etc may have potentially contaminated the soils under the buildings. However, those areas were not targeted during the present assessment.

Given the preliminary nature of the site assessment at 624 Pittwater Road and the uncertainties associated with TPH contamination and ground conditions under buildings, the potential for existing contamination remaining unidentified and the presence of hazardous building materials, a DSI would be required to outline potential risk to site developers and future occupants along with plain English management requirements.

On the basis of the *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (DECC, 2009), the site does not currently require notification under Section 60 of the Contaminated Land Management Act 1997.

3. Pockets of soil contamination

The remaining pockets of soil contamination are estimated to be 10% of the approximate $500m^2$ area previously covered by the Environ SAS (2013). Excavation and removal of these pockets encountered at depths of approximately 1.5m will include inverting the soil profile and placing the clean overlying layer at the base.

Not all contaminants will be removed from site. Seepage from the former service station will remain, however at levels that meet the remediation criteria and at levels that can be managed by vapour barrier walls and slab liners.

4. Vertical treatment of seepage water

Where sandstone excavation is required to level the southern end of the site, a retaining wall constructed along the street frontage of Lots A, B and C would accommodate building design. This retaining wall should be spray treated with a gas tight liquid boot. If a drainage feature is required to prevent seepage water ingress through the retaining wall, any vapour collection points would require ventilation to the atmosphere.

5. Asbestos removal works

A licensed asbestos removalist is required to prepare and implement a site specific Asbestos Removal Control Plan (ARCP) to manage the removal of all asbestos containing materials (ACM) located onsite. The ARCP should outline management controls including but not limited to air monitoring, PPE and use of dust suppression during demolition, excavation and trucking activities.

Note: *Class A Licence:* Can remove any amount or quantity of asbestos or ACM, including any amount of friable asbestos or non-friable asbestos or ACM.

Class B Licence: Can remove any amount of non-friable asbestos or ACM.

6. Concrete slab vapour barrier

Although the majority of the building footprint is considered low risk in terms of soil/ seepage/ vapour contamination, a gas tight underslab barrier system (ie. liquid boot) is required to be constructed under the whole of the new building footprint area to prevent potential soil vapour intrusion.

The vapour management area is limited to the building footprint, based on the existing environmental SAS for Lot A, B & C that states a vapour proof membrane would be required below the lower building slab if the proposed building is cut and built below ground level. Therefore suggestion is that no vapour protection is required in the proposed at grade carparks at the rear.

Due to limited environmental coverage of 624 Pittwater Road, there is a possibility that the proposed carpark area is not entirely free from vapour risk, however risk of new vapour sources is considered low.

These scenarios are further detailed in **Table 7** in terms of various environmental issues to be addressed during pre-construction stages of work.

Table 7 Pre-construction stages of work and associated environmental issues estimate

Stage of Works	Lot DP	Street #	Issue	Area (m2)	Percentage Required	Contam Layer (m)	Volume (m3)	Waste Class	Land Farming Potential	Seepage Water Treatment Required
Earthworks	Total Site	612 - 624	Removal of top 500mm of topsoil/ fill layer from across the site.	5600	100%	0.5	2800	GSW	No	No
	Lot 3	624	Tank removal - may require soil and seepage water removal.	50	100%	3	150	GSW	Yes	Yes
	Lot 1	620-622	Pockets of soil contamination require removal from original tank farm impact, identified in soil above bedrock in SAS at a depth of 1.5m below surface.	550	10%	1	5	GSW	Yes	Yes
			TOTAL	-	-	-	2955	-	-	-
Stage of Works	***Lot DP***	***Street #***	***Issue***	***Area (m2)***	***Barrier Layer Length (m)***	***Wall Height (m)***	***Volume (m3)***	***Waste Class***	***Land Farming Potential***	***Seepage Water Treatment Required***
Earthworks	Lot A	612	Retaining wall - known contaminated seepage water in footpath verge re-entering the site due to proposed floor cuttings.	7.5	15	0.5	NA	NA	NA	Yes
	Lot B	612		15	15	1	NA	NA	NA	Yes
	Lot C	612		67.5	45	1.5	NA	NA	NA	Yes
			TOTAL	90	75	3	-	-	-	-
Stage of Works	***Lot DP***	***Street #***	***Issue***	***Area (m2)***						
Demolition	*Lot 3*	*624*	Asbestos containing roof sheeting	1350						
	Lot 1	*620-622*	Asbestos building materials	200						
			TOTAL	1550						
Stage of Works	***Lot DP***	***Street #***	***Issue***	***Area (m2)***						
Construction	*Lot A, B, C*	*612*	Vapour intrusion mitigation measure - proposed building footprint requiring concrete slab liner.	1670						
			TOTAL	1670						

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

SMEC concludes the following:

- The site comprises three separate land uses as follows:
  - 612 Pittwater Road (Lots A, B and C DP375728) – formerly owned by Mobil Oil Australia Pty Ltd who operated a service station at the site until 1997 until the current landowner purchased the site in 2000
  - 620 Pittwater Road (Lot 1 DP500541) – formerly a residential dwelling (currently vacant) owned by the current landowner
  - 624 Pittwater Road (Lot 3 DP539384) – currently a commercial retail building leased to Barbeques Galore and another tenant who manufactures fire doors on the premises.
- Due to its historical use as a service station the site has had a number of previous investigations undertaken.
- The commercial lot presently comprises a UST with a vent pipe located on the side of the building. Although no bowser is present it is unknown whether the associated fuel related infrastructure remains underground. Based on GPR signals detected on 5 June 2014, SMEC concluded the UST was likely to be abandoned in situ and backfilled with sand/gravel.
- HI engaged SMEC to undertake a geotechnical and contamination TESA at the site as a part of due diligence requirements prior to entering a sale agreement with the owner of the site (Knarf Holdings Pty Ltd).
- SMEC conducted soil sampling at twelve targeted locations and groundwater sampling at three (3) targeted locations.
- There is fill across the site up to a depth of approximately 1.5 m.
- Analytical results indicate the following:
  - One soil sample (GB3/1.5) exceeded the site assessment criteria for:
    - TPH C_6-C_{10} in terms of health screening levels for vapour intrusion; and
    - TPH C_{10}-C_{16} in terms of ecological screening levels.
  - All remaining soil analytical results were either below the PQL or site assessment criteria;
  - All three groundwater samples (MB1, SP1 and SP2) exceeded the site assessment criteria for copper and zinc;
  - All remaining groundwater analytical results were either below the PQL or site assessment criteria.
- The source of TPH impacted soil in 620 Pittwater Road is likely to be from pockets of ‘minor residual hydrocarbon contamination’ as reported by Environ (2013).

- **Important Note:** PB (2003) reported in accordance with NEPM (1999), however this guidance document has since been updated and NEPM (2013) provides further guidance material in terms of risk associated with vapour intrusion and potential receptors.
- The main contaminants of concern for former service station sites (TPH, BTEX and Lead) were generally not reported above laboratory PQLs in groundwater. Therefore, the copper and zinc criteria exceedances may represent background seepage water quality for the area, not necessarily sourced from site.
- Given the reported analytical results of samples SMEC consider the site suitable for its proposed use as commercial land use, with the following implications:
  - Potential sources of ASS need to be further assessed/managed.
  - The potential for vapour intrusion from shallow soils located in the southwest corner of 620 Pittwater Road should be considered in light of future development plans and potential human receptors.
  - Given TPH in GB3 exceeded ecological screening levels, ecological receptors need to be considered for all land uses including commercial development sites in accordance with NEPM 2013. If ecological receptors are present, these may be the drivers for remediation and/or management plan implementation.
  - Demolition of on-site buildings should be conducted in accordance with an asbestos removal control plan developed by a licensed Class A or B removalist.

Development Constraints

Although the known areas of gross hydrocarbon contamination have been remediated, there remain minor pockets of hydrocarbon impacted soil associated with the former service station site. The current investigation indicates TPH concentrations in shallow soils exceed industry guidelines in terms of potential ecological receptors and vapour risk to human health. SMEC recommend appropriate management measures presented in Section 10 need to be implemented to protect potential ecological receptors and to prevent vapour intrusion into buildings and service conduits.

The main issues relating to management of risks associated with existing site conditions are:

- Potential ASS.
- Safe removal of asbestos containing materials and any other hazardous building materials
- Installation of a lower slab liner to prevent vapour intrusion.
- Design of barrier wall and passive venting system to allow any seepage water or odorous air to escape.
- Implementing a CEMP that addresses requirements of the RAP to manage soil/ stockpile movement and tracking, use of capping material, road base fill and potential re-use of material sourced from the site.

11.2 Recommendations

Prior to the commencement of developing the site as a community health facility, SMEC recommends:

- The Dangerous Goods licences search results for the commercial property at 624 Pittwater Road (624) indicate two positions that a tank may be located. A record exists for the proposed location of a tank on the northern side of the building and a second record exists for inspection of the known tank on the eastern side of the building.
- Given the presence of at least one underground storage tank (UST) and history of automotive workshop activities at 624, there is a potential for other currently unassessed environmental issues relating to automotive workshop activities. Environmental issues may include but not be limited to potential contaminating landuse activities associated with waste oil tanks, backfilled hoist pits, mechanical service bays, solvent benches associated with cleaning automotive parts and spray painting etc.
- While limited targeted investigation locations at 624 did not indicate gross contamination, a Detailed Site Investigation (DSI) for the combined sites is recommended prior to new works commencing.
- SMEC consider it prudent to conduct a vapour intrusion risk assessment to form part of the DSI.
- A site specific RAP will be required to address known contamination constraints to incorporate the proposed building design.
- A SVR will establish that the RAP objectives have been achieved.
- A site specific CEMP detailing issues such as UFP should be implemented during demolition and site development.
- An OEMP will be required for the post construction phase to demonstrate that suitable vapour protection has been achieved in the built environment and when the building is occupied.
- PASS present along the northern boundary of the site as identified in soil bores GB1 and GB2 require an ASSMP as part of the CEMP to provide oversight to civil works in dealing with ASS if and when it is engaged.
- A desktop review of the reports listed in **Section 3.1** and further assessment (if required) to better understand the on-site human health risks associated with known hydrocarbon vapours present at 620.
- Given TPH in GB3 exceeded ecological screening levels, in accordance with NEPM 2013 ecological receptors need to be considered for all land uses including commercial development sites. If ecological receptors are present, these may be the drivers for remediation and/or management plan implementation.
- In addition to other relevant matters, the CEMP should address placement of the concrete liner, barrier walls and venting systems to prevent soil vapour intrusion into the building. Trees and shrubs should be grown in planter boxes filled with

clean imported soil to prevent the root zone penetrating potential pockets of hydrocarbon impacted soils.

- Conduct a hazardous material survey for all on site buildings, and review any existing asbestos registers prior to demolition works, with all ACM earmarked for removal to be documented in an asbestos removal control plan prepared by a licensed Class A or B removalist.

12 REFERENCES

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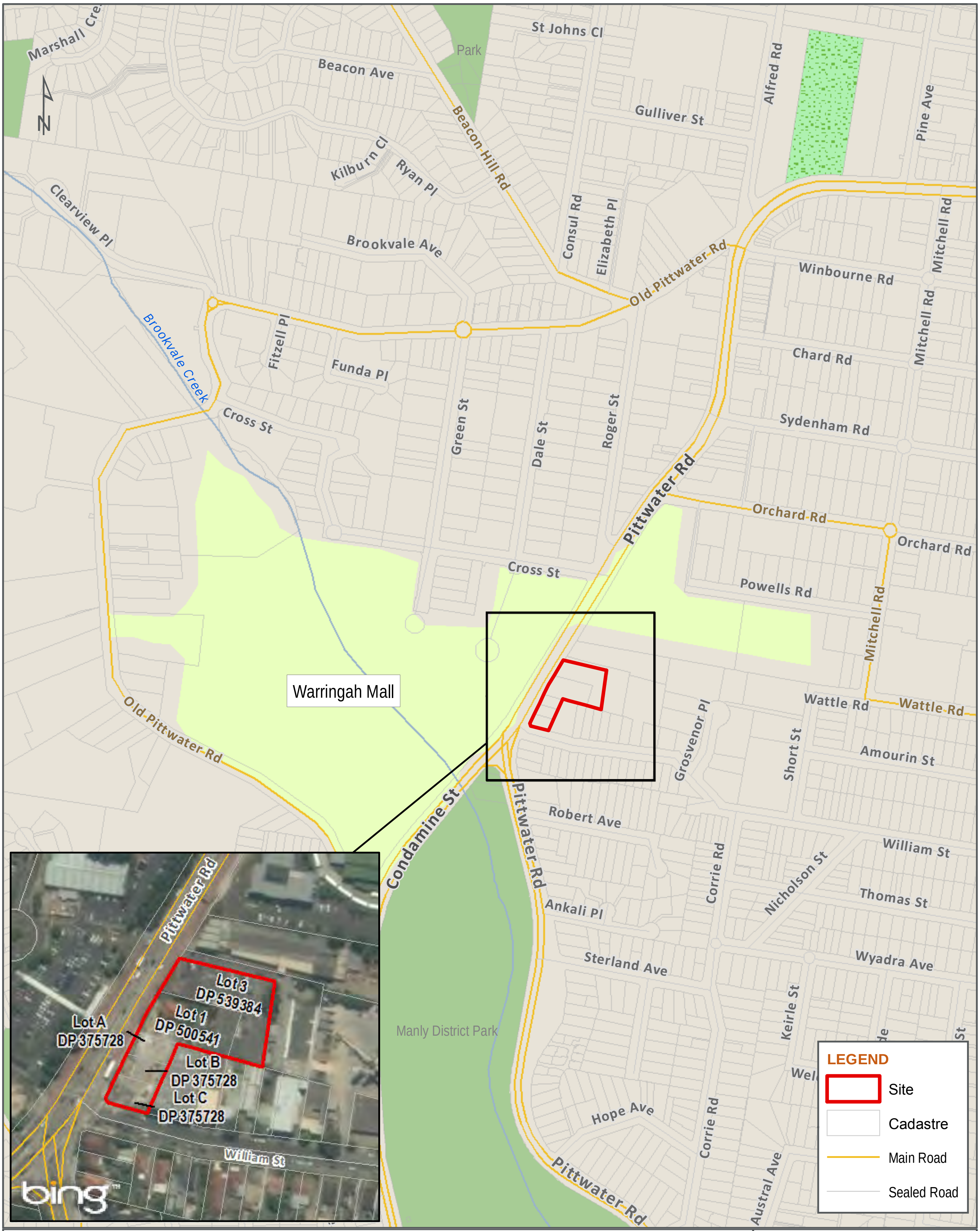
APPENDIX A – SITE FIGURES



DATE 02/06/2014

0 125 250 Metres

1:7,500

COORDINATE SYSTEM GDA 1994 MGA Zone 56

FIG NO. 1

FIGURE TITLE Location map

PAGE SIZE A4

PROJECT NO. 30011256

PROJECT TITLE Brookvale CHC

CREATED BY RC10721

SOURCES Vector backdrop – Roadnet © Map Data Services 2014
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SMEC

Location: I:\projects\30011256 - Northern Beaches Hospital EIS\008 DATA\GIS\Maps\Brookvale CHC\Figure1_LocationMap.mxd

Last updated by: RC10721 on 2/06/2014 at 13:45

DATE 10/06/2014

COORDINATE SYSTEM GDA 1994 MGA Zone 56

FIG NO. 2

FIGURE TITLE Provisional Sampling Plan

PAGE SIZE A4

PROJECT NO. 30011256

PROJECT TITLE Brookvale CHC

CREATED BY RC10721

SOURCES Vector backdrop data © MDS 2014

SMEC

Location: I:\projects\30011256 - Northern Beaches Hospital EIS\008 DATA\GIS\Maps\Brookvale CHC\Figure2_Provisional Sampling Plan.mxd

Last updated by: RC10721 on 10/06/2014 at 14:56

APPENDIX B – BOREHOLE LOGS

SMEC

ENVIRONMENTAL FIELD LOG - BOREHOLE WITH WELL

on behalf of
Health Infrastructure

BOREHOLE/WELL NO: EB1/MB1
Sheet No: 1 of 1
Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment
Purpose: Environmental Site Assessment
Location: 612 - 624 Pittwater Road, Brookvale NSW 2100
Co-ordinates System: E
N
Surface RL:
Inclination: -90
Total Depth: 7 m

DRILLING								SUBSTANCE						WELL DETAILS		OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	**Material Description** NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	As Built	Construction Notes	**Additional Observations** Origin Structure
					No					CONCRETE					Cement Seal and Gatic Cover 50mm PVC Casing	
			E EB1/0.3-0.4	0						FILL: sandy silty gravel, dark grey, with piece of brick						
									SC	CLAYEY SAND: yellow with grey mottling, highly weatherd sandstone, moist to wet						
						1			SC	CLAYEY SAND: yellow/grey, highly weatherd sandstone, moist to wet	W					
PT mm			E EB1/2.5-2.6	0.1	No	2			SC	CLAYEY SAND: grey, with white river gravel, moist	M					
						3			SC	CLAYEY SAND: Pinky brown,					Bentonite Seal	
										SANDSTONE: red/brown weathered sandstone					Filter Pack	
						4				SANDSTONE: red/white weathered sandstone with small white river gravel					50mm PVC Screen	
AS mm						5 6				SANDSTONE: red/brown, firm			▼			
						7				Drilling discontinued at 7.00m						

Groundwater observed: Yes **If Yes, Inflow at:** 5 m

Contractor: EPOCA Environmental **Commenced:** 7/6/14 **Logged By:** SS
Equipment: Geoprope 7822DT **Completed:** 7/6/14 **Checked By:** PF

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ENVIRONMENTAL FIELD LOG - BOREHOLE

on behalf of

Health Infrastructure

BOREHOLE NO: EB2

Sheet No: 1 of 1

Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment

Purpose: Environmental Site Assessment

Location: 612 - 624 Pittwater Road, Brookvale NSW 2100

Co-ordinates System E

N

Surface RL:

Inclination: -90

Total Depth: 3 m

DRILLING								SUBSTANCE						OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	**Material Description** NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	**Additional Observations,** Origin Structure
PT mm					No			■		ASPHALT				Bore potentially located in stormwater or sewer conduit.
			E EB2/0.5-0.6 (QC1 & QC2 also collected)	0				▩		FILL: grey and white ashy fill with traces of slag and gravel				
								▨	SC	CLAYEY SAND: yellow/brown, moist to wet				
			E EB2/1.0-1.1	0		1		▨						Grey staining observed at 1.0m.
						2		▨						
			E EB2/2.7-2.8	0				▨						White gravel inclusions from 2.7m
						3				Drilling discontinued at 3.00m				

Groundwater observed: **If Yes, Inflow at:** m

Contractor:	EPOCA Environmental	**Commenced:**	7/6/14	**Logged By:**	SS
Equipment:	Geoprope 7822DT	**Completed:**	7/6/14	**Checked By:**	PF

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ENVIRONMENTAL FIELD LOG - BOREHOLE

on behalf of
Health Infrastructure

BOREHOLE NO: EB3
Sheet No: 1 of 1
Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment
Purpose: Environmental Site Assessment
Location: 612 - 624 Pittwater Road, Brookvale NSW 2100
Co-ordinates System E
N
Surface RL:
Inclination: -90
Total Depth: 3 m

DRILLING								SUBSTANCE						OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	Material Description NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	Additional Observations, Origin Structure
PT mm					No					ASPHALT				
										FILL: brown snady gravel boadbase				
			E EB3/0.2-0.3	0.2						FILL: grey and white ashy fill with traces of slag and gravel				
										FILL: reworked clayey sand				
									CL-ML	SILTY CLAY: dark brown with traces of gravel				
			E EB3/1.0-1.1	0.2		1 2			SC	SANDY CLAY: light grey			▸	grading to lighter grey colour from 1.0m
			E EB2/2.6-2.7	0.4					SC	SANDY CLAY: light grey with yellow mottling				
						3				Drilling discontinued at 3.00m				

Groundwater observed: No **If Yes, Inflow at:** 1.1 m

Contractor:	EPOCA Environmental	**Commenced:**	7/6/14	**Logged By:**	SS
Equipment:	Geoprope 7822DT	**Completed:**	7/6/14	**Checked By:**	PF

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ENVIRONMENTAL FIELD LOG - BOREHOLE

on behalf of
Health Infrastructure

BOREHOLE NO: EB4
Sheet No: 1 of 1
Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment
Purpose: Environmental Site Assessment
Location: 612 - 624 Pittwater Road, Brookvale NSW 2100

Co-ordinates System E
N

Surface RL:
Inclination: -90
Total Depth: 0.5 m

DRILLING								SUBSTANCE						OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	Material Description NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	Additional Observations, Origin Structure
PT mm			E EB4/0.2-0.3	0	No					FILL: grey/yellow cleyey sandy gravel with pieces of red sandstone, wet	W			
AD mm										SANDSTONE: red				Very hard sandstone auger refusal at 0.5m
										Drilling discontinued at 0.50m				
						1								
						2								
						3								

Groundwater observed: **If Yes, Inflow at:** m

Contractor:	EPOCA Environmental	**Commenced:**	7/6/14	**Logged By:**	SS
Equipment:	Geoprope 7822DT	**Completed:**	7/6/14	**Checked By:**	PF

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ENVIRONMENTAL FIELD LOG - BOREHOLE

on behalf of
Health Infrastructure

BOREHOLE NO: EB5
Sheet No: 1 of 1
Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment
Purpose: Environmental Site Assessment
Location: 612 - 624 Pittwater Road, Brookvale NSW 2100
Co-ordinates System E
N
Surface RL:
Inclination: -90
Total Depth: 3.3 m

DRILLING								SUBSTANCE						OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	**Material Description** NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	**Additional Observations,** Origin Structure
PT mm										CONCRETE				
			E EB5/0.3-0.4	0.6						FILL: sandy clay, red and yellow mottles with red sandstone gravel				
					Yes	1				FILL: clayey sand, greeny grey with sandstone gravel				
			E EB5/1.4-1.5	63										
						2								Staining and odour observed, likely backfill tank location
						3								
			E EB5/3.2-3.3	22										
										Drilling discontinued at 3.30m				

Groundwater observed: **If Yes, Inflow at:** m

Contractor: EPOCA Environmental
Equipment: Geoprope 7822DT
Commenced: 7/6/14
Completed: 7/6/14
Logged By: SS
Checked By: PF

SMEC

ENVIRONMENTAL FIELD LOG - BOREHOLE

on behalf of
Health Infrastructure

BOREHOLE NO: EB6
Sheet No: 1 of 1
Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment
Purpose: Environmental Site Assessment
Location: 612 - 624 Pittwater Road, Brookvale NSW 2100
Co-ordinates System E
N
Surface RL:
Inclination: -90
Total Depth: 2.8 m

DRILLING								SUBSTANCE						OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	Material Description NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	Additional Observations, Origin Structure
PT mm					No					FILL: sandy clay, grey/white and yellow				No Staining observed
			E EB6/0.9-1.0	0					SC	SANDY CLAY: yellow, moist				
						1			SC	SANDY CLAY: red/brown with yellow mottles				
						2			SC	SANDY CLAY: red/brown with yellow/grey mottles				
			E EB6/2.6-2.7 E EB6/2.7-2.8	24	Yes				SC	SANDY CLAY: red/brown with yellow/grey mottles and sandstone gravel				Staining and strong odour observed
						3				Drilling discontinued at 2.80m				

Groundwater observed: **If Yes, Inflow at:** m

Contractor: EPOCA Environmental **Commenced:** 7/6/14 **Logged By:** SS
Equipment: Geoprope 7822DT **Completed:** 7/6/14 **Checked By:** PF

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ENVIRONMENTAL FIELD LOG - BOREHOLE

on behalf of
Health Infrastructure

BOREHOLE NO: EB7
Sheet No: 1 of 1
Project No: 30011256

Project: Geotechnical and Contamination Factual Assessment
Purpose: Environmental Site Assessment
Location: 612 - 624 Pittwater Road, Brookvale NSW 2100

Co-ordinates System E
N

Surface RL:
Inclination: -90
Total Depth: 3.6 m

DRILLING								SUBSTANCE						OBSERVATIONS
Method/ Diameter	Penetration	Recovery	Sample	PID (ppm)	Noted Odour	Depth (m)	Elev. (RL)	Graphic Log	USC	**Material Description** NAME: grain size / plasticity characteristics, colour, description of secondary component, minor components (i.e. some, trace,...), other soil substance observations	Moisture	Density Consistency	Water	**Additional Observations,** Origin Structure
PT mm					No					TOPSOIL				
			E EB7/0.2-0.3	0						FILL: gravelly sandy clay,				
			E EB7/0.5-0.6 E EB7/1.8-1.9	0 0		1			SC	SANDY CLAY: grey/brown, moist	W W			Saturated at 1.5m
						2			SC	SANDY CLAY: light grey	M			
						3			SC	SANDY CLAY: red/grey with yellow/brown sandstone gravel				
			E EB7/3.5-3.6	0					SC	SANDY CLAY: grey and red mottling with yellow/brown sandstone gravel				
										Drilling discontinued at 3.60m				

Groundwater observed: **If Yes, Inflow at:** m

Contractor: EPOCA Environmental
Equipment: Geoprope 7822DT
Commenced: 7/6/14
Completed: 7/6/14
Logged By: SS
Checked By: PF

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APPENDIX C – LABORATORY ANALYSIS RESULTS

						Asbestos	BTEX					Halogenated Benzenes	Inorganics				Lead	Metals										
				pHF (field pH test)*	pHFOX (field peroxide test)*	Asbestos fibres	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Hexachlorobenzene	Chloride	Moisture	pH (aqueous extract)	Sulphate	Lead	Arsenic	Cadmium	Chromium (III+VI)	Copper	Mercury	Nickel	Zinc	4,4-DDE	a-BHC	Aldrin	b-BHC
				pH Units	pH Units	-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	pH_Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL							0.2	1	0.5	2	1	0.1	10	0.1		10	1	4	0.4	1	1	0.1	1	1	0.1	0.1	0.1	0.1
NEPM 1999 Phytotoxicity Based Investigation Levels																2000			3			1						
NEPM 2013 EILs calculated																	1800	160		1100	210		1100	570				
NEPM 2013 ESL (commercial / industrial coarse soil)												80					1500	3000	900		240000	730	6000	400000				
NEPM 2013 Management Limits for TPH (commercial / industrial coarse soil)																												
NEPM 2013 HSLs for vapour intrusion (commercial / industrial, sand, 1-<2m)							3																					
NEPM 2013 HIL D Commercial/industrial												80					1500	3000	900		240000	730	6000	400000				
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**																									
EB1	EB1	0.3-0.4	7/06/2014	-	-	0	<0.2	<1	<0.5	<2	<1	-	-	17	-	-	120	8	0.5	34	26	0.3	5	180	-	-	-	-
EB2	EB2	0.5-0.6	7/06/2014	-	-	0	<0.2	<1	<0.5	<2	<1	-	-	13	-	-	6	<4	<0.4	9	8	<0.1	8	12	-	-	-	-
EB3	EB3	2.6-2.7	7/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	16	-	-	5	<4	<0.4	15	<1	<0.1	2	1	-	-	-	-
EB4	EB4	0.2-0.3	7/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	12	-	-	14	5	<0.4	32	15	<0.1	13	39	-	-	-	-
EB5	EB5	1.4-1.5	7/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	11	-	-	22	4	<0.4	17	5	<0.1	7	56	-	-	-	-
EB6	EB6	2.6-2.7	7/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	13	-	-	7	<4	<0.4	40	<1	<0.1	1	<1	-	-	-	-
EB7	EB7	0.2-0.3	7/06/2014	-	-	0	<0.2	<1	<0.5	<2	<1	<0.1	-	13	-	-	660	<4	0.6	44	150	<0.1	32	500	<0.1	<0.1	<0.1	<0.1
GB1	GB1	0.5	6/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	11	-	-	15	<4	<0.4	7	20	<0.1	10	28	-	-	-	-
GB1	GB1	2	6/06/2014	6.4	3.5	-	<0.2	<1	<0.5	<2	<1	-	<10	15	6.1	10	2	<4	<0.4	7	1	<0.1	<1	3	-	-	-	-
GB1	GB1	3.5	6/06/2014	-	-	-	-	-	-	-	-	-	<10	-	5.8	57	-	-	-	-	-	-	-	-	-	-	-	-
GB1	GB1	4.5	6/06/2014	5.1	3.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB2	GB2	0.5	6/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	11	-	-	33	10	<0.4	24	24	<0.1	23	50	-	-	-	-
GB2	GB2	1.2	6/06/2014	5.9	4.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB2	GB2	3.5	6/06/2014	6.3	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB3	GB3	1.5	6/06/2014	-	-	-	<0.2	11	<0.5	16	<1	-	-	13	-	-	6	<4	<0.4	31	2	<0.1	2	2	-	-	-	-
GB5	GB5	11	6/06/2014	-	-	-	<0.2	<1	<0.5	<2	<1	-	-	12	-	-	12	<4	<0.4	10	<1	<0.1	<1	<1	-	-	-	-
QC1	EB2	0.5-0.6	7/06/2014	-	-	0	<0.2	<1	<0.5	<2	<1	-	-	22	-	-	9	<4	<0.4	15	13	<0.1	12	18	-	-	-	-
Statistical Summary																												
Number of Results				4	4	4	13	13	13	13	13	1	2	13	2	2	13	13	13	13	13	13	13	13	1	1	1	1
Number of Detects				4	4	4	0	1	0	1	0	0	0	13	2	2	13	4	2	13	10	1	11	11	0	0	0	0
Minimum Concentration				5.1	3.4	0	<0.2	<1	<0.5	<2	<1	<0.1	<10	11	5.8	10	2	<4	<0.4	7	<1	<0.1	<1	<1	<0.1	<0.1	<0.1	<0.1
Minimum Detect				5.1	3.4	ND	ND	11	ND	16	ND	ND	ND	11	5.8	10	2	4	0.5	7	1	0.3	1	1	ND	ND	ND	ND
Maximum Concentration				6.4	4.3	0	<0.2	11	<0.5	16	<1	<0.1	<10	22	6.1	57	660	10	0.6	44	150	0.3	32	500	<0.1	<0.1	<0.1	<0.1
Maximum Detect				6.4	4.3	ND	ND	11	ND	16	ND	ND	ND	22	6.1	57	660	10	0.6	44	150	0.3	32	500	ND	ND	ND	ND
Average Concentration				5.9	3.8	0	0.1	1.3	0.25	2.2	0.5			14			70	3.5	0.25	22	20	0.069	8.9	68				
Median Concentration				6.1	3.65	0	0.1	0.5	0.25	1	0.5	0.05	5	13	5.95	33.5	12	2	0.2	17	8	0.05	7	18	0.05	0.05	0.05	0.05
Standard Deviation				0.59	0.4	0	0	2.9	0	4.2	0			3.1			180	2.7	0.13	13	40	0.069	9.5	138				

				Organochlorine Pesticides															Organophosphorous Pesticides													
				Chlordane (cis)	**Chlordane (trans)**	**d-BHC**	**DDD**	**DDT**	**Dieldrin**	**Endosulfan I**	**Endosulfan II**	**Endosulfan sulphate**	**Endrin**	**Endrin aldehyde**	**g-BHC (Lindane)**	**Heptachlor**	**Heptachlor epoxide**	**Methoxychlor**	**Bromophos-ethyl**	**Chlorpyrifos**	**Chlorpyrifos-methyl**	**Diazinon**	**Dimethoate**	**Ethion**	**Fenitrothion**	**Ronnel**	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benz(a)anthracene**	**Benzo(a) pyrene**	**Benzo(b)&(k)fluoranthene**
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2
NEPM 1999 Phytotoxicity Based Investigation Levels																																
NEPM 2013 EILs calculated								640																								
NEPM 2013 ESL (commercial / industrial coarse soil)													100			50		2500		2000												
NEPM 2013 Management Limits for TPH (commercial / industrial coarse soil)																																
NEPM 2013 HSLs for vapour intrusion (commercial / industrial, sand, 1-<2m)																																
NEPM 2013 HIL D Commercial/industrial													100			50		2500		2000												
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**																													
EB1	EB1	0.3-0.4	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	0.1	0.1	0.7	1	1.3
EB2	EB2	0.5-0.6	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
EB3	EB3	2.6-2.7	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
EB4	EB4	0.2-0.3	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EB5	EB5	1.4-1.5	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	0.1	<0.5	0.4
EB6	EB6	2.6-2.7	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
EB7	EB7	0.2-0.3	7/06/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
GB1	GB1	0.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
GB1	GB1	2	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB1	GB1	3.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB1	GB1	4.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB2	GB2	0.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
GB2	GB2	1.2	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB2	GB2	3.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB3	GB3	1.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB5	GB5	11	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QC1	EB2	0.5-0.6	7/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
Statistical Summary																																
Number of Results				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9	9	9	9	9	9
Number of Detects				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	2
Minimum Concentration				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.2
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	0.1	0.1	1	0.4
Maximum Concentration				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.7	1	1.3
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	0.1	0.7	1	1.3
Average Concentration																											0.05	0.056	0.056	0.13	0.33	0.27
Median Concentration				0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.25	0.1
Standard Deviation																											0	0.017	0.017	0.22	0.25	0.4

Table C1 - Soil Analytical Results

				PAH/Phenols											Polychlorinated Biphenyls	TPH									
				Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Phenolics Total	Total +ve PAHs	Pyrene	PCBs (Sum of total)	F1 - C6-C10 less BTEX	(F2) C10-C16	F2-less NAPHTHALENE	F3 > C16-C34	F4 >C34-C40	C6 - C9	C10 - C14	C15 - C28	C29-C36	C6-C10
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5		0.1	0.6	25	50	50	100	100	25	50	100	100	25
NEPM 1999 Phytotoxicity Based Investigation Levels																									
NEPM 2013 EILs calculated										370															
NEPM 2013 ESL (commercial / industrial coarse soil)															7	215		170	1700	3300					
NEPM 2013 Management Limits for TPH (commercial / industrial coarse soil)																700		1000	3500	10,000					
NEPM 2013 HSLs for vapour intrusion (commercial / industrial, sand, 1-<2m)																370									
NEPM 2013 HIL D Commercial/industrial															7										
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**																						
EB1	EB1	0.3-0.4	7/06/2014	0.5	0.7	0.1	1.4	<0.1	0.5	<0.1	0.4	-	8.5	1.5	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
EB2	EB2	0.5-0.6	7/06/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	0	<0.1	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
EB3	EB3	2.6-2.7	7/06/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	0	<0.1	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
EB4	EB4	0.2-0.3	7/06/2014	-	-	-	-	-	-	<1	-	-	-	-	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
EB5	EB5	1.4-1.5	7/06/2014	0.2	0.1	<0.1	0.3	<0.1	0.2	<0.1	<0.1	-	2.2	0.6	-	<25	130	130	480	180	<25	120	230	350	<25
EB6	EB6	2.6-2.7	7/06/2014	<0.1	<0.1	<0.1	0.3	0.1	<0.1	<0.1	0.4	-	1.1	0.2	-	57	75	75	<100	<100	47	93	<100	<100	57
EB7	EB7	0.2-0.3	7/06/2014	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<5	0.28	0.1	1.5	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
GB1	GB1	0.5	6/06/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	0	<0.1	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
GB1	GB1	2	6/06/2014	-	-	-	-	-	-	<1	-	-	-	-	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
GB1	GB1	3.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB1	GB1	4.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB2	GB2	0.5	6/06/2014	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.1	-	0.59	0.2	-	<25	<50	<50	330	750	<25	<50	<100	440	<25
GB2	GB2	1.2	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB2	GB2	3.5	6/06/2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GB3	GB3	1.5	6/06/2014	-	-	-	-	-	-	6	-	-	-	-	-	560	410	400	<100	<100	360	570	<100	<100	590
GB5	GB5	11	6/06/2014	-	-	-	-	-	-	<1	-	-	-	-	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
QC1	EB2	0.5-0.6	7/06/2014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	0	<0.1	-	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25

Statistical Summary

	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Phenolics Total	Total +ve PAHs	Pyrene	PCBs (Sum of total)	F1 - C6-C10 less BTEX	(F2) C10-C16	F2-less NAPHTHALENE	F3 > C16-C34	F4 >C34-C40	C6 - C9	C10 - C14	C15 - C28	C29-C36	C6-C10
Number of Results	9	9	9	9	9	9	13	9	1	9	9	1	13	13	13	13	13	13	13	13	13	13
Number of Detects	2	2	1	5	1	2	1	3	0	9	5	1	2	3	3	2	2	2	3	1	2	2
Minimum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	0	<0.1	1.5	<25	<50	<50	<100	<100	<25	<50	<100	<100	<25
Minimum Detect	0.2	0.1	0.1	0.1	0.1	0.2	6	0.1	ND	0.28	0.1	1.5	57	75	75	330	180	47	93	230	350	57
Maximum Concentration	0.5	0.7	0.1	1.4	0.1	0.5	6	0.4	<5	8.5	1.5	1.5	560	410	400	480	750	360	570	230	440	590
Maximum Detect	0.5	0.7	0.1	1.4	0.1	0.5	6	0.4	ND	8.5	1.5	1.5	560	410	400	480	750	360	570	230	440	590
Average Concentration	0.12	0.13	0.056	0.28	0.056	0.12	0.61	0.13		1.4	0.31		58	67	66	105	114	42	79	64	103	60
Median Concentration	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	2.5	0.28	0.1	1.5	12.5	25	25	50	50	12.5	25	50	50	12.5
Standard Deviation	0.15	0.22	0.017	0.43	0.017	0.15	1.6	0.15		2.8	0.48		151	108	105	137	194	96	151	50	131	160

		BTEX						**Lead**	**Metals**							**PAH/ Phenols**		
		Benzene	**Ethylbenzene**	**Toluene**	**Xylene (m & p)**	**Xylene (o)**	**C6-C10 less BTEX (F1)**	**Lead (Filtered)**	**Arsenic (Filtered)**	**Cadmium (Filtered)**	**Chromium (III+VI) (Filtered)**	**Copper (Filtered)**	**Mercury (Filtered)**	**Nickel (Filtered)**	**Zinc (Filtered)**	**Naphthalene**	**C10-C16**	**C16-C34**
		µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L
EQL		1	1	1	2	1	0.01	0.001	0.001	0.0001	0.001	0.001	0.00005	0.001	0.001	1	0.05	0.1
NEPM 2013 GILs, Fresh Waters		950				350		0.0034	0.24	0.0002	0.001	0.0014	0.00006	0.011	0.008	16		
ANZECC 2000 (Toxicity) Freshwater for slightly-moderately disturbed systems			2.1	6.3														
Field_ID	**Date**																	
First Round of Groundwater Sampling																		
MB1	7/06/2014	<1	<1	<1	<2	<1	<0.01	<0.001	<0.001	0.0001	0.001	0.003	<0.00005	0.003	0.17	<1	<0.05	<0.1
QA1 (duplicate of SP2)	7/06/2014	<1	<1	<1	<2	<1	<0.01	<0.001	<0.001	<0.0001	0.002	0.003	<0.00005	<0.001	0.062	<1	<0.05	<0.1
SP1	7/06/2014	<1	<1	<1	<2	<1	<0.01	0.002	0.002	<0.0001	0.002	0.006	<0.00005	0.001	0.083	<1	<0.05	<0.1
SP2	7/06/2014	<1	<1	<1	<2	<1	<0.01	<0.001	<0.001	<0.0001	0.002	0.003	<0.00005	<0.001	0.08	<1	<0.05	<0.1
TRIP BLANK	5/06/2014	<1	<1	<1	<2	<1	<0.01	-	-	-	-	-	-	-	-	<1	-	-
TRIP SPIKE	5/06/2014	0.9	0.9	0.92	0.91	0.92	-	-	-	-	-	-	-	-	-	-	-	-
Second Round of Groundwater Sampling																		
MB1	17/06/2014	<1	<1	<1	<2	<1	<0.01	-	-	-	-	-	-	-	-	<1	<0.05	<0.1
SP1	17/06/2014	<1	<1	11.85	54.78	11.61	0.302	-	-	-	-	-	-	-	-	6.19	0.155	2.651
QA2 (duplicate of MB1)	17/06/2014	<1	<1	<1	<2	<1	<0.01	-	-	-	-	-	-	-	-	<1	<0.05	<0.1

	TPH						
	C34-C40	F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	C6-C10
	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L
EQL	0.1	0.05	10	50	100	100	0.01
NEPM 2013 GILs, Fresh Waters							
ANZECC 2000 (Toxicity) Freshwater for slightly-moderately disturt							
Field_ID							
First Round of Groundwater Sampling							
MB1	<0.1	<0.05	<10	<50	<100	<100	<0.01
QA1 (duplicate of SP2)	<0.1	<0.05	<10	<50	<100	<100	<0.01
SP1	<0.1	<0.05	<10	<50	<100	<100	<0.01
SP2	<0.1	<0.05	<10	<50	<100	<100	<0.01
TRIP BLANK	-	-	<10	-	-	-	<0.01
TRIP SPIKE	-	-	-	-	-	-	-
Second Round of Groundwater Sampling							
MB1	<0.1	<0.05	<10	<50	<100	<100	<0.01
SP1	0.77	0.28	260	205	233	2924	0.4
QA2 (duplicate of MB1)	<0.1	<0.05	<10	<50	<100	<100	<0.01

Table C3 - Soil RPD Results

		SDG	111198	111198	
		Field_ID	EB2	QC1	**RPD**
		Date	7/06/2014	7/06/2014	
ChemName	**Units**	**EQL**			
Arsenic	mg/kg	4	<4.0	<4.0	0
Cadmium	mg/kg	0.4	<0.4	<0.4	0
Chromium (III+VI)	mg/kg	1	9.0	15.0	50
Copper	mg/kg	1	8.0	13.0	48
Lead	mg/kg	1	6.0	9.0	40
Mercury	mg/kg	0.1	<0.1	<0.1	0
Nickel	mg/kg	1	8.0	12.0	40
Zinc	mg/kg	1	12.0	18.0	40
Asbestos fibres	-		0.0	0.0	0
Acenaphthene	mg/kg	0.1	<0.1	<0.1	0
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	0
Anthracene	mg/kg	0.1	<0.1	<0.1	0
Benz(a)anthracene	mg/kg	0.1	<0.1	<0.1	0
Benzo(a) pyrene	mg/kg	0.5	<0.5	<0.5	0
Benzo(b)&(k)fluoranthene	mg/kg	0.2	<0.2	<0.2	0
Benzo(g,h,i)perylene	mg/kg	0.1	<0.1	<0.1	0
Chrysene	mg/kg	0.1	<0.1	<0.1	0
Dibenz(a,h)anthracene	mg/kg	0.1	<0.1	<0.1	0
Fluoranthene	mg/kg	0.1	<0.1	<0.1	0
Fluorene	mg/kg	0.1	<0.1	<0.1	0
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	<0.1	<0.1	0
Naphthalene	mg/kg	0.1	<0.1	<0.1	0
Phenanthrene	mg/kg	0.1	<0.1	<0.1	0
Pyrene	mg/kg	0.1	<0.1	<0.1	0
Total +ve PAHs	mg/kg		0.0	0.0	0
C10-C16	mg/kg	50	<50.0	<50.0	0
C16-C34	mg/kg	100	<100.0	<100.0	0
C34-C40	mg/kg	100	<100.0	<100.0	0
F2-NAPHTHALENE	mg/kg	50	<50.0	<50.0	0
C10 - C14	mg/kg	50	<50.0	<50.0	0
C15 - C28	mg/kg	100	<100.0	<100.0	0
C29-C36	mg/kg	100	<100.0	<100.0	0
Benzene	mg/kg	0.2	<0.2	<0.2	0
Ethylbenzene	mg/kg	1	<1.0	<1.0	0
Naphthalene	mg/kg	1	<1.0	<1.0	0
Toluene	mg/kg	0.5	<0.5	<0.5	0
C6 - C9	mg/kg	25	<25.0	<25.0	0
Xylene (m & p)	mg/kg	2	<2.0	<2.0	0
Xylene (o)	mg/kg	1	<1.0	<1.0	0
C6-C10 less BTEX (F1)	mg/kg	25	<25.0	<25.0	0
C6-C10	mg/kg	25	<25.0	<25.0	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 80 (1-10 x EQL); 50 (10-30 x EQL); 30 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories

Any methods in the row header relate to those used in the primary laboratory

Filter: SDG in('111198')

Table C4 - Groundwater RPD Results

		SDG	111198	111198	
		Field_ID	SP2	QA1	**RPD**
		Sampled_Date-Time	7/06/2014	7/06/2014	
ChemName	**Units**	**EQL**			
Arsenic (Filtered)	mg/l	0.001	<0.001	<0.001	0
Cadmium (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0
Chromium (III+VI) (Filtered)	mg/l	0.001	0.002	0.002	0
Copper (Filtered)	mg/l	0.001	0.003	0.003	0
Lead (Filtered)	mg/l	0.001	<0.001	<0.001	0
Mercury (Filtered)	mg/l	0.00005	<0.0001	<0.0001	0
Nickel (Filtered)	mg/l	0.001	<0.001	<0.001	0
Zinc (Filtered)	mg/l	0.001	0.08	0.062	25
C10-C16	mg/l	0.05	<0.05	<0.05	0
C16-C34	mg/l	0.1	<0.1	<0.1	0
C34-C40	mg/l	0.1	<0.1	<0.1	0
F2-NAPHTHALENE	mg/l	0.05	<0.05	<0.05	0
C10 - C14	µg/L	50	<50.0	<50.0	0
C15 - C28	µg/L	100	<100.0	<100.0	0
C29-C36	µg/L	100	<100.0	<100.0	0
Benzene	µg/L	1	<1.0	<1.0	0
Ethylbenzene	µg/L	1	<1.0	<1.0	0
Naphthalene	µg/L	1	<1.0	<1.0	0
Toluene	µg/L	1	<1.0	<1.0	0
C6 - C9	µg/L	10	<10.0	<10.0	0
Xylene (m & p)	µg/L	2	<2.0	<2.0	0
Xylene (o)	µg/L	1	<1.0	<1.0	0
C6-C10 less BTEX (F1)	mg/l	0.01	<0.01	<0.01	0
C6-C10	mg/l	0.01	<0.01	<0.01	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 80 (1-10 x EQL); 50 (10-30 x E

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any met

Filter: Lab_Report_Number in('111198')

APPENDIX D – CALIBRATION CERTIFICATES

ThermoFisher
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RENTALS

Equipment Report - MINIRAE 2000 PID

This PID has been performance checked / calibrated* as follows:

Calibration	Actual Value	Reading	Pass?		
Zero – fresh air	0.0 ppm	0.0 ppm	☑		
Span – Isobutylene	103 ppm	103 ppm	☑		
Set Alarm limits to	High	100 ppm	Low	50 ppm	
Operations Check					

☑ Performance Check (pump, lamp, sensor & battery voltage check)

☑ Battery Charged ☑ Filters Check ☑ Spare battery Voltage (5.5v minimum) 6 V

☑ Electrical Safety Tag attached (AS/NZS 3760) Tag No: TFR058 Valid to: 01/10/2014

☑ Bump test / Date: 04/06/2014

** Calibration gas traceability information is available upon request.*

This PID has been performance checked / calibrated* as follows:

Date: 04/06/2014 Checked by: MILENKO

Signed:

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $20 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**
☑	☐	MiniRae 2000 PID / Operational Check, plus Battery Voltage @ 5.3 V
☑	☐	Lamp Voltage @ 10.6 V Compound Set to: ISOBUTYLENE C/factor: 1
☑	☐	Protective yellow rubber boot
☑	☐	Inlet probe (attached to PID)
☑	☐	Spare water trap filter(s) Qty 1
☑	☐	Charger 240V to 12V 500mA
☑	☐	Instruction Manual behind foam on the lid of case ¨
☑	☐	Quick Guide Sheet behind foam on the lid of case ¨
☑	☐	Spare Alkaline Battery Compartment with batteries
☒	☐	Inline Moisture trap Filter Guide Laminated
☒	☐	Calibration regulator & tubing (optional)
☑	☐	Carry Case
	☐	Check to confirm electrical safety (tag must be valid)
☐	☐	

Processors Signature/ Initials MS

Quote Reference	CS000804	Condition on return
Customer Ref		
Equipment ID	PID MINSAK	
Equipment serial no.	11090027	
Return Date	/ /	
Return Time		

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APPENDIX E – LABORATORY REPORTS AND CHAIN OF CUSTODY INFORMATION

1517

SMEC

CHAIN OF CUSTODY FORM

SMEC OFFICE: NORTHSYD

PROJECT: 30011256

PROJECT NUMBER:

PROJECT MANAGER: DANIEL SAUNDERS

SAMPLED BY: DS

DATE SAMPLED: 6/6/14

Email Reports to (will default to PM if blank): penelope.ford@smec.com

Email Invoice to (will default to PM if blank):

Special Laboratory Instructions:

REPORT TUESDAY PM

GB – GEOTECH BORE LOCATIONS

TURNAROUND REQUIREMENTS : * 24hr TAT

☐ Standard - 5 day TAT

☑ Non Standard TAT (List due date): (50% surcharge)

LAB QUOTE NO.:

CONTACT PH: 0413456085

COC SEQUENCE NUMBER (Circle)

COC: [✓ 1] 2 3 4 5 6 7

OF: 1 2 3 [✓ 4] 5 6 7

LAB: ENVIROLAB

ATTENTION: David Springer

DISPATCH TO (ADDRESS & PHONE NO.):

12 Ashley St
Chatswood NSW 2067

RELINQUISHED BY: Penelope Ford

DATE/TIME: 9/6/14 7:15am

RECEIVED BY:

DATE/TIME: 9/6/14 12pm

RELINQUISHED BY:

DATE/TIME:

RECEIVED BY:

DATE/TIME:

ENVIROLAB

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

Job No: 111198

COMMENTS

Date Received: 9/6/14

Time Received: 12pm

Received by:

Temp: [✓ Cool]/Ambient 6.8°

Cooling: Ice/[✓ Icepack]

Security: Intact/Broken/[✓ None]

SAMPLE DETAILS						ANALYSIS REQUIRED								COMMENTS
LAB ID	SAMPLE ID	DATE / TIME	SAMPLE MATRIX	CONTAINER TYPE & PRESERVATIVE	TOTAL NO. CONTAINERS	Combo 1m	Combo 3	CL	SO4	pH	pHF	pHFOX	Combo 3a	PID
1	GB1 0.5	6/6/14	S	JAR / ICE	1		✓							0
2	GB1/2.0					✓		✓	✓	✓	✓	✓		0.5
3	GB1/3.5							✓	✓	✓				1.5
4	GB1/4.5										✓	✓		0
5	GB2/0.5						✓							0.2
6	GB2/1.2										✓	✓		0.4
7	GB2/3.5										✓	✓		0.1
8	GB3/1.5					✓								700
9	GB4/4													
10	GB5/11	↓	↓	↓	↓	✓								0.0
11	EB1/0.3-0.4	7/6/14	↓	↓ + zip lock	2								✓	
					TOTAL									

Notes: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

Copies: WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book

SMEC

CHAIN OF CUSTODY FORM

SMEC OFFICE: North Sydney
PROJECT: Brookvale
PROJECT NUMBER: 30011256
PROJECT MANAGER: Daniel Saunders
SAMPLED BY: PF
DATE SAMPLED: 7.6.14
Email Reports to (will default to PM if blank): penelope.ford@smec.com
Email Invoice to (will default to PM if blank):
Special Laboratory Instructions: Report Tuesday PM

TURNAROUND REQUIREMENTS: ☐ Standard - 5 day TAT ☑ Non Standard TAT (List due date): 24hr TAT
LAB QUOTE NO.:
CONTACT PH: 0413456085
COC SEQUENCE NUMBER (Circle)
COC: 1 [✓ 2] 3 4 5 6 7
OF: 1 2 3 [✓ 4] 5 6 7

LAB: ENVIROLAB
ATTENTION: David Springer
DISPATCH TO (ADDRESS & PHONE NO.): 12 Ashley St
Chatswood NSW 2067

RELINQUISHED BY: Penelope Ford
DATE/TIME: 9/6/14 7:15a
RECEIVED BY:
DATE/TIME: 9/6/14
RELINQUISHED BY:
DATE/TIME:
RECEIVED BY:
DATE/TIME:

SAMPLE DETAILS						ANALYSIS REQUIRED								COMMENTS
LAB ID	SAMPLE ID	DATE / TIME	SAMPLE MATRIX	CONTAINER TYPE & PRESERVATIVE	TOTAL NO. CONTAINERS	Combo 1m	Combo 3	Combo 3a	Combo 8a					
		7.6.14												
12	EB1/2.5-2.6		S	jar + Zip lock	2									
13	EB2/0.5-0.6							✓						
14	EB2/1.0-1.1													
15	EB2/2.7-2.8													
16	EB3/0.2-0.3													
17	EB3/1.0-1.1													
18	EB3/2.6-2.7						✓							
19	EB4/0.2-0.3					✓								
20	EB5/0.3-0.4													
21	EB5/1.4-1.5						✓							
22	EB5/3.2-3.3													
					TOTAL									

Notes: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

Copies: WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book

SMEC

CHAIN OF CUSTODY FORM

SMEC OFFICE: North Sydney
PROJECT: Brookvale
PROJECT NUMBER: 30011256
PROJECT MANAGER: Daniel Saunders
SAMPLED BY: P.F
DATE SAMPLED: 7.6.14
Email Reports to (will default to PM if blank): penelope.ford@smec.com
Email Invoice to (will default to PM if blank):
Special Laboratory Instructions: Report Tuesday PM

TURNAROUND REQUIREMENTS: ☐ Standard - 5 day TAT ☑ Non Standard TAT (List due date): 24hr TAT
LAB QUOTE NO.:
CONTACT PH: 0413456085

COC SEQUENCE NUMBER (Circle)
COC: 1 2 [✓ 3] 4 5 6 7
OF: 1 2 3 [✓ 4] 5 6 7

LAB: ENVIROLAB
ATTENTION: David Springer
DISPATCH TO (ADDRESS & PHONE NO.):
12 Ashley St
Chatswood NSW 2067

RELINQUISHED BY: Penelope Ford	RECEIVED BY: David	RELINQUISHED BY:	RECEIVED BY:
DATE/TIME: 9/6/14 7:15a	DATE/TIME: 9/6/14	DATE/TIME:	DATE/TIME:

SAMPLE DETAILS						ANALYSIS REQUIRED								COMMENTS
LAB ID	SAMPLE ID	DATE / TIME	SAMPLE MATRIX	CONTAINER TYPE & PRESERVATIVE	TOTAL NO. CONTAINERS	Combo 1m	Combo 3	Combo 3a	Combo 8a	BTEX	TRH C6-C9			
23	EB6/0.9-1.0	7.6.14	S	jar + ziplock	2									
24	EB6/2.6-2.7						✓							
25	EB6/2.7-2.8													
26	EB7/0.2-0.3								✓					
27	EB7/0.5-0.6													
28	EB7/1.8-1.9													
29	EB7/3.5-3.6													
30	QC1							✓						
31	QC2													
32	Trip blank	5.6.14	W	40ml vial						✓	✓			
33	Trip spike	5.6.14	W	40ml vial						✓				
				TOTAL										

Notes: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

Copies: WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book

SMEC

CHAIN OF CUSTODY FORM

SMEC OFFICE: North Sydney
PROJECT: Brookvale
PROJECT NUMBER: 30011256
PROJECT MANAGER: Daniel Saunders
SAMPLED BY: P. F
DATE SAMPLED: 7. 6. 14
Email Reports to (will default to PM if blank): penelope. ford@smec. com
Email Invoice to (will default to PM if blank):
Special Laboratory Instructions: Report Tuesday PM

TURNAROUND REQUIREMENTS : ☐ Standard - 5 day TAT ☐ Non Standard TAT (List due date): 24hr TAT
LAB QUOTE NO.:
CONTACT PH: 0413456085

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 [✓ 4] 5 6 7
OF: 1 2 3 [✓ 4] 5 6 7

LAB: Envirolab
ATTENTION: David Springer
DISPATCH TO (ADDRESS & PHONE NO.): 12 Ashley St
Chatswood NSW 2067

RELINQUISHED BY: Penelope Ford	**RECEIVED BY:**	**RELINQUISHED BY:**	**RECEIVED BY:**
DATE/TIME: 9/6/14 7:15	**DATE/TIME:** 9/6/14	**DATE/TIME:**	**DATE/TIME:**

SAMPLE DETAILS						ANALYSIS REQUIRED								COMMENTS
LAB ID	SAMPLE ID	DATE / TIME	SAMPLE MATRIX	CONTAINER TYPE & PRESERVATIVE	TOTAL NO. CONTAINERS	Combo 1m *								
34	SP1	7.6.14	W	1 Amber, 1 red plastic	5	✓								* Metals =
35	SP2	↓	↓	field filtered	↓	✓								As, Cd, Cr, Cu,
36	MB1	↓	↓	1 green plastic,	↓	✓								Pb, Hg, Ni, Zn
37	QA1	↓	↓	2 vials	↓	✓								
TOTAL														

Notes: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

Copies: WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book

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 111198

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: Daniel Saunders

Sample log in details:

Your Reference:	**30011256**
No. of samples:	31 soil, 6 water
Date samples received / completed instructions received	09/06/2014 / 09/06/2014

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:	10/06/14 / 10/06/14
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

ACCREDITED FOR TECHNICAL COMPETENCE

vTRH(C6-C10)/BTEXN in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------ ------------	111198-1 GB1 0.5 6/06/2014 Soil	111198-2 GB1 2.0 6/06/2014 Soil	111198-5 GB2 0.5 6/06/2014 Soil	111198-8 GB3 1.5 6/06/2014 Soil	111198-10 GB5 11 6/06/2014 Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
TRH C_6 - C_9	mg/kg	<25	<25	<25	360	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	590	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	560	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	11	<1
m+p-xylene	mg/kg	<2	<2	<2	16	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	6	<1
Surrogate aaa-Trifluorotoluene	%	78	80	88	82	72

vTRH(C6-C10)/BTEXN in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------ ------------	111198-11 EB1 0.3-0.4 7/06/2014 Soil	111198-13 EB2 0.5-0.6 7/06/2014 Soil	111198-18 EB3 2.6-2.7 7/06/2014 Soil	111198-19 EB4 0.2-0.3 7/06/2014 Soil	111198-21 EB5 1.4-1.5 7/06/2014 Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	84	86	93	95	97

vTRH(C6-C10)/BTEXN in Soil				
Our Reference:	UNITS	111198-24	111198-26	111198-30
Your Reference	-------------	EB6	EB7	QC1
Depth	------------	2.6-2.7	0.2-0.3	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014
TRH C_6 - C_9	mg/kg	47	<25	<25
TRH C_6 - C_{10}	mg/kg	57	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	57	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	97	84	89

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	111198-1	111198-2	111198-5	111198-8	111198-10
Your Reference	-------------	GB1	GB1	GB2	GB3	GB5
Depth	------------	0.5	2.0	0.5	1.5	11
Date Sampled		6/06/2014	6/06/2014	6/06/2014	6/06/2014	6/06/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
TRHC_{10} - C_{14}	mg/kg	<50	<50	<50	570	<50
TRHC_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRHC_{29} - C_{36}	mg/kg	<100	<100	440	<100	<100
TRH>C_{10}-C_{16}	mg/kg	<50	<50	<50	410	<50
TRH>C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	400	<50
TRH>C_{16}-C_{34}	mg/kg	<100	<100	330	<100	<100
TRH>C_{34}-C_{40}	mg/kg	<100	<100	750	<100	<100
Surrogate o-Terphenyl	%	81	87	91	90	86

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	111198-11	111198-13	111198-18	111198-19	111198-21
Your Reference	-------------	EB1	EB2	EB3	EB4	EB5
Depth	------------	0.3-0.4	0.5-0.6	2.6-2.7	0.2-0.3	1.4-1.5
Date Sampled		7/06/2014	7/06/2014	7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
TRHC_{10} - C_{14}	mg/kg	<50	<50	<50	<50	120
TRHC_{15} - C_{28}	mg/kg	<100	<100	<100	<100	230
TRHC_{29} - C_{36}	mg/kg	<100	<100	<100	<100	350
TRH>C_{10}-C_{16}	mg/kg	<50	<50	<50	<50	130
TRH>C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	130
TRH>C_{16}-C_{34}	mg/kg	<100	<100	<100	<100	480
TRH>C_{34}-C_{40}	mg/kg	<100	<100	<100	<100	180
Surrogate o-Terphenyl	%	86	82	79	81	79

svTRH (C10-C40) in Soil				
Our Reference:	UNITS	111198-24	111198-26	111198-30
Your Reference	-------------	EB6	EB7	QC1
Depth	------------	2.6-2.7	0.2-0.3	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014
TRH C_{10} - C_{14}	mg/kg	93	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100
TRH >C_{10}-C_{16}	mg/kg	75	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	75	<50	<50
TRH >C_{16}-C_{34}	mg/kg	<100	<100	<100
TRH >C_{34}-C_{40}	mg/kg	<100	<100	<100
Surrogate o-Terphenyl	%	82	82	81

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	111198-1 GB1 0.5 6/06/2014 Soil	111198-5 GB2 0.5 6/06/2014 Soil	111198-11 EB1 0.3-0.4 7/06/2014 Soil	111198-13 EB2 0.5-0.6 7/06/2014 Soil	111198-18 EB3 2.6-2.7 7/06/2014 Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.1	0.4	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	0.2	1.4	<0.1	<0.1
Pyrene	mg/kg	<0.1	0.2	1.5	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	0.7	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	0.7	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	1.3	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	0.09	0.89	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.5	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0.5	<0.1	<0.1
Benzo(a)pyrene TEQ NEPM B1	mg/kg	<0.5	<0.5	1.0	<0.5	<0.5
Total +ve PAH's	mg/kg	NIL (+)VE	0.59	8.5	NIL (+)VE	NIL (+)VE
Surrogate p-Terphenyl-d14	%	83	87	90	85	90

PAHs in Soil					
Our Reference:	UNITS	111198-21	111198-24	111198-26	111198-30
Your Reference	-------------	EB5	EB6	EB7	QC1
Depth	------------	1.4-1.5	2.6-2.7	0.2-0.3	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	0.4	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.3	0.3	0.1	<0.1
Pyrene	mg/kg	0.6	0.2	0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	0.4	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	0.30	0.06	0.07	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ NEPM B1	mg/kg	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	mg/kg	2.2	1.1	0.28	NIL (+)VE
Surrogate p-Terphenyl-d14	%	87	92	88	87

Organochlorine Pesticides in soil Our Reference:	UNITS	111198-26
Your Reference	-------------	EB7
Depth	------------	0.2-0.3
Date Sampled		7/06/2014
Type of sample		Soil
Date extracted	-	10/06/2014
Date analysed	-	10/06/2014
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Surrogate TCMX	%	74

Organophosphorus Pesticides Our Reference:	UNITS	111198-26
Your Reference	-------------	EB7
Depth	------------	0.2-0.3
Date Sampled		7/06/2014
Type of sample		Soil
Date extracted	-	10/06/2014
Date analysed	-	10/06/2014
Diazinon	mg/kg	<0.1
Dimethoate	mg/kg	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1
Ronnel	mg/kg	<0.1
Chlorpyriphos	mg/kg	<0.1
Fenitrothion	mg/kg	<0.1
Bromophos-ethyl	mg/kg	<0.1
Ethion	mg/kg	<0.1
Surrogate TCMX	%	74

Total PCBs in Soil		
Our Reference:	UNITS	111198-26
Your Reference	-------------	EB7
Depth	------------	0.2-0.3
Date Sampled		7/06/2014
Type of sample		Soil
Date extracted	-	10/06/2014
Date analysed	-	10/06/2014
Total PCB (Arochlor 1016-1260)	mg/kg	1.5
Surrogate TCLMX	%	77

Total Phenolics in Soil		
Our Reference:	UNITS	111198-26
Your Reference	-------------	EB7
Depth	------------	0.2-0.3
Date Sampled		7/06/2014
Type of sample		Soil
Date extracted	-	10/06/2014
Date analysed	-	10/06/2014
Total Phenolics (as Phenol)	mg/kg	<5

Acid Extractable metals in soil						
Our Reference:	UNITS	111198-1	111198-2	111198-5	111198-8	111198-10
Your Reference	-------------	GB1	GB1	GB2	GB3	GB5
Depth	------------	0.5	2.0	0.5	1.5	11
Date Sampled		6/06/2014	6/06/2014	6/06/2014	6/06/2014	6/06/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Arsenic	mg/kg	<4	<4	10	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	7	7	24	31	10
Copper	mg/kg	20	1	24	2	<1
Lead	mg/kg	15	2	33	6	12
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	10	<1	23	2	<1
Zinc	mg/kg	28	3	50	2	<1

Acid Extractable metals in soil						
Our Reference:	UNITS	111198-11	111198-13	111198-18	111198-19	111198-21
Your Reference	-------------	EB1	EB2	EB3	EB4	EB5
Depth	------------	0.3-0.4	0.5-0.6	2.6-2.7	0.2-0.3	1.4-1.5
Date Sampled		7/06/2014	7/06/2014	7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Arsenic	mg/kg	8	<4	<4	5	4
Cadmium	mg/kg	0.5	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	34	9	15	32	17
Copper	mg/kg	26	8	<1	15	5
Lead	mg/kg	120	6	5	14	22
Mercury	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	5	8	2	13	7
Zinc	mg/kg	180	12	1	39	56

Acid Extractable metals in soil				
Our Reference:	UNITS	111198-24	111198-26	111198-30
Your Reference	-------------	EB6	EB7	QC1
Depth	------------	2.6-2.7	0.2-0.3	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil
Date digested	-	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014
Arsenic	mg/kg	<4	<4	<4
Cadmium	mg/kg	<0.4	0.6	<0.4
Chromium	mg/kg	40	44	15
Copper	mg/kg	<1	150	13
Lead	mg/kg	7	660	9
Mercury	mg/kg	<0.1	<0.1	<0.1
Nickel	mg/kg	1	32	12
Zinc	mg/kg	<1	500	18

Miscellaneous Inorg - soil			
Our Reference:	UNITS	111198-2	111198-3
Your Reference	-------------	GB1	GB1
Depth	------------	2.0	3.5
Date Sampled		6/06/2014	6/06/2014
Type of sample		Soil	Soil
Date prepared	-	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014
pH 1:5 soil:water	pH Units	6.1	5.8
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	10	57

sPOCAS field test					
Our Reference:	UNITS	111198-2	111198-4	111198-6	111198-7
Your Reference	-------------	GB1	GB1	GB2	GB2
Depth	------------	2.0	4.5	1.2	3.5
Date Sampled		6/06/2014	6/06/2014	6/06/2014	6/06/2014
Type of sample		Soil	Soil	Soil	Soil
pH_F (field pH test)*	pH Units	6.4	5.1	5.9	6.3
pH_{FOX} (field peroxide test)*	pH Units	3.5	3.8	4.3	3.4
Reaction Rate*	-	Slight	Slight	Moderate	Moderate

Moisture						
Our Reference:	UNITS	111198-1	111198-2	111198-5	111198-8	111198-10
Your Reference	-------------	GB1	GB1	GB2	GB3	GB5
Depth	------------	0.5	2.0	0.5	1.5	11
Date Sampled		6/06/2014	6/06/2014	6/06/2014	6/06/2014	6/06/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Moisture	%	11	15	11	13	12

Moisture						
Our Reference:	UNITS	111198-11	111198-13	111198-18	111198-19	111198-21
Your Reference	-------------	EB1	EB2	EB3	EB4	EB5
Depth	------------	0.3-0.4	0.5-0.6	2.6-2.7	0.2-0.3	1.4-1.5
Date Sampled		7/06/2014	7/06/2014	7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Moisture	%	17	13	16	12	11

Moisture				
Our Reference:	UNITS	111198-24	111198-26	111198-30
Your Reference	-------------	EB6	EB7	QC1
Depth	------------	2.6-2.7	0.2-0.3	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil
Date prepared	-	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014
Moisture	%	13	13	22

Asbestos ID - soils					
Our Reference:	UNITS	111198-11	111198-13	111198-26	111198-30
Your Reference	-------------	EB1	EB2	EB7	QC1
Depth	------------	0.3-0.4	0.5-0.6	0.2-0.3	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014	7/06/2014
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Sample mass tested	g	Approx 45g	Approx 30g	Approx 35g	Approx 25g
Sample Description	-	Grey coarse-grained soil	Grey fine-grained soil	Brown coarse-grained soil & rocks	Grey fine-grained soil
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected

vTRH(C6-C10)/BTEXN in Water Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------ ------------	111198-32 TRIP BLANK - 5/06/2014 Water	111198-33 TRIP SPIKE - 5/06/2014 Water	111198-34 SP1 - 7/06/2014 Water	111198-35 SP2 - 7/06/2014 Water	111198-36 MB1 - 7/06/2014 Water
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014	10/06/2014
TRHC$_6$ - C$_9$	µg/L	<10	[NA]	<10	<10	<10
TRHC$_6$ - C$_{10}$	µg/L	<10	[NA]	<10	<10	<10
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10	[NA]	<10	<10	<10
Benzene	µg/L	<1	90%	<1	<1	<1
Toluene	µg/L	<1	92%	<1	<1	<1
Ethylbenzene	µg/L	<1	90%	<1	<1	<1
m+p-xylene	µg/L	<2	91%	<2	<2	<2
o-xylene	µg/L	<1	92%	<1	<1	<1
Naphthalene	µg/L	<1	[NA]	<1	<1	<1
Surrogate Dibromofluoromethane	%	101	102	102	101	102
Surrogate toluene-d8	%	100	101	100	98	101
Surrogate 4-BFB	%	102	102	99	101	102

vTRH(C6-C10)/BTEXN in Water Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------ ------------	111198-37 QA1 - 7/06/2014 Water
Date extracted	-	10/06/2014
Date analysed	-	10/06/2014
TRHC$_6$ - C$_9$	µg/L	<10
TRHC$_6$ - C$_{10}$	µg/L	<10
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10
Benzene	µg/L	<1
Toluene	µg/L	<1
Ethylbenzene	µg/L	<1
m+p-xylene	µg/L	<2
o-xylene	µg/L	<1
Naphthalene	µg/L	<1
Surrogate Dibromofluoromethane	%	103
Surrogate toluene-d8	%	100
Surrogate 4-BFB	%	101

svTRH (C10-C40) in Water					
Our Reference:	UNITS	111198-34	111198-35	111198-36	111198-37
Your Reference	-------------	SP1	SP2	MB1	QA1
Depth	------------	-	-	-	-
Date Sampled		7/06/2014	7/06/2014	7/06/2014	7/06/2014
Type of sample		Water	Water	Water	Water
Date extracted	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100
Surrogate o-Terphenyl	%	79	81	78	110

HM in water - dissolved Our Reference: Your Reference Depth Date Sampled Type of sample	 UNITS ------------ ------------	 111198-34 SP1 - 7/06/2014 Water	 111198-35 SP2 - 7/06/2014 Water	 111198-36 MB1 - 7/06/2014 Water	 111198-37 QA1 - 7/06/2014 Water
Date prepared	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Date analysed	-	10/06/2014	10/06/2014	10/06/2014	10/06/2014
Arsenic-Dissolved	µg/L	2	<1	<1	<1
Cadmium-Dissolved	µg/L	<0.1	<0.1	0.1	<0.1
Chromium-Dissolved	µg/L	2	2	1	2
Copper-Dissolved	µg/L	6	3	3	3
Lead-Dissolved	µg/L	2	<1	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	1	<1	3	<1
Zinc-Dissolved	µg/L	83	80	170	62

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (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.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110 -B.
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Metals-022 ICP-MS	Determination of various metals by ICP-MS.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Date analysed	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	111198-1	<25 || <25	LCS-13	77%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	111198-1	<25 || <25	LCS-13	77%
Benzene	mg/kg	0.2	Org-016	<0.2	111198-1	<0.2 || <0.2	LCS-13	65%
Toluene	mg/kg	0.5	Org-016	<0.5	111198-1	<0.5 || <0.5	LCS-13	79%
Ethylbenzene	mg/kg	1	Org-016	<1	111198-1	<1 || <1	LCS-13	82%
m+p-xylene	mg/kg	2	Org-016	<2	111198-1	<2 || <2	LCS-13	80%
o-Xylene	mg/kg	1	Org-016	<1	111198-1	<1 || <1	LCS-13	91%
naphthalene	mg/kg	1	Org-014	<1	111198-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	84	111198-1	78 || 76 || RPD: 3	LCS-13	80%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Date analysed	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	111198-1	<50 || <50	LCS-13	99%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	111198-1	<100 || <100	LCS-13	100%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	111198-1	<100 || <100	LCS-13	91%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	111198-1	<50 || <50	LCS-13	99%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	111198-1	<100 || <100	LCS-13	100%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	111198-1	<100 || <100	LCS-13	91%
Surrogate o-Terphenyl	%		Org-003	84	111198-1	81 || 87 || RPD: 7	LCS-13	95%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Date analysed	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	LCS-13	105%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	LCS-13	104%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	LCS-13	105%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	LCS-13	103%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	LCS-13	105%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	LCS-13	99%
Benzo(b+k)fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	111198-1	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	111198-1	<0.05 || <0.05	LCS-13	111%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	111198-1	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	93	111198-1	83 || 87 || RPD: 5	LCS-13	97%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	111198-26	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Date analysed	-			10/06/2014	111198-26	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
HCB	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	71%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	82%
Heptachlor	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	77%
delta-BHC	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	90%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	108%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	91%
Dieldrin	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	94%
Endrin	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	72%
pp-DDD	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	95%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	LCS-13	108%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	92	111198-26	74 || 76 || RPD: 3	LCS-13	80%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	111198-26	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Date analysed	-			10/06/2014	111198-26	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Diazinon	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	LCS-13	107%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	LCS-13	88%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	111198-26	<0.1 || <0.1	LCS-13	93%
Surrogate TCMX	%		Org-008	92	111198-26	74 || 76 || RPD: 3	LCS-13	79%

QUALITY CONTROL Total PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	111198-26	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Date analysed	-			10/06/2014	111198-26	10/06/2014 || 10/06/2014	LCS-13	10/06/2014
Total PCB (Arochlor 1016-1260)	mg/kg	0.6	Org-006	<0.6	111198-26	1.5 || 0.6 || RPD: 86	LCS-13	110%
Surrogate TCLMX	%		Org-006	92	111198-26	77 || 74 || RPD: 4	LCS-13	100%

QUALITY CONTROL Total Phenolics in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	[NT]	[NT]	LCS-1	10/06/2014
Date analysed	-			10/06/2014	[NT]	[NT]	LCS-1	10/06/2014
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	[NT]	[NT]	LCS-1	101%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date digested	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-2	10/06/2014
Date analysed	-			10/06/2014	111198-1	10/06/2014 || 10/06/2014	LCS-2	10/06/2014
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	111198-1	<4 || <4	LCS-2	105%
Cadmium	mg/kg	0.4	Metals-020 ICP-AES	<0.4	111198-1	<0.4 || <0.4	LCS-2	112%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	111198-1	7 || 5 || RPD: 33	LCS-2	107%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	111198-1	20 || 13 || RPD: 42	LCS-2	106%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	111198-1	15 || 9 || RPD: 50	LCS-2	107%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	111198-1	<0.1 || <0.1	LCS-2	86%
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	111198-1	10 || 6 || RPD: 50	LCS-2	107%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	111198-1	28 || 18 || RPD: 43	LCS-2	108%

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			10/06/2014	[NT]	[NT]	LCS-1	10/06/2014
Date analysed	-			10/06/2014	[NT]	[NT]	LCS-1	10/06/2014
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-1	101%
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	LCS-1	104%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	LCS-1	108%

QUALITY CONTROL sPOCAS field test	UNITS	PQL	METHOD	Blank
pH$_{F}$ (field pH test)*	pH Units		Inorg-063	[NT]
pH$_{FOX}$ (field peroxide test)*	pH Units		Inorg-063	[NT]

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			[NT]
Date analysed	-			[NT]
Moisture	%	0.1	Inorg-008	[NT]

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			10/06/2014	[NT]	[NT]	LCS-W1	10/06/2014
Date analysed	-			10/06/2014	[NT]	[NT]	LCS-W1	10/06/2014
TRHC$_{6}$ - C$_{9}$	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	98%
TRHC$_{6}$ - C$_{10}$	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	98%
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	98%
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	99%
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	97%
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	LCS-W1	97%
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	97%
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]

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
Surrogate Dibromofluoromethane	%		Org-016	102	[NT]	[NT]	LCS-W1	102%
Surrogate toluene-d8	%		Org-016	99	[NT]	[NT]	LCS-W1	101%
Surrogate 4-BFB	%		Org-016	99	[NT]	[NT]	LCS-W1	102%

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	-			10/06/2014	[NT]	[NT]	LCS-W1	10/06/2014
Date analysed	-			10/06/2014	[NT]	[NT]	LCS-W1	10/06/2014
TRHC_{10} - C_{14}	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	117%
TRHC_{15} - C_{28}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	108%
TRHC_{29} - C_{36}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	101%
TRH>C_{10} - C_{16}	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	117%
TRH>C_{16} - C_{34}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	108%
TRH>C_{34} - C_{40}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	101%
Surrogate o-Terphenyl	%		Org-003	103	[NT]	[NT]	LCS-W1	115%

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	-			10/06/2014	[NT]	[NT]	LCS-W1	10/06/2014
Date analysed	-			10/06/2014	[NT]	[NT]	LCS-W1	10/06/2014
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	100%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	[NT]	[NT]	LCS-W1	99%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	95%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	99%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	102%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	[NT]	[NT]	LCS-W1	104%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	98%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	[NT]	[NT]	LCS-W1	98%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	111198-30	10/06/2014 || 10/06/2014	111198-2	10/06/2014
Date analysed	-	111198-30	10/06/2014 || 10/06/2014	111198-2	10/06/2014
TRHC_6 - C_9	mg/kg	111198-30	<25 || <25	111198-2	69%
TRHC_6 - C_{10}	mg/kg	111198-30	<25 || <25	111198-2	69%
Benzene	mg/kg	111198-30	<0.2 || <0.2	111198-2	60%
Toluene	mg/kg	111198-30	<0.5 || <0.5	111198-2	72%
Ethylbenzene	mg/kg	111198-30	<1 || <1	111198-2	72%
m+p-xylene	mg/kg	111198-30	<2 || <2	111198-2	71%
o-Xylene	mg/kg	111198-30	<1 || <1	111198-2	74%
naphthalene	mg/kg	111198-30	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	111198-30	89 || 86 || RPD: 3	111198-2	72%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	111198-30	10/06/2014 || 10/06/2014	111198-2	10/06/2014
Date analysed	-	111198-30	10/06/2014 || 10/06/2014	111198-2	10/06/2014
TRHC_{10} - C_{14}	mg/kg	111198-30	<50 || <50	111198-2	101%
TRHC_{15} - C_{28}	mg/kg	111198-30	<100 || <100	111198-2	107%
TRHC_{29} - C_{36}	mg/kg	111198-30	<100 || <100	111198-2	117%
TRH>C_{10}-C_{16}	mg/kg	111198-30	<50 || <50	111198-2	101%
TRH>C_{16}-C_{34}	mg/kg	111198-30	<100 || <100	111198-2	107%
TRH>C_{34}-C_{40}	mg/kg	111198-30	<100 || <100	111198-2	117%
Surrogate o-Terphenyl	%	111198-30	81 || 81 || RPD: 0	111198-2	97%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	111198-30	10/06/2014 || 10/06/2014
Date analysed	-	111198-30	10/06/2014 || 10/06/2014
Naphthalene	mg/kg	111198-30	<0.1 || <0.1
Acenaphthylene	mg/kg	111198-30	<0.1 || <0.1
Acenaphthene	mg/kg	111198-30	<0.1 || <0.1
Fluorene	mg/kg	111198-30	<0.1 || <0.1
Phenanthrene	mg/kg	111198-30	<0.1 || <0.1
Anthracene	mg/kg	111198-30	<0.1 || <0.1
Fluoranthene	mg/kg	111198-30	<0.1 || <0.1
Pyrene	mg/kg	111198-30	<0.1 || <0.1
Benzo(a)anthracene	mg/kg	111198-30	<0.1 || <0.1
Chrysene	mg/kg	111198-30	<0.1 || <0.1
Benzo(b+k)fluoranthene	mg/kg	111198-30	<0.2 || <0.2
Benzo(a)pyrene	mg/kg	111198-30	<0.05 || <0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	111198-30	<0.1 || <0.1
Dibenzo(a,h)anthracene	mg/kg	111198-30	<0.1 || <0.1

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Benzo(g,h,i)perylene	mg/kg	111198-30	<0.1 || <0.1
Surrogate p-Terphenyl-d14	%	111198-30	87 || 91 || RPD: 4

QUALITY CONTROL Total PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	[NT]	[NT]
Date analysed	-	[NT]	[NT]
Total PCB (Arochlor 1016-1260)	mg/kg	[NT]	[NT]
Surrogate TCLMX	%	[NT]	[NT]

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	111198-30	10/06/2014 || 10/06/2014	111198-2	10/06/2014
Date analysed	-	111198-30	10/06/2014 || 10/06/2014	111198-2	10/06/2014
Arsenic	mg/kg	111198-30	<4 || <4	111198-2	105%
Cadmium	mg/kg	111198-30	<0.4 || <0.4	111198-2	112%
Chromium	mg/kg	111198-30	15 || 7 || RPD: 73	111198-2	102%
Copper	mg/kg	111198-30	13 || 14 || RPD: 7	111198-2	113%
Lead	mg/kg	111198-30	9 || 8 || RPD: 12	111198-2	106%
Mercury	mg/kg	111198-30	<0.1 || <0.1	111198-2	90%
Nickel	mg/kg	111198-30	12 || 8 || RPD: 40	111198-2	108%
Zinc	mg/kg	111198-30	18 || 11 || RPD: 48	111198-2	110%

Report Comments:

Asbestos-ID in soil: Excessive sample volumes were provided for asbestos analysis. A portion of each of the supplied samples were sub-sampled according to Envirolab procedures. We cannot guarantee that these sub-samples are indicative of the entire samples. Envirolab recommends supplying 40-50g (50mL) of sample in its own container as per AS4964-2004.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteriae has been exceeded for 111198-1 for Pb & Ni. Therefore a triplicate result has been issued as laboratory sample number 111198-38.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteriae has been exceeded for 111198-30 for Cr. Therefore a triplicate result has been issued as laboratory sample number 111198-39.

PCB's in soil: The RPD for duplicate results is accepted due to the non homogenous nature of the sample/s.

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

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

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in 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.

APPENDIX F – GEOTECHNICAL REPORT

SMEC Testing Services Pty Ltd

ACN 101 164 792 ABN 22 101 164 792
CONSULTING GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

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GEOTECHNICAL INVESTIGATION
CNR. OF WILLIAM STREET AND PITTWATER ROAD, BROOKVALE

FOR

SMEC AUSTRALIA PTY LIMITED

PROJECT NO. 19733/4378C **JUNE 2014**
REPORT NO. 14/1207

TABLE OF CONTENTS **PAGE NO.**

1. INTRODUCTION

This report presents the results of a geotechnical investigation undertaken by SMEC Testing Services Pty Limited (STS) for a proposed new development to be constructed at the corner of William Street and Pittwater Road, Brookvale (the ‘site’). The proposed development will include several above ground levels. A basement excavation is not proposed at this time.

The purpose of the investigation was to:

- determine the subsurface conditions over the site including groundwater depth,
- provide recommendations regarding the appropriate foundation system for the site including design parameters,
- comment on the aggressivity of the soils to buried steel and concrete.

The work was carried out at the request of Daniel Saunders of SMEC Australia Pty Limited.

SMEC Australia is separately providing an environmental report for the subject site. This geotechnical report will not provide comments on the results of the environmental investigation.

2. NATURE OF THE INVESTIGATION

2.1 Fieldwork Details

The geotechnical fieldwork consisted of drilling five (5) boreholes numbered BH1 to BH5, inclusive, at the locations shown on Drawing No. 14/1207. The boreholes were drilled using an Edson RP70 drilling rig owned and operated by SMEC Testing Services Pty Limited. The boreholes were advanced using solid flight augers and were drilled at locations nominated by SMEC Australia. In order to determine soil strengths, Dynamic cone penetrometer (DCP) tests were carried out at each geotechnical borehole location. Drilling operations were undertaken by one of STS's senior geologists who also logged the subsurface conditions encountered.

The subsurface conditions observed are recorded on the borehole logs in Appendix A. An explanation of the terms used on the logs is also given in Appendix A. Notes relating to geotechnical reports are also attached.

2.2 Laboratory Testing

For the purpose of assessing the soil aggressiveness representative samples were tested to determine pH, sulphate content and chloride content. These tests were carried out at the laboratory of Envirolab who are NATA accredited for these tests.

Detailed test reports are given in Appendix B.

3. GEOLOGY AND SITE CONDITIONS

The Sydney geological series sheet at a scale of 1:100,000 shows that part of the site is underlain by the Quaternary Age alluvial soils comprising silty sand, silt and clay. The site is located close to a geological boundary with Triassic Age Hawkesbury Sandstone. Rocks within this formation typically consist of medium to quartz grained sandstone with minor shale and laminite lenses.

At the time of the fieldwork, there were several existing buildings and structures present on the site, these typically comprised factory units, a single storey brick house and a multi storey concrete building. The existing surface comprised a mixture of asphaltic concrete and concrete pavements. Site vegetation comprised grass, weeds and shrubs. The groundsurface falls about 2.5 metres towards the northwest.

4. SUBSURFACE CONDITIONS

When making an assessment of the subsurface conditions across a site from a limited number of boreholes there is the possibility that variations may occur between test locations. The data derived from the site investigation programme are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. The actual conditions at the site may differ from those inferred, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies.

The subsurface conditions generally consist of concrete and fill overlying clayey silty sands, silty sands, clayey sands, sandy silty clays, sandy clays, silty clays and weathered sandstone. Concrete was cored in BH5 and has thicknesses of 120 mm. Fill was observed across the site to depths 1.2 to 1.5 metres. The fill appears to be uncontrolled and contains gravel, ash and sandstone pieces.

Underlying the concrete and fill are natural clayey silty sands, silty sands, clayey sands, sandy silty clays, sandy clays and silty clays to depths of 1.2 to 8.5 metres. The strength of these materials varied between very loose/firm to stiff, becoming very stiff with depth. Sandstone bedrock was encountered in all geotechnical boreholes to the depth of auger refusal, 1.7 to 9.7 metres. The bedrock becomes shallower towards the south.

Groundwater was observed in the boreholes during drilling at depths of 1.8 to 3.8 metres. Due to the shallow nature of the groundwater, piezometers were not installed.

5. GEOTECHNICAL ASSESSMENT

5.1 Site Classification

The classification has been prepared in accordance with the guidelines set out in the Residential Slabs and Footings" Code, AS2870 - 2011.

More than 400 mm of uncontrolled fill is present, therefore the site is classified a *problem site (P).*

5.2 Foundations

The allowable bearing pressures given below have been determined using the procedures given by Pells et al, in their paper titled "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region," published in the Australian Geomechanics Journal, 1998.

The fill materials encountered on the site do not appear to have been placed in a controlled manner, and therefore must not be relied upon for support. It is recommended that the loads be transferred to the underlying natural materials using piers.

Piers founded in the very stiff clays may be proportioned using an allowable bearing pressure of 450 kPa, provided that their depth to diameter ratio exceeds a value of 4. An allowable adhesion of 20 kPa applies to the portion of the shaft within the natural soils.

Piers founded in weathered sandstone may be proportioned using an allowable bearing pressure of 800 kPa. An allowable adhesion of 80 kPa applies to the portion of the shaft within the weathered rock. When piers are founded in weathered rock the adhesion in the overlying soils must be ignored. These values may be increased to 1000 kPa and 100 kPa respectively when founding below the depth of auger refusal as noted on the borehole logs.

The boreholes encountered alluvial soils and uncontrolled fill with a high water table, therefore the site will not be suitable for open hole bored piers. In this regard the site may be better suited to either steel screw piers or continuous flight auger (CFA) grout injected piers.

In order to ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations is free of all loose material prior to concreting. To this end, it is recommended that all excavations be concreted as soon as possible, preferably immediately after excavation, cleaning, inspection and approval.

During construction it is recommended that the founding level be inspected by a geotechnical engineer to assess adequate bearing has been achieved.

5.3 Soil Aggressiveness

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of soil pH and the types of salts present, generally sulphates and chlorides. In order to determine the degree of aggressiveness, the test values obtained are compared to Tables 6.4.2 (C) and 6.5.2 (C) in AS2159 – 2009 Piling – Design and Installation. The test results are summarised in the table below.

Sample No.	Location	Depth (m)	Chloride (mg/kg)	pH	Sulfate (mg/kg)
GB1 2.0	BH1	2.0	<10	6.1	10
GB1 3.5	BH2	3.5	<10	5.8	57

The report results range between:

- pH - 5.8 and 6.1
- soluble SO_4 - 10 and 57 mg/kg (ppm)
- soluble chloride - <10 mg/kg (ppm)

The soils on the site consist of sands and clays below the water table. Therefore, the soil conditions A are considered appropriate.

A review of the durability aspects indicates that:

- pH : minimum value of 5.8
- SO_4 : maximum 57 mg/kg (ppm) < 5000 ppm
- C1 : maximum <10 mg/kg (ppm) < 5000 ppm

The exposure classification for the onsite soils is non-aggressive for steel and mildly aggressive for concrete.

6. FINAL COMMENTS

During construction should the subsurface conditions vary to those inferred in this report, a suitably experienced geotechnical engineer should review the design and recommendations given above to determine if any alterations are required.

Matt Green BSC Hons Engineering Geologist	Laurie Ihnativ, BE, MEngSc, MBA, FIE Aust. Manager, SMEC Testing Services Pty Limited

SMEC TESTING SERVICES Pty. Ltd.	Scale: Unknown	Date: June 2014
Client: SMEC AUSTRALIA		
PRELIMINARY GEOTECHNICAL INVESTIGATION CNR WILLIAM STREET & PITTWATER ROAD, BROOKVALE BOREHOLE AND PENETROMETER LOCATIONS	Project No. 19733/4378C Drawing No: 14/1207	

NOTES RELATING TO GEOTECHNICAL REPORTS

Introduction

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC Testing Services Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, SMEC Testing Services Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC Testing Services Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information or Tendering Purposes

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

APPENDIX A

BOREHOLE LOGS AND EXPLANATION SHEETS

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: SMEC Australia
Project: Cnr William Street and Pittwater Road, Brookvale
Location: Refer to Drawing No. 14/1207

Project No.: 19733/4378C
Date : June 6, 2014
Logged: JK

BOREHOLE NO.: BH 1

Sheet 1 of 2

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
			ASPHALT: (70 mm thick)			
		1.0	SANDY GRAVEL: dark grey, fine to medium grained, dark grey gravel/ash ASH/FILL	GW	VERY LOOSE TO LOOSE	D
WT	GB1 @ 2.0 m	2.0	SILTY SAND: dark grey, fine to medium grained, trace of clay	SM	VERY LOOSE	M
		3.0	CLAYEY SILTY SAND: dark grey, fine to medium grained	SM	VERY LOOSE	W
	GB1 @ 3.6 m		SILTY SANDY CLAY: red brown, fine to medium grained, low plasticity	CL	STIFF	W
		4.0 5.0	SANDY CLAY: orange brown with light grey and red brown, fine to medium grained, medium plasticity, occasional gravel	CL	VERY STIFF	M

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: SMEC Australia
Project: Cnr William Street and Pittwater Road, Brookvale
Location: Refer to Drawing No. 14/1207

Project No.: 19733/4378C
Date : June 6, 2014
Logged: JK

BOREHOLE NO.: BH 1

Sheet 2 of 2

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
		7.0 8.0	SANDY CLAY: orange brown with light grey and red brown, fine to medium grained, medium plasticity, occasional gravel	CL	VERY STIFF	M
		9.0	WEATHERED SANDSTONE: light grey with orange brown and red brown, fine to medium grained		EXTREMELY LOW STRENGTH	M-D
		10.0 11.0	AUGER REFUSAL AT 9.7 M ON WEATHERED SANDSTONE			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: SMEC Australia
Project: Cnr William Street and Pittwater Road, Brookvale
Location: Refer to Drawing No. 14/1207

Project No.: 19733/4378C
Date : June 6, 2014
Logged: JK

BOREHOLE NO.: BH 2

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			ASPHALT: (50 mm thick)			
			SANDY GRAVEL: dark grey, fine to medium grained	GW	LOOSE	D
			CLAYEY GRAVELLY SAND: light brown with dark grey and red brown, fine to medium grained	GP	LOOSE	M-D
		1.0				
			FILL			
			SANDY CLAY: light grey with orange brown/yellow brown, fine to medium grained, medium plasticity	CL	SOFT TO FIRM	M-VM
		2.0			FIRM TO STIFF	
					STIFF	
		3.0			VERY STIFF	
WT						
		4.0				
			SILTY CLAY: yellow brown with light grey, medium to high plasticity	CL/CH	VERY STIFF	M-VM
		5.0				
			WEATHERED SANDSTONE: light grey with occasional orange brown, fine to medium grained		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 5.7 M ON WEATHERED SANDSTONE			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: SMEC Australia	Project No.: 19733/4378C	**BOREHOLE NO.: BH 3**
Project: Cnr William Street and Pittwater Road, Brookvale	Date : June 6, 2014	
Location: Refer to Drawing No. 14/1207	Logged: JK	Sheet 1 of 1

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
			GRAVELLY SANDY CLAY: light grey with light brown, fine to medium grained, low plasticity, gravel	CL	VARIABLE	M
		1.0				
			SANDSTONE/FILL			
			SANDY CLAY: light grey/dark grey, fine to medium grained, medium plasticity	CL	FIRM	M
		2.0			STIFF	
					VERY STIFF	
		3.0				
			WEATHERED SANDSTONE: yellow brown/orange brown, fine to medium grained		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 3.5 M ON WEATHERED SANDSTONE			
		4.0				
		5.0				

NOTES: D - disturbed sample   U - undisturbed tube sample   B - bulk sample
WT - level of water table or free water   N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: SMEC Australia
Project: Cnr William Street and Pittwater Road, Brookvale
Location: Refer to Drawing No. 14/1207

Project No.: 19733/4378C
Date : June 6, 2014
Logged: JK

BOREHOLE NO.: BH 4

Sheet 1 of 1

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
			CLAYEY SILTY SAND: dark brown, fine to medium grained, occasional gravel TOPSOIL/FILL	SM	LOOSE	M-VM
		1.0	SANDY CLAY: yellow brown with orange brown, fine to medium grained, occasional gravel, low plasticity FILL	CL	FIRM TO STIFF	M
		2.0 3.0	SANDY CLAY: light grey with orange brown, fine to medium grained, medium plasticity	CL	STIFF VERY STIFF	M
			WEATHERED SANDSTONE: orange brown with light grey, fine to medium grained, clayey seams		EXTREMELY LOW STRENGTH	M-D
		4.0 5.0	AUGER REFUSAL AT 3.5 M ON WEATHERED SANDSTONE			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: SMEC Australia	Project No.: 19733/4378C	**BOREHOLE NO.: BH 5**
Project: Cnr William Street and Pittwater Road, Brookvale	Date : June 6, 2014	
Location: Refer to Drawing No. 14/1207	Logged: JK	Sheet 1 of 1

WATER TABLE	**SAMPLES**	**DEPTH** (m)	**DESCRIPTION OF DRILLED PRODUCT** (Soil type, colour, grain size, plasticity, minor components, observations)	**SYMBOL**	**CONSISTENCY** (cohesive soils) or **RELATIVE DENSITY** (sands and gravels)	**MOISTURE**
			CONCRETE: (120 mm thick)			
			CLAYEY SAND: orange brown, fine to medium grained, occasional gravel	SC	FIRM	M
			SANDY CLAY: orange brown with light grey, fine to medium grained, medium plasticity, occasional gravel	CL	FIRM TO STIFF	M
		1.0	SANDY CLAY: light grey with orange brown, fine to medium grained, low plasticity	CL	STIFF TO VERY STIFF	M-D
			WEATHERED SANDSTONE: light grey with orange brown, fine to medium grained, clayey seams		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 1.7 M ON WEATHERED SANDSTONE			
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample	U - undisturbed tube sample	B - bulk sample	Contractor: STS
WT - level of water table or free water		N - Standard Penetration Test (SPT)	Equipment: Edson RP70
See explanation sheets for meaning of all descriptive terms and symbols			Hole Diameter (mm): 100
			Angle from Vertical (°) 0

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14/1 Cowpasture Place, Wetherill Park NSW 2164
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Dynamic Cone Penetrometer Test Report

Project: Cnr William Street & Pittwater Road, Brookvale
Project No.: 19733/4378C

Client: SMEC Australia
Report No.: 14/1207

Address: PO Box 1052, North Sydney
Report Date: 10/06/2014

Test Method: AS 1289.6.3.2
Page: 1 of 2

Site No.	P1	P2	P3	P4		P1	P2	P3	P4
Location	Refer to Drawing No. 14/1207	Refer to Drawing No. 14/1207	Refer to Drawing No. 14/1207	Refer to Drawing No. 14/1207					
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level					
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	*	*	22	1	3.00 - 3.15	6	10	18	
0.15 - 0.30	*	*	Refusal	2	3.15 - 3.30	7	12	22	
0.30 - 0.45	2	2	*	2	3.30 - 3.45	11	14	Refusal	
0.45 - 0.60	3	3	*	3	3.45 - 3.60	12	19		
0.60 - 0.75	2	4	*	3	3.60 - 3.75	13	22		
0.75 - 0.90	3	5	5	5	3.75 - 3.90	14	Refusal		
0.90 - 1.05	1	3	4	4	3.90 - 4.05	16			
1.05 - 1.20	1	2	6	4	4.05 - 4.20	18			
1.20 - 1.35	2	2	2	3	4.20 - 4.35	22			
1.35 - 1.50	1	1	2	5	4.35 - 4.50	Refusal			
1.50 - 1.65	2	2	2	4	4.50 - 4.65				
1.65 - 1.80	1	2	2	4	4.65 - 4.80				
1.80 - 1.95	1	2	2	4	4.80 - 4.95				
1.95 - 2.10	1	3	3	5	4.95 - 5.10				
2.10 - 2.25	1	3	4	8	5.10 - 5.25				
2.25 - 2.40	1	4	5	12	5.25 - 5.40				
2.40 - 2.55	1	5	6	14	5.40 - 5.55				
2.55 - 2.70	1	7	8	22	5.55 - 5.70				
2.70 - 2.85	1	8	14	Refusal	5.70 - 5.85				
2.85 - 3.00	1	8	10		5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Approved Signatory.................................. ....
Laurie Ihnativ - Manager

Technician: JK

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Dynamic Cone Penetrometer Test Report

Project: Cnr William Street & Pittwater Road, Brookvale | Project No.: 19733/4378C
Client: SMEC Australia | Report No.: 14/1207
Address: PO Box 1052, North Sydney | Report Date: 10/06/2014
Test Method: AS 1289.6.3.2 | Page: 2 of 2

Site No.	P5								
Location	Refer to Drawing No. 14/1207								
Starting Level	Surface Level								
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	*				3.00 - 3.15				
0.15 - 0.30	*				3.15 - 3.30				
0.30 - 0.45	2				3.30 - 3.45				
0.45 - 0.60	3				3.45 - 3.60				
0.60 - 0.75	3				3.60 - 3.75				
0.75 - 0.90	4				3.75 - 3.90				
0.90 - 1.05	5				3.90 - 4.05				
1.05 - 1.20	9				4.05 - 4.20				
1.20 - 1.35	19				4.20 - 4.35				
1.35 - 1.50	22				4.35 - 4.50				
1.50 - 1.65	Refusal				4.50 - 4.65				
1.65 - 1.80					4.65 - 4.80				
1.80 - 1.95					4.80 - 4.95				
1.95 - 2.10					4.95 - 5.10				
2.10 - 2.25					5.10 - 5.25				
2.25 - 2.40					5.25 - 5.40				
2.40 - 2.55					5.40 - 5.55				
2.55 - 2.70					5.55 - 5.70				
2.70 - 2.85					5.70 - 5.85				
2.85 - 3.00					5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Approved Signatory................................. ....

Technician: JK

Laurie Ihnativ - Manager

E1. CLASSIFICATION OF SOILS

E1.1 Soil Classification and the Unified System

An assessment of the site conditions usually includes an appraisal of the data available by combining values of engineering properties obtained by the site investigation with descriptions, from visual observation of the materials present on site.

The system used by SMEC in the identification of soil is the Unified Soil Classification system (USC) which was developed by the US Army Corps of Engineers during World War II and has since gained international acceptance and has been adopted in its metricated form by the Standards Association of Australia.

The Australian Site Investigation Code (AS1726-1981, Appendix D) recommends that the description of a soil includes the USC group symbols which are an integral component of the system.

The soil description should contain the following information in order:

Soil composition

- SOIL NAME and USC classification symbol (IN BLOCK LETTERS)
- plasticity or particle characteristics
- colour
- secondary and minor constituents (name estimated proportion, plasticity or particle characteristics, colour

Soil condition

- moisture condition
- consistency or density index

Soil structure

- structure (zoning, defects, cementing)

Soil origin

interpretation based on observation eg FILL, TOPSOIL, RESIDUAL, ALLUVIUM.

E1.2 Soil Composition

(a) Soil Name and Classification Symbol

The USC system is summarized in Figure E1.2.1. The primary division separates soil types on the basis of particle size into:

- Coarse grained soils - more than 50% of the material less than 60 mm is larger than 0.06 mm (60 µm).
- Fine grained soils - more than 50% of the material less than 60 mm is smaller than 0.06 mm (60 µm).

Initial classification is by particle size as shown in Table E1.2.1. Further classification of fine grained soils is based on plasticity.

TABLE E1.2.1 - CLASSIFICATION BY PARTICLE SIZE

NAME	SUB-DIVISION	SIZE
Clay (1)		< 2 µm
Silt (2)		2 µm to 60 µm
Sand	Fine Medium Coarse	60 µm to 200 µm 200 µm to 600 µm 600 µm to 2 mm
Gravel (3)	Fine Medium Coarse	2 mm to 6 mm 6 mm to 20 mm 20 mm to 60 mm
Cobbles (3)		60 mm to 200 mm
Boulders (3)		> 200 mm

Where a soil contains an appropriate amount of secondary material, the name includes each of the secondary components (greater than 12%) in increasing order of significance, eg sandy silty clay.

Minor components of a soil are included in the description by means of the terms “some” and “trace” as defined in Table E1.2.2.

TABLE E1.2.2 - MINOR SOIL COMPONENTS

TERM	DESCRIPTION	APPROXIMATE PROPORTION (%)
Trace	presence just detectable, little or no influence on soil properties	0-5
Some	presence easily detectable, little influence on soil properties	5-12

The USC group symbols should be included with each soil description as shown in Table E1.2.3

TABLE E1.2.3 - SOIL GROUP SYMBOLS

SOIL TYPE	PREFIX
Gravel	G
Sand	S
Silt	M
Clay	C
Organic	O
Peat	Pt

The group symbols are combined with qualifiers which indicate grading, plasticity or secondary components as shown on Table E1.2.4

TABLE E1.2.4 - SOIL GROUP QUALIFIERS

SUBGROUP	SUFFIX
Well graded	W
Poorly Graded	P
Silty	M
Clayey	C
Liquid Limit <50% - low to medium plasticity	L
Liquid Limit >50% - low to medium plasticity	H

(b) Grading

"Well graded"	Good representation of all particle sizes from the largest to the smallest.
"Poorly graded"	One or more intermediate sizes poorly represented
"Gap graded"	One or more intermediate sizes absent
"Uniformly graded"	Essentially single size material.

(c) Particle shape and texture

The shape and surface texture of the coarse grained particles should be described.

Angularity may be expressed as "rounded", "sub-rounded", "sub-angular" or "angular".

Particle **form** can be "equidimensional", "flat" or elongate".

Surface texture can be "glassy", "smooth", "rough", pitted" or striated".

(d) Colour

The colour of the soil should be described in the moist condition using simple terms such as:

Black White Grey Red
Brown Orange Yellow Green
Blue

These may be modified as necessary by "light" or "dark". Borderline colours may be described as a combination of two colours, eg. red-brown.

For soils that contain more than one colour terms such as:

- Speckled Very small (<10 mm dia) patches
- Mottled Irregular
- Blotched Large irregular (>75 mm dia)
- Streaked Randomly oriented streaks

(e) Minor Components

Secondary and minor components should be individually described in a similar manner to the dominant component.

E1.3 Soil Condition

(a) Moisture

Soil moisture condition is described as "dry", "moist" or "wet".

The moisture categories are defined as:
Dry (D) - Little or no moisture evident. Soils are running.
Moist (M) - Darkened in colour with cool feel. Granular soil particles tend to adhere. No free water evident upon remoulding of cohesive soils.

In addition the moisture content of cohesive soils can be estimated in relation to their liquid or plastic limit.

(b) Consistency

Estimates of the consistency of a clay or silt soil may be made from manual examination, hand penetrometer test, SPT results or from laboratory tests to determine undrained shear or unconfined compressive strengths. The classification of consistency is defined in Table E1.3.1.

TABLE E1.3.1 - CONSISTENCY OF FINE-GRAINED SOILS

TERM	UNCONFINED STRENGTH (kPa)	FIELD IDENTIFICATION
Very Soft	<25	Easily penetrated by fist. Sample exudes between fingers when squeezed in the fist.
Soft	25 – 50	Easily moulded in fingers. Easily penetrated 50 mm by thumb.
Firm	50 – 100	Can be moulded by strong pressure in the fingers. Penetrated only with great effort.
Stiff	100 – 200	Cannot be moulded in fingers. Indented by thumb but penetrated only with great effort.
Very Stiff	200 – 400	Very tough. Difficult to cut with knife. Readily indented with thumb nail.
Hard	>400	Brittle, can just be scratched with thumb nail. Tends to break into fragments.

Unconfined compressive strength as derived by a hand penetrometer can be taken as approximately double the undrained shear strength ($q_u = 2\ c_u$).

(c) Density Index

The insitu density index of granular soils can be assessed from the results of SPT or cone penetrometer tests. Density index should not be estimated visually.

TABLE E1.3.2 - DENSITY OF GRANULAR SOILS

TERM	SPT N VALUE	STATIC CONE VALUE q_c (MPa)	DENSITY INDEX (%)
Very Loose	0 – 3	0 - 2	0 - 15
Loose	3 – 8	2 - 5	15 - 35
Medium Dense	8 – 25	5 - 15	35 - 65
Dense	25 – 42	15 - 20	65 - 85
Very Dense	>42	>20	>85

E1.4 Soil Structure

(a) Zoning

A sample may consist of several zones differing in colour, grain size or other properties. Terms to classify these zones are:

Layer - continuous across exposure or sample
Lens - discontinuous with lenticular shape
Pocket - irregular inclusion
Each zone should be described, their distinguishing features, and the nature of the interzone boundaries.

(b) Defects

Defects which are present in the sample can include:

- fissures
- roots (containing organic matter)
- tubes (hollow)
- casts (infilled)

Defects should be described giving details of dimensions and frequency. Fissure orientation, planarity, surface condition and infilling should be noted. If there is a tendency to break into blocks, block dimensions should be recorded

E1.5 Soil Origin

Information which may be interpretative but which may contribute to the usefulness of the material description should be included. The most common interpreted feature is the origin of the soil. The assessment of the probable origin is based on the soil material description, soil structure and its relationship to other soil and rock materials.

Common terms used are:

“Residual Soil” - Material which appears to have been derived by weathering from the underlying rock. There is no evidence of transport.

“Colluvium” - Material which appears to have been transported from its original location. The method of movement is usually the combination of gravity and erosion.

“Landslide Debris” - An extreme form of colluvium where the soil has been transported by mass movement. The material is obviously distributed and contains distinct defects related to the slope failure.

“Alluvium” - Material which has been transported essentially by water. Usually associated with former stream activity.

“Fill” - Material which has been transported and placed by man. This can range from natural soils which have been placed in a controlled manner in engineering construction to dumped waste material. A description of the constituents should include an assessment of the method of placement.

E1.6 Fine Grained Soils

The physical properties of fine grained soils are dominated by silts and clays.

The definition of clay and silt soils is governed by their Atterberg Limits. Clay soils are characterised by the properties of cohesion and plasticity with cohesion defines as the ability to deform without rupture. Silts exhibit cohesion but have low plasticity or are non-plastic.

The field characteristics of clay soils include:

- dry lumps have appreciable dry strength and cannot be powdered
- volume changes occur with moisture content variation
- feels smooth when moist with a greasy appearance when cut.

The field characteristics of silt soils include:

- dry lumps have negligible dry strength and can be powdered easily
- dilatancy - an increase in volume due to shearing - is indicted by the presence of a shiny film of water after a hand sample is shaken. The water disappears upon remoulding. Very fine grained sands may also exhibit dilatancy.
- low plasticity index
- feels gritty to the teeth

E1.7 Organic Soils

Organic soils are distinguished from other soils by their appreciable content of vegetable matter, usually derived from plant remains.

The soil usually has a distinctive smell and low bulk density.

The USC system uses the symbol Pt for partly decomposed organic material. The O symbol is combined with suffixes “O” or “H” depending on plasticity.

Where roots or root fibres are present their frequency and the depth to which they are encountered should be recorded. The presence of roots or root fibres does not necessarily mean the material is an “organic material” by classification.

Coal and lignite should be described as such and not simply as organic matter.

APPENDIX B

LABORATORY TEST RESULTS

APPENDIX G – LICENCES TO KEEP DANGEROUS GOODS

APPENDIX H – SITE PHOTOGRAPHS

Site Photographs – 30011256 – 612 to 624 Pittwater Road, Brookvale NSW

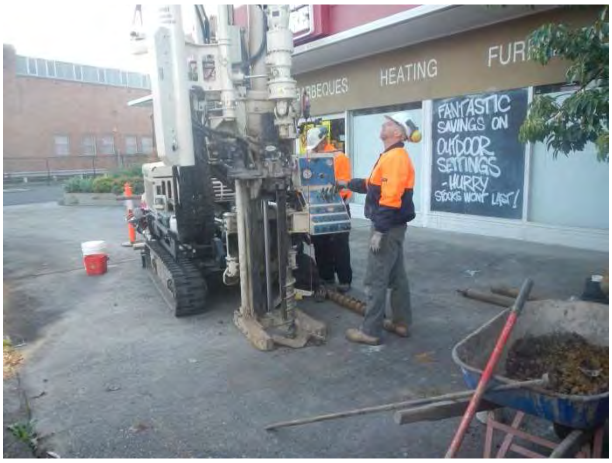


Photo 1 – Front of BBQ Galore (624/1 Pittwater Road) – Installation of MB1 - View looking North.

Photo 2 – Front of BBQ Galore (624/1 Pittwater Road) – Installation of MB1 - View looking South.

Photo 3 – Rear of BBQ Galore (624/1 Pittwater Road) – Potential UST - View looking South-east.

Photo 4 – Ash Fill identified within bore adjacent to potential UST at rear of 624/1 Pittwater Road.

Photo 5 – Side Access to 624/2 Pittwater Road. View looking east.

Photo 6 – Rear of BBQ Galore (624/2 Pittwater Road- Pet O). View looking south-east.

Site Photographs – 30011256 – 612 to 624 Pittwater Road, Brookvale NSW

Photo 7 – North-western (remediated) section of 620 Pittwater Road. View looking north-west.

Photo 8 – Shed and abandoned car at rear of 620 Pittwater Road. View looking north-east.

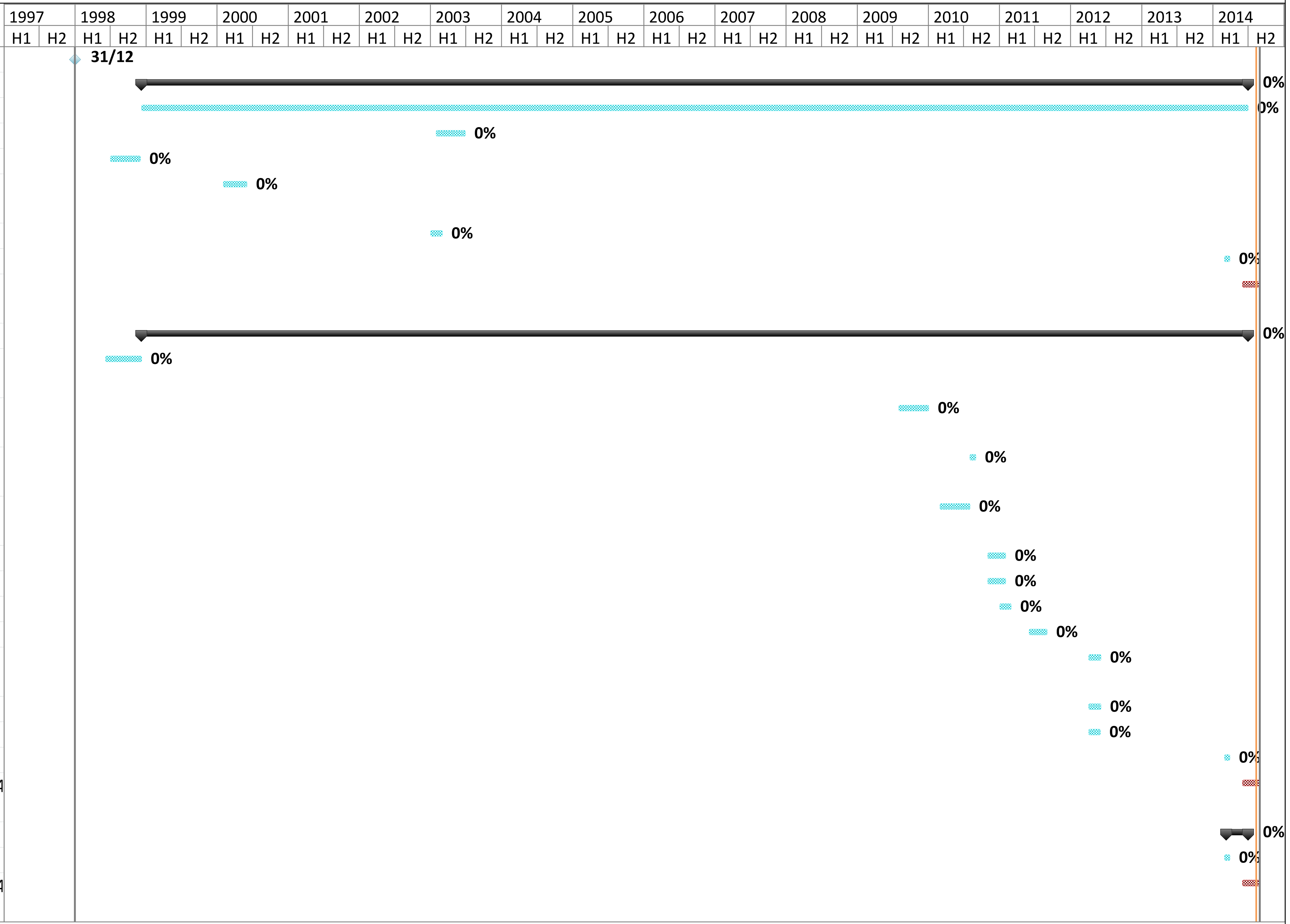
Photo 9 – Potential Asbestos shed rear of 620 Pittwater Road. View looking east.

Photo 10 – Remediated former Mobil Site (612 Pittwater Road). View looking south.

APPENDIX I – ENVIRONMENTAL SURVEY TIMELINE

Brookvale History Env Assessment

ID	Task Name
1	Mobile Service Station Closed
2	**612-614 Pittwater Road**
3	612-614 Pittwater Road
4	Summary Site Audit Report Former Mobil Service Station (David Lam)
5	Environmental Site Assessment 612 Pittwater Road Brookvale (Handex, 1998)
6	Remediation Action Plan - Former Mobil Service Station and Adjoing Property Cnr of Williams and Pittwater Road Brookvale (PPK, 2000)
7	Site Remediation and Validation 612 Pittwater Road Brookvale (PB, 2003)
8	Due Dilligence Assessment 612-624 Pittwater Road, Brookvale
9	Geotechnical and Contamination Targeted Environmental Site Assessment - 624 Pittwater Road Brookvale (SMEC, 2014)
10	**620 Pittwater Road**
12	Limited Environmental assessment - 620 Pittwater Road Brookvale (Handex, 1998)
13	Groundwater Monitoring Eevent August 2009 - 620 Pittwater Road, Brookvale (PB, 2010)
14	Post Phase 2 Environmental Site Assessment 620 Pittwater Road, Brookvale (PB, 2010)
15	Groundwater Monitoring Event March 2010 - 620 Pittwater Road Brookvale (PB, 2010
16	Soil Validation Report 620 Pittwater Road Brookvale (PB, 2011)
17	Soil Vapour Intrusion Assessment 620 Pittwater Road (PB, 2011)
18	Site Risk Assessment Plan 620 Pittwater Road (PB, 2011)
19	Environmental Report, 620 Pittwater Road Brookvale (PB, 2011)
20	Additional Onsite Human Health Risk Assessment Advice 620 Pittwater Road (PB, 2012)
21	Onsite Human Health Risk Assessment 620 Pittwater Road (PB, 2012)
22	Environmental Report 620 Pittwater Road (PB, 2012)
23	Due Dilligence Assessment 612-624 Pittwater Road, Brookvale
24	Geotechnical and Contaminated Targeted Environmental Site Assessment - 624 Pittwater Road Brookvale (SMEC, 2014)
25	**624 Pittwater Road**
27	Due Dilligence Assessment 612-624 Pittwater Road, Brookvale
28	Geotechnical and Contaminated Targeted Environmental Site Assessment - 624 Pittwater Road Brookvale (SMEC, 2014)



Critical Progress		Start-only		Baseline		Summary		Inactive Task	
Task		Finish-only		Baseline Split		Manual Summary		Inactive Milestone	◇
Split		Duration-only		Baseline Milestone	◇	Project Summary		Inactive Summary	
Task Progress		Critical		Milestone	◆	External Tasks		Deadline	↓
Manual Task		Critical Split		Summary Progress		External Milestone	◆		

Enclosure B

Parsons Brinckerhoff GME report

Parsons Brinckerhoff Australia Pty Limited

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A GRI Rating: Sustainability Report 2011

14 May 2015

Ryan Thoroughgood
Project Director
Health Infrastructure
Level 6, 77 Pacific Highway,
North Sydney, NSW, 2060

Our ref: 2201675A-RES-LTR-0841 RevA

By email
Ryan.Thoroughgood@health.nsw.gov.au

Dear Ryan

Groundwater Monitoring Event (May 2015) - 612–624 Pittwater Road, Brookvale NSW

1. Introduction

Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) was commissioned by NSW Health Infrastructure (HI) to undertake a wet weather and dry weather groundwater monitoring event (GME) in May 2015 at a site located at 612 – 624 Pittwater Road, Brookvale (the site), the site location is presented on Figure 1. The purpose of the GME was to establish the current status of the groundwater with respect to hydrocarbon contamination identified previously at the site. The objectives of the GME were to:

- monitor contaminant concentrations in groundwater at the site, in particular, hydrocarbon contamination historically identified at the western boundary of number 620 Pittwater Road
- monitor the potential effect rainfall has on contaminant concentrations in groundwater at the site
- compare groundwater data to previous results in order to identify any trends in the nature and extent of contamination
- assess the risk that any reported impacts may pose to future users of the proposed community health centre so that the requirement for a vapour assessment can be defined to measure potential vapour risks to future users of the site.

2. Scope of work

The scope of works for the May 2015 GME comprised:

- gauging and sampling of four groundwater monitoring wells located at the site (MW01 to MW03 and MB1) at two separate events, one wet weather event and one dry weather event in May 2015
- submission of the groundwater samples to the laboratories for analysis of contaminants of concern including total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylene (BTEX compounds), PAHs and metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc)
- preparation of this letter report documenting and interpreting the finding of the investigations.

3. Background

It is understood HI acquired the site in December 2014 with the intention to develop it into a new community health centre, as a part of the Northern Beaches Health Services Redevelopment. The site comprises the following:

- Number 612, comprising Lot A, Lot B and Lot C of deposit plan 375728, historically used as a service station and currently vacant
- Number 620, comprising Lot 1, DP 500541, historically used as a residence, and currently unused
- Number 624, comprising Lot 3 DP 539384, historically and currently used for commercial and light industrial activities

A number of previous investigations have been conducted at number 612 and number 620 comprising the removal and validation of underground storage tanks (USTs) at number 612, removal, land farming and replacement of hydrocarbon impacted soil at number 612 and removal and validation of hydrocarbon impacted soil at number 620. The following summarises the current status of the site:

- Number 612 was historically used as a service station containing seven USTs and additional fuel infrastructure. The fuel infrastructure was removed in 1999 and the site was validated in 2000, residual contamination was reported in soil at the northern boundary of the site. Material removed from the excavations was land farmed and backfilled. TRH exceedances of samples collected from land farmed material were identified when compared to the new NEPM.
- A review of hydrocarbon impacted material removed and land farmed historically at number 612 indicated concentrations of TRH exceed the current applicable NEPM HSL criteria.
- Residual hydrocarbon contamination was historically identified in soil, groundwater and soil vapour at number 620. The site was remediated to the extent practical in 2011; however, residual contamination was reported in soil at depths ranging from 2.7 mBGL to 3.0 mBGL on excavation surfaces.
- A site audit report conducted by Environ (2013b) reported the site had been remediated to the extent practicable to a standard considered suitable for commercial/industrial land use.
- Investigations conducted by SMEC of the entire site has identified soil and groundwater contamination at the western boundary of number 620 below the applicable criteria for commercial/industrial use, however, potential soil vapour risks have been identified
- Warehouse buildings at the site have been inspected and various contaminating activities have been identified. Contamination sampling has not been conducted below these structures
- Solutions Engineering have completed an asbestos register for structures on-site and identified asbestos in most structures. This was followed by the preparation of an asbestos management plan to be applied during site works.
- A survey was conducted for the site and was provided by HI, the survey identified one UST at the north-eastern portion of the site

4. Summary of previous investigations

A summary of recent investigations carried out my SMEC Australia Pty Ltd (SMEC) is provided in the following section.

4.1 Targeted ESA (August 2014)

SMEC undertook supplementary environmental site assessment (ESA) works in August 2014. The investigation comprised installation of 12 soil bores ranging from 0.5 metres below ground level (mBGL) to 9.7 mBGL for the purposes of a combined geotechnical and contamination assessment. One borehole was converted into a monitoring well, followed by groundwater monitoring of two existing and the newly installed well (three in total).

TRH C6-C10 and TPH >C10-C16 was reported above the relevant NEPM (2013) assessment criteria in the sample collected from one soil sample location at the south western corner of the house at number 620 at depth of 1.5 mBGL.

Remaining soil results were reported below the adopted site criteria or for compounds for which criteria is not available. Asbestos was not detected in samples analysed which were sampled for absence and presence, not in accordance with NEPM requirements for quantitative asbestos assessment.

Two groundwater sampling events were undertaken as a part of the investigation due to the effect of rainwater on the groundwater horizon. Three of six onsite monitoring wells were sampled, including MB1, SP1 and SP2. Standing water levels ranged from 0.79 mBGL (SP2) to 1.22 mBGL (MB1) during the first round of sampling (following the rainfall event) and 0.89 mBGL (SP2) to 1.27 mBGL (SP1) during the second round. Results indicated hydrocarbon impacts were detected in the sample collected from SP1 located at the south western corner of the house at number 620 with toluene exceeding the adopted site criterion.

4.2 Additional Investigation (September 2014)

Following completion of the August 2014 ESA, a number of data gaps were identified. SMEC completed an additional investigation to gain a better understanding of historical hydrocarbon contamination at number 620 and close data gaps associated with the remainder of the site.

In relation to the soil and groundwater assessment, the report indicated the following:

- three additional groundwater wells were installed,
- soils samples were collected from six additional boreholes (the depth of which was not disclosed),
- two off-site groundwater wells, one onsite well and three newly installed were assessed
- two soil vapour sampling locations at number 612 and four soil vapour sampling locations at number 620 were installed to target soil at a depth of 1 mBGL to 2 mBGL

SMEC reported results from off-site groundwater wells indicated groundwater was detected at depths of approximately 2.3 mBGL to 2.4 mBGL and reported hydrocarbon concentrations were below the adopted site criteria. Standing water levels for onsite wells were not recorded.

The presence of an UST was confirmed at the rear (east) of the building. Hydrocarbon results from a newly installed well targeting the UST were below the applicable HSL criteria.

SMEC reported trace level VOCs were reported at one soil vapour location, VP3, at the western boundary of number 620.

Parsons Brinckerhoff reviewed laboratory results for the investigation from HI. Laboratory results were compared to the relevant NEPM criteria for commercial/industrial use. A summary of the results are provided below:

- Hydrocarbon contamination was reported in the sample collected at a depth of 2.0-2.1 at location BH4; concentrations were below the HSL D criterion. It should be noted that elevated concentrations of naphthalene, ethylbenzene and F2 were detected for which not limiting (NL) factors were provided.
- Minor hydrocarbon contamination was reported in soil collected at a depth of 0.1-0.2 at location BH3 below the HSL D criterion. It should be noted that elevated concentrations of higher fraction TRH was detected for which criteria is not available.
- Concentrations of PAHs were reported in soil collected from BH2 at a depth of 0.5-0.6, BH4 at a depth of 2.0-2.1 and BH5 at a depth of 0.0-0.1 below the relevant HIL D criterion
- Soil vapour VOCs were detected at vapour sampling location VP3, adjacent to BH4. Elevated concentrations of hexane, ethylbenzene, 124-Trimethylbenzene and xylene, were detected. It should be noted that applicable HSL criterion is not provided for 124-trimethylbenzene or hexane. Other analytes were below the adopted HSL values.
- Results for off-site wells were not provided it is not clear if the wells were sampled
- Concentrations of chloroform were detected in monitoring wells sampled marginally above the LOR with the exception of MW2; concentrations are likely to be naturally occurring.
- Elevated concentrations of VOC compounds, including BTEX, were detected in groundwater sampled from MW2. It should be noted that relevant GIL criteria was not available for elevated VOC compounds.

In conclusion, evidence of residual hydrocarbon contamination was detected in soil, groundwater and soil vapour at the western boundary of number 620. Soil contamination was evident in natural material above bedrock and was not delineated horizontally or at depth, however, concentrations were reported below the adopted criteria. Soil vapour risks were reported at the western boundary of number 620.

5. Groundwater sampling methodologies

The four groundwater monitoring wells located at the site were gauged and sampled on 4 May 2015 to target a wet weather rain event and 7 May 2015 to target a dry weather monitoring event. The GME comprised gauging and sampling of the monitoring well in accordance with standard industry practice and the Parsons Brinckerhoff documented standard field procedures. The groundwater monitoring well was gauged prior to sampling with an oil-water interface probe to detect light non-aqueous phase liquids (LNAPLs) such as petroleum hydrocarbons.

HydraSleeve™ sampling was employed for sample collection. The HydraSleeve™ is a disposable 0.1 mm thick polyethylene sample sleeve containing a self-sealing reed-type check valve in the top of the sleeve. A re-useable stainless steel weight is attached to the bottom of the device in order to efficiently sink the sampler to the desired depth. When the sampling line is pulled taught, the sampler begins to fill as the device is lifted at a continuous slow rate (300 mm to 600 mm per second). Upon filling of the sleeve, the check-valve closes at the top and the sample is lifted to the surface. 625 mL sampler volume HydraSleeves with a 51 mm diameter were used for the investigation. Water quality parameters (pH, dissolved oxygen, electrical conductivity, reduction/oxidation (redox) potential and temperature) were recorded following sampling and groundwater was also visually assessed for turbidity. Samples were obtained directly from the HydraSleeve and decanted into laboratory-supplied bottles.

The field quality assurance and quality control (QA/QC) program included collection of field duplicate and triplicate samples, one equipment rinsate per sampling event, one trip blank and one trip spike per sampling event. Field duplicate samples were collected at a rate of approximately 10% of the total number of primary analyses. The duplicate sample was submitted to the primary laboratory (Envirolab Services) and the triplicate sample was sent to the secondary laboratory (Australian Laboratory Services, ALS) laboratories. Both the laboratories were accredited by National Association of Testing Authorities (NATA) for the analyses performed.

The samples were kept on ice while on-site and when in transit to the laboratories. All groundwater samples were submitted to the laboratories under chain of custody documentation by the field scientist. All the groundwater and equipment rinsate samples were analysed for the contaminants of potential concern, i.e. TRH, BTEX compounds, PAHs and metals.

6. Groundwater assessment criteria

To assess the contamination status of groundwater at a site, the assessment criteria provided in the National Environment Protection Council (NEPC) 1999, as amended 2013, *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM) were found to be applicable for the investigation. Schedule B-1 provides a framework for the use of investigation and screening levels based on a matrix of human health and ecological soil and groundwater risks.

The NEPM Schedule B-1 presents groundwater investigation levels (GILs) for protection of receiving water (ecological protection) and for human health (drinking water guidelines). It is necessary to assess the potential uses and receptors of groundwater downgradient of the site in order to correctly apply the GILs.

GILs are based on the following guidelines:

- Australian and New Zealand Conservation Council (ANZECC)/Agriculture, and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, *National water quality management strategy. Australian and New Zealand guidelines for fresh and marine water quality.*
- National Health and Medical Research Council (NHMRC)/National Resource Management Ministerial Council (NRMMC) 2011, *Australian Drinking Water Guidelines 6*.
- NHMRC 2008, *Guidelines for Managing Risk in Recreational Waters 2008*.

The GILs provide threshold values for drinking water and the protection of fresh and marine ecosystems. The GILs do not provide data for all BTEX compounds and PAHs; however, as the GILs are based on the ANZECC/ARMCANZ (2000) fresh and marine water quality guidelines, ANZECC/ARMCANZ low reliability trigger values for fresh and marine waters for BTEX compounds and PAHs can be considered.

Groundwater at the site is likely to discharge to the water bodies and urban drainage systems, such as Brookvale Creek, a freshwater water body, which is located approximately 150 m south and west and north of the site which flows into the Manly Beach, a marine water body. Based on this, the GILs for the protection of fresh ecosystems and marine ecosystems have been considered for this assessment. As the guidelines apply to receiving waters, it is generally conservative to apply these to groundwater discharging into receiving waters.

The drinking water GILs have been adopted due to the potential presence of domestic groundwater bores in proximity to the site.

Schedule B-1 of the NEPM also assesses the risk of vapour intrusion arising from groundwater impacted by hydrocarbons using health screening levels (HSLs). The adopted carbon fraction ranges for the HSLs are based on TRH analysis after subtraction of BTEX compounds and naphthalene.

The HSLs have been developed for sand, silt and clay soils based on texture classifications and criteria are listed for several depth intervals. The clay content of soils were not was analysed as a part of the investigation, therefore, soils provided for a sand profile will be adopted as a conservative approach for the investigation. Given groundwater was identified at shallow depths ranging from 0.470 mBGL to 0.845 mBGL, the HSLs for groundwater are not considered directly applicable, however, the HSL depth range of 2 mBGL to <4 mBGL was adopted as an indicative measure. The HSLs also depend on land uses scenarios. Due to the proposed commercial/industrial use of the site, the 'HSL D' criteria for commercial/industrial land use have been adopted.

Table 6.1 Groundwater assessment criteria

Analyte	HSL D(2) in sand (µg/L)		GILs (µg/L)	
	2 m to <4 m	Freshwater ecosystem(3)	Marine ecosystem(3)	Drinking water guidelines(3)
F1(1)	6000(4)	-	-	-
F2(1)	NL(4)	-	-	-
Benzene	5000	950	500	1
Toluene	NL(4)	180(6)	180(6)	800
Ethylbenzene	NL(4)	80(6)	80(6)	300
m- & p-Xylene	-	75(6)	75(6)	-
o-Xylene	-	350	-	-
Total Xylene	NL(4)	-	-	600
Naphthalene	-	16	50	-
Benzo(a)pyrene	-	-	-	0.01
Arsenic	-	24	-	10
Cadmium	-	0.2	0.7	2
Chromium(5)	-	1	4.4	50
Copper	-	1.4	1.3	2,000
Lead	-	3.4	4.4	10
Mercury	-	0.06	0.1	1
Nickel	-	11	7	20
Zinc	-	8	15	-

(1) F1: TPH C_6-C_{10} less BTEX; F2: TPH >C_{10}-C_{16} less naphthalene

(2) NEPM (2013) Schedule B1 Investigation levels for soil and groundwater – Table 1A(4)

(3) NEPM (2013) Schedule B1 Table 1C Groundwater Investigation Levels (GILs)

(4) NL – not limiting, i.e. soil vapour source concentration for a petroleum mixture could not exceed a level that would results in the maximum allowable vapour risk for the given scenario.

(5) Chromium (VI) value adopted as conservative guidelines for assessment of chromium

(6) Low reliability values (ANZECC/ARMCANZ, 2000)

7. Results

Groundwater field parameters and gauging data and samples were collected from the four monitoring wells (MW01 to MW03 and MB1) on two separate weather events, the wet weather sampling event was conducted on 4 May 2015 and the dry weather event was conducted on 7 May 2015. Results are reported in following section.

7.1 Groundwater parameters

Groundwater parameters are summarised in Tables B1 and B2 in Attachment B respectively, and historical field parameter and gauging results are summarised in Tables C1 and C2 in Attachment C. Groundwater sampling field sheets are provided in Attachment E.

SP02 could not be sampled during either sampling event due to obstruction caused by stored building materials above the well.

Table 7.1 Groundwater conditions

Parameter	Details
Depth to groundwater	The standing water levels in the four groundwater monitoring wells located across the site ranged between 0.410 m below top of casing (mBTOC) (MB1) and 0.825 mBTOC (MW03), during the wet weather event and 0.425(MB1) and 0.845 (MW03).The standing water level had decreased slightly from the wet weather to the dry weather event in all the monitoring wells across the site.
LNAPL occurrence	No LNAPL or hydrocarbon sheen was observed.
Groundwater flow direction	Groundwater flow is inferred to be towards the north. The inferred groundwater flow directions are consistent with the previous gauging results.
Groundwater quality	The field parameters measured during the wet weather and dry weather GME indicate the following: ▪ The results showed that groundwater pH values were between 4.38 and 5.03 for the wet weather event and 5.12 and 5.45 for the dry weather sampling event, indicative of acidic to circum-neutral conditions. ▪ The electrical conductivity varied between 502 µS/cm and 701 µS/cm for the wet weather event and 1021 µS/cm and1213 µS/cm for the dry weather sampling event indicating varying conditions from fresh to marginal ▪ The redox potential of the groundwater samples ranged from 322.1 mV to 515.3 mV for the wet weather e vent and 277 mV to 319 mV for the dry weather event indicating anaerobic conditions ▪ Groundwater had dissolved oxygen at concentrations between 5.63 ppm and 8.69 ppm for the wet weather event and 5.81 ppm to 8.68 ppm for the dry weather sampling event indicating moderately to well oxygenated conditions

7.2 Groundwater analytical results

Laboratory analytical results tables are provided in Attachment B, historical results are provided in Attachment C with laboratory certificates provided in Attachment G. Table 7.2 summarised the groundwater analytical results for the wet weather sampling event and Table 7.3 summarises the dry weather sampling event at the site.

Table 7.2 Groundwater results

No. of primary samples	Analyte	Conc. (µg/L)		Samples exceeding adopted GILs/HSLs	
		Min.	Max.	GILs	HSLs
TRH/BTEX compounds					
4	TRH C_6-C_{10}	<10	1,200	NA	NA
4	TRH C_6-C_{10} minus BTEX (F1)	<10	90	NA	-
4	TRH >C_{10}-C_{16}	<50	560	NA	NA
4	TRH >C_{10}-C_{16} minus naphthalene (F2)	<100	460	NA	-
4	TRH >C_{16}-C_{34} (F3)	<100	160	NA	NA
4	TRH >C_{34}-C_{40} (F4)	<100	<100	NA	NA
4	Benzene	<1	<1	-	-
4	Toluene	<2	30	-	-
4	Ethylbenzene	<2	210	MW2	-
4	m&p-Xylene	<2	830	MW2	NA
4	o-Xylene	<2	40		NA
4	Xylene (Total)	<2	870	MW2	-
4	Naphthalene	<1	94	NA	-
PAHs					
4	Naphthalene	<0.5	57	MW2	-
4	Benzo(a)pyrene	<0.5	<0.5	-	NA
Heavy metals					
4	Arsenic	<1	<1	-	NA
4	Cadmium	<0.1	2.2	MB1, MW3	NA
4	Chromium	<1	<1	-	NA
4	Copper	<1	12	MW1, MB1, MW3	NA
4	Lead	<1	18	MW3	NA
4	Mercury	<0.5	<0.5	-	NA
4	Nickel	<1	3	-	NA
4	Zinc	9	840	MW1, MB1, MW2, MW3	NA

(1) NA: Not applicable, no criteria available

(2) – no exceedance

Table 7.3 Groundwater results

No. of primary samples	Analyte	Conc. (µg/L)		Samples exceeding adopted GILs/HSLs	
		Min.	Max.	GILs	HSLs
TRH/BTEX compounds					
4	TRH C_6-C_{10}	<10	4,400	NA	NA

No. of primary samples	Analyte	Conc. (µg/L)		Samples exceeding adopted GILs/HSLs	
		Min.	Max.	GILs	HSLs
4	TRH C_6-C_{10} minus BTEX (F1)	<10	2,300	NA	-
4	TRH >C_{10}-C_{16}	<50	980	NA	NA
4	TRH >C_{10}-C_{16} minus naphthalene (F2)	<100	890	NA	-
4	TRH >C_{16}-C_{34} (F3)	<100	<100	NA	NA
4	TRH >C_{34}-C_{40} (F4)	<100	<100	NA	NA
4	Benzene	<1	<1	-	-
4	Toluene	<2	36	-	-
4	Ethylbenzene	<2	360	MW2	-
4	m&p-Xylene	<2	1,700	MW2	NA
4	o-Xylene	<2	52		NA
4	Xylene (Total)	<2	1,752	MW2	-
4	Naphthalene	<1	93	NA	-
PAHs					
4	Naphthalene	<0.5	110	MW2	-
4	Benzo(a)pyrene	<0.5	<0.5	-	NA
Heavy metals					
4	Arsenic	<1	<1	-	NA
4	Cadmium	<0.1	3.4	MW3	NA
4	Chromium	<1	<1	-	NA
4	Copper	<1	71	MW3	NA
4	Lead	<1	140	MW3	NA
4	Mercury	<0.5	<0.5	-	NA
4	Nickel	<1	5	-	NA
4	Zinc	9	1,500	MW1, MW3	NA

(1) NA: Not applicable, no criteria available
(2) – no exceedance

8. Discussion

8.1 Hydrocarbons

Lighter fraction hydrocarbons (TRH C_6-C_{10} and F1) and heavy fraction (TRH C_{10}-C_{16} and F2) were reported in groundwater sampled from MW2 during both sampling rounds. Concentrations of TRH C_6-C_{10} and F1 were reported up to three times the laboratory limit of reporting (LOR) and concentrations of TRH C_{10}-C_{16} and F2 were reported within the same order of magnitude of the LOR. Concentrations of ethylbenzene, m&p xylene, were reported above the adopted low reliability freshwater and marine water criteria and total xylene was reported above the adopted drinking water GIL criteria for the sample collected from MW2 for both sampling events. Toluene and naphthalene were also detected in the samples collected from MW2 below the criteria. TRH and BTEX compounds were reported at higher concentrations during the dry weather sampling event indicating rainfall effectively dilutes concentrations of hydrocarbon contaminants in groundwater below the site.

Hydrocarbon impacts reported during the current round of sampling were generally lower than the previous 2014 round of sampling with some TRH and BTEX concentrations an order of magnitude lower.

8.2 PAHs

Detections of naphthalene were reported in the maple collected from MW2 above the freshwater and marine water GIL criteria. Concentrations of remaining PAHs were reported below the LOR.

Historically, concentrations of naphthalene have decreased slightly from the 2014 sampling round in samples collected from MW2.

8.3 Heavy metals

Concentrations of heavy metals were detected in most groundwater monitoring wells. Concentrations of cadmium exceeded the freshwater, marine water and drinking water GILs in MB1 and MW3 during the wet weather event and MW3 during the dry weather event. Concentrations of copper exceeded the freshwater, and marine water GILs in MW1, MB1 and MW3 during the wet weather sampling event and MW3 during the dry weather sampling event. Lead exceeded the freshwater, marine water and drinking water GILs in MW3. Zinc exceeded the freshwater GIL in MW1 during the dry weather sampling event and MW2 during the wet weather sampling event and the freshwater, marine water GILs in MW1, MB1 and MW3 during the wet weather sampling event and MW3 during the dry weather sampling event.

Elevated heavy metal concentrations were generally reported in samples collected in most monitoring wells with higher concentrations general reported during the wet weather sampling event likely related to rainfall. Concentrations of heavy metals were generally similar to previous sampling events and are considered indicative of regional background concentrations found naturally within groundwater

8.4 Evaluation of quality assurance and quality control procedures

A review of quality assurance/quality control (QA/QC) results is provided in Attachment D, and a summary of QA/QC performance is provided in Attachment F. The data quality indicators (DQIs) for the GME are presented in Table 8.1.

Table 8.1 DQI performance

Procedures	Works were conducted by an experienced environmental scientist in accordance with Parsons Brinckerhoff procedures and relevant guidelines and regulations. All permits were obtained prior to works.
Storage and transport	Samples collected placed directly into laboratory prepared containers and stored in a secure chilled container. Chain of custody procedures were used to ensure the integrity of the samples from collection to receipt by the analytical laboratory.
Laboratory	All laboratories used comply with AS/NZS ISO 9001:2001 quality assurance programs, were NATA accredited and perform their own internal QA/QC programs.

QA/QC – field	For groundwater field samples, 1 in 8 blind duplicates were submitted to the primary laboratory (intra-laboratory) and to the secondary laboratory (inter-laboratory). Acceptance criteria for relative per cent difference (RPD) values are documented in Australian standard 4482.1-2005 Section 8.2.6 as 30% - 50% of the mean concentration for non- and semi-volatiles. For volatile compounds no published RPD acceptance criteria exists. The NEPM (2013) states, in Schedule B3, Guideline on laboratory analysis of potentially contaminated soil, that a review of potential causes of elevated RPDs should be conducted for results over 30%. For this investigation, RPDs <100% were considered acceptable for volatiles and <50% for semi- and non-volatiles. RPD exceedances are reported in Appendix F.
QA/QC – laboratory **Duplicates, spikes, blanks and surrogates – acceptable limits**	Laboratory DQIs vary between analytes and between laboratories. If duplicate results are not satisfactory, non-compliance is to be documented in laboratory reports. Primary laboratory QA/QC acceptance limits are as follows: ▪ Surrogates: 70% to 130% recovery ▪ Matrix spikes: 70% to 130% recovery or 80% to 120% recovery for inorganics ▪ Control samples: 80% to 120% ▪ Duplicate samples: >10 x PQL ±30% RPD; 5-10xPQL ±50% RPD; <5xPQL no criteria (due to elevated analytical uncertainty) ▪ Method blanks: zero to <PQL Three acceptance limits were reported and discussed in Attachment F.

9. Conclusion and recommendations

Parsons Brinckerhoff conducted a two groundwater sampling event at the site located at 612 – 624 Pittwater Road, Brookvale on 4 and 7 May 2015. Four groundwater wells were sampled from the monitoring well network located across the site. Samples were analysed for TRH, BTEX, PAHs and heavy metals.

Concentrations of hydrocarbon contaminants were reported in the sample collected from MW2 during both the dry weather and wet weather sampling events. Concentrations were evidently lower in the sample collected from the wet weather sampling event indicating the effect rainfall has on hydrocarbon concentrations in groundwater in the vicinity of MW2. The May 2015 groundwater results were similar to the previous sampling events with an evident decrease in hydrocarbon concentrations in MW2.

Concentrations of heavy metals were generally higher during the wet weather sampling event liely caused by an influx of rainfall. Concentrations of heavy metals were generally similar to previous sampling events and are considered indicative of regional background concentrations found naturally within groundwater.

Due to the shallow depth of groundwater at the site (above a depth of 1 mBGL), HSL criteria applicable to groundwater is generally not considered appropriate for comparison to reported groundwater results. Given concentrations of hydrocarbon contaminants were reported at elevated levels in MW2 and the nature of the secondary soil, groundwater and soil vapour investigation conducted by SMEC in September 2014 is considered limited and sampling procedures were not reported, it is considered necessary to conduct a soil vapour investigation at the site. A detailed soil vapour assessment should be conducted to target re-established land farmed material at number 612 and hydrocarbon impacted soil at number 624 to assess the potential vapour risks that any reported impacts may pose to future users of the proposed community health centre.

Yours sincerely

B Patel

Beejal Patel
Environmental Scientist

Enclosures

Attachment A	Figures
Attachment B	Groundwater analytical results
Attachment C	Historical analytical results
Attachment D	QA/QC summary tables
Attachment E	Groundwater field sheets
Attachment F	Data evaluation
Attachment G	Laboratory reports
Attachment H	Calibration certificates
Attachment I	Statement of limitations

10. References

ANZECC, 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Environ Australia Pty Ltd 2013b, *Site Audit Report – 620 Pittwater Road, Brookvale NSW.*

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Parsons Brinckerhoff 2011b*, Soil Vapour Intrusion Assessment, 620 Pittwater Road, Brookvale NSW.*

Parsons Brinckerhoff 2012a, *Site Risk Management Plan, 620 Pittwater Road, Brookvale, NSW*

Parsons Brinckerhoff 2012b, *Environmental Report, 620 Pittwater Road, Brookvale, NSW, dated June 2012.*

Parsons Brinckerhoff 2012c, *On site Human Health Risk Assessment - 620 Pittwater Road, Brookvale, NSW.*

Parsons Brinckerhoff 2013a, *Letter Addendum to 'On site Human Health Risk Assessment Report, June 2012* .

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SMEC 2014b, *Summary Of Findings Associated With New Supporting Environmental Information.*

SMEC 2014c, *Targeted Environmental Site Assessment 612–624 Pittwater Road, Brookvale NSW.*

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SMEC 2014f, *Summary of Environmental Investigations and Findings for 612-624 Pittwater Road, Brookvale.*

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Solutions Engineering 2014h, *Asbestos management Plan 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100*.

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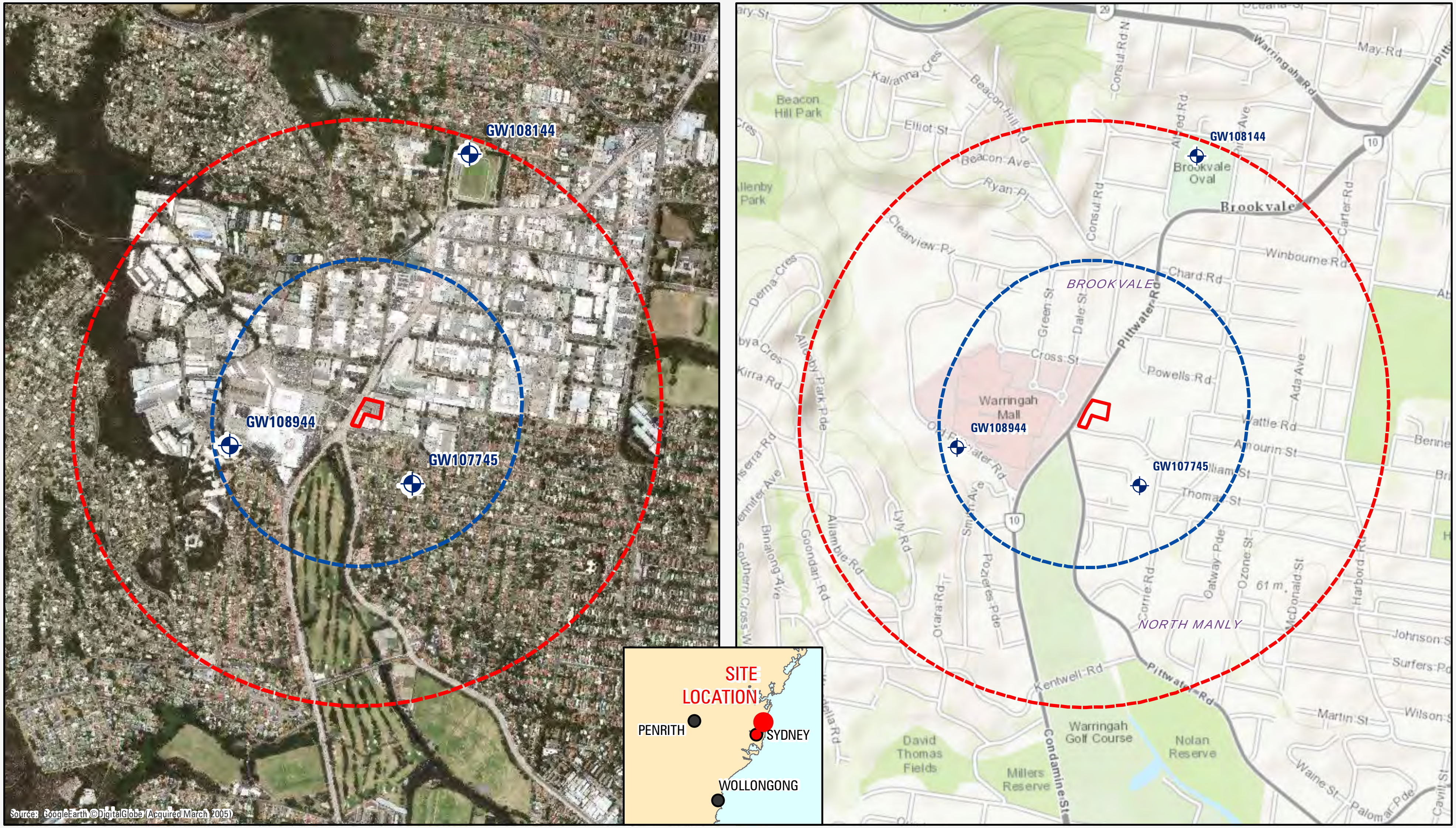
Attachment A

Figures

PARSONS BRINCKERHOFF

GROUNDWATER MONITORING EVENT - BROOKVALE
HEALTH INFRASTRUCTURE



🟥 Study area

▭ Study area 500m radius

▭ Study area 1000m radius

⊕ Registered Groundwater Bore

Figure 1 Site location

\\APSYDFIL03\proj\H\HLTH_INFRA_NSW\2201675A_CLM_NSW_HEALTH_INFRA_BROOKVAL\10_GIS\Projects\Maps\2210675A_GIS_001_A1.mxd // SaflianK // 15/05/2015

PARSONS BRINCKERHOFF

GROUNDWATER MONITORING EVENT - BROOKVALE

HEALTH INFRASTRUCTURE

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🟥	Site location
⌖	Groundwater investigation location
	RoadNameExtent

Figure 2 Groundwater Investigation locations

Attachment B

Groundwater analytical results

Table B1

Groundwater gauging results

Health Infrastructure

612-624 Pittwater Road, Brookvale, NSW

WELL No.	DATE GAUGED	WELL DEPTH (mBTOC)	SCREEN (mBTOC)	DEPTH TO WATER (m BTOC)	DEPTH TO LNAPL (m BTOC)
MW01	4/05/2015	6.900	-	0.470	Not detected
	7/05/2015	6.900	-	0.480	Not detected
MB1	4/05/2015	6.260	4.0 - 7.0	0.410	Not detected
	7/05/2015	6.260	4.0 - 7.0	0.425	Not detected
MW02	4/05/2015	5.010	-	0.550	Not detected
	7/05/2015	5.010	-	0.565	Not detected
MW03	4/05/2015	5.160	-	0.825	Not detected
	7/05/2015	5.160	-	0.845	Not detected

mBTOC - metres below top of casing
- screen depth unknown
LNAPL - Light non aqueous phase liquid

Table B2

Groundwater parameters
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

WELL No.	Date Sampled	pH	Electrical Conductivity (µs/cm)	Redox Potential[1] (mV)	Dissolved Oxygen (mg/L)	Temperature (°C)
MW01	4/05/2015	4.38	502	445.8	8.69	22.7
	7/05/2015	5.45	1021	315	8.68	22.3
MB1	4/05/2015	4.78	701	322.1	6.81	22.4
	7/05/2015	5.12	1136	306	5.81	22.8
MW02	4/05/2015	4.68	604	515.3	5.63	22.6
	7/05/2015	5.12	1137	277	8.12	22.7
MW03	4/05/2015	5.03	611	502.6	8.52	22.6
	7/05/2015	5.38	1213	319	7.56	22.5

[1] Redox potential values collected in the field using a silver chloride electrode have been corrected to standard hydrogen electrode values by adding 199 mV to each reading.

Table B3

Groundwater analytical results - TRH/BTEX compounds
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

			TRH C_6-C_{10} Fraction	**TRH >C_{10}-C_{16} Fraction**	**TRH >C_{16}-C_{34} Fraction**	**TRH >C_{34}-C_{40} Fraction**	**TRH >C_{10}-C_{40} Fraction**	**Benzene**	**Toluene**	**Ethylbenzene**	**m&p-Xylene**	**o-Xylene**	**Xylene (Total)**	**Naphthalene**	**F1 (TRH C6-C10 minus BTEX compounds)**	**F2 (TRH >C10-C16 minus naphthalene)**
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PQL	20	100	100	100	102	1	2	2	2	2	2	5	20	100
Groundwater HSLs for vapour intrusion - HSL D Commercial/Industrial: - 2 m to <4 m (in sand)[1]			-	-	-	-	-	5,000	NL	NL	-	-	NL	NL	6,000	NL
Groundwater Investigation Levels - Fresh waters[2]			-	-	-	-	-	950	180	80	75	350	-		-	-
Groundwater Investigation Levels - Marine waters[2]			-	-	-	-	-	500	180	80	75	-	-			
Groundwater Investigation Levels - Drinking water[2]			-	-	-	-	-	1	800	300	-	-	600		-	-
Location	**Sample date**	**Depth to water (m)**														
Primary samples																
MW1	4/05/2015	0.47	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<10	<50
	8/05/2015	0.48	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<10	<50
MB1	4/05/2015	0.41	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<10	<50
	8/05/2015	0.43	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<10	<50
MW2	4/05/2015	0.55	**1,200**	**560**	160	<100	**720**	<1	**30**	**210**	**830**	**40**	**870**	94	**90**	**460**
	8/05/2015	0.57	**4,400**	**980**	<100	<100	**980**	<1	**36**	**360**	**1,700**	**52**	**1,752**	93	**2,300**	**890**
MW3	4/05/2015	0.83	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<10	<50
	8/05/2015	0.85	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2	<2	<1	<10	<50

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[1] NEPC (2013) *NEPM* - Schedule B-1

[2] ANZECC (2000) *Guidelines for Fresh and Marine Water Quality*

[3] Friebel & Nadebaum, 2011, CRC CARE Technical Report No. 10: Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, Part 2: Application Document

NL = not limiting

< = concentration reported to be less than the laboratory practical quantitation limit

- = no assessment criteria available / not analysed

Bold	Detect
🟨	Exceeds adopted criteria

Table B4

Groundwater analytical results - PAHs
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

			Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b+j)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	Total PAHs
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PQL	1	1	1	1	1	1	1	1	1	1	1	1	0.5	1	1	1	0.5
Groundwater HSLs for vapour intrusion - HSL D Commercial/Industrial:																			
Groundwater HSLs for vapour intrusion - 2 m to <4 m (in sand)[1]			NL																
Groundwater Investigation Levels - Fresh waters[1,2]			16	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	
Groundwater Investigation Levels - Marine waters[1,2]			50																
Groundwater Investigation Levels - Drinking water[1]			-	-	-	-	-	-	-	-	-	-	-	-	0.01	-	-	-	-
Location	**Sample date**	**Depth (m)**																	
Primary samples																			
MW1	4/05/2015	0.47	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	<0.5
	8/05/2015	0.48	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	<0.5
MB1	4/05/2015	0.41	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	<0.5
	8/05/2015	0.43	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	<0.5
MW2	4/05/2015	0.55	**57**	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	**57.0**
	8/05/2015	0.57	**110**	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	**110.0**
MW3	4/05/2015	0.83	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	<0.5
	8/05/2015	0.85	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<5	<1	<1	<1	<0.5

[1] NEPC (2013) *NEPM* - Schedule B-1
[2] ANZECC (2000) *Guidelines for Fresh and Marine Water Quality*
NL = not limiting
< = concentration reported to be less than the laboratory practical quantitation limit
- = no assessment criteria available / not analysed

Bold	Detect
🟨	Exceeds adopted criteria

Table B5

Groundwater analytical results - Heavy metals
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

			Arsenic	Cadmium	Chromium[3]	Copper	Lead	Mercury	Nickel	Zinc
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PQL	1	0.1	1	1	1	0.1	1	5
Groundwater Investigation Levels - Fresh waters[1]			24	0.2	1	1.4	3.4	0.06	11	8
Groundwater Investigation Levels - Marine waters[1]				0.7	4.4	1.3	4.4	0.1	7	15
Groundwater Investigation Levels - Drinking water[1]			10	2	50	2,000	10	1	20	-
Location	**Sample date**	**Depth (m)**								
Primary samples										
MW1	4/05/2015	0.47	<1	**0.2**	<1	**3**	**2**	<0.05	**3**	**18**
	8/05/2015	0.48	<1	**0.2**	<1	<1	**2**	<0.05	<1	**11**
MB1	4/05/2015	0.41	<1	**2.1**	<1	**8**	2	<0.05	1	**780**
	8/05/2015	0.43	<1	0.1	<1	<1	<1	<0.05	<1	**7**
MW2	4/05/2015	0.55	<1	<0.1	<1	<1	<1	<0.05	<1	**9**
	8/05/2015	0.57	<1	<0.1	<1	<1	<1	<0.05	<1	4
MW3	4/05/2015	0.83	<1	**2.2**	<1	**12**	**18**	<0.05	**2**	**840**
	8/05/2015	0.85	<1	**3.4**	<1	**71**	**140**	<0.05	**5**	**1500**

[1] NEPC (2013) *NEPM* - Schedule B-1
[3] Investigation level for Chromium (VI) conservatively adopted for Total Chromium.
NL = not limiting
< = concentration reported to be less than the laboratory practical quantitation limit
- = no assessment criteria available / not analysed
units expressed as ug/L

Bold Exceeds one or more of the adopted GILs

Attachment C

Historical analytical results

Table C2

Summary of Groundwater Gauging Data (May 2010 to November 2013)

Health Infrastructure 612-624 Pittwater Road, Brookvale, NSW

WELL No.	DATE GAUGED	WELL DEPTH (mBTOC)	SCREEN (mBTOC)	DEPTH TO WATER (m BTOC)	DEPTH TO PSH (m BTOC)
MW1					
	4/05/2015	6.900	-	0.470	Not detected
	7/05/2015	6.900	-	0.480	Not detected
MB1					
	7/06/2014	6.850	3	1.220	Not detected
	17/06/2014	6.850	3	1.260	Not detected
	4/05/2015	6.260	4.0 - 7.0	0.410	Not detected
	7/05/2015	6.260	4.0 - 7.0	0.425	Not detected
SP1					
	7/06/2014	2.730		0.810	Not detected
	17/06/2014	2.730		1.270	Not detected
	well damaged				
	well damaged				
MW2					
					Not detected
					Not detected
	4/05/2015	5.010	-	0.550	Not detected
	7/05/2015	5.010	-	0.565	Not detected
SP2					
	7/06/2014			0.790	Not detected
	17/06/2014			0.890	Not detected
	Not sampled				
	Not sampled				
MW3					
	4/05/2015	5.160	-	0.825	Not detected
	7/05/2015	5.160	-	0.845	Not detected

Notes:

m BTOC - metres below top of casing, m AHD - metres Australia Height datum, PSH - Phase Separated Hydrocarbons (LNAP or DNAPL),
T.O.C - top of casing, CORR. DTW - corrected depth to water, CORR. WATER ELEV. - corrected water elevation

▨ Current (November 2013) sampling round

Table C3

Historical Groundwater Analytical Results - TPH and BTEX

Health Infrastructure 612-624 Pittwater Road, Brookvale, NSW

Sample ID	Sampling date	Laboratory report no.	F1	F2	TPH C_6-C_{10}	TPH C_{10}-C_{16}	TPH C_{15}-C_{34}	TPH C_{34}-C_{40}	Total TPH C_{10}-C_{40}	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene
MW1	19/09/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	4/05/2015	-	<20	<100	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2
	7/05/2015	-	<20	<100	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2
MB1	7/06/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	17/06/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	19/09/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	4/05/2015		<20	<100	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2
	7/05/2015		<20	<100	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2
SP1	7/06/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	17/06/2014		<10	<50	<20	155	2651	<50	2806	<1	11.85	<2	54.78	11.61
	19/09/2014		Not sampled											
	4/05/2015	-	well damaged											
	7/05/2015		well damaged											
MW2	19/09/2014		4,500	2,800	10,000	3000	<100	<100	3000	3	220	1,100	4,000	220
	4/05/2015		90	460	1200	560	160	<100	720	<1	30	210	830	40
	7/05/2015		2300	890	4400	980	<100	<100	980	<1	36	360	1700	52
SP2	7/06/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	17/06/2014	Not sampled												
	19/09/2014	Not sampled												
	4/05/2015	Not sampled												
	7/05/2015	Not sampled												
MW3	19/09/2014		<10	<50	<20	<50	<100	<50	<50	<1	<5	<2	<2	<2
	4/05/2015	-	<20	<100	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2
	7/05/2015	-	<20	<100	<10	<50	<100	<100	<100	<1	<2	<2	<2	<2

Notes:

Concentrations are expressed as µg/L, unless indicated

- not analysed / no assessment criteria available

▨ Groundwater results from the current (November 2013) sampling round

Table C4

Historical Groundwater Analytical Results - PAHs

Health Infrastructure 612-624 Pittwater Road, Brookvale, NSW

Sample ID	Sampling date	Laboratory report no.	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1.2.3.cd)pyrene	Dibenz(a.h)anthracene	Benzo(g.h.i)perylene	Total PAH
MW1	19/09/2014		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
	4/05/2015	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
	7/05/2015	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
MB1	7/06/2014		Not sampled																
	17/06/2014		Not sampled																
	19/09/2014		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
	4/05/2015		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
	7/05/2015		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
SP1	7/06/2014		Not sampled																
	17/06/2014		Not sampled																
	19/09/2014		Not sampled																
	4/05/2015		Well damaged																
	7/05/2015		Well damaged																
MW2	19/09/2014		240	<1	1	<1	1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	240
	4/05/2015		57	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	57
	7/05/2015		110	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	110
SP2	7/06/2014		Not sampled																
	17/06/2014		Not sampled																
	19/09/2014		Not sampled																
	4/05/2015		Not sampled																
	7/05/2015		Not sampled																
MW3	19/09/2014		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
	4/05/2015	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1
	7/05/2015	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<5	<1	<1	<1	<1

Notes:

Concentrations are expressed as µg/L, unless indicated

- not analysed / no assessment criteria available

🟦 Groundwater results from the current (November 2013) sampling round

Table C5

Historical Groundwater Analytical Results - Heavy metals

Health Infrastructure 612-624 Pittwater Road, Brookvale, NSW

Sample ID	Sampling date	Laboratory report no.	Arsenic	Cadmium	Total Chromium	Copper	Lead	Mercury	Nickel	Zinc
MW1	19/09/2014		<1	<0.1	<1	2	<1	<0.05	2	54
	4/05/2015	-	<1	0.2	<1	3	2	<0.05	3	18
	7/05/2015	-	<1	0.2	<1	<1	2	<0.05	<1	11
MB1	7/06/2014		<1.0	<1.0	0.1	3	<1.0	<0.05	3	170
	17/06/2014		Not sampled							
	19/09/2014		<1	<0.1	<1	2	<1	<0.05	<1	20
	4/05/2015		<1	2.1	<1	8	2	<0.05	1	780
	7/05/2015		<1	0.1	<1	<1	<1	<0.05	<1	7
SP1	7/06/2014		2	<1.0	2	6	2	<0.05	1	83
	17/06/2014		Not sampled							
	19/09/2014		Not sampled							
	4/05/2015	-	Well damaged							
	7/05/2015		Well damaged							
MW2	19/09/2014		<1	<0.1	<1	2	<1	<0.05	<1	120
	4/05/2015		<1	<0.1	<1	<1	<1	<0.05	<1	9
	7/05/2015		<1	<0.1	<1	<1	<1	<0.05	<1	4
SP2	7/06/2014		<1	<1	<0.1	3	<1	<0.05	<1	80
	17/06/2014		Not sampled							
	19/09/2014		Not sampled							
	4/05/2015		Not sampled							
	7/05/2015		Not sampled							
MW3	19/09/2014		<1	2.4	<1	3	<1	<0.05	2	660
	4/05/2015	-	<1	2.2	<1	12	18	<0.05	2	840
	7/05/2015	-	<1	3.4	<1	71	140	<0.05	5	1500

Notes:

Concentrations are expressed as µg/L, unless indicated

- not analysed / no assessment criteria available

🟦 Groundwater results from the current (November 2013) sampling round

Attachment D

QA/QC summary tables

Table D1

QA/QC groundwater analytical results - TRH/BTEX compounds

Health Infrastructure

612-624 Pittwater Road, Brookvale, NSW

	TRH C_6-C_{10} Fraction	TRH >C_{10}-C_{16} Fraction	TRH >C_{16}-C_{34} Fraction	TRH >C_{34}-C_{40} Fraction	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene
MW02	1,200	560	160	<100	<1	30	210	830	40
DUP01_04052015 (intra-laboratory duplicate of MW02)	1,500	570	120	<100	<1	29	250	920	37
RPD (%)	22%	2%	29%	-	-	3%	17%	10%	8%
MW02	1,200	560	160	<100	<1	30.0	210	830	40
DUP02_04052015 (inter-laboratory duplicate of MW02)	2,580	310	*50*	<100	<5	24.0	191	795	35
RPD (%)	73%	57%	**105%**	**-**	-	22%	9%	4%	13%
MW02	4,400	980	<100	<100	<1	36.0	360	1,700	52
DUP01_07052015 (intra-laboratory duplicate of MW02)	4,400	1,100	<100	<100	<1	36.0	370	1,700	50
RPD (%)	0%	12%	-	-	-	0%	3%	0%	4%
MW02	4,400	980	<100	<100	<1	36.0	360	1,700	52
DUP02_07052015 (inter-laboratory duplicate of MW02)	4,110	510	<100	<100	<5	32.0	288	1,380	54
RPD (%)	7%	**63%**	-	-	-	12%	22%	21%	4%

Notes:

All results are expressed in µg/L

Italics: A value equal to the PQL has been used for the calculation of RPDs

BOLD RPD exceeds acceptable levels.

Table D2

QA/QC groundwater analytical results - PAHs

Health Infrastructure

612-624 Pittwater Road, Brookvale, NSW

	Naphthalene	**Acenaphthylene**	**Acenaphthene**	**Fluorene**	**Phenanthrene**	**Anthracene**	**Fluoranthene**	**Pyrene**	**Benzo(a)anthracene**	**Chrysene**	**Benzo(b,j+k)fluoranthene**	**Benzo(a)pyrene**	**Indeno(1,2,3-c,d)pyrene**	**Dibenzo(a,h)anthracene**	**Benzo(g,h,i)perylene**
MW2	57.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DUP01_04052015 (intra-laboratory duplicate of MW2)	65.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
RPD (%)	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW2	57.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DUP02_04052015 (inter-laboratory duplicate of MW2)	39.6	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
RPD (%)	36%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW2	110.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DUP01_07052015 (intra-laboratory duplicate of MW2)	120.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
RPD (%)	9%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW2	110.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DUP02_07052015 (inter-laboratory duplicate of MW2)	60.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
RPD (%)	**58%**	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

All results are expressed in µg/L

Italics: A value equal to the PQL has been used for the calculation of RPDs

BOLD	RPD exceeds acceptable levels.

Table D3

QA/QC groundwater analytical results - Heavy metals
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
MW2	<1	<0.1	<1	*0.5*	<1	<0.05	*0.5*	9
DUP01_04052015 (intra-laboratory duplicate of MW2)	<1	<0.1	<1	1	<1	<0.05	3	14
RPD (%)	-	-	-	**67%**	-	-	**143%**	43%
MW2	<1	<0.1	<1	<1	<1	<0.05	<1	9
DUP02_04052015 (inter-laboratory duplicate of MW2)	<1	<0.1	<1	<1	<1	<1	<1	7
RPD (%)	-	-	-	-	-	-	-	25%
MW2	<1	<0.1	<1	<1	<1	<0.05	<1	4
DUP01_07052015 (intra-laboratory duplicate of MW2)	<1	<0.1	<1	<1	<1	<0.05	<1	5
RPD (%)	-	-	-	-	-	-	-	22%
MW2	<1	<0.1	<1	0.5	<1	<0.05	0.5	4
DUP02_07052015 (inter-laboratory duplicate of MW2)	<1	<0.1	<1	2	<1	<0.1	2	1.8
RPD (%)	-	-	-	**120%**	-	-	**120%**	**76%**

Notes:

All results are expressed in µg/L

Italics: A value equal to the PQL has been used for the calculation of RPDs

BOLD RPD exceeds acceptable levels.

Table D4

QA/QC blank/spike analytical results - TRH/BTEX compounds

Health Infrastructure

612-624 Pittwater Road, Brookvale, NSW

Blank	Date	Units	TRH C_6-C_{10} Fraction	TRH >C_{10}-C_{16} Fraction	TRH >C_{16}-C_{34} Fraction	TRH >C_{34}-C_{40} Fraction	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene	F1 (TRH C6-C10 minus BTEX compounds)	F2 (TRH >C10-C16 minus naphthalene)
Trip blanks													
TB_04052015	4/05/2015	µg/L	<10	<50	<100	<100	<1	<2	<2	<2	<2	<20	<50
TB_07052015	7/05/2015	µg/L	<10	<50	<100	<100	<1	<2	<2	<2	<2	<20	<50
Rinsate blank													
R_04052015	4/05/2015	µg/L	<10	<50	<100	<100	<1	<2	<2	<2	<2	<20	<50
R_07052015	7/05/2015	µg/L	<10	<50	<100	<100	<1	<2	<2	<2	<2	<20	<50
Trip spikes													
TS_04052015	4/05/2015	% recovery	-	-	-	-	106%	113%	101%	90%	107%	-	-
TS_07052015	7/05/2015	% recovery	-	-	-	-	103%	102%	102%	104%	104%	-	-

Notes:

BOLD exceeds acceptable levels.

Table D5

QA/QC blank/spike analytical results - PAHs
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

			PAHs															
			Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
Blank	**Date**	**Units**																
Rinsate blank																		
R_04052015	4/05/2015	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<1	<1	<1
R_07052015	7/05/2015	µg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.5	<1	<1	<1

Notes:

BOLD	RPD exceeds acceptable levels.

Table D6

QA/QC blank/spike analytical results - Heavy metals
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Blank	**Date**	**Units**								
Rinsate blank										
R_04052015	4/05/2015	µg/L	<1	<0.1	<1	<1	<1	<0.1	<1	<5
R_07052015	7/05/2015	µg/L	<1	<0.1	<1	<1	<1	<0.05	<1	<1

Notes:

BOLD	exceeds acceptable levels.

Table D7

Groundwater analytical results - PAHs

Health Infrastructure

612-624 Pittwater Road, Brookvale, NSW

Blank	Date	Units	Dichlorodifluoromethane	Chloromethane	Vinyl chloride	Bromomethane	Chloroethane	Trichlorofluoromethane	1.1-Dichloroethene	trans-1.2-Dichloroethene	1.1-Dichloroethane	cis-1.2-Dichloroethene	1.1.1-Trichloroethane	1.1-Dichloropropylene	Carbon Tetrachloride	1.2-Dichloroethane	Trichloroethene	Dibromomethane
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PQL	50	50	50	50	50	50	5	5	5	5	5	5	5	5	5	5
Rinsate blank																		
R_04052015	4/05/2015	µg/L	<50	<50	<50	<50	<50	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
R_07052015	7/05/2015	µg/L	<50	<50	<50	<50	<50	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

Blank	Date	Units	1.1.2-Trichloroethane	1.3-Dichloropropane	Tetrachloroethene	1.1.1.2-Tetrachloroethane	1.1.2.2-Tetrachloroethane	1.2.3-Trichloropropane	1.2-Dibromo-3-chloropropane	Hexachlorobutadiene	Chlorobenzene	Bromobenzene	2-Chlorotoluene	4-Chlorotoluene	1.3-Dichlorobenzene	1.4-Dichlorobenzene	1.2-Dichlorobenzene	1.2.4-Trichlorobenzene	1.2.3-Trichlorobenzene
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PQL	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Rinsate blank																			
R_04052015	4/05/2015	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
R_07052015	7/05/2015	µg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

[1] NEPC (2013) *NEPM* - Schedule B-1

[2] ANZECC (2000) *Guidelines for Fresh and Marine Water Quality*

NL = not limiting

< = concentration reported to be less than the laboratory practical quantitation limit

- = no assessment criteria available / not analysed

Bold	Detect
🟨	Exceeds adopted criteria

Attachment E

Groundwater field sheets

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER:	2201 6754	**WELL NUMBER:**	MW01
Client:	Health Infrastructure	**Purging Date:**	04/05/15
Site Location:	Brookvale	**Sampling Date:**	" "
Casing Diameter (mm):	50	Depth to Floating Product (mBTOC):	—
Casing Height Above Ground Level (mAGL):	—	Depth to Groundwater (mBTOC):	0.47
Bore [✓ Locked] / Covered?:		Product Thickness (mm):	n.a
Cap Type:	gatic	Well Depth from TOC (m):	6.90
Well condition:	good	Depth to be Purged (m):	6

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydrasleeve ☑	Planned Purge Volume: — Litres (5 well vols)
Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: polyethylene ☑	Actual Purge Volume: — Litres
Start Time (2400 hr): 12:30	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (µS/cm)	Redox (mV)	DO units % ☑ ppm ☐	Turbidity	Temp. °C
1	12:30		4.38	502	245.8	8.68	L	22.7
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

200 Pittwater rd manly

SAMPLING DETAILS

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydra sleeves

Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: polyethylene ☑

Equipment: Dedicated ☐ Decontaminated ☐ Other: ______

Is there a hydrocarbon sheen?: Yes ☐ No ☑

ANALYSIS DETAILS

TPH	☑	VOCs	☐
BTEX	☑	SVOCs	☐
PAHs	☑	______	☐
Metals	☑	______	☐

Colour: light brown	Odour: non	Sample ID: MW01	Duplicate ID: —
Turbidity: Low ☑ Medium ☐ High ☐		Rinse Blank After: Yes / [✓ No]	Triplicate ID: —

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Bazfal Patel

Sampler' signature:

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER: 2201675A	**WELL NUMBER:** MB1
Client: Health Infrastructure	**Purging Date:** 04/05/15
Site Location: Brookvale	**Sampling Date:** " "
Casing Diameter (mm): 50	Depth to Floating Product (mBTOC): —
Casing Height Above Ground Level (mAGL): —	Depth to Groundwater (mBTOC): 0.410
Bore [✓ Locked] / Covered?:	Product Thickness (mm): n.a
Cap Type: gatic	Well Depth from TOC (m): 6.260
Well condition: good	Depth to be Purged (m): 6

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydrasleeve ☑	Planned Purge Volume: \ Litres (5 well vols)
Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: ______ polyethylene ☑	Actual Purge Volume: \ Litres
Start Time (2400 hr): 1:00	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (µS/cm)	Redox (mV)	DO units % ☐ ppm ☑	Turbidity	Temp. °C
1			4.78	701	123.1	6.81	L	22.4
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS		ANALYSIS DETAILS			
Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ ☑ hydrasleeve		TPH	☑	VOCs	☐
Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: ______		BTEX	☑	SVOCs	☐
Equipment: Dedicated ☑ Decontaminated ☐ Other: ______		PAHs	☑	______	☐
Is there a hydrocarbon sheen?: Yes ☐ No ☑		Metals	☑	______	☐
Colour: light brown	Odour: non	Sample ID: MB1		Duplicate ID: \	
Turbidity: Low ☑ Medium ☐ High ☐		Rinse Blank After: Yes / [✓ No]		Triplicate ID: —	

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Bogial Patel	Sampler' signature:

Form FM-CLM 3.2-1 Revision E 06/04/10

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER: 2201675A	**WELL NUMBER:** MW2
Client: Health Infrastructure	**Purging Date:** 04/05/15
Site Location: Brookvale	**Sampling Date:** " "
Casing Diameter (mm): 50	Depth to Floating Product (mBTOC): \
Casing Height Above Ground Level (mAGL): –	Depth to Groundwater (mBTOC): 0.55
Bore [✓ Locked] / Covered?:	Product Thickness (mm): n.a
Cap Type: gatic	Well Depth from TOC (m): 5.01
Well condition: good	Depth to be Purged (m): 4.5

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydrasleeve ☑	Planned Purge Volume: \ Litres (5 well vols)
Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: ______	Actual Purge Volume: \ Litres
Start Time (2400 hr): 2:00	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (μS/cm)	Redox (mV)	DO units % ☐ ppm ☐	Turbidity	Temp. °C
1			4.68	804	316.3	5.63	L	22.6
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydrasleeve ☑

Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: ______

Equipment: Dedicated ☑ Decontaminated ☐ Other: ______

Is there a hydrocarbon sheen?: Yes ☑ Slight No ☐

ANALYSIS DETAILS

TPH	☑	VOCs	☐
BTEX	☑	SVOCs	☐
PAHs	☑	______	☐
Metals	☑	______	☐

Colour: light br	Odour: St. H.C	Sample ID: MW02	Duplicate ID: DUP01_040515
Turbidity: Low ☑ Medium ☐ High ☐		Rinse Blank After: Yes / [✓ No]	Triplicate ID: DUP02_040515

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Bejal Patel

Sampler' signature:

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER:		**WELL NUMBER:**	MW3
Client:	2201675A	**Purging Date:**	09/05/15
Site Location:	Health Infrastructure	**Sampling Date:**	" "
Casing Diameter (mm):	Brookvale	Depth to Floating Product (mBTOC):	
Casing Height Above Ground Level (mAGL):	50	Depth to Groundwater (mBTOC):	0.825
Bore [✓ Locked] / Covered?:		Product Thickness (mm):	
Cap Type:	gatic	Well Depth from TOC (m):	5.16
Well condition:	good	Depth to be Purged (m):	5

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydrasleeve ☑	Planned Purge Volume: Litres (5 well vols)
Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: ______	Actual Purge Volume: Litres
Start Time (2400 hr): 2:30	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (uS/cm)	Redox (mV)	DO units % ☐ ppm ☑	Turbidity	Temp. °C
1			5.03	611	303.6	8.52	L	22.6
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS		ANALYSIS DETAILS			
Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☐ hydrasleeve ☑		TPH	☑	VOCs	☐
Material: Teflon ☐ S/Steel ☐ HDPE ☐ PVC ☐ Other: ______		BTEX	☑	SVOCs	☐
Equipment: Dedicated ☑ Decontaminated ☐ Other: ______		PAHs	☑	______	☐
Is there a hydrocarbon sheen?: Yes ☐ No ☑		Metals	☑	______	☐
Colour: light tan	Odour: non	Sample ID: MW3		Duplicate ID:	
Turbidity: Low ☐ ✓ Medium ☐ High ☐		Rinse Blank After: [✓ Yes] / No		Triplicate ID:	

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Bejal Patel	Sampler' signature:

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER: 2201675A	**WELL NUMBER:** MW1
Client: Health Infrastructure	**Purging Date:** 07/05/2015
Site Location: Brookvale	**Sampling Date:** 15
Casing Diameter (mm): 50 mm 50	Depth to Floating Product (mBTOC): –
Casing Height Above Ground Level (mAGL): –	Depth to Groundwater (mBTOC): 0.48
Bore [✓ Locked] / Covered?:	Product Thickness (mm): n/a
Cap Type: gatic	Well Depth from TOC (m): 6.900
Well condition: good	Depth to be Purged (m): 6

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydrasleeve ☑	Planned Purge Volume: – Litres (5 well vols)
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: polyethylene ☑	Actual Purge Volume: – Litres
Start Time (2400 hr): 3:30 pm	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (µS/cm)	Redox (mV)	DO units % ☐ ppm ☒	Turbidity	Temp. °C
1	–	–	5.45	1021	116	8.68	L	22.3
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS	ANALYSIS DETAILS			
Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydra sleeve ☑	TPH	☒	VOCs	☐
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other:	BTEX	☒	SVOCs	☐
Equipment: Dedicated ☒ Decontaminated ☐ Other:	PAHs	☒	MNA	☐□
Is there a hydrocarbon sheen?: Yes ☐ No ☑	Metals	☒ Pb only		☐

Colour: light brown	Odour: non	Sample ID: MW1	Duplicate ID: –
Turbidity: [✓ Low ☑] Medium ☐ High ☐		Rinse Blank After: Yes / [✓ No]	Triplicate ID: –

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Beejal Patel

Sampler' signature:

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER: 2201675A	**WELL NUMBER:** MB1
Client: Health Infrastructure	**Purging Date:** 07/05/2015
Site Location: Brookvale	**Sampling Date:** " / " 15
Casing Diameter (mm): 50 mm 50	Depth to Floating Product (mBTOC):
Casing Height Above Ground Level (mAGL):	Depth to Groundwater (mBTOC): 0.425
Bore [✓ Locked] / Covered?:	Product Thickness (mm): n.a
Cap Type: gatic	Well Depth from TOC (m): 6.260
Well condition: good	Depth to be Purged (m): 6

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydrasleeve ☑	Planned Purge Volume: Litres (5 well vols)
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: ____________	Actual Purge Volume: Litres
Start Time (2400 hr): 4.00 pm	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (µS/cm)	Redox (mV)	DO units % ☐ ppm ☒	Turbidity	Temp. °C
1			5.12	1136	107	5.81	L	22.8
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS		ANALYSIS DETAILS			
Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydrasleeve ☑		TPH	☒	VOCs	☐
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: ________		BTEX	☒	SVOCs	☐
Equipment: Dedicated ☒ Decontaminated ☐ Other: ________		PAHs	☒	__MNA__	☐ ☐
Is there a hydrocarbon sheen?: Yes ☐ No ☑		Metals	☒ Pb only	________	☐
Colour: light brown	Odour: nil	Sample ID: MB1		Duplicate ID:	
Turbidity: Low ☑ Medium ☐ High ☐		Rinse Blank After: Yes / [✓ No]		Triplicate ID:	

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Beejal Patel	Sampler' signature:

0483385 11

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER: 2201675A	**WELL NUMBER:** MW 2
Client: Health Infrastructure	**Purging Date:** 07/05/2015
Site Location: Brookvale	**Sampling Date:** 07/05/2015
Casing Diameter (mm): 50 mm 50	Depth to Floating Product (mBTOC): -
Casing Height Above Ground Level (mAGL): -	Depth to Groundwater (mBTOC): 0.565
Bore [✓ Locked] / Covered?:	Product Thickness (mm): n.a
Cap Type: gatic	Well Depth from TOC (m): 5.010
Well condition: good	Depth to be Purged (m): 4.50

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydra sleeve ☑	Planned Purge Volume: Litres (5 well vols)
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: ____________	Actual Purge Volume: Litres
Start Time (2400 hr): 4.30 pm	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (uS/cm)	Redox (mV)	DO units % ☐ ppm ☒	Turbidity	Temp. °C
1			5.12	1137	78	8.12	L	22.7
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS / ANALYSIS DETAILS

SAMPLING DETAILS	ANALYSIS DETAILS			
Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydrasleeve ☑	TPH	☒	VOCs	☐
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: ________	BTEX	☒	SVOCs	☐
Equipment: Dedicated ☒ Decontaminated ☐ Other: ________	PAHs	☒	__MNA__	☐D
Is there a hydrocarbon sheen?: Yes ☑ SL No ☐	Metals	☒ Pb only	________	☐

Colour: light brown	Odour:	Sample ID: MW2	Duplicate ID: DUP01_070515
Turbidity: Low ☑ Medium ☐ High ☐		Rinse Blank After: Yes / [✓ No]	Triplicate ID: DUP02_070515

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Bejal Patel

Sampler' signature:

PARSONS BRINCKERHOFF

FORM FM-CLM 3.2-1
GROUNDWATER FIELD PARAMETERS

JOB NUMBER: 2201675A	**WELL NUMBER:** MW3
Client: Health Infrastructure	**Purging Date:** 07/05/2015
Site Location: Brookvale	**Sampling Date:** " " 15
Casing Diameter (mm): 50 mm 50	Depth to Floating Product (mBTOC): -
Casing Height Above Ground Level (mAGL): -	Depth to Groundwater (mBTOC): 0.845
Bore [✓ Locked] / Covered?:	Product Thickness (mm): n.a
Cap Type: gatic	Well Depth from TOC (m): 5.16
Well condition: good	Depth to be Purged (m): 5

PURGING INFORMATION

Purge 5 casing volumes or until 'dry':

1 casing volume = 2 L/m for 50 mm ID wells. *1 casing volume = 8 L/m for 100 mm ID wells.*

Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒ hydrasleeve ☑	Planned Purge Volume: - Litres (5 well vols)
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: polyethylene ☑	Actual Purge Volume: - Litres
Start Time (2400 hr): 5:00 pm	Did well purge 'dry'? No ☑ Yes ☐ At?: Litre

FIELD RESULTS WHILE PURGING

# Purge Volume	Time	SWL	pH	EC (µS/cm)	Redox (mV)	DO units % ☐ ppm ☒	Turbidity	Temp. °C
1			5.38	1213	120	7.56	L	22.5
2								
3								
4								
5								
Additional Volume:								
Acceptable Variation:	n/a	+/- 0.05m	+/- 0.05	+/- 3%	+/- 10%	+/- 10%	n/a	+/- 10%

Are the field results acceptable?:

SAMPLING DETAILS	ANALYSIS DETAILS			
Method/Pump Type: Bailer ☐ Waterra ☐ Whaler ☐ Micro-Purge ☒	TPH	☒	VOCs	☐
Material: Teflon ☐ S/Steel ☒ HDPE ☐ PVC ☐ Other: hydrasleeve ☑	BTEX	☒	SVOCs	☐
Equipment: Dedicated ☒ Decontaminated ☐ Other:	PAHs	☒	MNA	☐☐
Is there a hydrocarbon sheen?: Yes ☐ No ☑	Metals	☒ Pb only		☐

Colour: light brown	Odour:	Sample ID: MW3	Duplicate ID: -
Turbidity: Low ☑ Medium ☐ High ☐		Rinse Blank After: [✓ Yes] / No	Triplicate ID: -

WEATHER CONDITIONS

Cold - Cool - Mild - Warm - Hot	Clear - Medium - Cloudy	Dry - Medium - Humid - Rain	Still - Breeze - Windy	Dusty

Other comments and observations:

Sampler's Name: Bejal Patel

Sampler' signature:

Attachment F

Data evaluation

Table F–1: Evaluation of field and laboratory QA/QC procedures

	Groundwater
Laboratory report no.	127430; 127637; ES1521199; ES1521598
Were the samples received by the laboratory in good condition?	Yes
Were the samples properly and adequately preserved?	Yes
Were the samples analysed within the holding time?	Yes
Were the samples in proper custody between the field and the laboratory?	Yes.
Precision/accuracy assessment	
Did the laboratory used have NATA accredited for all the analytes tested?	Yes
Did the laboratory perform the requested tests?	Yes
Were the laboratory methods adopted NATA endorsed?	Yes
Were the appropriate test procedures followed?	Yes
Were the reporting limits satisfactory	Yes
Was the NATA seal provided in the laboratory reports?	Yes
Were the reports signed by authorised personnel?	Yes
Field QA/QC	
Were field duplicates collected as per the rate mentioned in the SAP?	Yes, 2 duplicate sample was collected and analysed.
Were field triplicates collected as per the rate mentioned in the SAP?	Yes, 2 triplicate sample was collected and analysed.

	Groundwater
Laboratory report no.	127430; 127637; ES1521199; ES1521598
Were RPD of field duplicates and triplicates within acceptable limits?	Yes , two exceedences were recorded for the intra-laboratory duplicates: • Copper - in laboratory sample MW2 and DUP01_04052015 at an RPD of 67%. • Nickel - in laboratory sample MW2 and DUP01_04052015 at an RPD of 143%. Six exceedences were recorded for the inter-laboratory duplicates: • TRH >C16-C34 Fraction - in laboratory sample MW2 and DUP02_04052015 at an RPD of 105%. • TRH >C10-C16 Fraction - in laboratory sample MW2 and DUP02_07052015 at an RPD of 63%. • Naphthalene - in laboratory sample MW2 and DUP02_07052015 at an RPD of 58%. • Copper - in laboratory sample MW2 and DUP02_07052015 at an RPD of 120%. • Nickel - in laboratory sample MW2 and DUP02_07052015 at an RPD of 120%. • Zinc - in laboratory sample MW2 and DUP02_07052015 at an RPD of 76%. Exceedances mostly related to varying laboratory sampling methods.
Were rinsate samples collected per day of sampling?	Yes
Were the rinsate samples free of contaminants?	Yes
Were trip blanks included per batch of samples?	Yes
Were the trip blanks samples free of contaminants?	Yes
Were trip spike included per batch of samples?	Yes
Were the trip spikes recovered within acceptable limits?	yes
Was there any other QA/QC samples collected?	No
Laboratory internal quality control procedures	
Did the laboratory have at least one laboratory/reagent blanks per batch of sample?	Yes
Were the laboratory/reagent blank free of contamination?	Yes

	Groundwater
Laboratory report no.	127430; 127637; ES1521199; ES1521598
Were the laboratory duplicate undertaken at least a rate of 1 per 10 samples?	Yes
Were the RPDs of the laboratory duplicate within control limits?	Yes
Did the laboratory analyse matrix spike for each water type?	Yes
Did the laboratory analyse laboratory control spike?	Yes
Were the spike recoveries within laboratory control limits?	Yes
Were the surrogate recoveries within control limits?	Yes

Attachment G

Laboratory reports

PB 100 YEARS®

White Page - Laboratory Copy
Yellow Page - Project File Copy
Pink Page - Remains in Book

ABN 80 078 004 798

☐ **Adelaide**
Level 16, 1 King William Street,
GPO Box 398 Adelaide SA 5001
Tel: (08) 8405 4300 Fax: (08) 8405 4301

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PO Box 1232 Subiaco WA 6904
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☐ **Brisbane**
Level 4, Northbank Plaza 69 Ann Street,
GPO Box 2907 Brisbane QLD 4001
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☐ **Singleton**
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PO Box 115 Singleton NSW 2330
Tel: (02) 6572 3377 Fax: (02) 6572 4080

☐ **Melbourne**
Level 7, 457 St. Kilda Road,
PO Box 7209 Melbourne VIC 8004
Tel: (03) 9861 1111 Fax: (03) 9861 1144

☐ **Newcastle**
3rd Floor, 55 Bolton Street,
PO Box 1162 Newcastle NSW, 2300
Tel: (02) 4929 3900 Fax: (02) 4929 7299

☐ **Sydney**
Level 27, Ernst & Young Centre
680 George Street,
GPO Box 5394, Sydney NSW 2000
Tel: (02) 9272 5100 Fax: (02) 9272 5101

☐ **ACT**
Level 3, Empire Chambers
1-13 Univrsity Ave
GPO Box 331, Canberra ACT 2601
Tel: (02) 6281 9500 Fax: (02) 6281 9501

Chain of Custody

Order No: 59966

Job Title: Health Infrastructure Brookvale
Laboratory Name: Envirolab
Address: Ashleigh St, Chatswood
Fax Number: -
Phone Number: (02) 9910 6700
Contact Name: Jacinta Hurst
Delivery Method: Courier
Quote Number:

PB Job Number: 2201675A
Job Location: Brookvale

Terms of Business	PB	Other	Checked

Project Manager: Beejal Patel
Results Expected by/on: ~~J~~ 15/5/15
Fax Results to: Beejal Patel
Fax Number: -
Phone Number: (02) 9272 1453 / 0402257222
Spreadsheet of Results Required: [✓ Y] / N
Format: GIDAT PDF
Turnaround Time Required: 5 days
Invoice to: B. Patel
Comments:

Date Sampled	Time		Sample I.D.	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCB's	Metals**	Combo 3						Initials	Comments/Additional Information and/or Analysis Required
08/05/15		1	MW1			W								Y							
		2	MB1											Y							
		3	MW2											Y							
		4	MW3											Y							
		5	DUP01_070515											Y							
		6	[illegible]_070515											Y							
		7	TS_0705[illegible]						~~X~~	~~X~~				[illegible]							
		8	TB0705[illegible]						X	X											

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

Job No: 127637
Date Received: 8/5/15
Time Received: 12:00
Received by: JYH.
Temp: [✓ Cool]/Ambient
Cooling: [✓ Ice]/Icepack
Security: [✓ Intact]/Broken/None

Relinquished by: Beejal Patel	Relinquished by:	Relinquished by:
Date & Time: 08/05/15	Date & Time:	Date & Time:
Company: PB	Company:	Company:
Signature:	Signature:	Signature:
Received in Good Order & Condition by (Name): JYH	Received in Good Order & Condition by (Name):	Received in Good Order & Condition by (Name):
Date & Time: 8/5/15 1200	Date & Time:	Date & Time:
Company: ELS	Company:	Company:
Signature:	Signature:	Signature:

Medium*: S = Soil, W = Water, V = Vapour

Legend**: (circle the following to be tested)
Metals: Al [✓ As] Be [✓ Cd] Co [✓ Cr] [✓ Cu] Fe [✓ Hg]
Li Mg Mn [✓ Ni] [✓ Pb] Se Sn V [✓ Zn]

Samples on Ice: ☑ Yes ☐ No

Please fax back a signed copy when samples are received at the laboratory

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 127430

Client:

Parsons Brinckerhoff Aust. Pty Ltd
GPO Box 5394
Sydney
NSW 2001

Attention: Beejal Patel

Sample log in details:

Your Reference:	**2201675A**	
No. of samples:	8 Waters	
Date samples received / completed instructions received	5/5/2015	/ 5/5/2015

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:	12/05/15	/ 11/05/15
Date of Preliminary Report:	Not Issued	

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

Results Approved By:

Jacinta Hurst
Laboratory Manager

ACCREDITED FOR TECHNICAL COMPETENCE

vTRH(C6-C10)/BTEXN in Water Our Reference:	UNITS	127430-1	127430-2	127430-3	127430-4	127430-5
Your Reference	-------------	MW1	MB1	MW2	MW3	Dup01_040515
Date Sampled	------------	4/05/2015	4/05/2015	4/05/2015	4/05/2015	4/05/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/05/2015	06/05/2015	06/05/2015	06/05/2015	06/05/2015
Date analysed	-	07/05/2015	07/05/2015	07/05/2015	07/05/2015	07/05/2015
TRHC$_6$ - C$_9$	µg/L	<10	<10	950	<10	1,200
TRHC$_6$ - C$_{10}$	µg/L	<10	<10	1,200	<10	1,500
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10	<10	90	<10	260
Benzene	µg/L	<1	<1	<1	<1	<1
Toluene	µg/L	<1	<1	30	<1	29
Ethylbenzene	µg/L	<1	<1	210	<1	250
m+p-xylene	µg/L	<2	<2	830	<2	920
o-xylene	µg/L	<1	<1	40	<1	37
Naphthalene	µg/L	<1	<1	94	<1	110
Surrogate Dibromofluoromethane	%	109	105	111	99	110
Surrogate toluene-d8	%	97	100	105	96	109
Surrogate 4-BFB	%	102	105	98	104	96

vTRH(C6-C10)/BTEXN in Water Our Reference:	UNITS	127430-6	127430-7	127430-8
Your Reference	-------------	R_040515	TS_040515	TB_040515
Date Sampled	------------	4/05/2015	4/05/2015	4/05/2015
Type of sample		Water	Water	Water
Date extracted	-	06/05/2015	06/05/2015	06/05/2015
Date analysed	-	07/05/2015	07/05/2015	07/05/2015
TRHC$_6$ - C$_9$	µg/L	<10	[NA]	<10
TRHC$_6$ - C$_{10}$	µg/L	<10	[NA]	<10
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10	[NA]	<10
Benzene	µg/L	<1	106%	<1
Toluene	µg/L	<1	113%	<1
Ethylbenzene	µg/L	<1	101%	<1
m+p-xylene	µg/L	<2	90%	<2
o-xylene	µg/L	<1	107%	<1
Naphthalene	µg/L	<1	[NA]	<1
Surrogate Dibromofluoromethane	%	106	107	110
Surrogate toluene-d8	%	95	104	97
Surrogate 4-BFB	%	102	103	109

Client Reference: 2201675A

svTRH (C10-C40) in Water	UNITS	127430-1	127430-2	127430-3	127430-4	127430-5
Our Reference:	UNITS	127430-1	127430-2	127430-3	127430-4	127430-5
Your Reference	-------------	MW1	MB1	MW2	MW3	Dup01_040515
Date Sampled	------------	4/05/2015	4/05/2015	4/05/2015	4/05/2015	4/05/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/05/2015	06/05/2015	06/05/2015	06/05/2015	06/05/2015
Date analysed	-	07/05/2015	07/05/2015	07/05/2015	07/05/2015	07/05/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	890	<50	940
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	200	<100	150
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	560	<50	570
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	460	<50	460
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	160	<100	120
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	86	103	107	83	98

svTRH (C10-C40) in Water	UNITS	127430-6
Our Reference:	UNITS	127430-6
Your Reference	-------------	R_040515
Date Sampled	------------	4/05/2015
Type of sample		Water
Date extracted	-	06/05/2015
Date analysed	-	07/05/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50
TRHC$_{15}$ - C$_{28}$	µg/L	<100
TRHC$_{29}$ - C$_{36}$	µg/L	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100
TRH>C$_{34}$ - C$_{40}$	µg/L	<100
Surrogate o-Terphenyl	%	90

PAHs in Water Our Reference:	UNITS	127430-1	127430-2	127430-3	127430-4	127430-5
Your Reference	-------------	MW1	MB1	MW2	MW3	Dup01_040515
Date Sampled	------------	4/05/2015	4/05/2015	4/05/2015	4/05/2015	4/05/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	06/05/2015	06/05/2015	06/05/2015	06/05/2015	06/05/2015
Date analysed	-	06/05/2015	06/05/2015	06/05/2015	06/05/2015	06/05/2015
Naphthalene	µg/L	<1	<1	57	<1	65
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	57	NIL (+)VE	65
Surrogate p-Terphenyl-d14	%	99	106	112	96	104

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	127430-6 R_040515 4/05/2015 Water
Date extracted	-	06/05/2015
Date analysed	-	06/05/2015
Naphthalene	µg/L	<1
Acenaphthylene	µg/L	<1
Acenaphthene	µg/L	<1
Fluorene	µg/L	<1
Phenanthrene	µg/L	<1
Anthracene	µg/L	<1
Fluoranthene	µg/L	<1
Pyrene	µg/L	<1
Benzo(a)anthracene	µg/L	<1
Chrysene	µg/L	<1
Benzo(b,j+k)fluoranthene	µg/L	<2
Benzo(a)pyrene	µg/L	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1
Dibenzo(a,h)anthracene	µg/L	<1
Benzo(g,h,i)perylene	µg/L	<1
Benzo(a)pyrene TEQ	µg/L	<5
Total +ve PAH's	µg/L	NIL (+)VE
Surrogate p-Terphenyl-d14	%	88

HM in water - dissolved Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ ------------	127430-1 MW1 4/05/2015 Water	127430-2 MB1 4/05/2015 Water	127430-3 MW2 4/05/2015 Water	127430-4 MW3 4/05/2015 Water	127430-5 Dup01_040515 4/05/2015 Water
Date prepared	-	06/05/2015	06/05/2015	06/05/2015	06/05/2015	06/05/2015
Date analysed	-	06/05/2015	06/05/2015	06/05/2015	06/05/2015	06/05/2015
Arsenic-Dissolved	µg/L	<1	<1	<1	<1	<1
Cadmium-Dissolved	µg/L	0.2	2.1	<0.1	2.2	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	3	8	<1	12	1
Lead-Dissolved	µg/L	2	2	<1	18	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	3	1	<1	2	3
Zinc-Dissolved	µg/L	18	780	9	840	14

HM in water - dissolved Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ ------------	127430-6 R_040515 4/05/2015 Water
Date prepared	-	06/05/2015
Date analysed	-	06/05/2015
Arsenic-Dissolved	µg/L	<1
Cadmium-Dissolved	µg/L	<0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	<1
Lead-Dissolved	µg/L	<1
Mercury-Dissolved	µg/L	<0.05
Nickel-Dissolved	µg/L	<1
Zinc-Dissolved	µg/L	<1

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (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.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/05/2015	[NT]	[NT]	LCS-W1	06/05/2015
Date analysed	-			07/05/2015	[NT]	[NT]	LCS-W1	07/05/2015
TRH C_6 - C_9	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	107%
TRH C_6 - C_{10}	µg/L	10	Org-016	<10	[NT]	[NT]	LCS-W1	107%
Benzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	104%
Toluene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	122%
Ethylbenzene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	110%
m+p-xylene	µg/L	2	Org-016	<2	[NT]	[NT]	LCS-W1	100%
o-xylene	µg/L	1	Org-016	<1	[NT]	[NT]	LCS-W1	112%
Naphthalene	µg/L	1	Org-013	<1	[NT]	[NT]	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	100	[NT]	[NT]	LCS-W1	107%
Surrogate toluene-d8	%		Org-016	95	[NT]	[NT]	LCS-W1	109%
Surrogate 4-BFB	%		Org-016	103	[NT]	[NT]	LCS-W1	101%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/05/2015	127430-1	06/05/2015 || 06/05/2015	LCS-W3	06/05/2015
Date analysed	-			07/05/2015	127430-1	07/05/2015 || 07/05/2015	LCS-W3	07/05/2015
TRH C_{10} - C_{14}	µg/L	50	Org-003	<50	127430-1	<50 || <50	LCS-W3	111%
TRH C_{15} - C_{28}	µg/L	100	Org-003	<100	127430-1	<100 || <100	LCS-W3	106%
TRH C_{29} - C_{36}	µg/L	100	Org-003	<100	127430-1	<100 || <100	LCS-W3	113%
TRH >C_{10} - C_{16}	µg/L	50	Org-003	<50	127430-1	<50 || <50	LCS-W3	111%
TRH >C_{16} - C_{34}	µg/L	100	Org-003	<100	127430-1	<100 || <100	LCS-W3	106%
TRH >C_{34} - C_{40}	µg/L	100	Org-003	<100	127430-1	<100 || <100	LCS-W3	113%
Surrogate o-Terphenyl	%		Org-003	101	127430-1	86 || 89 || RPD: 3	LCS-W3	89%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/05/2015	127430-1	06/05/2015 || 06/05/2015	LCS-W1	06/05/2015
Date analysed	-			06/05/2015	127430-1	06/05/2015 || 06/05/2015	LCS-W1	06/05/2015
Naphthalene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	86%
Acenaphthylene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Fluorene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	85%
Phenanthrene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	92%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Anthracene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	92%
Pyrene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	93%
Benzo(a)anthracene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Chrysene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	86%
Benzo(b,j+k) fluoranthene	µg/L	2	Org-012 subset	<2	127430-1	<2 || <2	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	LCS-W1	103%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012 subset	<1	127430-1	<1 || <1	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	127	127430-1	99 || 109 || RPD: 10	LCS-W1	120%

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	-			06/05/2015	127430-1	06/05/2015 || 06/05/2015	LCS-W2	06/05/2015
Date analysed	-			06/05/2015	127430-1	06/05/2015 || 06/05/2015	LCS-W2	06/05/2015
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127430-1	<1 || [N/T]	LCS-W2	99%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	127430-1	0.2 || [N/T]	LCS-W2	101%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127430-1	<1 || [N/T]	LCS-W2	95%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127430-1	3 || [N/T]	LCS-W2	93%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127430-1	2 || [N/T]	LCS-W2	101%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	127430-1	<0.05 || <0.05	LCS-W2	102%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127430-1	3 || [N/T]	LCS-W2	98%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127430-1	18 || [N/T]	LCS-W2	97%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	127430-2	06/05/2015
Date analysed	-	[NT]	[NT]	127430-2	07/05/2015
TRHC$_{10}$ - C$_{14}$	µg/L	[NT]	[NT]	127430-2	102%
TRHC$_{15}$ - C$_{28}$	µg/L	[NT]	[NT]	127430-2	104%
TRHC$_{29}$ - C$_{36}$	µg/L	[NT]	[NT]	127430-2	72%
TRH>C$_{10}$ - C$_{16}$	µg/L	[NT]	[NT]	127430-2	102%
TRH>C$_{16}$ - C$_{34}$	µg/L	[NT]	[NT]	127430-2	104%
TRH>C$_{34}$ - C$_{40}$	µg/L	[NT]	[NT]	127430-2	72%
Surrogate o-Terphenyl	%	[NT]	[NT]	127430-2	84%

QUALITY CONTROL PAHs in Water	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	127430-2	06/05/2015
Date analysed	-	[NT]	[NT]	127430-2	06/05/2015
Naphthalene	µg/L	[NT]	[NT]	127430-2	76%
Acenaphthylene	µg/L	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	[NT]	[NT]	127430-2	69%
Phenanthrene	µg/L	[NT]	[NT]	127430-2	77%
Anthracene	µg/L	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	[NT]	[NT]	127430-2	77%
Pyrene	µg/L	[NT]	[NT]	127430-2	78%
Benzo(a)anthracene	µg/L	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	[NT]	[NT]	127430-2	76%
Benzo(b,j+k)fluoranthene	µg/L	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	[NT]	[NT]	127430-2	94%
Indeno(1,2,3-c,d)pyrene	µg/L	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	[NT]	[NT]	127430-2	113%

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	127430-5	06/05/2015 || 06/05/2015	127430-3	06/05/2015
Date analysed	-	127430-5	06/05/2015 || 06/05/2015	127430-3	06/05/2015
Arsenic-Dissolved	µg/L	127430-5	<1 || <1	[NR]	[NR]
Cadmium-Dissolved	µg/L	127430-5	<0.1 || <0.1	[NR]	[NR]
Chromium-Dissolved	µg/L	127430-5	<1 || <1	[NR]	[NR]
Copper-Dissolved	µg/L	127430-5	1 || 1 || RPD: 0	[NR]	[NR]
Lead-Dissolved	µg/L	127430-5	<1 || <1	[NR]	[NR]
Mercury-Dissolved	µg/L	127430-5	<0.05 || [N/T]	127430-3	107%
Nickel-Dissolved	µg/L	127430-5	3 || 3 || RPD: 0	[NR]	[NR]
Zinc-Dissolved	µg/L	127430-5	14 || 14 || RPD: 0	[NR]	[NR]

Report Comments:

METALS_WLL_8_D: For the determination of dissolved metals in sample 127430-2, the unpreserved sample was filtered through 0.45um filter at the lab due to the presence of colloids and/or sediment in the supplied HNO3 bottle.

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
NA: Test not required
<: Less than

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

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

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in 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 (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics 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 127637

Client:

Parsons Brinckerhoff Aust. Pty Ltd
GPO Box 5394
Sydney
NSW 2001

Attention: Beejal Patel

Sample log in details:

Your Reference:	**2201675A, Brookvale**	
No. of samples:	8 waters	
Date samples received / completed instructions received	08/05/15	/ 08/05/15

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:	15/05/15	/ 13/05/15
Date of Preliminary Report:	Not Issued	

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

Results Approved By:

Jacinta Hurst
Laboratory Manager

ACCREDITED FOR TECHNICAL COMPETENCE

vTRH(C6-C10)/BTEXN in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ -----------	127637-1 MW1 08/05/2015 Water	127637-2 MB1 08/05/2015 Water	127637-3 MW2 08/05/2015 Water	127637-4 MW3 08/05/2015 Water	127637-5 DUP-070515 08/05/2015 Water
Date extracted	-	08/05/2015	08/05/2015	08/05/2015	08/05/2015	08/05/2015
Date analysed	-	09/05/2015	09/05/2015	09/05/2015	09/05/2015	09/05/2015
TRH C_6 - C_9	µg/L	<10	<10	3,500	<10	3,500
TRH C_6 - C_{10}	µg/L	<10	<10	4,400	<10	4,400
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	<10	2,300	<10	2,200
Benzene	µg/L	<1	<1	<1	<1	<1
Toluene	µg/L	<1	<1	36	<1	36
Ethylbenzene	µg/L	<1	<1	360	<1	370
m+p-xylene	µg/L	<2	<2	1,700	<2	1,700
o-xylene	µg/L	<1	<1	52	<1	50
Naphthalene	µg/L	<1	<1	93	<1	110
Surrogate Dibromofluoromethane	%	125	126	114	114	111
Surrogate toluene-d8	%	102	103	99	100	99
Surrogate 4-BFB	%	98	96	107	100	102

vTRH(C6-C10)/BTEXN in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ -----------	127637-6 R-070515 08/05/2015 Water	127637-7 TS-070515 08/05/2015 Water	127637-8 TB-070515 08/05/2015 Water
Date extracted	-	08/05/2015	08/05/2015	08/05/2015
Date analysed	-	09/05/2015	09/05/2015	09/05/2015
TRH C_6 - C_9	µg/L	<10	[NA]	<10
TRH C_6 - C_{10}	µg/L	<10	[NA]	<10
TRH C_6 - C_{10} less BTEX (F1)	µg/L	<10	[NA]	<10
Benzene	µg/L	<1	103%	<1
Toluene	µg/L	<1	102%	<1
Ethylbenzene	µg/L	<1	102%	<1
m+p-xylene	µg/L	<2	104%	<2
o-xylene	µg/L	<1	104%	<1
Naphthalene	µg/L	<1	[NA]	<1
Surrogate Dibromofluoromethane	%	112	113	114
Surrogate toluene-d8	%	100	100	100
Surrogate 4-BFB	%	100	105	101

svTRH (C10-C40) in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ ------------	127637-1 MW1 08/05/2015 Water	127637-2 MB1 08/05/2015 Water	127637-3 MW2 08/05/2015 Water	127637-4 MW3 08/05/2015 Water	127637-5 DUP-070515 08/05/2015 Water
Date extracted	-	11/05/2015	11/05/2015	11/05/2015	11/05/2015	11/05/2015
Date analysed	-	12/05/2015	12/05/2015	11/05/2015	12/05/2015	12/05/2015
TRH C_{10} - C_{14}	µg/L	<50	<50	1,700	<50	2,000
TRH C_{15} - C_{28}	µg/L	<100	<100	140	<100	150
TRH C_{29} - C_{36}	µg/L	<100	<100	<100	<100	<100
TRH >C_{10} - C_{16}	µg/L	<50	<50	980	<50	1,100
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50	<50	890	<50	1,000
TRH >C_{16} - C_{34}	µg/L	<100	<100	<100	<100	<100
TRH >C_{34} - C_{40}	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	106	92	95	91	116

svTRH (C10-C40) in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------ ------------	127637-6 R-070515 08/05/2015 Water
Date extracted	-	11/05/2015
Date analysed	-	12/05/2015
TRH C_{10} - C_{14}	µg/L	<50
TRH C_{15} - C_{28}	µg/L	<100
TRH C_{29} - C_{36}	µg/L	<100
TRH >C_{10} - C_{16}	µg/L	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	µg/L	<50
TRH >C_{16} - C_{34}	µg/L	<100
TRH >C_{34} - C_{40}	µg/L	<100
Surrogate o-Terphenyl	%	84

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	127637-1 MW1 08/05/2015 Water	127637-2 MB1 08/05/2015 Water	127637-3 MW2 08/05/2015 Water	127637-4 MW3 08/05/2015 Water	127637-5 DUP-070515 08/05/2015 Water
Date extracted	-	11/05/2015	11/05/2015	11/05/2015	11/05/2015	11/05/2015
Date analysed	-	11/05/2015	11/05/2015	11/05/2015	11/05/2015	11/05/2015
Naphthalene	µg/L	<1	<1	110	<1	120
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	110	NIL (+)VE	120
Surrogate p-Terphenyl-d14	%	95	102	104	98	119

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ------------- ------------	127637-6 R-070515 08/05/2015 Water
Date extracted	-	11/05/2015
Date analysed	-	11/05/2015
Naphthalene	µg/L	<1
Acenaphthylene	µg/L	<1
Acenaphthene	µg/L	<1
Fluorene	µg/L	<1
Phenanthrene	µg/L	<1
Anthracene	µg/L	<1
Fluoranthene	µg/L	<1
Pyrene	µg/L	<1
Benzo(a)anthracene	µg/L	<1
Chrysene	µg/L	<1
Benzo(b,j+k)fluoranthene	µg/L	<2
Benzo(a)pyrene	µg/L	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1
Dibenzo(a,h)anthracene	µg/L	<1
Benzo(g,h,i)perylene	µg/L	<1
Benzo(a)pyrene TEQ	µg/L	<5
Total +ve PAH's	µg/L	NIL (+)VE
Surrogate p-Terphenyl-d14	%	104

HM in water - dissolved						
Our Reference:	UNITS	127637-1	127637-2	127637-3	127637-4	127637-5
Your Reference	-------------	MW1	MB1	MW2	MW3	DUP-070515
Date Sampled	------------	08/05/2015	08/05/2015	08/05/2015	08/05/2015	08/05/2015
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	11/05/2015	11/05/2015	11/05/2015	11/05/2015	11/05/2015
Date analysed	-	11/05/2015	11/05/2015	11/05/2015	11/05/2015	11/05/2015
Arsenic-Dissolved	µg/L	<1	<1	<1	<1	<1
Cadmium-Dissolved	µg/L	0.2	0.1	<0.1	3.4	<0.1
Chromium-Dissolved	µg/L	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	<1	<1	<1	71	<1
Lead-Dissolved	µg/L	2	<1	<1	140	<1
Mercury-Dissolved	µg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel-Dissolved	µg/L	<1	<1	<1	5	<1
Zinc-Dissolved	µg/L	11	7	4	1,500	5

HM in water - dissolved		
Our Reference:	UNITS	127637-6
Your Reference	-------------	R-070515
Date Sampled	------------	08/05/2015
Type of sample		Water
Date prepared	-	11/05/2015
Date analysed	-	11/05/2015
Arsenic-Dissolved	µg/L	<1
Cadmium-Dissolved	µg/L	<0.1
Chromium-Dissolved	µg/L	<1
Copper-Dissolved	µg/L	<1
Lead-Dissolved	µg/L	<1
Mercury-Dissolved	µg/L	<0.05
Nickel-Dissolved	µg/L	<1
Zinc-Dissolved	µg/L	<1

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (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.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			08/05/2015	127637-1	08/05/2015 || 11/05/2015	LCS-W2	08/05/2015
Date analysed	-			08/05/2015	127637-1	09/05/2015 || 11/05/2015	LCS-W2	08/05/2015
TRHC_6 - C_9	µg/L	10	Org-016	<10	127637-1	<10 || <10	LCS-W2	110%
TRHC_6 - C_{10}	µg/L	10	Org-016	<10	127637-1	<10 || <10	LCS-W2	110%
Benzene	µg/L	1	Org-016	<1	127637-1	<1 || <1	LCS-W2	116%
Toluene	µg/L	1	Org-016	<1	127637-1	<1 || <1	LCS-W2	110%
Ethylbenzene	µg/L	1	Org-016	<1	127637-1	<1 || <1	LCS-W2	106%
m+p-xylene	µg/L	2	Org-016	<2	127637-1	<2 || <2	LCS-W2	110%
o-xylene	µg/L	1	Org-016	<1	127637-1	<1 || <1	LCS-W2	110%
Naphthalene	µg/L	1	Org-013	<1	127637-1	<1 || <1	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	121	127637-1	125 || 124 || RPD: 1	LCS-W2	120%
Surrogate toluene-d8	%		Org-016	103	127637-1	102 || 103 || RPD: 1	LCS-W2	101%
Surrogate 4-BFB	%		Org-016	98	127637-1	98 || 99 || RPD: 1	LCS-W2	105%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			11/05/2015	[NT]	[NT]	LCS-W2	11/05/2015
Date analysed	-			11/05/2015	[NT]	[NT]	LCS-W2	11/05/2015
TRHC_{10} - C_{14}	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W2	101%
TRHC_{15} - C_{28}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	95%
TRHC_{29} - C_{36}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	93%
TRH>C_{10} - C_{16}	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W2	101%
TRH>C_{16} - C_{34}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	95%
TRH>C_{34} - C_{40}	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	93%
Surrogate o-Terphenyl	%		Org-003	81	[NT]	[NT]	LCS-W2	73%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			11/05/2015	[NT]	[NT]	LCS-W3	11/05/2015
Date analysed	-			11/05/2015	[NT]	[NT]	LCS-W3	11/05/2015
Naphthalene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	81%
Acenaphthylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	81%
Phenanthrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	84%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	84%
Pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	87%
Benzo(a)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	78%
Benzo(b,j+k) fluoranthene	µg/L	2	Org-012 subset	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	85%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	96	[NT]	[NT]	LCS-W3	103%

QUALITY CONTROL HM in water - dissolved	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			11/05/2015	127637-3	11/05/2015 || 11/05/2015	LCS-W1	11/05/2015
Date analysed	-			11/05/2015	127637-3	11/05/2015 || 11/05/2015	LCS-W1	11/05/2015
Arsenic-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127637-3	<1 || <1	LCS-W1	100%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	127637-3	<0.1 || <0.1	LCS-W1	104%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127637-3	<1 || <1	LCS-W1	99%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127637-3	<1 || <1	LCS-W1	98%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127637-3	<1 || <1	LCS-W1	98%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	127637-3	<0.05 || [N/T]	LCS-W1	96%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127637-3	<1 || <1	LCS-W1	98%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	127637-3	4 || 4 || RPD: 0	LCS-W1	100%

Client Reference: 2201675A, Brookvale

QUALITY CONTROL HM in water - dissolved	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	127637-4	11/05/2015
Date analysed	-	[NT]	[NT]	127637-4	11/05/2015
Arsenic-Dissolved	µg/L	[NT]	[NT]	127637-4	98%
Cadmium-Dissolved	µg/L	[NT]	[NT]	127637-4	101%
Chromium-Dissolved	µg/L	[NT]	[NT]	127637-4	95%
Copper-Dissolved	µg/L	[NT]	[NT]	127637-4	85%
Lead-Dissolved	µg/L	[NT]	[NT]	127637-4	79%
Mercury-Dissolved	µg/L	[NT]	[NT]	[NR]	[NR]
Nickel-Dissolved	µg/L	[NT]	[NT]	127637-4	88%
Zinc-Dissolved	µg/L	[NT]	[NT]	127637-4	#

Report Comments:

METALS_WLL_8_D: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

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

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

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

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

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in 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 (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics 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.

White Page - Laboratory Copy
Yellow Page - Project File Copy
Pink Page - Remains in Book

ABN 80 078 004 798

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Tel: (02) 6281 9500 Fax: (02) 6281 9501

Chain of Custody

Order No: 59964

Job Title: Health Infrastructure Brookvale
Laboratory Name: Envirolab
Address: [illegible] St, Chatswood
Fax Number:
Phone Number: 9910 6200
Contact Name: Jacinta Hurst
Delivery Method: Courier
Quote Number: -

PB Job Number: 2201675A
Job Location:

Terms of Business	PB	Other	Checked

Project Manager: Beejal Patel
Results Expected by/on: 12/05/15
Fax Results to: bepatel@pb.com.au
Fax Number:
Phone Number: 0402257222
Spreadsheet of Results Required: [✓ Y] N
Format: ESDAT PDF
Turnaround Time Required: 5days
Invoice to: Beejal Patel
Comments:

Date Sampled	Time	Sample I.D.	Container Size	Sample Location	Medium*	Preservative Type	Filtered (X)	TPH	BTEX	PAH's	OC/OP/PCB's	Metals**	Combo 3	Initials	Comments/Additional Information and/or Analysis Required
04/05/15	1	MW1			W								Y		
	2	BB1											[illegible]		
	3	MW2											Y		
	4	MW3											Y		
	5	DUP01_040515											Y		
	6	R_040515											Y		
	7	TS_040515							Y						
	8	TB_040515						Y	Y						

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 127430
Date Received: 5/5/15
Time Received: 13.15
Received by: LSB
Temp: [✓ Cool]/Ambient
Cooling: [✓ Ice]/Icepack
Security: [✓ Intact]/Broken/None

Relinquished by: Beejal Patel	Relinquished by:	Relinquished by:
Date & Time: 04/05/15	Date & Time:	Date & Time:
Company: PB	Company:	Company:
Signature:	Signature:	Signature:
Received in Good Order & Condition by (Name): LSB	Received in Good Order & Condition by (Name):	Received in Good Order & Condition by (Name):
Date & Time: 5/5/15 13.15	Date & Time:	Date & Time:
Company: ELS	Company:	Company:
Signature:	Signature:	Signature:

Medium*: S = Soil, W = Water, V = Vapour

Legend**: (circle the following to be tested)

Metals: Al [✓ As] Be [✓ Cd] Co [✓ Cr] [✓ Cu] Fe [✓ Hg] Li Mg Mn [✓ Ni] [✓ Pb] Se Sn V [✓ Zn]

Samples on Ice: ☑ Yes ☐ No

Please fax back a signed copy when samples are received at the laboratory

Fadi Soro Frank ALS 11/5/15 1130

From: Brenda Hong
Sent: Monday, 11 May 2015 10:52 AM
To: Fadi Soro
Subject: FW: sample receipt

HI Fadi, please use below instructions from Beejal as the coc.

ID: DUP02_070515'
Project: H.I. Brookvale'

Thanks,
Brenda
+61 2 8784 8515

From: Patel, Beejal [mailto:BePatel@pb.com.au]
Sent: Monday, 11 May 2015 10:50 AM
To: Brenda Hong
Cc: ALSEnviro Sydney
Subject: RE: sample receipt

Hi,

The sample should be TRH, BTEXN, heavy metals, PAH on 4 day TAT.

Thanks

Environmental Division
Sydney
Work Order Reference
ES1521598
Telephone : +61-2-8784 8555

From: Brenda Hong [mailto:Brenda.Hong@alsglobal.com]
Sent: Monday, 11 May 2015 10:49 AM
To: Patel, Beejal
Cc: ALSEnviro Sydney
Subject: RE: sample receipt

HI Beejal, I have been advised that we have received this sample however there was no paperwork (coc). Please can you forward one on to us so that we can process the work.

Thanks,
Brenda
+61 2 8784 8515

From: Patel, Beejal [mailto:BePatel@pb.com.au]
Sent: Monday, 11 May 2015 10:06 AM
To: ALSEnviro Sydney
Subject: sample receipt

Can I please confirm you have received a sample labelled 'DUP02_070515' for 'H.I. Brookvale'?

The sample should be analysed for TRH, BTEXN, heavy metals, PAH.

I haven't received the sample receipt.

Thanks

Beejal Patel
Environmental Scientist

Level 27, Ernst & Young Centre, 680 George Street
Sydney NSW 2000
Australia

BePatel@pb.com.au

www.wspgroup.com
www.pbworld.com

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ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1521598**	Page	: 1 of 4
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS BEEJAL PATEL	Contact	:
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: BePatel@pb.com.au	E-mail	:
Telephone	: +61 02 92725100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 92725101	Facsimile	: +61-2-8784 8500
Project	: H.I. Brookvale	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 11-May-2015 11:30
C-O-C number	: ----	Date Analysis Commenced	: 11-May-2015
Sampler	: ----	Issue Date	: 15-May-2015 14:12
Site	: ----		
		No. of samples received	: 1
Quote number	: ----	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Pabi Subba	Senior Organic Chemist	Sydney Organics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**DUP02_070515**	**----**	**----**	**----**	**----**
			Client sampling date / time	[07-May-2015]	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1521598-001**	--------	--------	--------	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.018**	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1	µg/L	**60.8**	----	----	----	----
Acenaphthylene	208-96-8	1	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	**60.8**	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**3490**	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	**690**	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**690**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**DUP02_070515**	----	----	----	----
			Client sampling date / time	[07-May-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit	**ES1521598-001**	--------	--------	--------	--------
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
C6 - C10 Fraction	C6_C10	20	µg/L	**4110**	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**2360**	----	----	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L	**510**	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**510**	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	**380**	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	----	----	----	----
Toluene	108-88-3	2	µg/L	**32**	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	**288**	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	**1380**	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	**54**	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	**1430**	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	**1750**	----	----	----	----
Naphthalene	91-20-3	5	µg/L	**125**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1	%	**19.0**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1	%	**38.5**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1	%	**69.7**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1	%	**55.3**	----	----	----	----
Anthracene-d10	1719-06-8	1	%	**64.2**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1	%	**60.1**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**84.5**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**107**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**106**	----	----	----	----

QA/QC Compliance Assessment for DQO Reporting

Work Order : **ES1521598**
Page : 1 of 4

Client : **PARSONS BRINCKERHOFF AUST P/L**
Contact : MS BEEJAL PATEL
Project : H.I. Brookvale
Site : ----
Sampler : ----
Order number : ----

Laboratory : Environmental Division Sydney
Telephone : +61-2-8784 8555
Date Samples Received : 11-May-2015
Issue Date : 15-May-2015
No. of samples received : 1
No. of samples analysed : 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Dissolved Mercury by FIMS	0	1	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	0	4	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	0	1	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	4	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	0	1	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	*Extraction / Preparation*			*Analysis*		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
DUP02_070515	**07-May-2015**	**----**	----	----	**13-May-2015**	03-Nov-2015	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
DUP02_070515	**07-May-2015**	**----**	----	----	**14-May-2015**	04-Jun-2015	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
DUP02_070515	**07-May-2015**	**11-May-2015**	14-May-2015	✓	**12-May-2015**	20-Jun-2015	✓
EP075(SIM)T: PAH Surrogates							
Amber Glass Bottle - Unpreserved (EP075(SIM))							
DUP02_070515	**07-May-2015**	**11-May-2015**	14-May-2015	✓	**12-May-2015**	20-Jun-2015	✓
EP080S: TPH(V)/BTEX Surrogates							
Amber VOC Vial - Sulfuric Acid (EP080)							
DUP02_070515	**07-May-2015**	**11-May-2015**	21-May-2015	✓	**12-May-2015**	21-May-2015	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	0	1	**0.00**	**10.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	16	**12.50**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	4	**0.00**	**10.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	0	1	**0.00**	**10.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	2	17	**11.76**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	4	**25.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	17	**5.88**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	4	**25.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	17	**5.88**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	1	**100.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	4	**0.00**	**5.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	0	1	**0.00**	**5.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	17	**5.88**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

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White Page - Laboratory Copy
Yellow Page - Project File Copy
Pink Page - Remains in Book

ABN 80 078 004 798

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GPO Box 331, Canberra ACT 2601
Tel: (02) 6281 9500 Fax: (02) 6281 9501

Chain of Custody

Order No: 59965

Job Title: Health [illegible]
Laboratory Name: ALS
Address: Smithfield [illegible]
Fax Number:
Phone Number:
Contact Name:
Delivery Method:
Quote Number:

PB Job Number: 2201 [illegible]
Job Location:

Terms of Business	PB	Other	Checked

Project Manager: Begal Patel
Results Expected by/on: 12/05/15
Fax Results to: bepatel@pb.[redacted]
Fax Number:
Phone Number: [redacted]
Spreadsheet of Results Required: N
Format:
Turnaround Time:
[illegible]
[illegible]

Date Sampled	Time	Sample ID	Container Size	Sample Location	Medium	Preservative Type	Filtered (X)	TPH	BTEX	PAHs	OC/OP/PCBs	Metals									Initials	Comments/Additional Information and/or Analysis Required
6/05/15		[illegible]																				

Relinquished by: Begal Patel
Date & Time: 05/05/15
Company: PB
Signature:
Received in Good Order & Condition by (Name): Steven
Date & Time: 5/5/15 1500
Company: ALS
Signature:

Relinquished by:
Date & Time:
Company:
Signature:
Received in Good Order & Condition by (Name):
Date & Time:
Company:

Relinquished by:
Date & Time:
Company:
Signature:
Received in Good Order & Condition by (Name):
Date & Time:
Company:

Medium: S = Soil, W = Water, V = Vapour
Legend: (circle the following to be tested)
Metals: Al [illegible] Be [illegible] Co [illegible] Fe
[illegible] Li Mg Mn [illegible] V
Samples on Ice: ☐ Yes ☐ No
Please fax back a signed copy when [illegible]

Environmental Division
Sydney
Work Order Reference
ES1521199
Telephone : +61-2-8784 8555

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : **ES1521199**
Client : **PARSONS BRINCKERHOFF AUST P/L**
Contact : MS BEEJAL PATEL
Address : GPO BOX 5394
SYDNEY NSW, AUSTRALIA 2001
E-mail : BePatel@pb.com.au
Telephone : +61 02 92725100
Facsimile : +61 02 92725101
Project : 2201625 A HEALTH INFANT CENTRE
Order number : 59965
C-O-C number : ----
Sampler : ----
Site : ----
Quote number : ----

Page : 1 of 4
Laboratory : Environmental Division Sydney
Contact :
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail :
Telephone : +61-2-8784 8555
Facsimile : +61-2-8784 8500
QC Level : NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Date Samples Received : 05-May-2015 15:00
Date Analysis Commenced : 06-May-2015
Issue Date : 12-May-2015 17:26
No. of samples received : 1
No. of samples analysed : 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Pabi Subba	Senior Organic Chemist	Sydney Organics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- EG020: Positive result for sample ES1521199 - #001 has been confirmed by reanalysis.
- EP080: Particular samples required dilution due to the presence of high level contaminants. LOR values have been adjusted accordingly.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**DUP02_040515**	----	----	----	----
			Client sampling date / time	[04-May-2015]	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**ES1521199-001**	--------	--------	--------	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.007**	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1	µg/L	**39.6**	----	----	----	----
Acenaphthylene	208-96-8	1	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	----	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	**39.6**	----	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**2180**	----	----	----	----
C10 - C14 Fraction	----	50	µg/L	**520**	----	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	----	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**520**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	DUP02_040515	----	----	----	----
			Client sampling date / time	[04-May-2015]	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1521199-001	--------	--------	--------	--------
				Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued								
C6 - C10 Fraction	C6_C10	20	µg/L	**2580**	----	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**1540**	----	----	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L	**310**	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	----	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**310**	----	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	**240**	----	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<5	----	----	----	----
Toluene	108-88-3	2	µg/L	**24**	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L	**191**	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	**795**	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L	**35**	----	----	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	**830**	----	----	----	----
^ **Sum of BTEX**	----	1	µg/L	**1040**	----	----	----	----
Naphthalene	91-20-3	5	µg/L	**74**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1	%	**29.8**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1	%	**58.4**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1	%	**69.2**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1	%	**82.6**	----	----	----	----
Anthracene-d10	1719-06-8	1	%	**80.6**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1	%	**65.4**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**91.3**	----	----	----	----
Toluene-D8	2037-26-5	2	%	**102**	----	----	----	----
4-Bromofluorobenzene	460-00-4	2	%	**104**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1521199**	Page	: 1 of 7
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS BEEJAL PATEL	Contact	:
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: BePatel@pb.com.au	E-mail	:
Telephone	: +61 02 92725100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 92725101	Facsimile	: +61-2-8784 8500
Project	: 2201625 A HEALTH INFANT CENTRE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 59965	Date Samples Received	: 05-May-2015
C-O-C number	: ----	Date Analysis Commenced	: 06-May-2015
Sampler	: ----	Issue Date	: 12-May-2015
Site	: ----	No. of samples received	: 1
Quote number	: ----	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited
Laboratory 825

Accredited for
compliance with
ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out ir compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Pabi Subba	Senior Organic Chemist	Sydney Organics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 94783)									
ES1521202-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	53.3	49.3	7.78	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.002	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.009	0.009	0.00	No Limit
ES1521162-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.010	0.008	18.6	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 94782)									
ES1521153-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
ES1521202-002	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 93842)									
EN1511495-004	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
ES1521222-001	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 93842)									
EN1511495-004	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
ES1521222-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit
EP080: BTEXN (QC Lot: 93842)									
EN1511495-004	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit
ES1521222-001	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EP080: BTEXN (QC Lot: 93842) - continued									
ES1521222-001	Anonymous	EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 94783)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	96.1	85	115
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.2	85	115
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	89.8	85	115
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	93.9	85	115
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	94.7	85	115
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	90.1	85	115
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	98.6	85	115
EG035F: Dissolved Mercury by FIMS (QCLot: 94782)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	97.5	78	114
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 93686)								
EP075(SIM): Acenaphthene	83-32-9	1	µg/L	<1.0	5 µg/L	71.8	62	113
EP075(SIM): Acenaphthylene	208-96-8	1	µg/L	<1.0	5 µg/L	89.7	64	114
EP075(SIM): Anthracene	120-12-7	1	µg/L	<1.0	5 µg/L	83.3	64	116
EP075(SIM): Benz(a)anthracene	56-55-3	1	µg/L	<1.0	5 µg/L	72.2	64	117
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	5 µg/L	80.4	63	117
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	5 µg/L	72.8	62	119
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	1	µg/L	<1.0	5 µg/L	76.2	59	118
EP075(SIM): Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	5 µg/L	82.9	62	117
EP075(SIM): Chrysene	218-01-9	1	µg/L	<1.0	5 µg/L	87.2	63	116
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	5 µg/L	70.0	61	117
EP075(SIM): Fluoranthene	206-44-0	1	µg/L	<1.0	5 µg/L	94.0	64	118
EP075(SIM): Fluorene	86-73-7	1	µg/L	<1.0	5 µg/L	75.1	64	115
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	5 µg/L	75.0	60	118
EP075(SIM): Naphthalene	91-20-3	1	µg/L	<1.0	5 µg/L	81.1	59	119
EP075(SIM): Phenanthrene	85-01-8	1	µg/L	<1.0	5 µg/L	73.4	63	116
EP075(SIM): Pyrene	129-00-0	1	µg/L	<1.0	5 µg/L	98.0	63	118
EP080/071: Total Petroleum Hydrocarbons (QCLot: 93685)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	2000 µg/L	83.1	59	129
EP071: C15 - C28 Fraction	----	100	µg/L	<100	3000 µg/L	92.1	71	131
EP071: C29 - C36 Fraction	----	50	µg/L	<50	2000 µg/L	78.4	62	120
EP080/071: Total Petroleum Hydrocarbons (QCLot: 93842)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	78.9	75	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 93685)								

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 93685) - continued								
EP071: >C10 - C16 Fraction	>C10_C16	100	µg/L	<100	2500 µg/L	83.8	59	131
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	3500 µg/L	86.7	74	138
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	1500 µg/L	81.7	67	127
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 93842)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	80.5	75	127
EP080: BTEXN (QCLot: 93842)								
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	91.1	70	124
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	99.2	70	120
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	10 µg/L	98.8	69	121
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	78.2	70	124
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	98.5	72	122
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	99.7	65	129

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG020F: Dissolved Metals by ICP-MS (QCLot: 94783)							
ES1521153-002	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	100	70	130
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	103	70	130
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	88.3	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	97.2	70	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	93.0	70	130
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	91.5	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	104	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 94782)							
ES1521153-001	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	79.2	70	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 93842)							
EN1511495-004	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	99.7	70	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 93842)							
EN1511495-004	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	100	70	130
EP080: BTEXN (QCLot: 93842)							
EN1511495-004	Anonymous	EP080: Benzene	71-43-2	25 µg/L	95.7	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP080: BTEXN (QCLot: 93842) - continued							
EN1511495-004	Anonymous	EP080: Ethylbenzene	100-41-4	25 µg/L	106	70	130
		EP080: meta- & para-Xylene	108-38-3 106-42-3	25 µg/L	105	70	130
		EP080: Naphthalene	91-20-3	25 µg/L	95.6	70	130
		EP080: ortho-Xylene	95-47-6	25 µg/L	103	70	130
		EP080: Toluene	108-88-3	25 µg/L	106	70	130

QA/QC Compliance Assessment for DQO Reporting

Work Order	: **ES1521199**	Page	: 1 of 4
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS BEEJAL PATEL	Telephone	: +61-2-8784 8555
Project	: 2201625 A HEALTH INFANT CENTRE	Date Samples Received	: 05-May-2015
Site	: ----	Issue Date	: 12-May-2015
Sampler	: ----	No. of samples received	: 1
Order number	: 59965	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	3	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	0	11	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	3	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	0	11	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	***Sample Date***	*Extraction / Preparation*			*Analysis*		
***Container** / Client Sample ID(s)*		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) DUP02_040515	**04-May-2015**	**----**	----	----	**08-May-2015**	31-Oct-2015	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) DUP02_040515	**04-May-2015**	**----**	----	----	**11-May-2015**	01-Jun-2015	✓
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071) DUP02_040515	**04-May-2015**	**06-May-2015**	11-May-2015	✓	**07-May-2015**	15-Jun-2015	✓
EP075(SIM)T: PAH Surrogates							
Amber Glass Bottle - Unpreserved (EP075(SIM)) DUP02_040515	**04-May-2015**	**06-May-2015**	11-May-2015	✓	**07-May-2015**	15-Jun-2015	✓
EP080S: TPH(V)/BTEX Surrogates							
Clear glass VOC vial - HCl (EP080) DUP02_040515	**04-May-2015**	**06-May-2015**	18-May-2015	✓	**07-May-2015**	18-May-2015	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Mercury by FIMS	EG035F	2	8	**25.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	3	**0.00**	**10.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	0	11	**0.00**	**10.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	2	16	**12.50**	**10.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	3	**33.33**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	11	**9.09**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	3	**33.33**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	11	**9.09**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	3	**0.00**	**5.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	0	11	**0.00**	**5.00**	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	16	**6.25**	**5.00**	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Attachment H

Calibration certificates

ThermoFisher SCIENTIFIC

The world leader
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RENTALS

Equipment Report – Aquameter- Water Quality Meter

This Aquameter Water Quality Instrument has been performance checked / calibrated* as follows:

Electrodes cleaned/checked ☑

pH (Acidity/Alkalinity) ☑ pH 7.00 ☑ pH4.00

Electrical Conductivity ☐ 1413uS/cm ☑ 2570uS/cm ☐ 12880uS/cm

ORP ☑ 250 mV @ 25°C

Dissolved Oxygen ☑ 0.00ppm in Sodium Sulphite ☑ 100% Saturation in moist Air

Turbidity ☑ 0.00 NTU ☑ 20NTU ☑ 100NTU ☐ Temperature

Batteries (x 5 AA) 100 %

Aquameter S/N 16524027 Probe S/N 135420220

* Calibration solution traceability information is available upon request.

Date: 30/04/2015 Checked by: Dave O'Neill

Signed:

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $20 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	Received	Returned	Item
☑	☐	☐	Aquameter unit
☑	☐	☐	Aquameter ops check / Batteries 100 %.
☑	☐	☐	Instruction Manual / Quick use guide
☑	☐	☐	Protective sleeve cap
☑	☐	☐	Spare Batteries x 5 (Alkaline / Rechargeable 100% ~~volts~~)
☑	☐	☐	Aquameter flow cell (AQR200 SA)
☑	☐	☐	Posidrive screw driver
☑	☐	☐	Software & USB cable
☑	☐	☐	Quick release lanyard (Blue shoulder strap)
☑	☐	☐	pH/ORP cap (with red strap)
☑	☐	☐	pH/ORP probe storage solution
☑	☐	☐	Carry case

10m Cable

Processors Signature/ Initials

Quote Reference	CS002521	Condition on return
Customer Ref		
Equipment ID	AQR2000SC	
Return Date	/ /	
Return Time		

"We do more than give you great equipment… We give you great solutions!"

Attachment I

Statement of limitations

Scope of services

This groundwater monitoring event report (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and Parsons Brinkerhoff (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on data

In preparing the report, Parsons Brinckerhoff has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, Parsons Brinckerhoff has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Parsons Brinckerhoff will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Parsons Brinckerhoff.

Environmental conclusions

In accordance with the scope of services, Parsons Brinckerhoff has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Also, it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for benefit of client

The report has been prepared for the benefit of the client and no other party. Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other limitations

Parsons Brinckerhoff will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

Enclosure C

Parsons Brinckerhoff soil vapour report

Parsons Brinckerhoff Australia Pty Limited

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Our ref: 2201675A-ENV-LTR-1031 RevA

By email
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Dear Ryan

Soil Vapour Monitoring Event (June 2015) - 612–624 Pittwater Road, Brookvale NSW

1. Introduction

Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) was commissioned by NSW Health Infrastructure (HI) to undertake a soil vapour monitoring event (SVE) on 3 June 2015 at a site located at 612 – 624 Pittwater Road, Brookvale (the site). The site location is presented on Figure 1.

The soil vapour investigation was conducted following a soil vapour investigation completed by SMEC. The SMEC investigation was not in a state that could be interpreted by the HI. Therefore, an additional investigation was conducted as a confirmatory round and to fill some data gaps identified during previous investigations. The purpose of the SVE was to establish the current status of the soil vapour concentrations with respect to hydrocarbon contamination identified in soil and groundwater previously at the site

2. Objectives

The objectives of the June 2015 SVE were to:

- monitor contaminant concentrations in soil vapour at the site, in particular, hydrocarbon contamination historically identified at the western boundary of number 620 Pittwater Road and the reinstated land-farmed material at number 612 Pittwater Road
- assess potential risks that could be caused by vapour intrusion to future users of the of the proposed community health centre under commercial/industrial use and provide recommendations.

3. Scope of work

The scope of works for the June 2015 SVE comprised:

- installation of five active soil vapour bores to a depth of approximately 1 mBGL: two targeting a location historically reinstated with land farmed soil (SV01, SV02),and three targeting an area with hydrocarbon contamination identified in groundwater at the western boundary (SV03-SV05)

- sampling of five soil vapour monitoring bores located at the site (SV01-SV05)
- submission of the soil vapour samples to the laboratories for analysis of the TO-17 VOC suite
- preparation of this letter report documenting and interpreting the finding of the investigation.

4. Background

It is understood HI acquired the site in December 2014 with the intention to develop it into a new community health centre, as a part of the Northern Beaches Health Services redevelopment. The site comprises the following:

- number 612, comprising Lot A, Lot B and Lot C of deposit plan 375728, historically used as a service station and currently vacant
- number 620, comprising Lot 1, DP 500541, historically used as a residence, and currently unused
- number 624, comprising Lot 3 DP 539384, historically and currently used for commercial and light industrial activities.

A number of previous investigations have been conducted at number 612 and number 620 comprising the removal of underground storage tanks (USTs) and validation of the resulting excavations, land farming and replacement of hydrocarbon impacted soil at number 612 and removal and validation of hydrocarbon impacted soil at number 620.

The following summarises the current status of the number 612:

- Number 612 was historically used as a service station. Seven USTs were present at the site and included associated fuel infrastructure. The fuel infrastructure was located at the central and northern portions of the site and removed in 1999.
- It is assumed the site was validated in 2000 based on historical reports. Residual contamination was reported in soil at the northern boundary of the site. Material removed from the excavations was land farmed and backfilled.
- Soil samples were collected from land farmed material prior to reinstatement as a part of validation works in 2000. Parsons Brinckerhoff recently compared the results to the new NEPM HSL criteria for commercial/industrial use and identified several exceedances of TRH concentrations in samples analysed.

Warehouse buildings at the site have been inspected and various contaminating activities have been identified. Soil sampling has not been conducted below these structures

The following summarises the current status of the number 620:

- Residual hydrocarbon contamination was historically identified in soil, groundwater and soil vapour at number 620.
- The site was remediated to the extent practical in 2011; however, residual contamination was reported in soil at depths ranging from 2.7 mBGL to 3.0 mBGL on excavation surfaces.
- A site audit report conducted by Environ (2013b) reported the site had been remediated to the extent practicable to a standard considered suitable for commercial/industrial land use.
- Investigations conducted by SMEC of the entire site had identified soil and groundwater contamination at the western boundary of number 620. However concentrations were below the applicable criteria for commercial/industrial use. A soil vapour investigation discussed further in Section 5.2 below identified

potential soil vapour risks in samples collected from soil vapour sampling locations at number 620 below the applicable criteria

The following summarises the current status of the number 624:

- Solutions Engineering have completed an asbestos register for structures on-site and identified asbestos in most structures. This was followed by the preparation of an asbestos management plan to be applied during site works.
- A survey was conducted for the site and was provided by HI, the survey identified one UST at the north-eastern portion of the site
- Results from samples collected from soil and groundwater locations were below the adopted criteria

5. Summary of previous investigations

A summary of recent investigations carried out by SMEC Australia Pty Ltd (SMEC) is provided in the following section.

5.1 Targeted ESA (August 2014)

SMEC undertook supplementary environmental site assessment (ESA) works in August 2014. The investigation comprised installation of 12 soil bores across the entire site ranging from 0.5 metres below ground level (mBGL) to 9.7 mBGL for the purposes of a combined geotechnical and contamination assessment. One borehole was converted into a monitoring well, followed by groundwater monitoring of two existing and the newly installed well (three in total).

Concentrations of TRH C_6-C_{10} and TPH >C_{10}-C_{16} were reported above the relevant NEPM (2013) assessment criteria in the sample collected from one soil sample location at the south western corner of the house at number 620 at depth of 1.5 mBGL.

Remaining soil results were reported below the adopted site criteria or for compounds for which no criteria is available. Asbestos was not detected in samples analysed which were sampled for absence and presence, not in accordance with NEPM requirements for quantitative asbestos assessment.

Two groundwater sampling events were undertaken as a part of the investigation due to the effect of rainwater on the groundwater horizon. Three of six on-site monitoring wells were sampled, including MB1, SP1 and SP2. Standing water levels ranged from 0.79 mBGL (SP2) to 1.22 mBGL (MB1) during the first round of sampling (following the rainfall event) and 0.89 mBGL (SP2) to 1.27 mBGL (SP1) during the second round. Hydrocarbon impacts were detected in the sample collected from SP1 located at the south western corner of the house at number 620 with toluene exceeding the adopted site criterion.

5.2 Additional Investigation (September 2014)

Following completion of the August 2014 ESA, a number of data gaps were identified relating to potential hydrocarbon contamination at number 620. SMEC completed an additional investigation to gain a better understanding of historical hydrocarbon contamination at number 620 and close data gaps associated with the remainder of the site.

In relation to the soil and groundwater assessment, the report indicated the following:

- three additional groundwater wells were installed
- soils samples were collected from six additional boreholes (the depth of which was not disclosed)
- two off-site groundwater wells, one onsite well and three newly installed were assessed
- two soil vapour sampling locations at number 612 and four soil vapour sampling locations at number 620 were installed to target soil at a depth of 1 metre below ground level (mBGL) to 2 mBGL

In off-site monitoring wells, groundwater was measured at depths of approximately 2.3 mBGL to 2.4 mBGL and hydrocarbon concentrations were detected below the adopted site criteria. Standing water levels for on-site wells were not recorded.

The presence of an UST was confirmed at the rear (east) of the building. Hydrocarbon concentrations in a newly installed well targeting the UST were detected below the applicable HSL criteria.

SMEC reported trace level VOCs in one soil vapour location, VP3, at the western boundary of number 620.

Parsons Brinckerhoff reviewed laboratory results for the September 2014 investigation from HI. Laboratory results were compared to the relevant NEPM criteria for commercial/industrial use. A summary of the results are provided below:

- Hydrocarbon contamination was reported in the sample collected at a depth of 2.0-2.1 at location BH4; concentrations were below the HSL D criterion. It should be noted that elevated concentrations of naphthalene, ethylbenzene and F2 were detected.
- Minor hydrocarbon contamination was reported in soil collected at a depth of 0.1-0.2 at location BH3 below the HSL D criterion. It should be noted that elevated concentrations of higher fraction TRH was detected for which criteria is not available.
- Concentrations of PAHs were reported in soil collected from BH2 at a depth of 0.5-0.6, BH4 at a depth of 2.0-2.1 and BH5 at a depth of 0.0-0.1 below the relevant HIL D criterion.
- Soil vapour VOCs were detected at vapour sampling location VP3, adjacent to BH4. Elevated concentrations of hexane, ethylbenzene, 1,2,4-Trimethylbenzene and xylene, were detected. It should be noted that applicable HSL criterion is not provided for 124-trimethylbenzene or hexane. Other analytes were below the adopted HSL values.
- The methodology and borelogs for the installation and sampling of soil vapour wells was not provided and therefore results from the soil vapour investigation have been used indicatively.
- Results for off-site wells were not provided it is not clear if the wells were sampled.
- Concentrations of chloroform were detected in monitoring wells sampled marginally above the LOR with the exception of MW2; concentrations are likely to be naturally occurring.
- Elevated concentrations of VOC compounds, including BTEX, were detected in groundwater sampled from MW2. It should be noted that relevant GIL criteria was not available for elevated VOC compounds.

Evidence of residual hydrocarbon contamination was identified in soil, groundwater and soil vapour at the western boundary of number 620. Soil contamination was detected above the laboratory limits of reporting (LORs) in natural material above bedrock and was not delineated horizontally or at depth, however, concentrations were reported below the adopted criteria. Soil vapour risks were reported at the western boundary of number 620 at soil vapour location VP3. Soil vapour risks were not identified east of location VP3 or at the western boundary of number 612. Data gaps in the assessment of soil vapour have been identified directly north and south of VP3 and reinstated land farmed material at number 612. Soil vapour sampling locations sampled by SMEC as a part of the September 2014 investigation are provided on Figure 2.

6. Soil vapour sampling methodologies

Five soil vapour bores were installed by Parsons Brinckerhoff on 2 June 2015 and sampled by SGS Leeder Consulting on 3 June 2015.The location of soil vapour bores are presented on Figure 2. The following section provides a description of soil sampling methodologies.

6.1 Sampling design and rationale

One soil bore (SV4) was installed directly adjacent to groundwater monitoring well MW2 and two soil bores were installed 1 m to the north (SV5) and 1 m to the south (SV3) of MW2 to fill a data gaps related to the assessment of soil vapour north and south of historical soil vapour location VP3 and groundwater location MW2 both historically reporting hydrocarbon contamination. Two soil bores were installed to provide an indication of potential soil vapour risks associated with land farmed material historically reinstated at number 612 (SV1 and SV2). Soil bore installation and sampling methodology is presented in the following section, soil vapour bore locations are presented on Figure 2 in Attachment A.

6.2 Soil vapour bore construction

Soil vapour bores were installed using a hand auger to a depth of 1 mBGL. Sampling implants consisted of perforated stainless steel implants connected to Teflon tubing extending to and above the surface. The sampling end pieces were backfilled in coarse (5 mm) washed gravel, and concrete and bentonite plugs were placed above the gravel packs to seal the gravel packs and restrict the samples to the depth of the gravel pack.

6.3 Soil vapour sampling

Soil vapours were sampled using the USEPA TO-17 Determination of VOCs in Air using Active Sampling onto Sorbent Tubes method. Air samples were drawn from each sample location, using a low flow pump and passing the air through “Air Toxics” sorbent sampling tubes (thermal desorption tubes). Samples were collected over two different sampling periods to cater for unknown vapour concentrations.

The method is described in the ASTM Guide D5314-92 (2001) "Standard Guide for Soil Gas Monitoring in the Vadose Zone".

Prior to conducting active sampling the tubing was purged of its volume to remove stagnant air within the tube itself. Purging of the backfilled gravel pack was not necessary as the pore space air would be in concentration equilibrium with the formation pore space air. However, at the time of installation of the soil vapour bores, the gravel packs were purged by the removal of several litres of air to remove any contaminants introduced from the atmosphere during bore construction.

The sampling flow rates were set at the commencement of sampling and checked during and at the completion of the sampling run. Rotameters and pumps used for the collection of samples were calibrated prior to sampling using a primary standard.

The sampling train was shown to be sealed (leak free) by crimping the sampling tube momentarily to observe the flow rate dropping to zero. Verification that ambient atmospheric air is not being drawn down the bore into the sampling pack was undertaken by creating an isopropanol shroud at the head of the bore and testing for isopropanol in the soil vapour sample.

6.4 Analytical methodology for soil vapour samples

Analyses for volatile organic compounds were performed by thermal desorption using a method based on US EPA TO -17 – Determination of Volatile Organic Compounds in Ambient Air using Active Sampling onto Sorbent Tubes taken from the US EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air.

The sorbent tubes were returned to the laboratory where they were thermally desorbed and analysed by GC-MS. Thermal desorption is carried out in the laboratory using an Automated PE-ATD 400 thermal desorption unit coupled with a Hewlett Packard 6890 High Resolution Capillary Gas Chromatograph unit with analysis by a Hewlett Packard model 6890 HRC-GC/MS system.

6.5 Quality assurance and quality control

To ensure reliable data, the following quality assurance procedures were put in place:

- one trip blank was included with the batch of sampling tubes prepared and taken to site and returned along with the samples for analysis
- two shroud samples were collected and analysed for isopropyl alcohol to detect leaks during sample collection
- one duplicate sample was collected from SV1 to assess precision, accuracy, representativeness, comparability and completeness within the laboratory
- one method blank was run prior to analysis of the samples to ensure the laboratory instruments were free of contamination and interferences
- spiked samples were run in the laboratory as part of the internal quality control procedures.

Samples were collected as distributed volume pairs, as required by the TO-17 method, such that two samples were collected on thermal desorption tubes, one at a low volume and one at a higher volume so as to provide an alternative sample in case one was outside the optimum analytical concentration range. A third sample was collected on a carbon tube in case concentrations are higher than expected. Only the sample best fitting the optimum analytical range was reported, as is in accordance with the method.

7. Soil vapour assessment criteria

To assess the contamination status of groundwater at a site, the assessment criteria provided in the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM; as amended 2013) were found to be applicable for the investigation. Schedule B-1 provides a framework for the use of investigation and screening levels based on a matrix of human health and ecological soil, soil vapour and groundwater risks.

Schedule B-1 of the NEPM assesses the risk of vapour intrusion arising from soil impacted by hydrocarbons using health screening levels (HSLs). The adopted carbon fraction ranges for the HSLs are based on TRH analysis after subtraction of BTEX compounds and naphthalene.

The HSLs have been developed for sand, silt and clay soils based on texture classifications and criteria are listed for several depth intervals. The clay content of soils were not was analysed as a part of the investigation, therefore, soils provided for a sand profile will be adopted as a conservative approach for the investigation. Given soil vapour wells were installed to a depth of 1 m BGL, the HSLs for soil vapour a depth range of 0 mBGL to <1 mBGL was adopted. The HSLs also depend on land uses scenarios. Due to the proposed commercial/industrial use of the site, the ‘HSL D’ criteria for commercial/industrial land use have been adopted.

Table 6.1 Assessment criteria

Analyte	HSL D(2) in sand (mg/m^3)
	0 m to <1 m
F1(1)	680
F2(1)	500
Benzene	4
Toluene	4,800
Ethylbenzene	1,300
m- & p-Xylene	-
o-Xylene	-
Total Xylene	840
Naphthalene	3

(1) F1: TPH C_6-C_{10} less BTEX; F2: TPH >C_{10}-C_{16} less naphthalene

(2) NEPM (2013) Schedule B1 Investigation levels for soil and groundwater – Table 1A(5)

8. Results

Results for the soil vapour assessment are reported in the following section.

8.1 Soil

A summary of the subsurface profile encountered during the installation of soil vapour bores are presented in Table 7.1 below. Borelogs are provided in are provided in Attachment C.

Table 7.1 Groundwater conditions

Depth (mBGL)	General soil description
0.2 m to 0.2 m (SV1, SV2)	Concrete hardstand
0.2 m to 0.3 m (SV1, SV2)	Fill; Sandy Gravel; coarse, moderately grained, moist, grey 'blue metal' road base gravels, loose
0.0–0.3 m to 1.0 m (all bores)	Fill; Sandy Clay; medium plasticity, red/brown, firm with broken yellow/red sandstone angular cobbles, moist

8.2 Analytical results

Laboratory analytical results tables are provided in Attachment B, with laboratory certificates provided in Attachment E. Table 7.2 summarised the soil vapour analytical results.

Table 7.2 Results

No. of primary samples	Analyte	Conc. ($\mu g/m^3$)		Samples exceeding adopted HSLs
		Min.	Max.	
TRH/BTEX compounds				
5	F1	<0.0001	0.055	-
5	F2	0.00028	0.25	-
5	Benzene	<5	<100	-
5	Toluene	<5	8	-
5	Ethylbenzene	<5	<100	-
5	Total Xylene	<200	<10	-
5	Naphthalene	<5	<100	-

(1) – no exceedance

9. Evaluation of quality assurance and quality control procedures

Laboratory quality assurance/quality control (QA/QC) results are provided in Attachment E, and a summary of QA/QC performance is provided in Attachment D. The data quality indicators (DQIs) are presented in Table 8.1.

Table 8.1 DQI performance

Data quality indicators	Item	Conformance
Completeness (a measure of the amount of useable data (expressed as %) from a data collection activity)	All critical locations sampled	Yes
	All samples collected (from grid and depth)	Yes
	Standard Operational Protocols (SOPs) appropriate and complied with	Yes
	Experienced samplers	Yes
	Correct documentation	Yes
Comparability (the confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event)	Same SOPs used on each occasion	Yes
	Experience sampler	Yes
	Climatic conditions (temperature, rainfall, wind, etc)	It was sunny on the day of sampling.
	Same type of samples collected (filtered, size, fractions)	Yes, Air Toxic sorbent tubes were used for all sample locations.

Data quality indicators	Item	Conformance
	Sample blanks – rinsate, field blank, trip blank and trip spike	Partial, the trip blank has one concentration of 2-methyl butane detected greater than the laboratory LOR, trip spike had hydrocarbon recoveries within acceptable limits (67% to 90%) with the exception of ethylcyclohexane. There are no adopted assessment criteria for either of these analytes and when captured under the F1 and F2 fractions the results are reported below the adopted assessment criteria so these results are not considered to have a detrimental effect on the comparability of the analysis results.
Representativeness (the confidence (expressed qualitatively) that data are representative of each media present on the site)	Appropriate media sampled according to sampling plan	Yes
	All media identified in sampling plan sampled	Yes
Precision (a quantitative measure of the variability (or reproducibility) of data)	SOPs appropriate and complied with	Yes
Accuracy (bias) (a quantitative measure of the closeness of reported data to the true value)	SOPs appropriate and complied with	Yes

10. Discussion

Concentrations of risk driving compounds: BTEX and naphthalene were reported below the laboratory LORs in all samples analysed.

The analytical results showed detectable concentrations of volatile hydrocarbon contaminants such as 2-methylpentane, 2-methyl butane and 2-methylpentane above the laboratory LORs. There are no criteria specific to these analytes, however, they are captured under the F1 fraction comprising TRH C_6-C_{10} .Concentrations of the F1 fraction in all samples were reported below the adopted assessment criteria for commercial/industrial land use. The most elevated concentrations were reported in SV1 and SV2, located in the vicinity of historically re-instated land farmed material, and SV5, located in the vicinity of residual hydrocarbon contamination identified in soil, groundwater and soil vapour.

11. Conclusion

Soil vapour concentrations were detected below the adopted screening criteria at SV1 to SV5. Therefore no unacceptable vapour intrusion risks to potential users of the community health facility from the contaminants of concern investigated as part of this monitoring event has been identified. Parsons Brinckerhoff notes that the investigation was limited to the investigation location for the scope of work provided, considered representative of historical contamination previously identified at the site.

Yours sincerely

Beejal Patel
Environmental Scientist

Enclosures

Attachment A	Figures
Attachment B	Soil vapour analytical table
Attachment C	Borelogs
Attachment D	Data evaluation
Attachment E	Laboratory reports
Attachment F	Statement of limitations

12. References

Environ Australia Pty Ltd 2013b, *Site Audit Report – 620 Pittwater Road, Brookvale NSW.*

Handex Australia Pty Ltd (Handex) 1998, *Limited Environmental Site Assessment – 620 Pittwater Road, Brookvale NSW, Site No. No0263*

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NSW EPA, 1997 Guidelines for Consultants Reporting on Contaminated Sites

Parsons Brinckerhoff 2010a, *Groundwater Monitoring Event August 2009 – 620 Pittwater Road, Brookvale NSW.*

Parsons Brinckerhoff 2010b, *Post Phase 2 ESA – 620 Pittwater Rd, Brookvale, NSW*

Parsons Brinckerhoff 2010c, *Groundwater Monitoring Event March 2010 – 620 Pittwater Road, Brookvale NSW.*

Parsons Brinckerhoff 2011a, *Soil Validation Report 620 Pittwater Rd Brookvale, NSW 2100.*

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Parsons Brinckerhoff 2013a, *Letter Addendum to 'On site Human Health Risk Assessment Report, June 2012* .

PPK Environment and Infrastructure Pty Ltd (PPK, now Parsons Brinckerhoff) 1999, *Limited Environmental Site Assessment for 620 Pittwater Road, Brookvale NSW (lot adjacent to former Mobil Service Station).*

SMEC 2014a, *Brookvale Community Health Centre Planning and Environmental Constraints Due Diligence Assessment*.

SMEC 2014b, *Summary Of Findings Associated With New Supporting Environmental Information.*

SMEC 2014c, *Targeted Environmental Site Assessment 612–624 Pittwater Road, Brookvale NSW.*

SMEC 2014d, *Contamination Condition Review 614 – 624 Pittwater Road, Brookvale*.

SMEC 2014e, *Summary of Preliminary Environmental Investigation and Review for 612-624 Pittwater Road, Brookvale.*

SMEC 2014f, *Summary of Environmental Investigations and Findings for 612-624 Pittwater Road, Brookvale.*

Solutions Engineering 2014g, *Asbestos Register 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100.*

Solutions Engineering 2014h, *Asbestos management Plan 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100*.

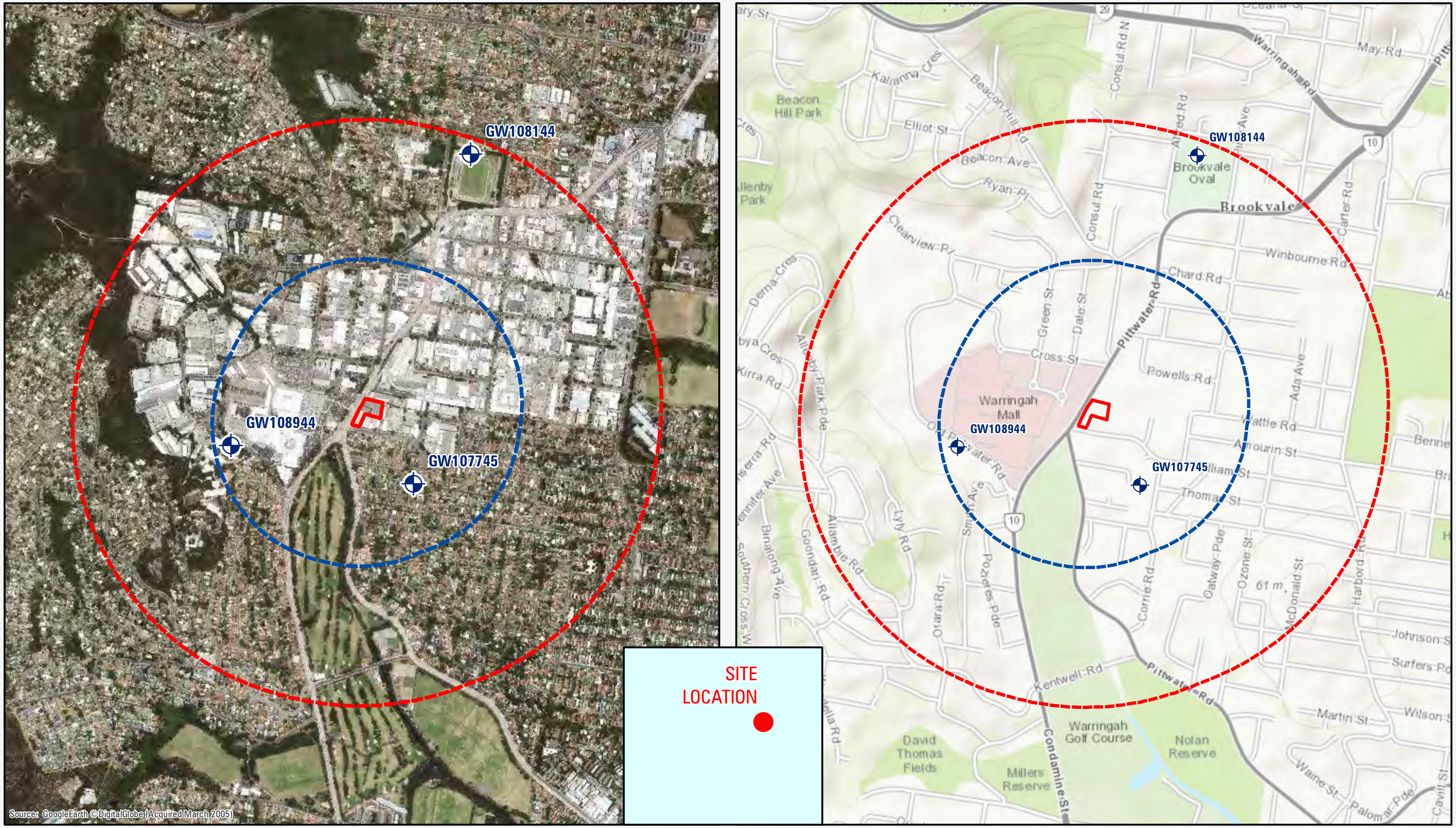
Attachment A

Figures

PARSONS BRINCKERHOFF

SOIL VAPOUR MONITORING EVENT - BROOKVALE

HEALTH INFRASTRUCTURE



Source: GoogleEarth ©DigitalGlobe (Acquired March 2005)

Figure 1 Site location

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🟥 Site location

● Soil vapour sampling location (PB, 2015)

● Historical soil vapour sampling location (SMEC, 2014)

Figure 2 Soil vapour sampling locations

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Attachment B

Soil vapour analytical table

Table B3
Soil vapour analytical results
Health Infrastructure
612-624 Pittwater Road, Brookvale, NSW

			Benzene	2-butanone(MEK)	n-Butylbenzene	Carbon tetrachloride	Chloroethane	Chloromethane	Cyclohexane	n-Decane	Dibromochloromethane	1,2-Dibromoethane	Dichlorodifluoromethane	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	2,4-dimethylpentane	n-Dodecane
		PQL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Units	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
HSL D(1) in sand			4000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sample ID	**Laboratory ID**	**Sampled date**																		
SV1	2015013807	3/06/2015	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1700	<100
SV1 Field dup	2015013809	3/06/2015	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1600	<100
SV2	2015013811	3/06/2015	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	2500	<50
SV3	2015013813	3/06/2015	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5.5	<5	<5	<5	<5	<5	<5	<5
SV4	2015013815	3/06/2015	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
SV5	2015013817	3/06/2015	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5.2	<5	<5	<5	<5	<5	2500	<5

			Ethylbenzene	Ethylcyclohexane	n-Heptane	n-Hexane	Isopropanol	Isopropylbenzene	4-Isopropyltoluene	2-Methyl butane	Methyl tert-butyl ether	Methylcyclohexane	2-Methylhexane	3-Methylhexane	2-Methylpentane	3-Methylpentane	Naphthalene	n-Nonane	n-Octane	n-Pentane	propylbenzene	Tetrachloroethene
		PQL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Units	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
HSL D(1) in sand			1,300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000	-	-	-	-	-
Sample ID	**Laboratory ID**	**Sampled date**																				
SV1	2015013807	3/06/2015	<100	<100	380	280	<100	<100	<100	7500	<100	<100	170	200	810	960	<100	<100	470	470	<100	<100
SV1 Field dup	2015013809	3/06/2015	<100	<100	320	270	<100	<100	<100	12000	<100	140	150	200	770	930	<100	<100	500	520	<100	<100
SV2	2015013811	3/06/2015	<50	<50	<50	130	<50	<50	<50	4600	<50	<50	110	200	1100	1600	<50	<50	<50	410	<50	<50
SV3	2015013813	3/06/2015	<5	<5	<5	6.4	<5	<5	<5	1700	<5	5.4	<5	<5	<5	<5	<5	<5	<5	31	<5	<5
SV4	2015013815	3/06/2015	<5	<5	<5	10	<5	<5	<5	420	<5	9.6	<5	<5	17	7.2	<5	<5	<5	50	<5	<5
SV5	2015013817	3/06/2015	<5	16	510	2000	<5	<5	<5	9700	<5	420	3600	3800	12000	5800	<5	<5	36	3000	<5	<5

			Toluene	1,1,1-trichloroethane	1,1,2-trichloroethane	Trichloroethene	Trichloromethane	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	n-Undecane	Vinyl Chloride	o-Xylene	m&p-Xylenes	Total xylene	C6-C10	C6-C10 F2 (less BTEX)	>C10-C16	>C10-C16 F1 (less Naphthalene)	Isopropanol
		PQL	0	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0
		Units	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
HSL D(1) in sand			4,800,000	-	-	-	-	-	-	-	-	-	-	840,000	-	500	-	680	-
Sample ID	**Laboratory ID**	**Sampled date**																	
SV1	2015013807	3/06/2015	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<200	250	250	46	46	<10
SV1 Field dup	2015013809	3/06/2015	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<200	250	250	55	55	<10
SV2	2015013811	3/06/2015	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<100	240	240	46	46	<5
SV3	2015013813	3/06/2015	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	1.5	1.5	0.65	0.65	<0.5
SV4	2015013815	3/06/2015	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	0.29	0.28	<0.1	<0.1	<0.5
SV5	2015013817	3/06/2015	8	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<10	35	35	0.14	0.14	<0.5

(1) NEPM (2013) Schedule B1 Investigation levels for soil and groundwater – Table 1A(5)

▨ Exceeds adopted commercial/industrial land use criteria

Attachment C

Borelogs

PARSONS BRINCKERHOFF

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.
SV01
SHEET 1 OF 1

Client: **Health infrastructure**
Project: **Brookvale Soil Vapour Assessment**
Borehole Location: **612-624 Pittwater Road, Brookvale NSW**
Project Number: **2201675A**

Date Commenced: **2/6/15**
Date Completed: **2/6/15**
Recorded By: **MM**
Log Checked By: **BP**

Drill Model/Mounting: **Hand Excavation**
Borehole Diameter: **100 mm**
Driller:
Driller Lic No:
Surface RL:
Co-ords:

Borehole Information							Field Material Description					
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	WELL CONSTRUCTION	RL(m)	DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY VS FB S VL F L ST MD VST D H VD	STRUCTURE AND ADDITIONAL OBSERVATIONS
CC		NFGWE						▦		Concrete Hardstand			No soil samples collected throughout
HA					0.20			▩		FILL; Sandy Gravel; coarse, moderately grained, moist, grey 'blue metal' road base gravels, loose	M	L	
					0.30			▩		FILL; Sandy Clay; medium plasticity, moist, red/brown, firm with broken yellow/red sandstone angular cobbles throughout		F	
					0.75			▩		FILL; Clayey Sand; medium grained, poorly graded, wet, brown, medium dense	W	MD	Slight odour
					1.00 1					Borehole terminated at 1.0 mBGL (target depth achieved) END OF BOREHOLE AT 1.00 m			

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

PARSONS BRINCKERHOFF

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.
SV02
SHEET 1 OF 1

Client:	**Health infrastructure**	Date Commenced:	**2/6/15**
Project:	**Brookvale Soil Vapour Assessment**	Date Completed:	**2/6/15**
Borehole Location:	**612-624 Pittwater Road, Brookvale NSW**	Recorded By:	**MM**
Project Number:	**2201675A**	Log Checked By:	**BP**

Drill Model/Mounting:	**Hand Excavation**	Driller:		Surface RL:	
Borehole Diameter:	**100 mm**	Driller Lic No:		Co-ords:	

Borehole Information							Field Material Description					
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	WELL CONSTRUCTION	RL(m)	DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY VS FB S VL F L ST MD VST D H VD	STRUCTURE AND ADDITIONAL OBSERVATIONS
CC		NFGWE								Concrete Hardstand			No soil samples collected throughout
HA					0.20					FILL; Sandy Gravel; coarse, moderately grained, moist, grey 'blue metal' road base gravels, loose	M	L	
					0.30					FILL; Sandy Clay; medium plasticity, moist, red/brown, firm with broken yellow/red sandstone angular cobbles throughout		F	
					0.75					FILL; Clayey Sand; medium grained, poorly graded, wet, brown, medium dense	W	MD	Slight odour
					1.00 1					Borehole terminated at 1.0 mBGL (target depth achieved) END OF BOREHOLE AT 1.00 m			

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

PARSONS BRINCKERHOFF

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.

SV03

SHEET 1 OF 1

Client:	**Health infrastructure**	Date Commenced:	**2/6/15**
Project:	**Brookvale Soil Vapour Assessment**	Date Completed:	**2/6/15**
Borehole Location:	**612-624 Pittwater Road, Brookvale NSW**	Recorded By:	**MM**
Project Number:	**2201675A**	Log Checked By:	**BP**

Drill Model/Mounting:	**Hand Excavation**	Driller:		Surface RL:	
Borehole Diameter:	**100 mm**	Driller Lic No:		Co-ords:	

Borehole Information								Field Material Description					
1	2	3	4	5		6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	WELL CONSTRUCTION	RL(m)	DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY VS S F ST VST H FB VL L MD D VD	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA		N F G W E						▨		FILL; Sandy Clay; medium plasticity, moist, red/brown, firm with broken yellow/red sandstone angular cobbles throughout	M	F	No soil samples collected throughout
				1.00	1					Borehole terminated at 1.0 mBGL (target depth achieved) END OF BOREHOLE AT 1.00 m			

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

PARSONS BRINCKERHOFF

BOREHOLE ENVIRONMENTAL LOG

BOREHOLE NO.

SV04

SHEET 1 OF 1

Client:	**Health infrastructure**	Date Commenced:	**2/6/15**
Project:	**Brookvale Soil Vapour Assessment**	Date Completed:	**2/6/15**
Borehole Location:	**612-624 Pittwater Road, Brookvale NSW**	Recorded By:	**MM**
Project Number:	**2201675A**	Log Checked By:	**BP**

Drill Model/Mounting:	**Hand Excavation**	Driller:		Surface RL:	
Borehole Diameter:	**100 mm**	Driller Lic No:		Co-ords:	

Borehole Information							Field Material Description					
1	2	3	4	5	6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	WELL CONSTRUCTION	RL(m)	DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY VS S F ST VST H FB VL L MD D VD	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA		N F G W E						▨		FILL; Sandy Clay; medium plasticity, moist, red/brown, firm with broken yellow/red sandstone angular cobbles throughout	M	F	No soil samples collected throughout
				1.00	1					Borehole terminated at 1.0 mBGL (target depth achieved) END OF BOREHOLE AT 1.00 m			

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

BOREHOLE ENVIRONMENTAL LOG

PARSONS BRINCKERHOFF

BOREHOLE NO.

SV05

SHEET 1 OF 1

Client:	**Health infrastructure**	Date Commenced:	**2/6/15**
Project:	**Brookvale Soil Vapour Assessment**	Date Completed:	**2/6/15**
Borehole Location:	**612-624 Pittwater Road, Brookvale NSW**	Recorded By:	**MM**
Project Number:	**2201675A**	Log Checked By:	**BP**

Drill Model/Mounting:	**Hand Excavation**	Driller:		Surface RL:	
Borehole Diameter:	**100 mm**	Driller Lic No:		Co-ords:	

Borehole Information								Field Material Description					
1	2	3	4	5		6	7	8	9	10	11	12	13
METHOD	SUPPORT	WATER	WELL CONSTRUCTION	RL(m)	DEPTH(m)	FIELD TEST	SAMPLE	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL FIELD DESCRIPTION	MOISTURE	RELATIVE DENSITY /CONSISTENCY VS S F ST VST H FB VL L MD D VD	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA		N F G W E						▨		FILL; Sandy Clay; medium plasticity, moist, red/brown, firm with broken yellow/red sandstone angular cobbles throughout	M	F	No soil samples collected throughout
					0.90 1					Borehole terminated at 0.9 mBGL (hand auger refusal on sandstone cobble) END OF BOREHOLE AT 0.90 m			

This borehole log should be read in conjunction with Parsons Brinckerhoff's accompanying standard notes.

Attachment D

Data evaluation

Table F–1: Evaluation of field and laboratory QA/QC procedures

	Soil vapour
Laboratory report no.	M151205
Were the samples received by the laboratory in good condition?	Yes
Were the samples properly and adequately preserved?	Yes
Were the samples analysed within the holding time?	Yes
Were the samples in proper custody between the field and the laboratory?	Yes
Precision/accuracy assessment	
Did the laboratory used have NATA accredited for all the analytes tested?	Yes
Did the laboratory perform the requested tests?	Yes
Were the laboratory methods adopted NATA endorsed?	Yes
Were the appropriate test procedures followed?	Yes
Were the reporting limits satisfactory	Yes
Was the NATA seal provided in the laboratory reports?	Yes
Were the reports signed by authorised personnel?	Yes
Field QA/QC	

	Soil vapour
Laboratory report no.	M151205
Were field duplicates collected as per NEPM?	Yes, 1 duplicate sample was collected and analysed.
Were field triplicates collected as per NEPM?	NA for soil vapour samples.
Were RPD of field duplicates within acceptable limits?	Yes with the exception of 2-methyl-butane with an RPD of 46%. This exceedance is not considered to be detrimental to the results as there is no adopted assessment criterion for this analyte and the concentration is reported below the adopted assessment criteria when captured under the F1 fraction.
Were rinsate samples collected per day of sampling?	NA – not required for soil vapour sampling.
Were the rinsate samples free of contaminants?	NA
Were trip blanks included per batch of samples?	Yes
Were the trip blanks samples free of contaminants?	No the trip blank has one concentration of 2- methyl butane detected greater than the laboratory LOR
Were trip spike included per batch of samples?	Yes
Were the trip spikes recovered within acceptable limits?	Yes with the exception of ethylcyclohexane. There is no adopted assessment criterion for this analyte and when captured under the F2 fraction the result is reported below the adopted assessment criteria. This result is not considered to have a detrimental effect on the comparability of the analysis results.
Was there any other QA/QC samples collected?	Yes - two shroud samples were collected and analysed for isopropyl alcohol to detect leaks during sample collection. Results reported were acceptable.
Laboratory internal quality control procedures	
Did the laboratory have at least one laboratory/reagent blanks per batch of sample?	Yes
Were the laboratory/reagent blank free of contamination?	Yes

	Soil vapour
Laboratory report no.	M151205
Were the laboratory duplicate undertaken at least a rate of 1 per 10 samples?	Yes
Were the RPDs of the laboratory duplicate within control limits?	Yes
Did the laboratory analyse matrix spike for each water type?	NA – not required for soil vapour sampling.
Did the laboratory analyse laboratory control spike?	NA – not required for soil vapour sampling.
Were the spike recoveries within laboratory control limits?	NA – not required for soil vapour sampling.
Were the surrogate recoveries within control limits?	NA – not required for soil vapour sampling.

Attachment E

Laboratory reports

SGS LEEDER CONSULTING

6 Day TAT

Site Log Sheet and Chain of Custody

Soil Gas and Sub-slab Gas Monitoring

Company: PB
Client Address: Sydney NSW
Client Contact: Beejal Patel
Client Email: BePatel@pb.com.au
Project / Site: Brookvale
Sampling Methods: LS:101

Job Number: M15|205
Purchase Order Number:
ABN:
Weather: Sunny 16°
Leak Testing: IPA
Sheet: 1 / 2 *4/6/15

Location ID: SV1
Time / Date: 3/6/15
Purge Volume: 300ml's
PID: 185 ppm
Shut in Test: Pass
Vacuum (in. Hg): -0.11
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D:E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi172811	30s	0.1	0.05	TO-17	
Mi155430	"	↓	"	"	Dup
Mi167315	15s		0.025	"	
Mi180172	"		"	"	Dup
AB558	2min		0.2	MA5	CT
AB559	"		"	"	CT Dup

Notes: TO-17 = PB target suite (ACH)
Southern most location in former UST Excavation.

Location ID: SV2
Time / Date: 3/6/15
Purge Volume: 300ml's
PID: 142 ppm.
Shut in Test: Pass
Vacuum (in. Hg): -0.08
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D:E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi155270	1 min	0.1	0.1	TO-17	
Mi180126	15s	0.1	0.025	"	
AB560	5min	0.1	0.5	MA-5	CT

Notes: Second location into site from William St.

Location ID: SV3
Time / Date: 3/6/15
Purge Volume: 300ml's
PID: 1.4 ppm
Shut in Test: Pass
Vacuum (in. Hg):
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D:E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi101153	10	0.1	1L	TO-17	
Mi101159	2.5	0.1	0.25	"	
AB555	5	0.1	0.5	MA-5	CT

Notes:

Relinquished by: D:E	Received by: Benedict Robinson	In esky? [✓ Yes]/No
Signature:	Signature:	With ice brick? Yes/[✓ No]
Date: 3/6/15 Time:	Date: 4/6/15 Time: 11:45am	

SGS LEEDER CONSULTING

Site Log Sheet and Chain of Custody

Soil Gas and Sub-slab Gas Monitoring

Company: PB
Client Address: Sydney NSW
Client Contact: Reeja Patel
Client Email:
Project / Site: Brookvale
Sampling Methods: LS:IGI

Job Number: MK51205
Purchase Order Number:
ABN:
Weather: Sunny 16°
Leak Testing: IPA
Sheet: 2 / 2 *4/6/15

Location ID: SV4
Time / Date: 3/6/15
Purge Volume: 300m's.
PID: 0.2
Shut in Test: Pass
Vacuum (in. Hg): -0.09
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D.E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
2027904	10	0.1	1L	TO-17	
2028033	2.5	"	0.25	"	
AB561	5	"	0.5	MA-5	CT

Notes:

Location ID: SV5
Time / Date: 3/6/15
Purge Volume: 300m's.
PID: 5.3
Shut in Test: Pass
Vacuum (in. Hg): -0.12
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D.E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
2027304	10	0.1	1	TO-17	
Mi101232	2.5	0.1	0.25	"	
AB562	5	0.1	0.5	MA-5	

Notes:

Location ID: QA/QC
Time / Date:
Purge Volume:
PID:
Shut in Test:
Vacuum (in. Hg):
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D.E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi 094134	–	–	–	TO-17	Trip Blank
2027472	15	0.1	0.025	IPA	Shroud Sample
AB556	"	"	"	"	" "
Mi180142					NOT USED

Notes:

Relinquished by: D.E	Received by: Benedict Robinson	In esky? [✓ Yes]/No
Signature:	Signature:	With ice brick? Yes/[✓ No]
Date: 3/6/15 Time: 4pm.	Date: 4/6/15 Time: 11:45am	

A.B.N. 44 000 964 278
3 - 5, 18 Redland Drive
Mitcham, Vic, 3132
Telephone: (03) 9874 1988
Fax: (03) 9874 1933

Chartered Chemists

REPORT NUMBER: M151205
Site/Client Ref: Brookvale
Order No: 2201675A

15-Jun-2015

Parsons Brinckerhoff

Ernst & Young Centre
Level 27/680 George Street
Sydney
NSW 2000
Attention: Beejal Patel

CERTIFICATE OF ANALYSIS

SAMPLES:	Fifteen samples were received for analysis
DATE RECEIVED:	**4-Jun-2015**
DATE COMMENCED:	**4-Jun-2015**
METHODS:	See Attached Results
RESULTS:	Please refer to attached pages for results.

Note: Results are based on samples as received at SGS Leeder Consulting's laboratories

All ATD tubes were certified prior to transport and found to be clean. Please see appendix two for trip blank certification chromatogram

REPORTED BY:

Adam Atkinson
Business Manager

NATA Accredited Laboratory Number: 14429

Accredited for compliance
with ISO/IEC 17025.

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.10 Volatile Organics (w/v)

Sample units are expressed in µg/m³

Leeder ID		2015013807	2015013809	2015013811	2015013813
Client ID		SV1 Mi172811	SV1 Field dup Mi155430	SV2 Mi155270	SV3 Mi101153
Sampled Date		03-Jun-15	03-Jun-15	03-Jun-15	03-Jun-15
Analyte Name	**PQL**				
Benzene		<100	<100	<50	<5
2-butanone(MEK)		<100	<100	<50	<5
n-Butylbenzene		<100	<100	<50	<5
Carbon tetrachloride		<100	<100	<50	<5
Chloroethane		<100	<100	<50	<5
Chloromethane		<100	<100	<50	<5
Cyclohexane		<100	<100	<50	<5
n-Decane		<100	<100	<50	<5
Dibromochloromethane		<100	<100	<50	<5
1,2-Dibromoethane		<100	<100	<50	<5
Dichlorodifluoromethane		<100	<100	<50	5.5
1,1-Dichloroethane		<100	<100	<50	<5
1,2-Dichloroethane		<100	<100	<50	<5
1,1-Dichloroethene		<100	<100	<50	<5
cis-1,2-Dichloroethene		<100	<100	<50	<5
trans-1,2-Dichloroethene		<100	<100	<50	<5
2,4-dimethylpentane		1700	1600	2500	<5
n-Dodecane		<100	<100	<50	<5
Ethylbenzene		<100	<100	<50	<5
Ethylcyclohexane		<100	<100	<50	<5
n-Heptane		380	320	<50	<5
n-Hexane		280	270	130	6.4
Isopropanol		<100	<100	<50	<5

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.10 Volatile Organics (w/v)

Sample units are expressed in µg/m³

	Leeder ID	2015013807	2015013809	2015013811	2015013813
	Client ID	SV1 Mi172811	SV1 Field dup Mi155430	SV2 Mi155270	SV3 Mi101153
	Sampled Date	03-Jun-15	03-Jun-15	03-Jun-15	03-Jun-15
Analyte Name	**PQL**				
Isopropylbenzene		<100	<100	<50	<5
4-Isopropyltoluene		<100	<100	<50	<5
2-Methyl butane		7500	12000	4600	1700
Methyl tert-butyl ether		<100	<100	<50	<5
Methylcyclohexane		<100	140	<50	5.4
2-Methylhexane		170	150	110	<5
3-Methylhexane		200	200	200	<5
2-Methylpentane		810	770	1100	<5
3-Methylpentane		960	930	1600	<5
Naphthalene		<100	<100	<50	<5
n-Nonane		<100	<100	<50	<5
n-Octane		470	500	<50	<5
n-Pentane		470	520	410	31
propylbenzene		<100	<100	<50	<5
Tetrachloroethene		<100	<100	<50	<5
Toluene		<100	<100	<50	<5
1,1,1-trichloroethane		<100	<100	<50	<5
1,1,2-trichloroethane		<100	<100	<50	<5
Trichloroethene		<100	<100	<50	<5
Trichloromethane		<100	<100	<50	<5
1,2,4-Trimethylbenzene		<100	<100	<50	<5
1,3,5-Trimethylbenzene		<100	<100	<50	<5
n-Undecane		<100	<100	<50	<5
Vinyl Chloride		<100	<100	<50	<5

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.10 Volatile Organics (w/v)

Sample units are expressed in µg/m³

	Leeder ID	2015013807	2015013809	2015013811	2015013813
	Client ID	SV1 Mi172811	SV1 Field dup Mi155430	SV2 Mi155270	SV3 Mi101153
	Sampled Date	03-Jun-15	03-Jun-15	03-Jun-15	03-Jun-15
Analyte Name	**PQL**				
o-Xylene		<100	<100	<50	<5
m&p-Xylenes		<100	<100	<50	<5

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.10 Volatile Organics (w/v)

Sample units are expressed in µg/m³

	Leeder ID	2015013815	2015013817
	Client ID	SV4 2027904	SV5 2027304
	Sampled Date	03-Jun-15	03-Jun-15
Analyte Name	**PQL**		
Benzene		<5	<5
2-butanone(MEK)		<5	<5
n-Butylbenzene		<5	<5
Carbon tetrachloride		<5	<5
Chloroethane		<5	<5
Chloromethane		<5	<5
Cyclohexane		<5	<5
n-Decane		<5	<5
Dibromochloromethane		<5	<5
1,2-Dibromoethane		<5	<5
Dichlorodifluoromethane		<5	5.2
1,1-Dichloroethane		<5	<5
1,2-Dichloroethane		<5	<5
1,1-Dichloroethene		<5	<5
cis-1,2-Dichloroethene		<5	<5
trans-1,2-Dichloroethene		<5	<5
2,4-dimethylpentane		<5	2500
n-Dodecane		<5	<5
Ethylbenzene		<5	<5
Ethylcyclohexane		<5	16
n-Heptane		<5	510
n-Hexane		10	2000
Isopropanol		<5	<5

(I) RESULTS

Matrix: Thermal Desorption Tube

Method: TO-17.10 Volatile Organics (w/v)

Sample units are expressed in µg/m³

	Leeder ID	2015013815	2015013817
	Client ID	SV4 2027904	SV5 2027304
	Sampled Date	03-Jun-15	03-Jun-15
Analyte Name	**PQL**		
Isopropylbenzene		<5	<5
4-Isopropyltoluene		<5	<5
2-Methyl butane		420	9700
Methyl tert-butyl ether		<5	<5
Methylcyclohexane		9.6	420
2-Methylhexane		<5	3600
3-Methylhexane		<5	3800
2-Methylpentane		17	12000
3-Methylpentane		7.2	5800
Naphthalene		<5	<5
n-Nonane		<5	<5
n-Octane		<5	36
n-Pentane		50	3000
propylbenzene		<5	<5
Tetrachloroethene		<5	<5
Toluene		<5	8.0
1,1,1-trichloroethane		<5	<5
1,1,2-trichloroethane		<5	<5
Trichloroethene		<5	<5
Trichloromethane		<5	<5
1,2,4-Trimethylbenzene		<5	<5
1,3,5-Trimethylbenzene		<5	<5
n-Undecane		<5	<5
Vinyl Chloride		<5	<5

(I) RESULTS

Matrix: Thermal Desorption Tube

Method: TO-17.10 Volatile Organics (w/v)

Sample units are expressed in µg/m³

	Leeder ID	2015013815	2015013817
	Client ID	SV4 2027904	SV5 2027304
	Sampled Date	03-Jun-15	03-Jun-15
Analyte Name	**PQL**		
o-Xylene		<5	<5
m&p-Xylenes		<5	<5

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Sample units are expressed in ng total

	Leeder ID	2015013820
	Client ID	Trip Blank Mi094134
	Sampled Date	
Analyte Name	**PQL**	
Benzene	5	nd
2-butanone(MEK)	5	nd
n-Butylbenzene	5	nd
Carbon tetrachloride	5	nd
Chloroethane	5	nd
Chloromethane	5	nd
Cyclohexane	5	nd
n-Decane	5	nd
Dibromochloromethane	5	nd
1,2-Dibromoethane	5	nd
Dichlorodifluoromethane	5	nd
1,1-Dichloroethane	5	nd
1,2-Dichloroethane	5	nd
1,1-Dichloroethene	5	nd
cis-1,2-Dichloroethene	5	nd
trans-1,2-Dichloroethene	5	nd
2,4-dimethylpentane	5	nd
n-Dodecane	5	nd
Ethylbenzene	5	nd
Ethylcyclohexane	5	nd
n-Heptane	5	nd
n-Hexane	5	nd
Isopropanol	50	nd

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Sample units are expressed in ng total

	Leeder ID	2015013820
	Client ID	Trip Blank Mi094134
	Sampled Date	
Analyte Name	**PQL**	
Isopropylbenzene	5	nd
4-Isopropyltoluene	5	nd
2-Methyl butane	5	250
Methyl tert-butyl ether	5	nd
Methylcyclohexane	5	nd
2-Methylhexane	5	nd
3-Methylhexane	5	nd
2-Methylpentane	5	nd
3-Methylpentane	5	nd
Naphthalene	5	nd
n-Nonane	5	nd
n-Octane	5	nd
n-Pentane	5	nd
propylbenzene	5	nd
Tetrachloroethene	5	nd
Toluene	5	nd
1,1,1-trichloroethane	5	nd
1,1,2-trichloroethane	5	nd
Trichloroethene	5	nd
Trichloromethane	5	nd
1,2,4-Trimethylbenzene	5	nd
1,3,5-Trimethylbenzene	5	nd
n-Undecane	5	nd
Vinyl Chloride	5	nd

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Sample units are expressed in ng total

	Leeder ID	2015013820
	Client ID	Trip Blank Mi094134
	Sampled Date	
Analyte Name	**PQL**	
o-Xylene	5	nd
m&p-Xylenes	5	nd

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Sample units are expressed in ng total

	Leeder ID	2015013821
	Client ID	Method
	Sampled Date	
Analyte Name	**PQL**	Blank
Benzene	5	nd
2-butanone(MEK)	5	nd
n-Butylbenzene	5	nd
Carbon tetrachloride	5	nd
Chloroethane	5	nd
Chloromethane	5	nd
Cyclohexane	5	nd
n-Decane	5	nd
Dibromochloromethane	5	nd
1,2-Dibromoethane	5	nd
Dichlorodifluoromethane	5	nd
1,1-Dichloroethane	5	nd
1,2-Dichloroethane	5	nd
1,1-Dichloroethene	5	nd
cis-1,2-Dichloroethene	5	nd
trans-1,2-Dichloroethene	5	nd
2,4-dimethylpentane	5	nd
n-Dodecane	5	nd
Ethylbenzene	5	nd
Ethylcyclohexane	5	nd
n-Heptane	5	nd
n-Hexane	5	nd
Isopropanol	50	nd

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Sample units are expressed in ng total

	Leeder ID	2015013821
	Client ID	Method
	Sampled Date	
Analyte Name	**PQL**	Blank
Isopropylbenzene	5	nd
4-Isopropyltoluene	5	nd
2-Methyl butane	5	nd
Methyl tert-butyl ether	5	nd
Methylcyclohexane	5	nd
2-Methylhexane	5	nd
3-Methylhexane	5	nd
2-Methylpentane	5	nd
3-Methylpentane	5	nd
Naphthalene	5	nd
n-Nonane	5	nd
n-Octane	5	nd
n-Pentane	5	nd
propylbenzene	5	nd
Tetrachloroethene	5	nd
Toluene	5	nd
1,1,1-trichloroethane	5	nd
1,1,2-trichloroethane	5	nd
Trichloroethene	5	nd
Trichloromethane	5	nd
1,2,4-Trimethylbenzene	5	nd
1,3,5-Trimethylbenzene	5	nd
n-Undecane	5	nd
Vinyl Chloride	5	nd

(I) RESULTS

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Sample units are expressed in ng total

	Leeder ID	2015013821
	Client ID	Method
	Sampled Date	
Analyte Name	**PQL**	Blank
o-Xylene	5	nd
m&p-Xylenes	5	nd

Matrix: Thermal Desorption Tube

Method: TO-17 TPH.03 mg/m3 (w/v)

Sample units are expressed in mg/m³

	Leeder ID	2015013807	2015013809	2015013811	2015013813
	Client ID	SV1 Mi172811	SV1 Field dup Mi155430	SV2 Mi155270	SV3 Mi101153
	Sampled Date	03-Jun-15	03-Jun-15	03-Jun-15	03-Jun-15
Analyte Name	**PQL**				
C6-C10		250	250	240	1.5
C6-C10 (less BTEX)		250	250	240	1.5
>C10-C16		46	55	46	0.65
>C10-C16 (less Naphthalene)		46	55	46	0.65

(I) RESULTS

Report N°: M151205

Matrix: Thermal Desorption Tube

Method: TO-17 TPH.03 mg/m3 (w/v)

Sample units are expressed in mg/m³

	Leeder ID	2015013815	2015013817
	Client ID	SV4 2027904	SV5 2027304
	Sampled Date	03-Jun-15	03-Jun-15
Analyte Name	PQL		
C6-C10		0.29	35
C6-C10 (less BTEX)		0.28	35
>C10-C16		<0.1	0.14
>C10-C16 (less Naphthalene)		<0.1	0.14

Matrix: Thermal Desorption Tube

Method: TO-17 TPH.04

Sample units are expressed in µg total

	Leeder ID	2015013820
	Client ID	Trip Blank Mi094134
	Sampled Date	
Analyte Name	PQL	
>C10-C16	0.1	nd
>C10-C16 (less Naphthalene)	0.1	nd
C6-C10	0.1	nd
C6-C10 (less BTEX)	0.1	nd

(I) RESULTS

Matrix: Thermal Desorption Tube

Method: TO-17 TPH.04

Sample units are expressed in µg total

	Leeder ID	2015013821
	Client ID	Method
	Sampled Date	
Analyte Name	**PQL**	Blank
>C10-C16	0.1	nd
>C10-C16 (less Naphthalene)	0.1	nd
C6-C10	0.1	nd
C6-C10 (less BTEX)	0.1	nd

Matrix: Carbon Tube

Method: MA-5.ST.ADD.02 Additional Volatile Organics

Sample units are expressed in mg/m³

	Leeder ID	2015013822
	Client ID	IPA Shroud AB556
	Sampled Date	03-Jun-15
Analyte Name	**PQL**	
Isopropanol		75000

(I) RESULTS

Matrix: Carbon Tube

Method: MA-5.ST.ADD.01 Additional Volatile Organics

Sample units are expressed in µg total

	Leeder ID	2015013823
	Client ID	Method
	Sampled Date	
Analyte Name	**PQL**	Blank
Isopropanol	0.5	nd

Matrix: Thermal Desorption Tube

Method: TO-17 Isopropanol (w/v)

Sample units are expressed in mg/m³

	Leeder ID	2015013807	2015013809	2015013811	2015013813
	Client ID	SV1 Mi172811	SV1 Field dup Mi155430	SV2 Mi155270	SV3 Mi101153
	Sampled Date	03-Jun-15	03-Jun-15	03-Jun-15	03-Jun-15
Analyte Name	**PQL**				
Isopropanol		<10	<10	<5	<0.5

Matrix: Thermal Desorption Tube

Method: TO-17 Isopropanol (w/v)

Sample units are expressed in mg/m³

	Leeder ID	2015013815	2015013817	2015013819
	Client ID	SV4 2027904	SV5 2027304	IPA Shroud 2027472
	Sampled Date	03-Jun-15	03-Jun-15	03-Jun-15
Analyte Name	**PQL**			
Isopropanol		<0.5	<0.5	4500 E,L

Matrix: Thermal Desorption Tube

Method: TO-17 Isopropanol

Sample units are expressed in µg total

	Leeder ID	2015013820
	Client ID	Trip Blank Mi094134
	Sampled Date	
Analyte Name	**PQL**	
Isopropanol	0.5	nd

(I) RESULTS

Matrix: Thermal Desorption Tube

Method: TO-17 Isopropanol

Sample units are expressed in µg total

	Leeder ID	2015013821
	Client ID	Method
	Sampled Date	
Analyte Name	**PQL**	Blank
Isopropanol	0.5	nd

(II) QUALITY CONTROL

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Quality Control Results are expressed in Percent Recovery of expected result

	Leeder ID	2015013824	2015013825
	Client ID	Method	Method
	Sampled Date		
Analyte Name	**PQL**	Spike	Spike Dup
2-butanone(MEK)		82	87
n-Decane		76	76
Dibromochloromethane		77	80
1,2-Dichloroethane		79	82
1,1-Dichloroethene		88	90
cis-1,2-Dichloroethene		78	81
n-Dodecane		67	61
Ethylbenzene		77	80
Ethylcyclohexane		26	28
n-Heptane		82	85
n-Hexane		81	85

(II) QUALITY CONTROL

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Quality Control Results are expressed in Percent Recovery of expected result

	Leeder ID	2015013824	2015013825
	Client ID	Method	Method
	Sampled Date		
Analyte Name	**PQL**	Spike	Spike Dup
Methyl tert-butyl ether		82	86
Methylcyclohexane		81	84
n-Nonane		79	81
n-Pentane		82	87
Toluene		79	82
1,1,1-trichloroethane		80	82
1,1,2-trichloroethane		76	82
Trichloromethane		82	84
n-Undecane		68	69
Vinyl Chloride		79	83

Matrix: Thermal Desorption Tube

Method: TO-17.09 Volatile Organics

Quality Control Results are expressed in Percent Recovery of expected result

	Leeder ID	2015013824	2015013825
	Client ID	Method	Method
	Sampled Date		
Analyte Name	**PQL**	Spike	Spike Dup
o-Xylene		74	78
m&p-Xylenes		76	79

(II) QUALITY CONTROL

Matrix: Thermal Desorption Tube

Method: TO-17 TPH.04

Quality Control Results are expressed in Percent Recovery of expected result

	Leeder ID	2015013824	2015013825
	Client ID	Method	Method
	Sampled Date		
Analyte Name	**PQL**	Spike	Spike Dup
>C10-C16		71	64
C6-C10		80	84

Matrix: Carbon Tube

Method: MA-5.ST.ADD.01 Additional Volatile Organics

Quality Control Results are expressed in Percent Recovery of expected result

	Leeder ID	2015013826	2015013827
	Client ID	Method	Method
	Sampled Date		
Analyte Name	**PQL**	Spike	Spike Dup
Isopropanol		112	124

QUALIFIERS / NOTES FOR REPORTED RESULTS

PQL	Practical Quantitation Limit
nd	Not Detected – The analyte was not detected above the reported PQL.
is	Insufficient Sample to perform this analysis.
T	Tentative identification based on computer library search of mass spectra.
NC	Not calculated and/or Results below PQL
NV	No Vacuum, Canister received above standard atmospheric pressure
nr	Not Requested for analysis.
R	Rejected Result – results for this analysis failed QC checks.
SQ	Semi-Quantitative result – quantitation based on a generic response factor for this class of analyte.
IM	Inappropriate method of analysis for this compound
U	Unable to provide Quality Control data – high levels of compounds in sample interfered with analysis of QC results.
UF	Unable to provide Quality Control data- Surrogates failed QCchecks due to sample matrix effects
L	Analyte detected at a level above the linear response of calibration curve.
E	Estimated result. NATA accreditation does not cover estimated results.
C1	These compounds co-elute.
--	Parameter Not Determined
CT	Elevated concentration. Results reported from carbon tube analysis
**	Sample shows non-petroleum hydrocarbon profile

APPENDIX ONE.

CHAIN OF CUSTODY DOCUMENT

SGS LEEDER CONSULTING

6 Day TAT

Site Log Sheet and Chain of Custody

Soil Gas and Sub-slab Gas Monitoring

Company: PB
Client Address: Sydney NSW
Client Contact: Beejal Patel
Client Email: BePatel@pb.com.au
Project / Site: Brookvale
Sampling Methods: WS!101

Job Number: M15/1205
Purchase Order Number:
ABN:
Weather: Sunny 16°
Leak Testing: IPA
Sheet: 1 , 32 *4/6/15

Location ID: SV1
Time / Date: 3/6/15
Purge Volume: 300ml's
PID: 185ppm
Shut in Test: Pass
Vacuum (in. Hg): -0.11
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D:E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi172811	30s	0.1	0.05	TO-17	
Mi155430	"		"	"	Dup
Mi167315	15s		0.025	"	
Mi180172	"		"	"	Dup
AB558	2min		0.2	MA5	CT
AB559	"	↓	"	"	CT Dup

Notes: TO-17 = PB target suite (ACH)
Southern most location in former UST Excavation.

Location ID: SV2
Time / Date: 3/6/15
Purge Volume: 300ml's
PID: 142 ppm.
Shut in Test: Pass
Vacuum (in. Hg): -0.08
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D:E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi155270	1min	0.1	0.1	TO-17	
Mi180126	15s	0.1	0.025	"	
AB560	5min	0.1	0.5	MA-5	CT

Notes: Second location into site from William St.

Location ID: SV3
Time / Date: 3/6/15
Purge Volume: 300ml's
PID: 1.4ppm
Shut in Test: Pass
Vacuum (in. Hg):
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D.E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi101153	10	0.1	1L	TO-17	
Mi101159	2.5	0.1	0.25	"	
AB555	5	0.1	0.5	MA-5	CT

Notes:

Relinquished by: D.E	Received by: Benedict Robinson	In esky? [✓ Yes]/No
Signature:	Signature:	With ice brick? Yes/[✓ No]
Date: 3/6/15 Time:	Date: 4/6/15 Time: 11:45am	

SGS LEEDER CONSULTING

Site Log Sheet and Chain of Custody

Soil Gas and Sub-slab Gas Monitoring

Company: PB
Client Address: Sydney NSW
Client Contact: Reeja / Patel
Client Email:
Project / Site: Brookvale
Sampling Methods: LS:IGI

Job Number: MK1205
Purchase Order Number:
ABN:
Weather: Sunny 16°
Leak Testing: IPA
Sheet: 2 / ~~1~~2 *4/6/15

Location ID: SV4
Time / Date: 3/6/15
Purge Volume: 300m's.
PID: 0.2
Shut in Test: Pass
Vacuum (in. Hg): -0.09
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D.E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
2027904	10	0.1	1L	TO-17	
2028033	2.5	"	0.25	"	
AB561	5	"	0.5	MA-5	CT

Notes:

Location ID: SV5
Time / Date: 3/6/15
Purge Volume: 300m's.
PID: 5.3
Shut in Test: Pass
Vacuum (in. Hg): -0.12
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D'E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
2027304	10	0.1	1	TO-17	
Mi101232	2.5	0.1	0.25	"	
AB562	5	0.1	0.5	MA-5	

Notes:

Location ID: QA/QC
Time / Date:
Purge Volume:
PID:
Shut in Test:
Vacuum (in. Hg):
Rotameter #: 83506-1
Pump #: 884006
Sampled by: D'E

Tube ID Number	Time	Flow (L/min)	Volume (L)	Analysis Required	Comments:
Mi094134	-	-	-	TO-17	Trip Blank
2027472	15	0.1	0.025	IPA	Shroud Sample
AB556	"	"	"	"	" "
Mi180142					NOT USED

Notes:

Relinquished by: D.E	Received by: Benedict Robinson	In esky? [✓ Yes]/No
Signature:	Signature:	With ice brick? Yes/[✓ No]
Date: 3/6/15 Time: 4pm.	Date: 4/6/15 Time: 11:45am	

From: Patel, Beejal [mailto:BePatel@pb.com.au]
Sent: Thursday, 4 June 2015 2:00 PM
To: AU.SampleReceipt.Mitcham (Melbourne)
Subject: RE: quote for job

Hi,

the project number is 2201675A.

From: AU.SampleReceipt.Mitcham (Melbourne) [mailto:AU.SampleReceipt.Mitcham@sgs.com]
Sent: Thursday, 4 June 2015 1:59 PM
To: Patel, Beejal
Cc: Egelton, Dane (Warrimoo)
Subject: RE: quote for job
Importance: High

Beejal,

Can you please provide a job reference number for the Brookvale sampling which Dane undertook?
Thanks for your time

Regards,

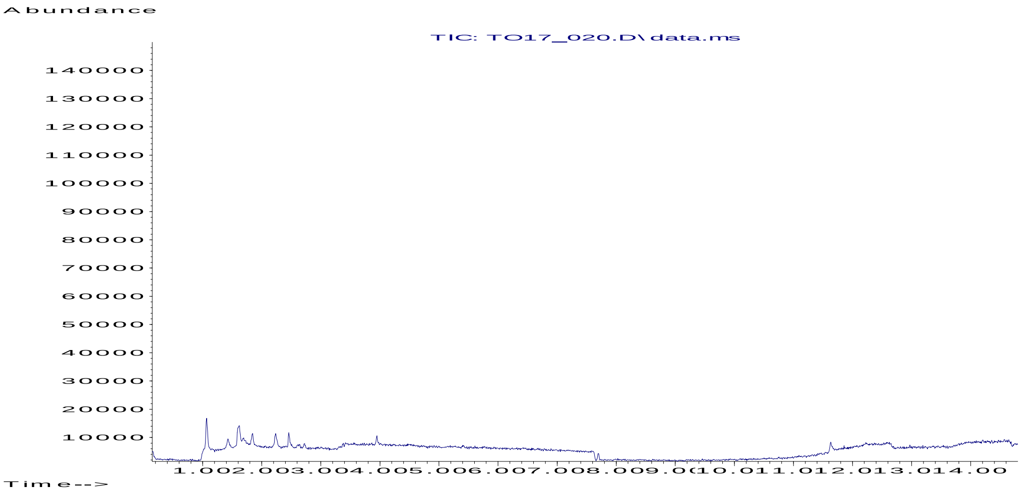
Lyndall Stevens
Environmental Services
Sample Reception Team Leader

SGS LEEDER CONSULTING
Melbourne Office
Unit 5 /18 Redland Drive
Mitcham VIC 3132,
Australia

Phone	+61 (0)3 9874 1988
Fax:	+61 (0)3 9874 1933
Email:	**lyndall.stevens@sgs.com**
Web:	www.au.sgs.com

APPENDIX TWO

Trip Blank Certification



Attachment F

Statement of limitations

Scope of services

This soil vapour report (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and Parsons Brinkerhoff (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on data

In preparing the report, Parsons Brinckerhoff has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, Parsons Brinckerhoff has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Parsons Brinckerhoff will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Parsons Brinckerhoff.

Environmental conclusions

In accordance with the scope of services, Parsons Brinckerhoff has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Also, it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for benefit of client

The report has been prepared for the benefit of the client and no other party. Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other limitations

Parsons Brinckerhoff will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

Enclosure D

IT Environmental Site Audit Report

Summary Site Audit Report
Former Mobil Service Station
612 Pittwater Road
Brookvale NSW
Volume 1 of 3

Prepared for:

Mobil Oil Australia Pty Ltd
31 Purcell Street
ELDERSLIE CAMDEN NSW 2570

29 July 2003
Project Reference: J109494A

Prepared by:

IT Environmental (Australia) Pty Ltd
17 Forrester Street, Kingsgrove 2208
New South Wales, Australia

Written/Submitted by:

David Lam
NSW EPA Accredited Site Auditor

IT Environmental (Australia) Pty Ltd
ABN 89 003 931 057
Tel: (02) 9502 4844, Fax: (02) 9502 2105
Email: Sydney.Admin@itenviro.com.au

Quality Endorsed Company

Record of Distribution

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
4	J109494A-R01.doc	Final	29 July 2003	Nikki Maksimovic, Mobil	
1	J109494A-R01.pdf	Final	29 July 2003	Nikki Maksimovic, Mobil	
1	J109494A-R01.doc	Final	29 July 2003	NSW Environment Protection Authority	
1	J109494A-R01.doc	Final	29 July 2003	IT Environmental, Melbourne	
1	J109494A-R01.doc	Final	29 July 2003	IT Environmental, Sydney	

Table of Contents

VOLUME 1

List of Attachments

FIGURES

All Figure references are to Figures included in the Appendicised Reports by Parsons Brinckerhoff.

TABLES

		VOLUME 1
Table 1	Summary of Assessment Criteria	
Table 2	Auditor QC sample Results	

APPENDICES

Appendix A	Parsons Brinckerhoff Australia Pty Limited report: " Site Remediation and Validation – Report – Former Mobil Service Station, 612 Pittwater Road, Brookvale, NSW (No 0035)", March, 2003	**VOLUMES 1 AND 2**
Appendix B	Parsons Brinckerhoff Australia Pty Limited (then PPK Environment and Infrastructure Pty Ltd) report: "Remedial Action Plan – Former Mobil Service Station and Adjoining Properties, Cnr Williams and Pittwater Roads, Brookvale, NSW", June 2000	**VOLUME 3**
Appendix C	Auditor Correspondence	**VOLUME 3**
Appendix D	Field Notes From Auditor Representative Site Visits	**VOLUME 3**

NSW SITE AUDITOR SCHEME

SITE AUDIT STATEMENT

Schedule 1, Form 2 (Contaminated Land Management Regulation 1998)

SITE AUDITOR (accredited under *Contaminated Land Management Act 1997*):

Name: **Mr David Lam** **Phone: 02-9502 4944**

Company: **IT Environmental (Australia) Pty Ltd**
Fax: **02-9502 4498**

Address: **12 Forrester Street**
Kingsgrove NSW 2208

Site Audit Statement No: **DL-001**

Site details:

Address:
612 Pittwater Road
Brookvale NSW 2100
Lot and DP Number:
Lots A, B and C, DP 375728
Local Government Area: Waringah Council

Site audit requested by:

Name: Nikki Maksimovic
Mobil Oil Australia Pty Ltd
Address: 31 Purcell Street
Elderslie Camden NSW 2570
Phone: 02-4658 1392
Fax: 02-4658 1611
Name of contact person (if different from above): N/A

Consultancy(ies) who conducted the site investigation(s) and/or remediation:
Parsons Brinckerhoff Australia Pty Limited
Handex Australia Pty Ltd

Title(s) of report(s) reviewed:

- Parsons Brinckerhoff Australia Pty Limited report: " Site Remediation and Validation – Report – Former Mobil Service Station, 612 Pittwater Road, Brookvale, NSW (No 0035)", March, 2003
- Parsons Brinckerhoff Australia Pty Limited (then PPK Environment and Infrastructure Pty Ltd) report: "Remedial Action Plan – Former Mobil Service Station and Adjoining Properties, Cnr Williams and Pittwater Roads, Brookvale, NSW", June 2000
- Appended to the 2003 Validation report was the report by Handex: "Environmental Site Assessment, 620 Pittwater Road, Brookvale, NSW", December 1998 (note this title is erroneous as the report refers to the 13 grid point samples carried out on the service station site at 612 Pittwater Road).

- Appended to the Remedial Action Plan was the report by Handex "Limited Environmental Site Assessment, 620 Pittwater Road, Brookvale, NSW", December 1998.
- Appended to the 2003 Validation report was the report by Handex: "High Vacuum Extraction Remediation Report (Events, 1, 2, and 3) Former Mobil Petrol Station, Cnr William Street and Pittwater Road, Brookvale, NSW", December 1998.
- Appended to the 2003 Validation report was the fax by Handex: "Brookvale, excavation and stockpile sampling, May1998. Note that PB attached to this fax some laboratory results for off-site grid point samples (in 620 Pittwater Road), from October, 1998 (well after the date of the fax).

Other information reviewed:
Various Fascimile correspondence from Parsons Brinckerhoff up to July, 2003, appendicised to the SSAR.

Summary Site Audit Report title:

Summary Site Audit Report
Former Mobil Service Station
612 Pittwater Road
BROOKVALE NSW
29 July, 2003

I have completed a site audit (as defined in the *Contaminated Land Management Act 1997*) and reviewed the reports and information referred to above with due regard to relevant laws and guidelines. I certify that the site (tick **all** appropriate boxes)

(a) is suitable for the following use(s):

~~☐ residential, including substantial vegetable garden and poultry;~~

~~☐ residential, including substantial vegetable garden, excluding poultry;~~

~~☐ residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry;~~

~~☐ residential with minimal opportunity for soil access, including units;~~

~~☐ daycare centre, preschool, primary school;~~

~~☐ secondary school;~~

~~☐ park, recreational open space, playing field;~~

☑ commercial/industrial use;

~~☐ other (please specify):~~

subject to

☑ condition(s) (please specify):

- Groundwater should not be used on site without assessment for the particular use.
- It is understood that the proposed development will include a car park at the lower level. Ideally the park should be built from ground level up, to avoid causing a basement level below periodic seepage level, because any pumping in such conditions could cause any nearby contaminants to flow back towards the site. This condition could be avoided if all nearby seepage water impact could be shown to have attenuated and detailed risk assessment could show residual levels in groundwater on and near the site to not represent an unacceptable risk. This however may be practically impossible, as wells in Pittwater Road are as the Auditor understands it unable to be permitted.
- If a car park is built below ground level such that seepage water could (without dewatering) enter the building basement, there should be a dewatering system designed such that seepage water in any weather conditions is prevented from entering the basement or any service pits or pipelines. This

would require a pumping system which a competent professional would need to design. Any water that was disposed from such a pumping system would need to be checked for compliance to be disposed to stormwater or sewer, and appropriate approvals obtained before any such operation was undertaken. If contaminated, such water may require treatment prior to disposal.

- In either of the above cases, it would be considered prudent to incorporate a combination of a membrane or vapour proof geofabric below the lower building slab, and a passive venting system to allow any vapours/odorous air to escape slowly to atmosphere rather than potentially build up in a confined air space within the car park. This system should be designed by a competent professional and would conservatively extend over the northern part of the site above former seepage water impact and areas likely to contain backfilled odorous soils.

~~(b) is not suitable for any beneficial use due to the risk of harm from contamination.~~

☐ ~~(comments):~~

I am accredited by the NSW Environment Protection Authority under *the Contaminated Land Management Act 1997* as a Site Auditor **(Accreditation Number: 0201).**

I certify that:

(a) I have personally examined and am familiar with the information contained in this statement, including the reports and information referred to in this statement, and

(b) this statement is, to the best of my knowledge, true, accurate and complete, and

(c) on the basis of my inquiries made to those individuals immediately responsible for making the reports, and obtaining the information, referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties for wilfully submitting false, inaccurate or incomplete information.

Signed: ______________________ Date: 29 July 2003

FORWARD TO:

Director, Contaminated Sites Section
NSW Environment Protection Authority
PO Box A290
SYDNEY SOUTH NSW 1232

Phone: 02 9995 5614
Fax: 02 9995 5999

Abbreviations

C_6-C_{36}	Hydrocarbon chainlength fraction
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
COC	Chain of Custody
CLM Act	Contaminated Land Management Act
DLWC	Department of Land and Water Conservation (NSW)
ESA	Environmental Site Assessment
IT	IT Environmental (Australia) Pty Ltd
LOR	Limit of Reporting
µg/L	micrograms per litre
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
NATA	National Association of Testing Authorities
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NSW EPA	Environment Protection Authority of New South Wales
OCP	Organochlorine Pesticide
OPP	Organophosphorous Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionisation Detector
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
RPD	Relative Percent Difference
SSAR	Summary Site Audit Report
SAS	Site Audit Statement
TPH	Total Petroleum Hydrocarbon
UST	Underground Storage Tank
VOC	Volatile Organic Compound

1 Introduction

1.1 Background

Mr David Lam who is a NSW EPA accredited site auditor, has undertaken an independent review under S47 of the Contaminated Land Management Act 1997 (CLM Act 1997) of a report prepared by Parsons Brinckerhoff Australia Pty Limited (PB) in relation to the contamination assessment and remediation of the site known as 612 Pittwater Road, Brookvale, NSW (the site). This summary site audit report (SSAR) has been prepared by Mr Lam of IT Environmental (Australia) Pty Ltd (*IT*) for Mobil Oil Australia Pty Ltd (Mobil). Originally the Audit was initiated by Mr Peter Mirkov of *IT* who was then an NSWEPA Accredited Site Auditor. Mr Mirkov decided to cease Auditing Activities in Early 2002, following which Mr Lam took up the Auditor's role following his accreditation in early 2002.

1.2 Purpose of the Audit

The audit has been conducted as a Non-Statutory Audit for the purpose of providing information to the recent site owner (Mobil) regarding the likely suitability of the site for redevelopment following remediation of contaminated site soils, and some remediation of groundwater. This Audit was requested by Mobil as part of sale of the land to Messrs Frank and Nick Curulli who own the adjacent property to the subject site's immediate north, in Pittwater Road. It is understood that there is no Development Application (DA) yet prepared.

Information received by the Auditor indicates that the proposed future use of the site under likely development by Messrs Frank and Nick Curulli is for a 3-storey commercial development (shops) with one level of open roof-top parking and one layer of bottom level parking. It is understood the bottom level parking may be either above or below ground. This description was obtained verbally from Mr Frank Curulli; detailed development plans have not been provided to the Auditor. A previous conceptual plan included by PPK Environment and Infrastructure (PPK, now Parsons Brinckerhoff, or PB) in their June 2000 Remediation Action Plan (Appendix B of this report), indicated that at that time the basement car park was envisaged to be below ground in the area of the former service station.

This SSAR has been prepared in accordance with the NSW EPA (1998) *Guidelines for the NSW Site Auditor Scheme*. These have been prepared by the NSW EPA under the CLM Act 1997.

A Site Audit is defined in S47(1) of the CLM Act 1997 as an independent review:

(a) that relates to investigation or remediation, carried out (whether under the CLM Act 1997 or otherwise) in respect of the actual or possible contamination of land, and
(b) that is conducted for the purpose of determining any one or more of the following matters:
  (i) the nature and extent of any contamination of the land;
  (ii) the nature and extent of any investigation or remediation;
  (iii) what investigation or remediation remains necessary before the land is suitable for any specified use or range of uses; and
  (iv) the suitability and appropriateness of a plan of remediation, a long term management plan, a voluntary investigation proposal or a remediation proposal.

Mobil commissioned PB to conduct a remediation and validation program on the site to satisfactorily remove previously identified contamination at the site and to assess the suitability of the site for the proposed land use of commercial development. Remediation has been conducted by Handex and PPK and a report summarising past remediation activities and detailing excavation validation sampling has been prepared.

Therefore the purpose of this audit is in accordance with S47(1) (b) i), ii) and iii) above.

1.3 Site Identification

The site is identified as 612 Pittwater Road, Brookvale, NSW and comprises Lots A B and C in DP 375728. The site has an area of approximately 1,378 m^2 (in a roughly rectangular shape) and is located on the corner of Pittwater Road and William Street, with frontages of approximately 47m on Pittwater Road and approximately 26 m on William Street (see Figure 2 and Figure 4 of the PB report in Appendix A of this report). The Certificate of Title is included in Appendix C of the PB validation report which is Appendix A of this report.

1.4 Scope of Review

The scope of work undertaken by the Auditor for Mobil included:

- review of previous contamination assessment reports relating to the site, provided by PB;
- site inspection by Mr Greg Brickle (of *IT*) on 27 November, 2001
- site inspection by Alison Brooks (of *IT*) on 11 April, 2002
- site inspection conducted by Mr David Lam and Mr Greg Brickle (both of *IT*) in September 2002;
- detailed auditor review of the Site Remediation and Validation report prepared by PB (March 2003), and the earlier Remediation Action Plan ;
- comments on the validation report and requirements for additional work;
- preparation of a Summary Site Audit Report (SSAR) and Site Audit Statement (SAS).

1.5 Proposed Land Use

The site is currently zoned as Locality F2 (PB, 2003) under the Warringah LEP (see Appendix E of the PB report in Appendix A of this report). Details from Warringah Council regarding this zoning indicate uses including bulky goods shops and other similar commercial uses, which is consistent with the Auditor's understanding of the proposed development.

The proposed development is commercial – multilevel shops, as discussed in Section 1.2. It is understood that the proposed development would extend across the service station and onto the property immediately to the north, which is currently owned by the proposed developer of the service station site.

1.6 Previous Investigation Reports

Previous reports, relating to the contamination assessment of the site audit area, have been reviewed as background to the SSAR and are listed below:

- Parsons Brinckerhoff Australia Pty Limited report: " Site Remediation and Validation – Report – Former Mobil Service Station, 612 Pittwater Road, Brookvale, NSW (No 0035)", March, 2003
- Parsons Brinckerhoff Australia Pty Limited (then PPK Environment and Infrastructure Pty Ltd) report: "Remedial Action Plan – Former Mobil Service Station and Adjoining Properties, Cnr Williams and Pittwater Roads, Brookvale, NSW", June 2000
- Appended to the 2003 Validation report was the report by Handex: "Environmental Site Assessment, 620 Pittwater Road, Brookvale, NSW", December 1998 (note this title is erroneous as the report refers to the 13 grid point samples carried out on the service station site at 612 Pittwater Road).
- Appended to the Remedial Action Plan was the report by Handex "Limited Environmental Site Assessment, 620 Pittwater Road, Brookvale, NSW", December 1998.
- Appended to the 2003 Validation report was the report by Handex: "High Vacuum Extraction Remediation Report (Events, 1, 2, and 3) Former Mobil Petrol Station, Cnr William Street and Pittwater Road, Brookvale, NSW", December 1998.
- Appended to the 2003 Validation report was the fax by Handex: "Brookvale, excavation and stockpile sampling, May1998. Note that PB attached to this fax some laboratory results for off-site grid point samples (in 620 Pittwater Road), from October 1998 (well after the date of the fax).

A brief summary of the earlier reports is presented below as background to the validation report which will be discussed more fully thereafter.

Handex, 1998, Remediation Report

This letter report detailed the recovery using high vacuum extraction of dissolved phase contaminants at the site on three occasions in October and November, 1998.

This report detailed the removal of some 1,900 Litres of water containing dissolved phase hydrocarbon, plus volatile organic compounds (VOCs) as vapour. Handex estimated the removal of some 33 kg of VOCs in total.

No phase separated hydrocarbon (PSH) was detected in any of the wells, before or after the high-vac events.

Photoionisation detector readings of VOCs (which are indicative, rather than quantitative, of true vapour concentrations) ranged typically around 1500 ppm_v in effluent air. This indicates significant volatiles were present in and around the shallow groundwater in 1998.

Handex, 1998, ESA

This report details the initial soil investigation of the site by Handex. The report shows that soils in the north west quadrant of the site, around and downgradient of the tank pit and bowsers, were impacted by petroleum hydrocarbon contaminants (including BTEX) at the depth of refusal of the geoprobe sampling equipment on sandstone bedrock. The depth of refusal varied from less than 1 m in the eastern half of the site (topographically the high side of the site) to over 2 m in the western (topographically low) half of the site.

A small number of shallow fill samples (four) were analysed for a range of metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn) and were shown to comply with Dutch intervention criteria that were then adopted. It is noted that for each metal, the criterion adopted is conservative with respect to NEHF criteria that are now considered relevant to the proposed commercial/industrial site use as currently planned.

Handex, 1998, Limited ESA (of adjacent site)

Handex completed assessment for Mobil, involving five Geoprobe sampling bores to 3.95 m maximum depth on the house block immediate north of the service station site. Soil samples were collected from the bores and analysed for hydrocarbons against Dutch Intervention levels.

Handex boring logs noted the presence of clay up to 2 to 3 m depth, with deeper refusal on sandstone.

The Handex report detailed the earlier installation by PB (then PPK) of five on site groundwater wells (BH1, BH2, BH3 BH4A and BH4B, the logs for which are in Appendix G of the PPK Validation report of March, 2003, in Appendix A of this report).

Handex recommended removal of impacted site soils and validation of the site. Handex also recommended the installation of five groundwater monitoring wells on the house block on the north boundary of the service station. To the Auditor's knowledge, no removal of impacted soils has occurred on the adjacent block. However, that block is not the subject of this voluntary Audit. The main implication of the earlier off-site study was to indicate the presence in 1998, and likely continued presence, of impacted soils on the adjacent block, that could contribute to a level of risk from volatile hydrocarbons to development on the service station site, whether the development is combined across the property boundaries or is separate on the service station site alone.

PB, 2000 – RAP

PB (then PPK) produced the RAP document in June 2000. This document detailed the results of six off-site soil bores (BH301 to BH306) in the property to the immediate north of the service station site. Four of these soil bores were installed as groundwater monitoring wells (BH301, BH302, BH304 and BH305).

The approach of the RAP can be summarised as follows.

- Previous remediation by soil excavation and validation had shown residual contamination by light fraction hydrocarbons including BTEX to remain on the north and west extremities of the excavation walls (Figure 3 of the RAP, which is Appendix B of this report).
- Shallow seepage/groundwater on site was impacted, and PB believed that this was mainly due to high adsorbed concentrations in soils.
- Soil contamination was noted to be present in the off-site property (620 Pittwater Road) to the immediate north of the service station.
- Off-site groundwater in 620 Pittwater Road was noted to be impacted, and groundwater to the west (under Pittwater Road itself) was assumed to be impacted. Off-site groundwater depth was noted in the range 1.1 to 1.3 m below ground surface.
- Surface soils above the impacted band around the depth of groundwater were considered to be clean with respect to adsorbed hydrocarbon contamination.
- The intended approach was to remove and stockpile clean surface soils, remove deeper contaminated soil down to bedrock, laterally to the site boundaries, remove and dispose any contaminated seepage water, line the Pittwater Road boundary with an impermeable liner, and backfill site with clean validated soils after landfarming.
- Proposed criteria for validation were noted to be NEHF F criteria as adopted from column 4 of the Soil Investigation Levels (SILs) from the NSW EPA Guidelines for the NSW Auditor Scheme. Where contaminants such as hydrocarbons including BTEX are not covered, conservative use of the NSW EPA Service Station Guidelines for sensitive use sites is to be adopted.

1.7 Current Validation Report (PB, March 2003)

This report is included as Appendix A of this report and details the following results.

- Demolition of some site infrastructure including seven underground storage tanks (USTs), bowsers, and an oil/water separator, supervised by Handex in May 1998.
- Results of pit validation sampling are included in Appendix A of the PB report (Appendix A of this report). These show high concentrations of petroleum hydrocarbons with respect to adopted criteria in the excavation pit walls.
- Section 2.2 of the PB report (Appendix A of this report) describes further preliminary remediation by PPK from June 1998 to February 2000. It was estimated that some 520 m^3 of soil were stockpiled and validated after "bioremediation" to within acceptance criteria and backfilled.
- Health risk assessment completed in 2000 was described, in which PB indicated that health risks would be unacceptable without the proposed further site remediation of residual contaminated soils.
- The validation report confirms the soil assessment criteria as noted in the earlier RAP. However, with regard to groundwater impact, the report concludes that aquatic ecosystem criteria are generally appropriate given the intermittent nature of the seepage water and the apparent lack of viable quantities of groundwater for extraction in the area. This is supported by the lack of any extraction bores within 1.5 km of the site.
- The validation report lists the range of samples which were taken for excavation validation within the site. It notes that a number of the samples returned concentrations above the adopted validation criteria. The validation report states that in these instances, further soils were excavated and the extended excavation wall was then re-tested to check whether the full extent of the contaminated soil had been removed. In fact, a review of sample locations shows that while this procedure was generally adhered to, there were a number of locations where the excavation wall that had earlier failed validation testing was later re-tested at approximately the same location. PB advises that this typically occurred when the (backfilled) excavation wall that had failed against final validation criteria, but where excavations were originally backfilled, was re-exposed by test pitting. (An example is BE7 from June/July, 1998, replaced by BV45 in April 2002.)
- Some samples that were recovered at the site boundary (NW corner) exceeded the adopted acceptance criteria. Excavations were not extended beyond the former service station property boundary, either to the north into 620 Pittwater Road, or the west into Pittwater Road.
- Stockpile validation samples were listed, and it was noted that samples were taken at a rate of approximately 1 per 25 m3. This can be checked by the fact that over 90 samples were recovered from 1214 m3 (in situ) so that the rate of sampling appears to be one per 14 m3, although it is noted that these stockpile samples appear in some cases taken in sequence, so that the rate is less than one sample per 14 m3. However, overall, it appears that stockpile sampling is at an appropriate rate.
- The validation report documents some 8.5 m grid sampling that was undertaken by borehole drilling in 1998. The RAP noted the intent to address a gap in data "between BH3 and BH9" (in fact this is really the unsampled space between those bores and BH5). The original intent was to see if there were fill soils, and if so to analyse them for TPH, BTEX, metals and OC pesticides. This was actually not undertaken. Instead, a new tank pit was later identified roughly in this area, so soil contaminant levels were defined in this area by pit wall samples such as BV24, BV28 and BV25. The intended analysis for metals and OCPs in this area was not undertaken, but given the identified contaminants of concern relate principally to the service station use of the site, this slight departure from the intent of the RAP is not considered significant.

- Imported Fill was noted as having been tested and complying with requirements for metals, TPHs, BTEX, OCPs and PCBs. These data are included in the RAP document, as the backfilling works referred to pre-dated the RAP.

2 Site Description

A detailed description of the site was presented in the PB validation report and in previous investigations listed in Section 1.7 of this SSAR. Site Information included in the PB validation (2003) report has been summarised below, with notes where other sources of information have been used.

2.1 Topography and Hydrology

The site is towards the bottom of a moderately steep slope falling east to west down towards Pittwater Road. This observation is from the Auditor's site visit. Along Pittwater Road there is a slight slope to the north, and surface drainage is believed to flow in this direction, to a stormwater pit entry some 70 north of the site, believed to discharge via a former drainage line at this location leading west and then south to Brookvale Creek.

2.2 Site Layout and Site Condition

During the Auditor site inspection in September 2003, the site had been largely cleared, with only minor rubble on parts of the site. Features which were previously located on site including a two-storey office/workshop building, a number of underground storage tanks bowsers had all been removed. The site surface level was slightly sloping and was level with Pittwater Road on the western boundary.

No abnormal odours or staining were visible and no significant vegetation was present on the site.

2.3 Surrounding Site Uses

The site is bounded by:

- A house lot with two sheds to the immediate north/northeast;
- Commercial building to the east/south-east (this building is up a significant slope);
- William Street and then residential properties to the south/south-west; and
- Pittwater road then a shopping centre car park (of Warringah Mall) to the west/north-west.

2.4 Site History

A site history was documented by PB in their validation report (2003) which is contained in Appendix A of this report.

- Aerial photographs show the site to be vacant around 1951, with possible indications of demolished houses discernible on the subject site. Site uses in the region are predominantly residential.
- The site is known to have been a service station since around 1952, with Vacuum Oil Company Pty Ltd (Mobil) owning the site from 1955.
- Demolition of site infrastructure occurred over the period from 1998 to November 2001.

A review of historical title documents held in the Land Titles Office of NSW was undertaken. Title documents are included in Appendix C of the PB validation report (Appendix A of this report). These documents show that Knarf Holdings bought the title for the subject land from Mobil in 2000. Mobil (including Vacuum Oil) owned the site from 1955 to 2000. Stanley Smith owned the site as a service station site from 1952 to 1955. A range of other owners previously owned Lots A and B (combined), and separately Lot C, although it appears that the site is likely to have been undeveloped or used for residential use only, based on the 1951 photograph.

Figure 2 in the Handex report which is in Appendix A of the PB validation report (which is in turn Appendix A of this report), shows the site (service station) infrastructure prior to site demolition and remediation.

In summary, the site history does indicate that the main sources of contamination are those associated with hydrocarbon contamination associated with the service station use of the site.

There is no information presented suggesting contamination of the site from off-site sources, and no indication of significant filling that would be likely to cause contamination.

2.4.1 Tank Removal

Section 3.6 of the PB Validation report details the 11 tanks that were ultimately removed from the site. Of these, the six USTs in the main tank pit and the waste oil tank were removed between 6 April 1998 and 1 May 1998. Four other tanks were removed from the site as follows:

- July 1998, PB oversaw the removal of a kerosene tank adjacent to the main UST pit. This area is shown on Figure 4 of the PB validation report, and is the area in which validation samples are prefixed "KT", in the site's north-east corner.
- In November 2001, three further tanks (10 to 15 kL each) were removed from the site's south-east corner. These tanks were in the area shown on Figure 4 of the PB validation report, where validation samples BV24 to BV41 were recovered.

The excavation sequence is detailed in Table 4.1 of the PB validation report, and shown on Figure 5 of that report.

2.5 Site Geology and Hydrogeology

The site geology and hydrogeology is described in the PB report and earlier reporting by Handex.

The Sydney 1:100,000 series geological sheet indicates that the site is located on Hawkesbury sandstone, which is medium to coarse-grained with minor shale and laminite lenses.

Investigations on site supported this expected regional geology. The depth to bedrock varied, being close to the surface in the (topographically high) south-east corner, with depth increasing towards the (low) north-west corner. PB noted the depth in the north west corner to be up to 3-4 mbgs, although the Auditor notes that Handex's grid point bore (by geoprobe) GP6, reached refusal at only 2.1 mbgs. Similarly, the depth of excavations that typically reached the top of bedrock, were around 2 to 2.5 mbgs on the site's northern boundary. It appears some of the bedrock had been excavated in the areas of tanks, so that it would still be true that a depth to bedrock of over 3 mbgs would exist in some locations.

A general log of the site is shown in section 3.3 of the PB validation report, and summarised as being a concrete surface (now largely removed) above fill to 0.2 to 0.7 m, above clayey sand down to bedrock, typically 1.5 to 2.5 mbgs. Bedrock was noted as being weathered sandstone.

There appears to be some minor inconsistency in reporting of the soils overlying the bedrock. The original Handex report contains logs that indicate the soils over the bedrock to be sandy clay, whereas the PB section on hydrogeology indicates the shallow soil is clayey sand. On the other hand, section 9.2 of the PB validation report assumes the shallow soils to be silty-clay (in using Oil Industry Working Group Guidelines to assess possible indoor air inhalation risk).

PB reported that a paper by D.R. Wolley states that water bearing zones in the Hawkesbury Sandstone are generally encountered at depths of 10 to 50 mbgs, with static water level at an average of 12 mbgs. The water is generally of good quality.

On site, shallow water was apparently perched "seepage" water, which appears to have been present above the sandstone bedrock. Photographs in Appendix D of the PB report show excavations in the north-west and south-east site corners; these photographs clearly show the presence of bedrock below the excavations. The bedrock below the north-west corner is dry; in the south-east corner excavation, the pit contains some apparently perched tank pit water.

During various phases of assessment, the following groundwater wells have been established on the site and in the nearby surrounds (all wells are shown on Figure 2 of the PB Remediation Action Plan):

- On site wells (now mostly destroyed as part of site excavations), BH1, BH2, BH3, BH4A, BH4B.
- Off-site wells BH301, BH302, BH304, BH305.

The flow direction of the perched seepage water is inferred to be to the north or north/west, in the direction of the surface slope, as reported by both Handex and PPK. Groundwater gauging data and contours provided by PB confirm flow to the north/north west in the area of the site.

Handex (1998) conducted a search of groundwater bores in which it was established that at that time there were no groundwater bores within 4.2 km of the site. PB included in Appendix H of their validation report a 1998 bore search which showed two bores within 2 km of the site, numbers 72222 and 20813.

DSNR (formerly DLWC) was contacted by the Auditor (May 2003) to assess the likelihood of groundwater extraction bores being constructed in the area in the intervening period. DSNR advised that such extraction was highly unlikely except from very deep in the sandstone. It was identified that the only likely future user of deep groundwater in the area would be Warringah Public Golf Course to the south of the site, upgradient in terms of shallow (perched) groundwater flow direction. DSNR considered that contamination of the shallow perched groundwater was of relatively low relevance in terms of extractive use, although the Auditor notes that clearly there needs to be consideration in terms of off-site impacts to surface waters, to other off-site receptors (such as building occupants) and service maintenance workers.

In order to clarify current groundwater use, the Auditor conducted a new search and identified that indeed there were still only the two bores identified by PPK within 2 km of the site. These are both well over a kilometre from the site (GW020813 being approximately 1.3 km south of the site, and GW72222 being some 1.5 km east of the site), and unlikely to be affected by the contamination identified at the subject site.

2.6 Potential Contaminants of Concern

The PB report identifies the potential sources of contamination as:

- USTs and associated infrastructure (super and unleaded fuel, diesel, waste oil)
- Workshop hoists.

PB listed the following as contaminants of potential concern (COPC) on the site:

- Lead (Pb)
- Total Petroleum Hydrocarbons (TPH)
- BTEX (benzene, toluene, ethylbenzene and xylene)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Phenols (waste oil only)

Whilst PB did no mention the kerosene tank also found on site, the contaminants of concern are consistent with the assumed list.

The Auditor raised a question with PB regarding shallow fill noted in a number of the borelogs from across the site, in terms of potential for other contaminants that may be present were that material sourced from for instance an industrial site. PB's response was that the fill material described in the logs is topsoil, apart from some minor road base material, and was not therefore considered to warrant broad screening analysis. The Auditor notes that the Handex report (in Appendix A of the PB validation report) does include four analyses for a screen of eight metals. Three of these four samples were logged by Handex as being from the shallow "fill", and all returned low concentrations relative to acceptance criteria. In addition, the fill descriptions in the bore logs do not include any notations of the presence of staining, ash, tar, slag or other indicators that contaminants of concern other than those addressed by the limited metals screening and hydrocarbon validation sampling would be likely to be present.

Other than the listed COPC, analyses from 1998 were included in the PB validation report for fill soils for OCPs/PCBs (table T7 of PB report) and metals (table T6 of PB report). Validation sample analyses from 2001 also included limited analyses for metals (table T10) and OCPs/PCBs (table T12).

The auditor considers that based on the site history, the substances listed, especially TPH, BTEX and lead, appropriately represent the range of potential contaminants most likely found on the site.

3 Review of Methodology

3.1 Introduction

The information provided in the PPK, PB and Handex reports was compared to current guidelines on contamination and remediation made or approved by the NSW EPA under Section 105 of the CLM Act (1997). Relevant guidelines included the following:

- NSW EPA (1995) Sampling *Design Guidelines.*
- NSW EPA (1997) Guidelines *for Consultants Reporting on Contaminated Sites.*
- NSW EPA (1994) Guidelines *for Assessing Service Station Sites.*
- NSW EPA (1998) Guidelines *for the NSW Site Auditor Scheme.*
- NSW EPA (1999) Guidelines *on Significant Risk of Harm from Contaminated Land and the Duty to Report.*
- ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*
- National Environment Protection Council (NEPC) (1999) *National Environment Protection (Assessment of Contamination) Measure.*

The audit comprised review of the reports listed in Section 1.6 of this SSAR.

3.2 Adopted Guidelines and Criteria

Some of the guideline documents listed above, in particular the NSW EPA (1994 and 1998), NEPC (1999) and ANZECC (2000) contain guideline values (henceforth referred to as criteria) for assessment of contaminants in soil and groundwater. In accordance with NSW EPA (1998), the criteria in the contamination assessment reports have been compared with those in the various guidance documents, taking into account the specific requirements for the site. A summary of the guidelines and criteria used for this Audit are listed in **Table 3**.

3.2.1 Soils

Guideline values for soils were principally taken from the NSW EPA "Guidelines for Assessing Service Station Sites" – sensitive landuse criteria for hydrocarbons, with other analytes generally referenced to the NSW EPA Guidelines for the NSW Site Auditor Scheme SIL (column 4). It is noted that the PB validation report lists a number of other criteria for various contaminants (for instance listing NEHF A criteria for PAHs in Table T11, whereas the RAP indicated the use of NEHF F, equal to SIL column 4). It is also noted that the validation report conservatively includes the TEX criteria for terrestrial organisms, as well as those for human health protection.

In this Audit Report the following terms have been used to refer to soil criteria as listed in **Table 3**:

- HIL F (equivalent to NSW EPA SIL column 4) - Health Investigation Level with exposure setting F using values from NEPC (1999) as described above.
- TC - Threshold Concentrations for hydrocarbon contamination where HILs are not available, using values from NSW EPA Guidelines for Assessing Service Station Sites (1994).

Whilst these criteria are from sources that were developed as investigation levels, rather than clean-up targets, in general the adoption of these criteria as validation criteria is considered to be protective of human health in the first instance, with any non-compliances able to be considered individually on a qualitative or quantitative risk basis.

3.2.2 Groundwater

Given that groundwater is unlikely to, but possibly could, discharge to a fresh water body the ANZECC (2000) Fresh Water Trigger Values, for protection of 95% of species have been used for assessing groundwater contamination. For substances not included in these guidelines, criteria from other sources have been used, with preference given to the NSW EPA (1994) guidelines where available.

It has been noted in the discussion on the nature of the seepage water that this water is not considered to represent a viable resource for extractive groundwater use.

3.2.3 Site Assessment Criteria

The nominated site assessment criteria are summarised in **Table 3** below.

TABLE 3 – Assessment Criteria

Parameter	Soils (mg/kg)		Groundwater Criteria (µg/L)	Laboratory PQL	
	Environmental Criteria (EIL(g) or SIL col 5 or TC)	Health based criteria (HIL F(b) or SIL col 4 or TC)	Fresh Water 95% Species Protection	Soil (mg/kg)	Water (µg/L)
Arsenic	20	500	24	2	1
Cadmium	3	100	0.2	1	0.1
Chromium (total)	400	60%	ID	2	1
Chromium (VI)	1	500	1.0	NT	NT
Copper	100	5000	1.4	2	NT
Lead	600	1500	3.4	2	1
Mercury	1	75	0.6	0.01	NT
Nickel	60	3000	11	2	1
Zinc	200	35000	8	2	2
TPH					
C_6-C_9	NE	65(c)		5	0.02
C_{10}-C_{14}			10,000(e)	10	5
C_{15}-C_{28}				50	1
C_{28}-C_{36}				50	1
Total C_{10}-C_{36}	NE	1000(c)		NA	1
Benzene	1(c)	1(c)	300(c)	0.2	0.5
Toluene	1.4(c)	130(c)	300(c)(h)	1	1
Ethylbenzene	3.1(c)	50(c)	140(c)(h)	1	1
Total Xylenes	14(c)	25(c)	385(c)	3	3
PAHs (total)	NE	100	3(a)	.	NT
Benzo(a)pyrene	NE	5	ID	0.5	NT
Naphthalene	NE	NE	ID	0.5	NT
Anthracene	NE	NE	ID	0.5	NT
Phenanthrene	NE	NE	ID	0.5	NT
Fluoranthene	NE	NE	ID	0.5	NT
Total OCPs			NA		
Dieldrin	NE	40(d)	NA	0.1	NT
Aldrin	NE	40(d)	NA	0.1	NT
Endrin	NE	NE	NA	0.1	NT
Chlordane	NE	200	NA	0.1	NT
Endosulfan	NE	NE	NA	0.1	NT
Methoxychlor	NE	NE	NA	0.1	NT
Heptachlor	NE	40	NA	0.1	NT
DDE	NE	800(f)	NA	0.1	NT
DDT	NE	800(f)	NA	0.1	NT
DDD	NE	800(f)	NA	0.1	NT

Notes: NA = not applicable; NT = not tested in current investigations; NE = guideline not established; and ID = insufficient data to derive a reliable trigger value.

a) NEPC (1999) Groundwater Investigation Level for Fresh Water Ecosystems.

b) Health-based Soil Investigation Levels for commercial industrial (NEHF F) in NSW EPA (1998) *Guidelines for the NSW Site Auditor Scheme*, or NEPM (1999) Schedule B(1) Health Investigation Levels.

c) From NSW EPA (1994) *Guidelines for Assessing Service Station Sites*.

d) Aldrin + Dieldrin.

e) Clean Waters Regulations 1972 require licensed discharges to be visually free of oil and grease. Experience shows this is equivalent to an oil and grease concentration of approximately 10mg/L.

f) DDE + DDT + DDD.

g) Provisional phytotoxicity-based investigation levels for sandy loam soils, pH 6-8, in NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme, or equivalent NEPM (1999) Schedule B(1) Ecological Investigation Levels.

h) Fresh water criteria

3.3 Data Quality Objectives (DQOs)

The PB report and assessment processes were reviewed in the context of whether the soil sampling plan in terms of spatial and depth coverage, parameters analysed, and laboratory practical quantitative limits (PQLs) would provide acceptable confidence that any potential soil contamination had been identified. In this regard the minimum sampling densities set out in AS 4482 were used to ensure that at least the minimum densities had been used for non-targeted sampling, and that sampling had been extended from tank excavations laterally and vertically to undisturbed or natural soils as appropriate.

With respect to analytes chosen these were reviewed to ensure that they were relevant to past site uses. Similarly laboratory detection levels (or PQLs) were also reviewed to ensure that they were at least 50% less than relevant parameter acceptance criteria values.

The Auditor considers the QA/QC procedures undertaken by PB were generally appropriate.

The overall program QA/QC procedures were reviewed to ensure that the results of the assessment could be confidently accepted. In this latter context the primary (mainly Amdel, but some AGAL) laboratory's overall performance was assessed against the results of a split sample sent to a second NATA registered laboratory (ALS).

Note that Section 5 of this report also deals extensively with the assessment programs, QA/QC, and draws the conclusion that the overall program data set is acceptable and meets the Auditor's implied DQOs for the project.

4 Completeness of Investigation

The main assessment report (Validation Report, PB, March 2003) generally addressed all the elements listed in NSW EPA (1997) *Guidelines for Consultants Reporting on Contaminated Sites*. The associated reports listed in Section 1.6 of this SSAR were intended to be read in conjunction with the Validation Report and describe further details of the groundwater assessment at the site. Information regarding the completeness of the various aspects of the reporting is summarised in the following section.

4.1 Completeness of Historical Review

A summary of the site history is included in Section 2.4 of this SSAR. The site history included in the PB Validation Report incorporates a review of the previous investigation reports listed in Section 1.6 of this SSAR.

In addition PB undertook the following:

- review of historical title documents from 1894–2003 held in the Land Titles Office of NSW;
- referenced earlier records of infrastructure site plans showing USTs and bowsers, and records of site inspection by Handex;
- aerial photographs of the site were viewed (and discussed in detail);
- detailed tank inventories from Handex records and PB investigations;
- inquiries to the Warringah Council regarding Section 149 certificates;

The site history appears to be reasonably comprehensive in identifying the previous site uses. It appears that the main activities which could give rise to contamination have been identified. It is considered that the site history review has met the main requirements of the NSW *EPA Guidelines for Consultants Reporting on Contaminated Sites* (1997).

In particular the Auditor considers that:

- the most significant potential contaminating activities have been identified;
- the main range of potential contaminants have been identified; and
- the site history does not indicate the likely presence of significant hotspots of contamination on the site other than that associated with the past petroleum infrastructure.

The PB report (last sentence in Section 3.11) states that no historical site use was identified that would require the analysis of a broad suite of unknown contaminants. Whilst the Auditor does not completely agree with this approach (which is not sufficiently precautionary), the various stages of investigation have cumulatively included a number of broad screening type analyses, at least of some typical indicator contaminants.

4.2 Completeness of the Site Sampling and Analysis Program

4.2.1 Sampling Density

Soil
Based on the PB report the Site Audit Area is approximately 1,378 m^2. Based on Table A in NSW EPA (1995) *Sampling Design Guidelines*, a minimum of 7 (grid-based) sampling locations would be required to detect a hotspot of diameter 19.9m or larger with a 95% confidence level.

Soil sampling across the site was conducted at different stages.

- Handex conducted grid-based sampling at 13 locations (GP1 to GP13) in March, 1998 for a range of potential contaminants, including four samples for arsenic (As), cadmium (Cd), chromium (Cr), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn) and mercury (Hg).
- This investigation (see section 2.1 of the PB validation report) identified contamination that was later the subject of remediation by excavation of petroleum infrastructure with validation sampling of excavation extents and validation of stockpiles.
- Additionally, a series of 10 boreholes was drilled by PB (September, 1998) in order to provide a grid covering areas not at that time covered by the excavations. (In fact, including the bores BH4A and BH4B, there were 11 locations.) Some of these locations were in turn subsequently excavated and validated by later tank pit samples, but a number of these bores (namely BH1, BH3, BH8, BH9, BH10) were outside the ultimate extent of tank pit excavations, and therefore provide a general grid sampling pattern to support the earlier Handex grid sampling. Note that the Handex report in Appendix A is incorrectly referenced as “620 Pittwater Road”, and the sample locations are prefixed “B”. IT has confirmed with PB that this report relates to the service station site and not off-site investigations done on four other locations BGP1 to BGP4 in October 1998.

With respect to meeting the sampling design guidelines specified by the NSW EPA (1995), it can be concluded that the sampling density meets the minimum recommended in the guidelines for characterisation of hotspots of contamination.

On the basis of the site history and the general absence of significant areas of contamination (outside the area of the petroleum infrastructure) it is considered the sampling density undertaken is sufficient to allow characterisation of the site contamination status. The validation program is discussed in Section 4.3.

With respect to sampling of tank pit excavations, reference is made to the NSW EPA Guidelines for Assessing Service Station Sites (1994). Section 4.2 of that document notes that validation sampling density of tank excavation pits should be on the basis of one sample from each wall and one from the floor for a single tank pit. This should be increased accordingly for multiple tank pits. Figure 5 of the PB validation report shows that the final excavation validation sampling was carried out with approximately 3 to 7 m spacing between wall validation samples , and a similar distance between floor samples. A total of over 50 final validation samples were recovered on a grid basis for the 11 tanks, and bowser lines, removed, over the Handex and PB validation exercises. This is considered to be consistent with the NSW EPA guidelines.

Stockpile validation is a little more difficult to follow, from the available information, although as noted in section 1.7, stockpile sampling appears to have been carried out at an appropriate rate, with a total of some 90 samples recovered.

Groundwater
A total of 9 groundwater wells were constructed, of which three of the five on-site wells were destroyed following site remediation works (the only remaining wells appear to be BH1 and BH3, which were below acceptance criteria at the last sampling in 2001).

The on and off-site wells are identified as follows.

- On site wells (now destroyed – except BH1 and BH3 - as part of site excavations), BH1, BH2, BH3, BH4A, BH4B. The five on-site wells were sampled five times from September, 1998 to March, 2001. The results are summarised in Table T13 of the PB validation report.
- Off-site wells BH301, BH302, BH304, BH305. These wells were sampled in May 1999 (along with on-site wells BH2 and BH4) and the results are summarised in Table D1 in Appendix E of the RAP (Appendix B of this report).

Note that sampling of on-site wells subsequent to excavation and validation from late 2001 to early 2002 was not possible as these further works had destroyed the relevant monitoring wells (BH2, BH4A and BH4B) and shown that the groundwater in those wells was representative of shallow seepage water. The off-site wells have not been subsequently sampled although they are believed to remain undamaged. The sampling conducted to date is believed sufficient to characterise the risks associated with site development, albeit that some concentrations in off-site wells are likely to have decreased somewhat as a result of natural attenuation processes.

4.2.2 Sampling Locations

Soil
As discussed above, soil sampling on site was carried out on a grid and basis across the site and specifically in tank pit excavations. The sampling locations are considered appropriate.

Groundwater
Groundwater sampling locations on site were spread upgradient of source areas (BH3) and near to and downgradient of on site sources (BH1, BH2, BH4A and BH4B). Off-site wells BH301, BH302, BH304, BH305 appropriately targeted the downgradient area from the areas found to be impacted on-site. There is an area of uncertainty with respect to impact that may extend to the west/north west under Pittwater Road. This area was not sampled owing to difficulty of access under Pittwater Road, but leaves an area of uncertainty in terms of possible off-site impact to potential receptors that needs to be considered with respect to potential for significant risk of harm. The investigations undertaken to date are considered however sufficient to characterise the potential risks to on-site development and consideration of management measures that may be required in order for on-site development to proceed.

4.2.3 Field Investigation Methodology

Field investigations summarised and conducted by PB for the Validation Report are summarised below.

- Grid-based sampling by Handex in March 1998, which identified hydrocarbon contamination and indicated an absence of metals.
- Seven USTs, bowsers and an oil/water separator removed up to May 1998, reported by Handex. Validation sampling showed continuing hydrocarbons contamination and some stockpile sampling was undertaken. Excavation extent is shown in the Handex fax, May 18 1998 in Appendix A of this report.

- PPK engaged for remediation works, May 1998.
- Further excavation of tank pit (including reportedly removal of the backfill soil – see 2.2.2 of PB report) April to October 1998 (refer also to Figure 5 of PB report). This involved some re-excavation of backfilled validated stockpile soils.
- Imported fill soils were analysed for TPH, BTEX, metals, OCs and PCBs during June to October,1998 (Tables T5 to T7, in the PB validation report).
- Eleven grid-based bores (BH1 to BH10, with two bores at BH4) installed, September 1998. Wells installed at five locations as noted elsewhere.
- Off-site groundwater bores including four wells described elsewhere installed, May 1999.
- Health Risk Assessment conducted June 2000 adopting RBCA-derived vapour transport modelling, indicating unacceptable risks without further remediation.
- Remedial Action plan for residual contamination developed June 2000.
- Removal of three further USTs and additional soils from previous excavation extents through October/November, 2001.
- Excavation of NW corner boundary areas, April 2002, with landfarming of soils up to June2002.

The validation sample summary is shown in Table 6.1. Note that all validation samples (within the site boundaries) where results were above the adopted screening criteria were subsequently re-excavated, except for some early samples where the excavation extent was re-excavated and re-tested. All samples were below the adopted criteria except for several samples on the site's north-west boundary walls.

Logs for sampling locations were included in various locations.

- Initial grid point sampling logs are in the Handex Report in Appendix A of the PB report.
- No logs were available for the Handex Pit validation sampling.
- Logs for the Handex off-site sampling in 620 Pittwater Road are included in the Handex Report appended to the RAP in Appendix B of this report.
- Logs for the PPK off-site soil bores in 620 Pittwater Road are appended to the RAP in Appendix B of this report.
- Logs for the 11 on-site bores by PPK are in Appendix G of the PB validation report.
- No logs are provided for tank pit validation samples, although Table T9 describes the depth, position and PID reading from validation samples taken in 2001.

The graphic logs confirmed the geology discussed in Section 2.5.

Overall the Auditor considers that the investigation methodology utilised during the investigation is appropriate for site characterisation with respect to the potential contaminant sources.

As noted in Section 4.2.2 there are some gaps in off-site groundwater impact, particularly towards Pittwater Road, and this is considered in determining appropriate limitations for site redevelopment.

4.3 Validation Sampling Program

4.3.1 Underground Storage Tanks

As described in the PB Validation Report, samples were obtained from the walls and base of the tankpit excavations following removal of the USTs and other petroleum infrastructure, and the

Auditor believes that the sampling was in accordance with NSW EPA (1994) guidelines. A total of 62 validation samples (including QA/QC samples) were collected during validation prior to 2001, and 62 samples (including 6 QA/QC) were recovered in 2001 (of which some 9 were in soils subsequently re-excavated).

The Auditor considers that the validation samples confirm the remediation of the UST area in the south west corner of the site, whilst noting that some elevated concentrations persisted in the tank pit walls on the site's north and west boundaries (refer Figure 4 of the PB validation report).

The Auditor considers the final validation samples confirm that soils contaminated by hydrocarbons, have been removed from the site, up to the site boundaries.

4.3.2 Stockpile Validation and Reuse

Excavated soils were reported by PB to have been landfarmed, with degradation augmented by the addition of manure, and mechanical turning of soils.

Stockpile samples analytical results are summarised in Tables T3 and T9 in the PB report. These tables were not clear to the Auditor, and did not clearly match with the 95% UCL calculations presented in Appendix K, nor with Figure 7 (landfarm samples from 12/6/2001 were not shown on the Figure). The Auditor therefore sought clarification from PB who provided a fax on 25 July, 2003 (see Appendix C of this report).

Based on this additional information, the Auditor can describe the stockpile validation and backfilling as follows:

- Two large stockpiles were sampled in 1998 (Table T3 samples taken on 21 July, 1998). These 25 analyses (excluding the three additional duplicate samples) produced 95% UCL concentrations (refer July, 2003 fax from PB in Appendix C of this report) as follows:

TPH C_6-C_9:	31.8 mg/kg
TPH C_{10}-C_{36}:	1,499.8 mg/kg
BTEX	not detected

- This soil was at that time considered to meet the acceptance criteria being used at the time (TPH criterion was 5,000 mg/kg per Dutch Intervention Levels, 1994 – refer to Section 5 of the PB RAP in Appendix B of this report). This soil (some 520 m3 including small volumes from GP4/GP5 excavations, according to section 2.2.2 of the PB validation report) was backfilled. PB stated that the 95% UCL of the mean concentrations of these (main excavation) soils met the site acceptance criteria. Given that the current criteria strictly include a limit of 1,000 mg/kg for C10-C40 TPHs, this statement is not now correct. These results will be discussed in further detail later in this report, although as a general comment it is noted that given the proposed site use, the lack of BTEX compounds in any of the relevant stockpile sample results, and the relative lack of toxic effects from aliphatic TPHs, the 95% UCL figure of some 1,500 mg/kg for C10-C40 TPHs is not considered to compromise the commercial development of the site.
- Stockpiled samples were recovered in July 1998 from GP4/5 excavations (SP1-SP5). Some of these results were elevated. The stockpile after landfarming was re-tested in November 1998. All samples in that re-test were below the NSW EPA Threshold concentrations for sensitive land use, and therefore no 95% UCL calculation was required.
- Soils excavated in 2001 and 2002 were tested in stockpiles as detailed in Table T9. As shown on the PB fax of 25 July, 2003, Figure 7 of their report is in error, as it shows stockpile results for the small oblong stockpile as being some of the samples taken on 11/04/2002. In fact, all samples recovered that day were (according to the recent PB fax in Appendix C and verbal

confirmation with Mr Malcolm Dale) from the larger Stockpile on the eastern boundary. The four samples (plus one QC sample) taken on 12/6/2002, were recovered from the smaller stockpile.

- According to Mr Dale, the sequence of stockpile sampling and backfilling was as follows:
  - Large stockpile shown in Figure 7 was sampled on 27/11/2001, and was mostly clean relative to the acceptance criteria. The stockpile was reduced in volume, with "clean" soil backfilled, and those parts where samples were above criteria being retained and combined with soils recovered from further excavations on 11/4/02. The part of the stockpile above criteria from 11/4/2002 was re-tested on 12 June 2002.
  - As all results indicating parts of stockpiles above criteria were reserved for further landfarming, until all remaining results were below criteria, PB did not consider a 95% UCL calculation necessary for validation. The Auditor notes that in any case, the exceedances, where they occurred were exceptions rather than the rule, and considers this along with the description by PB of the actual sequence, indicates that the soils backfilled from 2001/2002 excavations did, indeed, meet the acceptance criteria for the site.

Overall, this means that all soils backfilled in 2001/2002 can be considered to have met the conservatively adopted sensitive use criteria, whereas soils backfilled in 1998, while having low C_6-C_9 TPHs, and no detectable BTEX, did contain C_{10}-C_{36} TPHs in the range 1,000 to 1,500 mg/kg.

4.4 Laboratory Analysis Program

Soil and groundwater samples were analysed for mainly hydrocarbon impacts, as determined by the reviews of previous historical uses of the site.

Selected soil samples obtained during the Handex and PB investigations were analysed for the following analytes listed below.

- Metals: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn), and mercury (Hg)
- TPH (chain length fractions C_6-C_9, C_{10}-C_{14}, C_{15}-C_{28}, C_{29}-C_{36})
- BTEX
- PAHs
- OCPs
- PCBs
- Total Phenols

The groundwater samples were analysed for the following analytes:

- TPH (chain length fractions C_6-C_9, C_{10}-C_{14}, C_{15}-C_{28}, C_{29}-C_{36});
- BTEX; and
- lead (Pb),

It is considered that the range of analytes are consistent with the contaminants likely to be present across the site, and address the potential contaminants of concern identified in Section 2.6 of this SSAR.

Soil investigations indicated that total PAHs were either below the laboratory limits of reporting or were below the relevant assessment criteria, so that omission of PAHs from the groundwater analytical program is not considered relevant.

4.5 Completeness of Sampling Analysis Reporting

The sampling analysis reporting is considered to be confusing, because of the combination of various reports as previously discussed. This has lead to various acceptance criteria being listed at different stages in different reports, and the PB validation report does not include a fully updated summary of all results. However, when considered carefully in combination, the data are sufficient to enable an overall characterisation of conditions on the site and surrounds, in order to reach conclusions with regard to the contamination status of the site and requirements for commercial development to proceed.

5 Evaluation of Quality Assurance/Quality Control

5.1 Quality Assurance/Quality Control

The Quality Assurance/Quality Control procedures (QA/QC) undertaken by PB in the period 1998-2002 were reviewed by the Auditor with consideration to the recommendations contained in the following documents.

- NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (1997)
- NSW EPA Guidelines for the NSW Site Auditor Scheme (1998)
- NEPM (1999) Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils (NEPC 1999)

The first two guidelines outline the NSW EPA's expectation of field and laboratory QA/QC including planning of QA/QC programs and their interpretation. The NEPM (1999) provide procedures for sample storage, sample pre-treatment and extraction, as well as data analysis.

Discussions of the audit findings with respect to these issues are presented in the following sections.

5.2 Field QA/QC

5.2.1 Field Sampling Procedures

A review of the field sampling procedures (field QA) contained in the PB report text and Appendix I of the PB validation report was carried out by *IT*. In general the field procedures used for this assessment were considered appropriate to achieve the objectives of the site remediation and validation.

The procedures (for validation sampling only) were viewed in the field, and the Auditor's representative discussed this with the Auditor who considered them to be appropriate for investigations of this kind.

Note that PID screening results were included for PB's samples, in the summary tables. These screening results appear to have given a reasonable correlation to actual analysed results, with all samples above adopted criteria for volatiles showing PID readings > 1000 ppm_v. Some samples with high readings did not analyse as having elevated concentrations, however the Auditor notes that this is not unusual and can be the result of heterogeneous soils, especially where any rock is present, as is likely given the presence of shallow sandstone.

5.2.2 Duplicate Samples

Duplicate samples provide information on the variation in analyte concentration between samples collected from the same sampling point. A recommended minimum rate for analysis of duplicates is one for every 20 samples analysed.

Soil

Section 8.1 of the PB report indicates that during 1998 , 115 primary soil samples were analysed for TPH/BTEX, and 110 for lead, and intra-laboratory and inter-laboratory duplicates were recovered at a rate of approximately 5%.

Similar rates were maintained or bettered for 101 TPH/BTEX samples analysed in 2001/2002.

Soil samples for metals suites, PAHs, phenols, and OCPs/PCBs were not checked by inter or intra laboratory duplicates. This was addressed to a degree in 2001/2002, when some intra and inter laboratory duplicates were carried out.

Groundwater samples for TPH/BTEX were analysed at a rate of 10% for intra-laboratory duplicates, but only 3% for inter-laboratory duplicates, in 1998.

Of five groundwater analyses for TPH/BTEX in 2001/2002 , one was analysed for a inter-laboratory duplicate, but no intra-laboratory duplicate was analysed.

The Auditor had a representative recover duplicates from 5 validation soil samples in April 2002. These were analysed at Gribbles Analytical Laboratories, and as the primaries were analysed at Amdel (then a separate laboratory), these analyses are effectively intra-laboratory as well.

Duplicate samples were obtained as 'blind' field samples. The primary laboratory used by PB for the investigations was Amdel. The results of the duplicate analyses are presented in Table T15 of the PB validation report, a copy of which is provided in **Appendix A**.

The relative percent difference (RPD) is calculated using the following equation:
$RPD\% = [(X_1-X_2)/(X_1+X_2)/2] \times 100$

Where X_1 and X_2 represent the sample and duplicate concentrations respectively.

RPDs were calculated by PB and shown in Table T15. The generally acceptable range is between 30% and 50%. RPDs calculated by PB were generally found to be within this range. There were a number of exceptions. PB noted that they used the higher result in each case in characterising the site, and while this is considered appropriate, this is not really the point. The Auditor is more concerned about the reliability of the other results on which no QC check sample was analysed. The Auditor makes the following observations:

- Most duplicate (intra-laboratory) and triplicate (inter-laboratory) results gave results in the same order – gross discrepancies of more than an order of magnitude were rare.
- In the more critical light fraction results, there was no obvious trend of one laboratory being consistently higher or lower than the other – so no indication of systematic error in either laboratory.
- Most of the samples with significant RPDs did not straddle the acceptance criterion – that is, rarely was a sample characterised by one laboratory to be above the acceptance criterion, while the other laboratory differed (this did occur for C6-C9 TPHs in KT/BS/3.0, and in GP5/BS/3.0) where the Auditor notes this depth – in both cases – was in sandstone rock, in which consistent analytical results are difficult to achieve because of the inherent heterogeneity of the sampling medium. Note that the latter area was re-excavated in 2002, and re-validated by sample BV13.

The above comments are generally also true of the QC results for 2001/2002 (Table T16), although the correlations, if anything appear better, and the departures from the recommended RPD ranges are less relevant. To elaborate, 11 samples were below all criteria for both primary and QC sample, and six samples were above in both primary and QC samples, with no discrepancies, although in the case of BV20, the exceedance of criteria was for different analytes.

The laboratory results from the Auditor samples taken on 11/04/2002 are compared to the primary results, below.

Table 2 Auditor QC Analyses

	TPH C_6-C_9	TPH C_{10}-C_{14}	TPH C_{15}-C_{28}	TPH C_{29}-C_{36}	Benzene	Toluene	Ethyl Benzene	Xylenes
BV42	*1000*	*1300*	*100*	*50*	*2.6*	*ND*	*22*	*88*
SS2	*2500*	*910*	*230*	*170*	*5.5*	*2.4*	*56*	*210*
RPD	***86***	*35*	***79***	***109***	***72***	*NC*	***87***	***82***
BV43	280	260	ND	ND	ND	ND	ND	ND
SS1	270	210	66	28	ND	ND	ND	ND
RPD	4	21	NC	NC	NC	NC	NC	NC
BV44	*28*	*180*	*340*	*360*	*ND*	*ND*	*ND*	*ND*
SS5	*32*	*210*	*480*	*570*	*ND*	*ND*	*ND*	*ND*
RPD	*13*	*15*	*34*	*45*	*NC*	*NC*	*NC*	*NC*
BV45	ND	30	ND	ND	ND	ND	ND	ND
SS4	ND	38	55	51	ND	ND	ND	ND
RPD	NC	24	NC	NC	NC	NC	NC	NC
BV46	*14*	*140*	*240*	*240*	*ND*	*ND*	*ND*	*ND*
SS3	*23*	*150*	*370*	*430*	*ND*	*ND*	*ND*	*ND*
RPD	*-49*	*7*	*43*	***57***	*NC*	*NC*	*NC*	*NC*

ND = Not Detected
NC = Not Calculated (RPDs have not been calculated owing to results below detection limit)

Although some RPDs are elevated, in all cases the results are of the same order, and provide the Auditor confidence that the results of the main data set are representative of site conditions.

In general, while there were some departures from the recommended RPD ranges for all QC analysis groups, the data set can be considered appropriate for characterisation of the contamination status of the site.

The limited QC results for metals in soils showed some elevated RPDs, but these were at very low concentrations and low differences in total concentration, and are therefore not considered relevant. Limited QC results for OCPs/PCBs, PAHs showed no significant variation, with only minor PAHs detectable.

Groundwater

The duplicate and triplicate QC results from the groundwater analyses (Table T20) indicate generally consistent results, although again there were some departures from recommended ranges of RPDs. The Table is also in error in listing concentrations as being in mg/kg (read µg/L), and in failing to highlight differences in RPD from BH2 March 2001, and BH4B, January, 1999.

Notwithstanding some deficiencies in the QA/QC programs adopted during the various investigations associated with the site, it is the opinion of the Auditor that the QA/QC procedures undertaken by PB and the other Consultants are sufficient to enable an assessment of the contamination status of the site to be made, particularly taking into account the level of remediation and construction earthworks completed at the site, and the fact that some off-site groundwater contamination will remain an issue requiring further consideration.

5.2.3 Sampling Methodologies

Soil Sampling
Equipment rinsate blanks were not recovered for sampling. Although this is less than ideal, for pit validation sampling, samples were generally recovered using a new disposable glove from soils not in contact with the excavation equipment. The rinsate blank therefore would have been represented by rinsate from a clean new glove. This is not considered likely to greatly compromise the data set.

Trip blanks were recovered and showed no detectable contaminants (8.4.1 of PB's report).

A review of the field procedures as documented in the PB report indicated that standard industry methodologies were applied.

Overall it is considered that there is unlikely to be any bias from cross contamination relating to sample equipment in the results of the investigation.

Water Sampling
The PB report describes the sampling methodologies and procedures undertaken during sample collection, including use of disposable bailers, and well purging/sampling. It is considered that the methods used were appropriate and in accordance with standard practice. It is noted that there is a move towards low-flow (micropurge) sampling for volatiles, however the Auditor notes that this is really only a preferred method for dedicated pumps in long-term monitoring situations, and the Auditor does not consider the use of disposable bailers to represent any deficiency in the program.

5.2.4 Groundwater Well Installation

Well installation protocols are provided in PB's Appendix I, and appear appropriate. Logs in Appendix G of the PB report indicate appropriate construction, although water levels are not shown (refer gauging data in PB fax 17/7/2003 in Appendix C of this report).

5.2.5 Field Instrumentation and Methodology

Photoionisation Detector (PID) readings of volatile organic compounds (VOCs) were taken during the soil sample collection process.

PB recorded field parameters (pH, electrical conductivity, total dissolved oxygen, redox and temperature) at the time of groundwater sampling. No reference was made as to the type of instrumentation used. Note that the readings of dissolved oxygen in 2001 are to be regarded with caution as they appear to exceed saturation levels. Otherwise the results are within expectations.

5.2.6 Auditor Conclusions

Overall, the main limitations in the field QA/QC are considered to be:

- Some minor deficiencies in the number of some duplicates/triplicates and the range of duplicate parameters analysed.
- A deficiency of equipment rinsate blanks which were not collected on a one per day basis.

The level of RPD discrepancy is not considered to significantly affect the data integrity.

Notwithstanding the above limitations, given the extent of investigations undertaken at the site, it is considered the overall quality of the data is generally acceptable for the project to reasonably represent soil contamination conditions, and the limitations are unlikely to alter the conclusions reached. Review of the analytical results of duplicate and triplicate samples undertaken indicates that there is general agreement between the two sets of soil results and an absence of systematic differences between the laboratories. These comments also apply in respect of the groundwater data.

5.3 Sample Delivery and Analysis

5.3.1 Chain of Custody

Soil and water samples were logged on Chain of Custody (COC) forms by field staff prior to shipment of samples to the various laboratories. Copies of the COC forms signed by the receiving laboratory, were included with the results found in Appendix J of the Validation Report. Not all COC forms were signed in the "Relinquished By" section (a name was printed but some signatures were missing), but COCs were dated when received by the laboratory. It is considered that the COC procedures for the samples were not perfectly adhered to but are adequate to demonstrate generally the chain of custody.

5.3.2 Laboratory Holding Times

The NEPM (1999) Schedule B(3) indicates the most stringent holding time for the selected parameters is 14 days (for organics). PB protocols are consistent with the NEPM holding times and indicates the holding time for soil samples is 6 months for metals, 28 days for Hg, 7 days for PAHs, TPH and BTEX and 14 days for pesticides. Review of the laboratory reports indicated samples were analysed within the required holding times.

5.4 Laboratory QA/QC

The primary laboratory used by PB was Amdel. The check laboratory was ALS. The laboratories are each NATA registered for all analyses undertaken. Evidence of the NATA accreditation is provided in the Laboratory Reports, presented in Appendix J of the Validation Report. The internal quality control procedures undertaken by the laboratories are discussed in the following sections.

5.4.1 Laboratory Methodology

Descriptions of the laboratory methodologies provided in the Validation Report were reviewed by the Auditor in the context of the respective laboratories current NATA accreditation data for specific parameters. Given that the laboratories results are presented on NATA endorsed certificates it is concluded that the laboratories followed their accredited procedures. It is considered that the laboratories utilised for the analyses have appropriate procedures in place to provide some confidence in the accuracy and precision of their results (notwithstanding the need for independent checking of results).

5.4.2 Laboratory QA/QC Samples

An internal QC program consists of a laboratory self assessment program independently instigated by each of the laboratories, and undertaken as part of their normal QC procedures. PB stated that all laboratory QC results (for blank, spike and laboratory duplicate analysis) were in a range considered acceptable for QA/QC purposes.

A review of the laboratory QA/QC results, presented in the Validation Report for analysis of blanks, recoveries and laboratory duplicates by the Auditor indicated:

- control blanks were below the laboratory detection limits;
- matrix spikes were within the approximate range 70 to 130% (50-130% for phenolics); and
- RPDs calculated for laboratory repeats were less than 30% (for results> 10x PQL).

The laboratory QA/QC results are satisfactory for this Audit and the precision and accuracy of the laboratory analytical results are appropriate for assessment of the contamination status of the site.

5.4.3 Laboratory Reporting

The laboratory PQLs (practical quantitation limits) were all set below the relevant assessment criteria. Laboratory certificates were all signed by a laboratory representative; described the method numbers; and contained the results of all analyses and the results of Quality Control samples as previously described.

5.4.4 Auditors Conclusions

It is concluded that the extent of internal laboratory QA/QC carried out by the laboratories employed during this investigation generally meets the requirements of the relevant EPA made or endorsed guidelines and the laboratory analytical results are considered appropriate for input to the characterisation of the site.

6 Analytical Results and Evaluation

Summary tables of soil and groundwater results, in the Validation Report have been referred to throughout this SSAR.

6.1 Soils

The samples representative of soils remaining on site, have been considered by the Auditor as:

- final validation samples as indicated on Figure 4, plus
- soil stockpile validation results in Table T3 (SP1 and SP2 series, plus S1-S5), plus
- stockpile validation samples ("landfarm") in Table T9 (understanding that the elevated concentration result soils were reserved for subsequent treatment.

Some additional samples were analysed for broad screening parameters such as OCPs/PCBs, metals, and PAHs. However it is noted that on this site it is considered well demonstrated that only TPH and BTEX have been found at concentrations of concern.

A summary of the results (which have been discussed in detail through this report) is as follows:

- All Pit wall and floor extent samples have been shown to be below the sensitive site use criteria, except two wall samples in the north part of the west wall (fronting Pittwater Road) and three samples in the northern wall fronting 620 Pittwater Road. These samples were affected by volatile TPHs including C_6-C_9 fraction concentrations up to 1500 mg/kg (acceptance criterion 65 mg/kg), and benzene up to 3 mg/kg. Other TEX compounds were also found at elevated concentrations, some above both the human health criteria and the more conservative terrestrial organism criteria. In summary, the excavation extents were clean except for the walls in the north-west corner
- Backfilled soils from the 2001/2002 excavations all met acceptance criteria.
- Backfilled soils from 1998 met BTEX and light fraction (C_6-C_9) TPH criteria, but exceeded the conservatively adopted sensitive use criteria for C_{10}-C_{40} TPHs (1,000 mg/kg). These heavy fraction TPHs were at a 95% UCL of the mean of some 1,500 mg/kg, in the large stockpile that was backfilled into the main excavation pit.

6.2 Groundwater

Laboratory results (Table T13 of PB report) indicated that concentrations of all TPH, BTEX and lead were present in BH2 and BH4A at last sampling with up to 8.7 mg/L of benzene in BH4A.

Off-site wells were shown (Table D1, Appendix E of RAP) to have elevated concentrations of TPHs including BTEX, with up to 3.6 mg/L of benzene in BH302 (refer Figure 4 of RAP). Similar concentrations of other TEX compounds were present in BH302, along with 60 µg/L of lead. Elevated TPHs, ethyl benzene and xylenes were present in BH301.

6.3 Statistics

The statistics including arithmetic mean, standard deviation, and 95% upper confidence limit (UCL for analytes detected above the limit of reporting (mercury and zinc) have been calculated for soils backfilled into the main excavation, in PB's fax of 25/7/2003 in **Appendix C** of this SSAR. Such calculation was not deemed necessary for excavation extents, as all results other than two boundary wall areas were below criteria, and it is proposed that management measures be utilised to address these areas, rather than attempt to show that the soils across all excavations comply with guidelines on a 95% UCL basis. Similarly, all soils landfarmed in 2001/2002 ultimately met acceptance criteria, so no UCL calculation is necessary.

7 Assessment of Risk

7.1 Human Receptors

Having regard for the future use of the site as commercial development with minimal opportunity for soil access, with the site either excavated for a single level basement carpark, or built from existing ground level upwards, the categories of people who have the potential to experience exposure to the soils at this site would include:

- Construction or utility workers exposed to excavations at the site, whether associated with development of the ultimate end use, or at subsequent times.
- Persons using the car park including maintenance workers.
- Maintenance workers in services where seepage water may have extended on or off-site.

7.2 Method of Risk Assessment

With regard to site soils, analytical results exceeding the nominated criteria have the potential to pose human health risks under the proposed land use. Analytical results exceeding the EILs have the potential to pose environmental risks, although these are considered of minimal relevance on site, in the context of the proposed multi-storey shop development.

In order to evaluate risks, these concentrations are compared to the relevant site specific validation criteria, as discussed in Section 3.2.

Risk from exposure to contaminants in groundwater is also qualitatively considered. The Auditor notes that quantitative assessment is particularly difficult for this site given that seepage water conditions and potential for future migration of contaminants back to the site from off-site could change conditions significantly from conditions (in terms of concentrations) as last measured or that could be measured now. That is, current conditions are of limited relevance because of the possibility that on-site pumping in the context of deep basement excavation could allow contaminants no longer on site (eg. in seepage water under Pittwater Road) to flow back to the site.

7.3 Human Health Risks

With reference to the statistics for sample results representing soils remaining at the site, the 95% UCLs of the mean concentration for TPHs in soils backfilled into the main excavation is approximately 1,500 mg/kg. This is above the nominal 1,000 mg/kg limit for TPHs in the NSW Guidelines for Assessing Service Station Sites. However, the Auditor notes a number of mitigating factors in assessing risks associated with this soil that was backfilled in 1998:

- The site is commercial, and “sensitive” site use could be considered too conservative.
- There is little data to support an aliphatic TPH criterion on a risk basis of 1,000 mg/kg.
- The criterion of 1,000 mg/kg was itself based on a combination of detection limits and the Dutch intervention level (1994) of 5,000 mg/kg.
- The NEPM sets a limit for aliphatic C_{16+} TPHs of 28,000 mg/kg (HILF). Note that PAHs were generally absent on this site, and BTEX were absent from the stockpile validation samples, so it

is reasonable in the absence of a specific speciation analysis to assume the 95% UCL of the mean concentration of some 1,500 mg/kg to be basically aliphatic compounds only.

- The TPHs found are unlikely (in the absence of BTEX, and relatively low presence of light fraction TPHs) to represent an ongoing risk to groundwater.
- Some degradation is likely to have occurred since 1998.

In the context of the above, the Auditor considers that the TPHs present in the backfilled soil, while above the nominated acceptance criteria for the site, would not compromise the proposed development. Clearly, if the soils were removed as part of basement construction, this would further eliminate the risks from those soils, although this approach would introduce other risks from groundwater (seepage water) pumping. It is noted that the backfilled soils are likely to have some odours which could cause concerns during any disturbance of soils during construction.

The Auditor considers that the soils in the excavation extents within the site boundaries do not represent an ongoing health risk to the users of the proposed commercial development, although it is noted that some odours may still be present in soils.

The Auditor notes that soils on the north-west site corner excavation walls have not been validated below criteria.

As a precaution, to prevent volatile contaminants re-entering the site and any building on it, or odours from backfilled soils entering the car park, it would be prudent to provide a membrane barrier to vapours under any floor/basement slab. A further prudent measure would be to allow for a passive venting system, consisting of slotted pipes buried in a granular fill, vented via a passive rotary cowl to the atmosphere at the building roof line.

It is noted that the PB RAP involved placing a boundary barrier at the excavation extents, but this was not carried out by PB. PB indicated verbally that they considered that as seepage water was removed and shown not to be significantly recharging groundwater, contaminant mobility was considered low and so no barrier was deemed to be required. This was not put to the Auditor before site works ceased.

The Auditor notes that PB undertook some qualitative risk assessment (for soil and groundwater – both addressed here for convenience), in which they noted the following.

- Australian Oil Industry Working Group Guidelines were used for assessment of vapour risks from soil and groundwater.
- PB concluded that soils were not a risk to on-site users, as the concentrations remaining (in NW corner wall samples) were below those relevant for soils under silty clay at 1 m depth.
- Site contamination is unlikely to but may pose a health risk to off-site maintenance workers.
- Groundwater at some 2 m depth is below the depth of likely services.

The Auditor has some reservations with some of these conclusions, as follows.

- It is known that NSW EPA does not formally endorse the Australian Oil Industry Working Group Guidelines.
- Assuming a depth of 1 m (plus) to contamination is false if a basement could be constructed.
- Services (especially sewers) can exceed 2 m depth.
- On site services could well be within seepage water depths in the context of a deep construction.
- The risk of seepage water entering a basement drainage system was not considered.

The risks that the Auditor perceives are addressed later in this report.

7.4 Ecological Risks

Excavation extents and backfilled soils were generally below EILs for analysed contaminants. As with human health risk, there is some potential for contaminants above EILs to affect microorganisms at the north-west corner.

With respect to general ecological impact, it is concluded that the presence of the carpark ground floor or basement across the site will prevent rainfall infiltration and dust, and the potential for ecological impact is accordingly considered to be highly unlikely in the context of the proposed development.

7.5 Groundwater Impacts

As noted, groundwater on-site was assessed to exceed ecosystem protection criteria, prior to excavation of all soils and removal of seepage water on the sandstone rock surface, in the north-west site corner. Off-site impact is considered likely to persist, although the removal of the primary source of the contamination (petroleum infrastructure) suggests that impacts both on and off-site will be likely to attenuate over time. Given that the concentrations were in the ppm levels for benzene in on site and nearby off-site wells, it is considered likely that there is significantly contaminated shallow seepage in the nearby off-site areas. It is possible that some of this seepage water has flowed back onto the site, or could do so in future if any basement is constructed and drainage back towards the site is encouraged by basement infiltration and pumping. This situation could lead to a build-up of vapours in an on-site building even if groundwater currently on the site was shown to be clean with respect to assessment criteria. Only if all nearby groundwater impact (both on and off-site) was shown to be absent, could this concern be considered no longer relevant.

Groundwater was shown in some on and nearby off-site wells also to include lead at concentrations that could affect surface water ecosystems.

Groundwater (shallow seepage water) in nearby areas has not been demonstrated to be below all relevant acceptance criteria. Because of this, there is some potential for off-site Significant Risk of Harm, and Mobil should give consideration to discussing this potential with NSW EPA.

7.6 Aesthetic Impacts

Aesthetic impacts principally comprise visual and odour impacts. Whilst staining is likely to be limited, odours are likely in soils remaining on site if they are disturbed.

7.7 Auditor's Opinion

Overall the site through the remediation carried out and construction related excavations is considered not to present a risk to the environment or human receptors in terms of either soil or groundwater, for the proposed development, given some minor management precautions are adopted. The exception is that contamination that has spread off-site in groundwater has not been delineated or proved to have reduced to acceptance criteria and could pose an off-site risk.

The site itself is considered suitable for commercial redevelopment as planned, however, in order to ensure that minor risks from residual groundwater contamination and odours on site do not pose any concerns for the site redevelopment the some measures are recommended. These are detailed in the conclusions of this report and in the Statement.

8 Compliance with Regulatory Guidelines and Directions

The Auditor has reviewed the contents of the PB report and correspondence with respect to the requirements of relevant NSW EPA guidelines, and particularly the *Guidelines for Consultants Reporting on Contaminated Sites* (1997) and *Guidelines for the Site Auditor Scheme* (1998). Discussions of completeness of the various aspects of the investigation, assessment and reporting have been noted in the preceding sections of this SSAR. The Auditor considers that overall the report generally complies with the *Guidelines for Consultants Reporting on Contaminated Sites* and the other guidelines made or endorsed by the NSW EPA, albeit with noted deficiencies or differences of opinion, as has been discussed in this SSAR. Further PB's conclusion that the site is suitable for it's proposed commercial use, is generally consistent with use of the Decision Process for Assessing Urban Redevelopment Sites from the *Guidelines for the Site Auditor Scheme* (1998), although the Auditor has noted some prudent conditions that should be considered.

9 Conclusions

The Auditor has been engaged to undertake an independent review of the investigations completed at 612 Pittwater Road, Brookvale NSW under s.47(1) (b)(i), (ii) and (iii) of the CLM Act 1997 to determine the nature and extent of any contamination on the land, the nature and extent of the investigations and remediation, and what investigation or remediation remains necessary before the land is suitable for the proposed land use as commercial development.

Conclusions of the Site Audit are as follows:

1. The studies conducted by PB (2003) (including review of previous work by Handex) were assessed by the Auditor as being generally adequate to determine the contamination status of the site, and generally followed the NSW EPA 1997 publication *Guidelines for Consultants Reporting on Contaminated Sites.*
2. It is considered that the investigations undertaken at the site represent a generally adequate and appropriate assessment of the contaminant conditions at the site.
3. Soil and groundwater was assessed against relevant investigation levels.
4. The overall sampling frequency is considered acceptable and the analytical parameters are considered to be sufficient to characterise the soil and groundwater at the site.
5. Due to the extent of excavations conducted on the site during its redevelopment, any previously impacted soil has been treated before re-use, with imported soil also incorporated to fill cavities on site. Some backfilled soils are present above the nominated acceptance criteria, a fact overlooked by PB. However, the Auditor considers that these soils (with slightly elevated C_{10}-C_{40} TPHs) do not represent a significant health risk. Accordingly the soils within the site do not constitute an unacceptable human health or environmental risk. Soils at the site boundary have the potential to cause some risk and odour, and management measures to deal with these issues are suggested. The site is therefore considered suitable for the nominated use as a commercial development, (see Site Audit Statement for the permitted use).
6. The groundwater data reviewed in this report indicate that the previously reported elevated concentrations of BTEX, lead and TPH are likely to continue to be present in nearby off-site areas, albeit that some attenuation may have occurred since the last sampling of off-site wells. Use of the seepage water for any extractive use is considered highly unlikely, based on discussion with DSNR, records of groundwater use in the area, and site observations. Observations that indicated that the seepage water was of very limited extent (as shown in site photographs) suggest that extractive use is unlikely. However, the potential for migration of contaminants in seepage water back to the site, in periods of high rainfall, especially if there is any basement dewatering on-site, cannot be discounted, and so management measures are suggested to mitigate these risks.
7. Aesthetic impact is likely to be limited to the re-used landfarmed material, and the excavation extents in the north-west site corner.

Based on the audit conducted and the decision process for assessing urban redevelopment sites outlined in *Guidelines for the NSW Site Auditor Scheme* (1998), it is concluded that the site is suitable for commercial development with a bottom level car park subject to conditions as follows:

- Groundwater should not be used on site without assessment for the particular use.
- The bottom level car park should ideally be built from ground level up, to avoid causing a basement level below periodic seepage level, because any pumping in such conditions could cause any nearby contaminants to flow back towards the site. This condition could be avoided if

all nearby seepage water impact could be shown to have attenuated and detailed risk assessment could show residual levels in groundwater on and near the site to not represent an unacceptable risk. This however may be practically impossible, as wells in Pittwater Road are as the Auditor understands it unable to be permitted.

- If a car park is built below ground level such that seepage water could (without dewatering) enter the building basement, there should be a dewatering system designed such that seepage water in any weather conditions is prevented from entering the basement or any service pits or pipelines. This would require a pumping system which a competent professional would need to design. Any water that was disposed from such a pumping system would need to be checked for compliance to be disposed to stormwater or sewer, and appropriate approvals obtained before any such operation was undertaken. If contaminated, such water may require treatment prior to disposal.
- In either of the above cases, it would be considered prudent to incorporate a combination of a membrane or vapour proof geofabric below the lower building slab, and a passive venting system to allow any vapours/odorous air to escape slowly to atmosphere rather than potentially build up in a confined air space within the car park. This system would conservatively extend over the northern part of the site above former seepage water impact and areas likely to contain backfilled odorous soils.

The Site Audit Statement should be read in conjunction with this Summary Site Audit Report.

10 References

Note Appendicised reports are listed in Table of Contents

ANZECC (1992) Australian Water Quality Guidelines for Fresh and Marine Waters. Australian and New Zealand Environment & Conservation Council.

ANZECC & ARMCANZ (2000) Australia and New Zealand Guidelines for Fresh and Marine Water Quality.

NEPC (1999) National Environment Protection (Assessment Site Contamination) Measure Groundwater Investigation Levels.

NHMRC & ARMCANZ 1996 Australian Drinking Water Guidelines. National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand

NSW EPA (1999) Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes.

NSW EPA (1995) Sampling Design Guidelines. ISBN 0-7310-3756-1.

NSW EPA (1997) Guidelines for Consultants Reporting on Contaminated Sites. ISBN 0-7310-3892-4.

NSW EPA (1994) Guidelines for Assessing Service Station Sites. ISBN 0-7310-3712-X.

NSW EPA (1998) Guidelines for the NSW Site Auditor Scheme. ISBN°0-7313 0177 3

Standards Australia (1997). Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1. Non volatile and Semi-volatile Compounds. AS 4482.1-1997.

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Statement of Uncertainties

This report represents a review of data and information (together, "Information") relating to the subject property of this report. The Information was obtained not by the Auditor and IT Environmental but from other sources and contacts, some of whom may be noted in the report. The Auditor has conducted reasonable checks as to the adequacy of the information provided, and is satisfied that it is suitable for that purpose of auditing. However the Auditor notes that inherent in any assessment approach (and audits that rely on such assessments) is the fact that information is based on a number of "spot" tests, and that conditions may vary between those locations.

The analyses, evaluations, opinions and conclusions presented in this report are based on the Information provided, and they could change if the Information is in fact found to be unrepresentative of conditions between sampling and analysis locations.

The Site Auditor and IT Environmental will not update the report and has not taken into account events occurring after the time its review was conducted.

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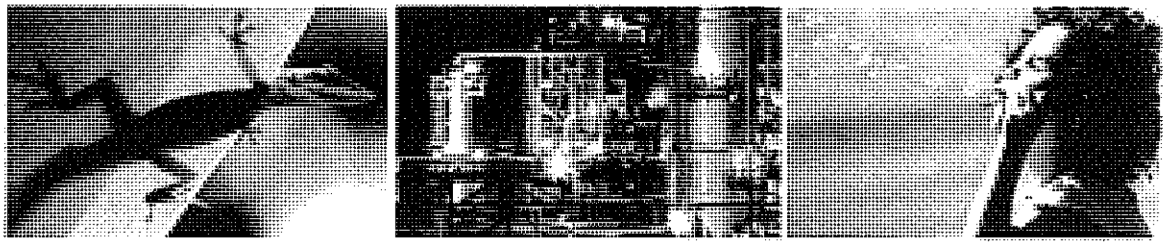
Enclosure E

Environ Australia Site Audit Report



Site Audit Report
Site Audit Report - 620 Pittwater Road, Brookvale, NSW

Prepared for:

Mobil Oil Australia Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

Date:
November 2013

Project Number:
AS121114

Audit Number:
GN 440

ENVIRON

NSW Site Auditor Scheme
SITE AUDIT STATEMENT

NSW EPA

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the* Contaminated Land Management Act 1997 *on 31st October 2012. For more information about completing this form, go to Part IV.

PART I: Site audit identification

Site audit statement no. GN 440

This site audit is a ~~**statutory audit**~~**/non-statutory audit*** within the meaning of the *Contaminated Land Management Act 1997.*

Site auditor details (as accredited under the *Contaminated Land Management Act 1997)*

Name:	Graeme Nyland	Company:	ENVIRON Australia Pty Ltd
Address:	Level 3, 100 Pacific Highway (PO Box 560)		
	North Sydney NSW	Postcode:	2060
Phone:	02 9954 8100	Fax:	02 9954 8150

Site details

Address: 620 Pittwater Road, Brookvale NSW

Postcode: 2100

Property description *(attach a list if several properties are included in the site audit)*

Part of Lot 1 DP 500541

Local Government Area: Warringah

Area of site (e.g. hectares): 529.1 m^2 Current zoning: F2 Brookvale Service Centre

To the best of my knowledge, the site ~~**is**~~**/is not*** the subject of a declaration, order, agreement or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985.*

Declaration/Order/Agreement/Proposal/Notice* no(s): NA

***Strike out as appropriate**

Site audit commissioned by

Name: Nikki Maksimovic

Company: Mobil Oil Australia

Address: PO Box 1141 Camden NSW

Postcode: 2570

Phone: 4636 6654

Fax: 4636 6659

Name and phone number of contact person (if different from above)

NA

Purpose of site audit

~~☐ A. To determine land use suitability *(please specify intended use[s])*~~

~~OR~~

☑ B(i) To determine the nature and extent of contamination, and/~~or~~

☑ B(ii) To determine the appropriateness of an **investigation/remedial action/~~management plan~~***, ~~and/or~~

~~☐ B(iii) To determine if the land can be made suitable for a particular use or uses by implementation of a specified **remedial action plan/management plan*** *(please specify intended use[s])*~~

....

....

Information sources for site audit

Consultancy(ies) which conducted the site investigation(s) and/or remediation

- Handex Australia Pty Ltd
- Parsons Brinkerhoff Pty Ltd

Title(s) of report(s) reviewed:

- "Limited Environmental Site Assessment – 620 Pittwater Road, Brookvale, NSW, Site No. No0263" dated 8 December 1998 by Handex.
- 'Groundwater Monitoring Event August 2009 – 620 Pittwater Road, Brookvale, NSW' dated January 2010, Parsons Brinkerhoff .
- 'Post Phase 2 Environmental Site Assessment – 620 Pittwater Road, Brookvale, NSW', dated August 2010, Parsons Brinkerhoff .
- 'Groundwater Monitoring Event March 2010 – 620 Pittwater Road, Brookvale, NSW' dated August 2010, Parsons Brinkerhoff .
- 'Soil Validation Report, 620 Pittwater Road, Brookvale, NSW 2100' dated February 2011, Parsons Brinkerhoff.
- 'Soil Vapour Intrusion Assessment, 620 Pittwater Road, Brookvale, NSW', dated February 2011, Parsons Brinkerhoff .
- 'Site Risk Management Plan, 620 Pittwater Road, Brookvale, NSW', dated March 2011, Parsons Brinkerhoff .

**Strike out as appropriate*

- 'Environmental Report, 620 Pittwater Road, Brookvale, NSW', dated March 2011, Parsons Brinkerhoff .
- 'Additional Onsite Human Health Risk Assessment Advice – 620 Pittwater Road, Brookvale NSW', dated September 2011, Parsons Brinkerhoff.
- 'Onsite Human Health Risk Assessment – 620 Pittwater Road, Brookvale NSW' dated June 2012, Parsons Brinkerhoff.
- 'Environmental Report 620 Pittwater Road, Brookvale NSW' Parsons Brinkerhoff, dated June 2012.
- Letter Addendum to 'Onsite Human Health Risk Assessment Report, June 2012' dated 1 July 2013 by Parsons Brinkerhoff.

Other information reviewed (including previous site audit reports and statements relating to the site)

- NA

Site audit report

Title: Site Audit Report – 620 Pittwater Road, Brookvale NSW

Report no. GN 440 (ENVIRON Ref: AS121114) Date: November 2013

Strike out as appropriate

PART II: Auditor's findings

Please complete either Section A or Section B, **not** both. *(Strike out the irrelevant section.)*

Use Section A where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land use(s).

Use Section B where the audit is to determine the nature and extent of contamination and/or the appropriateness of an investigation or remedial action or management plan and/or whether the site can be made suitable for a specified land use or uses subject to the successful implementation of a remedial action or management plan.

~~Section A~~

~~☐ **I certify that, in my opinion, the site is SUITABLE for the following use(s)** *(tick all appropriate uses and strike out those not applicable)*:~~

- ~~☐ Residential, including substantial vegetable garden and poultry~~
- ~~☐ Residential, including substantial vegetable garden, excluding poultry~~
- ~~☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ~~☐ Day care centre, preschool, primary school~~
- ~~☐ Residential with minimal opportunity for soil access, including units~~
- ~~☐ Secondary school~~
- ~~☐ Park, recreational open space, playing field~~
- ~~☐ Commercial/industrial~~
- ~~☐ Other *(please specify)* ....~~

~~**subject to compliance with the following environmental management plan** *(insert title, date and author of plan)* **in light of contamination remaining on the site:**~~

~~**OR**~~

~~☐ **I certify that, in my opinion, the site is NOT SUITABLE for any use due to the risk of harm from contamination.**~~

Overall comments:

Section B

Purpose of the plan[1] which is the subject of the audit is to investigate and remediate hydrocarbon contamination sourced from the adjacent former service station to the south.

I certify that, in my opinion:

☑ **the nature and extent of the contamination HAS/~~HAS NOT~~* been appropriately determined**

AND/~~OR~~

☑ **the investigation/remedial action plan/~~management~~ plan* IS/~~IS NOT~~* appropriate for the purpose stated above**

~~**AND/OR**~~

☐ ~~**the site CAN BE MADE SUITABLE for the following uses** *(tick all appropriate uses and strike out those not applicable)*:~~

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
- ☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ☐ ~~Day care centre, preschool, primary school~~
- ☐ ~~Residential with minimal opportunity for soil access, including units~~
- ☐ ~~Secondary school~~
- ☐ ~~Park, recreational open space, playing field~~
- ☐ ~~Commercial/industrial~~
- ☐ ~~Other *(please specify)*~~ ………………………………………………………………………

~~**if the site is remediated/managed* in accordance with the following remedial action plan/management plan*** *(insert title, date and author of plan)*~~

~~...~~

~~**subject to compliance with the following condition(s):**~~

...

---

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

***** ***Strike out as appropriate***

Overall comments

The site is part of a property formerly used for residential purposes that is adjacent to a former service station. Petroleum hydrocarbons emanating from the service station moved onto the western portion of the property. The extent of hydrocarbon contamination was investigated and remediated by excavation and offsite disposal. The Auditor considers that the hydrocarbon contamination has been remediated to the extent practicable and that the site has been remediated to a standard suitable for commercial / industrial land use with respect to petroleum hydrocarbons. Some minor residual contamination remains mainly near the surface of weathered rock at depth and odours and/or staining may be encountered during excavations at the site.

PART III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority under the *Contaminated Land Management Act 1997* (Accreditation No. 9808).

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997*, and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed...

Date... 18|11|2013

Enclosure F

Parsons Brinckerhoff Remedial Action Plan

NSW Health Infrastructure

Remediation Action Plan for Community Health Centre, 612–624 Pittwater Road, Brookvale NSW

13 October 2015

PARSONS
BRINCKERHOFF

Document information

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Author, Reviewer and Approver details

Prepared by:	Beejal Patel	Date: 13/10/2015	Signature:
Reviewed by:	Louise Walkden	Date: 13/10/2015	Signature:
Approved by:	Louise Walkden	Date: 13/10/2015	Signature:

Distribution

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A GRI Rating: Sustainability Report 2011

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Abbreviations

ASS	Acid Sulfate Soils
AST	Above ground storage tank
ANZECC	Australian & New Zealand Environment & Conservation Council
B[a]P	Benzo [a] pyrene (a PAH compound)
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
C_6–C_9	Light hydrocarbon chain groups (for example, petrol)
C_{10}–C_{14}	Medium hydrocarbon chain groups (for example, kerosene)
C_{15}–C_{28}	Heavy hydrocarbon chain groups (for example, diesel)
C_{29}–C_{36}	Heavy hydrocarbon chain groups (for example, lube oil)
DECCEW	Department of Climate Change, Energy and Water
Eh	Redox potential measured in mV
<1, <100	Less than the PQL, that is, less than 1 or 100 units
KDR	Knockdown and rebuild
LEL	Lower explosion limit. The lower limit (of vapour and oxygen) that explosive vapours occur for a particular compound
LOQ	Limit of quantitation (also see LOR or PQL) – of chemical concentrations attainable from laboratory analysis
LOR	Limit of Reporting
LPG	Liquefied petroleum gas
m BGL	Metres below ground level
mg/kg	Milligram per kilogram (or part per million)
mg/L	Milligram per litre (or part per million)
ND (nd)	Not detected above the LOQ or PQL
NHMRC	National Health & Medical Research Council
OCP	Organochlorine Pesticides
OPP	Organophosphorous Pesticides
PAH	Polycyclic Aromatic Hydrocarbon
%RPD	Relative per cent difference
PID	Photoionisation detector
ppm	Part per million
PQL	Practical Quantitation Limit (of chemical concentration)
PSH	Phase Separated Hydrocarbons, liquid petroleum products usually detected on the groundwater table. Also known as Free Product or Separate Phase (also see apparent thickness)
TDS	Total dissolved solids, a measure of salinity
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
µg/L	Microgram per litre (or part per billion)
µS/cm	MicroSiemens per centimetre a measure of conductivity and salinity
UCL	Upper confidence limit of data set
UPSS	Underground petroleum storage system
UST	Underground Storage Tank
VOC	Volatile Organic Compound

Executive summary

Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) was commissioned by NSW Health Infrastructure (HI) to prepare a Remediation Action Plan (RAP) for the removal of an underground storage tank (UST) located at 612 – 624 Pittwater Road, Brookvale (the site).

Parsons Brinckerhoff understands that Health Infrastructure intend to develop the site into a new community health centre, as a part of the Northern Beaches Health Services Redevelopment. The site has a total area of approximately 5,400 m^2 and comprises the following:

- Number 612, comprising Lot A, Lot B and Lot C of deposit plan (DP) 375728, historically used as a service station and currently vacant
- Number 620, comprising Lot 1, DP 500541, historically used as a residence, and currently unused
- Number 624, comprising Lot 3 DP 539384, historically and currently used for commercial and light industrial activities

Prior to development, Health Infrastructure intend on removing the following infrastructure which will include the following:

- Removal of aboveground residential infrastructure (single storey dwelling) at number 620, Lot 1, DP 500541
- Removal of aboveground commercial infrastructure at number 624, Lot 3 DP 539384
- Removal of the UST present in the north-east portion of number 624, Lot 3 DP 539384, the UST has a total volume of 11,900 L

The current design for the proposed Community Health Facility consists of four levels of suspended post tensioned walls with a ground bearing slab. The lower ground floor at the northern end is proposed to be suspended.

The objective of this RAP is to provide a framework for the work practices and environmental management techniques and to outline soil characterisation procedures to be implemented during the tank removal works.

Following removal of site infrastructure soils at the site will be characterised in accordance with relevant guidelines. Material excavated as a result of the removal of UST will be assessed against the nominated site assessment criteria for its suitability to be re-used on-site. If the excavated material is contaminated, i.e. concentrations greater than the adopted site assessment criteria, remediation options will be considered to reduce contaminant concentrations, or assess any potential ongoing risk associated with the material (i.e. comparison to vapour or direct contact HSLs). If some material is significantly contaminated, it may be necessary to dispose off-site to a licensed landfill facility.

Additional investigations targeting building footprints onsite are anticipated, the results of which may identify the requirement for further remediation. In the event of the requirement for further remediation, this RAP will be updated.

Following validation of the tank pit and soils under the existing site buildings, a validation report will be prepared for submission to the Council. The purpose of the validation report is to document the procedures and results of the UST removal and soil validation works.

1. Introduction

1.1 Purpose

Parsons Brinckerhoff Australia Pty Ltd (Parsons Brinckerhoff) was commissioned by NSW Health Infrastructure (HI) to prepare a Remediation Action Plan (RAP) for the removal of an underground storage tank (UST) located at 612 – 624 Pittwater Road, Brookvale (the site).

Parsons Brinckerhoff understands that Health Infrastructure intend to develop the site into a new community health centre, as a part of the Northern Beaches Health Services Redevelopment. The site has a total area of approximately 5,400 m^2 and comprises the following:

- Number 612 Pittwater Road, comprising Lot A, Lot B and Lot C of deposit plan (DP) 375728, historically used as a service station and currently vacant
- Number 620 Pittwater Road, comprising Lot 1, DP 500541, historically used as a residence, and currently unused
- Number 624 Pittwater Road, comprising Lot 3 DP 539384, historically and currently used for commercial and light industrial activities

1.2 Proposed development

Prior to development, Health Infrastructure intend on removing the following infrastructure:

- Removal of aboveground residential infrastructure (single storey dwelling) at number 620, Lot 1, DP 500541
- Removal of aboveground commercial infrastructure at number 624, Lot 3 DP 539384
- Removal of the UST present in the north-east portion of number 624, Lot 3 DP 539384, the UST has a total volume of 11,900 L

The current design for the proposed Community Health Facility consists of four levels of suspended post tensioned walls with a ground bearing slab. The lower ground floor at the northern end is proposed to be suspended.

A plan of the existing site layout, showing the approximate location of the existing UST and monitoring wells is provided as Figure 1, Appendix A.

1.3 Objectives

The objective of this RAP is to provide a framework for the work practices and environmental management techniques, and to outline soil characterisation procedures, to be implemented during the tank removal works.

1.4 Scope of RAP

The RAP includes:

- a summary of the site conditions and surrounding environment
- a summary of the contamination status of the site
- assessment of data gaps that may require further investigation
- identification of remediation goals associated with tank removal works
- outline the validation requirements
- site management issues
- contingency management

1.5 Technical framework

The RAP was completed in general accordance with:

- ANZECC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites
- *Contaminated Land Management Act 1997*
- National Occupational Health and Safety Commission (NOHSC) 1995, *Exposure Standards for Atmospheric Contaminants in the Occupational Environment*
- NSW Environmental Protection Agency (NSW EPA) 2014, *Technical Note: Investigation of Service Station Sites*.
- NSW EPA 1997, *Guidelines for Consultants Reporting on Contaminated Sites*.
- NSW Department of Environment, Climate Change and Water (NSW DECCW) 2008, *Guidelines for implementing the Protection of the Environment Operations (Underground Petroleum Storage systems) Regulation*.
- NSW DECCW 2009, *Guidelines on the duty to report contamination under the Contaminated Land Management Act 1997*.
- NSW Department of Urban Affairs and Planning (NSW DUAP) 1998, *Managing Land Contamination Planning Guidelines: State Environmental Planning Policy No. 55 – Remediation of Land*.
- *National Environment Protection (Assessment of Site Contamination) Measures 1999* (NEPM; as amended 2013).
- *Protection of the Environment Operations Act 1997* (POEO Act).
- *Protection of the Environment (Underground Petroleum Storage Systems) Regulation 2014* (UPSS Regulation).
- *State Environmental Planning Policy No 55—Remediation of Land* (SEPP55).
- NSW EPA 2014, *Waste Classification Guidelines – Part 1: Classifying Waste*.
- *Work Health and Safety Act* (2011).

2. Site setting

2.1 General information

General site information is provided in Table 2.1.

Table 2.1 General site identification details

Site address	612 – 624 Pittwater Road, Brookvale, 2100
Lot and DP	Lot 1 of DP 500541, Lot A, Lot B and Lot C of DP 375728, Lot 3 of DP 539384
Property owner	NSW Health Infrastructure
Area (total of three lots)	5,400 m^2
Current site use	The site is currently vacant. Historically, number 612 was used as a service station, number 620 was used as a residence, and number 624 was used for commercial and light industrial purposes.
Proposed future site use	Commercial/industrial (health facility).

2.2 Site description

2.2.1 Number 612

Number 612 (Lot A, Lot B and Lot C of DP 375728) is rectangular in shape and bordered by William Street to the south, Pittwater Road to the west and number 620 to the north. It was historically used as a service station containing seven USTs and additional fuel infrastructure. The aboveground infrastructure and fuel infrastructure was removed in 1999 and the site was validated in 2000 (PPK, 2003a), residual contamination was reported in soil at the northern boundary of the site. Material removed from the excavations was land farmed and used to backfill excavations on the site.

Currently, number 612 comprises uneven concrete hardstand with stockpiles of miscellaneous building materials.

2.2.2 Number 620

Number 620 (Lot 1, DP 500541) historically comprised an occupied residential property and is bordered by number 624 to the north, 612 to the south and Pittwater Road to the west. The premise is currently unoccupied and is rectangular in shape. The site is occupied by an abandoned residential property located in the western portion of the site, and a shed located in the north-eastern corner of the site. The remainder of the property comprises unevenly grassed and bare land. Medium dense vegetation is south of the shed.

2.2.3 Number 624

Number 624 (Lot 3 DP 539384) is currently occupied by commercial premises and bounded by commercial land to the north and east, number 620 to the south and Pittwater Road to the west.

Number 624 is irregular in shape and comprises a one story commercial building, the remainder of the site is concrete hardstand and utilised as a car park.

A UST is located beneath concrete hardstand at the north-eastern portion with a capacity to contain 11,900 L of unknown product and is currently considered to be abandoned.

Information relating to abandoned UST comes from SMEC (2014), and a detailed site survey conducted in June 2014 by Bee and Lethbridge Pty Ltd. The approximate location of UST is shown on Figure 1, Appendix A.

2.3 Surrounding land uses

Neighbouring land uses at the time of the last site visit were:

- to the north – commercial properties
- to the south – William Street and residential properties beyond
- to the east – Pittwater Road then Warringah Road
- to the west –commercial properties.

2.4 Sensitive human and environmental receptors

Potential sensitive human and environmental receptors include:

- Residential properties to the south of the site, across William Street
- Brookvale Creek located approximately 1.3 km to the south
- Groundwater last identified approximately 0.4 mBGL below the site

2.5 Topography

The site slopes down to the north towards number 620 and remains relatively flat across number 620 and number 624. The site elevation is between 12 and 14 metres Australian Height Datum (m AHD).

2.6 Geology

The 1:100,000 Sydney Geological Series Sheet 9130 (Geological Survey of NSW Department of Minerals and Energy, Edition 1, 1983) indicates that the site is underlain by Hawkesbury Sandstone comprising well sorted, medium grained arenitic quartz sandstone

The geology encountered onsite during previous investigations (SMEC 2014) is summarised in Table 2.3.

Table 2.2 Site Geology

Depth (mbgl)	Lithology encountered
Surface –0.2	Concrete, asphalt

Surface – depths between 0.3 and 3.3	FILL: brown sandy gravel, sandy gravel and clayey sand. Fill is present to depths of 3.3 m in areas previously excavated during tank removal works on site No. 612.
0.3 to 3.6	Clayey SAND, Sandy CLAY: grey/brown/light grey/red
2.8 to 7.0	SANDSTONE: red/brown/white, weathered and firm

2.7 Groundwater

Previous investigations, discussed in Section 3 of this report, indicate that the regional groundwater is shallow (identified between 0.4 and 0.8 mBGL).

A search of the Department of Natural Resources (DNR) licensed borehole register on 09 October 2015 (http://www.waterinfo.nsw.gov.au/gw/) indicated that there were five registered groundwater bores within a 500 m radius of the site.

Table 2.3 provides a summary of the information for the licensed bores and their locations.

Table 2.3 Groundwater database summary

Bore ID	Owner and use	Distance and direction from site	Screen depth (m)	SWL mBTOC	Total depth (m)	TDS (mg/L)
GW114515	Monitoring	150 (NE)	1-4	NL	4	NL
GW114516	Monitoring	150 (NE)	1-4	NL	4	NL
GW114517	Monitoring	150 (NE)	0.5-3.5	NL	3.5	NL
GW107745	Domestic	180 (SE)	11-12	9	12	NL
GW108944	Domestic	400 (W)	NL	NL	NL	NL

(1) SWL	Standing water level
(2) TDS	Total dissolved solids
(3) NL	Not listed

2.8 Acid sulfate soils

Acid sulfate soils (ASS) are acidic soil horizons or layers resulting from the aeration of soil materials that are rich in iron sulfides, primarily pyrite (FeS2). They are generally likely to be present in:

- marine and estuarine sediments of the recent (Holocene) geological age
- soils usually not more than five metres above sea level
- marine or estuarine settings.

Reference to the Acid Sulfate Soil Risk Map from the CSIRO Australian Soil Resource Information System (ASRIS) online available http://www.asris.csiro.au/index_ie.html (accessed on 09 October 2015) indicates an extremely low probability of occurrence/very low confidence for acid sulfate soils in the study area.

The 1:25,000 Sydney Sydney Heads Acid Sulfate Soil Risk Map (Land, Water and Conservation, Edition 2, 1997) identifies the northern portion of the site to be located in an area with a low probability occurrence of acid sulfate soils, the remainder of the site has no known occurrence.

The acid sulfate soil (ASS) map reported under the *Warringah local environmental plan* (LEP) (2011) identifies the general north-eastern portion of the sites as being Class 4 ASS which is the second lowest ASS risk classification. Clause 6.1 of the LEP (2011) specifies that for Class 4 soils, development consent is required only for works more than 2 metres below the natural ground surface (likely for the development), or for works by which the water table is likely to be lowered more than 2 metres below the natural ground surface (unlikely for the development).

The presence of acid sulfate soils have not been investigated historically during soil investigations at the site. Field investigations will be completed by Parsons Brinckerhoff to determine the extent and presence of acid sulfate soils at the site following the removal of remaining onsite structures.

3. Previous environmental investigations

A number of historic investigations have been completed to characterise the extent of contamination in soil, groundwater and soil vapour at the site. The reports documenting this work are:

- SMEC 2014a, *Brookvale Community Health Centre Planning and Environmental Constraints Due Diligence Assessment*.
- SMEC 2014b, *Summary Of Findings Associated With New Supporting Environmental Information.*
- SMEC 2014c, *Targeted Environmental Site Assessment 612–624 Pittwater Road, Brookvale NSW.*
- SMEC 2014d, *Contamination Condition Review 614 – 624 Pittwater Road, Brookvale.*
- SMEC 2014e, *Summary of Preliminary Environmental Investigation and Review for 612-624 Pittwater Road, Brookvale*.
- SMEC 2014f, *Summary of Environmental Investigations and Findings for 612-624 Pittwater Road, Brookvale*.
- Solutions Engineering 2014g, *Asbestos Register 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100.*
- Solutions Engineering 2014h, *Asbestos management Plan 2014, the Owners Corporation for 612-624 Pittwater Road, Brookvale, NSW, 2100.*
- Handex Australia Pty Ltd (Handex) 1998, *Limited Environmental Site Assessment – 620 Pittwater Road, Brookvale NSW, Site No. No0263*
- PPK Environment and Infrastructure Pty Ltd (PPK, now Parsons Brinckerhoff) 1999, *Limited Environmental Site Assessment for 620 Pittwater Road, Brookvale NSW (lot adjacent to former Mobil Service Station).*
- PPK 2000a, *Remedial Action Plan, Former Mobil Service Station and Adjoining Properties, Cnr Williams and Pittwater Roads, Brookvale.*
- PPK 2003a, *Site Remediation and Validation Report, Former Service Station, Corner William Street and Pittwater Road, Brookvale, NSW (Site No. No0263.)*
- IT Environmental (Australia) Pty Ltd 2003b, *Summary Site Audit Report Former Mobil Service Station 612 Pittwater Road Brookvale NSW*
- Parsons Brinckerhoff 2010a, *Groundwater Monitoring Event August 2009 – 620 Pittwater Road, Brookvale NSW.*
- Parsons Brinckerhoff 2010b, *Post Phase 2 ESA – 620 Pittwater Rd, Brookvale, NSW*
- Parsons Brinckerhoff 2010c, *Groundwater Monitoring Event March 2010 – 620 Pittwater Road, Brookvale NSW.*
- Parsons Brinckerhoff 2011a, *Soil Validation Report 620 Pittwater Rd Brookvale, NSW 2100.*
- Parsons Brinckerhoff 2011b*, Soil Vapour Intrusion Assessment, 620 Pittwater Road, Brookvale NSW.*

- Parsons Brinckerhoff 2012a, *Site Risk Management Plan, 620 Pittwater Road, Brookvale, NSW*
- Parsons Brinckerhoff 2012b, *Environmental Report, 620 Pittwater Road, Brookvale, NSW, dated June 2012.*
- Parsons Brinckerhoff 2012c, *On site Human Health Risk Assessment - 620 Pittwater Road, Brookvale, NSW.*
- Parsons Brinckerhoff 2013a, *Letter Addendum to 'On site Human Health Risk Assessment Report, June 2012* .
- Environ Australia Pty Ltd 2013b, *Site Audit Report – 620 Pittwater Road, Brookvale NSW.*

A detailed review of the reports listed above was conducted to characterise the status of contamination at the site and define existing data gaps prior to preparing a remediation design. The report is referenced as Parsons Brinckerhoff 2015, *Review of historical reports and data gap analysis for a Community Health Centre at Brookvale, NSW* (Referenced: ENV-LTR-0990).

A number of recommendations were provided as a part of the data gap review including the requirement for further investigations to ensure the site is suitable for its future use as health facility. To date, Parsons Brinckerhoff have completed a wet weather and dry weather groundwater monitoring event (GME) referenced Parsons Brinckerhoff 2015, *Groundwater Monitoring Event (May 2015) - 612–624 Pittwater Road, Brookvale NSW* (Referenced: 2201675A-RES-LTR-0841). The GME identified the requirement for a soil vapour assessment targeting known areas of soil impacted by hydrocarbon contamination. The soil vapour assessment, referenced Parsons Brinckerhoff 2015, *Soil Vapour Monitoring Event (June 2015) - 612–624 Pittwater Road, Brookvale NSW* (Referenced: 2201675A-ENV-LTR-1031) has been completed, however further assessment is required at remaining portions of the site.

A summary of the current status of the site and remaining areas requiring investigation is as follows:

- Number 612 was historically used as a Mobil service station containing seven underground storage tanks (USTs) and associated fuel infrastructure. The fuel infrastructure was removed in 1999 and the site was validated in 2000 (PPK, 2003a). Residual contamination was reported in soil at the northern boundary of the site. Concentrations of contaminants of concern in soil samples collected from the excavated material were reported below the adopted assessment criteria for re-use on site and the soil removed from the excavations was land farmed and backfilled on site. The concentrations of hydrocarbons in these historic soil samples were recently compared to the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM, as amended 2013) applicable health screening levels (HSLs) and TRH exceedances were identified in a number of samples.
- Residual hydrocarbon contamination was historically identified in soil at number 620. Number 620 was remediated and validated to the extent practical in 2011; however, residual contamination was reported in soil at depths ranging from 2.7 mBGL to 3.0 mBGL on excavation surfaces in the western portion of number 620. Excavation was undertaken up to the western site boundary and the boundary of the onsite house structure, no further excavation was possible due to the risk of undermining the roadway and the house.
- Investigations conducted by SMEC in 2014 of the entire site detected concentrations of contaminants of concern in soil and groundwater contamination at the western boundary of number 620 above the applicable criteria for commercial/industrial use which was consistent with the contamination discussed above.
- Five groundwater monitoring wells were previously installed at the site by SMEC.
- A groundwater monitoring event was conducted for four accessible wells at the entire site by Parsons Brinckerhoff in May 2015. The investigation identified hydrocarbon contaminants at elevated levels in a monitoring well (MW2) located at the western boundary of number 620. The NEPM (2013) HSL criteria could not be applied as the guidance is only intended for groundwater

depths greater than 2 m below ground level. A soil vapour assessment was recommended to assess the potential vapour intrusion risk that could result from the elevated groundwater concentrations.

- The soil vapour assessment was conducted by Parsons Brinckerhoff in June 2015 and targeted the residual soil and groundwater contamination at the western boundary of number 620 and the areas of historically backfilled land farmed soil at number 612. The investigation identified vapour concentrations below the applicable HSLs for commercial use. It was concluded that there were no unacceptable vapour intrusion risks to potential users of the community health facility from the residual concentrations of contaminants of concern remaining in portions of the site where exceedances of assessment criteria had previously been detected.
- Solutions Engineering completed an asbestos register for structures on-site in 2014 and identified asbestos in most structures onsite. This was followed by the preparation of an asbestos management plan to be applied during site works.
- Warehouse buildings across the entire site have been inspected and various contaminating activities have been identified. Contamination sampling has not been conducted below these structures. A soil investigation should be conducted below building footprints once onsite structures have been removed.
- A site survey provided by HI identified one UST in the north-eastern portion of the site at number 624. The UST should be removed prior to development and excavations should be validated in accordance with NEPM (2013).
- The acid sulfate soil (ASS) map sitting under the *Warringah local environmental plan* (LEP) (2011) identifies the general north-eastern portion of the sites as being Class 4 ASS which is the second lowest ASS risk classification. Clause 6.1 of the LEP (2011) specifies that for Class 4 soils, development consent is required only for works more than 2 metres below the natural ground surface (likely for the development), or for works by which the water table is likely to be lowered more than 2 metres below the natural ground surface (unlikely for the development). Parsons Brinckerhoff recommend testing of the onsite soils following removal of the existing onsite structures.

4. Summary of contamination

4.1 Contaminants of concern

The following contaminants of potential concern have been identified for the site:

- Total Recoverable Hydrocarbons (TRH).
- Benzene, toluene, ethylbenzene and xylenes (BTEX).
- Polycylic aromatic compounds (PAHs).
- Heavy metals.
- Asbestos
- Acid sulfate soils

4.2 Extent of hydrocarbon contamination

4.2.1 Number 612

Parsons Brinckerhoff (formerly known as PPK) completed remediation and validation works at number 612 to remove all onsite fuel infrastructure. The investigation concluded that excavations near the north-west boundary of number 612 could not be fully validated due to proximity to the site's boundary. Residual hydrocarbon contamination also remained between the northern edge of the tank pit and the northern boundary of number 612. Impacted material removed from the excavation was land farmed for the purposes of reuse as backfill. Samples collected from land farmed material prior to backfilling returned a number of results exceeding the relevant adopted site TRH criteria at the time of the investigation; however, statistical analysis was conducted of final results indicating that the 95% upper confidence limit of the concentrations was below the adopted criteria. Due to the introduction of the amended National Environment Protection Council (NEPC) 2013, *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM; as amended in 2013), Parsons Brinckerhoff compared concentrations of hydrocarbon contaminants from samples collected from land farmed material to the relevant current criteria. However, for TRH the NEPM specifies criteria for different hydrocarbon fractions than those previously reported by the laboratory, making a direct comparison impossible. An indicative comparison has been undertaken, with conservative grouping of hydrocarbon fractions to encompass the fractions in the NEPM. A review of results indicated a number of TRH values have the potential to exceed the relevant commercial/industrial criteria, based on this conservative grouping of TRH fractions. SMEC (2014) completed a soil and groundwater investigation comprising one soil location targeting historically backfilled material (EB5). Results indicated minor impact was identified in soil at a depth of 1.4 to 1.5 mBGL.

A site audit statement completed by IT Environmental (2003) for number 612 had reported the review of previous investigations conducted at the site and certified the site appropriate for commercial/industrial land use. It was reported that groundwater was not to be used onsite.

A soil vapour investigation conducted by Parsons Brinckerhoff (2015) targeting backfilled land farmed material at number 612 at two locations (SV1 and SV2) identifying no unacceptable vapour intrusion risks to potential users of the community health facility. However, it is considered necessary to corroborate results from the SMEC investigation through further soil investigation in order to confirm the low risk to maintenance works at the site during development.

4.2.2 Number 620

Residual hydrocarbon contamination was believed to have migrated off-site from number 612 to number 620 (Parsons Brinckerhoff, 2010). Subsequently, a number of soil and groundwater investigations we conducted to determine the extent of impact. Additional investigations identified hydrocarbon contamination in soil in the south-western corner of the site at a depth of 3.0 mBGL within sandstone bedrock, and hydrocarbon contamination in groundwater beneath the site. Remediation of impacted material in the western portion of number 620 was conducted. Following the removal of impacted soil, residual hydrocarbon impacted soil was reported at the base of the excavation at depths ranging from 2.0 m to 2.7 m and in one wall sample collected from the western boundary at a depth of 1.5 m.

Following the reported residual hydrocarbon contamination in soil and groundwater, a soil vapour assessment was conducted at number 620 (Parsons Brinckerhoff 2011b). The results indicated concentrations of volatile hydrocarbon vapours are present in the soil profile at some locations near the western boundary. Concentrations of hexane detected at one location at the western boundary were considered to potentially pose a risk to maintenance workers in confined spaces, including trenches.

A human health risk assessment (Parsons Brinckerhoff 2012c) and site audit report (Environ Australia Pty Ltd 2013b), completed for number 620 concluded that hydrocarbon contamination in groundwater beneath number 620 was not considered likely to pose any unacceptable health risks to future users of number 620 and residual hydrocarbon contamination remaining near the surface of weathered sandstone bedrock may emit odours or be observed to be stained during excavation at number 620.

The soil and groundwater investigation completed by SMEC (2014) identified soil hydrocarbon contamination in soil and groundwater west of the house corresponding to previously identified contamination. Due to the shallow nature of groundwater at number 620 (0.4 mBGL to 0.8 mBGL) a soil vapour assessment was considered necessary. The soil vapour investigation conducted by Parsons Brinckerhoff (2015) targeting identified residual contamination at the western boundary of number 620 at three locations (SV3 to SV5) identified no unacceptable vapour intrusion risks to potential users of the community health facility.

4.2.3 Number 624

Historically, investigations conducted at number 624 were limited to the SMEC soil and groundwater ESA. The investigation did not identify any areas of concern in soil and groundwater below the site, however a search of the Dangerous Goods Record by SMEC indicated a UST was present on site. A ground penetrating radar (GPR) survey conducted at the site identified the UST located in the north-east portion of the site. A building material survey conducted for on-site structures identified hazardous materials , including bonded asbestos roof sheeting, reported to be present in the existing building structures on-site.

4.3 Areas of uncertainty

There is uncertainty related to the contamination status below all building structures onsite, this includes the residential dwelling on number 620 and commercial buildings on number 624. Asbestos and hazardous materials have been identified in onsite structures and it is not known whether there is soil impact from these hazardous materials.

The contamination status of soil and groundwater in the vicinity of the UST is also currently unknown.

The potential presence of acid sulfate soil in the northern portion of the site has been identified, however, field sampling and laboratory analysis has not yet been conducted to confirm its presence.

5. Conceptual site model

The conceptual site model (CSM) has been developed based on the available information. The CSM outlines potential source, transport and receptor linkages, taking into account the site settings and surrounding land use. A source, a receptor (human or environmental) and pathway between the source and receptor must be present for a complete exposure pathway to exist. The CSM is summarised in Table 5.1.

Table 5.1 Preliminary site conceptual model

Potential sources	Potential sources include: ■ Potentially contaminated fill material in the subsurface. ■ Petroleum hydrocarbons in soil at number 612 ■ Petroleum hydrocarbons in soil and groundwater at the western portion of number 620. ■ Hazardous materials in building structures onsite. ■ Asbestos in building structures onsite ■ Petroleum hydrocarbons in soil and groundwater in the vicinity of the UST in the north-east portion of number 624 ■ Acid sulfate soil in the northern portion of the site
Contaminants of potential concern	Contaminants of potential concern include: ■ TRH ■ BTEX ■ PAHs ■ heavy metals ■ asbestos. ■ Acid sulfate soil
Potential pathways	Potential migration pathways include: ■ Leaching and migration of contaminants vertically into underlying groundwater. ■ Surface water flow and lateral migration of contaminated water through preferential pathways such as drainage lines, sewers and infrastructure trenches. ■ Human exposure to impacted soil and/or perched groundwater during construction works (direct contact with soils and perched groundwater through dermal contact, ingestion and inhalation). ■ Human inhalation of vapours and asbestos fibres (onsite and offsite at neighbouring land during construction). ■ Users of groundwater bores in vicinity of the route.
Potential receptors	■ Brookvale Creek located approximately 1.3 km south of the site ■ Groundwater last identified approximately 0.4 mBGL below the site ■ Drainage lines and minor waterways. ■ Site infrastructure workers and utility/construction personnel undertaking works during construction. ■ Surrounding residential occupants or commercial site users.

Potential complete exposure pathways	Potential complete exposure pathways include: - Inhalation of contaminated surface dust by construction workers at the site or users of the site and adjacent properties during construction works. - Ingestion of contaminated soil or groundwater by construction workers at the site. - Inhalation of accumulated vapour from soil or groundwater by workers at the site or users of the site.

6. Remediation goals and strategies

6.1 Remediation objectives

6.1.1 General

When setting remediation goals and objectives, general site remediation strategies outlined in the NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition) and NSW DECC (2007) Guidelines for the Assessment and Management of Groundwater Contamination were considered.

The NSW DEC (2006) Guidelines for the NSW Site Auditor Scheme (2nd Edition) indicate that the preferred order of options for the remediation of contaminated soil, taking into account sustainable practices, is:

- on-site treatment of soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, or
- off-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site.

If the above options cannot be implemented, then other options that should be considered include:

- removal of contaminated soil to an approved site or facility followed, where necessary, by replacement with clean fill
- consolidation and isolation of the soil on-site by containing with a properly designed barrier.

If remediation is likely to cause a greater adverse effect than would occur were the site left undisturbed, then remediation should not proceed.

These general site remediation strategies were considered when setting remediation goals and objectives and when assessing the remediation options available at the site.

The State Environmental Planning Policy No 55 (SEPP 55) – Remediation of Land under the Environmental Planning and Assessment Act 1979 aims to promote the remediation of contaminated land to reduce the risk of harm to human health and the environment. The policy requires a consent authority, when considering a development application, to take into consideration whether land is contaminated, and if so, whether the land is suitable for the proposed development, either in its current state, or subject to remediation.

As per clause 9 of the SEPP 55 the remediation activity outline in this RAP is considered to be category 1 remediation and will be carried out with the consent of the Warringah Council requirements.

6.1.2 Specific remediation goals

Parsons Brinckerhoff considers that the remediation objective is to ensure the site is suitable for commercial/industrial use as a community health centre.

6.2 Proposed remediation works

The UST will be excavated along with any fuel lines and associated fuel infrastructure. After removal of the tank and lines, soils from the walls and floors of the excavation will be sampled to characterise the remaining soils. Further excavations may be considered if concentrations exceed the adopted soil characterisation criteria (see Section 7.3) and contaminated soils are considered to pose a risk to groundwater.

The requirement for remediation below building footprints onsite will be determined following the findings of future investigation targeting soil below the building footprints. Should material requiring remediation be identified, this RAP will be updated to provide the appropriate remedial approach.

6.3 Remediation criteria

This RAP has been prepared for assessing the hydrocarbon impacts in soil at the site after the removal of the UST. Therefore, the potential human receptors relevant to this investigation are the excavation and maintenance workers during removal works and future users of the site as a health care facility. The exposure pathways identified were vapour intrusion into buildings and shallow trenches, dermal contact and ingestion. Based on the potential receptors identified and the exposure pathways, the applicable remediation criteria are the soil health screening levels (HSLs) for vapour intrusion risks and soil health based investigation levels (HILs) for direct contact and ingestion risks. The HSLs and HILs for commercial users are provided in the NEPM (2013). For the intrusive maintenance workers, the recommended assessment criteria for vapour and direct contact pathways provided in the Cooperative Research Council for Contamination Assessment and Remediation for the Environment (CRC CARE) *Technical Report no. 10* (Friebel and Nadebaum, 2011) have been adopted.

Following validation of excavation walls, the excavation will be reinstated with imported fill, and then paved with concrete. As the site will be used as a health care facility and is expected to be entirely paved, the ecological screening levels (for the protection of plants and terrestrial organisms) for petroleum hydrocarbons have limited relevance and have not been included in the assessment.

Should the requirement for remediation be identified during further investigation below the building footprints, the adopted remediation criteria may be updated.

The HSLs and HILs for the commercial site users and the intrusive maintenance workers are summarised in Table 6.1 and Table 6.2.

Table 6.1 Soil health screening levels for vapour intrusion into buildings and health investigation levels for human contact with soil – commercial land use

Chemical	HSLs(1) (mg/kg)				HILs(1) (mg/kg) – commercial/ industrial (HIL-D)
	Commercial/industrial land use (HSL-D) in sand				
	0 to < 1 m	1 m to < 2 m	2 m to < 4 m	≥ 4 m	
F1(2)	260	370	630	NL	-
F2(2)	NL	NL	NL	NL	-
Benzene	3	3	3	3	-
Toluene	NL	NL	NL	NL	-
Ethylbenzene	NL	NL	NL	NL	-
Xylene	230	NL	NL	NL	-
Naphthalene	NL	NL	NL	NL	-
Carcinogenic PAHs (BaP TEQ)[3]	-	-	-	-	40
Total PAHs	-	-	-	-	4,000
Arsenic					3,000
Cadmium					900
Chromium					3,600[6]
Copper	-	-	-	-	240,000
Lead					1,500
Mercury					730
Nickel					6,000
Zinc					400,000

(1) *Schedule B1 Investigation levels for soil and groundwater* (NEPM, 2013)

(2) F1 = TRH C_6-C_{10} less BTEX, F2 = TRH >C_{10}-C_{16} less naphthalene.

(3) Benzo(a)pyrene toxic equivalency quotient, a weighted sum of carcinogenic PAHs. Further detail provided in the NEPM Schedule B1

(4) NL: not limiting

(5) -: criteria are not available.

(6) HIL for chromium VI adopted for total chromium as a conservative approach

Table 6.2 Soil health screening levels for vapour intrusion into trenches and direct contact – intrusive maintenance workers

Chemical	HSL (mg/kg) for Intrusive maintenance worker (shallow trench)(1)			
	Vapour intrusion			Direct contact
	0 to < 1 m	1 m to < 2 m	≥ 4 m	
TRH C_6-C_{10}	NL	NL	NL	82,000

Chemical	HSL (mg/kg) for Intrusive maintenance worker (shallow trench)(1)			
	Vapour intrusion			Direct contact
	0 to < 1 m	1 m to < 2 m	≥ 4 m	
TRH >C_{10}-C_{16}	NL	NL	NL	62,000
TRH >C_{16}-C_{34}	-	-	-	85,000
TRH >C_{34}-C_{40}	-	-	-	120,000
Benzene	77	160	NL	1,100
Toluene	NL	NL	NL	120,000
Ethylbenzene	NL	NL	NL	85,000
Xylene	NL	NL	NL	130,000
Naphthalene	NL	NL	NL	29,000

(1) CRC CARE *Technical Report no. 10* (Friebel and Nadebaum, 2011)

(2) NL: not limiting;

(3) -: criteria are not available.

6.4 Waste disposal criteria

Prior to the transportation of soils off-site for disposal, the excavated soils shall be tested then classified. The classification of excavated soils will be classified in accordance with the NSW EPA (2014) *Waste Classification Guidelines – Part 1: Classifying Waste*. A summary of the waste acceptance criteria is included in Table 6.3.

Table 6.3 Waste classification guidelines

Chemicals	CT (without TCLP)(1)		SCC (with TCLP)(2)			
	Maximum value for classification without TCLP		Maximum values for leachable concentration and specific contaminant concentrations when used together			
	General Solid (CT1)	Restricted Solid (CT2)	General solid		Restricted solid	
			TCLP1	SCC1	TCLP2	SCC2
	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)
TRH C_6-C_9	650	2,600	na	650	na	2,600
TRH C_{10}-C_{36}	10,000	40,000	na	10,000	na	40,000
Benzene	10	40	2	18	2	72
Toluene	288	1,152	57.6	518	57.6	2,073
Ethylbenzene	600	2,400	120	1080	120	4,320
Total xylene	1,000	4,000	200	1,800	200	7,200
Benzo(a)pyrene	0.8	3.2	0.16	10	0.16	23
Total PAHs	200	800	na	200	na	800
Arsenic	100	400	5	500	20	2,000
Cadmium	20	80	1	100	4	400
Chromium (VI)	100	400	5	1,900	20	7,600
Lead	100	400	5	1,500	20	6,000
Mercury	4	16	0.2	50	0.8	200
Nickel	40	160	2	1,050	8	4,200

(1) Extracted from Table 1 in *Waste Classification Guidelines. Part 1: Classifying Waste* (NSW EPA, 2014)

(2) Extracted from Table 2 in *Waste Classification Guidelines. Part 1: Classifying Waste* (NSW EPA, 2014

6.5 Groundwater

Should any monitoring wells will be destroyed during the development works, Parsons Brinckerhoff recommends destroyed wells be decommissioned in accordance with relevant guidelines. Decommissioning would generally involve the following:

- Removal of the well screen and casing.
- Removal of the sand, grout and bentonite using solid stem augers.
- Filling the void with a bentonite/cement grout.

7. Remediation approach - source removal methodology

7.1 Preliminaries

Prior to commencement of remedial works at the site, the following activities would need to be completed:

- Obtain all relevant regulatory approvals for the remediation works.
- Prepare an Environmental Management Plan (EMP) to commencement of site works.
- Ensure that all site personnel are aware of the health, safety and environmental management requirements relating to the excavation of potentially contaminated soils.
- Ensure that the contractor conducting the excavation has adequate safety equipment (for example, adequate fencing, barrier boards, barricades and warning signage) to secure the work area and minimise the danger to contractor and the public for the duration of the tank replacement works.

7.2 General

As discussed in Section 6.2, the removal of UST would reduce the possibility of additional contamination of soil and groundwater occurring.

All excavation works should be undertaken by licensed contractors, experienced in decommissioning and removal of fuel infrastructure and the remediation of contaminated soils.

An environmental scientist should be present during the excavation works, particularly to assess the contamination status of the material excavated with the tanks and determine on-site during excavation works whether further excavation of tank pit walls and floor is needed to remove heavily contaminated soil.

As a minimum, the following Codes of Practice are applicable to the work and a copy should be obtained by the Contractor. Standards should be the most recent version available unless otherwise specified:

- AS 4976:2008 – The removal of underground storage tanks.
- AS 1940 Section 9 – The storage and handling of flammable and combustible liquids.

7.3 Primary source removal

The concrete pavement will be broken to allow access to the UST, fuel lines and interceptor pits. 'Tank Clearance' consists of draining product from tanks and associated pipes, tank and pipe removal, vapour venting, de-gassing of tanks, proper labelling of tanks, disposal, treatment of abandoned tanks and backfilling (as appropriate). Once tanks are 'cleared' they may be gas tested for vapours and then deemed safe by an appropriately qualified person.

For underground tanks and lines, the tank atmosphere and the excavation area shall be checked regularly for presence of vapour until all tanks are removed from the excavation and site.

All applicable permits must be obtained prior to the beginning of any work associated with tank clearance.

All product liquids and residues removed from the tank shall be handled in accordance with appropriate standards and local regulations associated with environmentally hazardous materials and dangerous goods.

The contractor shall submit written procedures to complete the following activities outlined below:

- Draining pipes and pumping out tanks.
- Removal of pipework.
- Removal of tank from ground and de-gassing.
- Labelling of the tank.
- Transporting of the tank.
- Tank destruction.

7.4 Soil sampling and characterisation

Following the tank removal and subsequent excavation, soil samples will be collected from the walls and floor of the excavation. All soil samples will be screened in the field using a handheld PID to measure indicative concentrations of VOCs. Samples will be analysed for the contaminants of potential concern, i.e. TRH, BTEXN and lead.

The tank pit characterisation will be undertaken in accordance with the NSW EPA (2014) *Technical Note: Investigation of Service Station Sites*. Section 2.6 of these guidelines states that:

> Where a UST is removed, as a guide sampling should be one sample from beneath the centre of the UST if tank length is less than 4 m and at least one sample from each of the four walls. If the tank is 4–10 m long, at least two samples from each of the four walls and under each end. If the tank is longer than 10 m, at least three samples from each of the four walls and under each end are taken. This applies to each tank in the same tank pit

Quality assurance/quality control (QA/QC) samples will be collected and analysed as described in Section 7.9.

The excavations will be left open while waiting for laboratory results. If validation samples exceed the nominated assessment reference values, further excavation will be undertaken if remaining impacted soil is deemed to be unsuitable.

Field sampling for acid sulfate soils will be undertaken during excavation works to confirm the presence of ASS. Sampling should be undertaken in accordance with the Acid Sulfate Soil Management Plan prepared for the site.

7.5 Groundwater sampling

Based on the validation results, a groundwater investigation may be required to assess the presence of dissolved phase hydrocarbons in groundwater from residual contamination associated with the UST. The requirement for groundwater monitoring will depend on validation sampling results.

7.6 Reporting

At the completion of the site works, a validation report will be prepared in general accordance with the UPSS Regulation. The validation report should detail the methodologies and results of the validation works. A checklist of the reporting requirement is provided in the NSW DECCW (2009) *Guidelines for Implementing the Protection of the Environment Operation (Underground Petroleum Storage System) Regulation – Technical note: Site Validation Reporting.*

7.7 Management of excavated materials

Following the removal of the UST, Parsons Brinckerhoff recommends that the excavated materials are segregated into separated stockpiles based on the field observations, such as type soil, field PID readings, olfactory evidence of contamination and depths (i.e. above or below the tanks) where the materials are excavated.

The NEPM (2013) Schedule B2, Guideline on Site Characterisation, outlines the minimum number of samples for assessment of stockpiles. For stockpile volume less than 200 m^3, the recommended sampling frequency is 1 per 25 m^3. For stockpiles greater than 200 m^3, lower sampling rates may be used, although sampling should be suitable for calculating the 95% upper confidence level (UCL) of the dataset of results. All the stockpile soil samples shall be analysed for TRH, BTEXN, and lead. Selected soil samples will also be analysed for other heavy metals (arsenic, cadmium, mercury and nickel).

The excavated soils are likely to be disposed at an approved landfill facility. However, some of the excavated soils may be suitable for re-use on-site if the contaminant concentrations are less than the site assessment criteria (see Table 6.1 and 6.2). For disposal, the soils results will be compared to guideline values in the waste classification guidelines (NSW EPA, 2014; see Table 6.3).

The excavated material will be temporarily stockpiled on-site while awaiting laboratory results. The material is to be stockpiled on plastic sheeting and the stockpiles areas are to be securely bunded using silt fencing and hay bales to prevent surface water (and silt laden surface water) from entering or leaving the stockpiles or the site. Plastic sheeting will also be placed over the stockpile to minimise wind-blown dust. The stockpile area will be fenced with orange mesh and metal pins.

Disposal dockets for tracking and tracing waste will be maintained by the contractor for inclusion in the final validation report.

7.8 Reinstatement of site

Following excavation and characterisation of the tank pits and excavated materials fill material may be required for reinstatement. The fill materials should be certified suitable for the intended use using the following procedures:

7.8.1 Re-use of excavated material

As discussed in Section 7.7, excavated material with contaminant concentrations below the site assessment criteria may be reused on-site.

7.8.2 Virgin excavated natural material (VENM)

Where VENM is required for backfilling excavation, this should be certified suitable for the intended use. This procedure would involve:

- reviewing the history of the source of the material
- a visual inspection for foreign material, unusual staining and any odours
- confirmation sampling to ensure VENM meets adopted site criteria.

All analytical results are required to be less than the soil validation criteria detailed in Section 6.3

7.8.3 Excavated natural material (ENM)

Where ENM is to be imported to the site for use as backfill, the material should be assessed in accordance with the NSW EPA (2012) *Excavated Natural Material Exemption* prior to being imported to the site.

7.9 Quality Assurance/Quality Control (QA/QC)

The data quality indicators (DQIs) for any validation and monitoring events are summarised in Table 7.1.

Table 7.1 Data quality indicators

Summary	
Procedures	All approvals and licences required must be obtained prior to work commencing. All field work will be carried out in accordance with relevant guidelines and stand operation procedures. Sign site register (and induction, if required), inspection of remediation equipment. All field work information to be recorded on field day sheets. All works to be undertaken by experienced staff.
Storage and Transport	Samples collected placed directly into laboratory prepared containers and stored in a secure chilled container. Chain of custody to be used to ensure the integrity of the samples from collection to receipt by the analytical laboratory.
Laboratory	All laboratories used should comply with AS/NZS ISO 9001:2001 quality assurance programs, be accredited by the National Association of Testing Authorities for the analyses requested and perform their own internal QA/QC programs.
QA/QC – Field	The field QA/QC procedures, at the minimum, should comprise: **Duplicate samples** - 1 in 20 blind duplicates (intra-laboratory) to the primary laboratory and 1 in 20 split duplicates (inter-laboratory) to the secondary laboratory. NEPM (2013) indicates that for soil samples if the relative per cent difference (RPD) for the primary and duplicate is greater than 30%, a review should be conducted of the cause (e.g. instrument calibration, extraction efficiency, appropriateness of the method used, etc.). The RPD variation can be expected to be higher for organic analysis than for inorganics, and for low concentrations analytes (AS4482.1, 2005). **Sample blanks** - Sample blanks are to be collected to verify that cross contamination had not occurred during sampling or during transportation of the samples. Equipment rinsate samples will be collected for each sampling day and analysed for the contaminant of concern. Trip blanks (prepared by the laboratory) will be analysed for each batch of soil and groundwater samples submitted to the laboratory. The trip blanks will be analysed for volatile contaminants.

Summary	
	Trip spikes - The purpose of a trip spike is to confirm the adequacy of sample preservation in the field and during sample transportation to the laboratory by measuring the amount of volatile losses. Trip spikes will be prepared by the laboratory using the following procedures. Non-compliance is to be documented in the report and the sample to be re-analysed or higher level to be conservatively adopted.
QA/QC – Laboratory Duplicates, spikes, blanks and surrogates – Acceptable Limits	Laboratory QA/QC limits vary between analytes and between laboratories. If duplicate results are not satisfactory, non-compliance is to be documented in laboratory reports. Primary laboratory QA/QC acceptance limits are as follows: Surrogates: 70 – 130% recovery Matrix spikes: 70 – 140% recover (organics) and 80-120% (inorganics) Control samples: 70 – 139% recovery (soil) and 80-120% (water) Duplicate samples: RPD less than 30% Method blanks: 0 to < PQL.

8. Contingency management

Should additional contamination be encountered during site works below the building footprints or at other areas of the site, remediation may be required. Table 8.1 provides the procedures to be applied if unexpected finds are found at the site.

Table 8.1 Contingency management plans

Anticipated problems	Corrective actions
Chemical/fuel spill	Stop work. Use accessible soil or appropriate absorbent material on site to absorb the spill (if practicable). Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Asbestos	Should asbestos be noted in soil, notify Health Infrastructure and the consultant Project Managers. Refer to the Environmental Management Plan for control measures. Asbestos monitoring may be required to continue works.
Acid sulfate soils	If acid sulfate soils are identified, stop works and assess the material in accordance with the procedures identified within the Environmental Management Plan.
Potential contamination below building footprints	If contamination is identified below building footprints following the additional investigation, impacted material should be stockpiled and secured and sampled. This RAP may require updating to address the requirement for remediation.
Excessive dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates.
Excessive noise	Identify the source, isolate the source if possible, and modify the actions of the source.
Excessive odours/vapours	If excessive organic odours/vapours are being generated, stop works and monitor ambient air across site for organic vapours with a PID and odours at site boundaries. Implement control measures including respirators for site workers, use of odour suppressants, wetting down of excavated material.
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible divert surface water away from active work areas or excavations.
Water in excavations	Collect samples and assess against relevant assessment criteria, to enable disposal options to be formulated.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair failed control measure.
Unearthing unexpected materials, fill or waste	Stop activities, contact the Client and Consultant Project Manager. Prepare a management plan to address the issue.
Equipment failures	Ensure that spare equipment is on hand at site, or that the failed equipment can be serviced by site personnel or a local contractor.
Complaint management	Notify Health Infrastructure and Parsons Brinckerhoff Project Managers following complaint. Report complaint as per management procedures. Implement control measures to address reason of complaint (if possible).

9. Environmental management plan

An Environmental Management Plan (EMP) will be developed for the site remediation works to ensure that the on-site and off-site environment is not adversely impacted during the remediation works. As a minimum, it will consider:

- Incident response
- General site management applied during site works
- Methodology applied during the disturbance of soil
- Acid sulfate soil management proceedures should they be encountered
- Unexpected finds protocol

10. Conclusions

In summary, the following remediation works have been proposed at the site:

- Removal of all aboveground infrastructure on all lots.
- Removal of the identified UST and associated infrastructure.
- Removal of contaminated soil/fill surrounding the UST infrastructure
- Disposal of contaminated material requiring offsite disposal to a licensed landfill following waste classification sampling to determine disposal classification.
- Soil characterisation sampling of the tank excavations to document the condition of the residual soils.
- Reinstatement of excavations with certified clean fill/and or excavated material which has been assessed to be suitable for re-use on the site

If the requirement for further remediation is identified below building structures onsite, this RAP will be require updating to outline the remediation strategy.

11. Statement of limitations

1. This Report has been prepared by Parsons Brinckerhoff Australia Pty Limited (“*Parsons Brinckerhoff*”) for the benefit of NSW Health Infrastructure (“Health Infrastructure”), the registered proprietor or tenant of the site

2. The nature and extent of the environmental consulting and remediation works at the Site detailed in the Report reflects the scope of the Services set out in the Request for Proposal under the Agreement and the Scope of Works set out in section 1.2 of Schedule 1 of the Agreement (“Scope of Works”).

3. A potential purchaser (but not including a purchaser’s successor in title) of the Site may rely on the findings contained in the Report for the purpose of considering the possible (but not actual) level of contamination of or at that Site at the time of the contamination assessment of the Site was undertaken (“Permitted Purpose”).

4. The registered proprietor of the land to which the report relates at the time of writing the report (but not including any proprietor’s successor in title) may rely on the findings contained in the Report for the purpose of assessing the possible level of contamination of that Site (“Permitted Purpose”) and subject to the limitations set out in the Scope of Works.

5. The findings contained in the Report are subject to the qualifications, assumptions and limitations set out in the Report or otherwise communicated to, or by, Health Infrastructure. To the extent of any inconsistency between this Limitation Statement and the qualifications, assumptions and limitations in the Report, this Limitation Statement shall prevail.

6. The Report may contain information provided by others. Except as otherwise stated in the Report, Parsons Brinckerhoff has not verified the accuracy or completeness of this information. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the Report (“Conclusions”) are based in whole or in part on this information, those Conclusions are contingent upon the accuracy and completeness of that information. Parsons Brinckerhoff accepts no responsibility for the reliability, accuracy, completeness or adequacy of information provided by others.

7. Parsons Brinckerhoff has prepared the Report without regard to any special or particular interest of any person (including that of a potential purchaser), other than Health Infrastructure when undertaking the Services or setting out its findings in the Report.

8. The Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose and does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise in relation to the Site (“Investment Decision”).

9. Matters material to a potential purchaser, may have been omitted from the Report, or may not have been investigated because of the scope of the Services. It follows that a potential purchaser should be cognisant of the restrictions inherent in or otherwise set out in the Report and should commission the preparation of a contamination assessment of the Site that caters for its own interests and scope of services, and which will provide findings in relation to the level of contamination of or at the Site at the time the potential purchaser is making an Investment Decision.

10. The Report has not and will not be updated for events occurring after the date of the Report or any other matter which may have a material effect on its contents which come to light after the date of the Report.

Parsons Brinckerhoff will not be obliged to inform a potential purchaser of any matter arising or coming to its attention after the date of the Report, which may affect or qualify the Report.

11. Parsons Brinckerhoff is not liable to a potential purchaser in respect of errors or omissions in the Report which a potential purchaser knows of, or ought to be aware of, from:

    a) its own actual knowledge and inquiries
    b) inquiries made by its advisers; or
    c) matters which a potential purchaser should have been aware of by making reasonable inquiry (including the inquiries recommended at Item 9 above).

To the fullest extent permitted at law, Parsons Brinckerhoff, its related bodies corporate, its officers, employees and agents assume no liability and will not be liable to any potential purchaser for, or in relation to, any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of income or profit, revenue or loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, business interruption and pure economic loss) of any kind (and whether arising in contract, tort (including negligence), under statute, in equity or otherwise, suffered or incurred by a potential purchaser (or any other third party) arising out of or in connection with any matter outside the ambit of the Permitted Purpose in relation to the Report or findings expressed in the Report.

12. References

- ANZECC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites.
- ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.
- Australian Government – National Health and Medical Research Council (2004) Australian Drinking Water Guidelines.
- Australian Oil Industry Guidelines (AOIG) (1999) Guidelines for the management of petroleum hydrocarbon impacted land.
- Australian Standard AS4482 1-2005 Guide to Sampling and Investigation of Potentially Contaminated Soil – Part 1: Non-volatile and Semi-volatile compounds (2005).
- Australian Standard AS4482.1 (1999) Guide to the sampling and investigation of potentially contaminated soil - Part 2: Volatile substances.
- Australian Standard AS5667, Water Quality – Sampling – Guidance on Sampling of Groundwaters (1998).
- Australian Standard 4976 – The Removal and Disposal of Underground Petroleum Storage Tanks.
- ARMCANZ (2003) Minimum construction requirements for water bores in Australia – Edition 2.
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Figures

🟥 Site_Boundary

▨ UST location

Figure 1 - Site Location

Pittwater Rd, Brookvale NSW

Health Infrastructure
Remedial Action Plan
Project 2201675A

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Image Source: NSW Land & Property Information

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