Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Detailed Site Investigation

Proposed Mixed Use Development
23 – 41 Lindfield Avenue and 9 – 11 Havilah Lane
Lindfield NSW

Prepared for
Aqualand Projects Pty Ltd

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	Signature	Date
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Reviewer		20 January 2015

NCS INTERNATIONAL CERTIFIED QUALITY MANAGEMENT SYSTEM

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Executive Summary

This report presents the results of a detailed site investigation (DSI) undertaken for the proposed mixed development at 23 – 41 Lindfield Avenue and 9 – 11 Havilah Lane, Lindfield NSW. The proposed mixed use development includes the excavation of a basement car park, a commercial/retail level and multiple residential levels.

The objectives of the DSI were to assess the potential for contamination from past and present site uses, assess the potential contamination source-pathway-receptor linkages, provide an opinion on the suitability of the site for the proposed development and provide data that can be used in the development of a remediation or management plan, if required.

The scope of works included a site walkover, review of previous reports for the site, review of site history records and examination of mapping information for 39-41 Lindfield Avenue, the drilling and sampling of nine test bores and sampling of four existing groundwater monitoring wells across the site. The site has historically been used for retail and commercial purposes.

The areas of environmental concern identified during the assessment are as follows:

- Imported fill of unknown origin;
- Current site uses and features (e.g. potential asbestos in buildings); and
- Adjacent land uses (service station and mechanics workshop located to the north of the site).

The investigation also included an *in situ* waste classification assessment.

Soil results have been compared to HIL B residential with minimal access criteria and HSLs for vapour intrusion have been compared to commercial/industrial criteria. The soil results indicated that all contaminants analysed as part of the investigation were within the adopted site assessment criteria (SAC).
Groundwater was assessed for BTEX and VOCs. Low level chloroform was identified (possibly due to a water supply leak or is naturally occurring). All other concentrations were below PQL. It is noted that the previous investigation identified concentrations of TCE (part of the VOC suite) but not during the current investigation. This detection may have been an anomaly.

Based on the *in situ* waste classification results the fill is likely to be classified as general solid waste, however this classification is subject to confirmation *ex situ*.

On the basis of the previous reports and the current investigation, the site is considered to be suitable, from an environmental perspective, for the proposed mixed use development, subject to the implementations of recommendations listed in Section 13 of the report.

Table of Contents

Page

Report on Detailed Site Investigation
23 – 41 Lindfield Avenue and 9 – 11 Havilah Avenue, Lindfield NSW

1. Introduction

This report presents the results of a detailed site (contamination) investigation (DSI) undertaken for a proposed mixed use development at 23 – 41 Lindfield Avenue & 9 – 11 Havilah Avenue, Lindfield NSW (the 'site'). The DSI was commissioned by Mr Mathew Wagstaff of Aqualand Projects Pty Ltd and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal dated 3 December 2014.

It is understood that the development of the site will include construction of up to three basement levels for car parking, commercial/retail ground floor, and residential premises on upper floors, up to seven stories.

The objectives of the DSI were to:

- assess the potential for contamination based on past and current site features and uses;
- assess potential contamination source – pathway – receptor linkages through the development of a conceptual site model (CSM);
- provide an opinion on the suitability of the site for the proposed development; and
- provide data that could be used in the development of a remediation or management plan, if required.

The DSI was conducted and reported in accordance with the National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (amended 2013) (NEPC, 2013) and included a review of previous contamination investigation reports, review of historical information, a site walkover, development of a conceptual site model, soil sampling from new boreholes, groundwater sampling from existing monitoring wells, and analysis of the samples for various contaminants of concern.

A preliminary waste classification has also been conducted as part of the investigation.

2. Scope of Works

The scope of the DSI included a desktop study, a site walkover, and an intrusive investigation to assess the presence of contaminants of potential concern (COPC) in soil and groundwater. The investigation included the following:

2.1 Desktop Study

- Identification of the property – street address and property description;
- Review of previous contamination investigation reports, discussed further in Section 4; and
- Review general site information, including geographical and hydrogeographical information.

For 39 and 41 Lindfield Avenue:

- Search of current and historic titles and deposited plans to identify previous owners and site use;
- Review of historic aerial photographs;
- A search of the contaminated land register for notices issued under the *Contaminated Land Management Act*, 1997 (CLM Act), and the public register of notices and licenses issued under the *Protection of the Environment Operations Act* 1997 (POEO Act);
- Search of the NSW Office of Water database for groundwater bores located in the vicinity of the site;
- Search of the WorkCover Dangerous Goods records for any current or historical dangerous goods licences;
- Review of Council records for the site; and
- Obtain and review Section 149 (2 and 5) planning certificates.

2.2 Fieldwork

- Site walkover by an experienced Environmental Scientist to observe current site features and note any indicators of potential contamination and/or potential contamination sources;
- Drilling of nine test bores to a maximum depth of 8.07 m below ground level (bgl);
- Collection of soil samples from the test bores at broadly regular intervals and based on potential indicators of contamination, such as staining or olfactory signs;
- Dispatch of fourteen soil samples (including one duplicate sample) to a NATA accredited laboratory for analysis of the following COPC:
    - Metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc – 13 samples;
    - Total recoverable hydrocarbons (TRH) – 13 samples;
    - Monocyclic aromatic hydrocarbons (BTEX: benzene, toluene, ethylbenzene, xylenes) – 13 samples;
    - Polycyclic aromatic hydrocarbons (PAH) – 13 samples;
    - Phenols – nine samples;
    - Organochlorine pesticides (OCP) – nine samples;
    - Asbestos – 13 samples;
    - QA/QC samples – one trip blank and trip spike for TRH and BTEX, and one intra-laboratory duplicate for BTEX and heavy metals;

- Development and sampling of four existing groundwater monitoring wells;
- Analysis of groundwater samples for the following COPC:
  - o BTEX; and
  - o VOC.

2.3 Reporting

This DSI report has been prepared, detailing the findings of the desktop study, site inspection, soil and groundwater sampling, fieldwork methodology, a discussion of analytical results and recommendations for further work (if required). The report has been prepared in general accordance with NSW EPA endorsed guidelines.

3. Site Identification and Location

3.1 Site Identification

The site is identified as 23-41 Lindfield Avenue and 9-11 Havilah Lane, Lindfield NSW (the 'site'). The site is located within Ku-ring-gai Council local government area, Parish of Gordon, County of Cumberland. The site occupies a total area of approximately 3,800 m^2.

3.2 Site Location

The site is situated approximately 14 km to the north west of the Sydney CBD (see Drawing 1, Site Location, Appendix A). The site is bordered by United Petrol station and part of a council carpark to the north, Kochia Lane and a commercial building to the south, Havilah Lane to the east and Lindfield Avenue to the west. Beyond Lindfield Avenue is the North Shore and Northern train line.

3.3 Geology and Topography

3.3.1 Topography

The site is located on the eastern side of a ridgeline that is generally oriented in a north west to south east direction approximately 70m south west of the site, in the vicinity of the railway line.

The site typically falls to the north east at similar slopes to the surrounding topography with slopes of approximately 2 – 4^o.

Surface water runoff from the site is expected to flow into the local stormwater system which is expected to discharge into Gordon Creek located approximately 0.7km to the north east of the site. Gordon Creek eventually flows into Middle Harbour at a location approximately 2.7km to the north east of the site.

3.3.2 Geology

Reference to the Sydney 1:100,000 Series Geological Sheet indicates that the Lindfield area is underlain by Ashfield Shale, which typically comprises black to dark grey shale and laminite.

The mapping was confirmed in the current investigation where the soil profile beneath the concrete hardstand comprised fill, underlain by silty clay, sandstone and laminite (see Section 10.1 for details).

3.4 Groundwater

A groundwater bore search of the NSW Office of Water database (previously held by the Department of Natural Resources) was conducted on 7 January 2015, for bores located within 2 km of the site. Work summaries that were available for the bores and full details have been provided in Appendix B.

Details are as follows:

- GW106029, located about 1km to the north of the site, was identified as a domestic bore with a standing water level (SWL) of 63.00 m bgl;
- GW023498, located about 600 m to the north-west of the site, was identified as a general use domestic bore. No SWL was recorded; and
- GW108792, located about 1.2 km to the south-east of the site, was identified as a domestic bore with a SWL of 65.00 m bgl.

During the current investigation, SWL were recorded between 1.55 m bgl (MW3) and 2.81 m bgl (BH1). Recharge rates were slow. Further details are provided in Section 10.2 of this report.

Groundwater in the region is expected to flow north east towards Middle Head. As such, none of the abovementioned registered bores are located hydraulically downgradient of the site.

3.5 Acid Sulphate Soils

Based on a review of the NSW Acid Sulphate Soils Map the site has not been identified as being in an area of potential acid sulphate soils (ASS). The closest area mapped as having a high probability of ASS is more than 1 km from the site.

4. Previous Reports

While no reports have specifically been conducted for 39 – 41 Lindfield Avenue, reports have been prepared for other parts of the site. These reports include the following:

- Environmental Investigation Services (EIS) *Report to Coogee Bay Village Pty Ltd on Stage 1 Preliminary Environmental Site Assessment for Proposed Mixed Retail and Residential*

Development at Corner of Lindfield Avenue and Kochia Lane, Lindfield NSW (Reference E24013Krpt, June 2010) [EIS 2010];

- Douglas Partners (DP), *Report on Limited Phase 2 Contamination Assessment, Proposed Mixed-Use Retail and Residential Development, 23 – 37 Lindfield Avenue & 11 Havilah Lane, Lindfield*. (Reference 73174-2, February 2013) [DP 2013]; and
- EIS *Report to Ku-ring-gai Council on Phase 2 Environmental Site Assessment (ESA) for Proposed Development at 9 Havilah Lane, Lindfield, NSW, 2070* (Reference E26122KGrpt, 15 August 2013 [EIS 2013].

EIS (2010) applied to 23-37 Lindfield Avenue, and 11 Havilah Lane (investigation area 1) and included a review of site history, including historical aerial photographs, title deeds, WorkCover and council records. The EIS report should be referenced for full details. In summary the historical information indicated that investigation area 1 had been developed for commercial/industrial purposes by 1930, with alterations/ redevelopment occurring in the 1960s and 1970s/80s.

The EIS (2010) report identified the following potential sources of contamination:

- Potentially contaminated, imported fill material;
- Use of chemicals for manufacturing purposes in the 11 Havilah Lane portion of the site [DP notes that this activity also applies to 33 – 37 Lindfield Avenue];
- Potential asbestos contamination associated with former use in the 11 Havilah Lane portion of the site (fibrous works), and associated demolition of the former site buildings/sheds [DP notes that this activity also applies to 33 – 37 Lindfield Avenue];
- Historical use of the wider site for commercial/industrial purposes;
- Historical activities such as use of pesticides;
- The two grease traps located in the north-eastern section of investigation area 1; and
- Unidentified underground storage tanks (USTs) [note: no records or indicators of USTs identified by EIS or DP].

There were no recorded notices listed on the NSW DECCW (EPA) CLM or POEO register, and WorkCover had no records of UST licenses issued for investigation area 1.

DP (2013) was conducted also over investigation area 1. The report reviewed the history of the site and conducted an intrusive investigation comprising the drilling of six boreholes (BH1 to BH6, refer Drawing 2, Appendix A) and the installation of two groundwater monitoring wells at two of these locations (BH1 and BH4). Soil and groundwater samples were subjected to a range of analysis including metals, TRH, BTEX, PAH, PCB, OCP, OPP, PCB and Asbestos. The investigation had the following findings:

- Shallow fill was encountered during the drilling works, although potential indicators of contamination including concrete rubble and hydrocarbon odours were observed at some locations;
- Nine soil samples and two groundwater samples (plus QA/QC) were sent to a NATA accredited laboratory for analysis;

- All soil laboratory results were within the adopted site criteria (for a residential with minimal soil access land use). Groundwater results were within the adopted criteria with the exception of minor exceedances of copper and zinc. These were considered to be within background ranges and not a cause for concern;
- A low level concentration of trichloroethene (TCE), within the adopted reference levels, was recorded in groundwater samples from the down-gradient well (BH4). Although the concentration is within accepted limits the source of the TCE is unknown. It was considered that the sample may be associated with the edge of a plume of groundwater with higher levels of contaminants;
- A hazardous buildings assessment was recommended, and a fibre cement fragment was found on the ground of the site. An unexpected finds protocol was recommended as the presence of asbestos containing materials could not be ruled out; and
- The site was considered suitable for the proposed development pending further assessment of the TCE in groundwater.

EIS (2013) applied to the Council carpark at the northern end of the site (investigation area 2), part of which is now incorporated into the site as shown on Drawing 1, Appendix A. The investigation included this drilling and soil sampling from six boreholes, and the installation and sampling of groundwater from three groundwater monitoring bores. The bores and wells considered relevant to the current investigation are BH2, BH6, MW1, MW3. A commercial / industrial land use assumption was made in the absence of a development proposal.

Soil and groundwater samples were subjected to a range of analysis including metals, TRH, BTEX, PAH, PCB, OCP, OPP, PCB and Asbestos. All soil test results were below the health investigation and screening levels for a commercial / industrial land use. All groundwater test results were within the adopted investigation levels, however, anthracene was reported at the practical qualitation limit, which was higher than the investigation level.

Fill material and natural soil around BH2 were classified by EIS as General Solid Waste (non-putrescible), whilst natural silty clay, apart from that around BH2, was classified as virgin excavated natural material (VENM).

5. Site History – 39, 41 Lindfield Avenue

The previous investigations summarised in Section 4 did not include 39 and 41 Lindfield Avenue, as these properties were added to the project footprint at a later date. As such, in order to establish contamination potential at this two premises, a review of historical information was carried out.

A review of the history was based on historical aerial photographs, historical title deeds, a WorkCover Dangerous Goods database search, a search of regulatory notices (issued under the CLM Act 1997 and the POEO Act 1997), and a review of Council's Section 149 (2) and (5) planning certificates. Council's records of the properties were also reviewed as part of the assessment.

5.1 Aerial Photograph Record

Historical aerial photographs from the years 1943, 1950, 2007 and 2014 were obtained from the Department of Lands Office, Google Earth and SixViewer websites. These photographs were studied in order to identify the likely past uses and changes to the site, particularly those of a potentially contaminating nature. The findings are summarised below and the photographs are provided in Appendix C.

1943 A commercial building appears across the Lindfield Avenue portion of the properties. To the east appears to be a couple of smaller sheds. The property to the north and the surrounds are residential.

1950 The properties appears to have been redeveloped since the 1943 photograph, however still appear to be commercial / retail in nature. At least one of the sheds at the back of the properties appears to have gone and there is now a service station located on the property to the north.

2007 The layout of the properties has not significantly changed since 1950. Much of the surrounding area is commercial / retail in nature.

2014 The site appears relatively unchanged since 2007.

It is noted that during the 50 year period between the 1950s and early 2000s no significant changes to the site use have been observed.

5.2 Historical Title Deeds Search

A historical title deeds search was conducted for the properties. Searches were undertaken by Mark Groll of Legal Liaison Searching Services Pty Ltd. Tables 1a to 1c below summarise the reported title deed information and possible uses are presented. A full copy is also provided in Appendix D.

Table 1a: Lot D D.P. 347906 & Lot 4 D.P. 713505 (As regards the whole of the subject lands)

Date of Acquisition	Registered Proprietor	Possible Site Use
28.08.1901 (1901 to 1923)	Edward Hugh Palmer (Civil Servant)	Residential
16.05.1923 (1923 to 1923)	Maria Elizabeth Palmer (Widow) Arthur Joseph Howard Palmer (Solicitor)	Residential
30.05.1923 (1923 to 1939)	Alexander James Webster (Manufacturing Chemist) Eliza Emmeline Webster (Married Woman)	Retail/Commercial
31.10.1939 (1939 to 1942)	Eliza Emmeline Webster (Widow)	Retail/Commercial
22.04.1942 (1942 to 1943)	Frederick Edwin Penfold (Company Director) Donald Roy McDermid (Manufacturer's Agent)	Retail/Commercial

Table 1b: Search continued as regards Lot D D.P. 347906

Date of Acquisition	Registered Proprietor(s)	Possible Site Use
09.04.1943 (1943 to 1944)	Samuel William Pither (Boot Maker)	Retail/Commercial
28.06.1944 (1944 to 1953)	Una Pither (Widow) Now Una Nooke (Married Woman)	Retail/Commercial
24.03.1953 (1953 to 1973)	Cecil Henry Boyd Carpenter (Furniture Retailer)	Retail/Commercial
06.12.1973 (1973 to 1997)	Chia Properties Pty Limited	Retail/Commercial
20.02.1997 (1997 to 2001)	Geoffrey Noel Dalgliesh Susan Margaret Dalgliesh Lisandro Bartoletti Barbara Janice Bartoletti	Retail/Commercial
03.05.2001 (2001 to 2004)	Barry Cho Yeung Whang Su-Lin Roberta Whang	Retail/Commercial
10.08.2004 (2004 to 2011)	Lindfield One Pty Limited	Retail/Commercial
11.01.2011 (2011 to date	# Linshop Pty Ltd	Retail/Commercial

# Denotes current registered proprietor

Search continued as regards Lot D D.P. 347906

Easements: -

- 09.04.1943 (D 198682) – Cross Easements

Leases: -

- 11.04.1985 to Terence John Heilmann&Newks Investments Pty Limited – expired 29.09.1986
- 29.09.1986 to Newks Tennis World Pty Limited – expires 11.04.1988
- 21.03.1990 (Y 897755) – expired due to effluxion of time – not investigated
- 21.06.1991 (Z 720822) – expired due to effluxion of time – not investigated
- 21.07.1994 (U 460385) – expired due to effluxion of time or surrendered – not investigated
- 03.05.2001 (7582199) – expired due to effluxion of time – not investigated
- 16.03.2010 (AF 374720) – expired due to effluxion of time or surrendered – not investigated
- 14.11.2012 to ToonaSinensis Pty Ltd, of Ground Floor shop – expires 31.07.2014, also 3 year option

Table 1c: Search continued as regards Lot 4 D.P. 713505

Date of Acquisition	Registered Proprietor(s)	Possible Site Use
08.11.1943 (1943 to 1987)	Evelyn Mary Chasmar Gee (Married Woman)	Retail/Commercial
26.03.1987 (1987 to 1997)	Clement Morville Gee	Retail/Commercial
13.05.1997 (1997 to 2004)	Sheila Dorothy Gee	Retail/Commercial
10.08.2004 (2004 to 2011)	Lindfield One Pty Limited	Retail/Commercial
11.01.2011 (2011 to date	# Linshop Pty Ltd	Retail/Commercial

# Denotes current registered proprietors

Easements: -

- 05.07.1929 Right of Way over the land hatched red on D.P. 713505 – cancelled 12.09.1984
- 09.04.1943 (D 198682) – Cross Easements

Leases: -

- 19.10.1956 to Reginald Sidney Holmes, Pastry Cook & Edith Holmes, Married Woman – expired 02.09.1968
- 04.01.1968 to Athol Gordon Pickering, Pastry Cook & Joan Pickering, Married Woman – expired 24.10.1974
- 04.07.1974 to David Jan, Business Proprietor & Sandra Jan, Married Woman
- 07.05.1991 (Z 617624) – expired due to effluxion of time – not investigated
- 22.07.1998 (5143995) – expired due to effluxion of time – not investigated
- 20.06.2001 (7702747) – expired due to effluxion of time – not investigated

5.3 NSW WorkCover Dangerous Goods Database

A search of the NSW WorkCover Dangerous Goods Database indicated that no dangerous goods have previously been registered and stored at the properties.

Records of the database search are provided in Appendix E.

5.4 Council Section 149 (2) & (5) Planning Certificates

The Section 149 (2) & (5) planning certificates were obtained for the site from Ku-ring-gai Council and are dated 16 January 2015. A copy of the certificates is provided in Appendix F.

The certificate indicates that the site is zoned B2 Local Centres under the Ku-ring-gai Local Environmental Plan (Local Centres) 2012. The property is not affected by matters as prescribed by Section 59(2) of the Contaminated Land Management Act 1997.

5.5 Regulatory Notices Search

The EPA publishes records of contaminated sites under section 58 of the CLM Act on a public database accessed via the internet. The notices relate to investigation and/or remediation of site contamination considered to be significantly contaminated under the definition in the CLM Act. More specifically the notices cover the following:

- Actions taken by the EPA under sections 15, 17, 19, 21, 23, 26 or 28 of the CLM Act;
- Actions taken by the EPA under sections 35 or 36 of the Environmentally Hazardous Chemicals Act 1985;
- Site audit statements provided to the EPA under section 52 of the CLM Act on sites subject to an in-force remediation order.

A search of the public database on 8 January 2015 revealed that the subject properties are not listed.

It should be noted that the EPA record of Notices for contaminated land does not provide a record of all contaminated land in NSW.

One property has been listed as contaminated under the CLM register and one property has been listed as a contaminated site and notified to the EPA in Lindfield, under the *List of NSW Contaminated Sites Notified to the EPA*. These include the following, respectively:

- *Former BP Service Station*, 478 Pacific Highway, Lindfield. The site has been declared as significantly contaminated land and is subject to an approved Voluntary Management Program. The contaminants of concern include BTEX and TRH C_6-C_{40} (approximately 800m north west of the site); and
- *Mobil Service Station*, 238 Pacific Highway, Lindfield. The site is currently under assessment by the EPA (approximately 500 m south west of the site).

Neither of the two sites are considered to be impacting on soil and groundwater quality at the properties.

The NSW EPA also issues environmental protection licenses under section 308 of the POEO Act. The register contains:

- Environmental protection licenses;
- Applications for new licenses and to transfer or vary existing licenses;
- Environment protection and noise control licenses;
- Convictions in prosecutions under the POEO Act;
- The result of civil proceedings;
- License review information;
- Exemptions from provisions of the POEO Act or Regulation;
- Approvals granted under Clause 9 of the POEO Act or Regulations;
- Approvals granted under Clause 7a of the POEO (Clean Air) Regulation.

A search of the public register indicates that no licenses were listed for the subject properties.

5.6 Council Records Search

A search of the Ku-ring-gai Council records was conducted on the 7 January 2015.

The record search indicated that the properties had largely been used as a restaurant and take away food facility. It is understood that prior to its use as a food outlet, the premises had been used as a childrens wear shop (during the early 1970s), a tennis goods shop (mid to late 1970s) and then in 1988 as a pizza outlet. No matters of a contaminating nature were identified during the council record search.

It is noted, however, that the premises next door (currently a United Petrol Station) was previously owned by Caltex.

6. Site Inspection

A site plan is included as Drawing 1, Appendix A and site photographs are provided in Appendix G.

23 - 25 Lindfield Avenue
At the time of the inspection this section of the site was occupied by a single storey commercial/ retail brick building with a small brick outhouse. A crawl space was present underneath the building/ part of the building, and wood, tools and general rubbish could be seen through the access hole.

The area to the north of the building was paved with asphaltic concrete and was used for parking, vehicle access from Kochia Lane and pedestrian access to Lindfield Arcade. Occupants included property/legal advice agent. No signs of contaminant concern were observed in this area.

27 - 31 Lindfield Avenue
This section of the site was occupied by Lindfield Arcade and extended from Lindfield Avenue through to Havilah Lane. Lindfield Arcade comprised a three storey brick building, including a partial basement level located below Lindfield Avenue but with ground level entrance off Havilah Lane. The Arcade extended onto 11 Havilah Lane, as discussed below.

The majority of the stores within the arcade were vacant at the time of the inspection with the exception of a hair salon and massage parlour. Remnant signage on some of the vacant shops indicated that the arcade was previously occupied by retail tenancies including a fruit shop and butcher. The partial basement level was located beneath the retail floors and was used as a car park, loading dock and storage areas for the commercial/retail premises above.

A fibreglass above-ground grease trap was located towards the north-east end of the basement. The grease trap was located on a concrete slab, although the area was not bunded. Various items/ rubbish were present on the floor around the grease trap.

Two 44 gallon drums were present against the eastern wall of the basement, and the drums were labelled as waste cooking oil. Some dark staining was present on the floor around the tanks. Other various items/ rubbish including car parts were also sporadically dumped within the basement.

A second, above-ground grease trap was located within the boundary of this part of the site, in the central portion of the north western site boundary, in an alcove in the wall of the building accessible from 11 Havilah Lane.

The south western end of the basement level included a cool room, which was not entered, and other storage areas.

33 - 41 Lindfield Avenue
This section of the site was occupied by five, two storey brick buildings with single storey sections towards the rear (north-east). The bottom floors fronting Lindfield Avenue were occupied by a now closed down seafood retailer (with “hot food”), a closed down newsagency a possible closed down Chinese restaurant and a still operational café and liquor land outlet occupied the ground floors (fronting Lindfield Avenue) and the upper storeys appeared to be for residential use.

The rear yard areas were occupied by a small metal sheds an area of overgrown grass and several waste bins (assumed to be associated with the retail activities). The rear of 33 Lindfield Avenue, occupied by the seafood shop, had an above-ground grease trap, connected with an in-ground drain adjacent to the south east boundary (with 27-31 Lindfield Ave), a small outhouse and toilet was present at the rear of 33.

The rear of 39 Lindfield Avenue (the cafe) was enclosed by large metal fences and was not able to be inspected. 41 Lindfield Avenue is directly adjacent the united service station located to the north of the site.

11 Havilah Lane
A two storey, brick building with an undercroft occupied this section of the site and was part of Lindfield Arcade, connected with the 27-31 Lindfield Avenue building. At the time of the inspection this section of the site was occupied by a Franklins grocery store.

The undercroft area was generally used as a car park, loading dock and for storage. One of the grease traps located at 11 Lindfield Avenue was accessible from the under croft.

9 Havilah Lane
This section of site was occupied by an asphalt paved car park in good condition with no significant cracking or penetrations through the hardstand, at the time of the inspection the carpark had been fenced off to prevent its use.

7. Preliminary Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be

exposed to contamination either in the present or the future i.e. it enables an assessment of the potential source – pathway – receptor linkages.

7.1 Potential Contamination Sources and Contaminants of Concern

Based on the previous investigations, site inspection, and historical review of 39 and 41 Lindfield Avenue, the following potential sources of contamination and associated contaminants of concern have been identified (Table 2).

Table 2: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
Imported fill of unknown origin	Fill material across the site	Common contaminants associated with fill include heavy metals, TRH, BTEX, PAH, PCB, OCP, OPP, PCB, phenols, asbestos
Current site use and features	Asbestos in buildings/general wear and tear – it is known that the site has previously had a shed potentially containing asbestos materials.	Asbestos (bonded and fibrous forms), heavy metals, TRH, PAH, BTEX, VOC, phenols
Adjacent land uses	An operational service station and mechanical workshop is located to the north of the site (United Petrol)	TRH, BTEX, PAH, metals, VOCs, phenols

The potential contamination sources (S) on and adjacent to the site are therefore as follows:

S1 Fill

S2 Current site use and features

S3 Adjacent land uses – service station

7.2 Potential Receptors

7.2.1 Human Health Receptors

R1 Current site users (workers and customers of commercial premises)

R2 Construction and maintenance workers

R3 Final end users (residential and commercial users with limited soil access)

R4 Land users in adjacent areas (residential and commercial).

7.2.2 Environmental Receptors

R5 Groundwater

R6 Surface water (urban water draining to Middle Harbour)

R7 Ecology

7.2.3 Potential Pathways

Potential pathways for contamination include the following:

P1 Direct contact with soil or groundwater (ingestion and dermal)

P2 Inhalation of dust and/or vapours

P3 Leaching of contaminants and vertical migration into groundwater

P4 Surface water run-off

P5 Lateral migration of groundwater

7.3 Summary of Preliminary CSM

A 'source-pathway-receptor' approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1 to S3) and receptors (R1 to R7) are provided in Table 3 below.

Table 3: Preliminary Conceptual Site Model

Potential Source	Pathway	Receptor
S1 - Fill	P1 – direct contact	R1, R2, R3, R6, R7
	P2 - Inhalation	R1, R2, R3, R4
	P3 – Leaching of contaminants	R5, R7
S2 – Current site use and features	P1 – direct contact	R1, R2, R3, R6, R7
	P2 - Inhalation	R1, R2, R3, R4
	P3 – Leaching of contaminants	R5, R7
	P4 – Surface water runoff	R5, R7
S3 – Adjacent land uses	P1 – direct contact	R1, R2, R3, R6, R7
	P2 - Inhalation	R1, R2, R3, R4
	P3 – Leaching of contaminants	R5, R7

8. Fieldwork and Analysis

8.1 Data Quality Objectives and Project Quality Procedures

The DSI has been devised broadly in accordance with the seven step data quality objective (DQO) process which is provided in Appendix B, Schedule B2 of NEPC (2013). The DQO process is outlined as follows:

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

Referenced sections for the respective DQOs listed above are presented in Appendix H.

8.2 Data Quality Indicators

The performance of the assessment in achieving the DQO was assessed through the application of Data Quality Indicators (DQI), defined as follows:

Precision:	A quantitative measure of the variability (or reproducibility) of data;
Accuracy:	A quantitative measure of the closeness of reported data to the "true" value;
Representativeness:	The confidence (expressed qualitatively) that data are representative of each media present on the site;
Completeness:	A measure of the amount of useable data from a data collection activity;
Comparability:	The confidence (expressed qualitatively) that data can be considered equivalent for each sampling and analytical event.

Further comments on the DQIs are presented in Appendix H.

8.3 Soil Sampling Locations and Rationale

A total of nine boreholes (BH101 to BH109) were drilled across the site to supplement sampling conducted previously by EIS (2013) and DP (2013). The number of boreholes complies with the NSW EPA's *Sampling Design Guidelines* 1995 (EPA 1995), which requires a minimum of nine sampling points to characterise the site. The total number of sampling locations relevant to the investigation is 19. The density of sampling was requested to provide reasonable confidence in the *in situ* waste classification, as discussed in Section 12.4.

Environmental work, including drilling and soil sampling, was conducted on 11 and 12 December 2014, simultaneously with DP's geotechnical investigation works, the results of which are reported separately (DP Project 73174.02). Groundwater development took place on the 5 December 2014, and sampling took place on the 12 December 2014. Soil samples were collected from the nine test bores (BH101 to BH109) and groundwater samples were collected from the four existing groundwater monitoring wells (BH1, BH5, MW1 and MW4).

Borehole locations are shown on Drawing 2, Appendix A.

8.4 Drilling Methods

Drilling was undertaken using a bobcat mounted drill rig (Dando Terrier) using the push tube method and disposable liners. Concrete coring was undertaken, followed by push tube to a maximum depth of 2.6 m bgl. A 110 mm diameter solid flight auger and rotary drilling were used to drill to bedrock at one location (BH101) for geotechnical investigation purposes. Refusal was encountered at location BH105 on a suspected ironstone band. The target depth was reached for all other locations. Boreholes were backfilled and / or reinstated with concrete.

8.5 Soil and Groundwater Sampling Procedures

Environmental sampling was performed according to standard operating procedures outlined in the DP *Field Procedures Manual*. All sampling data was recorded on borehole logs presented in Appendix I and selected samples for laboratory analysis were recorded on DP chain-of-custody (COC) sheets. The general soil sampling procedure comprised:

- Decontamination of re-useable sampling equipment using a 3% phosphate free detergent (Decon90) and distilled water prior to collecting each sample or use of disposable sampling equipment;
- Use of disposable sampling equipment including nitrile gloves and disposable groundwater tubing;
- Transfer of samples into laboratory prepared glass jars and bottles (with appropriate preservatives for analytes) and capping immediately with Teflon lined lids;
- Labelling of sampling containers with individual and unique identification, including project number sample location and sample depth; and
- Placement of sample containers and bags into a cooled, insulated and sealed container for transport to the laboratory.

The groundwater levels were measured using an interface meter and the wells were developed by removing a minimum of three bore volumes of water using a submersible pump. The wells were allowed to recharge and groundwater levels re-measured including the measurement of phase separated hydrocarbons (PSH). No PSH were noted.

The wells were micro-purged using a low flow pump (Geopump) until field parameters (pH, temperature, dissolved oxygen (DO), conductivity, total dissolved solids (TDS) and redox) had stabilised. Once field parameters had stabilised, samples were collected using the low flow pump.

Samples were placed with a minimum of aeration into appropriately preserved bottles. For analysis of metals the relevant sample fraction was filtered using an in-line disposable 0.45 µ filter that was changed between samples.

The sample pump and all non-disposable sampling equipment was decontaminated between samples via a "triple rinse" procedure i.e. a rinse of all particulates in tap water followed a decontamination using a 3% Decon 90 solution and a final rinse in deionised water.

The sample management comprised the following:

- Collection of 10% replicate samples for QA/QC purposes, or at least one per field sampling date. In addition laboratory prepared trip spikes and blanks were taken into the field unopened for every day of sampling;
- Placement of samples in insulated coolers (through the use of ice; topped up as required) until transported to the analytical laboratory, and
- Chain of custody documentation was maintained at all times and countersigned by the receiving laboratory on transfer of samples.

Envirolab Services Pty Ltd, accredited by NATA, was employed to conduct the primary sample analysis. The laboratory is required to carry out in-house QC procedures.

8.6 Analytical Rationale

The analytical scheme was designed to obtain an indication of the potential presence and possible distribution of identified COPC based on information obtained in previous investigations and the preliminary CSM for past and present activities and features within the site. The primary contaminants of concern as identified in Section 7 are metals, TRH, BTEX, PAH, VOC, phenols, OCP, PCB and asbestos. Soil samples were selected for analysis on the basis of site observations (odour, staining etc), and their location within the subsoil strata (i.e. fill or natural).

8.7 Field Quality Assurance and Quality Control

The field QC procedures for sampling were as prescribed in Douglas Partners' *Field Procedures Manual*, and are outlined in Section 8.5.

Field replicates were recovered and analysed for a limited suite of contaminants by means of intra-laboratory and inter-laboratory analysis. Trip blanks and trip spikes were also taken into the field. This is in accordance with standard industry practice and guidelines.

8.8 Laboratory QA/QC

The analytical laboratories, accredited by NATA, are required to conduct in-house QA/QC procedures. These are normally incorporated into every analytical run and include reagent blanks, spike recovery,

surrogate recovery and duplicate samples. These results are included in the laboratory certificates in Appendix J.

The results of the DP assessment of laboratory QA/QC are shown in Appendix H, with the full laboratory certificates of analysis included in Appendix J.

9. Assessment Criteria

The assessment criteria have been sourced from the National Environment Protection Council (NEPC) *National Environment Protection Measure (Assessment of Site Contamination)* 1999, as amended 2013 (NEPM 2013).

The site assessment criteria (SAC) comprise health-based investigation levels (HILs), health screening levels (HSLs), management limits for TRH, groundwater investigation levels (GILs) and groundwater screening levels (GSLs) as detailed below. The laboratory Practical Quantitation Limit (PQL) has also been adopted as a screening level for some contaminants.

9.1 Soils

9.1.1 Health-based Investigation Levels (Non-petroleum Chemical Contaminants)

Table 4 shows the HILs that have been adopted by NEPC (2013) Schedule B1, Table 1A(1) for assessing the human health risk from a contaminant via relevant pathways of exposure as detailed in the CSM (Section 7). Table 4 only includes contaminants analysed in this assessment and not the full list provided in NEPC (2013).

The proposed development is a mixture of commercial / retail and residential, the most sensitive in terms of exposure to contaminants being residential. As such, unless discussed otherwise, the SAC have been selected for a residential land use with minimal opportunities for soil access.

Table 4: Health Investigation Levels (Non-petroleum Chemical Contaminants)

Contaminant	HIL B – Residential with minimal soil access (mg/kg)
Metals and Inorganics	
Arsenic	500
Cadmium	150
Chromium (IV)	500
Copper	30,000
Lead	1,200
Mercury (inorganic)	120
Nickel	1,200
Zinc	60,000
PAH	
Carcinogenic PAH (as benzo(a)pyrene TEQ)	4
Total PAH	400
Phenols	
Phenol	45,000
OCP	
DDT + DDD + DDE	600
Aldrin + Dieldrin	10
Chlordane	90
Endosulfan (total)	400
Endrin	20
Heptachlor	10
HCB	15
Methoxychlor	500
Other Pesticides	
Chlorpyrifos	340
Other Organics	
PCB	1

9.1.2 Petroleum Contaminants (Health Screening Levels and Management Limits)

Health Screening Levels

Table 5 shows petroleum hydrocarbon compounds adopted from NEPC (2013) Schedule B1, Table 1A(3) and are based on the exposure to petroleum hydrocarbons through the dominant vapour inhalation exposure pathway only (i.e. not direct contact to soils). The screening levels are adopted given the exposure risk as detailed in the CSM (Section 7). The proposed development incorporates a basement level car park, as well as a retail/commercial level on the ground floor followed by residential space from level one. Therefore, as noted in the footnotes to Table 1A(3) of NEPC (2013), the relevant and adopted HSLs are HSL D, commercial/industrial.

The HSLs are based on overlying soil type and depth. HSLs for both clay and sand have been used based on the materials encountered at the site (refer to Section 10). Given the shallow depth of fill and the proposed basement excavation, the depth range of 0m to <1m has been used.

Direct contact HSLs have not been included as assessment criteria as the current proposed land use minimises soil contact. It is further noted that NEPC (2013) Schedule B1 Section 2.4.11 states that HSLs for direct contact are significantly higher than most other soil screening levels and are unlikely to become drivers for further investigation or soil management.

Table 5: Soil Health Screening Levels for Vapour Intrusion

Contaminant	Soil Type	HSL D Commercial/Industrial (mg/kg)
		Depth 0m to <1m
Toluene	Sand	NL
Ethylbenzene		NL
Xylenes		230
Naphthalene		NL
Benzene		3
TRH C_6-C_{10} less BTEX [F1]		260
TRH >C_{10}-C_{16} less Naphthalene [F2]		NL
Toluene	Clay	NL
Ethylbenzene		NL
Xylenes		NL
Naphthalene		NL
Benzene		4
TRH C_6-C_{10} less BTEX [F1]		310
TRH >C_{10}-C_{16} less Naphthalene [F2]		NL

Note: - NL "not limiting" to human health for the proposed land use for vapour intrusion from petroleum hydrocarbons

Management Limits (TRH Only)

NEPC (2013) Table 1B(7) provides 'management limits' for TRH fractions, which are applied after consideration of relevant HSLs. The management limits have been adopted to avoid or minimise the following potential effects of petroleum hydrocarbons:

- Formation of non-aqueous phase liquids (LNAPL);
- Fire and explosive hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

The presence of site TRH contamination at the levels of the management limits does not imply that there is no need for administrative notification or controls in accordance with jurisdictional requirements. The adopted management limits are shown in Table 6 and have been selected based on the CSM (Section 7).

Management limits for coarse material are presented in Table 6 due to the presence of both clayey and sandy soil at the site, however, management limits for coarse soil textures are adopted as the first level for comparison as this is more conservative of the two.

Table 6: Management Limits for TRH Fractions in Soil

TRH Fraction	Soil Texture	Management Limit Residential (mg/kg)
C_6-C_9	Coarse	700
>C_{10}-C_{16}	Coarse	1,000
>C_{16}-C_{34}	Coarse	2,500
>C_{34}-C_{40}	Coarse	10,000

9.1.3 Asbestos

Presence/absence testing for asbestos has been conducted as a screening assessment. If asbestos or indicators of asbestos (e.g. significant inclusions of building debris) are observed, further assessment and/or management for asbestos in accordance with NEPC (2013) will be recommended.

9.2 Groundwater

9.2.1 Groundwater Investigation Levels

The groundwater investigation levels (GILs) adopted in NEPC (2013) are based on:

- *Australian Water Quality Guidelines* 2000 (AWQG);
- *Australian Drinking Water Guidelines* 2011 (ADWG);
- *Guidelines for Managing Risk in Recreational Waters* 2008 (GMRRW); and
- National water quality management strategy. Australian and New Zealand *Guidelines for Fresh and Marine Water Quality* 2000 (ANZECC and ARMCANZ).

The adopted GILs for the analytes included in this assessment and the corresponding source documents, are shown in Table 7. Drinking water thresholds have not been adopted as there is no known drinking water receptor in close proximity to the site.

Table 7: Groundwater Investigation Levels (in µg/L unless otherwise stated)

Analyte		GIL	Comments
Metals	Arsenic (III) Arsenic (V) Cadmium Chromium (III) Chromium (VI) Copper Lead Mercury (total) Nickel Zinc	24 13 0.2 3.3 1 1.4 3.4 0.06 11 8	GIL have not been adjusted for hardness.
PAH	Naphthalene Benzo(a)pyrene	16 0.1[a]	
BTEX	Benzene Toluene Ethylbenzene Xylene (o) Xylene (p)	950 180[a] 80[a] 350 200	
OCP	Chlordane DDT Endosulfan Endrin Heptachlor	0.03 0.006 0.03 0.01 0.01	
PCB	Aroclor 1242 Aroclor 1254	0.3 0.01	
VOC	Trichloroethene (TCE) Chloroform	330[a] 370[a]	Given the exhaustive list of VOC contaminants, only those VOC concentrations detected above the laboratory reporting limits and with GILs have been included in this table

Note: In cases where no high reliability trigger values are provided, the moderate or low reliability trigger values provided in ANZECC & ARMCANZ (2000) have been used as screening levels (a)

9.2.2 Health Screening Levels – Petroleum Hydrocarbons

The proposed development incorporates a basement level car park, as well as a retail/commercial level on the ground floor followed by residential space from level one. Therefore, as noted in the footnotes to Table 1A(4) of NEPC (2013), the relevant and adopted HSLs are HSL D, commercial/industrial.

In addition, the HSL adopted is predicted on the following inputs prescribed in Table 8.

Table 8: Inputs to the Derivation of HSLs

Variable	Input	Comment
Potential exposure pathway	Groundwater vapour intrusion	Exposure pathway via groundwater vapour intrusion affects the adopted HSL
Soil Type	Sand (in the absence of laboratory particle analysis sand HSL have been adopted as an initial conservative screen), sand being the most conservative soil type.	Soil properties including soil saturation porosity affect risk of exposure and are therefore factored into HSLs. A conservative soil type should be selected where the soil profile is not uniform (NEPC, 2013)
Depth to Contamination	2 m to <4 m	initial screening depth given the proposed basement excavation below the standing water level

The adopted groundwater HSL for vapour intrusion, from Table 1A(4), Schedule B1 of NEPC (2013) are shown in the following Table 9.

Table 9: Groundwater Health Screening Levels (HSL) for Vapour Intrusion (µg/L)

Analyte		HSL D	Comments
TRH	$C_6 – C_{10}$ (less BTEX) [F1]	6,000	*Sand profile depth to contamination 2 m to <4 m*
	$>C_{10} – C_{16}$ (less naphthalene) [F2]	NL	
BTEX	Benzene	5,000	
	Toluene	NL	
	Ethylbenzene	NL	
	Xylene	NL	
PAH	Naphthalene	NL	

Notes:

NL – the solubility limit is defined as the groundwater concentration at which the water cannot dissolve any more of an individual chemical based on a petroleum mixture. The soil vapour which is in equilibrium with the groundwater will be at its maximum. If the derived groundwater HSL exceeds the water solubility limit, a soil-vapour source concentration for a petroleum mixture could not exceed a level that would result in the maximum allowable vapour risk for a given scenario. For these scenarios no HSL is presented for these chemicals. These are denoted as not limiting 'NL'.

9.3 Contaminants with No Assessment Criteria

Where no guidance is provided in NEPC (2013) for a specific analyte, the PQL will be used as the initial screening criteria.

If concentrations are recorded above the PQL, reference criteria will be sourced from other national and international guidance as relevant and use to determine the significance of the detected analyte.

The referenced criteria are provided in the results summary tables (Section 11, Laboratory Results).

10. Fieldwork Observations

10.1 Soil

The bore logs applicable to this DSI are included in Appendix I. Based on the logs at the test locations the subsoil profile can be broadly described as:

CONCRETE or ASPHALT – Concrete slabs to depths of 0.12 m to 0.17 m or asphalt to depths of 0.02 m bgl; underlain by,

FILL - Variable fill, including sand and gravels (basalt and concrete), whole bricks and fragments (BH109) to depths of up to 0.47; underlain by,

SILTY CLAY – stiff to very stiff to depths up to 3.8 m bgl; underlain by,

SHALY/SANDY CLAY – to depths up to 5.05 m bgl; underlain by,

SANDSTONE – low to medium then medium strength, highly weathered sandstone to 7.0 m bgl; underlain by,

LAMINITE – low to medium strength, slightly fractured.

10.2 Groundwater

No free groundwater was observed during auguring.

Water levels measured at groundwater monitoring well locations are summarised in Table 10.

Table 10: Water Measurements at Monitoring Well Locations

GWMW	Installation Date	Groundwater Measurements (m bgl)		
		5/12/2014 (prior to development)	5/12/2014 (post development)	12/12/2014 (prior to sampling)
MW1	18/07/2013 (EIS)	2.0	-	1.77
MW3	18/7/2013 (EIS)	2.5	-	1.55
1	17/9/2012 (DP)	2.5	-	2.81
4	17-18/9/2012 (DP)	3.0	-	2.7

No odours were recorded during sampling and no free product or sheen was observed. Low recharge rates were noted.

11. Analytical Results

The results of the laboratory analysis are presented in the following Table 11 (Soil) and Table 12 (Groundwater).

The full NATA laboratory reports together with the chain of custody and sample receipt information are presented in Appendix J.

					BTEX							Halogenated Benzenes	Lead		Metals								OCP/OPP							
					Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene Total	C6-C10 less BTEX (F1)	Hexachlorobenzene	Lead	Lead TCLP	Arsenic	Cadmium	Chromium (III+VI)	Copper	Mercury	Nickel	Nickel TCLP	Zinc	Aldrin + Dieldrin	DDT+DDE+DDD	Endrin	Heptachlor	Methoxychlor	Chlorpyrifos	Benzo(a) pyrene TEQ	BaP TCLP
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
PQL					0.2	1	0.5	2	1		25	0.1	1	0.05	4	0.4	1	1	0.1	1	0.02	1			0.1	0.1	0.1	0.1	0.05	
NEPM (2013) Table 1A(1) HILs Residential B Soil												80	1200		500	150		30,000	120	1200		60,000	10	600	20	10	500	340	4	
NEPM (2013) Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Clay																														
0-1m					4	NL	NL			NL	310																			
NEPM (2013) Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																														
0-1m					3	NL	NL			230	260																			
NEPM (2013) Table 1B(7) Management Limits Residential, Coarse Soil																														
NSW EPA (2014) General Solid Waste CT1					10	600	288			1000			100		100	20	100		4	40			<50 (total Scheduled Chemicals)					0.8	
NSW EPA (2014) General Solid Waste SCC1					18	1080	518			1800			1500		500	100	1900		50	1050			<50 (total Scheduled Chemicals)					10	
NSW EPA (2014) General Solid Waste TCLP1 (only analytes with project TCLP tests are shown)														5							2								
DP 2012																														
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**																										
BH1	BH1	0.4	17/09/2012	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	130	0.04	4	<0.5	17	10	<0.1	8	-	66	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	-	-
BH2	BH2	0.5	14/09/2012	Sandy Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	23	-	10	<0.5	35	<1	<0.1	2	-	21	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	-	-
BH2	BH2	1.3	14/09/2012	Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	25	-	4	<0.5	16	<1	<0.1	<1	-	3	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	-	-
BH2	BH2	2.7-2.9	14/09/2012	Shaly Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH3	BH3	0.25	19/09/2012	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	36	-	7	<0.5	24	11	<0.1	5	-	76	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	-	-
BH3	BH3	1	19/09/2012	Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	18	-	8	<0.5	29	<1	<0.1	<1	-	1	-	-	-	-	-	-	-	-
BH4	BH4	0.6	17/09/2012	Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	14	-	9	<0.5	35	4	<0.1	7	-	7	-	-	-	-	-	-	-	-
BH5	BH5	0.2	17/09/2012	Sandy Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	120	0.09	8	0.6	34	42	0.4	6	-	170	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	-	-
BH5	BH5	1.7	17/09/2012	Shaly Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	11	-	6	<0.5	24	<1	<0.1	<1	-	<1	-	-	-	-	-	-	-	-
BH6	BH6	0.25	17/09/2012	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	14	-	<4	<0.5	14	8	<0.1	10	-	6	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	-	-
BH6	BH6	1	17/09/2012	Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	16	-	<4	<0.5	7	1	<0.1	<1	-	<1	-	-	-	-	-	-	-	-
DUP1	DUP1	-	17/09/2012	Field Replicate of BH3/1	-	-	-	-	-	-	-	-	17	-	7	<0.5	36	<1	<0.1	<1	-	4							-	-
DUP1A	DUP2	-	17/09/2012	Field Triplicate of BH3/1	-	-	-	-	-	-	-	-	21	-	14	0.4	20	<2	<0.05	<1	-	8.9	-	-	-	-	-	-	-	-
EIS 2013																														
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**																										
BH1	BH1	0.2-0.4	18/07/2013	Silty Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	28	-	7	<0.4	36	5	<0.1	6	-	140	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH1	BH1	1.3-1.5	18/07/2013	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	31	-	9	<0.4	47	10	<0.1	6	-	67	-	-	-	-	-	-	<0.5	-
BH2	BH2	0.1-0.3	18/07/2013	Silty Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	87	-	7	0.7	28	27	0.1	24	-	130	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	2	<PQL
BH2	BH2	0.8-1.0	18/07/2013	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	93	-	8	<0.4	38	45	0.5	6	-	100	-	-	-	-	-	-	<0.5	-
BH3	BH3	0.2-0.4	18/07/2013	Sily Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	90	-	6	0.9	27	27	0.1	14	-	100	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	2	<PQL
BH3	BH3	0.8-1.0	18/07/2013	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	14	-	7	<0.4	39	2	<0.1	5	-	4	-	-	-	-	-	-	<0.5	-
BH4	BH4	0.1-0.3	18/07/2013	Silty Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	38	-	5	<0.4	28	12	<0.1	19	-	35	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH4	BH4	1.3-1.5	18/07/2013	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	14	-	8	0.5	31	6	<0.1	1	-	2	-	-	-	-	-	-	<0.5	-
BH5	BH5	0.1-0.2	18/07/2013	Silty Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	13	-	6	<0.4	31	6	<0.1	13	-	11	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH5	BH5	5.6-5.9	18/07/2013	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	12	-	10	<0.4	15	5	<0.1	<1	-	2	-	-	-	-	-	-	<0.5	-
BH6	BH6	0.1-0.2	18/07/2013	Silty Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	7	-	<4	<0.4	8	51	<0.1	97	0.07	130	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH6	BH6	0.1-0.2	18/07/2013	Silty Clay Filling	-	-	-	-	-	-	-	-	85	-	<4	3.1	20	30	<0.1	44	-	2300	-	-	-	-	-	-	-	-
BH6	BH6	1.3-1.5	18/07/2013	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	12	-	8	<0.4	31	<1	0.2	<1	-	16	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
DUP 1	DUP1	-	18/07/2013	Field Replicate of BH6/0.1-0.2	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	13	-	<4	0.4	9	53	<0.1	94	-	190	-	-	-	-	-	-	<0.5	-
DUP1A	DUP1A	-	18/07/2013	Field Triplicate of BH6/0.1-0.2	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	16	-	<4	0.5	12	63	<0.1	110	-	240	-	-	-	-	-	-	0.5	-
TB	TB	-	18/07/2013	Trip Blank	-	<1	<0.5	<2	<1	<3	<25	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FR	FR	-	18/07/2013	Field Rinsate	-	<1	<0.5	<2	<1	<3	<25	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Current Assessment (DP 2015)																														
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**																										
BH101	BH101	0.1	12/12/2014	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	-	6	-	<4	<0.4	11	65	<0.1	120	0.2	45	-	-	-	-	-	-	<0.5	-
BH101	BH101	0.5	12/12/2014	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	26	-	7	<0.4	43	2	<0.1	6	-	16	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH101 - TRIPLICATE	BH101 - TRIPLICATE	0.5	12/12/2014	Lab Triplicate	-	-	-	-	-	-	-	-	23	-	8	<0.4	44	2	<0.1	6	-	12	-	-	-	-	-	-	-	-
BH102	BH102	0.05-0.15	11/12/2014	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	4	-	<4	<0.4	10	62	<0.1	120	0.2	41	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH103	BH103	0.7-0.1	11/12/2014	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	19	-	8	<0.4	18	<1	<0.1	<1	-	<1	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH104	BH104	0.12-0.18	11/12/2014	Gravel Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	5	-	<4	<0.4	13	50	<0.1	49	-	23	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH105	BH105	0.2-0.3	11/12/2014	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	7	-	<4	<0.4	87	26	<0.1	87	0.08	46	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH106	BH106	0.08-0.2	11/12/2014	Clay Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	15	-	<4	<0.4	11	6	<0.1	5	-	7	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH106	BH106	1.6-1.7	11/12/2014	Shaly Clay	<0.2	<1	<0.5	<2	<1	<3	<25	-	15	-	<4	<0.4	2	3	<0.1	<1	-	<1	-	-	-	-	-	-	<0.5	-
BH107	BH107	0.2-0.3	11/12/2014	Gravel Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	19	-	4	<0.4	25	7	<0.1	20	-	13	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.5	-
BH107 - TRIPLICATE	BH107 - TRIPLICATE	0.2-0.3	11/12/2014	Lab Triplicate	-	-	-	-	-	-	-	-	25	-	8	<0.4	16	4	<0.1	12	-	10	-	-	-	-	-	-	-	-
BH108	BH108	0.15-0.35	11/12/2014	Sandy Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	33	-	<4	<0.4	13	16	<0.1	11	-	25	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	0.9	-
BH109	BH109	0.02-0.1	11/12/2014	Sand Filling	<0.2	<1	<0.5	<2	<1	<3	<25	<0.1	78	-	7	<0.4	75	34	0.2	65	0.03	130	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	0.7	-
BH109	BH109	0.7-1	11/12/2014	Silty Clay	<0.2	<1	<0.5	<2	<1	<3	<25	-	11	-	9	<0.4	31	<1	<0.1	<1	-	<1	-	-	-	-	-	-	<0.5	-
BH109	BH109	1.7-2	11/12/2014	Shaly Clay	<0.2	<1	<0.5	<2	<1	<3	<25	-	16	-	6	<0.4	19	<1	<0.1	<1	-	<1	-	-	-	-	-	-	<0.5	-
BD1A/111214	BD1A/111214	-	12/12/2014	Field Replicate of BH108/0.15-0.35	<0.2	<1	<0.5	<2	<1	<3	-	-	22	-	<4	<0.4	17	35	<0.1	25	-	31	-	-	-	-	-	-	-	-
TB	TB	-	12/12/2014	Trip Blank	<0.2	<1	<0.5	<2	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TS	TS	-	12/12/2014	Trip Spike	1.03	1.08	1.04	1.08	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

BTEX	Benzene, Toluene, Ethylbenzene and Xylene	PAH	Polycyclic Aromatic Hydrocarbon
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment	PQL	Practical Quantiation Limit
HIL	Health Investigation Level	TEQ	Toxicity Equivalence Quotient
HSL	Health Screening Level	TRH	Total Recoverable Hydrocarbon
NAD	No Asbestos Detected at Reporting Limit of 0.1g/kg; No Asbestos Detected	VOC	Volatile Organic Compounds
NEPM	National Environmental Protection Measure		
OCP/OPP	Organochlorine Pesticides/Organophosphorus Pesticides		
PCB	Polychlorinated Biphenyls		

Exceeds HIL/HSL

\- Not Analysed/Not Applicable/Not Available

					PAH			PCB	TPH										Asbestos	VOC
					Naphthalene	PAHs (Sum of total)	Phenolics Total		C10-C16	C16-C34	C34-C40	F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	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
PQL					0.1		5	0.1	50	100	100	50	25	50	100	100		25	NAD	-
NEPM (2013) Table 1A(1) HILs Residential B Soil						400														
NEPM (2013) Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Clay																				
0-1m					NL							NL								
NEPM (2013) Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand																				
0-1m					NL							NL								
NEPM (2013) Table 1B(7) Management Limits Residential, Coarse Soil									1000	2500	10,000							700		
NSW EPA (2014) General Solid Waste CT1						200							650				10,000		NAD	
NSW EPA (2014) General Solid Waste SCC1						200							650				10,000		NAD	
NSW EPA (2014) General Solid Waste TCLP1 (only analytes with project TCLP tests are shown)																				
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**																
BH1	BH1	0.4	17/09/2012	Sand Filling	<0.1	2.35	<5	<0.1	-	-	-	<50	<25	<50	<100	<100	<250	<25	NAD	<1
BH2	BH2	0.5	14/09/2012	Sandy Clay Filling	<0.1	<0.1	<5	<0.1	-	-	-	<50	<25	<50	<100	<100	<250	<25	NAD	<1
BH2	BH2	1.3	14/09/2012	Clay	<0.1	<0.1	<5	<0.1	-	-	-	<50	<25	150	<100	<100	150	<25	-	<1
BH2	BH2	2.7-2.9	14/09/2012	Shaly Clay	<0.1	-	-	-	-	-	-	<50	<25	<50	<100	<100	<250	<25	-	<1
BH3	BH3	0.25	19/09/2012	Sand Filling	<0.1	0.2	<5	<0.1	-	-	-	<50	<25	<50	<100	<100	<250	<25	NAD	<1
BH3	BH3	1	19/09/2012	Clay	<0.1	<0.1	-	-	-	-	-	<50	<25	<50	<100	<100	<250	<25	-	-
BH4	BH4	0.6	17/09/2012	Clay	<0.1	<0.1	-	-	-	-	-	<50	<25	<50	<100	<100	<250	<25	-	-
BH5	BH5	0.2	17/09/2012	Sandy Clay Filling	<0.1	7.56	<5	<0.1	-	-	-	<50	<25	<50	<100	<100	<250	<25	NAD	<1
BH5	BH5	1.7	17/09/2012	Shaly Clay	<0.1	<0.1	-	-	-	-	-	<50	<25	<50	<100	<100	<250	<25	-	<1
BH6	BH6	0.25	17/09/2012	Sand Filling	<0.1	<0.1	<5	<0.1	-	-	-	<50	<25	<50	<100	<100	<250	<25	NAD	<1
BH6	BH6	1	17/09/2012	Clay	<0.1	<0.1	-	-	-	-	-	<50	<25	<50	<100	<100	<250	<25	-	-
DUP1	DUP1	-	17/09/2012	Field Replicate of BH3/1	-	<0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DUP1A	DUP2	-	17/09/2012	Field Triplicate of BH3/1	-	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**																
BH1	BH1	0.2-0.4	18/07/2013	Silty Clay Filling	<0.1	<0.1	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH1	BH1	1.3-1.5	18/07/2013	Silty Clay	<0.1	<0.1	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
BH2	BH2	0.1-0.3	18/07/2013	Silty Clay Filling	<0.1	12	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH2	BH2	0.8-1.0	18/07/2013	Silty Clay	<0.1	0.05	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
BH3	BH3	0.2-0.4	18/07/2013	Sily Clay Filling	<0.1	9.7	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH3	BH3	0.8-1.0	18/07/2013	Silty Clay	<0.1	<0.1	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
BH4	BH4	0.1-0.3	18/07/2013	Silty Clay Filling	<0.1	2.8	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH4	BH4	1.3-1.5	18/07/2013	Silty Clay	<0.1	<0.1	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
BH5	BH5	0.1-0.2	18/07/2013	Silty Clay Filling	<0.1	<0.1	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH5	BH5	5.6-5.9	18/07/2013	Silty Clay	<0.1	<0.1	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
BH6	BH6	0.1-0.2	18/07/2013	Silty Clay Filling	<0.1	0.1	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH6	BH6	0.1-0.2	18/07/2013	Silty Clay Filling	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH6	BH6	1.3-1.5	18/07/2013	Silty Clay	<0.1	<0.1	-	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
DUP 1	DUP1	-	18/07/2013	Field Replicate of BH6/0.1-0.2	<0.1	3.6	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
DUP1A	DUP1A	-	18/07/2013	Field Triplicate of BH6/0.1-0.2	<0.1	0.8	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	-	-
TB	TB	-	18/07/2013	Trip Blank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FR	FR	-	18/07/2013	Field Rinsate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field_ID	**LocCode**	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**																
BH101	BH101	0.1	12/12/2014	Sand Filling	<0.1	0	-	-	<50	160	150	<50	<25	<50	<100	140	215	<25	NAD	-
BH101	BH101	0.5	12/12/2014	Silty Clay	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH101 - TRIPLICATE	BH101 - TRIPLICATE	0.5	12/12/2014	Lab Triplicate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH102	BH102	0.05-0.15	11/12/2014	Sand Filling	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH103	BH103	0.7-0.1	11/12/2014	Silty Clay	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH104	BH104	0.12-0.18	11/12/2014	Gravel Filling	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH105	BH105	0.2-0.3	11/12/2014	Sand Filling	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH106	BH106	0.08-0.2	11/12/2014	Clay Filling	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH106	BH106	1.6-1.7	11/12/2014	Shaly Clay	<0.1	0	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH107	BH107	0.2-0.3	11/12/2014	Gravel Filling	<0.1	0	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH107 - TRIPLICATE	BH107 - TRIPLICATE	0.2-0.3	11/12/2014	Lab Triplicate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH108	BH108	0.15-0.35	11/12/2014	Sandy Filling	<0.1	5.9	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH109	BH109	0.02-0.1	11/12/2014	Sand Filling	<0.1	4	<5	<0.1	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH109	BH109	0.7-1	11/12/2014	Silty Clay	<0.1	0	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BH109	BH109	1.7-2	11/12/2014	Shaly Clay	<0.1	0	-	-	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	NAD	-
BD1A/111214	BD1A/111214	-	12/12/2014	Field Replicate of BH108/0.15-0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TB	TB	-	12/12/2014	Trip Blank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TS	TS	-	12/12/2014	Trip Spike	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
HIL	Health Investigation Level
HSL	Health Screening Level
NAD	No Asbestos Detected at Reporting Limit of 0.1g/kg; No Asbestos Detected
NEPM	National Environmental Protection Measure
OCP/OPP	Organochlorine Pesticides/Organophosphorus Pesticides
PCB	Polychlorinated Biphenyls

Table 12: Summary of Laboratory Results for Groundwater

Sample ID	Date	Hardness	Metals								Polycyclic Aromatic Hydrocarbons				Total Recoverable Hydrocarbons				Volatile Organic Compounds								PCB	OCP	OPP
			As	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Naphthalene	Phenanthrene	Anthracene	Other PAH	C6 - C9	C10 - C36	C6 - C10 less BTEX	>C10-C16 less Naphthalene	Benzene	Toluene	Ethylbenzene	o-xylene	m+p xyelene	TCE	Chloroform	Bromodichloromethane	Other VOC			
		mgCaCO3/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	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Current Results																													
BH1	12/12/14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<1	<2	<1	<1	<1	<PQL	-	-	-
BH5	12/12/14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<1	<2	<1	<1	<1	<PQL	-	-	-
MW1	12/12/14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<1	<2	<1	13	2	<PQL	-	-	-
MW4	12/12/14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<1	<2	<1	<1	<1	<PQL	-	-	-
EIS 2013 Results																													
MW1	5/8/13	110 (M)	<4	<0.2	<1	1	<1	<0.05	2	15	<0.1	<0.1	<0.1	<PQL	<10	<250	<10	<100	<1	<1	<1	<1	<2	-	-	-	-	-	-	-
MW2	5/8/13	31 (S)	<4	<0.2	<1	<1	<1	<0.05	1	4	<0.1	0.1	**0.1**	<PQL	20	<250	20	<100	<1	<1	<1	<1	<2	-	-	-	-	-	-	-
DUP1A	5/8/13	-	<4	<0.2	<1	<1	<1	<0.05	1	5	<0.1	0.1	**0.1**	<PQL	21	<250	21	<100	<1	<1	<1	<1	<2	-	-	-	-	-	-	-
MW3	5/8/13	37 (S)	<4	<0.2	<1	<1	<1	<0.05	1	5	0.1	<0.1	<0.1	<PQL	<10	<250	<10	<100	<1	<1	<1	<1	<2	-	-	-	-	-	-	-
DP 2012 Results																													
GW1	12/11/12	23 (S)	<1	<0.1	<1	**6**	<1	<0.05	2	**21**	<0.1	<0.1	<0.1	<PQL	<10	<250	-	-	<1	<1	<1	<1	<2	<1	<1	<1	<PQL	<PQL	<PQL	<PQL
GW4	12/11/12	10 (S)	<1	<0.1	<1	1	<1	<0.05	<1	**25**	<0.1	<0.1	<0.1	<PQL	<10	<250	-	-	<1	<1	<1	<1	<2	2	<1	<1	<PQL	<PQL	<PQL	<PQL
GWBD1A	12/11/12	10 (S)	<1	<0.1	<1	**2**	<1	<0.05	<1	4	<0.1	<0.1	<0.1	<PQL	<10	<250	-	-	<1	<1	<1	<1	<2	2	<1	<1	<PQL	-	-	-
GWBD1B	12/11/12	8 (S)	<1	<0.1	**2**	**2**	<1	<0.0001	<1	5	<0.1	<0.1	<0.1	<PQL	<40	<450	-	-	<0.5	<0.5	<0.5	<0.5	<1	1	<1	<1	<PQL	-	-	-
Guideline Values																													
Groundwater Investigation Levels			24 as As(III) 13 as As(V)	0.2 (S) 0.5 (M)	3.3 (S) & 8.3 (M) as Cr(III) 1 as Cr(VI)	1.4 (S) 3.5 (M)	3.4 (S) 13.6 (M)	0.06	11 (S) 28 (M)	8 (S) 20 (M)	16	0.6	0.01	-	-	-	-	-	950	180	80	350	200 as p-xylene 75 as m-xylene	6500	370	-	-	-	-	-
Health Screening Levels for Vapour Intrusion			-	-	-	-	-	-	-	-	NL	-	-	-	-	-	6000	NL	5000	NL	NL	NL		-	-	-	-	-	-	-

Notes:

DUP1A	Replicate of MW2 (5/8/13)
GWBD1A	Replicate of GW4 (12/11/12)
GWBD1B	Replicate of GW4 (12/11/12)
PQL	Practical Quantitation Limit
-	Not analysed / No value
(S)	Soft water hardness
(M)	Moderate water hardness
As	arsenic
Cd	cadmium
Cr	chromium
Cu	copper
Pb	lead
Hg	mercury
Ni	nickel
Zn	zinc
TCE	Trichloroethene
PCB	polychlorinated biphenyls
OCP	organochlorine pesticides
OPP	organophosphorus pesticides

12. Discussion of Results

12.1 Desktop Study

The site has previously been used largely for commercial purposes since at least the 1940s, as identified from the 1943 aerial photograph. The Council record search and title search also confirm that the site has more recently been utilised for commercial purposes, largely for retail and as restaurants. The WorkCover search indicated that no tanks have been registered for the site, and the council record search identified that a grease trap has been located at the site.

The site next door to the north is currently a United Petrol Station with a number of tanks located across the site, presenting a potential off-site source of contamination. In this regard on and off-site petroleum hydrocarbon sources may be difficult to differentiate if any unknown tanks are identified on the site during redevelopment works. Based on the findings of this and previous reports it is considered that the likelihood of underground storage tanks on the subject site is negligible.

Asbestos-containing material may have previously formed structures across the site, however, these are unlikely to be a source of sub-soil contamination since the site has been covered by hard stand for many years. The importation of shallow fill of an unknown origin for site levelling is more likely to be the source of COPC. It is also noted that a property located adjacent to the subject site conducted “fibrous works” which are of an unknown origin but may have involved using asbestos and asbestos based products.

The CSM identified the above potential sources of contamination, likely pathways and potential receptors (Section 7). The results of the intrusive investigation are discussed below.

12.2 Contaminants in Soil

All results for soils analysed as part of the current site investigation were within the adopted SAC. Low level detections of TRH were identified at BH101/0.1, which is located to the north east (down gradient) of the service station.

12.3 Contaminants in Groundwater

Groundwater sampling was conducted for BTEX and VOCs due to the results of the previous investigations. The previous investigations noted the presence of TCE in groundwater. The results of the current investigation found all concentrations of BTEX and VOC were below PQL, with the exception of low level concentration of chloroform at MW1 (13 µg/L). The previous detection of TCE (part of the VOC suite) is therefore considered to be an anomaly as no obvious source can be identified. Chloroform is likely to be naturally occurring, or the result of water supply leaks, and therefore not significant.

12.4 Waste Classification

An *in situ* waste classification was conducted as part of this investigation. The *in situ* material was assessed in accordance with the NSW EPA *Waste Classification Guidelines* 2014. The threshold levels for General Solid Waste (CT1, SCC1, TCLP1) are shown on Table 11.

The results indicated that the samples from this assessment were within the General Solid Waste CT1 criteria with the exception of samples BH101/0.1, BH102/0.05-0.15, BH104/0.12-0.18 and BH105/0.2-0.3 for nickel. As a result TCLP analysis was conducted and returned results that were within the acceptance criteria for **General Solid Waste** (GSW) with TCLP (i.e. SCC1, TCLP1).

It is noted that the EIS (2013) report also found nickel concentrations above the GSW CT1 criteria without TCLP. TCLP results indicated that the soil was suitable to be removed from site as GSW with TCLP. The previous DP (2012) report also found elevated concentrations of lead, which with TCLP also made the soil suitable to be disposed of as GSW with TCLP.

It should be noted that this testing for waste classification is *in situ* in nature and subject to further confirmation ex situ. This is due to the limitation in sampling locations (i.e. no samples recovered from beneath many of the existing buildings) and the inherent variability in fill composition.

Based on the analytical data and lack of historical contaminating activities, it is also considered that the natural soil and bedrock beneath the site may be classified as virgin excavated natural material (VENM), provided the materials are free from contamination related odours and staining.

13. Recommendations and Conclusions

Based on the previous reports and the current investigation, the site is considered to be suitable, from an environmental perspective, for the proposed mixed use development, subject to the following:

- All existing buildings should be assessed for the presence of hazardous building materials (e.g. asbestos) and such materials removed and disposed off site in accordance with current legislation and guidelines;
- Upon the removal of hazardous building materials, and the subsequent demolition and removal of existing structures and hardstand, the site surface must be cleared of remnant asbestos containing materials (ACM) by a qualified occupational hygienist;
- Upon the removal of the several grease traps observed at the site (and any other underground pit discovered during demolition or excavation works) an environmental consultant must validate the waste classification for soils surrounding the pits;
- Prior to and during the soil excavation process, the waste classifications assigned in Section 12.4 must be confirmed / monitored by an experienced environmental consultant, Confirmation may be visual and/or analytical, based on observations. This is particularly relevant around the EIS BH2, in which PAH was detected by EIS in natural soils;
- Given the proximity of the adjoining service station, the deep excavations, particularly in the vicinity of the service station, must continue to be monitored for signs of deep petroleum

contamination, such as odours and staining. If found, specific waste classification of impacted soils / bedrock will be required; and

- An unexpected finds protocol should form part of the demolition and excavation contractor's standard work method statements / construction management plans such that there is a plan of action to deal with finds of potential contamination not encountered by the current investigations.

14. Limitations

Douglas Partners (DP) has prepared this report for this project at 39 – 41 Lindfield Avenue, Lindfield NSW in accordance with DP's proposal dated 3 December 2014 and acceptance received from Mr Mathew Wagstaff of Aqualand Projects Pty Ltd. The work was carried out under DP's conditions of Engagement. This report is provided for the exclusive use of Aqualand Projects Pty Ltd for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. DP has necessarily relied upon information provided by the client and/or their agents.

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

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

Asbestos-based materials have not been detected by observation or by laboratory analysis either on the surface of the site or in fill at the locations sampled and analysed. A secondary indicator of the possible presence of asbestos-based materials is the presence of demolition materials including concrete, brick, tile and/or other miscellaneous waste materials. Such materials were detected at some of the locations sampled and analysed. The sampling plan adopted for this investigation is appropriate to achieve the stated project objectives, however, there are necessarily parts of the site that have not been sampled and analysed or visually assessed. It is therefore possible that asbestos-based materials may be present in unobserved areas of the site or between sample points and no warranty can be given that asbestos is not present.

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

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

Douglas Partners Pty Ltd