ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

HEALTH INFRASTRUCTURE (NSW)

ON

PRELIMINARY SOIL CONTAMINATION INVESTIGATION AND WASTE CLASSIFICATION

FOR

PROPOSED ALTERATIONS AND ADDITIONS

AT

ST GEORGE HOSPITAL, KOGARAH, NSW

JANUARY 2012

REF: E25264KPrpt2

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EXECUTIVE SUMMARY

Sweett (Australia) Pty Ltd, acting on behalf of Health Infrastructure (NSW), commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake a preliminary soil contamination investigation and waste classification for the proposed alterations and additions at St George Hospital, Kogarah, NSW ("the site"). The investigation was undertaken in conjunction with a geotechnical investigation by J&K.

The preliminary soil contamination investigation and waste classification was limited to nominated areas within Lot 12 in DP800476 and Lot 1 in DP791072 of the wider hospital site. The site location is shown on Figure 1, and the soil contamination investigation and waste classification were confined to the investigation locations as shown on Figure 2.

EIS has previously undertaken a preliminary environmental site assessment for the proposed development and the results are detailed in the report titled *"Report to Health Infrastructure NSW on Stage 1 Preliminary Environmental Site Assessment for Proposed Alterations and Additions at St George Hospital, Kogarah, NSW"* (Ref: E25264KPrpt, dated November 2011). This report has been prepared following a specific request from Sweett (Australia) Pty Ltd for an additional soil contamination screening in selected areas of the site.

The primary objectives of the investigation were to: assess the soils at the client nominated borehole locations for a range of potential contaminants; and provide a waste classification for the material to be excavated from the investigation areas, generally in accordance with the NSW DECC Waste Classification Guidelines - Part 1: Classifying Waste (2009).

The scope of work undertaken to achieve the objective included: limited review of the EIS 2011 report; soil sampling from the six boreholes drilled for the geotechnical investigation; analysis of selected fill and natural soil samples for a range of potential contaminants; implementation of a field quality assurance/quality control (QA/QC) procedure; and preparation of a report presenting the results of the investigation and waste classification.

Soil samples obtained for the investigation were analysed for the potential contaminants of concern identified at the site. Elevated concentrations of TPH (C_{10}-C_{36}), total PAHs and benzo(a)pyrene, above the site assessment criteria (SAC) adopted for this investigation, were encountered in one fill soil sample obtained from BH101 (0m-0.2m). The remaining results were below the SAC.

Asbestos was not encountered in any of the samples analysed and none of the heavy metal concentrations exceeded the PPILs with respect to plant phyto-toxicity.

The contamination encountered in sample BH101 (0m-0.2m) is likely to be associated with the slag in the fill soil at this location. Slag material of this nature is likely to have originated from various historical metal processing industries within the Sydney region and was commonly used as fill material in the early to mid 1900s when the St George Hospital site was developed.

Due to the presence of PAHs and TPHs in BH101, remediation and/or management of this area will be required to meet the requirements of SEPP55. An additional investigation in the vicinity of BH101 would be prudent (following the demolition of the existing building in this area) in order to establish the horizontal extent of the contaminated fill material. A remedial action plan (RAP) should subsequently be prepared and implemented during the proposed works.

The above recommendations do not supersede those made within the EIS 2011 report. The additional investigation detailed above should be completed in conjunction with the additional works recommended in the EIS 2011 report, and if required, the RAP should be prepared for the St George Hospital site as a whole based on the findings of the additional works.

The conclusions presented in this report have been made within the limitations of the scope of works undertaken for the investigation. The conclusions and recommendations should be read in conjunction with the limitations presented in the body of the report.

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1 INTRODUCTION

Sweett (Australia) Pty Ltd, acting on behalf of Health Infrastructure NSW, commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake a preliminary soil contamination investigation and waste classification for the proposed alterations and additions at St George Hospital, Kogarah, NSW ("the site").

EIS has previously undertaken a preliminary environmental site assessment for the proposed development and the results are detailed in the report titled *"Report to Health Infrastructure NSW on Stage 1 Preliminary Environmental Site Assessment for Proposed Alterations and Additions at St George Hospital, Kogarah, NSW"* (Ref: E25264KPrpt, dated November 2011[1]). Site information from the EIS 2011 report has been incorporated into **Section 3** of this report and a limited summary of the preliminary assessment findings is presented in **Section 4**. The EIS 2011 report should be read in conjunction with this report.

The preliminary soil contamination screening and waste classification was limited to nominated areas within Lot 12 in DP800476 and Lot 1 in DP791072 of the wider hospital site. The site location is shown on Figure 1, and the soil contamination investigation and waste classification were confined to the investigation locations as shown on Figure 2.

The screening was undertaken generally in accordance with an EIS proposal (Ref: EP6044KP) of 7 December 2011 and written acceptance from Sweett (Australia) Pty Ltd, acting on behalf of Health Infrastructure NSW.

A geotechnical investigation was undertaken in conjunction with the soil contamination investigation and waste classification by J&K and the results are presented in a separate report (Ref: 25264Zrpt2).

This report has been prepared following a specific request from Sweett (Australia) Pty Ltd for an additional soil contamination screening in selected areas of the site.

[1] EIS 2011

1.1 Proposed Development Details

Based on the details provided in the Sweett brief dated 7 September 2011, the proposed alterations and additions include a new emergency department building, a new sub-acute building, an oxygen tank hardstand, a waste handling area, and extensions to the Rose Cottage/technical skills building.

The proposed extensions to the Rose Cottage/technical skills building were subsequently abandoned and a new substation and an engineering building were included in the proposed development scheme. Details of the proposed works are presented below.

No further information regarding the proposed works was provided at the time of this investigation.

Proposed New Emergency Department Building

The proposed works in this area will include demolition of existing buildings and structures on site, and construction of a new five to six storey concrete framed building. The building platform will be formed at reduced level (RL) 28.4m, which will require excavations to a maximum depth of 2.2m over the northern portion of the building site. The southern portion of the building site will either be filled up to 1.5m or the building slab will be supported over the existing subgrade. The area will also include an Ambulance Hardstand.

Proposed Waste Handling Area

The proposed waste handling area will be constructed over a building platform at RL31.0m. Further details were not provided.

Proposed Substation Building

No details for the proposed substation building were provided.

Proposed Sub-acute Building

The proposed works in this area will include demolition of existing buildings and structures on site, and the construction of a single or double storey concrete framed building with a structural steel framed roof. The building platform will be at approximately RL25.39m and will require excavation to a maximum depth of 2.5m adjacent to the western corner of the building, and filling up to 0.7m along the eastern portion of the building.

Proposed Oxygen Tank Hardstand

The proposed oxygen tank hardstand will be of concrete construction and will be between RL27.35m and RL28.0m.

Proposed Engineering Building

The proposed works in this area will include demolition/re-location of existing buildings and structures on site, and the construction of a two storey modular structure supported by a steel chassis suspended between stub columns approximately 0.6m above ground level.

1.2 References to the State Body for Environmental Regulation

Over the past few years the environmental regulatory body has undergone a number of name changes, including:

- Department of Environment and Conservation (DEC);
- Department of Environment and Climate Change (DECC);
- Department of Environment, Climate Change and Water (DECCW);
- Office of Environment and Heritage (OEH).

The department is currently known as Environment Protection Authority (EPA).

2 OBJECTIVES AND SCOPE OF WORK

2.1 Objectives

The primary objectives of the investigation were to:

- Assess the soils at the client nominated borehole locations for a range of potential contaminants; and
- Provide a waste classification for the material to be excavated from the investigation areas, generally in accordance with the *NSW DECC Waste Classification Guidelines - Part 1: Classifying Waste* (2009[2]).

2.2 Scope of Work

The scope of work undertaken to achieve the objective included:

1. Limited review of the EIS 2011 report;
2. Soil sampling from the six boreholes drilled for the geotechnical investigation;
3. Analysis of selected fill and natural soil samples for a range of potential contaminants;
4. Implementation of a field quality assurance/quality control (QA/QC) procedure;
5. Preparation of a report presenting the results of the investigation and waste classification.

Field work for this investigation was undertaken on 15 December 2011.

[2] *Waste Classification Guidelines, Part 1: Classifying Waste,* NSW DECC, 2009 (Waste Classification Guidelines 2009)

3 SITE INFORMATION

The site identification details are summarised in the following table:

Site Owner:	Various lots registered to: South Eastern Sydney and Illawarra Area Health Services; and The St George Hospital
Site Address:	See below
Lot & Deposited Plan^:	The site comprises the following lots: • Lot 12 in DP800476 (16 Kensington and 11 South Streets); and • Lot 1 in DP791072 (28A Gray Street).
Current Land Use:	Medical / health services
Proposed Land Use:	Medical / health services
Local Government Authority:	Kogarah City Council
Current Zoning:	Special Uses 5(a) – Special Uses (General) Zone
Hospital Site Area:	Approximately 52,000m^2
AHD:	Approximately 25-35m
Geographical Location (MGA):	E: 327590 N: 6239925 (approximately)
Site Locality Plan:	Refer to Figure 1
Borehole Location Plan:	Refer to Figure 2
Lot Layout Plan:	Refer to Figure 3

^ Information obtained from https://six.maps.nsw.gov.au/wps/portal/SIXViewer

3.1 Site Description

The St George Hospital site occupies a large parcel of land generally bound by: Kensington Street to the north; Gray Street to the west; Short and Chapel Streets to the south; and Belgrave and South Streets to the east. Kensington Street extends along a ridgeline in the regional topographic setting and the majority of the hospital site falls towards the south, away from Kensington Street.

A description of each of the proposed development/investigation areas (completed during the EIS 2011 assessment) is presented below:

Proposed New Emergency Department Building

The development area for the proposed emergency department building is located in the western section of the site, adjacent to Gray Street. At the time of the inspection the development area was generally occupied by a one and two storey brick services building, medical oxygen bay, a metal shed/waste disposal area and a driveway.

The area generally fell towards the south at slopes of approximately 2-3° and it appeared that the northern extent of the waste disposal facility was cut into the hill side.

Relatively small garden beds were located adjacent to the driveway and several small to medium sized trees (3-6m in height) were located in the gardens. The trees showed no signs of any stress based on cursory observations.

It was noted that "radioactive waste" was stored in the waste disposal area (based on the signage observed during the inspection). A UST for the hospital backup generator was also located approximately 15m to the north-east of the development area (as shown on Figure 2). No other obvious signs of chemical storage were observed during the inspection, however, we note that access to all areas within the services building and adjacent building to the south (which we understand includes the boiler house) was not possible during the inspection.

The development area was generally bounded by a grassed area and two storey cottage to the north; a driveway and multi-storey car park to the south; a paved driveway area and multi-storey hospital buildings to the east; and Gray Street to the west.

Waste Handling Area

The development area for the proposed waste handling area is located approximately 20m to the north-east of the proposed emergency department building envelope. At the time of the inspection the area formed part of an asphaltic concrete (AC) paved car park with a central strip garden bed and several relatively large trees. The trees showed no signs of any stress based on cursory observations.

The area fell gently to the south at slopes of approximately 1-2°. A generator was located immediately beyond the southern extent of the area and the UST (as mentioned above) was located adjacent to the generator. There were no obvious signs of chemical storage within the development footprint.

The development area was generally bounded by: a medical centre building to the north; a multi-storey hospital building to the south; car park and driveway areas to the east; and a fire station (off-site) and a two storey cottage to the west.

Proposed Substation Building

The development area for the proposed substation building is located in the south-west section of the site, adjacent to Gray Street and immediately to the west of the multi-storey car park. A detailed inspection of this area was not undertaken as it was not initially included as one of the investigation areas, however, we understand that the area was grassed.

Proposed Sub-acute Building

The development area for the proposed sub-acute building is located in the central-east section of the site, adjacent to the intersection of Belgrave and South Streets. At the time of the inspection the area was occupied by two buildings associated with the St George Hospital (including an X-ray department).

The floor levels of the buildings appeared to be raised at the south-eastern ends to accommodate the slope. The area generally fell towards the south-west at slopes of 2-4°. The buildings were surrounded by small garden beds and concrete foot paths.

The development area was generally bounded by: an AC paved car park to the north-west; South and Belgrave Streets to the north and east; and foot paths/grassed areas and a relatively new building to the south and south-east.

Proposed Oxygen Tank Hardstand

The development area for the proposed oxygen tank hardstand is located in the central-east section of the site, approximately 20-30m to the north-west of the proposed sub-acute building envelope. At the time of the inspection the area formed part of an AC paved car park and was occupied by parked cars. The pavement appeared to be in reasonable condition and no major cracks or potholes were observed.

The area appeared to fall gently towards the south-east at slopes of approximately 1-2°. A retaining wall was located beyond the west extent of the proposed hardstand area which retained the adjacent walkway approximately 1.2-1.4m above the existing level of the car park.

The development area was generally bounded by: demountable buildings to the north; the AC car park areas to the south and east; and the retaining wall and walkway to the west.

Proposed Engineering Building

The development area for the proposed engineering building is located along the south-eastern site boundary. A detailed inspection of this area was not undertaken as it was not initially included as one of the investigation areas, however, we understand that the area was paved and occupied by a demountable type building.

The development area was generally bounded by; a paved driveway and buildings associated with St George Hospital to the north-west; a grassed yard and single storey building to the north-east; the site boundary and St George Private Hospital to the south-west; and paved areas and demountable buildings to the west.

3.1.1 Surrounding Land Use, Surface Water Bodies and Drainage

The surrounding land use typically included the following:

- Commercial areas to the north, including a church, medical centre and fire station;
- Mixed commercial/residential areas to the east, including a multi-storey car park and a research and education centre;
- Commercial areas to the south (St George Private Hospital); and
- Residential areas to the west, including one and two storey residences, and apartments.

There were no surface water bodies located within the Hospital site. The nearest surface water bodies are the ponds located within Scarborough Park, approximately 850m down-gradient and to the east of the site.

The site is generally expected to drain towards the south and south-east. During rain events, water would be expected to be intercepted by the on-site stormwater drainage system and eventually discharge into the regional stormwater system. It is understood that a stormwater detention tank is located beneath the driveway at the south end of the proposed engineering building development area.

3.2 Regional Geology

The geological map of Sydney (1983[3]) indicates the site to be underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses.

3.3 Hydrogeology

NSW Office of Water[4] records were researched for the EIS 2011 assessment and indicated that approximately eight registered groundwater bores lie within approximately 530m of the site. The groundwater works summaries and a map

[3] *1:100,000 Geological Map of Sydney (Series 9130)*, Department of Mineral Resources (1983)

[4] http://www.waterinfo.nsw.gov.au/gw/, visited on 27 October 2011

indicating the location of the bores in relation to the site are attached in Appendix C of the EIS 2011 report. The details are summarised in the following table:

Ref No	Approximate Distance from site (m)	Approximate Direction from site	Gradient from site	Depth (m)	Registered Purpose
GW023354	340	South-east	Down	3.6	Domestic
GW024615	180	South-east	Down	5.5	Domestic
GW106882	530	South-east	Down	5.0	Domestic
GW107606	420	South-east	Down	7.0	Domestic
GW107799	400	South-east	Down	5.5	Domestic
GW108551	360	East	Down	6.0	Domestic
GW109183	380	South-east	Down	8.0	Domestic
GW111229	420	South-east	Down	6.0	Domestic

EIS noted that there were numerous groundwater bores located further to the east of the site that were registered for domestic/general use.

The stratigraphy of the site is expected to consist of residual clayey soils overlying relatively shallow bedrock. Based on these conditions, groundwater is unlikely to be a significant resource at the site or in the immediate vicinity. However, the areas down gradient and further to the east of the site are characterised by relatively high permeability alluvial sandy soil overlying deep bedrock. These conditions and the presence of numerous registered groundwater users in these areas indicates that the groundwater is being utilised as a significant resource.

4 EIS 2011 REPORT

The EIS 2011 report was prepared to address the preliminary Stage 1 environmental site assessment (ESA) requirements of *State Environmental Planning Policy No.55 – Remediation of Land (1998[5]),* for the lodgement of a Part 3A Development Application to the Department of Planning.

Based on the details provided, the proposed development included alterations and additions, including: a new emergency department building; a new sub-acute building; an oxygen tank hardstand; a waste handling area, and extensions to the Rose Cottage/technical skills building. The proposed extensions to the Rose Cottage/technical skills building were subsequently abandoned and a new substation and an engineering building were included in the proposed development scheme.

The primary objectives of the preliminary Stage 1 ESA were to:

- Assess the potential risk of significant, widespread soil and groundwater contamination at the site;
- Make a preliminary assessment of the soil contamination conditions in the vicinity of the proposed development areas;
- Undertake a waste classification assessment for off-site disposal of excavated soil associated with the proposed redevelopment works; and
- Prepare a report presenting the results of the assessment/investigation.

The scope of work undertaken to achieve the objectives included: a desktop assessment of historical information; a walkover site inspection; soil sampling from the geotechnical boreholes (drilled by J&K); laboratory analysis of selected soil samples for the contaminants of concern identified at the site; and preparation of a report.

The search of historical information indicated the following:

- The historical aerial photographs indicated that the site was occupied by what appeared to be a number of residential type properties, several larger buildings and associated yard areas from at least 1930. Demolition and construction works were progressive across the site from 1930, with larger scale construction evident from 1970 onwards;
- The land title information indicated that the earliest records pertaining to use of the site as a hospital dated back to the late 1800s. There were numerous registered proprietors associated with the former lots and most of the proprietors were individuals as opposed to companies. Despite some of the proprietors

[5] *State Environmental Planning Policy No. 55 – Remediation of Land,* NSW Government, 1998 (SEPP55)

professions listed in the land title documentation, wide scale use of the site for potentially contaminating land uses was considered unlikely;

- WorkCover records indicated that a 10,000L UST (containing diesel) was located to the north-east of the proposed emergency department building (as shown on Figure 2). Historical records that dated back to the 1940s and 1970s indicated that at least two USTs were formally utilised by the St George Hospital and small scale petroleum storage was also permitted in a storage area. The locations of these former facilities could not be established;
- There were no recorded notices listed on the NSW EPA CLM register; and
- The EPA POEO register indicated that the St George Hospital has a current licence for the generation or storage of hazardous and/or industrial and/or Group A waste at the site.

Elevated concentrations of contaminants were not encountered in the soil samples analysed for the investigation. All results were below the SAC.

Based on the above and the historical information reviewed for this assessment, EIS were of the opinion that the potential for significant, widespread soil and/or groundwater contamination at the site was low to moderate.

Soil contamination may be encountered at discrete locations across the site and would most likely be associated with unidentified USTs, the existing 10,000L UST, asbestos from former building/demolition activities and/or improper storage of fuel in the above ground depots.

Asbestos was not detected above the reporting limit in the soil samples analysed for the investigation. However, Envirolabs noted that loose fibre bundles of chrysotile and amosite asbestos were encountered in BH10 (0-0.1m). The calculated weight of the fibre bundles was 0.0032g which was less than the reporting limit of 0.1g/kg. The presence of asbestos impacted the waste classification in this area.

With the exception of the material in the vicinity of the proposed sub-acute building, the fill material in the proposed development areas was classified **as 'General Solid Waste (non-putrescible)'** according to the criteria outlined in Waste Classification Guidelines 2009.

The fill material in the vicinity of the proposed sub-acute building was classified as **'General Solid Waste (non-putrescible) containing asbestos'** according to the criteria outlined in Waste Classification Guidelines 2009. Due to the asbestos encountered in BH10, this material was not considered suitable for reuse on site.

The findings of the preliminary Stage 1 ESA were considered to be a trigger for further investigation in order to meet the requirements of SEPP55. The report stated that a detailed Stage 2 environmental site investigation was unlikely to be possible due to the existing hospital operations, however, the report recommended the following:

- *"A UPSS assessment (including the installation of a monitoring well network and soil sampling and analysis) should be completed in accordance with the UPSS Regulation 2008 for the existing 10,000L UST in the north-west section of the site. In the event that contamination is identified, the nature and extent of the contamination should be characterised, a RAP should be prepared and the area should be remediated and validated to meet the requirements of the UPSS regulation 2008 and SEPP55;*
- *An additional soil and groundwater investigation should be undertaken to assess the potential for contamination to be migrating onto the site from the adjacent fire station property (located at the corner of Gray and Kensington Streets), and to assess whether any contamination is migrating off-site at the down-gradient site boundaries (associated with the unidentified UST and other historical site activities);*
- *An additional waste classification assessment should be undertaken if material is to be excavated for the proposed substation and engineering buildings;*
- *A detailed unexpected finds protocol should be prepared and implemented for the proposed development works. This should document a procedure to be implemented in the event that fibre cement (asbestos) fragments, unidentified USTs, stained or odorous soils, and/or other potentially contaminated materials are encountered during the works;*
- *A hazardous building materials survey should be completed by a suitably qualified consultant prior to the demolition of any buildings or parts of the existing buildings at the site. The demolition works should be completed in accordance with the recommendations made within the hazardous building materials report; and*
- *Due to the presence of asbestos fibres encountered in BH10, a suitably qualified asbestos consultant should be engaged to inspect and better assess the fill soils in this area following the demolition of the existing buildings and prior to the commencement of works associated with the proposed sub-acute building. The consultant should provide recommendations for managing the works and should oversee any asbestos related issues in this area."*

Based on the scope of work undertaken for the preliminary Stage 1 ESA, EIS were of the opinion that the site could be made suitable for the proposed development subject to the findings of the additional investigation and implementation of the recommendations detailed in the report.

No soil contamination was identified in the proposed development areas that would inhibit the proposed works, however, in order to meet the requirements of SEPP55 further work would be required in order to conclude that the site is suitable for the proposed development.

5 POTENTIAL SOIL CONTAMINANTS OF CONCERN

The EIS 2011 ESA identified a number of potential soil contaminants of concern at the site. These include:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- Total Petroleum Hydrocarbons (TPHs);
- Monocyclic aromatic hydrocarbons (BTEX compounds, including benzene, toluene, ethylbenzene and xylenes);
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Organochlorine Pesticides (OCPs);
- Organophosphorus Pesticides (OPPs);
- Polychlorinated Biphenyls (PCBs); and
- Asbestos.

The potential contaminants of concern listed above form the analysis schedule for the soil contamination investigation and waste classification outlined in this report.

6 ASSESSMENT CRITERIA DEVELOPMENT

6.1 Regulatory Background

In 1997 the NSW Government introduced the CLM Act. This Act has been amended by the *Contaminated Land Management Amendment Act* (2008[6]).

The CLM Act 1997, associated regulations, *State Environmental Planning Policy No.55* (1998[7]) and NSW EPA guidelines, were designed to provide uniform state-wide control of the management, investigation and remediation of contaminated land.

Prior to granting consent for any proposed rezoning or development, SEPP55 requires the consent authority to:

- Consider whether the land is contaminated;
- Consider whether the site is suitable, or if contaminated, can be made suitable by remediation, for the proposed land use; and
- Be satisfied that remediation works will be undertaken prior to use of the site for the proposed use.

Should the assessment indicate that the site poses a risk to human health or the environment, remediation of the site may be required prior to occupation of the proposed development. SEPP55 requires that the relevant local council be notified of all remediation works, whether or not development consent is required. Where development consent is not required, 30 days written notice of the proposed works must be provided to council. Details of validation of remediation work must also be submitted to Council within one month of completion of remediation works.

The consent authority may request that a site audit be undertaken during, or following the completion of the site assessment process. Under the terms of the CLM Act 1997 the NSW EPA Site Auditor Scheme was developed to provide a system of independent review for assessment reports. An accredited Contaminated Site Auditor is engaged to review reports prepared by suitably qualified consultants to ensure that the investigation has been undertaken in accordance with the guidelines and confirm that the sites are suitable for their intended use.

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[6] *Contaminated Land Management Amendment Act*, NSW Government Legislation, 2008 (CLM Amendment Act 2008)

[7] *State Environmental Planning Policy No. 55 – Remediation of Land*, NSW Government, 1998 (SEPP55)

Section 59(2) of the CLM Act 1997 states that specific notation relating to contaminated land issues must be included on Section149 (s149) planning certificates prepared by Council where the land to which the certificate relates is:

- Within an investigation or remediation area;
- Subject to an investigation or remediation order by the EPA;
- The subject of a voluntary investigation or remediation proposal; and/or
- The subject of a site audit statement.

Submission of contaminated site investigation and validation reports to council as part of rezoning or development application submissions may also result in notation of actual or potential site contamination on future s149 certificates prepared for the site.

Section 60 of the CLM Amendment Act 2008 sets out a positive duty on a land owner, or person whose activities have caused contamination, to notify the EPA if they are or become aware that contamination exists on a site that generally poses *"an unacceptable risk to human health or the environment, given the site's current or approved use"*. This duty to report is based on trigger values, above which notification is required.

Off-site disposal of fill, contaminated material and excess soil/rock excavated as part of the proposed development works is regulated by the provisions of the *Protection of the Environment Operations Act* (1997[8]) and associated regulations and guidelines including the Waste Classification Guidelines 2009. All materials should be classified in accordance with these guidelines prior to disposal.

Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner.

6.2 Soil Contaminant Threshold Concentrations

The soil investigation levels adopted for this investigation are derived from the NSW DEC document *Guidelines for the NSW Site Auditor Scheme, 2nd Edition* (2006[9]) and the National Environmental Protection Council document *National Environmental Protection (Assessment of Site Contamination) Measure* (1999[10]). The contaminant

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[8] *Protection of Environment Operations Act,* NSW Government, 1997 (POEO Act 1997)

[9] *Guidelines for the NSW Site Auditor Scheme, 2nd ed.,* NSW DEC, 2006 (Site Auditor Guidelines 2006)

[10] *National Environmental Protection (Assessment of Site Contamination) Measure,* National Environment Protection Council (NEPC), 1999 (NEPM 1999)

thresholds listed below are levels at which further investigation and evaluation is required to assess whether the site is considered suitable for the proposed urban land use.

To accommodate the range of human and ecological exposure settings, a number of generic settings are used on which the Health based Investigation Levels (HILs) can be based. Four categories of HILs are adopted for urban site assessments. Contaminant levels for a standard residential site with gardens and accessible soil (Column A) are based on protection of a young child resident at the site. The remaining categories (Columns D to F) present alternative exposure settings where there is reduced access to soil or reduced exposure time. These categories include residential land use with limited soil access, recreational and public open space and commercial/industrial use. Where the proposed land use will include more than one land use category (eg. mixed residential/commercial development) the exposure setting of the most "sensitive" land use is adopted for the site.

Threshold concentrations for petroleum hydrocarbon contaminants including total TPH and BTEX compounds have previously been established in the *NSW EPA Contaminated Sites: Guidelines for Assessing Service Station Sites* (1994[11]) publication and this document is referenced in the Site Auditor Guidelines 2006. Heavy fraction petroleum hydrocarbon aliphatic/aromatic component threshold concentrations have also been introduced in NEPM 1999.

Soil samples for this investigation have been analysed for total recoverable hydrocarbons (TRH) rather than TPH. TRH analysis is undertaken without a preliminary silica gel clean-up of the sample. Consequently the TRH result may include other compounds such as phthalates, humic acids, fatty acids and sterols (if present).

6.2.1 Provisional Phyto-toxicity Investigation Levels (PPILs)

The Provisional Phyto-toxicity Investigation Levels (PPILs) are generic values based on phytotoxicity data for plant response to specific contaminants in a sandy loam matrix and are included in the contaminated site assessment where the proposed land use includes gardens or accessible soils. The PPILs are listed in the Site Auditor Guidelines 2006. The PPILs are identical to the Ecological Investigation Levels (EILs) originally specified in NEPM 1999.

[11] *Guidelines for Assessing Service Station Sites,* NSW EPA, 1994 (Service Station Guidelines 1994)

6.2.2 Asbestos in Soil

NEPM 1999 does not provide numeric guidelines for the assessment of asbestos in soil. NSW EPA advice (2006) has indicated that consultants should use their 'professional judgement' regarding determination of appropriate investigation and remediation levels for asbestos in soils; however the NSW EPA have not published numerical guidelines for the assessment of asbestos in subsurface soils.

The WorkCover publication *Working with Asbestos Guide* (2008[12]) states that, where buried asbestos is encountered, "A competent occupational hygienist should assess the site to determine:

- If asbestos material is bonded or friable
- The extent of asbestos contamination
- Safe work procedures for the remediation of the site"

"Any asbestos cement products that have been subjected to weathering, or damaged by hail, fire or water blasting are considered to be friable asbestos and an asbestos removal contractor with a WorkCover license for friable asbestos removal is required for its removal". Under the *NSW Occupational Health and Safety (OHS) Regulations 2001*[13] and WorkCover requirements all necessary disturbance works associated with friable asbestos containing materials must be conducted by a licensed AS-1 Asbestos Removal Contractor.

6.2.3 Site Assessment Criteria (SAC) for Soil Contaminants

The 'commercial/industrial' (Column F) exposure setting has been adopted for this assessment and the appropriate soil criteria are listed in the following table:

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[12] *Working with Asbestos Guide,* NSW WorkCover, 2008 (WorkCover Working with Asbestos Guide 2008)

[13] *Occupational Health and Safety Regulation,* NSW Government, 2001 (NSW OH&S Regulation 2001)

Contaminant	SAC - HILs Column F (mg/kg)	PPILs (mg/kg)
Heavy Metals		
Arsenic (total)	500	20
Cadmium	100	3
Chromium (III)	60%	400
Copper	5000	100
Lead	1500	600
Mercury (inorganic)	75	1
Nickel	3000	60
Zinc	35000	200
Petroleum Hydrocarbons		
TPH (C_6-C_9)	65 [a]	-
TPH (C_{10}-C_{36})	1000 [a]	-
Benzene	1 [a]	-
Toluene	1.4 [a]	-
Ethylbenzene	3.1 [a]	-
Total Xylenes	14 [a]	-
PAHs		
Total PAHs	100	-
Benzo(a)pyrene	5	-
Pesticides (OCPs & OPPs)		
Aldrin + Dieldrin	50	-
Chlordane	250	-
DDT+ DDD + DDE	1000	-
Heptachlor	50	-
Total OPPs	0.1 [b]	-
Others		
PCBs (Total)	50	-
Asbestos	NDLR [c]	-

Note:

[a] Service Station Guidelines 1994

[b] Due to the absence of locally endorsed guideline criteria, the laboratory practical quantitation limit (PQL) has been adopted.

[c] Not Detected at Limit of Reporting (NDLR)

6.2.4 Waste Classification Assessment Criteria

For the purpose of off-site disposal, the classification of soil into 'General Solid Waste (non-putrescible)', 'Restricted Solid Waste (non-putrescible)' and 'Hazardous Waste (non-putrescible)' categories is defined by chemical contaminant criteria outlined in the Waste Classification Guidelines 2009. The contaminant criteria are summarised in Table A-2.

6.3 Evaluation of Soil Analysis Data and Contaminant Threshold Concentrations

Assessment of the soil analytical data using the soil contaminant threshold concentrations has been undertaken in accordance with the methodology outlined in the NEPM 1999 Schedule 7(a) and the statistical analysis methods outlined in the *NSW EPA Contaminated Sites Sampling Design Guidelines* (1995[14]).

The following criteria have been adopted for assessment of the analytical data:

- For a site to be considered suitable for the proposed land use, the 95% Upper Confidence Limit (UCL) value of the arithmetic mean concentration of each contaminant should be less than the applicable contaminant threshold concentration;
- The relevance of localised elevated values must also be considered and should not be obscured by consideration only of the arithmetic mean of the results. The results must also meet the following criteria:
  - the standard deviation of the results must be less than 50% of the soil assessment criteria; and
  - no single value exceeds 250% of the relevant soil assessment criteria.
- Where the concentration of each contaminant is less than the applicable contaminant threshold concentration (site assessment criteria) in all samples, UCL calculations may not be required and the suitability of the site for the proposed use may be assessed based solely on individual analytical results.

In some cases where the data set is too small to produce statistically reliable results, this will be noted within the report.

[14] *Contaminated Sites Sampling Design Guidelines,* NSW EPA, 1995 (EPA Sampling Design Guidelines 1995)

7 ASSESSMENT PLAN

7.1 Soil Sampling Density

The *NSW EPA Contaminated Sites Sampling Design Guidelines* (1995[15]) for contaminated site investigations state that samples should be obtained from a minimum of 57 evenly spaced sampling points for a site the size of St George Hospital (approximately 52,000m^2). Samples were obtained from 13 sampling locations (BH1 to BH13 inclusive) for the EIS 2011 assessment. Samples were obtained from six additional, client nominated sampling locations (BH101 to BH106 inclusive) for this investigation.

7.2 Data Quality Objectives (DQOs)

The DQOs for the assessment were developed with reference to the US EPA document *Data Quality Objectives Process for Hazardous Waste Site Investigations* (2000[16]). The document includes seven steps as follows:

1. State the problem
2. Identify the decision
3. Identify inputs into the decision
4. Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Errors
7. Optimise the Design for Obtaining data

Field investigations are undertaken generally in accordance with EIS sampling protocols outlined in Appendix C.

7.3 Data Quality Indicators (DQIs) and Quality Assurance

The validation, as part of the DQOs, involves the technical review of the data using defined QA Assessment Criteria. The success of the DQIs is based on assessment of the data set as a whole and not on individual acceptance or exceedance within the data set.

Review of QA criteria was based on laboratory data including surrogate recovery, repeat analysis, laboratory control sample (LCS), matrix spikes and method blanks.

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[15] *Contaminated Sites Sampling Design Guidelines,* NSW EPA, 1995 (EPA Sampling Design Guidelines 1995)

[16] *Data Quality Objectives Process for Hazardous Waste Site Investigations,* US EPA, *2000* (US EPA 2000)

Field QA/QC included collection and analysis of the following:

- One field soil sample (approximately 10%) as an intra-laboratory duplicate analysed for heavy metals, PAHS, TPH and BTEX; and
- One trip blank and one trip spike analysed for BTEX.

Success of field DQIs is based on the following criteria:

- Relative percentage differences (RPDs) were calculated for the intra-laboratory duplicate. The RPD was calculated as the absolute value of the difference between the initial and repeat result divided by the average value, expressed as a percentage. The following acceptance criteria were used to assess the RPD results:
  - For results that were greater than 10 times the Practical Quantitation Limit (PQL) RPDs less than 50% were considered acceptable.
  - For results that were between 5 and 10 times PQL RPDs less than 75% were considered acceptable.
  - For results that were less than 5 times the PQL RPDs less than 100% were considered acceptable.
- Acceptable concentrations in blank and spike samples.

Success of laboratory DQIs is based on the following criteria:

- RPDs were calculated for the laboratory duplicates (as detailed above). The following acceptance criteria were used to assess the RPD results:
  - For results that were less than 5 times the PQL, any RPD was considered acceptable;
  - For results that were greater than 5 times the PQL, RPDs between 0-50% were considered acceptable.
- The following acceptance criteria were used to assess the matrix spikes and LCS recovery:
  - 70-130% was considered acceptable for metals and inorganics;
  - 60-140% was considered acceptable for organics; and
  - 10-140% was considered acceptable for VOCs.
- The following acceptance criteria were used to assess the surrogate spike recovery:
  - 60-140% was considered acceptable for general organics; and
  - 10-140% was considered acceptable for VOCs.
- LPQL in blank samples.

8 INVESTIGATION PROCEDURE

8.1 Soil Sampling Methods

The subsurface investigation at three locations (BH101 to BH103 inclusive) was undertaken using a track mounted hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.

The SPT sampler was washed with phosphate free detergent and rinsed following each sampling event. The spiral flight augers were decontaminated using a scrubbing brush and potable water and Decon 90 solution (phosphate free detergent) followed by rinsing with potable water. Details of the decontamination procedure adopted during sampling are presented in Appendix C.

Due to access restrictions associated with the existing development, the subsurface investigation at three sampling locations was undertaken using hand equipment. The hand equipment was decontaminated using a scrubbing brush, potable water and Decon 90 solution (phosphate free detergent) followed by rinsing with potable water after each sampling event. Details of the decontamination procedure adopted during sampling are presented in Appendix C.

Soil and rock samples were obtained at various depths, based on observations made during the field investigation. During sampling, soil at selected depths was split into initial and duplicate samples for QA/QC assessment.

All samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. Sampling personnel used disposable nitrile gloves during sampling activities.

During the investigation, soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS 4482.1-2005[17] and AS 4482.2-1999[18] as summarised in the following table:

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[17] *Guide to the Investigation and Sampling of sites with Potentially Contaminated Soil,* Standards Australia, 2005 (AS 2005)

[18] *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part2: Volatile Substances,* Standards Australia, 1999 (AS 1999)

Analyte	Preservation	Storage
Heavy metals	Unpreserved glass jar with Teflon lined lid	Store at <4°, analysis within 28 days (mercury and Cr[VI]) and 180 days (other metals).
VOCs (TPH/BTEX)		Store at <4°, nil headspace, extract within 14 days, analysis within forty days
PAHs, OCP, OPP & PCBs		
Asbestos	Sealed plastic bag	None

The samples were labelled with the job number, sampling location, sampling depth and date. All samples were recorded on the borehole logs presented in Appendix A and on the laboratory chain of custody (COC) record presented in Appendix B.

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures. Detailed EIS field sampling protocols are included in Appendix C.

8.2 Photoionisation Detector (PID) Screening

A portable PID was used to screen the samples for the presence of volatile organic compounds (VOCs). The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The portable PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source.

The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents.

PID screening of detectable VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. The PID headspace data is presented on the COC documents. PID calibration records are presented in Appendix D.

8.3 Laboratory Analysis

Laboratory analysis was undertaken by Envirolab Services Pty Ltd (NATA Accreditation No. 2901). Soil samples were analysed using the following analytical methods detailed in Schedule B(3) of NEPM (1999[19]):

- Heavy metals – Nitric acid digestion. Analysis by ICP/AES;
- Low level mercury – cold vapour AAS;
- OC and OP pesticides and PCBs – Extracted with dichloromethane/acetone. Analysis by GC/ECD;
- PAHs – Soil extracted with dichloromethane/acetone. Analysis by GC/MS;
- TPH (volatile) – Soil extracted with methanol. Analysis by P&T GC/MS;
- TPH – Soil extracted with dichloromethane/acetone. Analysis by GC/FID;
- BTEX – Soil extracted with methanol. Analysis by P&T GC/MS; and
- Asbestos – Polarizing light microscopy.

Toxicity characteristic leaching procedure (TCLP) leachates were prepared by rotating soil samples in a mild acid solution for 18 hours (NSW EPA WD-3 Method). Leachates were analysed using the analytical procedures outlined above.

[19] *Guideline on Laboratory Analysis of Potentially Contaminated Soils*, Schedule B(3), NEPM, 1999 (Schedule B(3))

9 RESULTS OF INVESTIGATION

9.1 Subsurface Conditions

Borehole locations are shown on Figure 2. For details of the subsurface soil profile reference should be made to the borehole logs in Appendix A. A summary of the subsurface conditions encountered in the boreholes is presented below:

Pavement

Asphaltic concrete (AC) pavement was encountered at the surface in BH102. The AC was approximately 0.03m thick. Concrete pavement was encountered at the surface in BH103. The total pavement thickness in BH103 was approximately 0.69m

Fill

Fill material was encountered at the surface or beneath the pavement in all boreholes except BH103. The fill material comprised grey or dark brown gravelly sand, clayey sand, gravelly clayey sand or clayey silty sand with inclusions of slag gravel, igneous, ironstone and sandstone gravel, and root fibres. The fill material extended to a maximum depth of approximately 0.5m in BH105 and BH106.

Natural Soils

Natural soil was encountered directly beneath the pavement in BH103 and beneath the fill material in all remaining boreholes. The natural soil comprised orange brown, light grey, brown and/or red brown sandy clay, clayey sand, silty sand and silty clay. BH102, BH104, BH105 and BH106 were terminated in the natural soil at depths ranging from approximately 0.7m to 0.9m.

Bedrock

Sandstone bedrock was encountered beneath the natural soil in BH101 and BH103. The sandstone was typically light grey and/or yellow brown and extended to the termination/refusal depth of BH101 and BH103 at 4.0m and 1.6m respectively.

Groundwater

A standing water level (SWL) of approximately 0.5m was recorded in BH103 on completion of drilling. It is possible that this was the result of water introduced into the borehole during the concrete coring process. No groundwater seepage was encountered during drilling and all remaining boreholes were dry on completion.

9.2 Laboratory Results

The laboratory reports are presented in Appendix B. The results have been assessed against the SAC adopted for this investigation and against the waste classification criteria as outlined previously in this report.

The soil laboratory results are presented in Table B and Table C. The results of the analyses are summarised below.

Heavy Metals

Four fill and six natural soil samples were analysed for heavy metals. The results of the analyses were below the SAC. None of the heavy metal results exceeded the PPILs (i.e. with respect to plant phyto-toxicity)

Waste Classification:

The results of all analyses were less than the SCC1 criteria outlined in the Waste Classification Guidelines 2009.

TCLP leachates were prepared from the four fill samples and analysed for arsenic, cadmium, chromium, lead, mercury and nickel. The results were less than the TCLP1 criteria.

Petroleum Hydrocarbons (TPH) and Monocyclic Aromatic Hydrocarbons (BTEX)

PID soil sample headspace readings were all zero ppm equivalent isobutylene. These results indicate a lack of PID detectable VOCs.

The four fill and six natural soil samples were analysed for TPH and BTEX compounds. An elevated concentration of mid to heavy fraction (C_{10}-C_{36}) TPH, of 1,280mg/kg, was encountered in the fill sample obtained from BH101 (0m-0.2m). This result was above the SAC of 1,000mg/kg. The results of the remaining analyses were below the SAC.

A detectable concentration of TPH (C_{10}-C_{36}), was encountered in the natural soil sample obtained from BH102 (0.3m-0.7m), however, this was below the SAC.

Due to the limited data set, statistically reliable UCL calculations could not be performed using the TPH data and therefore these results have not been reported.

Waste Classification:

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Polycyclic Aromatic Hydrocarbons (PAHs)

The four fill and six natural soil samples were analysed for a range of PAHs including benzo(a)pyrene. Elevated concentrations of total PAHs and benzo(a)pyrene, of 288mg/kg and 41mg/kg respectively, were encountered in BH101 (0m-0.2m). These results were above the SAC for total PAHs and benzo(a)pyrene of 100mg/kg and 5mg/kg respectively. The results of the remaining analyses were below the SAC.

Due to the limited data set, statistically reliable UCL calculations could not be performed using the total PAH and benzo(a)pyrene data and therefore these results have not been reported. It is noted however that the benzo(a)pyrene concentration in BH101 (0m-0.2m) is greater than 250% of the SAC and therefore this result would fail the data assessment criteria despite a UCL calculation.

Detectable concentrations of PAHs, below the SAC, were encountered in the natural soil samples obtained from BH101 (0.5m-0.95m) and BH102 (0.3m-0.7m).

<u>Waste Classification:</u>

The benzo(a)pyrene concentration in BH101 (0m-0.2m) exceeded the SCC2 criterion outlined in the Waste Classification Guidelines 2009. The total PAH concentration in this sample exceeded the SCC1 criterion. The remaining results of the analyses were below the SCC1 criteria.

TCLP leachates were prepared from the four samples and analysed for PAHs. The results of the analyses were less than the TCLP1 criterion for benzo(a)pyrene.

Organochlorine (OCPs) and Organophosphorous (OPPs) Pesticides

The four fill and six natural soil samples were analysed for a range of OCPs and OPPs. The results of the analyses were below the SAC.

<u>Waste Classification:</u>

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Polychlorinated Biphenyls (PCBs)

The four fill and six natural soil samples were analysed for a range of PCBs. The results of the analyses were below the laboratory PQL and less than the SAC.

Waste Classification:

The results of all analyses were less than the SCC1 criterion outlined in the Waste Classification Guidelines 2009.

Asbestos

The four fill soil samples were screened for the presence of asbestos fibres. The results of the analyses indicated that asbestos fibres were not encountered within the samples above the limit of reporting and no respirable fibres were detected.

10 ASSESSMENT OF ANALYTICAL QA/QC

The DQOs and DQIs established for the investigation have been assessed in this section of the report. The assessment includes a review of the laboratory QA/QC procedure to assess whether the sample data is reliable.

The laboratory report for this investigation has been checked and issued as final by Envirolab Services Pty Ltd, NATA Accreditation No. 2901, report number 66659.

The RPD results for the field QA/QC duplicate sample are summarised in Table D. The trip spike and trip blank results are summarised in Table E. An assessment of the DQIs adopted for this investigation is summarised in the following table. A brief explanation of the individual DQI is presented in Appendix C.

DQO	Number of Samples	DQI
Precision:		
Intra-laboratory duplicate Dup 1 is a duplicate of soil sample BH106 (0m-0.3m)	Soil x 1	The intra-laboratory RPD values indicated that field precision was acceptable.
Trip Blank T.B is a sand trip blank carried during sampling and transport on 15.12.11	Soil x 1	The trip blank was found to be free of analyte concentrations above the PQLs. This indicated that there were no cross contamination artefacts associated with the sample storage.
Trip Spike T.S is a sand trip spike carried during sampling and transport on 15.12.11	Soil x 1	Trip spike recovery values were within acceptable limits. This indicated that sample preservation for volatile contaminants was appropriate.
Laboratory duplicate RPD values	Soil x 2	Laboratory duplicate RPD results for the soil analysis were generally within the acceptance criteria adopted by the laboratory. Elevated RPDs outside the acceptable range were encountered for some hydrocarbons (PAHs and TPH) and copper. The laboratory attributed these results to the non-homogenous nature of the sample. The higher laboratory duplicate values have been adopted for TPH (C_{10}-C_{36}) and PAHs as a conservative measure as these results were above the SAC.

DQO	Number of Samples	DQI
Accuracy:		
Surrogate Spikes	All organic analytes	The surrogate spike recovery values indicated that laboratory accuracy was good and that no outliers were reported.
Matrix Spikes	Soil x 1	The matrix spike recovery values indicated that laboratory accuracy was good and that no outliers were reported.
LCS	All analytes	The LCS recovery values indicated that laboratory accuracy was good and that no outliers were reported.
Representativeness:		
Samples extracted and analysed within holding time	All Samples	All samples were extracted and analysed within the appropriate holding times outlined in the investigation procedure.
Analysis of Laboratory Blanks	All laboratory QA samples	All laboratory blanks were found to be free of analyte concentrations above the PQLs.
Comparability:		
EIS sampling protocols	All Samples	Sampling was undertaken in accordance with the EIS sampling protocols outlined in Appendix C.
Standard laboratory analytical methods used	All Samples	All Samples
Samples obtained by qualified staff	All Samples	All Samples
Completeness:		
Documentation (including site notes, borehole logs and COC etc) was correctly maintained	All Samples	All Samples
Samples obtained were analysed for the contaminants of concern	All Samples	All Samples
Appropriate analytical methods used by the laboratory	All Samples	All Samples

11 DISCUSSION

The preliminary soil contamination investigation and waste classification undertaken for the proposed alterations and additions at St George Hospital, Kogarah was designed to:

- Assess the soils at the client nominated borehole locations for a range of potential contaminants; and
- Provide a waste classification for the material to be excavated from the investigation areas.

11.1 Summary and Discussion of Soil Conditions

Soil samples obtained for the investigation were analysed for the potential contaminants of concern identified at the site. Elevated concentrations of TPH (C_{10}-C_{36}), total PAHs and benzo(a)pyrene, above the SAC adopted for this investigation, were encountered in one fill soil sample obtained from BH101 (0m-0.2m). The remaining results were below the SAC.

Asbestos was not encountered in any of the samples analysed and none of the heavy metal concentrations exceeded the PPILs with respect to plant phyto-toxicity.

The contamination encountered in sample BH101 (0m-0.2m) is likely to be associated with the slag in the fill soil at this location. Slag material of this nature is likely to have originated from various historical metal processing industries within the Sydney region and was commonly used as fill material in the early to mid 1900s when the St George Hospital site was developed.

PAHs (and also the TPHs in this instance) associated with this type of slag are typically bound in a relatively insoluble matrix and therefore the potential for these contaminants to leach from the fill soil is relatively low. This was supported by the following:

- The TCLP analysis results from BH101 (0m-0.2m) indicated that detectable concentrations of PAHs were not encountered in the leachate. This suggested that the PAHs were relatively immobile; and
- The underlying natural soil sample obtained from BH101 (0.5m-0.95m) did not encounter any detections of PAHs or TPHs above the laboratory PQLs. This suggested that the contaminants had not impacted the underlying natural material.

Detectable concentrations of TPH (C_{10}-C_{36}) and PAHs, below the SAC, were encountered in the natural soil sample obtained from BH102 (0.3m-0.7m). EIS are of the opinion that the material logged as natural silty clay at this location may potentially be fill material as these contaminants are typically not encountered in natural soil.

The primary exposure route for the contaminants encountered at the site is ingestion. As BH101 is located in an area of the hospital that is unpaved, the potential for exposure to the contamination at this location is increased.

11.2 Waste Classification

11.2.1 Classification of Fill Soils

Based on the results of the assessment, the fill material at the investigation locations is classified as **'General Solid Waste (non-putrescible)'** according to the criteria outlined in Waste Classification Guidelines 2009.

The *Approvals of Immobilisation* published on the OEH website[20] includes an immobilisation approval for metallurgical furnace slag contaminated materials (approval number 2009/07). The GAI 2009/07 states that metallurgical furnace slag contaminated materials *"...can be classified according to their leachable concentration (TCLP) values alone."*. The GAI 2009/07 has been adopted for the waste classification of the fill material in BH101.

11.2.2 Classification of Natural Soil and Bedrock

With the exception of natural soils in the vicinity of BH102, the natural soil and underlying sandstone bedrock at the investigation locations is considered to be **virgin excavated natural material (VENM)**. The material is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site. Where doubt exists about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted.

As a result of the TPH and PAHs encountered in the BH102 sample, further analysis of the natural material at this location would be required prior to providing a VENM classification.

VENM must not be mixed with any fill material (including building rubble) as this will invalidate the VENM classification.

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[20] http://www.environment.nsw.gov.au/resources/waste/200907_Metallurgical_furnace_slag.pdf (GAI 2009/07)

11.3 Recommendations

Due to the presence of PAHs and TPHs in BH101, remediation and/or management of this area will be required to meet the requirements of SEPP55. An additional investigation in the vicinity of BH101 would be prudent (following the demolition of the existing building in this area) in order to establish the horizontal extent of the contaminated fill material. A remedial action plan (RAP) should subsequently be prepared and implemented during the proposed works.

The above recommendations do not supersede those made within the EIS 2011 report. The additional investigation detailed above should be completed in conjunction with the additional works recommended in the EIS 2011 report, and if required, the RAP should be prepared for the St George Hospital site as a whole based on the findings of the additional works.

11.4 Regulatory Requirement

The requirement to report to the EPA under Section 60 and *Guidelines on the Duty to Report Contamination*[21] under the CLM Amendment Act 2008 should be assessed once the results of the additional investigation works have been reviewed and a remedial strategy has been selected.

Please note that in the event the recommendations for additional work and remediation are not undertaken, there may be justification to report to the EPA. EIS can be contacted for further advice regarding notification.

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[21] *Guidelines on the Duty to Report Contamination*, NSW Government Legislation, 2008 (Duty to Report Contamination 2008)

12 LIMITATIONS

The boreholes drilled for the investigation have enabled an assessment to be made of the existence of significant, large quantities of contaminated soils. EIS adopts no responsibility whatsoever for any problems such as USTs, buried items or contaminated material that may be encountered between sampling locations at the site. The proposed construction activities at the site should be planned on this basis, and any unexpected problem areas that are encountered between boreholes should be immediately inspected by experienced environmental personnel. This should ensure that such problems are dealt with in an appropriate manner, with minimal disruption to the project timetable and budget.

The conclusions developed in this report are based on site conditions which existed at the time of the site assessment and the scope of work outlined previously in this report. They are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, and visual observations of the site and vicinity, together with the interpretation of available historical information and documents reviewed as described in this report.

The investigation for this assessment and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined previously in this report.

Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated.

EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination.

Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes.

Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work.

EIS accept no responsibility for potential asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site.

EIS have not and will not make any determination regarding finances associated with the site.

Changes in the proposed or current site use may result in remediation or further investigation being required at the site.

During construction at the site, soil, fill and any unsuspected materials that are encountered should be monitored by qualified environmental and geotechnical engineers to confirm assumptions made on the basis of the limited investigation data, and possible changes in site level and other conditions since the investigation. Soil materials considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of EIS. EIS has used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report.

Should you require any further information regarding the above, please do not hesitate to contact us.

Yours faithfully
For and on behalf of
ENVIRONMENTAL INVESTIGATION SERVICES

B Page

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ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulfate Soil
B(a)P	Benzo(a)pyrene
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
COC	Chain of Custody documentation
CLM	Contaminated Land Management
DECCW	Department of Environment, Climate Change and Water
DNR	NSW Department of Natural Resources
DWE	NSW Department of Water and Energy
DP	Deposited Plan
DQO	Data Quality Objective
EC	Electrical Conductivity
EPA NSW	Environment Protection Authority, New South Wales
GC-ECD	Gas Chromatograph-Electron Capture Detector
GC-FID	Gas Chromatograph-Flame Ionisation Detector
GC-MS	Gas Chromatograph-Mass Spectrometer
HIL	Health Based Investigation Level
HM	Heavy Metals
ICP-AES	Inductively Couple Plasma – Atomic Emission Spectra
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
NHMRC	National Health and Medical Research Council
OEH	Office of Environment and Heritage
OCPs	Organochlorine Pesticides
OHS (OH&S)	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
PPIL	Provisional Phyto-toxicity Investigation Levels
PQL	Practical Quantitation Limit
P&T	Purge & Trap
RAP	Remedial Action Plan
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percentage Difference
SAC	Site Assessment Criteria
SEPP	State Environmental Planning Policy
sPOCAS	suspension Peroxide Oxidation Combined Acidity and Sulfate
SPT	Standard Penetration Test
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

IMPORTANT INFORMATION ABOUT THE SITE ASSESSMENT REPORT

These notes have been prepared by EIS to assist with the assessment and interpretation of this report.

An Environmental Assessment Report is Based on a Unique Set of Project Specific Factors:

This report has been prepared in response to specific project requirements as stated in the EIS proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- the proposed land use is altered;
- the defined subject site is increased or sub-divided;
- the proposed development details including size, configuration, location, orientation of the structures are modified;
- the proposed development levels are altered, eg addition of basement levels; or
- ownership of the site changes.

EIS/J&K will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by EIS to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions

Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (eg. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Assessment is Based on Professional Interpretations of Factual Data

Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Environmental Site Assessment Limitations

Although information provided by an environmental site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Environmental Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an environmental assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Environmental Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the test of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

TABLE A - 2
CHEMICAL CONTAMINANT CRITERIA FOR WASTE CLASSIFICATION
Waste Classification Guidelines. Part 1: Classifying Waste DECC (now DECCW) NSW July 2009

GENERAL SOLID WASTE	RESTRICTED SOLID WASTE	HAZARDOUS WASTE
IF SCC ≤ CT1, TCLP NOT NEEDED TO CLASSIFY AS GENERAL SOLID WASTE	IF SCC ≤ CT2, TCLP NOT NEEDED TO CLASSIFY AS RESTRICTED SOLID WASTE	IF SCC > CT2, TCLP NOT NEEDED TO CLASSIFY AS HAZARDOUS WASTE
IF TCLP ≤ TCLP1 AND SCC ≤ SCC1 TREAT AS GENERAL SOLID WASTE	IF TCLP ≤ TCLP2 AND SCC ≤ SCC2 TREAT AS RESTRICTED SOLID WASTE	IF TCLP > TCLP2 AND/OR SCC > SCC2 TREAT AS HAZARDOUS WASTE

	GENERAL SOLID WASTE			RESTRICTED SOLID WASTE		
CONTAMINANT	CT1 (mg/kg)	TCLP1 (mg/L)	SCC1 (mg/kg)	CT2 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	100	5	500	400	20	2,000
Beryllium	20	1.0	100	80	4	400
Cadmium	20	1.0	100	80	4	400
Chromium VI	100	5	1,900	400	20	7,600
Cyanide (total)	320	16	5,900	1280	64	23,600
Cyanide (Amenable)	70	3.5	300	280	14	1,200
Fluoride	3,000	150	10,000	12,000	600	40,000
Lead	100	5	1,500	400	20	6,000
Mercury	4	0.2	50	16	0.8	200
Molybdenum	100	5	1,000	400	20	4,000
Nickel	40	2	1,050	160	8	4,200
Selenium	20	1	50	80	4	200
Silver	100	5.0	180	400	20	720
Benzene	10	0.5	18	40	2	72
Toluene	288	14.4	518	1,152	57.6	2,073
Ethylbenzene	600	30	1,080	2,400	120	4,320
Total xylenes	1,000	50	1,800	4,000	200	7,200
Total petroleum hydrocarbons (C6-C9)	-	-	650	-	-	2,600
Total petroleum hydrocarbons (C10-C36) (C10-C14, C15-C28, C29-C36)	-	-	10,000	-	-	40,000
Benzo(a)pyrene	0.8	0.04	10	3.2	0.16	23
Polycyclic aromatic hydrocarbons (Total)	-	-	200	-	-	800
Polychlorinated biphenyls	-	-	<50	-	-	<50
Phenol (nonhalogenated)	288	14.4	518	1,152	57.6	2,073
Scheduled chemicals	-	-	<50	-	-	<50

NOTE:

SCC – Specific Contaminant Concentration

CT – Contaminant Threshold

TCLP – Toxicity Characteristics Leaching Procedure

TABLE B
SUMMARY OF LABORATORY RESULTS
SOIL ASSESSMENT
All data in mg/kg unless stated otherwise

ANALYTE			HEAVY METALS Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	PAHs Total PAHs	B(a)P	ORGANOCHLORINE PESTICIDES Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	OP PESTICIDES	PCBs
PQL - Envirolab Services			4	0.5	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	0.1
Site Assessment Criteria ^			500 *	100 *	60% *	5000 *	1500 *	75 *	3000 *	35000 *	100 *	5 *	50 *	250 *	1000 *	50 *	0.1 ^^	50 *
PPILs			20 **	3 **	400 **	100 **	600 **	1 **	60 **	200 **	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl
General Solid Waste CT1+			100	20	100	nsl	100	4	40	nsl	nsl	0.8	nsl					nsl
General Solid Waste SCC1+			500	100	1900	nsl	1500	50	1050	nsl	200	10	50					50
Restricted Solid Waste CT2+			400	80	400	nsl	400	16	160	nsl	nsl	3.2	nsl					nsl
Restricted Solid Waste SCC2+			2000	400	7600	nsl	6000	200	4200	nsl	800	23	50					50
Sample Reference	**Sample Depth**	**Sample Description**																
BH101¢	0-0.2	Fill: gravelly sand	LPQL	LPQL	9	90	26	LPQL	9	32	288.2	41	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
BH101	0.5-0.95	Sandy clay	5	LPQL	7	LPQL	6	LPQL	LPQL	1	0.05	0.05	nc	nc	nc	nc	nc	nc
BH102	0.3-0.7	Sandy clay	LPQL	LPQL	12	69	8	LPQL	54	31	13.3	1.6	nc	nc	nc	nc	nc	nc
BH103	0.7-0.9	Clayey sand	LPQL	LPQL	5	3	5	LPQL	LPQL	2	LPQL	LPQL	nc	nc	nc	nc	nc	nc
BH104	0-0.2	Fill: clayey sand	5	LPQL	10	36	88	LPQL	4	82	37.5	2.8	0.1	0.1	LPQL	LPQL	LPQL	LPQL
BH104	0.3-0.4	Silty sand	LPQL	LPQL	9	8	28	LPQL	1	22	17.7	1	nc	nc	nc	nc	nc	nc
BH105	0-0.2	Fill: gravelly sand	7	LPQL	16	17	35	LPQL	2	67	9.38	0.68	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
BH105	0.5-0.6	Silty clay	4	LPQL	18	LPQL	10	LPQL	1	5	LPQL	LPQL	nc	nc	nc	nc	nc	nc
BH106	0-0.3	Fill: clayey silty sand	LPQL	LPQL	9	41	27	LPQL	8	91	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
BH106	0.5-0.7	Silty clay	10	LPQL	30	2	28	LPQL	1	64	0.26	0.06	nc	nc	nc	nc	nc	nc
Total Number of samples			10	10	10	10	10	10	10	10	10	10	4	4	4	4	4	4
Maximum Value			10	LPQL	30	69	88	LPQL	54	91	288.2	41	0.1	0.1	LPQL	LPQL	LPQL	LPQL

ANALYTE			PETROLEUM HYDROCARBONS Petroleum Hydrocarbons C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10} - C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	PID VALUES	ASBESTOS FIBRES
PQL - Envirolab Services			25	50	100	100	250	0.5	0.5	1	3		100
Site Assessment Criteria ^			65 #	nsl	nsl	nsl	1000 #	1 #	1.4 #	3.1 #	14 #		100^^
PPILs			nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl		-
General Solid Waste CT1+			nsl	nsl			nsl	10	288	600	1000	-	-
General Solid Waste SCC1+			650	nsl			10000	18	518	1080	1800	-	-
Restricted Solid Waste CT2+			nsl	nsl			nsl	40	1152	2400	4000	-	-
Restricted Solid Waste SCC2+			2600	nsl			40000	72	2073	4320	7200	-	-
Sample Reference	**Sample Depth**	**Sample Description**											
BH101¢	0-0.2	Fill: gravelly sand	LPQL	LPQL	410	870	1280	LPQL	LPQL	LPQL	LPQL	0	NDLR
BH101	0.5-0.95	Sandy clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH102	0.3-0.7	Sandy clay	LPQL	LPQL	300	400	700	LPQL	LPQL	LPQL	LPQL	0	na
BH103	0.7-0.9	Clayey sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH104	0-0.2	Fill: clayey sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	NDLR
BH104	0.3-0.4	Silty sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH105	0-0.2	Fill: gravelly sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	NDLR
BH105	0.5-0.6	Silty clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH106	0-0.3	Fill: clayey silty sand	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	NDLR
BH106	0.5-0.7	Silty clay	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
Total Number of samples			10	10	10	10	10	10	10	10	10	10	4
Maximum Value			LPQL	LPQL	410	870	1280	LPQL	LPQL	LPQL	LPQL	0	nc

EXPLANATION:

^ Site Assessment Criteria: Guideline concentrations adopted for the investigation as outlined below:

* National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC Guidelines)
Health Investigation Levels (HIL) - Column F, Commercial/Industrial

** Provisional Phyto-toxicity Investigation Levels (PPILs)

NSW EPA Guidelines for Assessing Service Station Sites (1994)

^^ In the absence of Australian guidelines, the laboratory PQL has been adopted as the site assessment criteria

+ NSW DECCW Waste Classification Guidelines (2009)

¢ The higher laboratory duplicate values for TPH (C10-C36), total PAHs and benzo(a)pyrene have been adopted for sample BH101 0-0.2

Concentration above the Site Assessment Criteria — **VALUE**
Concentration above PPILs — VALUE

ABBREVIATIONS:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyls

UCL: Upper Level Confidence Limit on Mean Value
na: Not Analysed
nc: Not Calculated
nsl: No Set Limit
NDLR: Not Detected at Limit of Reporting

TABLE C
SUMMARY OF LABORATORY RESULTS
TOXICITY CHARACTERISTICS LEACHING PROCEDURE (TCLP)
All data in mg/L unless stated otherwise

ANALYTE		Arsenic	Cadmium	Chromium	Lead	Mercury	Nickel	B(a)P
PQL - Envirolab Services		0.05	0.01	0.01	0.03	0.0005	0.02	0.001
TCLP1 - General Solid Waste *		5	1	5	5	0.2	2	0.04
TCLP2 - Restricted Solid Waste *		20	4	20	20	0.8	8	0.16
TCLP3 - Hazardous Waste *		>20	>4	>20	>20	>0.8	>8	>0.16
Sample Reference	**Sample Depth**							
BH101	0-0.2	LPQL	LPQL	LPQL	0.08	LPQL	LPQL	LPQL
BH104	0-0.2	LPQL	LPQL	LPQL	0.05	LPQL	LPQL	LPQL
BH105	0-0.2	LPQL	LPQL	LPQL	0.05	LPQL	LPQL	LPQL
BH106	0-0.3	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL
Total Number of samples		4	4	4	4	4	4	4
Maximum Value		LPQL	LPQL	LPQL	0.08	LPQL	LPQL	LPQL

EXPLANATION:

* NSW DECCW Waste Classification Guidelines (2009)

Concentration above the General Solid Waste value	VALUE
Concentration above the Restricted Solid Waste value	Value

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
B(a)P: Benzo(a)pyrene
nc: Not Calculated
na: Not Analysed

TABLE D
SUMMARY OF LABORATORY RESULTS
QA/QC - SOIL INTRA-LABORATORY DUPLICATE
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Intra-laboratory Soil sample ID = BH106 0-0.3m Dup ID = Dup 1	Arsenic	4	LPQL	LPQL	nc	nc
	Cadmium	0.5	LPQL	LPQL	nc	nc
	Chromium	1	9	8	8.5	12
	Copper	1	41	39	40	5
	Lead	1	27	28	27.5	4
	Mercury	0.1	LPQL	LPQL	nc	nc
	Nickel	1	8	8	8	0
	Zinc	1	91	85	88	7
	Naphthalene	0.1	LPQL	LPQL	nc	nc
	Acenaphthylene	0.1	LPQL	LPQL	nc	nc
	Acenaphthene	0.1	LPQL	LPQL	nc	nc
	Fluorene	0.1	LPQL	LPQL	nc	nc
	Phenanthrene	0.1	LPQL	LPQL	nc	nc
	Anthracene	0.1	LPQL	LPQL	nc	nc
	Fluoranthene	0.1	LPQL	LPQL	nc	nc
	Pyrene	0.1	LPQL	LPQL	nc	nc
	Benzo(a)anthracene	0.1	LPQL	LPQL	nc	nc
	Chrysene	0.1	LPQL	LPQL	nc	nc
	Benzo(b)&(k)fluorant	0.2	LPQL	LPQL	nc	nc
	Benzo(a)pyrene	0.05	LPQL	LPQL	nc	nc
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	nc	nc
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	nc	nc
	Benzo(ghi)perylene	0.1	LPQL	LPQL	nc	nc
	C_6-C_9 TPH	25	LPQL	LPQL	nc	nc
	C_{10}-C_{14} TPH	50	LPQL	LPQL	nc	nc
	C_{15}-C_{28} TPH	100	LPQL	LPQL	nc	nc
	C_{29}-C_{36} TPH	100	LPQL	LPQL	nc	nc
	Benzene	0.5	LPQL	LPQL	nc	nc
	Toluene	0.5	LPQL	LPQL	nc	nc
	Ethylbenzene	1	LPQL	LPQL	nc	nc
	m+p-xylene	2	LPQL	LPQL	nc	nc
	o-xylene	1	LPQL	LPQL	nc	nc

EXPLANATION:

The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

- Results > 10 times PQL = RPD value < 50% are acceptable
- Results between 5 & 10 times PQL = RPD value < 75% are acceptable
- Results < 5 times PQL = RPD value < 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
RPD: Relative Percentage Difference
LPQL: Less than PQL
na: Not Calculated

TABLE E
SUMMARY OF LABORATORY RESULTS
QA/QC - TRIP SPIKE AND TRIP BLANK

ANALYSIS	**Envirolab PQL** mg/kg	$T.B^s$ 15.12.11 mg/kg	$T.S^s$ 15.12.11 % Recovery
Benzene	1	LPQL	100
Toluene	1	LPQL	100
Ethylbenzene	1	LPQL	100
m+p-xylene	2	LPQL	92
o-xylene	1	LPQL	88

EXPLANATION:

^{W} Sample type (water)

^{S} Sample type (sand)

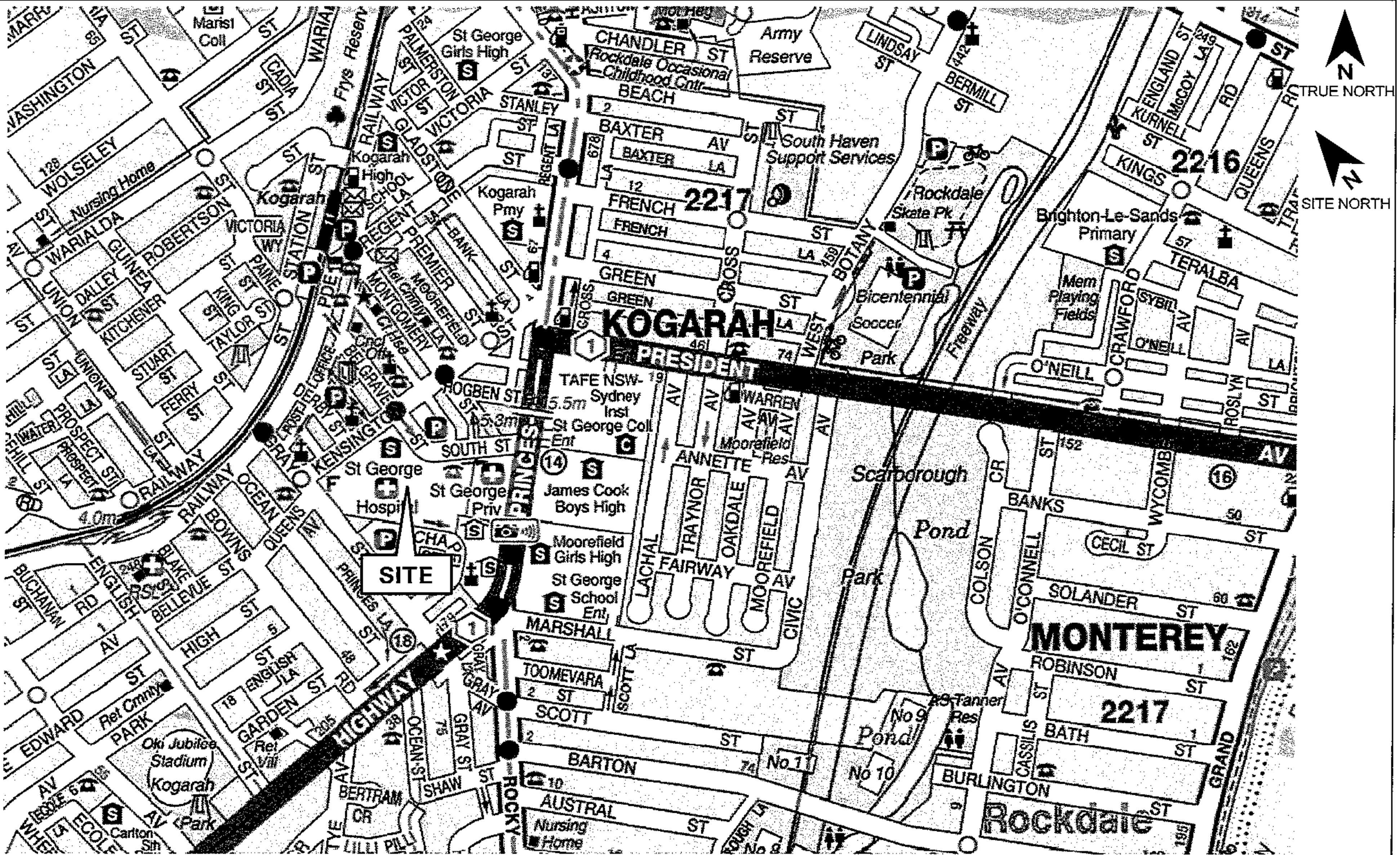
BTEX concentrations in trip spikes are presented as % recovery

Results Above the PQLs / outside acceptable limits VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit

LPQL: Less than PQL

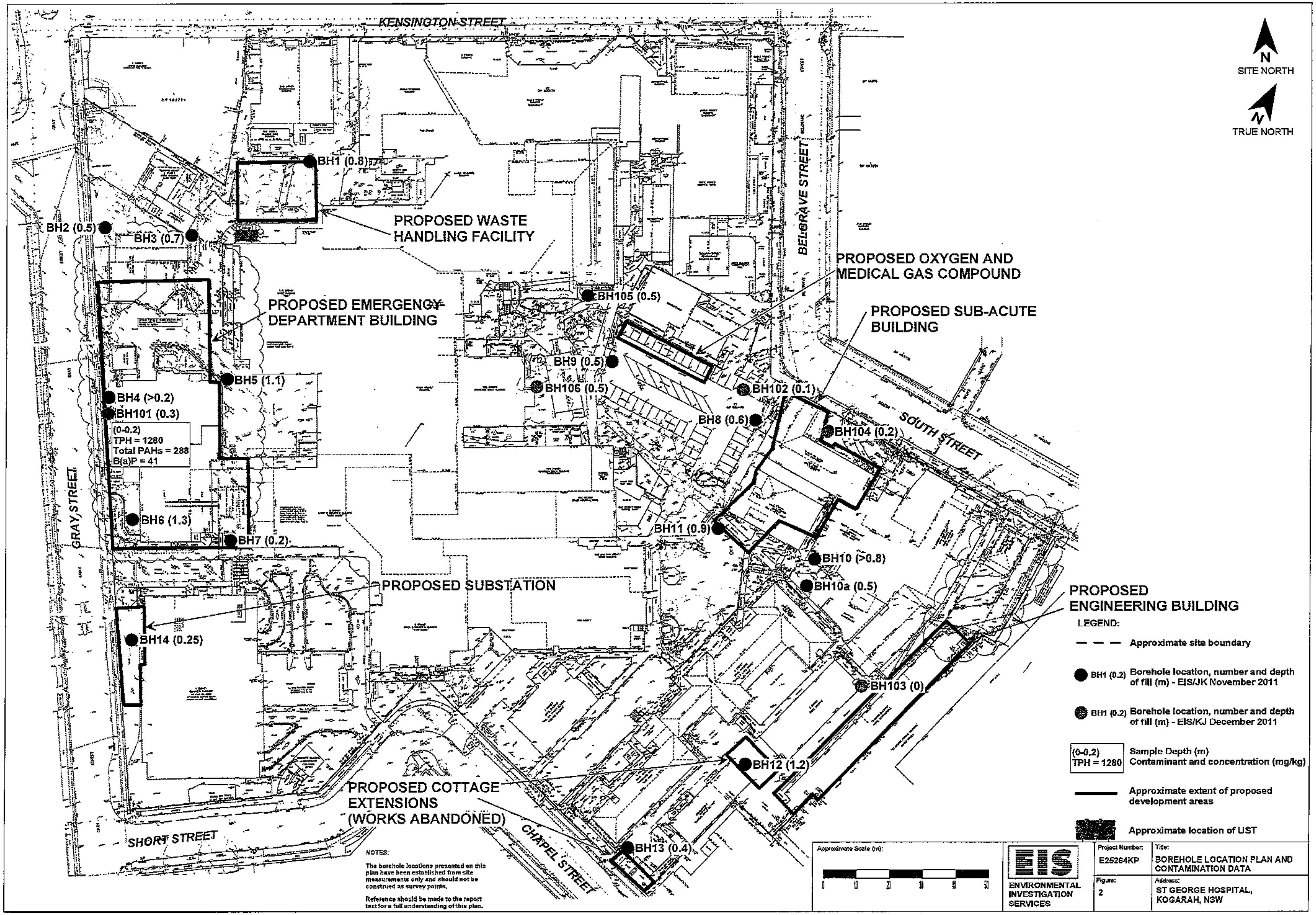


NOTES:
Figure 1 has been recreated from UBD on disc (version 5.0). Figure is not to scale.

UBD Map ref: 294 G-H 5-6

Reference should be made to the report text for a full understanding of this plan.

EIS ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: E25264KP	Title: SITE LOCATION PLAN
	Figure: 1	Address: ST GEORGE HOSPITAL, KOGARAH, NSW

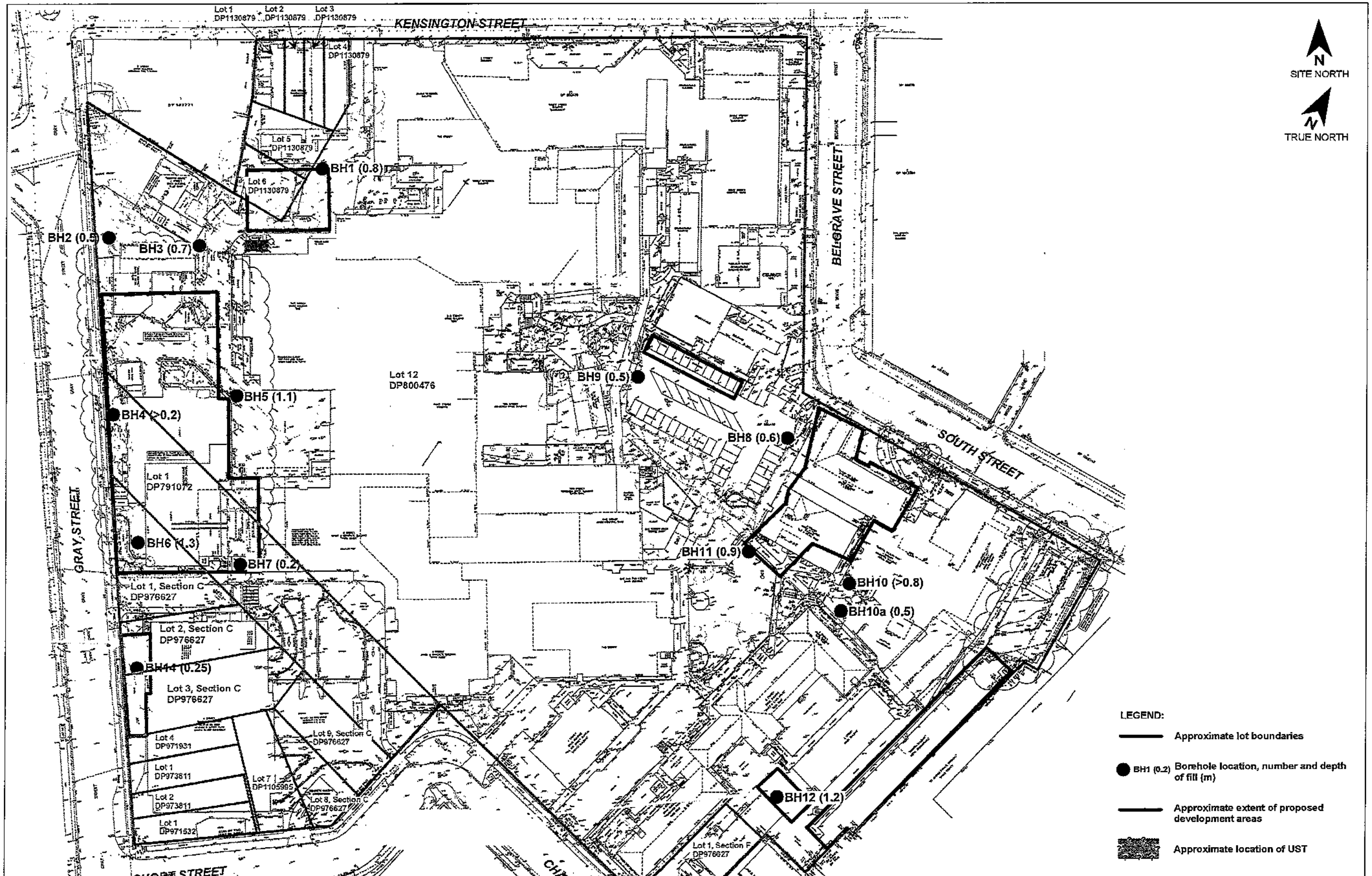


NOTES:

The borehole locations presented on this plan have been established from site measurements only and should not be construed as survey points.

Reference should be made to the report text for a full understanding of this plan.

EIS ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: E25264KP	Title: BOREHOLE LOCATION PLAN AND CONTAMINATION DATA
	Figure: 2	Address: ST GEORGE HOSPITAL, KOGARAH, NSW



NOTES:

The borehole locations presented on this plan have been established from site measurements only and should not be construed as survey points.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m): 0 10 20 30 40 50

ENVIRONMENTAL INVESTIGATION SERVICES

Project Number:	Title:
E25264KP	LOT LAYOUT PLAN
Figure: 3	Address: ST GEORGE HOSPITAL, KOGARAH, NSW

APPENDIX A

(Borehole Logs and Geotechnical Explanatory Notes)

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **101**

1/1

Client: HEALTH INFRASTRUCTURE (NSW)

Project: PROPOSED ALTERATIONS AND ADDITIONS

Location: ST GEORGE HOSPITAL, GRAY STREET, KOGARAH, NSW

Job No. 25264Z2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≈ 28.4m

Date: 15-12-11 **Datum:** AHD

Logged/Checked by: H.W./ PR

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		0		FILL: Gravelly sand, fine to medium grained, dark brown, fine to coarse grained slag gravel.	D			
	N = 12 8,8,4		CL	SANDY CLAY: low plasticity, orange brown and grey, with fine to medium grained ironstone gravel, trace of ash and root fibres.	MC<PL	VSt	- 350 300 320	RESIDUAL
	N = 34 20,20,14	1	-	SANDSTONE: fine to medium grained, light grey and yellow brown, with iron indurated bands.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
		2						
		3		SANDSTONE: fine to medium grained, light grey.	DW	VL-L		LOW RESISTANCE
					SW	H		
		4		END OF BOREHOLE AT 4.0m				'TC' BIT REFUSAL
		5						
		6						
		7						

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
102
1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE (NSW)
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: ST GEORGE HOSPITAL, GRAY STREET, KOGARAH, NSW

Job No. 25264Z2 **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≈ 26.9m
Date: 15-12-11 **Datum:** AHD
Logged/Checked by: H.W./ft

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0		-	ASPHALTIC CONCRETE: 30mm.t				
									FILL: Gravelly sand, fine to medium grained, grey, fine to medium grained igneous.				
								CL	SANDY CLAY: low plasticity, light grey mottled orange brown, with fine to medium grained ironstone gravel.	MC≈PL	St	150 200 200	RESIDUAL
													'TC' BIT REFUSAL ON INFERRED BEDROCK
						1			END OF BOREHOLE AT 0.7m				
						2							
						3							
						4							
						5							
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **103**
1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE (NSW)
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: ST GEORGE HOSPITAL, GRAY STREET, KOGARAH, NSW

Job No. 25264Z2
Date: 15-12-11
Method: SPIRAL AUGER JK300
Logged/Checked by: H.W./
R.L. Surface: ≈ 22.8m
Datum: AHD

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			CONCRETE: 120mm.t				8mm DIA. REINFORCEMENT, 75mm TOP COVER
ON COMPLETION									CONCRETE: 570mm.t				
								SC	CLAYEY SAND: fine to medium grained, light grey and orange brown.	M	-	-	
						1		-	SANDSTONE: fine to medium grained, light grey.	DW-SW	H	-	HIGH 'TC' BIT RESISTANCE
									END OF BOREHOLE AT 1.6m				'TC' BIT REFUSAL
						2							
						3							
						4							
						5							
						6							
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
104
1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE (NSW)
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: ST GEORGE HOSPITAL, GRAY STREET, KOGARAH, NSW

Job No. 25264Z2 **Method:** HAND AUGER **R.L. Surface:** ≈ 25.9m
Date: 15-12-11 **Datum:** AHD
Logged/Checked by: H.W./

Groundwater Record	SAMPLES ES U50 DB DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		REFER TO DCP TEST RESULTS	0			FILL: Clayey sand, fine to medium grained, dark brown, with fine to medium gravel sandstone gravel and root fibres.	D			GRASS COVER
					SM	SILTY SAND: fine to medium grained, brown, with clay fines.	D	L	-	RESIDUAL
					SC	CLAYEY SAND: fine to coarse grained, brown and orange brown, with fine to coarse grained sandstone gravel.				
			1			END OF BOREHOLE AT 0.9m				HAND AUGER REFUSAL ON INFERRED BEDROCK
			2							
			3							
			4							
			5							
			6							
			7							

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CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **105**

1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE (NSW)
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: ST GEORGE HOSPITAL, GRAY STREET, KOGARAH, NSW

Job No. 25264Z2 **Method:** HAND AUGER **R.L. Surface:** ≈ 29.9m
Date: 15-12-11 **Datum:** AHD
Logged/Checked by: H.W./

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION					REFER TO DCP TEST RESULTS	0			FILL: Gravelly clayey sand, fine to medium grained, grey, fine to coarse grained ironstone gravel.	M			APPEARS POORLY COMPACTED
								CH	SILTY CLAY: high plasticity, orange brown, with fine to coarse grained ironstone gravel.	MC>PL	St VSt	250 150 120 350 310 380	HAND AUGER REFUSAL
						1			END OF BOREHOLE AT 0.75m				
						2							
						3							
						4							
						5							
						6							
						7							

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Borehole No. **106**
1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE (NSW)
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: ST GEORGE HOSPITAL, GRAY STREET, KOGARAH, NSW

Job No. 25264Z2 **Method:** HAND AUGER **R.L. Surface:** ≈ 29.9m
Date: 15-12-11 **Datum:** AHD
Logged/Checked by: H.W./

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION					REFER TO DCP TEST RESULTS	0			FILL: Clayey silty sand, fine to medium grained, dark brown, with root fibres.	M			APPEARS POORLY COMPACTED
								CH	SILTY CLAY: high plasticity, grey and red brown, with fine to coarse grained ironstone gravel.	MC≈PL	H	>600 >600	
						1			END OF BOREHOLE AT 0.75m				HAND AUGER REFUSAL
						2							
						3							
						4							
						5							
						6							
						7							

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ABN 17 003 550 801

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (eg sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N>30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

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

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

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

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

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soil for Engineering Purposes'*. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

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

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document *'Guidelines for the Provision of Geotechnical Information in Tender Documents'*, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed <u>or</u> where only a limited investigation has been completed <u>or</u> where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or

iii) full time engineering presence on site.

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GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CH)
- SILTY CLAY (CL, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML)
- PEAT AND ORGANIC SOILS

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE
- SILTSTONE, MUDSTONE, CLAYSTONE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

DEFECTS AND INCLUSIONS

- CLAY SEAM
- SHEARED OR CRUSHED SEAM
- BRECCIATED OR SHATTERED SEAM/ZONE
- IRONSTONE GRAVEL
- ORGANIC MATERIAL

OTHER MATERIALS

- CONCRETE
- BITUMINOUS CONCRETE, COAL
- COLLUVIUM

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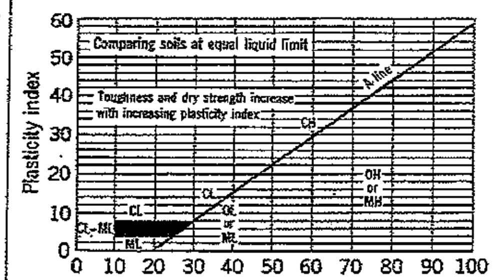
UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)				Group Symbols *	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria		
Coarse-grained soils More than half of material is *larger* than 75 μm sieve size[b] (The 75 μm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name: indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for *GW*	
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures			Atterberg limits below "A" line, or *PI* less than 4	Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics		Atterberg limits above "A" line, with *PI* greater than 7	
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for *SW*	
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures			Atterberg limits below "A" line or *PI* less than 5	Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures			Atterberg limits below "A" line with *PI* greater than 7	

	Identification Procedures on Fraction Smaller than 380 μm Sieve Size	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils More than half of material is *smaller* than 75 μm sieve size (The 75 μm sieve size is about the smallest particle visible to naked eye)	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	

Use grain size curve in identifying the fractions as given under field identification



Plasticity chart
for laboratory classification of fine grained soils

NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

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LOG SYMBOLS

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
		0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
		0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
		1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
		3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
		10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
A.B.N. 17 003 550 801 A.C.N. 003 550 801

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.
	—C—	Extent of borehole collapse shortly after drilling.
		Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY - runs freely through fingers.
	M	MOIST - does not run freely but no free water visible on soil surface.
	W	WET - free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa
	S	SOFT - Unconfined compressive strength 25-50kPa
	F	FIRM - Unconfined compressive strength 50-100kPa
	St	STIFF - Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa
	H	HARD - Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.

LOG COLUMN	SYMBOL			
Density Index/ Relative Density (Cohesionless Soils)		Density Index (I_D) Range (%)		SPT 'N' Value Range (Blows/300mm)
	VL	Very Loose	<15	0-4
	L	Loose	15-35	4-10
	MD	Medium Dense	35-65	10-30
	D	Dense	65-85	30-50
	VD	Very Dense	>85	>50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.		
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.		
Remarks	'V' bit	Hardened steel 'V' shaped bit.		
	'TC' bit	Tungsten carbide wing bit.		
	60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.		

Ref: Standard Sheets Log Symbols
August 2001

APPENDIX B

(Laboratory Reports and Chain of Custody Documents)

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 66659

Client:

Environmental Investigation Services
PO Box 976
North Ryde BC
NSW 1670

Attention: Brendan Page

Sample log in details:

Your Reference:	**E25264KP, Kogarah**	
No. of samples:	13 soils	
Date samples received / completed instructions received	16/12/11	/ 16/12/11

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:	23/12/11	/ 22/12/11
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:

Rhian Morgan
Reporting Supervisor

Hinoko Miyazaki
Chemist

Paul Ching
Approved Signatory

Jeremy Faircloth
Chemist

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

vTRH & BTEX in Soil						
Our Reference:	UNITS	66659-1	66659-2	66659-3	66659-4	66659-5
Your Reference	-------------	BH101	BH101	BH102	BH103	BH104
Depth	------------	0-0.2	0.5-0.95	0.3-0.7	0.7-0.9	0-0.2
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
vTRH C_6 - C_9	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
Surrogate aaa-Trifluorotoluene	%	78	77	97	96	106

vTRH & BTEX in Soil						
Our Reference:	UNITS	66659-6	66659-7	66659-8	66659-9	66659-10
Your Reference	-------------	BH104	BH105	BH105	BH106	BH106
Depth	------------	0.3-0.4	0-0.2	0.5-0.6	0-0.3	0.5-0.7
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
vTRH C_6 - C_9	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
Surrogate aaa-Trifluorotoluene	%	97	107	88	96	95

vTRH & BTEX in Soil				
Our Reference:	UNITS	66659-11	66659-12	66659-13
Your Reference	-------------	DUP1	TS	TB
Depth	------------	-	-	-
Date Sampled		15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011
vTRH C_6 - C_9	mg/kg	<25	[NA]	[NA]
Benzene	mg/kg	<0.2	100%	<0.2
Toluene	mg/kg	<0.5	100%	<0.5
Ethylbenzene	mg/kg	<1	100%	<1
m+p-xylene	mg/kg	<2	92%	<2
o-Xylene	mg/kg	<1	88%	<1
Surrogate aaa-Trifluorotoluene	%	95	100	99

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	66659-1	66659-2	66659-3	66659-4	66659-5
Your Reference	-------------	BH101	BH101	BH102	BH103	BH104
Depth	------------	0-0.2	0.5-0.95	0.3-0.7	0.7-0.9	0-0.2
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	130	<100	300	<100	<100
TRH C_{29} - C_{36}	mg/kg	310	<100	400	<100	<100
Surrogate o-Terphenyl	%	93	95	120	98	96

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	66659-6	66659-7	66659-8	66659-9	66659-10
Your Reference	-------------	BH104	BH105	BH105	BH106	BH106
Depth	------------	0.3-0.4	0-0.2	0.5-0.6	0-0.3	0.5-0.7
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	99	95	94	91	95

sTRH in Soil (C10-C36)		
Our Reference:	UNITS	66659-11
Your Reference	-------------	DUP1
Depth	------------	-
Date Sampled		15/12/2011
Type of sample		Soil
Date extracted	-	19/12/2011
Date analysed	-	19/12/2011
TRH C_{10} - C_{14}	mg/kg	<50
TRH C_{15} - C_{28}	mg/kg	<100
TRH C_{29} - C_{36}	mg/kg	<100
Surrogate o-Terphenyl	%	96

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-1 BH101 0-0.2 15/12/2011 Soil	66659-2 BH101 0.5-0.95 15/12/2011 Soil	66659-3 BH102 0.3-0.7 15/12/2011 Soil	66659-4 BH103 0.7-0.9 15/12/2011 Soil	66659-5 BH104 0-0.2 15/12/2011 Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	20/12/2011	20/12/2011	20/12/2011	20/12/2011	20/12/2011
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.2
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	1.2
Acenaphthene	mg/kg	0.7	<0.1	<0.1	<0.1	0.1
Fluorene	mg/kg	0.2	<0.1	<0.1	<0.1	0.6
Phenanthrene	mg/kg	4.7	<0.1	0.7	<0.1	5.5
Anthracene	mg/kg	1.4	<0.1	0.3	<0.1	1.4
Fluoranthene	mg/kg	14	<0.1	1.8	<0.1	6.8
Pyrene	mg/kg	14	<0.1	2.2	<0.1	6.0
Benzo(a)anthracene	mg/kg	4.7	<0.1	1.4	<0.1	3.1
Chrysene	mg/kg	5.7	<0.1	1.4	<0.1	2.6
Benzo(b+k)fluoranthene	mg/kg	16	<0.2	2.3	<0.2	4.2
Benzo(a)pyrene	mg/kg	13	0.05	1.6	<0.05	2.8
Indeno(1,2,3-c,d)pyrene	mg/kg	10	<0.1	0.7	<0.1	1.5
Dibenzo(a,h)anthracene	mg/kg	1.3	<0.1	0.2	<0.1	0.3
Benzo(g,h,i)perylene	mg/kg	10	<0.1	0.7	<0.1	1.2
Surrogate p-Terphenyl-d_{14}	%	108	117	113	111	111

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-6 BH104 0.3-0.4 15/12/2011 Soil	66659-7 BH105 0-0.2 15/12/2011 Soil	66659-8 BH105 0.5-0.6 15/12/2011 Soil	66659-9 BH106 0-0.3 15/12/2011 Soil	66659-10 BH106 0.5-0.7 15/12/2011 Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	20/12/2011	20/12/2011	20/12/2011	20/12/2011	20/12/2011
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	3.2	0.3	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.3	0.2	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	2.4	1.6	<0.1	<0.1	<0.1
Anthracene	mg/kg	2.3	0.4	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	2.6	1.8	<0.1	<0.1	0.1
Pyrene	mg/kg	2.2	1.6	<0.1	<0.1	0.1
Benzo(a)anthracene	mg/kg	0.9	0.7	<0.1	<0.1	<0.1
Chrysene	mg/kg	1	0.6	<0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	0.4	1.0	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	1.0	0.68	<0.05	<0.05	0.06
Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	0.3	<0.1	<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	0.9	0.2	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d_{14}	%	113	111	114	105	117

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-11 DUP1 - 15/12/2011 Soil
Date extracted	-	19/12/2011
Date analysed	-	20/12/2011
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	<0.1
Pyrene	mg/kg	<0.1
Benzo(a)anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1
Surrogate p-Terphenyl-d_{14}	%	115

Organochlorine Pesticides in soil					
Our Reference:	UNITS	66659-1	66659-5	66659-7	66659-9
Your Reference	-------------	BH101	BH104	BH105	BH106
Depth	------------	0-0.2	0-0.2	0-0.2	0-0.3
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	21/12/2011	21/12/2011	21/12/2011	21/12/2011
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	105	98	106	100

Organophosphorus Pesticides Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-1 BH101 0-0.2 15/12/2011 Soil	66659-5 BH104 0-0.2 15/12/2011 Soil	66659-7 BH105 0-0.2 15/12/2011 Soil	66659-9 BH106 0-0.3 15/12/2011 Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	21/12/2011	21/12/2011	21/12/2011	21/12/2011
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	105	98	106	100

PCBs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- -------------	66659-1 BH101 0-0.2 15/12/2011 Soil	66659-5 BH104 0-0.2 15/12/2011 Soil	66659-7 BH105 0-0.2 15/12/2011 Soil	66659-9 BH106 0-0.3 15/12/2011 Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	21/12/2011	21/12/2011	21/12/2011	21/12/2011
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	105	98	106	100

Acid Extractable metals in soil						
Our Reference:	UNITS	66659-1	66659-2	66659-3	66659-4	66659-5
Your Reference	-------------	BH101	BH101	BH102	BH103	BH104
Depth	------------	0-0.2	0.5-0.95	0.3-0.7	0.7-0.9	0-0.2
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Arsenic	mg/kg	<4	5	<4	<4	5
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	9	7	12	5	10
Copper	mg/kg	30	<1	69	3	36
Lead	mg/kg	26	6	8	5	88
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	9	<1	54	<1	4
Zinc	mg/kg	32	1	31	2	82

Acid Extractable metals in soil						
Our Reference:	UNITS	66659-6	66659-7	66659-8	66659-9	66659-10
Your Reference	-------------	BH104	BH105	BH105	BH106	BH106
Depth	------------	0.3-0.4	0-0.2	0.5-0.6	0-0.3	0.5-0.7
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Arsenic	mg/kg	<4	7	4	<4	10
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	9	16	18	9	30
Copper	mg/kg	8	17	<1	41	2
Lead	mg/kg	28	35	10	27	28
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	1	2	1	8	1
Zinc	mg/kg	22	67	5	91	64

Acid Extractable metals in soil		
Our Reference:	UNITS	66659-11
Your Reference	-------------	DUP1
Depth	------------	-
Date Sampled		15/12/2011
Type of sample		Soil
Date digested	-	19/12/2011
Date analysed	-	19/12/2011
Arsenic	mg/kg	<4
Cadmium	mg/kg	<0.5
Chromium	mg/kg	8
Copper	mg/kg	39
Lead	mg/kg	28
Mercury	mg/kg	<0.1
Nickel	mg/kg	8
Zinc	mg/kg	85

Moisture Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-1 BH101 0-0.2 15/12/2011 Soil	66659-2 BH101 0.5-0.95 15/12/2011 Soil	66659-3 BH102 0.3-0.7 15/12/2011 Soil	66659-4 BH103 0.7-0.9 15/12/2011 Soil	66659-5 BH104 0-0.2 15/12/2011 Soil
Date prepared	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	20/12/2011	20/12/2011	20/12/2011	20/12/2011	20/12/2011
Moisture	%	6.7	8.7	7.4	20	11

Moisture Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-6 BH104 0.3-0.4 15/12/2011 Soil	66659-7 BH105 0-0.2 15/12/2011 Soil	66659-8 BH105 0.5-0.6 15/12/2011 Soil	66659-9 BH106 0-0.3 15/12/2011 Soil	66659-10 BH106 0.5-0.7 15/12/2011 Soil
Date prepared	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	20/12/2011	20/12/2011	20/12/2011	20/12/2011	20/12/2011
Moisture	%	12	13	16	18	16

Moisture Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-11 DUP1 - 15/12/2011 Soil
Date prepared	-	19/12/2011
Date analysed	-	20/12/2011
Moisture	%	19

Asbestos ID - soils					
Our Reference:	UNITS	66659-1	66659-5	66659-7	66659-9
Your Reference	-------------	BH101	BH104	BH105	BH106
Depth	------------	0-0.2	0-0.2	0-0.2	0-0.3
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	22/12/2011	22/12/2011	22/12/2011	22/12/2011
Sample mass tested	g	Approx 40g	Approx 40g	Approx 40g	Approx 40g
Sample Description	-	Brown coarse-grained soil	Brown coarse-grained soil	Brown coarse-grained soil	Brown coarse-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

Metals in TCLP USEPA1311					
Our Reference:	UNITS	66659-1	66659-5	66659-7	66659-9
Your Reference	-------------	BH101	BH104	BH105	BH106
Depth	------------	0-0.2	0-0.2	0-0.2	0-0.3
Date Sampled		15/12/2011	15/12/2011	15/12/2011	15/12/2011
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011
Date analysed	-	19/12/2011	19/12/2011	19/12/2011	19/12/2011
pH of soil for fluid# determ.	pH units	8.4	8.1	8.0	8.0
pH of soil for fluid # determ. (acid)	pH units	1.6	1.6	1.6	1.6
Extraction fluid used	-	1	1	1	1
pH of final Leachate	pH units	4.9	4.9	4.9	4.9
Arsenic in TCLP	mg/L	<0.05	<0.05	<0.05	<0.05
Cadmium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01
Chromium in TCLP	mg/L	<0.01	<0.01	<0.01	<0.01
Lead in TCLP	mg/L	0.08	0.05	0.05	<0.03
Mercury in TCLP	mg/L	<0.0005	<0.0005	<0.0005	<0.0005
Nickel in TCLP	mg/L	<0.02	<0.02	<0.02	<0.02

PAHs in TCLP (USEPA 1311) Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ------------- ------------	66659-1 BH101 0-0.2 15/12/2011 Soil	66659-5 BH104 0-0.2 15/12/2011 Soil	66659-7 BH105 0-0.2 15/12/2011 Soil	66659-9 BH106 0-0.3 15/12/2011 Soil
Date extracted	-	20/12/2011	20/12/2011	20/12/2011	20/12/2011
Date analysed	-	20/12/2011	20/12/2011	20/12/2011	20/12/2011
Naphthalene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Acenaphthylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Acenaphthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Fluorene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Phenanthrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Fluoranthene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Chrysene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Benzo(b+k)fluoranthene in TCLP	mg/L	<0.002	<0.002	<0.002	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001	<0.001	<0.001	<0.001
Surrogate p-Terphenyl-d_{14}	%	109	96	101	93

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.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-008	Moisture content determined by heating at 105 deg C for a minimum of 4 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.
Inorg-004	Toxicity Characteristic Leaching Procedure (TCLP) using AS 4439 and USEPA 1311.
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 21st ED, 4500-H+.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Org-012 subset	Leachates are extracted with Dichloromethane and analysed by GC-MS.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
Date analysed	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
vTRH C_6 - C_9	mg/kg	25	Org-016	<25	66659-1	<25 || <25	LCS-3	98%
Benzene	mg/kg	0.2	Org-016	<0.2	66659-1	<0.2 || <0.2	LCS-3	95%
Toluene	mg/kg	0.5	Org-016	<0.5	66659-1	<0.5 || <0.5	LCS-3	97%
Ethylbenzene	mg/kg	1	Org-016	<1	66659-1	<1 || <1	LCS-3	99%
m+p-xylene	mg/kg	2	Org-016	<2	66659-1	<2 || <2	LCS-3	99%
o-Xylene	mg/kg	1	Org-016	<1	66659-1	<1 || <1	LCS-3	97%
Surrogate aaa-Trifluorotoluene	%		Org-016	102	66659-1	78 || 89 || RPD: 13	LCS-3	102%

QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
Date analysed	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	66659-1	<50 || <50	LCS-3	73%
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	66659-1	130 || 410 || RPD: 104	LCS-3	87%
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	66659-1	310 || 870 || RPD: 95	LCS-3	83%
Surrogate o-Terphenyl	%		Org-003	74	66659-1	93 || 105 || RPD: 12	LCS-3	111%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-5	19/12/2011
Date analysed	-			20/12/2011	66659-1	20/12/2011 || 20/12/2011	LCS-5	20/12/2011
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	<0.1 || 0.1	LCS-5	105%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	0.1 || 0.4 || RPD: 120	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	0.7 || 0.9 || RPD: 25	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	0.2 || 0.3 || RPD: 40	LCS-5	104%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	4.7 || 9.0 || RPD: 63	LCS-5	97%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	1.4 || 2.8 || RPD: 67	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	14 || 40 || RPD: 96	LCS-5	90%
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	14 || 42 || RPD: 100	LCS-5	95%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	4.7 || 16 || RPD: 109	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	5.7 || 18 || RPD: 104	LCS-5	97%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(b+k)fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	66659-1	16 || 51 || RPD: 104	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	66659-1	13 || 41 || RPD: 104	LCS-5	100%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	10 || 31 || RPD: 102	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	1.3 || 4.7 || RPD: 113	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	66659-1	10 || 31 || RPD: 102	[NR]	[NR]
Surrogate *p*-Terphenyl-d_{14}	%		Org-012 subset	113	66659-1	108 || 115 || RPD: 6	LCS-5	90%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
Date analysed	-			21/12/2011	66659-1	21/12/2011 || 21/12/2011	LCS-3	21/12/2011
HCB	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	117%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	127%
Heptachlor	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	114%
delta-BHC	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	108%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	121%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	127%
Dieldrin	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	123%
Endrin	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	121%
pp-DDD	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	137%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	LCS-3	124%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-005	99	66659-1	105 || 101 || RPD: 4	LCS-3	129%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
Date analysed	-			21/12/2011	66659-1	21/12/2011 || 21/12/2011	LCS-3	21/12/2011
Diazinon	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	LCS-3	114%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	LCS-3	132%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	66659-1	<0.1 || <0.1	LCS-3	132%
Surrogate TCLMX	%		Org-008	99	66659-1	105 || 101 || RPD: 4	LCS-3	91%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-3	19/12/2011
Date analysed	-			21/12/2011	66659-1	21/12/2011 || 21/12/2011	LCS-3	21/12/2011
Arochlor 1016	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	LCS-3	126%
Arochlor 1260	mg/kg	0.1	Org-006	<0.1	66659-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	99	66659-1	105 || 101 || RPD: 4	LCS-3	94%

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	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-1	19/12/2011
Date analysed	-			19/12/2011	66659-1	19/12/2011 || 19/12/2011	LCS-1	19/12/2011
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	66659-1	<4 || <4	LCS-1	107%
Cadmium	mg/kg	0.5	Metals-020 ICP-AES	<0.5	66659-1	<0.5 || <0.5	LCS-1	111%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	66659-1	9 || 9 || RPD: 0	LCS-1	108%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	66659-1	30 || 17 || RPD: 55	LCS-1	106%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	66659-1	26 || 25 || RPD: 4	LCS-1	102%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	66659-1	<0.1 || <0.1	LCS-1	107%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	66659-1	9 || 8 || RPD: 12	LCS-1	108%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	66659-1	32 || 33 || RPD: 3	LCS-1	106%

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 Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/12/2011	[NT]	[NT]	LCS-W1	20/12/2011
Date analysed	-			21/12/2011	[NT]	[NT]	LCS-W1	21/12/2011
Arsenic in TCLP	mg/L	0.05	Metals-020 ICP-AES	<0.05	[NT]	[NT]	LCS-W1	107%
Cadmium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	105%
Chromium in TCLP	mg/L	0.01	Metals-020 ICP-AES	<0.01	[NT]	[NT]	LCS-W1	100%
Lead in TCLP	mg/L	0.03	Metals-020 ICP-AES	<0.03	[NT]	[NT]	LCS-W1	97%
Mercury in TCLP	mg/L	0.0005	Metals-021 CV-AAS	<0.0005	[NT]	[NT]	LCS-W1	84%
Nickel in TCLP	mg/L	0.02	Metals-020 ICP-AES	<0.02	[NT]	[NT]	LCS-W1	101%

QUALITY CONTROL PAHs in TCLP (USEPA 1311)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/12/2011	[NT]	[NT]	LCS-W1	20/12/2011
Date analysed	-			20/12/2011	[NT]	[NT]	LCS-W1	20/12/2011
Naphthalene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	77%
Acenaphthylene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Acenaphthene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluorene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	92%
Phenanthrene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	93%
Anthracene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Fluoranthene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	93%
Pyrene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	96%
Benzo(a)anthracene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Chrysene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	91%
Benzo(b+k)fluoranthene in TCLP	mg/L	0.002	Org-012 subset	<0.002	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	LCS-W1	86%
Indeno(1,2,3-c,d)pyrene -TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	Org-012 subset	<0.001	[NT]	[NT]	[NR]	[NR]
Surrogate *p*-Terphenyl-d_{14}	%		Org-012	108	[NT]	[NT]	LCS-W1	110%

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
Date analysed	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
vTRH C_6 - C_9	mg/kg	66659-11	<25 || <25	66659-5	93%
Benzene	mg/kg	66659-11	<0.2 || <0.2	66659-5	90%
Toluene	mg/kg	66659-11	<0.5 || <0.5	66659-5	94%
Ethylbenzene	mg/kg	66659-11	<1 || <1	66659-5	95%
m+p-xylene	mg/kg	66659-11	<2 || <2	66659-5	93%
o-Xylene	mg/kg	66659-11	<1 || <1	66659-5	92%
Surrogate aaa-Trifluorotoluene	%	66659-11	95 || 91 || RPD: 4	66659-5	97%

QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
Date analysed	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
TRHC $_{10}$ - C $_{14}$	mg/kg	66659-11	<50 || <50	66659-5	95%
TRHC $_{15}$ - C $_{28}$	mg/kg	66659-11	<100 || <100	66659-5	132%
TRHC $_{29}$ - C $_{36}$	mg/kg	66659-11	<100 || <100	66659-5	112%
Surrogate o-Terphenyl	%	66659-11	96 || 97 || RPD: 1	66659-5	118%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
Date analysed	-	66659-11	20/12/2011 || 20/12/2011	66659-5	20/12/2011
Naphthalene	mg/kg	66659-11	<0.1 || <0.1	66659-5	98%
Acenaphthylene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	66659-11	<0.1 || <0.1	66659-5	97%
Phenanthrene	mg/kg	66659-11	<0.1 || <0.1	66659-5	94%
Anthracene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	66659-11	<0.1 || <0.1	66659-5	86%
Pyrene	mg/kg	66659-11	<0.1 || <0.1	66659-5	93%
Benzo(a)anthracene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	66659-11	<0.1 || <0.1	66659-5	92%
Benzo(b+k)fluoranthene	mg/kg	66659-11	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	66659-11	<0.05 || <0.05	66659-5	106%
Indeno(1,2,3-c,d)pyrene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	66659-11	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d $_{14}$	%	66659-11	115 || 112 || RPD: 3	66659-5	103%

Client Reference: E25264KP, Kogarah

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	66659-5	19/12/2011
Date analysed	-	[NT]	[NT]	66659-5	21/12/2011
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	66659-5	89%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	66659-5	94%
Heptachlor	mg/kg	[NT]	[NT]	66659-5	82%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	66659-5	79%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	66659-5	89%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	66659-5	89%
Dieldrin	mg/kg	[NT]	[NT]	66659-5	91%
Endrin	mg/kg	[NT]	[NT]	66659-5	90%
pp-DDD	mg/kg	[NT]	[NT]	66659-5	100%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	66659-5	93%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	66659-5	100%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	66659-5	19/12/2011
Date analysed	-	[NT]	[NT]	66659-5	21/12/2011
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dimethoate	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ronnel	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	66659-5	87%
Fenitrothion	mg/kg	[NT]	[NT]	66659-5	103%
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	66659-5	102%
Surrogate TCLMX	%	[NT]	[NT]	66659-5	104%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	66659-5	19/12/2011
Date analysed	-	[NT]	[NT]	66659-5	21/12/2011
Arochlor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Arochlor 1254	mg/kg	[NT]	[NT]	66659-5	104%
Arochlor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	66659-5	106%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
Date analysed	-	66659-11	19/12/2011 || 19/12/2011	66659-5	19/12/2011
Arsenic	mg/kg	66659-11	<4 || <4	66659-5	100%
Cadmium	mg/kg	66659-11	<0.5 || <0.5	66659-5	95%
Chromium	mg/kg	66659-11	8 || 9 || RPD: 12	66659-5	103%
Copper	mg/kg	66659-11	39 || 34 || RPD: 14	66659-5	93%
Lead	mg/kg	66659-11	28 || 28 || RPD: 0	66659-5	95%
Mercury	mg/kg	66659-11	<0.1 || <0.1	66659-5	115%
Nickel	mg/kg	66659-11	8 || 7 || RPD: 13	66659-5	95%
Zinc	mg/kg	66659-11	85 || 79 || RPD: 7	66659-5	95%

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	66659-5	20/12/2011
Date analysed	-	[NT]	[NT]	66659-5	21/12/2011
Arsenic in TCLP	mg/L	[NT]	[NT]	66659-5	103%
Cadmium in TCLP	mg/L	[NT]	[NT]	66659-5	101%
Chromium in TCLP	mg/L	[NT]	[NT]	66659-5	97%
Lead In TCLP	mg/L	[NT]	[NT]	66659-5	94%
Mercury in TCLP	mg/L	[NT]	[NT]	66659-5	84%
Nickel in TCLP	mg/L	[NT]	[NT]	66659-5	99%

Report Comments:

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

Acid Extractable Metals in Soil:The RPD for duplicate results is accepted due to the inhomogeneous nature of the sample/s.

Total Recoverable Hydrocarbons in soil (semivol):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	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

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

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

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

SAMPLE RECEIPT ADVICE

Client:

Environmental Investigation Services
PO Box 976
North Ryde BC NSW 1670

ph: 02 9888 5000
Fax: 02 9888 5001

Attention: Brendan Page

Sample log in details:

Your reference:	**E25264KP, Kogarah**
Envirolab Reference:	**66659**
Date received:	16/12/11
Date results expected to be reported:	**23/12/11**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	13 soils
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice

Comments:

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples.

Contact details:

Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
Envirolab Services Pty Ltd 12 Ashley Street Chatswood NSW 2067 Phone: (02) 99106200 Fax: (02) 99106201 Attention: Aileen	EIS Job Number: E25264KP Date Results Required: Standard Sheet 1 / 1	Environmental Investigation Services Rear 115 Wicks Road Macquarie Park NSW 2113 Phone: (02) 9888 5000 Fax: (02) 9888 5004 Contact: Brendan Page

Project: Proposed Works
Location: Kogarah
Sampler: HW

Sample Preservation: In esky on ice

Tests Required

Date Sampled	Lab Ref:	Borehole/ Sample Number	Depth (m)	Sample Container	PID	Sample Description	Combo 6	Combo 6a	Combo 13 + asbestos	8 Metals	TPH	BTEX	PAHs	Combo 3		TCLP 6 Metals	TCLP PAHs	
15.12.11	1	BH101	0-0.2	Glass jar + Asb Bag	0	Soil			X									
	2	BH101	0.5-0.95	Glass jar + Asb Bag	0									X				
	3	BH102	~~0.03-0.4~~ 0.3-0.7	Glass jar + Asb Bag	0									X				
	4	BH103	0.7-0.9	Glass jar + Asb Bag	0									X				
	5	BH104	0-0.2	Glass jar + Asb Bag	0				X									
	6	BH104	0.5-0.9	Glass jar + Asb Bag	0									X				
	7	BH105	0-0.2	Glass jar + Asb Bag	0				X									
	8	BH105	0.5-0.6	Glass jar + Asb Bag	0									X				
	9	BH106	0-0.3	Glass jar + Asb Bag	0				X									
	10	BH106	0.5-0.7	Glass jar + Asb Bag	0									X				
	11	Dup 1	-	Glass jar + ~~Asb Bag~~	-									X				
	12	T.S	-	Glass jar + ~~Asb Bag~~	-	Spike						X						
	13	T.B	-	Glass jar + ~~Asb Bag~~	-	Blank						X						
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
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				Glass jar + Asb Bag														
				Glass jar + Asb Bag														

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 66659
Date Received: 16.12.11
Time Received: 11:30
Received by: DK
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Remarks (comments/detection limits required):

Relinquished By:	Date:	Time:	Received By:	
BP	16-12-11	9:00am	DK	

APPENDIX C

(Sampling Protocols and QA/QC Definitions)

EIS

SOIL AND GROUNDWATER SAMPLING PROTOCOLS

These protocols specify the basic procedures to be used when sampling soils or groundwater for environmental site assessments undertaken by EIS. The purpose of these protocols is to provide standard methods for: sampling, decontamination procedures for sampling equipment, sample preservation, sample storage and sample handling. Deviations from these procedures must be recorded.

Soil Sampling

a) Prepare a test pit/borehole log.
b) Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill/rig excavator such that the drill rig/excavator can operate in a safe manner.
c) Ensure all sampling equipment has been decontaminated prior to use.
d) Remove any surface debris from the immediate area of the sampling location.
e) Collect samples and place in glass jar with a Teflon seal. This should be undertaken as quickly as possibly to prevent the loss of volatiles. If possible, fill the glass jars completely.
f) Collect samples for asbestos analysis and place in a zip-lock plastic bag.
g) Label the jar and/or bag with the EIS job number, sample location (eg. BH1), sampling depth interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).
h) Photoionisation detector (PID) screening of volatile organic compounds (VOCs) should be undertaken on samples using the soil sample headspace method. Headspace measurements are taken following equilibration of the headspace gasses in partly filled zip-lock plastic bags. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.
i) Record the lithology of the sample and sample depth on the borehole/test pit log in accordance with AS1726-1993[22].
j) Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab. All samples are preserved in accordance with AS 4482.1:2005, AS 4482.2:1999 and AS/NZS 5667.1:1998.
k) Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.

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[22] *Geotechnical Site Investigations*, Standards Australia 1993 (AS1726-1993)

l) Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

Decontamination Procedures for Soil Sampling Equipment

a) All of the equipment associated with the soil sampling procedure should be decontaminated between every sampling location.

b) The following equipment and materials are required for the decontamination procedure:
   - ➢ Phosphate free detergent (Decon 90)
   - ➢ Potable water
   - ➢ Stiff brushes
   - ➢ Plastic sheets

c) Ensure the decontamination materials are clean prior to proceeding with the decontamination.

d) Fill both buckets with clean potable water and add phosphate free detergent to one bucket.

e) In the bucket containing the detergent scrub the sampling equipment until all the material attached to the equipment has been removed.

f) Rinse sampling equipment in the bucket containing potable water.

g) Place cleaned equipment on clean plastic sheets.

If all materials are not removed by this procedure, high-pressure water cleaning is recommended. If any equipment is not completely decontaminated by both these processes that equipment should not be used until it has been thoroughly cleaned.

Groundwater Sampling

Groundwater samples are more sensitive to contamination than soil samples and therefore adhesion to this protocol is particularly important to obtain reliable, reproducible results. The recommendations detailed in AS/NZS 5667.1:1998 are considered to form a minimum standard.

The basis of this protocol is to maintain the security of the borehole and obtain accurate and representative groundwater samples. The following procedure should be used for collection of groundwater samples from previously installed groundwater monitoring wells.

a) After monitoring well installation, at least three bore volumes should be pumped from the monitoring wells (well development) to remove any water introduced during the drilling process and/or the water that is disturbed during installation of the monitoring well. This should be completed prior to purging and sampling.

b) Groundwater monitoring wells should then be left to recharge for at least three days before purging and sampling. Prior to purging or sampling the condition of each well should observed and any anomalies recorded on the field data sheets. The following information should be noted: the condition of the well, noting any signs of damage, tampering or complete destruction; the condition and operation of the well lock; the condition of the protective casing and the cement footing (raised or cracked); and, the presence of water between protective casing and well.

c) Take the groundwater level from the collar of the piezometer/monitoring well using an electronic dip meter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.

d) Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or low flow) techniques. Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:

- Micropore filtration system or Stericup single-use filters (for heavy metals samples).
- Filter paper for Micropore filtration system.
- Bucket with volume increments.
- Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles.
- Bucket with volume increments.
- Flow cell.
- pH/EC/Eh/T meters.
- Plastic drums used for transportation of purged water.
- Esky and ice.
- Nitrile gloves.
- Distilled water (for cleaning).
- Electronic dip meter.
- Micro-purge pump pack and pump head.
- Air and water tubing for Micro-purge.
- Groundwater sampling forms.

e) If single-use stericup filtration is not being used, clean the Micropore filtration system thoroughly with distilled water prior to use and between each sample. Filter paper should be changed between samples. 0.45um filter paper should be placed below the glass fibre filter paper in the filtration system.

f) Ensure all non-disposable sampling equipment is decontaminated or that new disposable equipment is available prior to any work commencing at a new location. The procedure for decontamination of groundwater equipment is outlined at the end of this section.

EIS

g) Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.

h) Groundwater samples are obtained from the monitoring wells using low flow/micro-purge sampling equipment to reduce the disturbance of the water column and loss of volatiles.

i) During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.

j) All measurements are recorded on specific data sheets.

k) Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles, BTEX vials or plastic bottles.

l) All samples are preserved in accordance with water sampling requirements detailed in the NEPM 1999 and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice in accordance with AS/NZS 5667.1:1998.

m) Record the sample on the appropriate log in accordance with AS1726:1993. At the end of each water sampling complete a chain of custody form.

Decontamination Procedures for Groundwater Sampling Equipment

a) All of the equipment associated with the groundwater sampling procedure (other than single-use items) should be decontaminated between every sampling location.

b) The following equipment and materials are required for the decontamination procedure:
   - Phosphate free detergent.
   - Potable water.
   - Distilled water
   - Plastic Sheets or bulk bags (plastic bags)

c) Fill one bucket with clean potable water and phosphate free detergent, and one bucket with distilled water.

d) Flush potable water and detergent through pump head. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.

e) Flush pump head with distilled water.

f) Change water and detergent solution after each sampling location.

g) Rinse sampling equipment in the bucket containing distilled water.

h) Place cleaned equipment on clean plastic sheets.

i) If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned

QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994[23]) methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (H. Keith 1991[24]).

Practical Quantitation Limit (PQL), Limit of Reporting (LOR) and Estimated Quantitation Limit (EQL)

These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection limit (MDL) for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations. *"The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit"* Keith 1991.

Precision

The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD). Acceptable targets for precision in this report will be less than 50% RPD for concentrations greater than ten times the PQL, less than 75% RPD for concentrations between five and ten times the PQL and less than 100% RPD for concentrations that are less than five times the PQL.

Accuracy

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter being measured. The assessment of accuracy for an analysis can be achieved through the analysis of known reference materials or assessed by the analysis of surrogates, field blanks, trip spikes and matrix spikes.

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[23] *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* US EPA, 1994 (US EPA SW-846)

[24] *Environmental Sampling and Analysis, A Practical Guide*, Keith, H, 1991 (Keith 1991)

The proximity of an averaged result to the true value, where all random errors have been statistically removed. Accuracy is measured by percent recovery. Acceptable limits for accuracy generally lie between 70% to 130% recoveries. Certain laboratory methods may allow for values that lie outside these limits.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is primarily dependent upon the design and implementation of the sampling program. Representativeness of the data is partially ensured by the avoidance of contamination, adherence to sample handing and analysis protocols and use of proper chain-of-custody and documentation procedures.

Completeness

Completeness is a measure of the number of valid measurements in a data set compared to the total number of measurements made and overall performance against DQIs. The following information is assessed for completeness:

- Chain-of-custody forms;
- Sample receipt form;
- All sample results reported;
- All blank data reported;
- All laboratory duplicate and RPDs calculated;
- All surrogate spike data reported;
- All matrix spike and lab control spike (LCS) data reported and RPDs calculated;
- Spike recovery acceptable limits reported; and
- NATA stamp on reports.

Comparability

Comparability is the evaluation of the similarity of conditions (eg. sample depth, sample homogeneity) under which separate sets of data are produced. Data comparability checks include a bias assessment that may arise from the following sources:

- Collection and analysis of samples by different personnel;
- Use of different techniques;
- Collection and analysis by the same personnel using the same methods but at different times; and
- Spatial and temporal changes (due to environmental dynamics).

Blanks

The purpose of laboratory and field blanks is to check for artifacts and interferences that may arise during sampling and analysis.

Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula;

$$\frac{\text{(Spike Sample Result - Sample Result)}}{\text{Concentration of Spike Added}} \times 100$$

Acceptable recovery limits are 70% to 130%.

Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula where D1 is the sample concentration and D2 is the duplicate sample concentration:

$$\frac{(D1 - D2)}{\{(D1 + D2)/2\}} \times 100$$

APPENDIX D

(PID Calibration Record)

JOB NO: E25264KP
LOCATION: St George Hospital, Kogarah

PID FIELD CALIBRATION CERTIFICATE

Make: MiniRAE	Model: 2000	Unit: 1	Date of last factory calibration: 12/9/11
Date of calibration: 15/12/11		Name of Calibrator: BP	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: 100 ppm		Error in measured reading: ± 0 ppm	
Make: MiniRAE	Model: 2000	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: ppm		Error in measured reading: ± ppm	
Make: MiniRAE	Model: 2000	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: ppm		Error in measured reading: ± ppm	
Make: MiniRAE	Model: 2000	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: ppm		Error in measured reading: ± ppm	
Make: MiniRAE	Model: 2000	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: ppm		Error in measured reading: ± ppm	
Make: MiniRAE	Model: 2000	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: ppm		Error in measured reading: ± ppm	
Make: MiniRAE	Model: 2000	Unit:	Date of last factory calibration:
Date of calibration:		Name of Calibrator:	
Calibration gas: Iso-butylene		Calibration Gas Concentration:	100.0 ppm
Measured reading: ppm		Error in measured reading: ± ppm	