ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

INGHAM HEALTH RESEARCH INSTITUTE

ON

PHASE 1 AND 2 ENVIRONMENTAL SITE ASSESSMENT

FOR

PROPOSED NEW INGHAM HEALTH RESEARCH INSTITUTE BUILDING

AT

1 CAMPBELL STREET, LIVERPOOL

NOVEMBER 2009

REF: E23302K-rpt

AS/NZS ISO 9001 Certified

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1 INTRODUCTION

Capital Insight Pty Ltd, acting on behalf of Ingham Health Research Institute, commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake a Phase 1 and 2 environmental site assessment to assess the likelihood of contamination of the subsurface soils for a proposed new Ingham Health Research Institute Building at 1 Campbell Street, Liverpool also known of Part of 44 Goulburn Street, Liverpool. The site is identified as part of Lot 3 in DP 596770 and is located in east section of the lot. At the time of this investigation the site was occupied by a child centre and a disused brick building. The site location is shown on Figure 1 and the investigation was confined to the site boundaries as shown on Figure 2.

The screening was undertaken generally in accordance with an EIS proposal of 14 July 2009 and written email acceptance from Capital Insight Pty Ltd on behalf of Ingham Health Research Institute on 11 August 2009.

EIS understand that the proposed development includes construction of a four storey research building with amenities and basement car parking requiring a maximum excavation depth of approximately 3m. Proposed air bridges will connect the new building to existing hospital buildings to the west and south.

This report describes the investigation procedures and presents the results of the environmental site assessment, together with comments, discussion and recommendations.

A geotechnical investigation was undertaken in conjunction with the environmental site screening by J&K and the results are presented in a separate report (Ref. M23303ZA RPT, currently under preparation).

2 ASSESSMENT OBJECTIVES

2.1 Investigation Objectives

The primary objective of the investigation was to assess the soil conditions at the site in relation to the suitability of the site for the proposed land use in accordance with the *Guidelines for Consultants Reporting on Contaminated Sites NSW DECCW (formerly the EPA) 1997* and the *State Environmental Planning Policy No.55 – Remediation of Land* (SEPP55).

A secondary investigation objective was to undertake a waste classification assessment for off-site disposal of excavated soil and rock associated with the proposed development works.

2.2 Scope of Work

The scope of work undertaken to achieve the objective included:

1. Assessment of historical site use, including review of historical aerial photographs, land title records search, review of the deposited plan and development applications/building approvals held by Council;
2. Review of regional geology and groundwater conditions, including the location of registered groundwater bores and major underground services in the vicinity of the site;
3. Search of WorkCover records for licenses to store Dangerous Goods and investigation/remediation orders issued by the NSW DECCW (EPA).
4. Design and implementation of a field sampling program;
5. Laboratory analysis of selected soil samples; and
6. Preparation of a report presenting the results of the assessment of potential soil contamination.

Field work for this investigation was undertaken on 22 and 23 October 2009.

2.3 Data Quality Objectives

The purpose of Data Quality Objectives is to develop criteria to assess the reliability of the laboratory data. The Data Quality Objectives established for this project are summarised below:

- Collection and analysis of 14% of the field samples as intra-laboratory duplicates.
- Relative percentage differences (RPDs) were calculated for the intra-laboratory duplicates. 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.

- Review of laboratory QA/QC data (including surrogate recovery, repeat analysis, duplicates, matrix spikes and method blanks).

The success of the Data Quality Objectives is based on assessment of the data set as a whole and not on individual acceptance or exceedance within the data set.

3 SITE INFORMATION

3.1 Site Description

The site identification details are summarised below:

Site Owner:	Health Administration Corporation
Site Address:	1 Campbell Street, Liverpool also known of Part of 44 Goulburn Street, Liverpool
Lot & Deposited Plan:	Part of Lot 3 in DP 596770
Local Government Authority:	Liverpool City Council
Current Zoning:	SP2 Infrastructure (Health Services Facility and Educational Establishment)
Site Area:	Approximately 1,570m^2
AHD:	Approximately 10m
Geographical Location (MGA):	N: 6244975 E: 308640 (approximately)
Site Locality Plan:	Refer to Figure 1
Site Layout Plan	Refer to Figure 2

The site is located to the north-west of the junction of Campbell Street and Forbes Street which forms the south and east site boundaries respectively. The site is located within a flat regional topographic setting. The site has a slight slope down to the east at approximately 1°.

At the time of the investigation the site was occupied by a one storey brick building in the north section of the site and a two storey brick building in the central section of site. Brick paved car parking areas were located in the east and west sections of the site. Grassed areas and garden beds were located in the south section of the site. A playground court yard with rubber matting was located in the north section of the site. An "L" shaped brick retaining wall approximately 0.5m high was located along the majority of the south and west site boundaries. The wall retained material to the north and west.

The site was bounded by an ambulance station and an industrial area to the north and west. Liverpool Hospital was located to the south of the site. Liverpool Girls High School was located to the west of the site.

3.2 Regional Geology and Hydrogeology

The 1:100,000 geological map of Penrith (Map 9030, 1:100,000 Department of Mineral Resources [now the Department of Primary Industries] – 1991) indicates the site to be underlain by Bringelly Shale of the Wianamatta Group, which typically consists of shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone, rare coal and tuff.

Department of Water and Energy (DWE) records were researched for the investigation and indicated that several registered groundwater bores lie within 2km of the site. The details are summarised below:

Ref No	Approx. distance from site (m)	Approx. direction from site	Up, down or cross gradient	Depth (m)	Registered Purpose
GW017355	1,900	North-east	Up gradient	9.4	Irrigation
GW058698	550	South-east	NA (opposite side of Georges River)	19.5	Exploration
GW058697	620	South-east	NA	19.2	Exploration
GW102641	1,020	South	NA	16.5	Industrial
GW029192	1,200	South	NA	2.4	Waste disposal
GW028330	1,800	South, south-east	NA	6.4	Waste disposal
GW103800	1,300	West	Up gradient	3	Monitoring

The stratigraphy of the site is expected to consist of residual clayey soils overlying relatively shallow bedrock. Based on these conditions groundwater is not considered to be a significant resource in the immediate area of the site.

4 SITE HISTORY ASSESSMENT

4.1 Aerial Photographs

Aerial photographs were reviewed as part of the assessment of the site history. The following information was obtained:

1930 - The site was vacant and cleared of significant vegetation. The surface appeared to be grass covered with the exception of dirt tracks, including

an oval shaped track. The site appeared to be part of an area utilised as a racing or training track.

The oval shaped track extended to the north and west of the area currently occupied by the site. The land to the south and east of the site was paddocks. Further to the west and south were low density residential properties interspersed with cleared and vacant paddock. A small number of larger commercial buildings occupied areas adjacent to Georges River to the south of the site. Further to the east were cultivated areas visible on either side of Georges River.

1943 - The site was cleared, vacant and grassed and utilized as a residential backyard surrounded by fences.

A residential development with small sheds, paths, fences and garden/cultivated areas was located to the west of the site. The surrounding area was generally similar to the 1930 aerial photograph, with the exception of an increased density in residential properties and commercial properties to the south.

1951 - The site generally appeared similar to the 1943 aerial photograph.

The surrounding land use generally appeared similar to the 1943 aerial photograph with the exception of an increased density in residential and commercial properties to the north, south and west of the site.

1961 - The site was occupied by what appeared to be a two or three storey building surrounded by fences.

The surrounding land use included residential developments to the north and west. Liverpool Hospital was situated to the east and south of the site. Land use beyond the immediate vicinity of the site generally appeared to be a mix of residential, commercial and industrial properties together with some cleared and vacant properties. In general residential properties occupied areas to the north, commercial and industrial properties occupied areas to the south of the site.

1970 - The site generally appeared similar to the 1961 aerial photograph.

The surrounding land use generally appeared similar to the 1961 aerial photograph. The density of development in the surrounding area appeared to have increased.

1978 - The site generally appeared similar to the 1970 aerial photograph.

The surrounding land use generally appeared similar to the 1978 aerial photograph with the exception of the addition and demolition of Liverpool Hospital buildings to the south of the site.

1986 - The site generally appeared similar to the 1978 aerial photograph.

The surrounding land use generally appeared similar to the 1978 aerial photograph with the exception of the addition of commercial buildings to the south and north-west of the site.

1994 - The site generally appeared similar to the 1986 aerial photograph with the addition of a smaller rectangular building at the north section of the site. The two buildings appeared similar to the currently existing buildings on the site.

The surrounding land use generally appeared similar to the 1986 aerial photograph with the exception of the addition of a multi-level rectangular building directly abutting the west site boundary and additional commercial buildings to the south of the site.

2005 - The site generally appeared similar to the 1994 aerial photograph.

The surrounding land use generally appeared similar to the 1994 aerial photograph with the exception of the addition of large commercial buildings to the south of the site.

4.2 Land Title Search

A limited historical land title search was performed on our behalf by Advanced Legal Search. Details are presented in Appendix C and a summary of the relevant information is provided below:

Registration Date	Proprietor
2007 – to date	Health Administration Corporation
1992 – 2007	Sydney South West Area Health Services
1988 – 1992	The Liverpool Hospital
Lot 3 DP 596770 – CTVol 14500 Fol 199	
1981 – 1988	The Liverpool Hospital
Allotment 4 Section 30 Town of Liverpool and other lands – Area 37 Acres 2 roods 26 perches – CTVol 8176 Fol 22	
1980 – 1981	The Liverpool Hospital
1964 – 1980	Her Most Gracious Majesty Queen Elizabeth the Second
1961 – 1964	The Liverpool District Hospital
Allotment 4 Section 30 Town of Liverpool – Area 2 Roods 26 Perches	
Prior – 1961	Crown Land
(1955 – 1961)	*(Dedication for Hospital Purposes)*
(1924 – 1955)	*(Extension of Liverpool Hospital)*

The land search has not indicated any particular land use that may be considered to have resulted in significant contamination of the soil at the site.

4.3 Council Records

A search of the property file records held by Liverpool City Council was undertaken on behalf of EIS. The results of the search are summarised below:

Registration Date	Application number	Development Description
Applied: 4/1/1984 Consent granted: 2/3/1984	DA 1/84	Liverpool Hospital Child Care Centre: Child care facility including timber and brick building, car park and landscaping.
Applied: 2/1/1990 Consent granted: 17/12/1990	DA 868/89	Medical services and equipment storage buildings: 4 storey building including car park and landscaping. The Development Application (DA) included demolition of the former antenatal building. The DA also stated the former building was associated with clinical waste. This DA was for part of Lot3 in DP 596770 (located to the west of the investigation site).

The property file search documented the demolition of the former antenatal building that potentially contained hazardous construction materials and clinical waste. The

former antenatal building was situated in the west section of Lot 3 DP 596770 located approximately 30m from the site. In summary the property file search has not indicated any particular land use that may be considered to have resulted in significant contamination of the soil at the subject site.

4.4 WorkCover Database Records

A records search for underground storage tanks was undertaken on our behalf by WorkCover. The records indicated the storage of various dangerous goods located within the main Liverpool Hospital grounds located to the south of the site on the opposite side of Campbell Street. The records did not indicate the existence of any licences for underground storage tanks at this site.

4.5 NSW EPA Records

A search of the NSW EPA on line database did not indicate the existence of any DECC (EPA) notices for the site under section 58 of the Contaminated Land Management Act (1997).

4.6 Assessment of Historical Information Integrity

The site history assessment has generally been obtained from: government records including the NSW land titles office, historical archives, historical aerial photographs and NSW WorkCover records. The veracity of the information from these sources is considered to be high, however, given the age of the development and the lack of information available on activities prior to 1930's, a certain degree of information loss is to be expected.

Non verifiable anecdotal information has not been relied upon during assessment of historical site use. Therefore, there is considered to be a high level of integrity associated with information obtained with respect to historical use of the site.

4.7 Summary of Historical Site Use

The search of historical information has indicated the following:

- The site has been Crown Land dedicated to hospital use prior to the mid 1920s.
- The site was generally vacant prior to 1961;
- Between 1961 and 1986 the site a single building was constructed on-site;
- An additional building was added to the north section of the site during the 1990s which, according to Council records, the Liverpool Hospital Child Care Centre;

- At the time of the investigation the site was occupied by the two above-mentioned buildings;
- There are no recorded notices listed on the NSW DECC CLM register and WorkCover have no records of underground storage tank licenses issued for the site.

4.8 Potential Contamination Sources

4.8.1 General Contamination Processes

Contamination of surface and subsurface soils generally arises from previous land use that can include petroleum hydrocarbon and warehouse storage, manufacturing processes and pesticide and fertiliser usage. Imported fill soils may contain contaminants derived from unknown sources. Migration of contaminants can occur in permeable subsurface soil or fill materials and via man-made and natural drainage systems. The extent of contamination migration is dependent on the hydro-geological environment and the chemical and physical characteristics of the contaminants. Contamination migration in clayey soils can be expected to be limited, whilst sandy soils are conducive to greater spatial migration.

Backfill to service trenches can form contamination migration pathways via poorly compacted or permeable backfill. Backfill may also be contaminated.

The general history of contamination of sites in the Sydney region indicates that analysis for heavy metals including lead, copper and zinc should be incorporated in the schedule of laboratory testing. In addition screening tests should be performed on selected samples for polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCs), polychlorinated biphenyls (PCBs), petroleum hydrocarbons (TPH), monocyclic aromatic hydrocarbons (BTEX) and asbestos.

4.8.2 Potential Site Specific Contamination

Potential contamination at the site would be anticipated to be associated with:

- Potentially contaminated, imported fill material; and
- Buried Hazardous Building Materials.

4.8.3 Site Specific Contaminants of Concern

The compounds identified as soil contaminants of concern at the subject site include:

- Heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc;

- Total petroleum hydrocarbons (TPH);
- Monocyclic aromatic hydrocarbon (BTEX) compounds: Benzene, Toluene, Ethyl Benzene and Xylenes;
- Polycyclic aromatic hydrocarbons (PAHs) including Benzo(a)pyrene;
- Organochlorine pesticides (OCPs): Aldrin, dieldrin, DDT, chlordane, etc;
- Organophosphorus pesticides (OPPs);
- Polychlorinated Biphenyls (PCBs); and
- Asbestos.

4.9 Potential Receptors

The main potential contamination receptors are considered to include:

- Georges River located approximately 410m to the south-east of the site;
- Site visitors, workers and adjacent property owners, who may come into contact with contaminated soil and/or be exposed to contaminated dust/vapours arising from construction activity; and
- Future site occupants.

4.10 Contaminant Laydown and Transport Mechanisms

At this site, mobile contaminants would be expected to move down to the rock surface and migrate laterally down-slope from the source. The movement of contaminants would be expected to be associated with groundwater flow and seepage at the top of the bedrock.

5 ASSESSMENT CRITERIA DEVELOPMENT

5.1 Regulatory Background

In 1997 the NSW Government introduced the *Contaminated Land Management Act, 1997* (CLM Act). This Act has recently been amended by the *Contaminated Land Management Amendment Act 2008 (CLM Amendment Act 2008).* This act, associated regulations, State Environmental Planning Policy (SEPP) No.55 – Remediation of Land (1998) and associated NSW DECCW (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;
- 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 is required prior to commencement of the proposed development works. 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 the NSW DECCW (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.

Section 59(2) of the CLM Act states that specific notation relating to contaminated land issues must be included on S.149 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 DECCW (EPA).
- the subject of a voluntary investigation or remediation proposal.
- 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 S.149 certificates prepared for the site.

Section 60 of the CLM Act sets out a positive duty on a land owner, or person whose activities have caused contamination, to notify the DECCW 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 (POEO Act 1997) and associated regulations and guidelines including the *Waste Classification Guidelines Part 1: Classifying Waste. DECCW NSW 2009.* All materials should be classified in accordance with these guidelines prior to disposal.

Section 143 of the *Protection of the Environment Operations 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.

5.2 Soil Contaminant Threshold Concentrations

The soil investigation levels adopted for this investigation are derived from the NSW DEC (now DECCW) document *Guidelines for the NSW Site Auditor Scheme (2nd Edition) 2006* and the National Environmental Protection Council document *National Environmental Protection (Assessment of Site Contamination) Measure 1999*. The contaminant 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 in Table A-1) 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 petroleum hydrocarbons (TPH) and monocyclic aromatic hydrocarbon (BTEX) compounds have previously been established in the *NSW DECCW (EPA) Contaminated Sites: Guidelines for Assessing Service Station Sites* (1994) publication and this document is referenced in the 2006 Site Auditor Guidelines. Heavy fraction petroleum hydrocarbon aliphatic/aromatic component threshold concentrations have also been

introduced in the *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (NEPC Guidelines).

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 and accessible soils.

The *National Environmental Protection (Assessment of Site Contamination) Measure 1999* (NEPC Guidelines) do not provide numeric guidelines for the assessment of asbestos in soil. NSW DECCW (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 DECCW (EPA) have not published numerical guidelines for the assessment of asbestos in subsurface soils.

The WorkCover publication *Working with Asbestos Guide* (NSW WorkCover 2008) states that, where buried asbestos in 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* and WorkCover requirements all necessary disturbance works associated with asbestos containing materials must be conducted by a licensed AS-1 Asbestos Removal Contractor.

5.2.1 Site Assessment Criteria for Soil Contaminants

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

Site Soil Assessment Criteria (mg/kg)			
Contaminant	**HIL Column F Exposure Setting**	**Guidelines for Assessing Service Station Sites (1994)**	**Phyto-toxicity Investigation Levels**
Inorganics			
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
Organic Contaminants			
TPH (C_6-C_9)		65	
TPH (C_{10}-C_{36})		1000	
Benzene		1	
Toluene		1.4	
Ethylbenzene		3.1	
Total Xylenes		14	
Total PAHs	100		
Benzo(a)pyrene	5		
Aldrin + Dieldrin	50		
Chlordane	250		
DDT + DDD + DDE	1000		
Heptachlor	50		
PCBs (Total)	50		

For the purpose of off-site disposal, the classification of soil into "General Solid Waste", "Restricted Solid Waste" and "Hazardous Waste" categories is defined by chemical contaminant criteria outlined in *Waste Classification Guidelines Part 1: Classifying Waste. DECCW (formerly DECC) NSW 2009.* These chemical contaminant criteria are summarised in Table A-2.

5.3 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 *National Environmental Protection (Assessment of Site Contamination) Measure (1999) Schedule 7(a).*

For the site to be considered suitable for the proposed land use each individual contaminant concentration should be less than the applicable contaminant threshold concentration.

Where contamination results exceed the site criteria developed above a method of remediating the site is to physically and selectively remove the contamination hotspots from the site. This process should be continued until analysis of the data meets the above criteria. Validation of the remediated site is generally required to demonstrate that the site is suitable for the proposed land use.

6 ASSESSMENT PLAN AND METHODOLOGY

The *NSW DECCW (EPA) Sampling Design Guidelines (1995)* for contaminated site investigations state that samples should be obtained from a minimum of seven evenly spaced sampling points for a site of this size (approximately 1,400m^2). Samples were obtained from seven sampling locations for this investigation. This density meets the minimum sampling density.

The boreholes were drilled on a systematic grid sampling plan with a spacing of up to 30m between sampling points. A systematic sampling plan was considered most appropriate for this investigation as:

- no specific potential contaminant sources were identified by the available site history; and
- the distribution of contamination is expected to be associated with imported potentially contaminated fill material and is therefore likely to be random.

Sampling was not undertaken beneath the trees and the existing buildings at the site as access was not possible during the field investigation.

7 INVESTIGATION PROCEDURE

7.1 Subsurface Investigation and Soil Sampling Methods

Subsurface investigations in BH1 and BH2 were undertaken using a truck/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. Sampling personnel used disposable Nitrile gloves during sampling activities.

Subsurface investigations in BH3 to BH7 inclusive were undertaken using a four-wheel-drive (4wd) mounted hydraulically operated push tube rig. Soil samples were obtained from disposable polyethylene push tube samplers. Sampling personnel used disposable Nitrile gloves during sampling activities.

Soil and rock samples were obtained at various depths, based on observations made during the field investigation. 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. During the investigation, soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS 4482.1-2005 and AS 4482.2-1999 as summarised in the following table:

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, OC/PCBs		
Asbestos	Sealed plastic bag	None

Each sample was labelled with a unique job number, the sampling location, sampling depth and date. All samples were recorded on the borehole logs presented in Appendix A and on the 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 chain of custody procedures. Detailed EIS field sampling protocols are included in Appendix D.

7.1.1 Photoionisation Detector (PID) Screening

A portable PID was used in this investigation to assist with selection of samples for laboratory hydrocarbon (TPH/BTEX) analysis. The PID is sensitive to volatile organic compounds. 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.

Photoionisation detector (PID) screening of detectable volatile organic compounds (VOC) was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled glass jar samples following equilibration of the headspace gases. The PID headspace data is included on the COC documents.

7.2 Laboratory Analysis

7.2.1 Soil Samples

Analysis of soil samples was undertaken by NATA registered laboratories using analytical methods detailed in the Schedule B(3) NEPC (1999) Guideline on Laboratory Analysis of Potentially Contaminated Soils. Laboratory analysis was undertaken by Envirolab Services Pty Ltd (NATA Accreditation No. 2901).

For this investigation selected soil samples were analysed for contaminants using the following laboratory techniques:

- Heavy metals – Nitric acid digestion. Analysis by ICP.
- Low level mercury – cold vapour AAS.
- OC and OP pesticides and PCBs – Extracted with acetone/hexane. 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/PID.
- TPH – Soil extracted with dichloromethane/acetone. Analysis by GC/FID.
- BTEX – Soil extracted with methanol. Analysis by P&T PID. Confirmed with column flame ionisation detection.
- Asbestos – Polarizing light microscopy.

8 RESULTS OF INVESTIGATION

8.1 Subsurface Conditions

Seven boreholes (two geotechnical and five environmental) were drilled for this investigation. Site details and 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 by the boreholes is presented below:

Pavement

Brick pavers were encountered at the surface at all locations. The pavers were a maximum thickness of approximately 50mm. At five of the seven borehole locations (RB1, RB3, RB4, RB6 and RB7) a layer of fine to medium grained sand (approximately 30mm thick) was encountered beneath the pavers. Concrete pavement was encountered beneath the sand at five of the seven borehole locations (RB1, RB3, RB4, RB6 and RB7). The maximum thickness of the concrete pavement was approximately 110mm.

Fill

Fill material was encountered beneath the pavers or concrete pavement at all locations and extended to a maximum depth of approximately 0.95m in RB5. The fill material varied and consisted of: silty clay; silty gravely clay; gravely sand; sand; sandy gravel; and silty sandy gravely clay. The fill material contained inclusions of fine and coarse grained igneous gravel, ironstone gravel and ash.

Natural Soils

Natural silty clay and interbedded silty clay was encountered beneath the fill at all locations and extended to a maximum depth of approximately 3.8m in RB2. Five borehole locations (RB3 to RB7 inclusive) were terminated in the natural silty clay or interbedded silty clay at a maximum depth of approximately 1.5m. The silty clay and interbedded silty clay varied in colour from light grey, light brown to red brown and orange brown with inclusions of ironstone gravel.

Bedrock

Shale bedrock was encountered beneath the natural silty clay and interbedded silty clay in two boreholes (RB1 and RB2) and extended to a maximum depth of termination of 7.22m in RB1. The shale varied in colour from grey, light grey, light brown, orange brown to dark grey with iron indurated bands.

Groundwater

All the boreholes were dry on complete of augering.

8.2 Laboratory Results - Soil

The laboratory analysis results for soil samples are summarised in Table B inclusive and analysis reports are presented in Appendix B. The site soil assessment criteria for this investigation are specified in the "Site Assessment Criteria for Soil Contaminants" section earlier in this report. The results of the analyses are summarised below.

Heavy Metals

Seven fill and four natural soil samples were analysed for heavy metals. The results of the analyses were below the site assessment criteria.

The results of all analyses were less than the CT1 criteria outlined in the Waste Classification Guidelines Part 1: Classifying Waste DECCW NSW 2009.

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 volatile organic contaminants. Seven fill and four natural soil samples were analysed for petroleum hydrocarbons and BTEX compounds. The results of the analyses were below the site assessment criteria.

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines Part 1: Classifying Waste DECCW NSW 2009.

Polycyclic Aromatic Hydrocarbons (PAHs)

Seven fill and four natural soil samples were analysed for a range of PAHs including benzo(a)pyrene. The results of the analyses were below the laboratory practical quantitation limit and less than the site assessment criteria.

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines Part 1: Classifying Waste DECCW NSW 2009.

Organochlorine (OC) and Organophosphorus (OP) Pesticides and Polychlorinated Biphenyls (PCBs)

Seven fill and four natural soil samples were analysed for a range of OC and OP pesticides and PCBs. The results of the analyses were below the laboratory practical quantitation limit and less than the site assessment criteria.

The results of all analyses were less than the SCC1 criteria outlined in the Waste Classification Guidelines Part 1: Classifying Waste DECCW NSW 2009.

Asbestos

Seven selected 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 and no respirable fibres were detected.

8.3 Assessment of Analytical QA/QC

The objective of the assessment of the laboratory QA/QC is to ensure that the sample data is reliable. All laboratory reports for project E23302K have been checked and issued as final by Envirolab Services Pty Ltd, NATA Accreditation No. 2901, Report numbers: 34660 and 34660-A.

Chain of custody documentation was signed and dated by Envirolab Services laboratory stating that all samples were received cool, in good order and in suitable containers. Compliance of holding times was met for all analyses undertaken by the above laboratory. EIS and laboratory QA/QC procedures for the site screening are summarised in the following table:

Contaminant	QA/QC Procedure							
	Total no. of Samples	Intra-lab Duplicate	Repeat Analysis	Matrix Spike	LCS	Lab Blank	Surrogate Spike	Field Blank
Heavy metals	11	1	1	-	2	2	-	-
TPH	11	1	2	1	2	2	11	-
BTEX	11	1	2	1	2	2	11	1
PAH	11	1	2	1	2	2	11	-
OCP	11	1	2	1	2	2	11	-
OPP	11	1	2	1	2	2	11	-
PCB	11	1	2	1	2	2	11	-

Field QA/QC samples are specified below:

Intra-laboratory duplicates - Dup1 is a field duplicate of soil sample RB3(0.2-0.3m)
Field blank - FB1 was a sample of commercially available sand

The RPD results for the field QA/QC duplicate samples are summarised in Table C. The following comments are an overall summary of the quality of the analytical component of the project:

1. Sample integrity and container requirements were documented as satisfactory.
2. All sample extraction analyses were performed within the required holding times.
3. Laboratory control sample (LCS) and surrogate recovery values indicated that the laboratory accuracy was very good, and that no outliers were reported.
4. Laboratory duplicate RPD results indicated that the sample precision was acceptable.
5. All method and field blank results were free of analyte concentrations above the PQLs.

6. The intra -laboratory RPD values indicated that field precision was acceptable.

The QA/QC data reported by Envirolab Services laboratory for the documented soil samples were assessed to be of sufficient quality to be considered acceptable for the environmental assessment of EIS project E23302K. The QA/QC data including the RPD results are considered to meet the Data Quality Objectives developed for this project.

9 COMMENTS AND RECOMMENDATIONS

The environmental site assessment undertaken for the proposed hospital development at 1 Campbell Street, Liverpool, was designed to assess the suitability of the site for the proposed land use. A secondary investigation objective was to undertake a waste classification assessment for off-site disposal of excavated soil and rock associated with the proposed development works.

EIS understand that the proposed development includes construction of a four storey research building with amenities and basement car parking requiring a maximum excavation depth of approximately 3m. Proposed air bridges will connect the new building to existing hospital buildings to the west and south.

The site assessment included performance of a site inspection, review of historical site use, including examination of regional aerial photographs and review of geology and groundwater conditions. Historical information and inspection of the site and surrounding areas did not indicate any obvious on-site or nearby off-site activity that could be expected to generate significant soil or groundwater contamination. Potential contamination at the site would be anticipated to be associated with:

- Potentially contaminated, imported fill material; and
- Buried Hazardous Building Materials.

The site soil/fill sampling was subsequently undertaken on the basis of a relatively uniform exploration spacing.

9.1 Site Contamination

The results of the laboratory tests on selected soils samples covered a range of contaminants commonly encountered in the Sydney region. Elevated levels of contaminants were not detected in the samples analysed. All results were less than Provisional Phyto-toxicity Investigation Levels and the appropriate Health Investigation Levels.

Groundwater was not encountered in the boreholes during auger drilling (to a maximum depth of approximately 4.14m). Groundwater is not considered to be a significant resource in the area and on this basis has not been considered in any further detail for this assessment.

9.2 Waste Classification

The fill soils are classified as 'General Solid Waste (non-putrescible)' according to the criteria outlined in *NSW DECCW (DECC) Waste Classification Guidelines, Part 1: Classifying Waste, 2009*. Any excess excavated soils should be disposed of to a suitable NSW DECCW (EPA) licensed landfill.

The natural silty clay soil, interbedded silty clay and shale bedrock below the fill material can be considered to be virgin excavated natural material (VENM). The material is considered suitable for re-use on-site, or alternatively, the material can be disposed to a NSW DECCW licensed landfill. The VENM may be suitable for reuse on another site, however the material should be assessed for geotechnical suitability and may not be suitable for some landscaped areas. Where doubt exists about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted for advice. VENM must not be mixed with any fill material (including building rubble and fill soil) as this will invalidate the VENM classification.

9.3 General

The boreholes drilled for the investigation have enabled an assessment to be made of the existence of significant, large quantities of contaminated soils. The conclusions based on this investigation are that, while major contamination of the site is not apparent, problems may be encountered with smaller scale features between boreholes. EIS adopts no responsibility whatsoever for any problems such as underground storage tanks, 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.

9.4 Conclusions

Based on the scope of work undertaken for this assessment EIS consider that the site can be made suitable for the proposed development provided that: a Hazardous

Building Material Survey of the buildings is undertaken prior to demolition; and during demolition and excavation works, the site is inspected by experienced environmental personnel to assess any unexpected conditions or subsurface facilities that may be discovered between investigation locations (particularly beneath the buildings). This should facilitate appropriate adjustment of the works programme and schedule in relation to any change in site conditions.

Normal good engineering site management practice including control of run-off and dust suppression is recommended during earthworks and construction.

10 LIMITATIONS

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 potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1970 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

Belinda Sinclair
Environmental Engineer

Adrian Kingswell
Senior Associate

ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
ADWG	Australian Drinking Water Guidelines
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 (formerly DECC, DEC and EPA)
DNR	NSW Department of Natural Resources (now split between DWE and DECCW)
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 (now part of DECCW)
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
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
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
WP	Work Plan

ENVIRONMENTAL INVESTIGATION SERVICES

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by Environmental Investigation Services (EIS) to assist with the assessment and interpretation of this assessment report.

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

This assessment report has been prepared in response to specific project requirements as stated in the EIS proposed 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 subdivided;
- 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

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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 problems, 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.

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.

REFERENCE DOCUMENTS

- ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (and updates).
- NSW DEC (2007) (now DECCW) Guidelines for the Assessment and Management of Groundwater Contamination.
- Australian Government, National Occupational Health and Safety Commission (2005) Code of Practice for the Safe Removal of Asbestos.
- Australian Government, National Occupational Health and Safety Commission (2005) Code
- DUAP/NSW EPA (1998) (now NSW Department of Planning / NSW Department of Environment, Climate Change and Water (DECCW) incorporating the EPA) Managing Land Contamination: Planning Guidelines SEPP 55 - Remediation of Land.
- Dutch Ministry of Housing, Spatial Planning and the Environment (2000) Circular on target values for soil remediation.
- NEPM. (1999) National Environmental Protection (Assessment of Site Contamination) Measure (NEPC. Guidelines).
- NSW EPA (1994) (now NSW DECCW) Contaminated Sites: Guidelines for Assessing Service Station Sites.
- NSW EPA (1995) (now NSW DECCW) Contaminated Sites: Sampling Design Guidelines.
- NSW EPA (1996) (now NSW DECCW) Guidelines for Solid Waste Landfills.
- NSW EPA (1997) (now NSW DECCW) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.
- NSW DEC (2006) (now DECCW) Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd Edition).
- NSW EPA (1999) (now NSW DECCW) Contaminated Sites: Guidelines on Significant Risk of Harm and the Duty to Report.
- NSW DECC (2009) (now DECCW) Waste Classification Guidelines Part 1: Classifying Waste and Part 2: Immobilisation of Waste.
- NSW Legislation (1948) Rivers and Foreshores Improvement Act.
- NSW Legislation (1975) Dangerous Goods Act.
- NSW Legislation (1994) Environmental Planning and Assessment Act (EP&AA) and associated Regulations.
- NSW Legislation (1997) Contaminated Land Management Act.
- NSW Legislation (1997) Protection of the Environment Operations Act No156 which includes Schedule 2 of the Clean Waters Regulations 1972 made under the Clean Waters Act (1970).
- NSW Legislation (2000) Occupational Health and Safety Act.
- NSW Regulation (2001) Occupation Health and Safety Regulation.
- NSW WorkCover (2008) Working With Asbestos Guide.
- US EPA (2004) Region 9 Preliminary Remediation Goals.

TABLE A-1
ENVIRONMENTAL AND HEALTH-BASED SOIL INVESTIGATION LEVELS (mg/kg)

Substances	Health Investigation Levels (HILs)[1]				Provisional Phyto-toxicity Investigation Levels (PPILs)[1]	NSW EPA Guidelines for Assessing Service Station Sites[2]	Back-ground Ranges[1]
	A	D	E	F			
	'Standard' residential with garden/ accessible soil (home-grown produce contributing less than 10% of vegetable and fruit intake; no poultry); includes children's day-care centres, kindergartens, preschools and primary schools	Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise apartments and flats	Parks, recreational open space and playing fields; includes secondary schools	Commercial/Industrial; includes premises such as shops and offices as well as factories and industrial sites			
METALS/METALLOIDS							
Arsenic (total)	100	400	200	500	20		1-50
Barium					300		100-3000
Beryllium	20	80	40	100			
Cadmium	20	80	40	100	3		1
Chromium(III)	12%	48%	24%	60%	400		
Chromium(VI)	100	400	200	500	1		
Chromium (total)							5-1000
Cobalt	100	400	200	500			1-40
Copper	1000	4000	2000	5000	100		2-100
Lead	300	1200	600	1500	600		2-200
Manganese	1500	6000	3000	7500	500		850
Methyl mercury	10	40	20	50			
Mercury (inorganic)	15	60	30	75	1		0.03
Nickel	600	2400	600	3000	60		5-500
Vanadium					50		20-500
Zinc	7000	28000	14000	35000	200		10-300
ORGANICS							
Aldrin + Dieldrin	10	40	20	50			
Chlordane	50	200	100	250			
DDT + DDD + DDE	200	800	400	1000			
Heptachlor	10	40	20	50			
Polycyclic aromatic hydrocarbons (PAHs)	20	80	40	100			
Benzo(a)pyrene	1	4	2	5			
Phenol	8500	34000	17000	42500			
PCBs (total)	10	40	20	50			
Petroleum Hydrocarbon Components (constituents):							
>C16 - C35 Aromatics	90	360	180	450			
>C16 - C35 Aliphatics	5600	22400	11200	28000			
>C35 Aliphatics	56000	224000	112000	280000			
C6-C9						65	
C10-C40						1000	
Benzene						1	
Toluene						1.4	
Ethyl Benzene						3.1	
Total Xylenes						14	
OTHER							
Boron	3000	12000	6000	15000			
Cyanides (complexed)	500	2000	1000	2500			
Cyanides (free)	250	1000	500	1250			
Phosphorus					2000		
Sulfur					600		
Sulfate					2000		

Reference should be made to the following guidelines for further details (as referenced in the above table):

1 National Environment Protection (Assessment of Site Contamination) Measure - 1999, National Environment Protection Council. Human exposure settings based on land use have been established for HILs and details are outlined in Taylor and Langley 1998.

2 NSW DECCW (formerly EPA) Guidelines for Assessing Service station Sites - 1994.

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 > SCC2 TREAT 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 > TCLP2 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

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

ANALYTE			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES				OP	PCBs	PETROLEUM HYDROCARBONS								PID	ASBESTOS
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Aldrin and Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	PESTICIDES		Petroleum Hydrocarbons				Benzene	Toluene	Ethyl Benzene	Total Xylenes	VALUES	FIBRES
																			C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10} - C_{36}					
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	25	50	100	100	250	0.5	0.5	1	3		
Site Assessment Criteria ^			200 *	40 *	24% *	2000 *	600 *	30 *	600 *	14000 *	40 *	2 *	20 *	100 *	400 *	20 *	0.1 ^^	20 *	65 #	NSL	NSL	NSL	1000 #	1 #	1.4 #	3.1 #	14 #		
Provisional Phyto-toxicity Investigation Levels			20 **	3 **	400 **	100 **	600 **	1 **	60 **	200 **	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	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	NSL	NSL	NSL		NSL	10	288	600	1000		
General Solid Waste SCC1'			500	100	1900	NSL	1500	50	1050	NSL	200	10	50					50	650	NSL			10000	18	518	1080	1800		
Restricted Solid Waste CT2'			400	80	400	NSL	400	16	160	NSL	NSL	3.2	NSL					NSL	NSL	NSL			NSL	40	1152	2400	4000		
Restricted Solid Waste SCC2'			2000	400	7600	NSL	6000	200	4200	NSL	800	23	50					50	2600	NSL			40000	72	2073	4320	7200		
Location	Depth in metres	DESCRIPTION																											
RB1	0.3-0.4	Fill - Silty Clay	11	LPQL	17	13	28	LPQL	10	160	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
RB1	1-1.1	Silty Clay	17	LPQL	10	18	12	LPQL	2	23	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	N/A
RB2	0.3-0.4	Fill - Silty Clay	8	LPQL	21	12	33	0.1	14	25	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
RB2	0.5-0.95	Silty Clay	15	LPQL	25	24	17	LPQL	6	29	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	N/A
RB3	0.2-0.3	Fill - Silty Clay	14	LPQL	26	13	32	LPQL	9	34	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
RB4	0.2-0.9	Fill - Silty Gravely Clay	12	LPQL	23	7	23	LPQL	6	18	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
RB5	0.2-0.35	Fill - Silty Sandy Gravely Clay	9	LPQL	16	11	41	0.1	6	65	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
RB5	1-1.2	Silty Clay	16	LPQL	30	18	20	LPQL	9	33	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	N/A
RB6	0.3-0.7	Fill - Silty Sandy Gravely Clay	11	LPQL	20	6	19	LPQL	8	21	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
RB6	0.9-1.1	Silty Clay	16	LPQL	21	12	14	LPQL	3	17	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	N/A
RB7	0.2-0.9	Fill - Silty Clay	12	LPQL	19	18	83	0.2	8	98	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	No asbestos detected
Total no. of samples			11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	7
Maximum Value			17	LPQL	30	24	83	0.2	14	160	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	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 E, Parks, recreational open space
** Provisional Phyto-toxicity Investigation Levels (PPILs)
# NSW DECC (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
' Waste Classification Guidelines – Part 1: Classifying Waste (2009)

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
NA: Not Analysed
NC: Not Calculated
OP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyls
NSL: No Set Limit

TABLE C
SOIL INTRA-LABORATORY DUPLICATE RESULTS
QA/QC - RELATIVE PERCENTAGE DIFFERENCES

SAMPLE	ANALYSIS	INITIAL (mg/kg)	REPEAT (mg/kg)	MEAN (mg/kg)	RPD %
Intra-laboratory Soil sample ID = RB3(0.2-0.3m) Dup ID = DUP1 Envirolab Report: 34660	Arsenic	14	12	13	15
	Cadmium	LPQL	LPQL	NC	NC
	Chromium	26	21	23.5	21
	Copper	13	12	12.5	8
	Lead	32	34	33	6
	Mercury	LPQL	LPQL	NC	NC
	Nickel	9	8	8.5	12
	Zinc	34	35	34.5	3
	Naphthalene	LPQL	LPQL	NC	NC
	Acenaphthylene	LPQL	LPQL	NC	NC
	Acenaphthene	LPQL	LPQL	NC	NC
	Fluorene	LPQL	LPQL	NC	NC
	Phenanthrene	LPQL	LPQL	NC	NC
	Anthracene	LPQL	LPQL	NC	NC
	Fluoranthene	LPQL	LPQL	NC	NC
	Pyrene	LPQL	LPQL	NC	NC
	Benzo(a)anthracene	LPQL	LPQL	NC	NC
	Chrysene	LPQL	LPQL	NC	NC
	Benzo(b)&(k)fluorant	LPQL	LPQL	NC	NC
	Benzo(a)pyrene	LPQL	LPQL	NC	NC
	Indeno(123-cd)pyrene	LPQL	LPQL	NC	NC
	Dibenzo(ah)anthracene	LPQL	LPQL	NC	NC
	Benzo(ghi)perylene	LPQL	LPQL	NC	NC
	Total PAHs	LPQL	LPQL	NC	NC
	Total OCP	LPQL	LPQL	NC	NC
	Total OPP	LPQL	LPQL	NC	NC
	Total PCBs	LPQL	LPQL	NC	NC
	C_6-C_9 TPH	LPQL	LPQL	NC	NC
	C_{10}-C_{14} TPH	LPQL	LPQL	NC	NC
	C_{15}-C_{28} TPH	LPQL	LPQL	NC	NC
	C_{29}-C_{36} TPH	LPQL	LPQL	NC	NC
	Benzene	LPQL	LPQL	NC	NC
	Toluene	LPQL	LPQL	NC	NC
	Ethylbenzene	LPQL	LPQL	NC	NC
	Total Xylenes	LPQL	LPQL	NC	NC

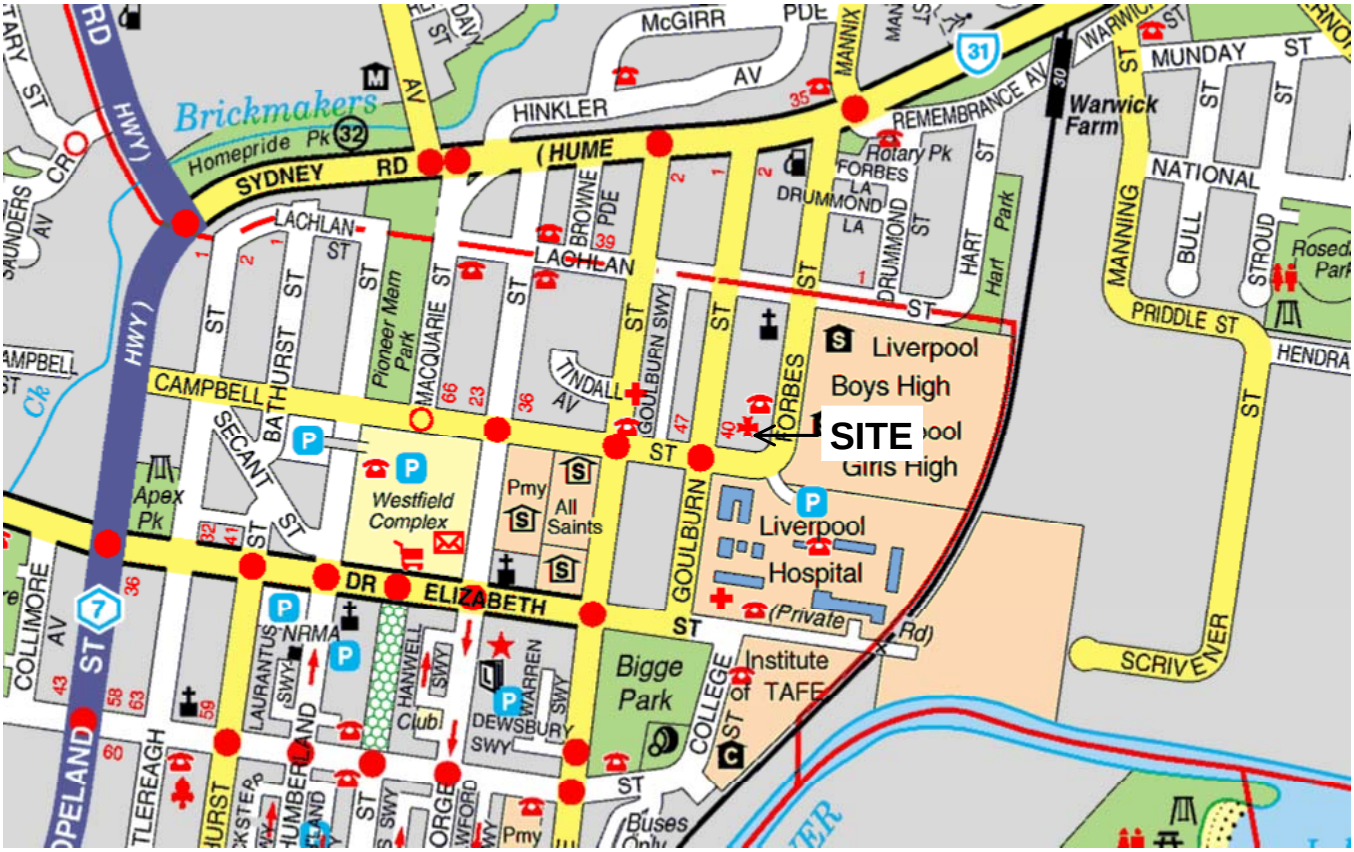
ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
NC: Not Calculated

TABLE D
QA-QC - SOIL FIELD BLANK ANALYSIS RESULTS

Sample Identification	FB
Sample Date	23/10/2009
Sample Type	Sand
Analyte	mg/kg
Benzene	LPQL
Toluene	LPQL
Ethylbenzene	LPQL
Total Xylenes	LPQL

ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
NA: Not Analysed

E23302K
November 2009



Reproduced from UBD page 269 square G1

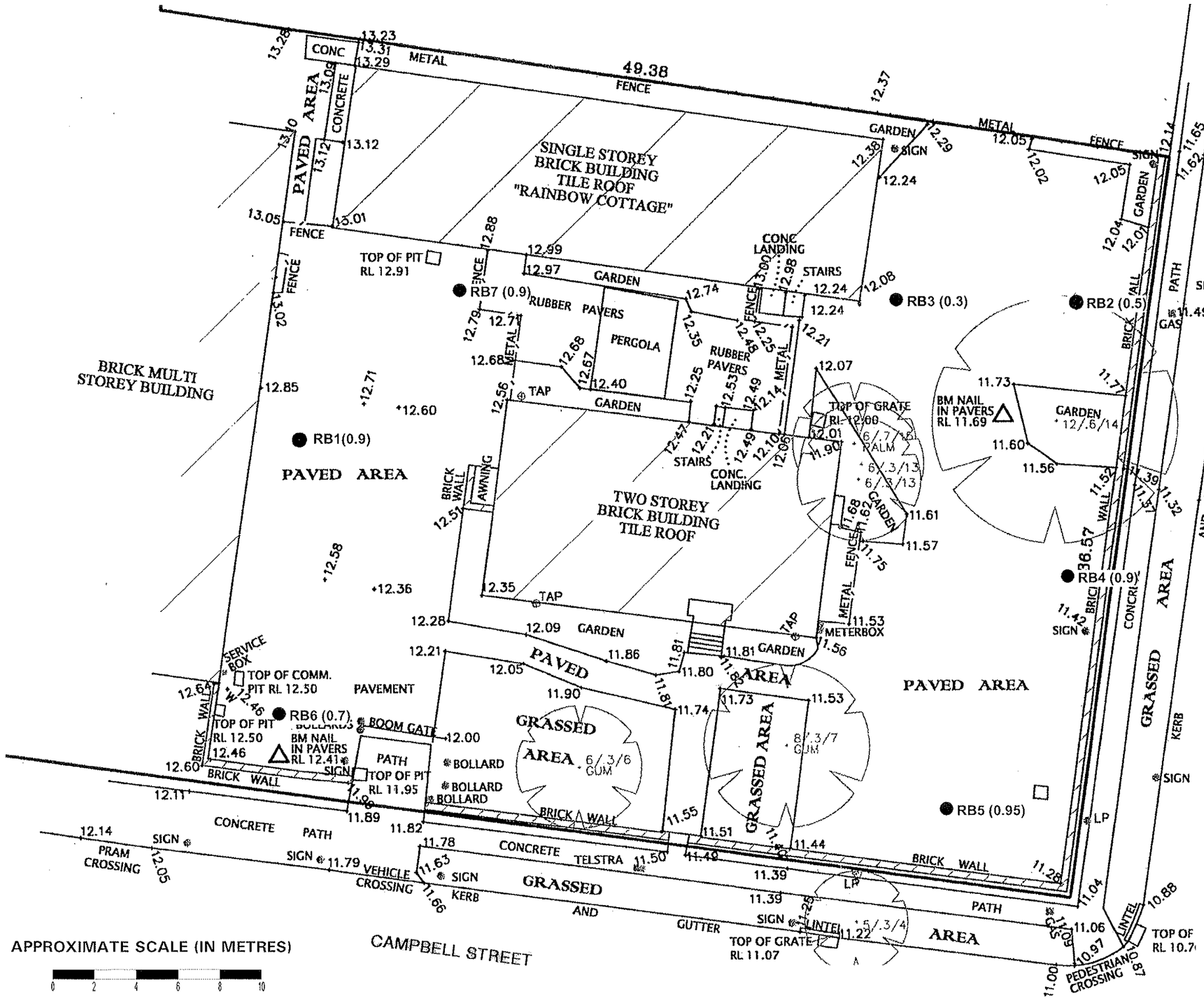
SITE LOCATION PLAN

1 CAMPBELL STREET LIVERPOOL

ENVIRONMENTAL INVESTIGATION SERVICES

Job No: E23302K
Figure: 1

Note: Reference should be made to the text of the report for a full description of this plan.



APPROXIMATE SCALE (IN METRES)

0 2 4 6 8 10

KEY

● RB1 (0.9m) **Borehole location number & depth of fill**

Note: Reference should be made to the text for a full understanding of this plan

BOREHOLE LOCATION PLAN

1 CAMPBELL STREET LIVERPOOL

ENVIRONMENTAL INVESTIGATION SERVICES

Job No: E23302K
Figure: 2

APPENDIX A

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Borehole No. **RB1** 1/2

BOREHOLE LOG

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL, NSW

Job No. M23302ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≈ 12.7m

Date: 22-10-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGERING					N = 4 2,2,2	0		-	BRICK PAVERS: 50mm.t	-	-	-	
								-	FILL: Sand, fine to medium grained, yellow brown.	-	-	-	NO OBSERVED REINFORCEMENT
								-	CONCRETE: 80mm.t	M	-	-	
									FILL: Gravelly sand, fine to coarse grained, light brown, fine to medium grained angular igneous gravel.	MC>PL			APPEARS POORLY COMPACTED
						1		CH	FILL: Silty clay, high plasticity, brown, with a trace of fine to medium grained angular and sub angular igneous and ironstone gravel.	MC>PL	St	150	RESIDUAL
ON COMPLETION OF CORING					N > 15 10,15/ 50mm REFUSAL			CL	SILTY CLAY: high plasticity, light brown mottled red brown.		VSt -H	250 400	
						2			SILTY CLAY: medium plasticity, light grey, with XW shale bands and a trace of fine to medium grained sub angular ironstone gravel.				
					N > 20 11,20/ 100mm REFUSAL	3				MC<PL	H	>600 >600	
								-	SHALE: grey and light brown.	DW	VH	>600	HIGH 'TC' BIT RESISTANCE
									REFER TO CORED BOREHOLE LOG			-	
						4							
						5							
						6							
						7							

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Borehole No. **RB1** 2/2

CORED BOREHOLE LOG

Client: INGHAM HEALTH RESEARCH INSTITUTE
Project: PROPOSED NEW BUILDING
Location: 1 CAMPBELL STREET, LIVERPOOL, NSW

Job No. M23302ZA **Core Size:** NMLC **R.L. Surface:** ≈ 12.7m
Date: 22-10-09 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK300 **Bearing:** - **Logged/Checked by:** G.F./

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (EL VL L M H VH EH)	DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		3		START CORING AT 3.40m					
80% RET-URN		4		SHALE: light grey and light brown, bedded at 0°.	DW	VH			- HEALED J, 30°, P
				SHALE: orange brown and dark grey, with light grey laminae, bedded at 0-5°.		L-M			- J, 35°, P, R, IS - XWS/CS, 100mm.t - Cr, 10mm.t - Cr, 20mm.t - Cr/XWS, 30mm.t - J, 90°, P, R - CS, 30mm.t - J, 40-90°, Un, R - CS, 30mm.t - J, 90°, Un, S - Cr, 15mm.t - J, 45°, P, S - J, 40-90°, Un, R - 2xJ, 40°, P, S - Cr, 20mm.t - CS/XWS, 10mm.t - XWS/Cr, 15mm.t - XWS/CS, 5mm.t - J, 45°, P, S, CLAY INFILL 10mm.t - XWS, 150mm.t - J, 80-90°, Un, R
		5							
		6		CORE LOSS 0.17m					
				SHALE: orange brown and dark grey, with light grey laminae, bedded at 0-5°.	DW	L-M			- XWS, 50mm.t - J, 80-90°, P, S - CS, 30mm.t - Cr, 50mm.t - CS/XWS, 20mm.t - CS, 5mm.t - Cr, 5mm.t - Cr, 5mm.t - CS/XWS, 10mm.t - Cr, 5mm.t
		7		SHALE: dark grey, with light grey laminae, bedded at 0°.	SW	H			
				END OF BOREHOLE AT 7.22m					
		8							
		9							

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Borehole No. **RB2** 1/2

BOREHOLE LOG

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL, NSW

Job No. M23302ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≈ 11.9m

Date: 22-10-09 **Datum:** AHD

Logged/Checked by: G.F./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION OF AUGERING						0		-	BRICK PAVERS: 50mm.t	M	-	-	
									FILL: Sand, fine to medium grained, brown.	MC>PL			
					N = 9 3,4,5			CH	FILL: Sandy gravel, fine to medium grained, angular and sub angular igneous, grey, fine to coarse grained sand.	MC>PL	H	>600 >600 >600	RESIDUAL
						1			FILL: Silty clay, high plasticity, brown, with a trace of fine to medium grained angular igneous gravel.		VSt		
					N = 28 6,13,15			CL	SILTY CLAY: high plasticity, light brown and orange brown, with a trace of fine to medium grained sub angular ironstone gravel.	MC<PL	H	350 >600 >600	
						2			SILTY CLAY: high plasticity, light grey mottled red brown and orange brown, with a trace of fine to medium grained sub angular ironstone gravel.				
▼ ON COMPLETION OF CORING						3			SILTY CLAY: low plasticity, light grey mottled orange brown, with a trace of fine to medium grained sub angular ironstone gravel.				
									SILTY CLAY: medium plasticity, light grey, with XW shale bands and a trace of fine to medium grained sub angular ironstone gravel.				
						4		-	SHALE: dark brown and orange brown.	DW	L-M		LOW 'TC' BIT RESISTANCE
									REFER TO CORED BOREHOLE LOG				
						5							
						6							
						7							

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Borehole No. **RB2** 2/2

CORED BOREHOLE LOG

Client: INGHAM HEALTH RESEARCH INSTITUTE
Project: PROPOSED NEW BUILDING
Location: 1 CAMPBELL STREET, LIVERPOOL, NSW

Job No. M23302ZA **Core Size:** NMLC **R.L. Surface:** ≈ 11.9m
Date: 22-10-09 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK300 **Bearing:** - **Logged/Checked by:** G.F./

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components.)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ (EL VL L M H VH EH)	DEFECT SPACING (mm) (600 300 100 60 30 10)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating.) Specific / General
		3							
		4		START CORING AT 4.14m					
				CORE LOSS 0.14m					
90% RET-URN		5		SHALE: dark brown and orange brown, with dark grey seams, bedded at 0-5°.	DW	M	×		- J, 90°, P, S - Cr, 10mm.t - Cr, 10mm.t - Cr, 10mm.t - Cr, 10mm.t - J, 50°, P, S - J, 70°, Un, S - J, 70-80°, P, R - J, 80-90°, P, S, CLAY COATED - J, 80°, P, R - J, 90°, P, S
				as above, but with clay seams and M strength seams.	XW-DW	EL-VL			
		6		SHALE: dark brown and orange brown, with dark grey seams, bedded at 0-5°.	DW	M-H	×		- Cr, 40mm.t - Cr, 5mm.t - Cr, 15mm.t - J, 85-90°, P, S
						H	×		- J, 90°, P, S
							×		- J, 80-90°, P, R - J, 30°, P, S - Cr, 5mm.t - J, 20°, P, R - J, 90°, P, S - Cr, 40mm.t
		7		SHALE: dark grey, with light grey laminae, bedded at 0°.	SW		×		- J, 90°, P, S
				END OF BOREHOLE AT 7.15m					
		8							
		9							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 3 1/1

Environmental logs are not to be used for geotechnical purposes

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL,

Job No. E23302K **Method:** EZY PROBE **R.L. Surface:**

Date: 23-10-09 **Datum:**

Logged/Checked by: B.S./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0		-	PAVERS: 50 mm.t.				
								-	FILL: Sand, fine to medium grained, brown.	D	-	-	NO RECOVERY OF MATERIALS
								-	CONCRETE: 110 mm.t.	-	-	-	
								CH	FILL: silty clay, medium to high plasticity, brown with ironstone gravel and igneous gravel.	MC > PL	-	-	
						0.5			SILTY CLAY: high plasticity, red brown, mottled orange brown and light grey.	MC < PL			
						1							
								-	SHALE: light grey, mottled red and orange brown.	XW	-	-	PUSH TUBE REFUSAL
						1.5			END OF BOREHOLE AT 1.4m				
						2							
						2.5							
						3							
						3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

ENVIRONMENTAL LOG

Borehole No. 4 1/1

Environmental logs are not to be used for geotechnical purposes

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL,

Job No. E23302K **Method:** EZY PROBE **R.L. Surface:**

Date: 23-10-09 **Datum:**

Logged/Checked by: B.S./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0			PAVERS: 50mm.t.				
								-	FILL: Sand, fine to medium grained, orange brown.	W	-	-	NO RECOVERY OF MATERIALS
								-	CONCRETE: 110mm.t.	-	-	-	
						0.5		-	FILL: Silty gravelly clay, low to medium plasticity, dark grey, mottled light brown to orange with ironstone, igneous gravel and a trace of ash.	MC < PL	-	-	APPEARS POORLY COMPACTED (VERY LOW PUSH TUBE RECOVERY)
						1		CL-CH	SILTY CLAY: medium to high plasticity, red brown, mottled orange brown with ironstone gravel.	MC < PL	-	-	
						1.5			END OF BOREHOLE AT 1.5m				
						2							
						2.5							
						3							
						3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 5 1/1

Environmental logs are not to be used for geotechnical purposes

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL,

Job No. E23302K **Method:** EZY PROBE **R.L. Surface:**

Date: 23-10-09 **Datum:**

Logged/Checked by: B.S./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0		-	PAVERS: 50mm.t.	W	-	-	APPEARS POORLY COMPACTED
									FILL: Gravel, medium to coarse grained grey.	MC < PL			
						0.5			FILL: Silty sandy gravelly clay, low plasticity, brown with gravel and with a trace of ash.				
						1		CL	SILTY CLAY: medium plasticity, orange brown, mottled red brown with a trace of ironstone gravel.	MC < PL	-	-	
						1.5			END OF BOREHOLE AT 1.5m				
						2							
						2.5							
						3							
						3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 6 1/1

Environmental logs are not to be used for geotechnical purposes

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL,

Job No. E23302K **Method:** EZY PROBE **R.L. Surface:**

Date: 23-10-09 **Datum:**

Logged/Checked by: B.S./

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0		-	PAVERS: 50mm.t.	-	-	-	NO RECOVERY
								-	FILL: Sand, fine to medium grained, orange brown.	-	-	-	
								-	CONCRETE: 120mm.t.	MC≈PL	-	-	
						0.5			FILL: Silty sandy gravelly clay, low to medium plasticity, brown mottled red brown with igneous ironstone and ash.				
								CH	SILTY CLAY: high plasticity, orange brown, mottled red brown with ironstone gravel.	MC < PL	-	-	
						1							
								-	SHALE: light grey, mottled red brown.	XW	-	-	PUSH TUBE REFUSAL
						1.5			END OF BOREHOLE AT 1.48m				
						2							
						2.5							
						3							
						3.5							

ENVIRONMENTAL INVESTIGATION SERVICES

CONSULTING ENVIRONMENTAL ENGINEERS

EIS

ENVIRONMENTAL LOG

Borehole No. 7 1/1

Environmental logs are not to be used for geotechnical purposes

Client: INGHAM HEALTH RESEARCH INSTITUTE

Project: PROPOSED NEW BUILDING

Location: 1 CAMPBELL STREET, LIVERPOOL,

Job No. E23302K **Method:** EZY PROBE **R.L. Surface:**

Date: 23-10-09 **Datum:**

Logged/Checked by: B.S./KM

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0			PAVERS: 50mm.t.	W	-	-	NO RECOVERY
									FILL: Sand, fine to medium grained, red brown.	-	-	-	
									CONCRETE: 100mm.t.	-	-	-	
									FILL: Silty clay, low plasticity, dark grey with ironstone, igneous gravel and with a trace of ash.				
						0.5							VERY LOW SAMPLE RECOVERY
						1		CH	SILTY CLAY: high plasticity, orange brown, mottled brown.	MC<PL	-	-	VERY LOW SAMPLE RECOVERY
						1.5			END OF BOREHOLE AT 1.5m				
						2							
						2.5							
						3							
						3.5							

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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 subsurface 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.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or 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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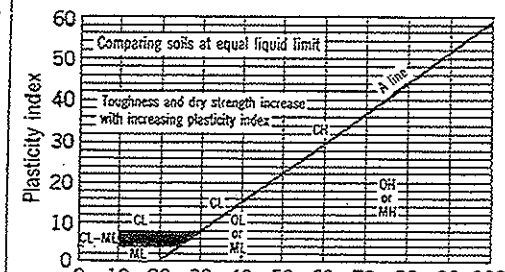
UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)						Group Symbols [a]	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 For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics 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*)	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 Use grain size curve in identifying the fractions as given under field identification
			Predominantly one size or a range of sizes with some intermediate sizes missing			*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)			*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)			*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		
	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		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *GW* 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 Atterberg limits above "A" line, with *PI* greater than 7
			Predominantly one size or a range of sizes with some intermediate sizes missing			*SP*	Poorly graded sands, gravelly sands, little or no fines		
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)			*SM*	Silty sands, poorly graded sand-silt mixtures		
			Plastic fines (for identification procedures, see *CL* below)			*SC*	Clayey sands, poorly graded sand-clay mixtures		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for *SW* 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 Atterberg limits below "A" line with *PI* greater than 7
Fine-grained soils: More than half of material is *smaller* than 75 μm sieve size	Identification Procedures on Fraction Smaller than 380 μm Sieve Size								
	Silts and clays: liquid limit less than 50	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)					
		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 For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions 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	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		
	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		
		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		



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

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.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
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.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (Id) 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.
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

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ABN 17 003 550 801

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	0.03	Easily remoulded by hand to a material with soil properties.
Very Low:	VL	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low:	L	0.3	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.
Medium Strength:	M	1	A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
High:	H	3	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.
Very High:	VH	10	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.
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	

APPENDIX B

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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CERTIFICATE OF ANALYSIS 34660

Client:
Environmental Investigation Services
PO Box 976
North Ryde BC
NSW 1670

Attention: Belinda Sinclair

Sample log in details:

Your Reference:	**E23302K, Liverpool**
No. of samples:	15 Soils
Date samples received:	23/10/09
Date completed instructions received:	23/10/09

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:	30/10/09
Date of Preliminary Report:	Not issued
Issue Date:	30/10/09

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

Results Approved By:

Matt Mansfield
Chemist

Joshua Lim
Chemist

vTPH & BTEX in Soil						
Our Reference:	UNITS	34660-1	34660-3	34660-5	34660-7	34660-9
Your Reference	----------	RB1	RB2	RB3	RB4	RB5
Depth	----------	0.3-0.4	0.3-0.4	0.2-0.3	0.2-0.9	0.2-0.35
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	27/10/2009	27/10/2009	27/10/2009	27/10/2009	27/10/2009
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	83	89	82	98	72

vTPH & BTEX in Soil					
Our Reference:	UNITS	34660-11	34660-13	34660-14	34660-15
Your Reference	----------	RB6	RB7	FB1	DUP1
Depth	----------	0.3-0.7	0.2-0.9	-	-
Date Sampled		23/10/2009	23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	27/10/2009	27/10/2009	27/10/2009	27/10/2009
vTPH C_6 - C_9	mg/kg	<25	<25	[NA]	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	90	74	89	109

sTPH in Soil (C10-C36)						
Our Reference:	UNITS	34660-1	34660-3	34660-5	34660-7	34660-9
Your Reference	----------	RB1	RB2	RB3	RB4	RB5
Depth	----------	0.3-0.4	0.3-0.4	0.2-0.3	0.2-0.9	0.2-0.35
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	98	96	97	96	99

sTPH in Soil (C10-C36)				
Our Reference:	UNITS	34660-11	34660-13	34660-15
Your Reference	----------	RB6	RB7	DUP1
Depth	----------	0.3-0.7	0.2-0.9	-
Date Sampled		23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100
Surrogate o-Terphenyl	%	95	98	96

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ---------- 	34660-1 RB1 0.3-0.4 22/10/2009 Soil	34660-3 RB2 0.3-0.4 22/10/2009 Soil	34660-5 RB3 0.2-0.3 23/10/2009 Soil	34660-7 RB4 0.2-0.9 23/10/2009 Soil	34660-9 RB5 0.2-0.35 23/10/2009 Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<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	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d_{14}	%	137	139	134	133	139

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ---------- 	34660-11 RB6 0.3-0.7 23/10/2009 Soil	34660-13 RB7 0.2-0.9 23/10/2009 Soil	34660-15 DUP1 - 23/10/2009 Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009
Naphthalene	mg/kg	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d_{14}	%	135	135	133

Organochlorine Pesticides in soil						
Our Reference:	UNITS	34660-1	34660-3	34660-5	34660-7	34660-9
Your Reference	----------	RB1	RB2	RB3	RB4	RB5
Depth	----------	0.3-0.4	0.3-0.4	0.2-0.3	0.2-0.9	0.2-0.35
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	95	94	97	91	92

Organochlorine Pesticides in soil				
Our Reference:	UNITS	34660-11	34660-13	34660-15
Your Reference	----------	RB6	RB7	DUP1
Depth	----------	0.3-0.7	0.2-0.9	-
Date Sampled		23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009
HCB	mg/kg	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1
Surrogate TCLMX	%	91	96	89

Organophosphorus Pesticides Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-1 RB1 0.3-0.4 22/10/2009 Soil	34660-3 RB2 0.3-0.4 22/10/2009 Soil	34660-5 RB3 0.2-0.3 23/10/2009 Soil	34660-7 RB4 0.2-0.9 23/10/2009 Soil	34660-9 RB5 0.2-0.35 23/10/2009 Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	95	94	97	91	92

Organophosphorus Pesticides Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-11 RB6 0.3-0.7 23/10/2009 Soil	34660-13 RB7 0.2-0.9 23/10/2009 Soil	34660-15 DUP1 - 23/10/2009 Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009
Diazinon	mg/kg	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1
Surrogate TCLMX	%	91	96	89

PCBs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-1 RB1 0.3-0.4 22/10/2009 Soil	34660-3 RB2 0.3-0.4 22/10/2009 Soil	34660-5 RB3 0.2-0.3 23/10/2009 Soil	34660-7 RB4 0.2-0.9 23/10/2009 Soil	34660-9 RB5 0.2-0.35 23/10/2009 Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	95	94	97	91	92

PCBs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-11 RB6 0.3-0.7 23/10/2009 Soil	34660-13 RB7 0.2-0.9 23/10/2009 Soil	34660-15 DUP1 - 23/10/2009 Soil
Date extracted	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1	<0.1
Surrogate TCLMX	%	91	96	89

Acid Extractable metals in soil						
Our Reference:	UNITS	34660-1	34660-3	34660-5	34660-7	34660-9
Your Reference	----------	RB1	RB2	RB3	RB4	RB5
Depth	----------	0.3-0.4	0.3-0.4	0.2-0.3	0.2-0.9	0.2-0.35
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	27/10/2009	27/10/2009	27/10/2009	27/10/2009	27/10/2009
Arsenic	mg/kg	11	8	14	12	9
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	17	21	26	23	16
Copper	mg/kg	13	12	13	7	11
Lead	mg/kg	28	33	32	23	41
Mercury	mg/kg	<0.1	0.1	<0.1	<0.1	0.1
Nickel	mg/kg	10	14	9	6	6
Zinc	mg/kg	160	25	34	18	65

Acid Extractable metals in soil				
Our Reference:	UNITS	34660-11	34660-13	34660-15
Your Reference	----------	RB6	RB7	DUP1
Depth	----------	0.3-0.7	0.2-0.9	-
Date Sampled		23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil
Date digested	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	27/10/2009	27/10/2009	27/10/2009
Arsenic	mg/kg	11	12	12
Cadmium	mg/kg	<0.5	<0.5	<0.5
Chromium	mg/kg	20	19	21
Copper	mg/kg	6	18	12
Lead	mg/kg	19	83	34
Mercury	mg/kg	<0.1	0.2	<0.1
Nickel	mg/kg	8	8	8
Zinc	mg/kg	21	98	35

Moisture Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-1 RB1 0.3-0.4 22/10/2009 Soil	34660-3 RB2 0.3-0.4 22/10/2009 Soil	34660-5 RB3 0.2-0.3 23/10/2009 Soil	34660-7 RB4 0.2-0.9 23/10/2009 Soil	34660-9 RB5 0.2-0.35 23/10/2009 Soil
Date prepared	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009	26/10/2009	26/10/2009
Moisture	%	18	14	16	15	19

Moisture Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-11 RB6 0.3-0.7 23/10/2009 Soil	34660-13 RB7 0.2-0.9 23/10/2009 Soil	34660-15 DUP1 - 23/10/2009 Soil
Date prepared	-	26/10/2009	26/10/2009	26/10/2009
Date analysed	-	26/10/2009	26/10/2009	26/10/2009
Moisture	%	19	19	19

Asbestos ID - soils						
Our Reference:	UNITS	34660-1	34660-3	34660-5	34660-7	34660-9
Your Reference	----------	RB1	RB2	RB3	RB4	RB5
Depth	----------	0.3-0.4	0.3-0.4	0.2-0.3	0.2-0.9	0.2-0.35
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	30/10/2009	30/10/2009	30/10/2009	30/10/2009	30/10/2009
Sample Description	-	30g Soil	30g Soil	10g Soil	10g Soil	40g Soil & Rocks
Asbestos ID in soil	-	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected	Respirable fibres not detected

Asbestos ID - soils			
Our Reference:	UNITS	34660-11	34660-13
Your Reference	----------	RB6	RB7
Depth	----------	0.3-0.7	0.2-0.9
Date Sampled		23/10/2009	23/10/2009
Type of sample		Soil	Soil
Date analysed	-	30/10/2009	30/10/2009
Sample Description	-	8g Soil	5g Soil
Asbestos ID in soil	-	No asbestos found at reporting limit of 0.1g/kg	No asbestos found at reporting limit of 0.1g/kg
Trace Analysis	-	Respirable fibres not detected	Respirable fibres not detected

Method ID	Methodology Summary
GC.16	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.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC.8	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC-6	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
AS4964-2004	Qualitative identification of asbestos type fibres in bulk using Polarised Light Microscopy and Dispersion Staining Techniques.

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			26/10/2009	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/2009
Date analysed	-			27/10/2009	34660-5	27/10/2009 || 27/10/2009	LCS-1	27/10/2009
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	34660-5	<25 || <25	LCS-1	93%
Benzene	mg/kg	0.5	GC.16	<0.5	34660-5	<0.5 || <0.5	LCS-1	103%
Toluene	mg/kg	0.5	GC.16	<0.5	34660-5	<0.5 || <0.5	LCS-1	91%
Ethylbenzene	mg/kg	1	GC.16	<1.0	34660-5	<1.0 || <1.0	LCS-1	72%
m+p-xylene	mg/kg	2	GC.16	<2.0	34660-5	<2.0 || <2.0	LCS-1	100%
o-Xylene	mg/kg	1	GC.16	<1.0	34660-5	<1.0 || <1.0	LCS-1	96%
Surrogate aaa-Trifluorotoluene	%		GC.16	90	34660-5	82 || 90 || RPD: 9	LCS-1	99%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			26/10/2009	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/2009
Date analysed	-			26/10/2009	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/2009
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	34660-5	<50 || <50	LCS-1	81%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	34660-5	<100 || <100	LCS-1	93%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	34660-5	<100 || <100	LCS-1	90%
Surrogate o-Terphenyl	%		GC.3	92	34660-5	97 || 100 || RPD: 3	LCS-1	95%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			26/10/2009	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/2009
Date analysed	-			26/10/2009	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/2009
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	LCS-1	101%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	LCS-1	90%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	LCS-1	98%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	LCS-1	95%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	LCS-1	100%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	LCS-1	105%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	34660-5	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	34660-5	<0.05 || <0.05	LCS-1	95%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	134	34660-5	134 || 132 || RPD: 2	LCS-1	128%

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	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/09
Date analysed	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/09
HCB	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	64%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	68%
Heptachlor	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	64%
delta-BHC	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	62%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	60%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	66%
Dieldrin	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	65%
Endrin	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	69%
pp-DDD	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	63%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	LCS-1	69%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	91	34660-5	97 || 93 || RPD: 4	LCS-1	91%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/09
Date analysed	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/09
Diazinon	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	LCS-1	77%
Fenitrothion	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	LCS-1	68%
Bromophos-ethyl	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	GC.8	<0.1	34660-5	<0.1 || <0.1	LCS-1	95%
Surrogate TCLMX	%		GC.8	91	34660-5	97 || 93 || RPD: 4	LCS-1	92%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/09
Date analysed	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-1	26/10/09
Arochlor 1016	mg/kg	0.1	GC-6	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	GC-6	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	GC-6	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	GC-6	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	GC-6	<0.1	34660-5	<0.1 || <0.1	LCS-1	130%
Arochlor 1260	mg/kg	0.1	GC-6	<0.1	34660-5	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-6	91	34660-5	97 || 93 || RPD: 4	LCS-1	93%

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	-			26/10/09	34660-5	26/10/2009 || 26/10/2009	LCS-2	26/10/09
Date analysed	-			27/10/09	34660-5	27/10/2009 || 27/10/2009	LCS-2	27/10/09
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4	34660-5	14 || 12 || RPD: 15	LCS-2	104%
Cadmium	mg/kg	0.5	Metals.20 ICP-AES	<0.5	34660-5	<0.5 || <0.5	LCS-2	108%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1	34660-5	26 || 22 || RPD: 17	LCS-2	107%
Copper	mg/kg	1	Metals.20 ICP-AES	<1	34660-5	13 || 12 || RPD: 8	LCS-2	108%
Lead	mg/kg	1	Metals.20 ICP-AES	<1	34660-5	32 || 26 || RPD: 21	LCS-2	107%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.1	34660-5	<0.1 || <0.1	LCS-2	99%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1	34660-5	9 || 8 || RPD: 12	LCS-2	108%
Zinc	mg/kg	1	Metals.20 ICP-AES	<1	34660-5	34 || 27 || RPD: 23	LCS-2	108%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			26/10/2009
Date analysed	-			26/10/2009
Moisture	%	0.1	LAB.8	<0.10

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

Report Comments:

Asbestos was analysed by Approved Identifier: Matt Mansfield
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within 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. Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and speciated phenols.

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CERTIFICATE OF ANALYSIS 34660-A

Client:
Environmental Investigation Services
PO Box 976
North Ryde BC
NSW 1670

Attention: Belinda Sinclair

Sample log in details:

Your Reference:	**E23302K, Liverpool**
No. of samples:	Additional Testing on 4 Soils
Date samples received:	23/10/09
Date completed instructions received:	05/11/09

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:	12/11/09
Date of Preliminary Report:	Not issued
Issue Date:	9/11/09

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Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinta Hurst
Operations Manager

vTPH & BTEX in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-A-2 RB1 1-1.1 22/10/2009 Soil	34660-A-4 RB2 0.5-0.95 22/10/2009 Soil	34660-A-10 RB5 1-1.2 23/10/2009 Soil	34660-A-12 RB6 0.9-1.1 23/10/2009 Soil
Date extracted	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
vTPH C_6 - C_9	mg/kg	<25	<25	<25	<25
Benzene	mg/kg	<0.5	<0.5	<0.5	<0.5
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1.0	<1.0	<1.0	<1.0
m+p-xylene	mg/kg	<2.0	<2.0	<2.0	<2.0
o-Xylene	mg/kg	<1.0	<1.0	<1.0	<1.0
Surrogate aaa-Trifluorotoluene	%	91	100	93	100

sTPH in Soil (C10-C36) Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-A-2 RB1 1-1.1 22/10/2009 Soil	34660-A-4 RB2 0.5-0.95 22/10/2009 Soil	34660-A-10 RB5 1-1.2 23/10/2009 Soil	34660-A-12 RB6 0.9-1.1 23/10/2009 Soil
Date extracted	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
TPH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50
TPH C_{15} - C_{28}	mg/kg	<100	<100	<100	<100
TPH C_{29} - C_{36}	mg/kg	<100	<100	<100	<100
Surrogate o-Terphenyl	%	95	88	87	87

PAHs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-A-2 RB1 1-1.1 22/10/2009 Soil	34660-A-4 RB2 0.5-0.95 22/10/2009 Soil	34660-A-10 RB5 1-1.2 23/10/2009 Soil	34660-A-12 RB6 0.9-1.1 23/10/2009 Soil
Date extracted	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate p-Terphenyl-d_{14}	%	94	90	86	85

Organochlorine Pesticides in soil					
Our Reference:	UNITS	34660-A-2	34660-A-4	34660-A-10	34660-A-12
Your Reference	----------	RB1	RB2	RB5	RB6
Depth	----------	1-1.1	0.5-0.95	1-1.2	0.9-1.1
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
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	%	140	122	119	131

Organophosphorus Pesticides Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	34660-A-2 RB1 1-1.1 22/10/2009 Soil	34660-A-4 RB2 0.5-0.95 22/10/2009 Soil	34660-A-10 RB5 1-1.2 23/10/2009 Soil	34660-A-12 RB6 0.9-1.1 23/10/2009 Soil
Date extracted	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
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	%	140	122	119	131

PCBs in Soil Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ---------- 	34660-A-2 RB1 1-1.1 22/10/2009 Soil	34660-A-4 RB2 0.5-0.95 22/10/2009 Soil	34660-A-10 RB5 1-1.2 23/10/2009 Soil	34660-A-12 RB6 0.9-1.1 23/10/2009 Soil
Date extracted	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
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	%	140	122	119	131

Acid Extractable metals in soil					
Our Reference:	UNITS	34660-A-2	34660-A-4	34660-A-10	34660-A-12
Your Reference	----------	RB1	RB2	RB5	RB6
Depth	----------	1-1.1	0.5-0.95	1-1.2	0.9-1.1
Date Sampled		22/10/2009	22/10/2009	23/10/2009	23/10/2009
Type of sample		Soil	Soil	Soil	Soil
Date digested	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Arsenic	mg/kg	17	15	16	16
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	10	25	30	21
Copper	mg/kg	18	24	18	12
Lead	mg/kg	12	17	20	14
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	6	9	3
Zinc	mg/kg	23	29	33	17

Moisture Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ---------- 	34660-A-2 RB1 1-1.1 22/10/2009 Soil	34660-A-4 RB2 0.5-0.95 22/10/2009 Soil	34660-A-10 RB5 1-1.2 23/10/2009 Soil	34660-A-12 RB6 0.9-1.1 23/10/2009 Soil
Date prepared	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Date analysed	-	6/11/2009	6/11/2009	6/11/2009	6/11/2009
Moisture	%	19	21	27	21

Method ID	Methodology Summary
GC.16	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.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC.8	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC-6	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			6/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-4	6/11/2009
Date analysed	-			6/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-4	6/11/2009
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	34660-A-2	<25 || <25	LCS-4	112%
Benzene	mg/kg	0.5	GC.16	<0.5	34660-A-2	<0.5 || <0.5	LCS-4	82%
Toluene	mg/kg	0.5	GC.16	<0.5	34660-A-2	<0.5 || <0.5	LCS-4	126%
Ethylbenzene	mg/kg	1	GC.16	<1.0	34660-A-2	<1.0 || <1.0	LCS-4	122%
m+p-xylene	mg/kg	2	GC.16	<2.0	34660-A-2	<2.0 || <2.0	LCS-4	115%
o-Xylene	mg/kg	1	GC.16	<1.0	34660-A-2	<1.0 || <1.0	LCS-4	116%
Surrogate aaa-Trifluorotoluene	%		GC.16	106	34660-A-2	91 || 90 || RPD: 1	LCS-4	113%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-1	06/11/2009
Date analysed	-			06/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-1	06/11/2009
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	34660-A-2	<50 || <50	LCS-1	97%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	34660-A-2	<100 || <100	LCS-1	103%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	34660-A-2	<100 || <100	LCS-1	93%
Surrogate o-Terphenyl	%		GC.3	90	34660-A-2	95 || 90 || RPD: 5	LCS-1	88%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			6/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-1	6/11/2009
Date analysed	-			6/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-1	6/11/2009
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	LCS-1	98%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	LCS-1	90%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	LCS-1	98%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	LCS-1	93%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 || <0.1	LCS-1	99%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ǁ Duplicate ǁ %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-1	103%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	34660-A-2	<0.2 ǁ <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	34660-A-2	<0.05 ǁ <0.05	LCS-1	90%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	85	34660-A-2	94 ǁ 91 ǁ RPD: 3	LCS-1	82%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ǁ Duplicate ǁ %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/11/2009	34660-A-2	6/11/2009 ǁ 6/11/2009	LCS-4	06/11/2009
Date analysed	-			06/11/2009	34660-A-2	6/11/2009 ǁ 6/11/2009	LCS-4	06/11/2009
HCB	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	139%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	140%
Heptachlor	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	99%
delta-BHC	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	134%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	111%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	124%
Dieldrin	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	115%
Endrin	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	111%
pp-DDD	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	105%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	LCS-4	117%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	34660-A-2	<0.1 ǁ <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	127	34660-A-2	140 ǁ 133 ǁ RPD: 5	LCS-4	133%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-4	06/11/2009
Date analysed	-			06/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-4	06/11/2009
Diazinon	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	LCS-4	132%
Fenitrothion	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	LCS-4	124%
Bromophos-ethyl	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	GC.8	<0.1	34660-A-2	<0.1 || <0.1	LCS-4	134%
Surrogate TCLMX	%		GC.8	127	34660-A-2	140 || 133 || RPD: 5	LCS-4	135%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-4	06/11/2009
Date analysed	-			06/11/2009	34660-A-2	6/11/2009 || 6/11/2009	LCS-4	06/11/2009
Arochlor 1016	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	LCS-4	91%
Arochlor 1260	mg/kg	0.1	GC-6	<0.1	34660-A-2	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-6	127	34660-A-2	140 || 133 || RPD: 5	LCS-4	116%

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	-			06/11/09	[NT]	[NT]	LCS-4	06/11/09
Date analysed	-			06/11/09	[NT]	[NT]	LCS-4	06/11/09
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4	[NT]	[NT]	LCS-4	105%
Cadmium	mg/kg	0.5	Metals.20 ICP-AES	<0.5	[NT]	[NT]	LCS-4	104%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1	[NT]	[NT]	LCS-4	106%
Copper	mg/kg	1	Metals.20 ICP-AES	<1	[NT]	[NT]	LCS-4	111%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Lead	mg/kg	1	Metals.20 ICP-AES	<1	[NT]	[NT]	LCS-4	103%
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.1	[NT]	[NT]	LCS-4	105%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1	[NT]	[NT]	LCS-4	107%
Zinc	mg/kg	1	Metals.20 ICP-AES	<1	[NT]	[NT]	LCS-4	104%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			06/11/2009
Date analysed	-			06/11/2009
Moisture	%	0.1	LAB.8	<0.10

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	34660-A-4	6/11/2009
Date analysed	-	[NT]	[NT]	34660-A-4	6/11/2009
vTPH C_6 - C_9	mg/kg	[NT]	[NT]	34660-A-4	94%
Benzene	mg/kg	[NT]	[NT]	34660-A-4	72%
Toluene	mg/kg	[NT]	[NT]	34660-A-4	108%
Ethylbenzene	mg/kg	[NT]	[NT]	34660-A-4	104%
m+p-xylene	mg/kg	[NT]	[NT]	34660-A-4	93%
o-Xylene	mg/kg	[NT]	[NT]	34660-A-4	95%
Surrogate aaa-Trifluorotoluene	%	[NT]	[NT]	34660-A-4	107%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	34660-A-4	06/11/2009
Date analysed	-	[NT]	[NT]	34660-A-4	06/11/2009
TPH C_{10} - C_{14}	mg/kg	[NT]	[NT]	34660-A-4	95%
TPH C_{15} - C_{28}	mg/kg	[NT]	[NT]	34660-A-4	102%
TPH C_{29} - C_{36}	mg/kg	[NT]	[NT]	34660-A-4	92%
Surrogate o-Terphenyl	%	[NT]	[NT]	34660-A-4	87%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	34660-A-4	6/11/2009
Date analysed	-	[NT]	[NT]	34660-A-4	6/11/2009
Naphthalene	mg/kg	[NT]	[NT]	34660-A-4	91%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	34660-A-4	86%
Phenanthrene	mg/kg	[NT]	[NT]	34660-A-4	94%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	34660-A-4	91%
Pyrene	mg/kg	[NT]	[NT]	34660-A-4	96%
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	34660-A-4	98%
Benzo(b+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	34660-A-4	89%
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	[NT]	[NT]	34660-A-4	81%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	34660-A-4	06/11/2009
Date analysed	-	[NT]	[NT]	34660-A-4	06/11/2009
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	34660-A-4	121%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	34660-A-4	137%
Heptachlor	mg/kg	[NT]	[NT]	34660-A-4	113%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	34660-A-4	117%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	34660-A-4	100%
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]	34660-A-4	113%
Dieldrin	mg/kg	[NT]	[NT]	34660-A-4	104%
Endrin	mg/kg	[NT]	[NT]	34660-A-4	106%
pp-DDD	mg/kg	[NT]	[NT]	34660-A-4	81%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	34660-A-4	113%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	34660-A-4	140%
QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	34660-A-4	06/11/2009
Date analysed	-	[NT]	[NT]	34660-A-4	06/11/2009
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]	34660-A-4	120%
Fenitrothion	mg/kg	[NT]	[NT]	34660-A-4	109%
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	34660-A-4	123%
Surrogate TCLMX	%	[NT]	[NT]	34660-A-4	123%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	34660-A-4	06/11/2009
Date analysed	-	[NT]	[NT]	34660-A-4	06/11/2009
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]	34660-A-4	92%
Arochlor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	34660-A-4	106%

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within 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. Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and speciated phenols.

APPENDIX C

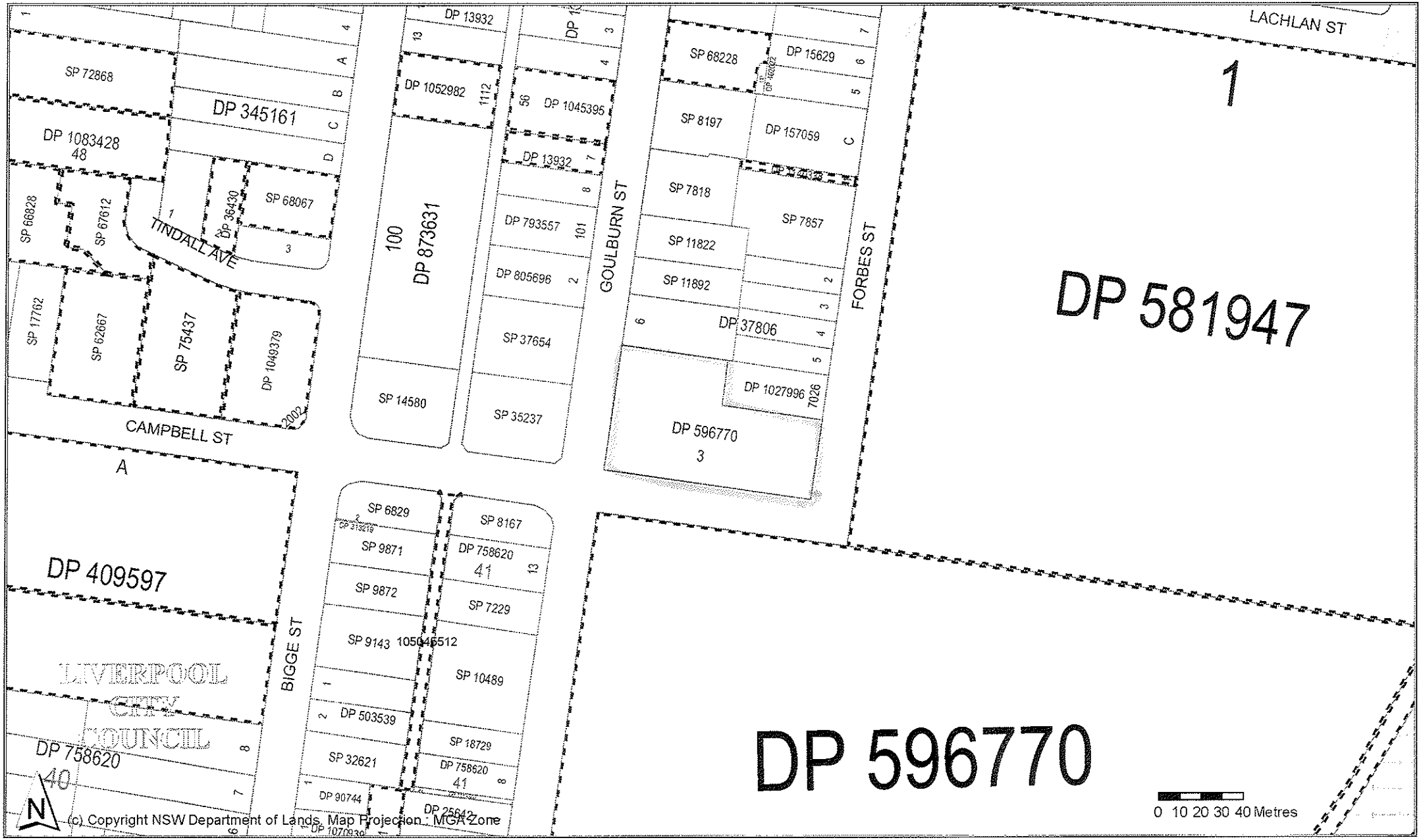
Department of Lands
Reliable from the ground up

Cadastral Records Enquiry Report

Ref : BOX 97 - LIVERPOOL

Requested Parcel : Lot 3 DP 596770 **Identified Parcel :** Lot 3 DP 596770

Locality : LIVERPOOL **LGA :** LIVERPOOL **Parish :** ST LUKE **County :** CUMBERLAND



Report Generated 11:42:41 AM, 13 August, 2009

This information is provided as a searching aid only. While every endeavour is made to ensure the current cadastral pattern is accurately reflected, the Registrar General cannot guarantee the information provided. For all ACTIVITY PRIOR to SEPT 2002 you must refer to the RGs Charting and Reference Maps.

Information Provided Through
Advance Legal Search Pty Ltd
Ph. 0297541590 *Fax.* 0297541364

Title Search

LEAP Legal
An Approved LPI *NSW*
Information Broker

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 3/596770

SEARCH DATE	TIME	EDITION NO	DATE
12/8/2009	2:18 PM	3	2/7/2007

LAND

LOT 3 IN DEPOSITED PLAN 596770
AT LIVERPOOL
LOCAL GOVERNMENT AREA LIVERPOOL
PARISH OF ST LUKE COUNTY OF CUMBERLAND
TITLE DIAGRAM DP596770

FIRST SCHEDULE

HEALTH ADMINISTRAION CORPORATION (T AD223445)

SECOND SCHEDULE (2 NOTIFICATIONS)

1 LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2 E967835 EASEMENT FOR ELECTRICITY PURPOSES AFFECTING PART OF THE LAND ABOVE DESCRIBED SHOWN SO BURDENED IN DP645792

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

EIS - Liverpool ALSP PRINTED ON 12/8/2009

Information Provided Through
Advance Legal Search Pty Ltd
Ph. 0297541590 *Fax.* 0297541364

Historical Search

LEAP Legal
An Approved LPI *NSW*
Information Broker

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

SEARCH DATE
12/8/2009 2:20PM

FOLIO: 3/596770

First Title(s): SEE PRIOR TITLE(S)
Prior Title(s): VOL 14500 FOL 199

Recorded	Number	Type of Instrument	C.T. Issue
28/3/1988		TITLE AUTOMATION PROJECT	LOT RECORDED FOLIO NOT CREATED
9/9/1988		CONVERTED TO COMPUTER FOLIO	FOLIO CREATED CT NOT ISSUED
17/3/1992	DP645792	DEPOSITED PLAN	
3/12/1992	E941159	CHANGE OF NAME	EDITION 1
17/12/1992	E967835	GRANT OF EASEMENT	EDITION 2
23/12/1992		AMENDMENT: CT DELIVEREE	
19/5/1994		AMENDMENT: LOCAL GOVT AREA	
2/7/2007	AD223444	APPLICATION	
2/7/2007	AD223445	TRANSFER	EDITION 3

*** END OF SEARCH ***

EIS - Liverpool ALSP PRINTED ON 12/8/2009

Form: 01T
Release: 3.2
www.lands.nsw.gov.au

(1)

TRANSFER

New South Wales
Real Property Act 1900

AD223445N

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

STAMP DUTY Office of State Revenue use only

NEW SOUTH WALES DUTY
26-06-2007 0004365470-012
SECTION OTHR LEGN-ORIGINAL
NO DUTY PAYABLE

(A) **FOLIO OF THE REGISTER** 3/596770

(B) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and LLPN if any	CODES
411B	LLPN 13283V Reference: JOSH LIVERPOOL **TRAVERS & CO** Suite 502, 5th Floor 66 King St., Sydney 2000 DX 590 SYDNEY Telephone: 9262 5811	T TW (Sheriff)

(C) **TRANSFEROR** Sydney South West Area Health Service

(D) **CONSIDERATION** The transferor acknowledges receipt of the consideration of $ 1.00 and as regards

(E) **ESTATE** the above folio of the Register transfers to the transfers an estate in fee simple

(F) **SHARE TRANSFERRED** _____

(G) Encumbrances (if applicable): _____

(H) **TRANSFEREE** Health Administation Corporation
ABN 45 100 538 161

(I) **TENANCY:**

DATE _____

(J) I certify that the person(s) signing opposite, with whom I am personally acquainted or as to whose identity I am otherwise satisfied, signed this instrument in my presence.

Signature of witness: D Flood

Name of witness: D Flood
Address of witness: 735 Menai Rd
BANGOR

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer:

Authorised officer's name: Michael Wallace
Authority of officer: Chief Executive
Signing on behalf of: Sydney South West AHS

I certify that the person(s) signing opposite, with whom I am personally acquainted or as to whose identity I am otherwise satisfied, signed this instrument in my presence.

Signature of witness: Ian Hayes

Name of witness: ABA IAN HAYES
Address of witness: 48A KINGSLANGLEY RD
GREENWICH 2065

Certified correct for the purposes of the Real Property Act 1900 by the authorised officer named below.

Signature of authorised officer: Patsy Cho

Authorised officer's name: Patsy Cho
Authority of officer: Ass. Director Assets
Signing on behalf of: Health Admin. Corporati

PLAN FORM 2

Plan Drawing only to appear in this space

Signatures and seals only.

* OFFICE USE ONLY

D.P. 596770

Registered: 28-8-1978

C.A.:

Title System: TORRENS

Purpose: RESUMPTION

Ref. Map: TOWN OF LIVERPOOL

Last Plan: —

PLAN SHOWING LAND TO BE ACQUIRED FOR P.T.C. OF N.S.W. PURPOSES FROM CROWN GRANT VOL.8176 FOL.22

Reduction Ratio 1: 2000
Lengths are in metres.

Mun/Shire: City LIVERPOOL

Locality: LIVERPOOL

Parish: ST. LUKE

County: CUMBERLAND

This is sheet 1 of my plan in ... shoots.
(Delete if inapplicable)

I, KEVIN PATRICK TOWNSEND
of WAYS & WORKS BRANCH PTC. OF N.S.W.
a surveyor registered under the Surveyors Act, 1929, as amended, hereby certify that the survey represented in this plan *
is accurate and has been made *(1) by me (2) under my immediate supervision in accordance with the Survey Practice Regulations, 1933, and was completed on 1
16TH MARCH 1978

Signature: K.P. Townsend

Surveyor registered under Surveyors Act, 1929, as amended.
Datum Line of Azimuth: A-B
*Strike out either (1) or (2). (Insert date of survey.

Panel for use only for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements or restrictions as to user.

* EXCEPT AS REGARDS LOTS 2 & 3.

NOTE: IT IS INTENDED TO ACQUIRE LOT 1.

* IRREG. WIRE FENCE

LOT 1. 2371 m²

LAND REVOKED BY GAZ. No. 15 OF 7-2-1964

D.P. 596770

D.P. 581947

SEC. 30

4789 m²

ST.

FORBES (ALIGD 355°12'8 - 3'66) ST.

CAMPBELL ST L.I. 2169

FORMER SITE OF CAMPBELL ST. CLOSED BY GAZ. NO. 36 2-8-46

CAMPBELL ST. CLOSED BY GAZ. 5-11-26

RM'D&B W on FACE WALL FD.

RM'D&B W on KERB FD.

PEG AT INT. TO RM'D&B W

CAVITY BRICK BUILDING UNDER CONSTRUCTION

2 14·42 ha DEDUCED

GOULBURN

INCINERATOR & FOUR CAR CARPORT ON CONC. SLAB.

CENTRE G.I. POST

TO SYDNEY

LAND

RAILWAY

FROM LIVERPOOL

RM WING OF CASUALTY WARD BUILDING

ELIZABETH ST. L.I. 2163

MAIN FACE OF WALL

SPIKE GONE

RAGLD GONE PEG FD.

STEEL POST

GATE

H.W.M.

WATER

HIGH

MARK

RIVER

GEORGES

COLLEGE ST.

FORMER SITE OF MANNING ST. CLOSED BY GAZ. 5-11-26

RES. NO 68 FOR PUBLIC RECREATION

Ms 17585 Sy

D P 2 2 4 9 3 3

D.P. 555187

DH&W III TOP WALL FD.

NO.	BEARING	DISTANCE
1	87° 55' 50"	8·557
2	198° 38' 34"	47·044
3	202° 09' 13"	52·501
4	207° 29' 12"	76·318
5	211° 23' 27"	107·585
6	239° 50' 56"	3·954
7	201° 22' 06"	8·719
8	252° 38' 39"	16·491
9	35° 18' 07"	26·808
10	77° 17' 51"	82·013
11	28° 30' 30"	82·299
12	24° 39' 52"	11·478
13	19° 19' 20"	80·707

ALTERATIONS AND ADDITIONS MADE THIS 27th DAY OF AUGUST 1978.

Council Clerk's Certificate

I hereby certify that –

(a) the requirements of the Local Government Act, 1919, (other than the requirements for the registration of plans), and

*(b) the requirements of section 348 of the Metropolitan Water, Sewerage and Drainage Act, 1924, as amended, Hunter District Water, Sewerage, and Drainage Act, 1938, as amended

have been complied with by the applicant in relation to the proposed ...
(Insert "new road", "subdivision" or "consolidated lot") set out herein

Subdivision No. ...

Date ...

(Signature) ...
Council Clerk

*This part of certificate to be deleted where the application is only for a consolidated lot or the opening of a new road or where the land to be subdivided is wholly outside the areas of operations of the Metropolitan Water Sewerage and Drainage Board and the Hunter District Water Board.
†Delete if inapplicable.

M.P.D

Table of mm

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

I, Bruce Richard Davies, Registrar General for New South Wales, certify that this negative is a photograph made as a permanent record of a document in my custody this 30th day of August, 1978

FILE NO. 13187
SURVEYOR'S REFERENCE 197-214

D.P. 596770

NEW SOUTH WALES

CERTIFICATE OF TITLE

REAL PROPERTY ACT, 1900

Vol. 14500 Fol. 199

Prior Title (Crown Grant)
Vol.8176 Fol.22

EDITION ISSUED

13 8 1981

I certify that the person described in the First Schedule is the registered proprietor of the undermentioned estate in the land within described subject nevertheless to such exceptions encumbrances and interests as are shown in the Second Schedule.

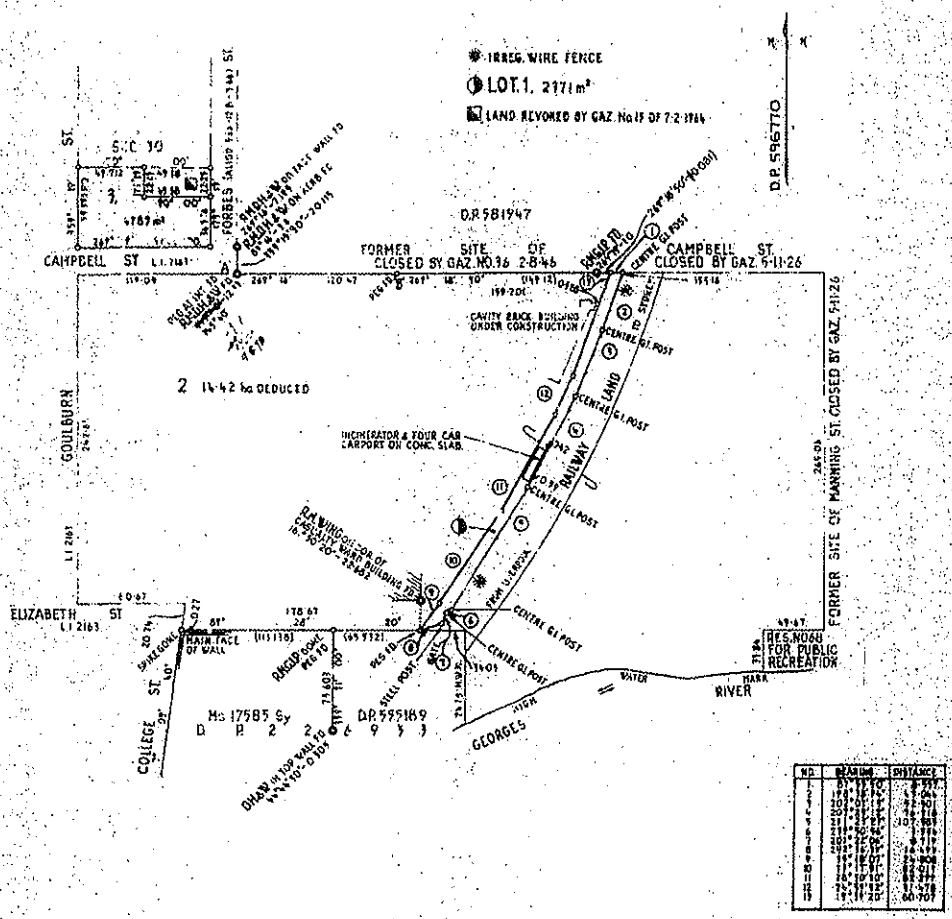
CANCELLED

Registrar General.

SEE AUTO FOLIO

PLAN SHOWING LOCATION OF LAND

LENGTHS ARE IN METRES



ESTATE AND LAND REFERRED TO

Estate in Fee Simple in Lot 3 in Deposited Plan 596770 at Liverpool in the City of Liverpool Parish of St.Luke and County of Cumberland. EXCEPTING THEREOUT the minerals reserved by the Crown Grant.

FIRST SCHEDULE

THE LIVERPOOL HOSPITAL.

SECOND SCHEDULE

GRM 1. Reservations and conditions, if any, contained in the Crown Grant above referred to.

FIRST SCHEDULE (continued)

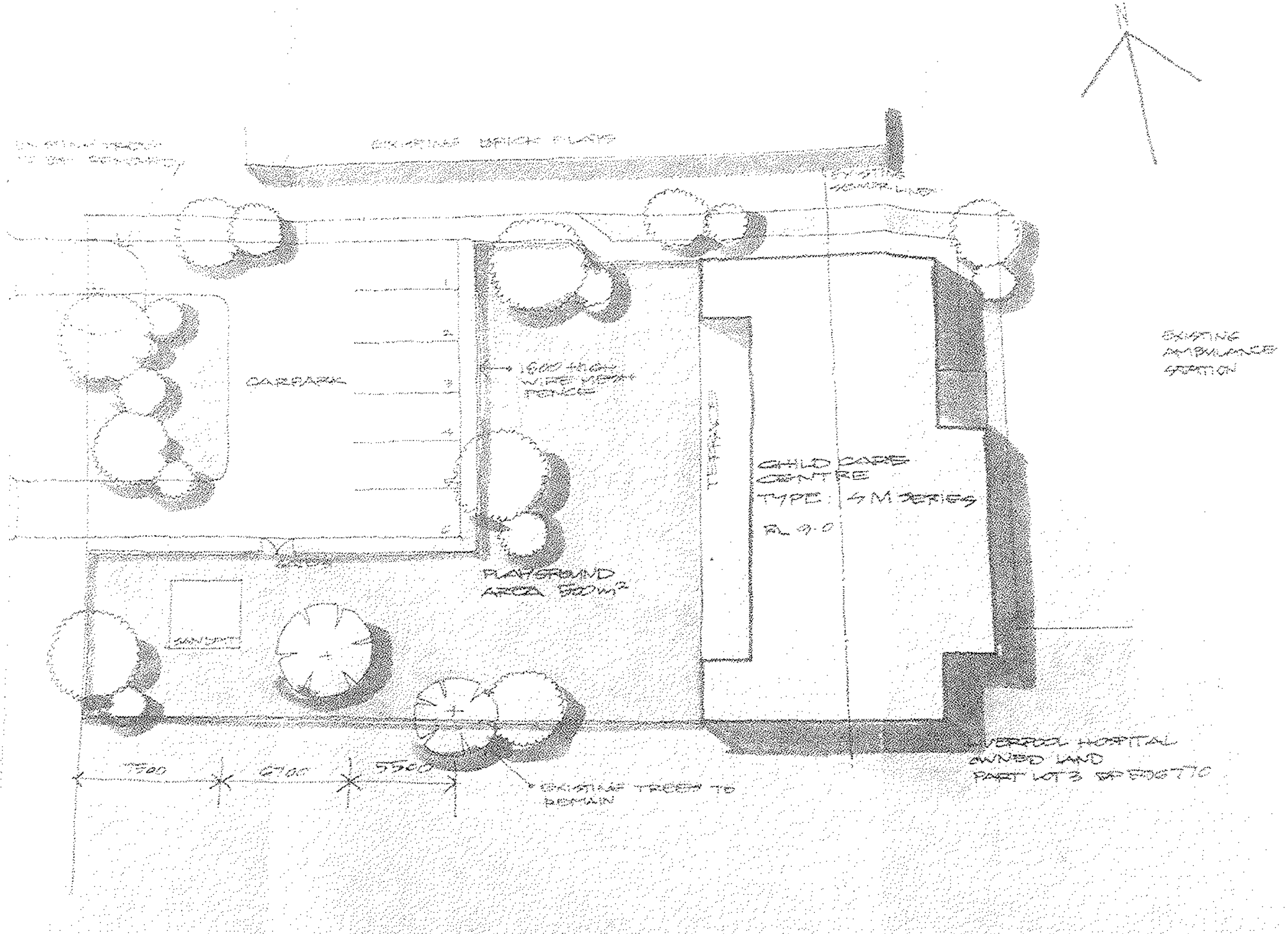
REGISTERED PROPRIETOR	Registrar General
CANCELLED SEE AUTO FOLIO	

SECOND SCHEDULE (continued)

PARTICULARS	Registrar General	CANCELLATION

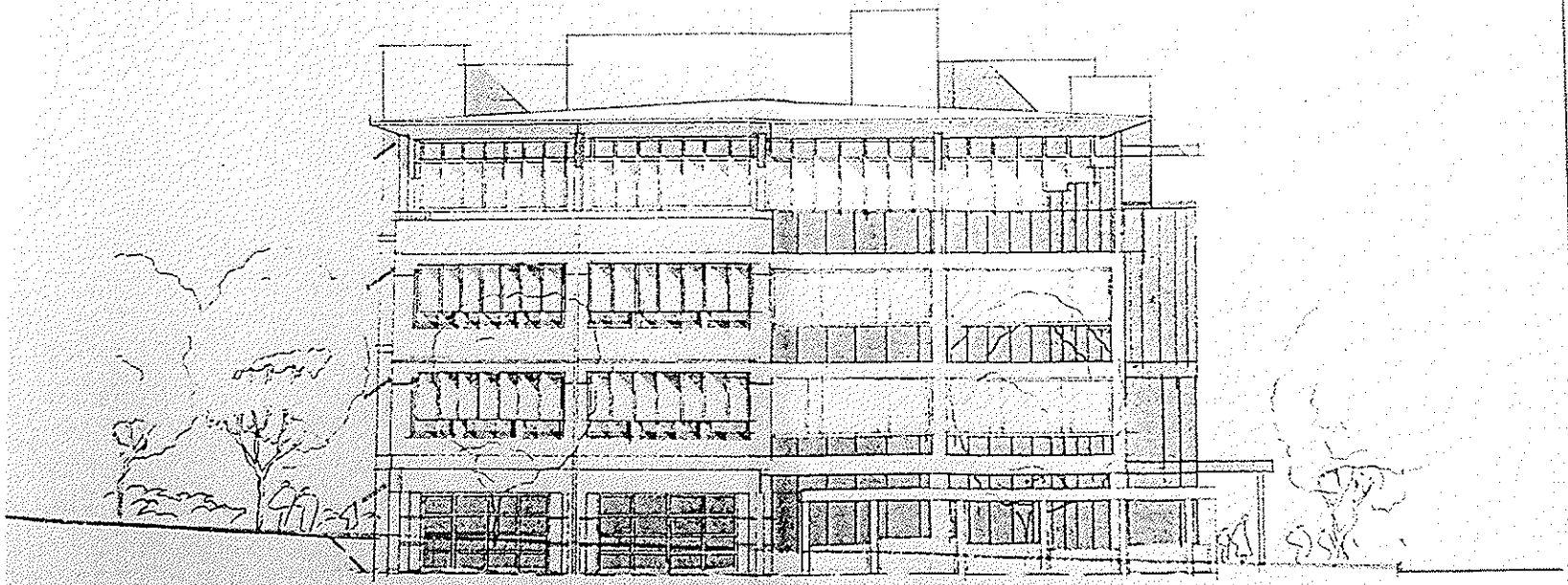
NOTATIONS AND UNREGISTERED DEALINGS

NOTE: ENTRIES RULED THROUGH AND AUTHENTICATED BY THE SEAL OF THE REGISTRAR GENERAL ARE CANCELLED



PROPOSED CHILD CARE CENTRE
LIVERPOOL
HOUSING COMMISSION OF NEW SOUTH WALES

Development approved 2/3/1984



Development approved 17/12/1990

STRUCTURAL ENGINEERS
SOUTH WESTERN SYDNEY AREA HEALTH SERVICE

PROJECT MANAGER
CAPPORRS MANAGEMENT PTY LTD

ARCHITECTS
THE RICE DAUBNEY GROUP

THE LIVERPOOL HOSPITAL
HEALTH SERVICES BUILDING

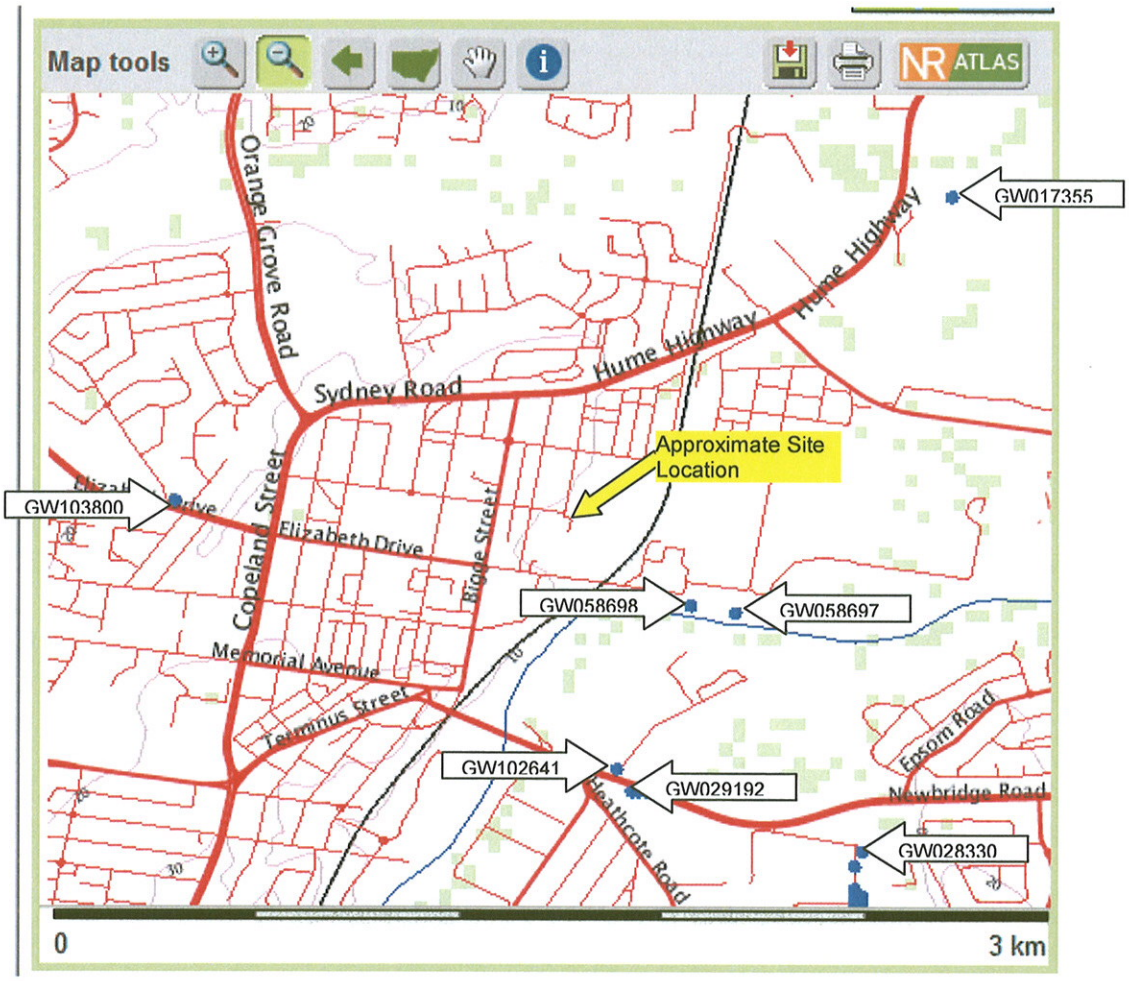
WEST ELEVATION

SCALE
1:200

DATE
21 DEC 1989

APPENDIX D

Groundwater Bore Search Summary – E23302K Liverpool



Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW017355

Works Details (top)

GROUNDWATER NUMBER	GW017355
LIC-NUM	10BL008340
AUTHORISED-PURPOSES	IRRIGATION
INTENDED-PURPOSES	IRRIGATION
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	
FINAL-DEPTH (metres)	9.40
DRILLED-DEPTH (metres)	9.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	603 - SYDNEY BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9030-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6246281.00
EASTING	309981.00
LATITUDE	33 54' 24"
LONGITUDE	150 56' 41"
GS-MAP	0056D4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	253

Licensed (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	252

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter; ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	0.00	101			Seated on Bottom
1	1	Casing	(Unknown)	0.00	0.00	203			Suspended in Clamps
1	1	Opening	Screen		1.20	0		1	SL: 0mm; A: 0mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.00	8.00	3.00	Unconsolidated	3.30					(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	4.26	4.26	Clay Yellow		
4.26	5.02	0.76	Clay Sandy		
5.02	6.09	1.07	Sand Yellow Wet		
6.09	8.07	1.98	Sand Yellow Water Supply		
8.07	8.22	0.15	Clay Sandy		
8.22	9.44	1.22	Sand Coarse		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW028330

Works Details (top)

GROUNDWATER NUMBER	GW028330
LIC-NUM	10BL019162
AUTHORISED-PURPOSES	WASTE DISPOSAL
INTENDED-PURPOSES	WASTE DISPOSAL
WORK-TYPE	Well
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1966-01-01
FINAL-DEPTH (metres)	6.40
DRILLED-DEPTH (metres)	6.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9030-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6243564.00
EASTING	309728.00
LATITUDE	33 55' 52"
LONGITUDE	150 56' 29"
GS-MAP	0056D4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	HOLSWORTHY
PORTION-LOT-DP	L2 (56)

Licensed (top)

COUNTY	CUMBERLAND
PARISH	HOLSWORTHY
PORTION-LOT-DP	NOT AVAILABLE

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Backfill	Backfill	0.00	6.40	609			
1	1	Casing	Asbestos Cement	0.00	6.40	609			(Unknown)

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
5.40	5.40	0.00	Unconsolidated	1.80					(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	5.48	5.48	Driller		
5.48	6.40	0.92	Sand Nominal Water Supply		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW103800

Works Details (top)

GROUNDWATER NUMBER	GW103800
LIC-NUM	10BL156592
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Auger
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1992-03-11
FINAL-DEPTH (metres)	3.00
DRILLED-DEPTH (metres)	3.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	MOBIL LIVERPOOL
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6244964.00
EASTING	307325.00
LATITUDE	33 55' 5"
LONGITUDE	150 54' 57"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	10//25032

Licensed (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	10 25032

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	3.00	100			Auger
1	1	Casing	PVC Class 18	0.00	0.00	50			

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.20	0.20	CONCRETE		
0.20	1.00	0.80	FILL,SAND,DARK GREY		
1.00	3.00	2.00	CLAY,GREY,BROWN,SEMIPLASTIC		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW102641

Works Details (top)

GROUNDWATER NUMBER	GW102641
LIC-NUM	10BL158829
AUTHORISED-PURPOSES	INDUSTRIAL
INTENDED-PURPOSES	INDUSTRIAL
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	1998-01-01
FINAL-DEPTH (metres)	16.50
DRILLED-DEPTH (metres)	16.70
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	SALES HAND CARWASH
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	420.00
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6243885.00
EASTING	308873.00
LATITUDE	33 55' 41"
LONGITUDE	150 55' 56"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	HOLSWORTHY
PORTION-LOT-DP	45 867545

Licensed (top)

COUNTY	CUMBERLAND
PARISH	HOLSWORTHY
PORTION-LOT-DP	45 867545

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter; ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	16.70	225			Rotary Air/Mud
1	1	Casing	PVC Class 9	-0.50	13.50	140			Screwed; Seated on Bottom
1	1	Opening	Screen	13.50	16.50	140			Steel; A: 1mm; Screwed
1		Annulus	Waterworn/Rounded	0.00	16.70				Graded; GS: 1.2-2.6mm; Q: .3m³

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
14.20	16.10	1.90		5.13		0.20			420.00

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	2.00	2.00	BROWN LT. CLAY		
2.00	3.40	1.40	CLAY RED AND BROWN		
3.40	10.50	7.10	SILT LT. BROWN AND FINE SAND		
10.50	14.20	3.70	SILT CLAYING BROWN YELLOW		

14.20	16.10	1.90	GRAVELS
16.10	16.70	0.60	SHALE

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW029192

Works Details (top)

GROUNDWATER NUMBER	GW029192
LIC-NUM	10BL022597
AUTHORISED-PURPOSES	WASTE DISPOSAL
INTENDED-PURPOSES	WASTE DISPOSAL
WORK-TYPE	Well
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1968-11-01
FINAL-DEPTH (metres)	2.40
DRILLED-DEPTH (metres)	2.40
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9030-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6243794.00
EASTING	308927.00
LATITUDE	33 55' 44"
LONGITUDE	150 55' 58"
GS-MAP	0056D4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	HOLSWORTHY
PORTION-LOT-DP	56

Licensed (top)

COUNTY	CUMBERLAND
PARISH	HOLSWORTHY
PORTION-LOT-DP	56

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Concrete Cylnder	0.00	2.40	914			(Unknown)

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	2.43	2.43	Loam Sandy		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW058698

Works Details (top)

GROUNDWATER NUMBER	GW058698
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	G/WATER XPLORE
WORK-TYPE	Bore
WORK-STATUS	Test Hole
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1984-07-01
FINAL-DEPTH (metres)	19.50
DRILLED-DEPTH (metres)	19.50
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9030-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6244568.00
EASTING	309117.00
LATITUDE	33 55' 19"
LONGITUDE	150 56' 6"
GS-MAP	0056D4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	260

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	11.50	11.50	Clay Black Grey		
11.50	12.00	0.50	Clay Coarse Sandy Gravel		
12.00	19.00	7.00	Clay Grey Sandy		
19.00	19.50	0.50	Shale		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Wednesday, August 12, 2009

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW058697

Works Details (top)

GROUNDWATER NUMBER	GW058697
LIC-NUM	10BL130184
AUTHORISED-PURPOSES	TEST BORE
INTENDED-PURPOSES	G/WATER XPLORE
WORK-TYPE	Bore
WORK-STATUS	Test Hole
CONSTRUCTION-METHOD	Cable Tool
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1984-07-01
FINAL-DEPTH (metres)	19.20
DRILLED-DEPTH (metres)	19.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	213 - SYDNEY COAST - GEORGES RIVER
AREA-DISTRICT	
CMA-MAP	9030-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6244541.00
EASTING	309271.00
LATITUDE	33 55' 20"
LONGITUDE	150 56' 12"
GS-MAP	0056D4

AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	260

Licensed (top)

COUNTY	CUMBERLAND
PARISH	ST LUKE
PORTION-LOT-DP	260

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter; ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	Threaded Steel	0.00	9.00	150			(Unknown)
1	1	Opening	Screen	0.00	0.00	150		1	Stainless Steel; SL: 0mm; A: .9mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
8.50	14.00	5.50	Unconsolidated	8.50		0.13			(Unknown)

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	5.00	5.00	Clay Stiff		
5.00	6.00	1.00	Sand Soft Silty		
6.00	8.00	2.00	Sand Coarse Silty		
6.00	8.00	2.00	Wood Charcoal		
8.00	14.00	6.00	Sand Grey Silty Coarse Water Supply		
14.00	16.00	2.00	Clay Grey Silty		
14.00	16.00	2.00	Some Coarse Sand		
16.00	18.30	2.30	Clay Grey Silty		
18.30	19.20	0.90	Slate Clayey		

APPENDIX E

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 Environmental Investigation Services. 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

(i) Prepare a test pit/borehole log.

(ii) 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.

(iii) Ensure all sampling equipment has been decontaminated prior to use.

(iv) Remove any surface debris from the immediate area of the sampling location.

(v) Collect samples and place in glass jar with a Teflon sea. This should be undertaken as quickly as possibly to prevent the loss of volatiles. If possible, fill the glass jars completely.

(vi) Collect samples for asbestos analysis (if required) and place in a zip-lock plastic bag.

(vii) 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).

(viii) 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 glass jars. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.

(ix) Record the lithology of the sample and sample depth on the borehole/test pit log in accordance with AS1726-1993.

(x) 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 and AS 4482.2-1999.

(xi) 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.

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

DECONTAMINATION PROCEDURES FOR SOIL SAMPLING EQUIPMENT

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

(ii) The following equipment and materials are required for the decontamination procedure:

- Phosphate free detergent (Decon)
- Tap water
- Two buckets
- Stiff brushes

- Plastic sheets

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

(iv) Fill both buckets with clean tap water and add phosphate free detergent to one bucket.

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

(vi) Rinse sampling equipment in the bucket containing tap water.

(vii) 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 AS2306.1 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 piezometers.

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

(ii) Piezometers 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.

(iii) Take the groundwater level from the collar of the piezometer using an electronic dipmeter. The collar level should be taken (if required) during the site visit using a dumpy level and staff.

(iv) Purging and sampling of piezometers 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 1ml nitric acid, 75mL glass vials with 1mL hydrochloric acid, 1L 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.

(v) 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.

(vi) 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.

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

(viii) 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.

(ix) 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%.

(x) All measurements are recorded on specific data sheets.

(xi) 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.

(xii) All samples are preserved in accordance with water sampling requirements detailed in the NEPC Guidelines (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.

(xiii) 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 PROCEDURE FOR GROUNDWATER SAMPLING EQUIPMENT

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

(ii) The following equipment and materials are required for the decontamination procedure:

- Phosphate free detergent.
- Tap water.
- Distilled water.
- Two buckets.
- Plastic sheets.

(iii) Fill one bucket with clean tap water and phosphate free detergent, and one bucket with distilled water.
(iv) Flush tap 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.
(v) Flush pump head with distilled water.
(vi) Change water and detergent solution after each sampling location.
(vii) Rinse sampling equipment in the bucket containing distilled water.
(viii) Place cleaned equipment on clean plastic sheets.

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 current US EPA SW-846 (1994) methods and those described in Environmental Sampling and Analysis, A Practical Guide, (H. Keith 1991).

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).

Accuracy

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.

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.

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;

$$\frac{(\text{spiked sample result} - \text{sample result})}{\text{concentration of spike added}} \times 100$$

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:

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

where D1 is the sample concentration and D2 is the duplicate sample concentration.