Statement of Environmental Effects,
Proposed Wollongong Hospital
Carpark

APPENDIX E

LAND CONTAMINATION REPORT (EIS)

Cardno
Shaping the Future

ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

NSW HEALTH INFRASTRUCTURE

ON

ENVIRONMENTAL SITE ASSESSMENT

FOR

PROPOSED CAR PARK DEVELOPMENT

AT

WOLLONGONG HOSPITAL, 3-11 DUDLEY STREET, WOLLONGONG, NSW

DECEMBER 2012 **REF: E26129KPrpt**

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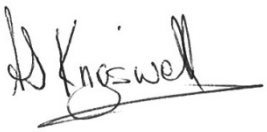

Adrian Kingswell
Principal

EXECUTIVE SUMMARY

Introduction

NSW Health Infrastructure ('the client') commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake an Environmental Site Assessment (ESA) for the proposed car park development at Wollongong Hospital, 3-11 Dudley Street, Wollongong, NSW ('the site').

The site is identified as part of Lot 101 in DP1043216. The site location is shown on Figure 1 and the ESA was confined to the proposed development area as shown on Figure 2.

The ESA and preparation of this report has been undertaken with reference to *State Environmental Planning Policy No.55 – Remediation of Land* (1998[1]) and the *NSW EPA Guidelines for Consultants Reporting on Contaminated Sites* (1997[2]).

Proposed Development Details

Based on the details provided, we understand that the proposed development includes demolition of several existing buildings and construction of a multi-level car park over the majority of the site. Significant bulk excavation works will be required to maximum depths ranging from approximately 10m (along the Dudley Street boundary) to 13m (along the New Dapto Street boundary), to achieve the required levels.

Objectives and Scope of Work

The objectives of the ESA are to: assess the potential risk for soil and groundwater contamination to be present at the site; make a preliminary assessment of the soil contamination conditions at the site; assess the potential for human health or environmental risks posed by contaminants at the site; and provide a waste classification for the off-site disposal of soil/bedrock to be excavated for the development.

The scope of work undertaken for the ESA included:

- Preparation of site specific Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs);
- A limited site history assessment to identify historical land uses that may have resulted in potential site contamination;
- A site inspection to identify potential contamination sources and areas of environmental concern (AEC);
- Preparation of a Conceptual Site Model (CSM) identifying the Primary Contaminants of Concern (PCC) and potential sensitive receptors;
- Design and implementation of a field sampling and laboratory analysis program;
- Interpretation of the analytical results based on the Site Assessment Criteria (SAC) adopted for the ESA; and
- Preparation of a report presenting the results of the ESA.

CSM and Assessment Findings

The site history has indicated that: there were no records for the site on the EPA registers; there is a registered depot for the storage of small quantities of paints and other products in the maintenance building; and the site has most likely been used for residential purposes prior to its current use as part of Wollongong Hospital.

Based on a review of the site history information and the site inspection, the following AEC have been identified:

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

[2] *Guidelines for Consultants Reporting on Contaminated Sites,* NSW EPA, 1997 (Reporting Guidelines 1997)

- Potentially contaminated, imported fill soils may have been used to level sections of the site prior to construction of the existing buildings and car park. For the purpose of the CSM, this AEC extends over the whole site area;
- Potential asbestos containing materials may have been used in the construction of the existing buildings. Furthermore, there is a potential for asbestos to be present in the fill soils and/or as a result of improper demolition/construction of former site buildings. For the purpose of the CSM, this AEC extends over the whole site area; and
- Use of the site as a car park may have resulted in some localised oil/fuel leaks from vehicles that may have permeated cracks and potholes in the pavement. This AEC is limited to the paved car park areas.

The primary PCC associated with the above AEC include:
- heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- petroleum hydrocarbons (TPH and BTEX – Benzene, Toluene, Ethyl Benzene and Xylenes);
- organochlorine and organophosphorus pesticides (OCPs and OPPs);
- polycyclic aromatic hydrocarbons (PAHs);
- polychlorinated biphenyls (PCBs); and
- asbestos.

The investigation included soil sampling from eight boreholes and the analysis of fill and natural soil/bedrock samples for the PCC. Elevated concentrations of contaminants, above the SAC, were not encountered in the soil samples analysed for the ESA.

The laboratory analysis has indicated that a waste classification of 'General Solid Waste (non-putrescible)' applies to the fill soils, and a classification of 'virgin excavated natural material (VENM)' applies to the natural soil/bedrock. Additional waste classification testing is recommended for any fill soils to be excavated from beneath the existing buildings.

Discussion and Conclusions

Based on the findings of the historical assessment and the results of the laboratory analysis, EIS are of the opinion that the potential for significant widespread soil contamination at the site is relatively low.

An assessment of the groundwater contamination conditions was outside the scope of this ESA. However, based on the historical information reviewed for this assessment, and the results of the soil analysis, EIS are of the opinion that the potential for significant groundwater contamination issues to be encountered at the site is relatively low.

As the contaminant concentrations in the soil samples analysed were less than the SAC, EIS are of the opinion that the risk posed by contamination to the receptors (identified in **Section 5.3** of this report) is low.

The potential risks associated with exposure to asbestos may increase as a result of improper demolition of the existing structures and/or during excavation of the fill soils (i.e. in the event of an unexpected asbestos find). Recommendations have been included below to reduce these risks.

Based on the scope of work undertaken for this ESA, EIS consider the site to be suitable for the proposed car park development provided that:
- A hazardous building materials survey is undertaken prior to the demolition of any buildings on-site;
- The buildings are demolished in accordance with the hazardous building materials report(s) and suitable clearance documentation is provided on completion of the demolition works; and

- Any unexpected conditions encountered during demolition/excavation works (i.e. potential contamination issues) are immediately inspected by a qualified environmental consultant. If required, a suitable strategy should be developed and implemented to address the issue identified.

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

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1 INTRODUCTION

NSW Health Infrastructure ('the client') commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake an Environmental Site Assessment (ESA) for the proposed car park development at Wollongong Hospital, 3-11 Dudley Street, Wollongong, NSW ('the site').

The site is identified as part of Lot 101 in DP1043216 which is collectively referred to as 3-11 Dudley Street. This lot also comprises several properties that have been referred to by their former street addresses within this report (these were applicable prior to consolidation of the existing lot).

The site location is shown on Figure 1 and the ESA was confined to the proposed development area as shown on Figure 2. Information regarding the former addresses for the individual buildings located at the site (as noted above) is also shown on Figure 2.

The ESA was undertaken generally in accordance with an EIS proposal (Ref: EP6647KP2) of 25 October and written acceptance from the client.

The ESA and preparation of this report has been undertaken with reference to *State Environmental Planning Policy No.55 – Remediation of Land* (1998[3]) and the *NSW EPA Guidelines for Consultants Reporting on Contaminated Sites* (1997[4]).

A geotechnical investigation was undertaken in conjunction with the ESA by JK Geotechnics (a division of J&K) and the results are presented in a separate report under project reference 26129S.

1.1 Proposed Development Details

Based on the details provided, we understand that the proposed development Includes:

- Demolition of the buildings referred to as 104, 106 and 108 New Dapto Road;
- Possible demolition of the buildings referred to as 13, 15 and 17 Dudley Street;
- Demolition of the existing maintenance workshop and relocation of this facility to the existing car park located to the north of the site;
- Retention of the existing buildings at the corner of New Dapto Road and Urunga Parade (referred to as 2 and 4 Urunga Parade, or 4 Urunga Parade and 110 New Dapto Road);

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

[4] *Guidelines for Consultants Reporting on Contaminated Sites,* NSW EPA, 1997 (Reporting Guidelines 1997)

- Construction of a multi-level car park over the majority of the site. Significant bulk excavation works will be required to maximum depths ranging from approximately 10m (along the Dudley Street boundary) to 13m (along the New Dapto Street boundary), to achieve the required levels.

Reference should be made to the attached Figure 2 which shows the existing buildings, site features and indicative footprint for the proposed car park.

1.2 Objectives

The objectives of the ESA are to:

- Assess the potential risk for soil and groundwater contamination to be present at the site;
- Make a preliminary assessment of the soil contamination conditions at the site;
- Assess the potential for human health or environmental risks posed by contaminants at the site; and
- Provide a waste classification for the off-site disposal of soil/bedrock to be excavated for the development.

1.3 Scope of Work

The scope of work undertaken for the ESA included:

- Preparation of site specific Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs);
- A limited site history assessment to identify historical land uses that may have resulted in potential site contamination;
- A site inspection to identify potential contamination sources and areas of environmental concern (AEC);
- Preparation of a Conceptual Site Model (CSM) identifying the Primary Contaminants of Concern (PCC) and potential sensitive receptors;
- Design and implementation of a field sampling and laboratory analysis program;
- Interpretation of the analytical results based on the Site Assessment Criteria (SAC) adopted for the ESA; and
- Preparation of a report presenting the results of the ESA.

The scope of work was generally undertaken with reference to the regulations/guidelines outlined in the following table. Individual guidelines applicable for this ESA are also referenced within the text of the report.

Table 1-1: Guidelines

Guidelines/Regulations/Documents
Contaminated Land Management Amendment Act (2008[5])
SEPP55
Reporting Guidelines 1997
Guidelines on the Duty to Report Contamination[6]
Guidelines for the NSW Site Auditor Scheme, 2nd Edition (2006[7])
National Environmental Protection (Assessment of Site Contamination) Measure (1999[8]).
NSW EPA Contaminated Sites Sampling Design Guidelines (1995[9])
NSW DECCW Waste Classification Guidelines - Part 1: Classifying Waste (2009[10])
NSW EPA Contaminated Sites: Guidelines for Assessing Service Station Sites (1994[11])
Working with Asbestos Guide (2008[12])

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

[6] *Guidelines on the Duty to Report Contamination*, NSW EPA, Draft 2011 (Duty to Report Contamination 2011)

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

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

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

[10] *Waste Classification Guidelines, Part 1: Classifying Waste,* NSW DECCW, 2009 (Waste Classification Guidelines 2009)

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

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

2 DATA QUALITY OBJECTIVES

2.1 DQOs for the Assessment

The DQO process includes a clear statement of the objectives of the study and a methodology for collecting enough data of sufficient quality to support the decisions of the study. The DQOs provide a systematic approach for undertaking the assessment and outlines the criteria against which the data can be assessed.

A methodology for establishing the DQOs is presented in the US EPA document *Data Quality Objectives Process for Hazardous Waste Site Investigations* (2000[13]). This methodology has been adopted by the NEPC in NEPM 1999, AS4482.1-2005[14] and the Site Auditor Guidelines 2006. The main steps involved in preparing the DQOs include:

1. State the problem;
2. Identify the decision;
3. Identify inputs into the decision;
4. Study boundaries;
5. Develop a decision rule;
6. Specify limits on decision errors; and
7. Optimise the design for obtaining data.

The first six steps provide qualitative and quantitative statements which are used in the final step to develop a data collection plan. The data is then assessed against adopted performance criteria.

2.1.1 State the Problem

Present and historical land uses may have resulted in soil and groundwater contamination at the site. The presence of contamination may pose a risk to human health and the environment. An ESA is required to assess these risks and to consider the suitability of the site for the proposed development

2.1.2 Identify the Decision

The assessment aims to address the following decisions:

- Does the site history indicate previous land uses that may have resulted in contamination;

[13] *Data Quality Objectives Process for Hazardous Waste Site Investigations,* US EPA, *2000* (US EPA 2000)
[14] *Guide to the Investigation and Sampling of sites with Potentially Contaminated Soil,* Standards Australia, 2005 (AS 2005)

- Does the site inspection indicate the presence of potential on-site and/or off-site contamination sources;
- Are the contaminant concentrations above the SAC;
- If contamination is identified, has the contamination source and extent been established;
- Is there potential for off-site migration of contamination;
- Does the contamination pose a potential human-health, ecological and/or environmental risk;
- Are there any potential receptors which may be impacted by the contamination; and
- Based on the assessment findings, are any further works considered necessary to better assess the site contamination conditions.

2.1.3 Inputs into the Decision

The following inputs will be used to address the decisions:

Table 2-1: Inputs into the Decision

Inputs	Details
Site Inspection & Physical Setting	Undertake a site inspection to identify potential on and off-site contamination sources. Assess the physical setting including a review of regional geology, topography, acid sulfate soil (ASS) potential and hydrogeology.
Site History Assessment	Review of site history information and other information as outlined in **Section 4**.
Conceptual Site Model	Prepare a CSM identifying the PCC and potential receptors.
Sampling	Undertake soil sampling as outlines in **Section 7**.
Laboratory Analysis	Soil and groundwater samples will be analysed for the PCC as outlined in **Section 5.1**.
Assessment of Analytical Data	The Data Quality Indicators (DQIs) that will be used to assess the analytical data are outlined in **Section 2.2**.
Assessment Criteria	Analytical results will be compared to the SAC outlined in **Section 6**.

2.1.4 Study Boundary

The assessment will be confined to the site boundaries as shown in Figure 2.

2.1.5 Develop a Decision Rule

The analytical results will be compared with the SAC as outlined in **Section 6**. Statistical analysis will be undertaken on the analytical results (if required) as outlined in the EPA Sampling Design Guidelines 1995. The following criteria will be adopted for the assessment:

- The 95% Upper Confidence Limit (UCL) value of the arithmetic mean concentration of each contaminant should be less than the SAC;
- The standard deviation (SD) of the results must be less than 50% of the SAC; and
- No single value exceeds 250% of the relevant SAC.

UCL calculations may not be required if all results are below the SAC. Further assessment or remediation will be required when the concentration of contaminants exceed the above criteria.

A review of the field and laboratory DQIs will be undertaken.

2.1.6 Specify Limits on Decision Errors

Decision errors are false positive (i.e. stating the site is free of contamination when it is not) or false negative (i.e. stating that the site is contaminated when it is not). The more significant error is the false positive which may result in potential risks to human health and the environment. To account for this, the ESA has assumed that elevated concentrations of contaminants are present in the samples unless demonstrated otherwise.

2.1.7 Optimise the Design for Obtaining Data

The Site Auditor Guidelines 2006 recommend evaluating the data set as a whole to determine any limitations within the data set. The overall data set will be optimised by reviewing the data as the project proceeds. When necessary, adjustments will be made to the sampling or analytical program.

2.2 DQIs for Analytical Data

The analytical data will be assessed against the following DQIs: precision, accuracy, representativeness, completeness and comparability. Definitions of the individual DQIs are presented in Appendix D. The table below outlines the steps that will be taken to address the DQIs:

Table 2-2: DQIs

Indicator	Methods
Completeness	Data and documentation completeness will be achieved by: • Preparation of sampling and analysis plan; • Preparation of chain of custody (COC) records; • Review the laboratory sample receipt information; • Use of a National Association of Testing Authorities (NATA) registered laboratory for all analysis; • Visual and PID screening of samples during the investigation; and • Laboratory analysis to target PCC.
Comparability	Data comparability will be achieved by: • Maintaining consistency in sampling techniques; • Use of appropriate preservation, storage and transport methods; and • Use of consistent analysis techniques and reporting standards by the laboratory.
Representativeness	Data representativeness will be achieved by: • Appropriate coverage of sample locations across accessible areas of the site; and • Representative coverage of analysis for PCC.
Precision	Precision will be achieved by: • Calculating the relative percentage difference (RPD) of duplicate samples; • The following acceptance criteria will be used to assess the RPD results: ➢ results > 10 times the practical quantitation limit (PQL), RPDs < 50% are acceptable; ➢ results between 5 and 10 times PQL, RPDs < 75% are acceptable; ➢ results > 5 times PQL, RPDs < 100% are acceptable; and • An explanation is provided if RPD results are outside the acceptance criteria. As a conservative measure, the higher value is adopted when the value exceeds the SAC.
Accuracy	Accuracy will be achieved by: • Use of trained and qualified field staff; • Appropriate industry standard sampling equipment and decontamination procedures; • Sampling and screening equipment will be factory calibrated on a regular basis. Calibration will be checked internally prior to use; • Sampling and equipment decontamination; • Collection and analysis of field Quality Assurance (QA) and Quality Control (QC) samples for PCC; • The field QA/QC analysis will include:

Indicator	Methods
	➢ One sample as an intra-laboratory duplicate; ➢ One trip blank sample per batch; and ➢ One trip spike sample per batch; • Acceptable concentrations in trip blanks and trip spikes samples. Non-compliance to be documented in the report; • Appropriate sample preservation, handing, holding time and COC procedure; • Review of the primary laboratory QA/QC data including: RPDs, surrogate recovery, repeat analysis, blanks, laboratory control samples (LCS) and matrix spikes; • The following acceptance criteria will be used to assess the primary laboratory QA/QC results. Non-compliance to be documented: ➢ RPDs: o results that are < 5 times the PQL, any RPD is acceptable; and o results > 5 times the PQL, RPDs between 0-50% are acceptable; ➢ LCS recovery and matrix spikes: o 70-130% recovery acceptable for metals and inorganics; o 60-140% recovery acceptable for organics; and o 10-140% recovery acceptable for VOCs; ➢ Surrogate spike recovery: o 60-140% recovery acceptable for general organics; and o 10-140% recovery acceptable for VOCs; ➢ Blanks: All less than PQL (ALTPQL); and • Reporting to industry standards.

3 SITE INFORMATION AND PHYSICAL SETTING

3.1 Site Identification

Table 3-1: Site Identification Information

Site Owner:	Health Administration Corporation
Site Address:	3-11 Dudley Street, Wollongong, NSW
Lot & Deposited Plan:	Part of Lot 101 in DP1043216
Current Land Use:	Various hospital facilities including a car park, consulting rooms and maintenance building
Proposed Land Use:	Car park
Local Government Authority:	Wollongong City Council
Current Zoning:	SP1 – Special Activities (LEP 2009)
Site Area (m^2):	8,500
RL (AHD in m) (approx.):	31-47
Geographical Location (MGA) (approx.):	N: 6188710 E: 305343
Site Location Plan:	Figure 1
Borehole Location Plan:	Figure 2

3.2 Site Location and Setting

The site is located on the east side of Dudley Street and towards the crest of a north facing hillside. The site extends towards the south and east to the Urunga Parade and New Dapto Road boundaries respectively.

The areas to the west of the site are generally occupied by medium density residential housing. The areas to the east and south of the site are generally utilised for health related services associated with Wollongong Hospital. A multi-storey car park is located to the north of the site.

3.3 Topography

The regional topography is characterised by undulating, low-lying hills. The main Wollongong Hospital building (which is to the east of the site) is located towards a hilltop and the site itself is located towards the hill crest and on the mid-slope. Overall, the site falls to the north and north-west at slopes varying between approximately 5-10º.

3.4 Site Inspection

A walkover inspection of the site and visual inspection of the immediate surrounds was undertaken on 14 November 2012. The inspection was limited to accessible areas of the site and did not include an internal inspection of all buildings.

At the time of the inspection, the site was occupied by a number of residential-type buildings/cottages, a paved car park and a two-storey workshop building.

The buildings in the south-west section of the site (formerly 13, 15 and 17 Dudley Street as shown on Figure 2) generally comprised single storey, brick and/or weatherboard cottages with tile roofs. A metal shed and brick garage were also located in this area. The specific use of each building was not obvious during the site visit, however, it is possible that the buildings were used for either residential purposes and/or facilities associated with the hospital (such as consultation rooms and offices etc).

There were small garden beds, grassed areas and mature trees around the buildings. Some minor cut and fill works had been undertaken to create the garden areas and floor levels for the buildings.

The buildings located at the corner of Urunga Parade and New Dapto Road (formerly 2 and 4 Urunga Parade, or 4 Urunga Parade and 110 New Dapto Road as shown on Figure 2) include brick and weatherboard structures with tile roofs. It is understood that these buildings are utilised for hospital related services. An asphaltic concrete (AC) driveway and car park was located to the north and west of the buildings. These areas were retained up to approximately 1-1.5m above the adjacent areas to the north and west. Relatively small trees and shrubs were located in garden beds and grassed areas around the buildings.

Three other brick or weatherboard cottages and a metal clad demountable building were located along the New Dapto Road frontage (formerly 104, 106 and 108 New Dapto Road, as shown on Figure 2). A small, retained car park was located to the west of the number 108 property and a grassed batter was located to the west of the number 106 property. The batter fell at approximately 40-45° towards the north-west.

An on-grade, AC paved car park extended north through the central sections of the site from Urunga Parade to the north site boundary. Some pavement cracks and potholes were observed throughout the car park areas.

A two storey maintenance building was located in the north-west section of the site (adjacent to Dudley Street). The building had been cut back into the site and a retaining wall (up to approximately 6m in height) was located to the south and east of the building. Small quantities of petroleum and paint products were stored in containers (above ground) in the workshop area (as shown on Figure 2). It was noted that this area was concrete paved and no obvious cracks were observed during a cursory inspection.

3.4.1 Interview with Site Personnel

A limited discussion with one of the maintenance managers confirmed that only relatively small quantities of petroleum (to service the mowers and other small machinery) and paint were stored at the site, within containers in the workshop. No underground storage tanks (USTs) were known to exist within the subject site.

3.5 Regional Geology

The regional geological map of Wollongong-Port Hacking (1985[15]) indicates the site to be underlain by Budgong Sandstone of the Shoalhaven group which typically consists of red, brown and grey lithic sandstone.

3.6 Acid Sulfate Soil (ASS) Risk Map

The risk maps prepared by the Department of Land and Soil Conservation indicate areas of high risk, low risk and no known occurrence of ASS. The ASS risk map for Wollongong (1997[16]) indicates that the site is located in an area of "no known occurrence" of ASS. The nearest ASS risk area is mapped as being located approximately 600m to the north-east of the site.

Based on the geology, site elevation and ASS risk map, the potential for ASS to be encountered at the site during the proposed development works is considered to be very low. On this basis, an ASS management plan is not required for the works.

3.7 Hydrogeology

A search of the groundwater bore summary records available on the NSW Office of Water[17] website was undertaken for the ESA. The search was limited to registered bores located within approximately 1km of the site. A copy of the records and a plan showing the approximate location of the bores is attached in Appendix C. A brief summary of relevant information pertaining to the ESA is presented in the following table:

[15] *1:100,000 Geological Map of Wollongong-Port Hacking (Series 9029-9129),* Department of Mineral Resources (1985)

[16] *1:25,000 Acid Sulfate Soil Risk Map (Series 9029S2, Ed 2),* Department of Land and Water Conservation (1997)

[17] http://www.waterinfo.nsw.gov.au/gw/, visited on 30 November 2012

Table 3-2: Summary of Groundwater Bores

Reference	Distance from site (m) (approx.)	Direction & Gradient from site	Final Depth (m)	Standing Water Level (SWL) (m)	Registered Purpose
GW048563	900	West-north-west	30.5	Unknown	Unknown
GW048564	900	West-north-west	30.5	Unknown	Unknown
GW108391	730	East-south-east	6.2	Unknown	Monitoring
GW108392	730	East-south-east	6.0	5.83	Monitoring
GW110516	1000	North-east	6.0	2.5	Monitoring
GW110517	1000	North-east	5.0	4.0	Monitoring
GW110518	1000	North-east	6.0	4.0	Monitoring

The stratigraphy of the site is expected to consist of residual clayey soils overlying relatively shallow bedrock. Based on these conditions and the results of the groundwater bore search, groundwater is not considered to be a significant resource for abstraction purposes in the immediate vicinity of the site.

3.8 Surface Water Flows

Surface water bodies were not identified in the immediate vicinity of the site. The closest surface water body is an un-named creek that extends through Wiseman and Beaton Parks, located approximately 570m to the north-north-west of the site. Due to the distance from the site, this creek is not considered to be a potential receptor.

4 SITE HISTORY ASSESSMENT

4.1 Aerial Photographs

Historical aerial photographs of the site and immediate surrounds were reviewed for the site history assessment. The majority of the photographs were obtained from the NSW Department of Lands. A summary of the relevant information is presented in the following table:

Table 4-1: Summary of Historical Aerial Photos

Year	Details
1948	The site was made up of a number of residential lots (approximately 12-13 in total). A residential-type building occupied each lot and several smaller buildings (possible sheds and/or garages) were located adjacent to, or to the rear of the residences. Trees were visible in the yards of most properties. Urunga Parade, New Dapto Road and Dudley Street (as they are currently known) were visible to the south, east and west of the site respectively. The area to the north of the site appeared to be vacant. Residential type developments were located further to the west and south of the site. Several larger buildings and associated access roads/driveways were located to the east of the site.
1951	The site generally appeared to be similar to the 1948 photograph. Additional buildings had been constructed in the area to the east of the site.
1961	The site and immediate surrounds generally appeared to be similar to the 1951 photograph.
1974	The site generally appeared to be similar to the 1961 photograph. An open-air car park had been constructed immediately to the north of the site.
1984	One of the properties along the Dudley Street frontage had been demolished (to the north of what is currently referred to as No. 13 Dudley Street). The remainder of the site and the immediate surrounds generally appeared to be similar to the 1974 photograph.
1994	A building had been constructed along the Dudley Street frontage. The central areas of the site had been reconfigured to create a car park. A number of the former sheds/garages had been demolished. The car park appeared to be paved. Construction works appeared to be underway to the north of the site as the car park was no longer visible.
2005	The new building that was observed along the Dudley Street frontage in the 1994

Year	Details
	photograph had been demolished and a relatively large building had been constructed in the west section of the site. This building appeared to be consistent with the existing (2012) maintenance building. The overall site layout generally appeared to be consistent with the existing (2012) layout. The area to the north was occupied by a car park that appeared similar to the existing (2012) multi-level car park immediately to the north of the site.

4.2 WorkCover Records

WorkCover records were reviewed for the site history assessment. Copies of the records are attached in Appendix C. The records indicate that there is a storage depot for small quantities of paint and ethanol in the maintenance building. No other records were available for the site.

The records indicated that there were several dangerous goods depots in the main hospital areas, to the east of New Dapto Road. These depots were for USTs and above ground storage tanks (ASTs) that contain diesel and liquefied oxygen. Although the diesel containing USTs/AST are up-gradient of the site, these facilities are not considered to be a significant potential off-site contamination source as they are located approximately 40m (or greater) from the nearest site boundary.

4.3 NSW EPA Records

The NSW EPA records available online were reviewed for the site history assessment. A summary of the relevant information is provided in the following table:

Table 4-2: Summary of NSW EPA Online Records

Source	Details
CLM Act 1997[19]	No notices for the site under Section 58 of the Act.
NSW EPA List of Contaminated Sites[20]	The site is not listed in the NSW EPA register.
POEO Register[21]	No notices for the site in the POEO register. There was a record for a former licence that was applicable to the main Wollongong Hospital site (Loftus Street) for 'hazardous, industrial or Group A waste generation or storage. The license is no longer in force.

[19] http://www.environment.nsw.gov.au/prclmapp/searchregister.aspx, visited on 3 December 2012
[20] http://www.environment.nsw.gov.au/clm/publiclist.htm, visited on 3 December 2012
[21] http://www.environment.nsw.gov.au/prpoeoapp/, visited on 3 December 2012

4.4 Integrity of Site History Information

The site history information has generally been obtained from government organisations including: Department of Lands, NSW WorkCover records and NSW EPA records. The veracity of the information from these sources is considered to be high, however, a certain degree of information loss can be expected as all possible records were not researched for this ESA.

Non verifiable anecdotal information has not been relied upon for this ESA. Therefore, there is considered to be a high level of integrity associated with information reviewed for the assessment.

5 CONCEPTUAL SITE MODEL (CSM)

5.1 Areas of Environmental Concern (AEC) and Potential Contaminants of Concern (PCC)

Based on a review of the site history information and the site inspection, the following AEC have been identified:

- Potentially contaminated, imported fill soils may have been used to level sections of the site prior to construction of the existing buildings and car park. For the purpose of the CSM, this AEC extends over the whole site area;
- Potential asbestos containing materials may have been used in the construction of the existing buildings. Furthermore, there is a potential for asbestos to be present in the fill soils and/or as a result of improper demolition/construction of former site buildings. For the purpose of the CSM, this AEC extends over the whole site area; and
- Use of the site as a car park may have resulted in some localised oil/fuel leaks from vehicles that may have permeated cracks and potholes in the pavement. This AEC is limited to the paved car park areas.

The primary PCC associated with the above AEC include:

- heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc);
- petroleum hydrocarbons (TPH and BTEX – Benzene, Toluene, Ethyl Benzene and Xylenes);
- organochlorine and organophosphorus pesticides (OCPs and OPPs);
- polycyclic aromatic hydrocarbons (PAHs);
- polychlorinated biphenyls (PCBs); and
- asbestos.

As the potential contamination sources identified at this site are surface based, groundwater contamination is likely to be associated with soil/fill contamination and, therefore no specific assessment of groundwater contamination has been included.

5.2 Contamination Fate and Transport

The fate of the PCC identified above is summarised in the following table:

Table 5-1: Fate and Transport of PCC

PCC	Fate and Transport
Non-volatile contaminants including metals, heavy fraction PAHs, OCPs, OPPs, PCBs and asbestos	With the exception of asbestos, non-volatile contaminants are predominantly confined to the soil and groundwater medium. The mobility of these contaminants varies depending on: the nature and type of contaminant present (e.g. leachability, viscosity etc); soil

PCC	Fate and Transport
	type/porosity; surface water infiltration; groundwater levels; and the rate of groundwater movement. At this site, surface water infiltration is fairly limited as a result of the pavement areas, which would reduce the migration potential for certain contaminants. The presence of paved surfaces in the surrounding areas can also limit the migration potential for non-volatile contaminants. Some surface water may infiltrate the garden beds and grassed areas which could increase the migration potential in these areas, however, the proportion of the site that is unpaved is relatively limited. Non-volatile contaminants associated with ash and slag waste (which is a relatively common inclusions in fill soils and can contain some heavy metals, heavy fraction PAHs, and occasionally heavy fraction TPHs) are bound within a relatively insoluble matrix. Slag and ash is usually formed as a by-product of combustion at high temperatures which 'locks in' the contaminants within the matrix. The potential for migration of asbestos fibres would increase during demolition of structures where asbestos containing building materials were used, and following disturbance of asbestos contaminated soils. This would occur during demolition and excavation works. A number of studies have found that soils effectively filter out asbestos fibres and retain them near the surface. The studies concluded that there is no significant migration of asbestos fibres, either through soil or groundwater. The transport of airborne asbestos is associated with disturbance of the material and therefore would be expected during demolition and excavation works.
Volatile contaminants including TPH, BTEX, VOCs and light fraction PAHs	Volatile contaminants are usually more mobile when compared to the non-volatile compounds. The potential for migration of volatile contaminants such as light molecular weight PAHs and volatile petroleum hydrocarbons is relatively high. These contaminants break down rapidly as a result of microbial activity and availability of nutrients including nitrogen, oxygen etc. The mobile contaminants would be expected to move down to the rock surface or groundwater table and migrate down gradient from the source. The mobility would depend on a range of factors such as: soil type/porosity; surface water infiltration; groundwater levels; and the rate of groundwater movement.

5.3 Potential Receptors and Exposure Pathways

The potential receptors and exposure pathways identified for the PCC at the site are presented in the following table:

Table 5-2: Potential Receptors and Exposure Pathways

Receptor	Details	Exposure Pathway
Human Receptors	Human receptors include: - On and off-site occupants; - Site visitors; - Contractors and workers; and - Future site occupants.	- Exposure by direct dermal contact, ingestion and inhalation (soil and groundwater contaminants) - Inhalation of dust containing contaminants - Inhalation of airborne asbestos fibres
Environmental Receptors	Environmental receptors include: - Proposed landscaped areas (if constructed during the proposed works)	- Migration of contaminated groundwater - Migration of contaminants via surface water flows (sediment transport) - Exposure by direct contact with plants and animals

6 SITE ASSESSMENT CRITERIA (SAC)

6.1 Soil

The assessment criteria for soil contamination are derived from NEPM 1999 and the Site Auditor Guidelines 2006.

6.1.1 Health Investigation Levels (HILs)

The NEPM 1999 includes Health Based Investigation Levels (HILs) for a range of contaminants based on the risk of exposure, duration of exposure, toxicity and land use (availability). The HILs are divided into four categories outlined in the following table:

Table 6-1: HILs Categories

Category/Column	Land Use
Column A	'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.
Column D	Residential with minimal opportunities for soil access: includes dwellings with fully and permanently paved yard space such as high-rise apartments and flats.
Column E	Parks, recreational open space and playing fields: includes secondary schools.
Column F	Commercial/Industrial: includes premises such as shops and offices as well as factories and industrial sites.

Where the proposed land use includes more than one land use category (for example a mixed-use development including residential/retail/commercial land uses) the exposure setting of the most 'sensitive' land use should be adopted for the site.

6.1.2 Petroleum Hydrocarbons in Soil

Threshold concentrations for petroleum hydrocarbon including total TPH and BTEX compounds have been adopted from the Service Station Guidelines 1994 referenced in the Site Auditor Guidelines 2006. Heavy fraction petroleum hydrocarbon aliphatic/aromatic component threshold concentrations have been adopted from NEPM 1999 (as applicable).

Soil samples are initially analysed for total recoverable hydrocarbons (TRH) without a preliminary silica gel clean-up of the sample. Consequently the TRH result may include other compounds such as phthalates, humic acids, fatty acids and sterols (if present).

Silica gel clean-up should remove these other compounds and result in a more accurate result for petroleum hydrocarbons. If undertaken these results have been referred to as TPH_{sgel} within this report.

6.1.3 Provisional Phyto-toxicity Investigation Levels (PPILs)

PPILs are included in the assessment where the proposed land use includes landscaped areas or garden accessible soils. Contaminants above the PPIL threshold may cause phytotoxicity in some plant species. The PPILs are listed in the Site Auditor Guidelines 2006 and are identical to the Ecological Investigation Levels (EILs) specified in NEPM 1999.

6.1.4 Asbestos in Soil

The NEPM 1999 do not provide numeric guidelines for the assessment of asbestos in soil. The draft NEPM[22] guidelines have essentially adopted the Western Australian Asbestos Guidelines 2009[23] which prescribe a site investigative model and asbestos clean-up goals. These guidelines however, have not yet been adopted in NSW and as such are generally only used on a site specific basis.

The general criterion currently used for the assessment of asbestos in soil is the presence/absence of asbestos in soil in accordance with AS4964-2004[24]. If asbestos is found to be present, the status of the asbestos material (friable or bonded/non-friable) is further considered due to the implications associated with site remediation and/or management.

The WorkCover publication *Working with Asbestos Guide* (2008[25]) recommends that the status of the asbestos material in soil should be assessed by an occupational hygienist. More recently, the 2011 WHS Regulation[26] and associated Safe Work

[22] *Draft National Environmental Protection (Assessment of Site Contamination) Measure,* as varied, National Environment Protection Council (NEPC), 2011 (Draft NEPM 2011)

[23] *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*, WA Department of health, Perth, Australia, May 2009 (Western Australian Asbestos Guidelines 2009)

[24] Australian Standard 4964, *Method for the Qualitative Identification of Asbestos in Bulk Samples*, Australian Standards, 2004

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

[26] *Work Health and Safety Regulation*, NSW Government 2011

Australia code of practice, *How to Safely Remove Asbestos*[27] (endorsed by WorkCover NSW) states that the assessment of asbestos contaminated soil is to be undertaken by a licenced asbestos assessor or competent person. WorkCover NSW has not currently issued any licences for asbestos assessors. Correspondence with WorkCover indicates that the licence program is currently being implemented in accordance with the Safe Work Australia Guide for Applicants for Asbestos Assessor Licences[28]. The ACT Planning and Land Authority currently issues licences for asbestos assessor Class A and Class B.

At present, the assessment of asbestos contamination in soil is undertaken in accordance with the NEPM guidelines, the adoption of the draft NEPM is considered only on a site specific basis. Assessment of the contaminant levels and status of asbestos contaminated soil is undertaken by a combination of: site assessment by experienced environmental consultants and ACT accredited asbestos assessors; and soil screening by NATA endorsed laboratories using AS4964-2004.

6.1.5 Soil Assessment Criteria

The soil assessment criteria adopted for the ESA is presented in the following table:

Table 6-2: Soil SAC

Analyte	Column F[1] (mg/kg)	PPILs[2] (mg/kg)
Metals		
Arsenic (total)	500	20
Cadmium	100	3
Chromium (III)	60%	400
Copper	5000	100
Lead	1500	600
Mercury (inorganic)	75	1
Nickel	3000	60
Zinc	35000	200
Petroleum Hydrocarbons		
TPH (C_6-C_9)	65 [a]	Na
TPH (C_{10}-C_{36})	1000 [a]	Na
Benzene	1 [a]	Na
Toluene	1.4 [a]	Na
Ethylbenzene	3.1 [a]	Na
Total Xylenes	14 [a]	Na
PAHs		

[27] *National Code of Practice How to Safely Remove Asbestos*, Safe Work Australia 2011

[28] *Guide for Applicants for Asbestos Removal and Asbestos Assessor Licences and Notifications*, Safe Work Australia 2012

Analyte	Column F[1] (mg/kg)	PPILs[2] (mg/kg)
Total PAHs	100	Na
Benzo(a)pyrene	5	Na
Pesticides		
Aldrin + Dieldrin	50	Na
Chlordane	250	Na
DDT+ DDD + DDE	1000	Na
Heptachlor	50	Na
Total OPPs	0.1[b]	Na
Others		
PCBs (Total)	50	Na
Asbestos	NDLR [c]	Na

Note:
1 – HILs outlined in NEPM 1999
2 – PPILs outlined in the Site Auditor Guidelines 2006
a - Service Station Guidelines 1994
b- Due to the absence of locally endorsed guideline criteria, the laboratory PQL has been adopted
c - Not Detected at Limit of Reporting (NDLR)
Na – Not Applicable

Only selected VOCs (i.e. BTEX compounds) were incorporated into the analysis schedule for this ESA. A preliminary, semi-quantitative screening for VOCs was also undertaken as detailed in **Section 8.1.1**. Samples were not analysed for the more extensive list of volatile compounds as there is only limited health-based data available for assessing VOCs in soil.

6.1.6 Waste Classification Criteria for Off-Site Disposal

Any material excavated for the proposed development will require a waste classification for off-site disposal in accordance with the Waste Classification Guidelines 2009.

Soils are classed into the following categories based on the chemical contaminant criteria outlined in the guidelines (refer to Table A):

Table 6-3: Waste Categories

Category	Description
General Solid Waste (non-putrescible) (GSW)	• If SCC ≤ CT1 then TCLP not need to classify the soil as GSW • If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as GSW
Restricted Solid Waste (non-putrescible) (RSW)	• If SCC ≤ CT2 then TCLP not need to classify the soil as RSW • If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as RSW
Hazardous Waste (HW)	• If SCC > CT2 then TCLP not need to classify the soil as HW • If TCLP > TCLP2 and/or SCC > SCC2 then treat as HW
Virgin Excavated Natural Material (VENM)	Natural material (such as clay, gravel, sand, soil or rock fines) that meet the following: • that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial mining or agricultural activities; • that does not contain sulfidic ores or other waste; and • includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice published in the NSW Government Gazette.

Note:
SCC – Specific Contaminant Concentration
CT – Contaminant Threshold
TCLP – Toxicity Characteristics Leaching Procedure

7 INVESTIGATION PROCEDURE

7.1 Soil Sampling Rationale

The NSW EPA Sampling Design Guidelines 1995 recommend a sampling density for a contamination assessment based on a systematic sampling pattern. Based on the size of the investigation area, the guidelines provide a minimum number of sampling points required for the investigation. The guidelines recommend sampling from a minimum of 20 evenly spaced sampling points for a site of this size (approximately 8,500m^2).

Samples for this investigation were obtained from eight sampling points. The sampling points were distributed relatively evenly throughout the accessible areas of the site as shown on the attached Figure 2. This density is approximately 43% of the minimum sampling density.

The sampling locations were placed on a relatively systemic plan with a grid spacing of approximately 25-30m. A systemic plan was considered suitable to address potential contaminants associated with the AEC.

Sampling was not undertaken in inaccessible areas of the site such as beneath existing buildings.

7.1.1 Soil Sampling Methods

Sampling locations were set out using a tape measure and were marked using spray paint. The sampling locations were cleared for underground services prior to drilling.

Seven sample locations (BH1 to BH7 inclusive) were drilled using a truck 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. Due to access limitations, one location (BH8) was drilled using a hand auger.

Soil samples were collected from the fill and natural profiles encountered during the investigation. Samples were also obtained when there was a distinct change in lithology or based on the observations made during the investigation. All samples were recorded on the borehole logs attached in Appendix A.

During sampling, soil at selected depths was split into initial and duplicate samples for field QA/QC analysis.

Samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags.

Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date.

7.1.2 VOC Screening

A portable Photoionisation Detector (PID) was used to screen the samples for the presence of VOCs and to assist with selection of samples for BTEX analysis.

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

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

PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. The PID headspace data is presented on the COC documents and borehole logs. PID calibration records are retained on file by EIS.

7.1.3 Decontamination and Sample Preservation

Details of the decontamination procedure adopted during sampling are presented in Appendix D. Where applicable, the sampling equipment was decontaminated using a scrubbing brush and potable water and Decon 90 solution (phosphate free detergent) followed by rinsing with potable water.

Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS4482.1-2005 and AS4482.2-1999[34] as summarised in the following table:

Table 7-1: Soil Sample Preservation and Storage

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).

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

Analyte	Preservation	Storage
VOCs (TPH/BTEX)	As above	Store at <4°, analysis within 14 days
PAHs, OCP, OPP & PCBs	As above	Store at <4°, analysis within 14 days
Asbestos	Sealed plastic bag	None

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures. Field sampling protocols adopted for this assessment are summarised in Appendix D.

7.2 Laboratory Analysis

The soil samples were analysed by the laboratory as detailed in the following table:

Table 7-2: Laboratory Details

Samples	Laboratory	Report Reference
All primary soil and groundwater samples, intra-laboratory duplicates, trip blanks, trip spikes and field rinsate samples	Envirolab Services Pty Ltd, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance)	81831 and 81831-A

Samples were analysed by Envirolabs using the analytical methods detailed in Schedule B(3) of NEPM (1999[37]). Reference should be made to the laboratory reports attached in Appendix B for further details.

7.3 Soil Analytical Schedule

The soil analytical schedule is outlined in the following table:

Table 7-3: Laboratory Analytical Schedule

PCC	No. of Fill Soil Samples	No. of Natural Soil Samples
Heavy Metals	9	3
TPH/BTEX	9	3
PAHs	9	3
OCPs/OPPs	5	2
PCBs	5	2
Asbestos	5	0

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

8 INVESTIGATION RESULTS

8.1 Subsurface Conditions

A summary of the subsurface soil conditions encountered during the investigation is presented in the table below. Reference should be made to the borehole logs attached in Appendix A for further details.

Table 8-1: Summary of Subsurface Conditions

Profile	Depth (mBGL[1])	Description
Pavement	Surface to maximum of 0.4m	AC pavement was encountered at the surface in all boreholes except BH8. The AC ranged in thickness from approximately 0.08m to 0.4m.
Fill	Maximum depth of 1.4m	Fill material was encountered at the surface in BH8, and beneath the pavement in BH1, BH2, BH3, BH4 and BH7. The fill material typically consisted of grey brown or brown gravelly sand, gravelly silty sand, clayey sandy silt, silty sand and/or silty clay. The fill contained inclusions of charcoal, igneous, brick and sandstone gravels, ash and slag (logged as clinker). BH8 was terminated in the fill soil at a depth of 0.4m due to refusal on an obstruction (possibly within the fill or on bedrock).
Natural Soil	Maximum depth of 4.7m	Natural soil was encountered beneath the pavement in BH6, and beneath the fill in BH5 and BH7. The natural soil typically comprised red brown, light grey and/or orange brown silty clay, sandy clay or sandy gravelly clay.
Bedrock	To the termination depth of each borehole	Sandstone bedrock was encountered directly beneath the fill soils in BH1, BH2, BH3 and BH4, and beneath the natural soils in BH5, BH6 and BH7. The sandstone was of variable colour (orange brown, brown, grey). A silty clay band was encountered in the bedrock profile in BH2.
Groundwater	4.5m to 11 on completion of augering (refer to BH logs)	Standing water levels of approximately 11m and 4.5m were recorded in BH4 and BH5 on completion of augering. The remaining boreholes were 'dry' on completion of augering. The water levels recorded in the remaining boreholes were most likely the result of water introduced during the coring process.

8.1.1 VOC Screening

PID soil sample headspace readings are presented in Table B. All results were 0ppm equivalent isobutylene which indicates a lack of PID detectable volatile organic contaminants.

8.2 Soil Laboratory Results

The soil laboratory results are presented in Table B and Table C attached to the report. The laboratory reports are attached in Appendix B. A summary of the results assessed against the SAC is presented below.

Table 8-2: Summary of Soil Laboratory Results

Analyte	Results Compared to SAC, PPILs and Waste Classification Guidelines
Heavy Metals	All results were below the SAC. 8.2.1 The concentrations of copper in two fill samples and zinc in two fill samples were above the PPILs. The remaining results were below the PPILs. **WC:** All results were less than the SCC1 criteria. The lead concentration in three fill samples exceeded the CT1 criteria. TCLP leachates were prepared from the three relevant fill samples and analysed for lead. The results were less than the TCLP1 criterion. 8.2.2
TPH & BTEX	All results were below the SAC. Quantifiable concentrations of mid to heavy fraction (C10-C36) TPHs were encountered in two fill samples. However, these results were below the SAC of 1,000mg/kg. **WC:** All results were less than the relevant CT1 and SCC1 criteria.
PAHs	All results were below the SAC. Quantifiable concentrations of PAHs were encountered in four fill samples. However, these results were significantly below the relevant SAC of 100mg/kg for total PAHs and 5mg/kg for benzo(a)pyrene. **WC:** All results were less than the relevant CT1 and SCC1 criteria.
OCPs & OPPs	All results were below the laboratory practical quantitation limits (PQLs) and were less than the SAC. **WC:** All results were less than the relevant CT1 and SCC1 criteria.

Analyte	Results Compared to SAC, PPILs and Waste Classification Guidelines
PCBs	All results were below the PQLs and were less than the SAC. **WC:** All results were less than the SCC1 criterion.
Asbestos	All results were below the laboratory reporting limit.

Note:
PPILs – Provision Phyto-toxicity Investigation Levels
SAC – Site Assessment Criteria
WC – Waste Classification Guidelines 2009

9 QA/QC ASSESSMENT

The QA/QC assessment includes a review of the DQIs established for the investigation (see **Section 2.2**). A summary of the field QA/QC samples are outlined below:

Table 9-1: Field QA/QC Samples

Field QA/QC	Frequency	Sample Details
Intra-laboratory duplicates	Approximately 10% of Primary Samples	Soil Samples: DUP1 is a soil duplicate of sample BH1 (0.2-0.4m)
Trip blank	One per batch	Trip Blank is a sand blank carried during all three fieldwork days and during transport to the laboratory
Trip Spike (TS)	One per batch	Trip Spike is a soil spike carried during all three fieldwork days and during transport to the laboratory

An assessment of the DQIs is summarised in the following table.

Table 9-2: Assessment of DQIs

Completeness
Data and documentation completeness was achieved through the following measures: • A sampling and analysis plan was prepared for the investigation; • Chain of custody (COC) records were prepared for each batch of samples sent to the labs (see Appendix B); • Laboratory sample receipt information was reviewed for each batch (see Appendix B); • NATA registered laboratories were used for all analysis; • Visual observations and PID screening of samples was undertaken during the investigation as noted on the COC documents (see Appendix B); and • Samples were analysed for the PCC identified in **Section 5.1**.
Comparability
Data comparability was achieved through the following measures: • Similar sampling techniques were used during the investigation; • Appropriate preservation, storage and transport methods were adopted for all samples; and • Consistent analysis techniques and reporting standards were adopted by the laboratory.
Representativeness
Data representativeness was achieved through the following measures: • The sampling plan was optimised to obtain suitable coverage of sample locations based on the access requirements; and • The assessment included a representative coverage of analysis for PCC.

Precision

Intra-laboratory RPD Results:

The intra-laboratory soil RPD results are summarised in Table D. The results indicated that field precision was acceptable.

Accuracy

Accuracy was achieved through the following measures:

- Trained and qualified field staff were used for the investigation;
- Appropriate industry standard sampling equipment and decontamination procedures were adopted for the investigation as outlined in Appendix D;
- Sampling and screening equipment is routinely factory calibrated. An in-house calibration check was undertaken prior to using onsite;
- Appropriate sample preservation, handling, holding time and COC procedures were adopted for the investigation;
- The report was prepared generally in accordance with Reporting Guidelines 1997; and
- Review of trip spike and trip blank results are summarised below:

Trip Spike Results:

The trip spike results are summarised in Table E. The BTEX results for the trip spikes ranged from 99% to 100% and indicated that field preservation methods were appropriate.

Trip Blank Results:

The trip blank results summarised in Table E were all less than the PQLs. This indicated that there were no cross-contamination artefacts associated with the sample storage and transport.

Laboratory Duplicate RPD Results:

Laboratory duplicate RPD results for the soil analysis were generally within the acceptance criteria adopted by the laboratory. Marginally elevated RPDs were noted for zinc and copper in sample 81831-14 (see Envirolabs report 81831). A triplicate was analysed, however, as both the initial, duplicate and triplicate results were below the SAC, these results are not considered to have had an adverse impact on the dataset as a whole.

Matrix Spike Recovery:

Matrix spike recovery concentrations were within the acceptable limits of 60-140% for organics and 70-130% for inorganics. A spike recovery was not obtained for copper, however, it was noted that a suitable LCS recovery was achieved. This result is not considered to have had an adverse impact on the dataset as a whole.

Surrogate Spike Recovery:

Surrogate spike recovery concentrations were within the acceptable limits of 60-140% for organics and 10-140% for VOCs.

LCS recovery:

LCS recovery concentrations were within the acceptable limits of 60-140% for organics and 70-130% for inorganics.

Other:
Envirolabs noted that several samples scheduled for asbestos analysis were below the recommended sample volume. As no asbestos fibres were detected in any of the samples analysed, and as no fragments of fibre cement were noted in the fill soils, EIS are of the opinion that this is unlikely to have had an impact on the data set.

EIS are of the opinion that the DQIs adopted for this ESA (see **Section 2.2**) have been suitably addressed.

10 DISCUSSION

10.1 Soil

Elevated concentrations of contaminants, above the SAC, were not encountered in the soil samples analysed for the ESA.

Based on the findings of the historical assessment and the results of the laboratory analysis, EIS are of the opinion that the potential for significant widespread soil contamination at the site is relatively low.

The low concentrations of TPHs and PAHs (below the SAC) in several fill samples are considered likely to be the result of localised leaks (possibly from parked vehicle) and from ash/slag inclusions in the fill soils respectively. These results are not considered to be indicative of a significant, widespread contamination issue.

10.1.1 PPILs

Several fill samples encountered elevated concentrations of copper and zinc above the PPILs. The PPIL criteria are principally concerned with phytotoxicity (i.e. adverse effects on plant growth in established and proposed areas of landscaping) and are described in NEPM 1999 as "*somewhat arbitrary*", as the effect of these compounds on plant growth will depend on the soil and plant type.

In the event that the fill material in the vicinity of BH2, BH3 and BH8 is left in-situ and landscaping is undertaken in these areas, further consideration of these elevations may be required. The elevations are not considered to pose an environmental risk for off-site areas.

10.2 Waste Classification

10.2.1 Classification of Fill Soil for Off-Site Disposal

The waste classification for the fill material is summarised in the following table:

Table 10-1: Waste Classification of Fill

Extent	Classification	Disposal Option
Fill material over the entire site	General Solid Waste (non-putrescible) (GSW)	A facility licensed by the NSW EPA to receive the waste stream.

The fill material must be disposed of to a NSW EPA licensed facility. It is the responsibility of the receiving facility to ensure that the material meets their EPA license conditions. EIS accepts no liability whatsoever for illegal or inappropriate disposal of excavated material.

Further waste classification testing is recommended to confirm the waste classification for the fill soils beneath the existing buildings. This should be undertaken following demolition works once better access is available.

10.2.2 Classification of Natural Soil and Bedrock for Off-Site Disposal

The waste classification for the natural material is summarised in the following table:

Table 10-2: Waste Classification of Natural Material

Extent	Classification	Disposal Option
Natural soils and sandstone bedrock over the entire site	Virgin excavated natural material (VENM)	VENM is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site as fill material. Alternatively, the natural material can be disposed of as VENM to a facility licensed by the NSW EPA to receive the waste stream.

Material classed as VENM must not be mixed with any fill material (including building rubble) as this will invalidate the VENM classification. Where doubt exists about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted.

10.3 Groundwater

An assessment of the groundwater contamination conditions was outside the scope of this ESA. However, based on the historical information reviewed for this assessment, and the results of the soil analysis, EIS are of the opinion that the potential for significant groundwater contamination issues to be encountered at the site is relatively low.

In the event groundwater is intercepted during excavation works, dewatering will be required. In the event that dewatering is necessary, a temporary construction dewatering license should be obtained from the NSW Office of Water prior to commencement. Council and other relevant approvals will also be required prior to disposal of groundwater into the stormwater system. As the approval process can take several weeks, this should be allowed for during the planning stages.

10.4 Assessment of Risk

As the contaminant concentrations in the soil samples analysed were less than the SAC, EIS are of the opinion that the risk posed by contamination to the receptors identified in **Section 5.3** is relatively low.

The potential risks associated with exposure to asbestos may increase as a result of improper demolition of the existing structures and/or during excavation of the fill soils (i.e. in the event of an unexpected asbestos find). Recommendations have been included in the following section of this report to reduce these risks.

11 CONCLUSION

Based on the scope of work undertaken for this ESA, EIS consider the site to be suitable for the proposed car park development provided that:

- A hazardous building materials survey is undertaken prior to the demolition of any buildings on-site;
- The buildings are demolished in accordance with the hazardous building materials report(s) and suitable clearance documentation is provided on completion of the demolition works; and
- Any unexpected conditions encountered during demolition/excavation works (i.e. potential contamination issues) are immediately inspected by a qualified environmental consultant. If required, a suitable strategy should be developed and implemented to address the issue identified.

Additional waste classification testing should also be undertaken for any fill soils to be excavated from beneath the existing buildings.

EIS consider that the objectives of this ESA (detailed in **Section 1.2**) and the DQOs (detailed in **Section 2**) have been met.

11.1 Regulatory Requirement

The regulatory requirements applicable for the site are outlined in the following table:

Table 11-1: Regulatory Requirement

Guideline	Applicability
Duty to Report Contamination 2008[38]	EIS are of the opinion that there is currently no requirement to report to the NSW EPA under Section 60 of the CLM Act and Duty to Report Contamination 2008 guidelines.
POEO Act 1997	Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. 11.1.1
Work Health and Safety Code of Practice 2011[40]	Sites contaminated with asbestos become a 'workplace' when work is carried out there and require a register and asbestos management plan.

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

[40] Code of Practice – How to Manage and Control Asbestos in the Workplace, WHS Regulation 2011

12 LIMITATIONS

The sampling locations for the investigation have enabled an assessment to be made of the risk of the existence of significant, large quantities of contamination. 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 sampling points.

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. Development activities at the site should be planned on this basis, and any unexpected problems that may be encountered between sampling locations should be immediately inspected by experienced environmental personnel. This should ensure that such problems are dealt with in an appropriate manner, with minimal disruption to the project timetable and budget.

The conclusions developed in this report are based on site conditions which existed at the time of the investigation and the scope of work outlined in the 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 immediate surrounds, together with the interpretation of available historical information and documents reviewed as described in this report.

The investigation 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 in the report.

EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report.

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-1990 constructed buildings or fill material at the site.

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

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

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

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

LIST OF IN-TEXT TABLES:

IMPORTANT INFORMATION ABOUT THIS REPORT

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

The Report is Based on a Unique Set of Project Specific Factors:
This report has been prepared in response to specific project requirements as stated in the EIS proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

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

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

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

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

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

Assessment Limitations
Although information provided by a 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.

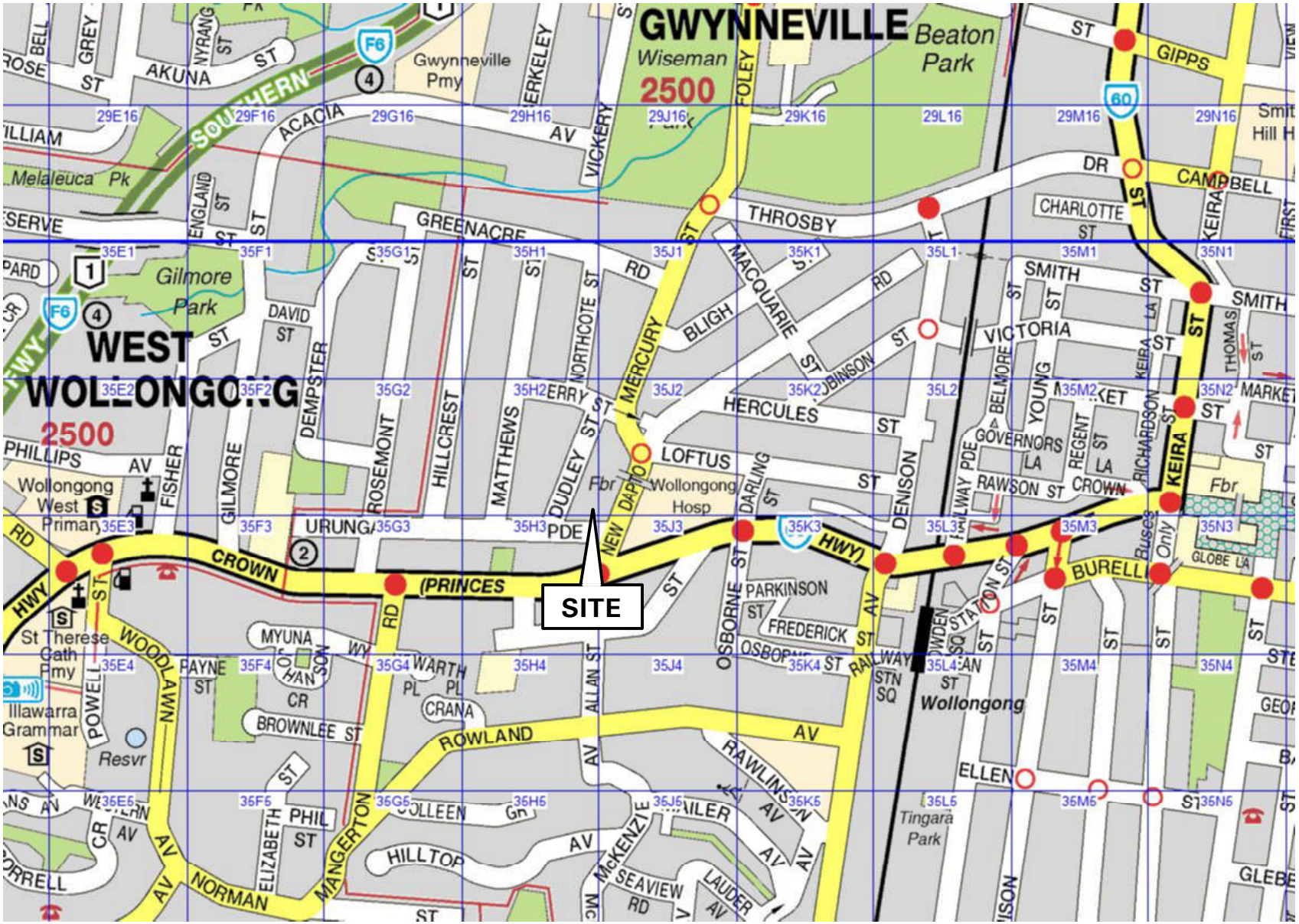
Misinterpretation of Site Assessments by Design Professionals
Costly problems can occur when other design professionals develop plans based on misinterpretation of an assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with 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 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 reduce these potential 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 text of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

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

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

REPORT FIGURES

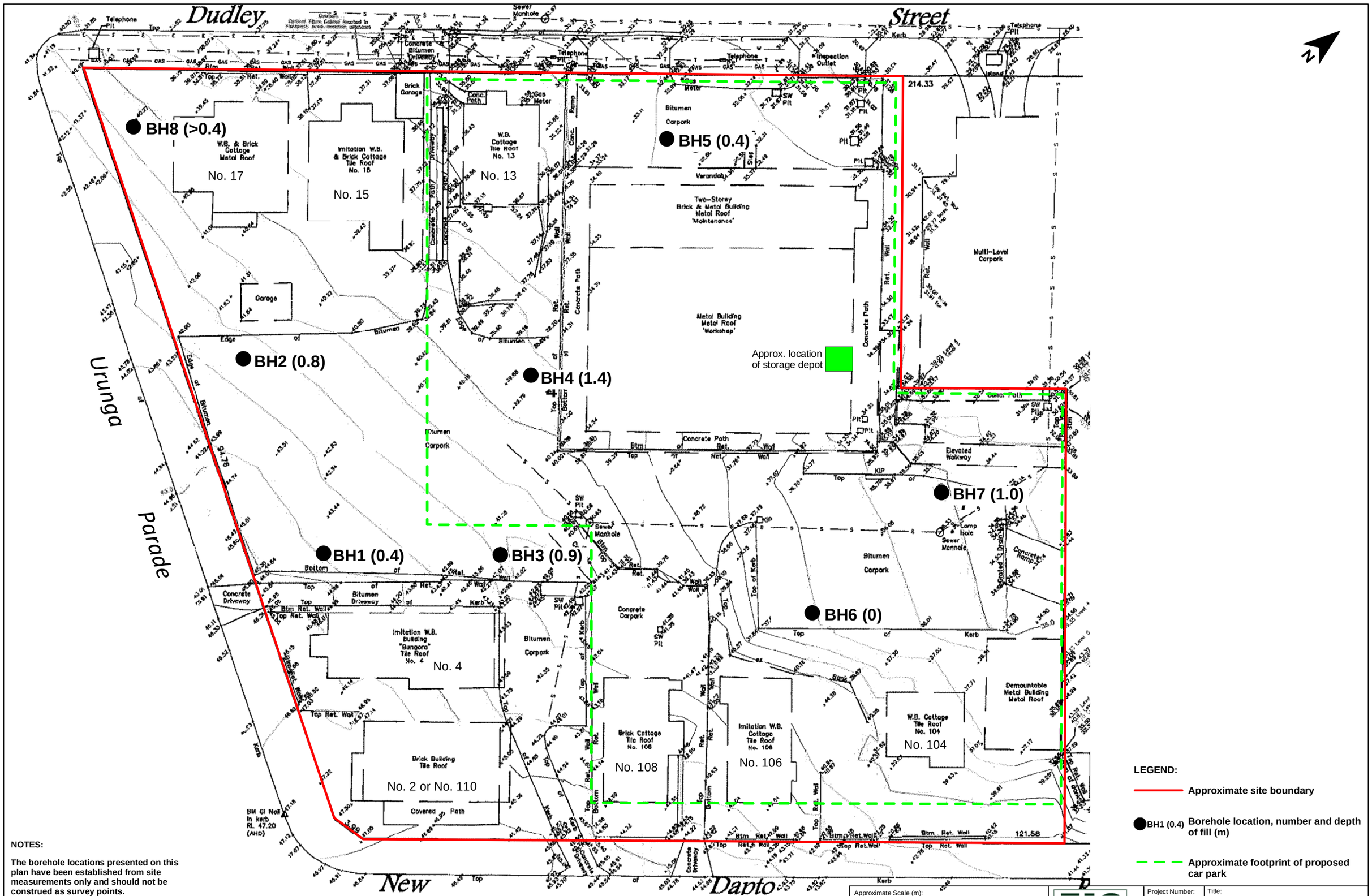


NOTES:
Figure 1 has been recreated from UBD on disc (version 5.0). Figure is not to scale.

UBD Map ref: 35 H-J 2

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

ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: **E26129KP**	Title: **SITE LOCATION PLAN**
	Figure: **1**	Address: **WOLLONGONG HOSPITAL, 3-11 DUDLEY STREET, WOLLONGONG, NSW**



NOTES:

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

The site boundaries and proposed basement footprint is indicative only.

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

LEGEND:

- **Approximate site boundary**
- **BH1 (0.4) Borehole location, number and depth of fill (m)**
- **Approximate footprint of proposed car park**

Approximate Scale (m): 0 4 8 12 16 20

ENVIRONMENTAL INVESTIGATION SERVICES

Project Number:	Title:
E26129KP	BOREHOLE LOCATION PLAN
Figure: 2	Address: WOLLONGONG HOSPITAL, 3-11 DUDLEY STREET, WOLLONGONG, NSW

REPORT TABLES

TABLE A
CHEMICAL CONTAMINANT CRITERIA FOR WASTE CLASSIFICATION
Waste Classification Guidelines Part 1: Classifying Waste DECCW NSW July 2009
All data in mg/kg unless stated otherwise

CONTAMINANT	GENERAL SOLID WASTE			RESTRICTED SOLID WASTE		
	CT1 (mg/kg)	TCLP1 (mg/L)	SCC1 (mg/kg)	CT2 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Heavy Metals						
Arsenic	100	5	500	400	20	2,000
Beryllium	20	1	100	80	4	400
Cadmium	20	1	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	180	400	20	720
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)						
Benzene	10	0.5	18	40	2	72
Toluene	288	14.4	518	1,152	57.6	2,073
Ethyl benzene	600	30	1,080	2,400	120	4,320
Total xylenes	1,000	50	1,800	4,000	200	7,200
Total Petroleum Hydrocarbons (TPHs)						
Light Fraction TPH (C6-C9)	nsl	nsl	650	nsl	nsl	2,600
Mid to Heavy Fraction TPH (C10-C36)	nsl	nsl	10,000	nsl	nsl	40,000
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)pyrene	0.8	0.04	10	3.2	0.16	23
Total PAHs	nsl	nsl	200	nsl	nsl	800
Others						
Polychlorinated biphenyls	nsl	nsl	<50	nsl	nsl	<50
Phenol (non-halogenated)	288	14.4	518	1,152	57.6	2,073
Scheduled chemicals	nsl	nsl	<50	nsl	nsl	<50

Explanation:

1). General Solid Waste (GSW):

- If SCC ≤ CT1 then TCLP not needed to classify the material as GSW
- If TCLP ≤ TCLP1 and SCC ≤ SCC1 then treat as GSW

2). Restricted Solid Waste (RSW):

- If SCC ≤ CT2 then TCLP not needed to classify the material as RSW
- If TCLP ≤ TCLP2 and SCC ≤ SCC2 then treat as RSW

3). Hazardous Waste (HW):

- If SCC > CT2 then TCLP not needed to classify the material as HW
- If TCLP > TCLP2 and/or SCC > SCC2 then treat as HW

Abbreviations:

SCC – Specific Contaminant Concentration
CT – Contaminant Threshold
TCLP – Toxicity Characteristics Leaching Procedure
nsl - No Set Limit
DECCW - NSW Department of Environment, Climate Change and Water (now EPA)

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

			HEAVY METALS								PAHs		OCPs				TOTAL OPPs	Total PCBs	TPH					BTEX COMPOUNDS				PID VALUES	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor			C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes		
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		100
Site Assessment Criteria (SAC) [1]			500	100	60%	5000	1500	75	3000	35000	100	5	50	250	1000	50	0.1[a]	50	65[b]	nsl	nsl	nsl	1000[b]	1[b]	1.4[b]	3.1[b]	14[b]		100[c]
PPILs [2]			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 [3]			100	20	100	nsl	100	4	40	nsl	nsl	0.8	nsl	nsl	nsl	nsl	detect[4]	nsl	nsl		nsl		nsl	10	288	600	1000	-	-
General Solid Waste SCC1 [3]			500	100	1900	nsl	1500	50	1050	nsl	200	10	Scheduled Chemicals <50					50	650		nsl		10000	18	518	1080	1800	-	-
Restricted Solid Waste CT2 [3]			400	80	400	nsl	400	16	160	nsl	nsl	3.2	nsl	nsl	nsl	nsl	detect[4]	nsl	nsl		nsl		nsl	40	1152	2400	4000	-	-
Restricted Solid Waste SCC2 [3]			2000	400	7600	nsl	6000	200	4200	nsl	800	23	Scheduled Chemicals <50					50	2600		nsl		40000	72	2073	4320	7200	-	-
Sample Reference	**Sample Depth**	**Sample Description**																											
BH1	0.2-0.4	Fill	5	LPQL	13	17	12	LPQL	4	30	0.25	0.05	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH2	0.2-0.3	Fill	LPQL	LPQL	4	***270***	8	LPQL	7	51	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH2	0.5-0.7	Fill	14	LPQL	9	***140***	150	LPQL	7	170	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH3	0.2-0.4	Fill	16	1	23	100	310	LPQL	10	***560***	2.34	0.24	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH3	0.6-0.8	Fill	9	LPQL	18	7	7	LPQL	2	24	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	340	240	580	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH3	1.0-1.2	Sandstone	6	LPQL	10	8	8	LPQL	1	17	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH4	0.5-0.7	Fill	8	LPQL	16	6	7	LPQL	2	22	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH5	0.2-0.4	Fill	LPQL	LPQL	27	18	LPQL	LPQL	1	5	0.1	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	120	120	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH5	0.5-0.7	Silty clay	LPQL	LPQL	11	9	10	LPQL	LPQL	4	LPQL	LPQL	na	na	na	na	na	na	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH6	0.4-0.5	Sandy gravelly clay	5	LPQL	14	11	10	LPQL	2	12	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	na
BH7	0.3-0.4	Fill	7	LPQL	29	16	12	LPQL	2	20	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
BH8	0-0.1	Fill	7	1	15	56	160	LPQL	7	***250***	0.37	0.07	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	Not detected
Total Number of samples			12	12	12	12	12	12	12	12	12	12	7	7	7	7	7	7	12	12	12	12	12	12	12	12	12	12	0
Maximum Value			16	1	29	270	310	LPQL	10	560	2.34	0.24	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	340	240	580	LPQL	LPQL	LPQL	LPQL	0	nc

Explanation:

1 - Site Assessment Criteria (SAC): NEPM 1999 (NEPC Guidelines) HILs - Column F 'Commercial/Industrial'
2 - Provisional Phyto-toxicity Investigation Levels (PPILs)
3 - NSW DECCW Waste Classification Guidelines (2009)
4 - Some Individual OPPs have CT1 & CT2 values. Reference should be made to the Waste Classification Guidelines in the event of any detections
a - In the absence of Australian guidelines, the laboratory PQL has been adopted as the SAC
b - NSW DECC Guidelines for Assessing Service Station Sites (1994)
c - The PQL has been adopted as the SAC

Concentration above the SAC — VALUE
Concentration above PPILs — ***VALUE***

Abbreviations:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OPP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyls
UCL: Upper Level Confidence Limit on Mean Value
ALPQL: All values less than PQL
na: Not Analysed
nc: Not Calculated
nsl: No Set Limit
SAC: Site Assessment Criteria
TPH: Total Petroleum Hydrocarbons
BTEX: Monocyclic Aromatic Hydrocarbons
OCP: Organochlorine Pesticides
CT: Contaminant Threshold
SCC: Specific Contaminant Concentration
HILs: Health Investigation Levels
NEPM: National Environmental Protection Measure

TABLE C
SUMMARY OF LABORATORY RESULTS - TCLP
All data in mg/L unless stated otherwise

		Arsenic	Cadmium	Chromium	Lead	Mercury	Nickel	B(a)P
PQL - Envirolab Services		0.05	0.01	0.01	0.03	0.0005	0.02	0.001
TCLP1 - General Solid Waste [1]		5	1	5	5	0.2	2	0.04
TCLP2 - Restricted Solid Waste [1]		20	4	20	20	0.8	8	0.16
TCLP3 - Hazardous Waste [1]		>20	>4	>20	>20	>0.8	>8	>0.16
Sample Reference	**Sample Depth**							
BH2	0.5-0.7	na	na	na	0.1	na	na	na
BH3	0.2-0.4	na	na	na	0.08	na	na	na
BH8	0-0.1	na	na	na	LPQL	na	na	na
Total Number of samples		0	0	0	3	0	0	0
Maximum Value		-	-	-	0.1	-	-	-

EXPLANATION:
1 - NSW DECCW Waste Classification Guidelines (2009)

General Solid Waste	VALUE
Restricted Solid Waste	VALUE
Hazardous Waste	VALUE

ABBREVIATIONS:
PQL: Practical Quantitation Limit
LPQL: Less than PQL
B(a)P: Benzo(a)pyrene
nc: Not Calculated
na: Not Analysed
TCLP: Toxicity Characteristics Leaching Procedure

TABLE D
SOIL INTRA-LABORATORY DUPLICATE RESULTS & RPD CALCULATIONS
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Sample Ref = BH1 0.2-0.4	Arsenic	4	5	6	5.5	18.2
Dup Ref = DUP1	Cadmium	0.5	LPQL	LPQL	nc	nc
	Chromium	1	13	13	13	0.0
	Copper	1	17	23	20	30.0
	Lead	1	12	9	10.5	28.6
	Mercury	0.1	LPQL	LPQL	nc	nc
	Nickel	1	4	5	4.5	22.2
	Zinc	1	30	29	29.5	3.4
	Naphthalene	0.1	LPQL	LPQL	nc	nc
	Acenaphthylene	0.1	LPQL	LPQL	nc	nc
	Acenaphthene	0.1	LPQL	LPQL	nc	nc
	Fluorene	0.1	LPQL	LPQL	nc	nc
	Phenanthrene	0.1	LPQL	LPQL	nc	nc
	Anthracene	0.1	LPQL	LPQL	nc	nc
	Fluoranthene	0.1	0.1	<0.1	0.075	66.7
	Pyrene	0.1	0.1	<0.1	0.075	66.7
	Benzo(a)anthracene	0.1	LPQL	LPQL	nc	nc
	Chrysene	0.1	LPQL	LPQL	nc	nc
	Benzo(b)&(k)fluorant	0.2	LPQL	LPQL	nc	nc
	Benzo(a)pyrene	0.05	0.05	0.025	0.0375	66.7
	Indeno(123-cd)pyrene	0.1	LPQL	LPQL	nc	nc
	Dibenzo(ah)anthracene	0.1	LPQL	LPQL	nc	nc
	Benzo(ghi)perylene	0.1	LPQL	LPQL	nc	nc
	C_6-C_9 TPH	25	LPQL	LPQL	nc	nc
	C_{10}-C_{14} TPH	50	LPQL	LPQL	nc	nc
	C_{15}-C_{28} TPH	100	LPQL	LPQL	nc	nc
	C_{29}-C_{36} TPH	100	LPQL	LPQL	nc	nc
	Benzene	0.5	LPQL	LPQL	nc	nc
	Toluene	0.5	LPQL	LPQL	nc	nc
	Ethylbenzene	1	LPQL	LPQL	nc	nc
	m + p-xylene	2	LPQL	LPQL	nc	nc
	o-xylene	1	LPQL	LPQL	nc	nc

EXPLANATION:

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

Results > 10 times PQL = RPD value < = 50% are acceptable

Results between 5 & 10 times PQL = RPD value < = 75% are acceptable

Results < 5 times PQL = RPD value < = 100% are acceptable

RPD Results Above the Acceptance Criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit

LPQL: Less than PQL

na: Not Analysed

nc: Not Calculated

TPH: Total Petroleum Hydrocarbons

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

ANALYSIS	Envirolab PQL		Trip Blank[s]	TS[s]
	mg/kg	µg/L	mg/kg	% Recovery
Benzene	1	1	LPQL	99
Toluene	1	1	LPQL	99
Ethylbenzene	1	1	LPQL	99
m + p-xylene	2	2	LPQL	99
o-xylene	1	1	LPQL	100

EXPLANATION:

[S] Sample type (sand)

BTEX concentrations in trip spikes are presented as % recovery

Values above PQLs/Acceptance criteria VALUE

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
(-) : Not Applicable / Not Analysed
TS: Trip Spike
na: Not Analysed
nc: Not Calculated
TPH: Total Petroleum Hydrocarbons

APPENDIX A

Borehole Logs and Explanatory Notes

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 1
1/2

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 14-11-12

Method: SPIRAL AUGER
JK350

R.L. Surface: ≈ 44.0m
Datum: AHD

Logged/Checked by: I.S./P.S

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 COMPLE -TION					10/5mm REFUSAL	0			ASHPHALT: 200mm.t.		-		
								-	FILL: Gravelly sand.	M	-		
								-	SANDSTONE: fine to medium grained, orange brown and red brown.	DW	M-H	-	MODERATE 'TC' BIT RESISTANCE
						1			as above, but orange brown.		L-M		MODERATE RESISTANCE WITH LOW BANDS
									SANDSTONE: fine grained, red brown and grey with extremely weathered bands.	EW-DW	VL		VERY LOW RESISTANCE
						2					L		LOW RESISTANCE
						3			SANDSTONE: fine grained, light grey and orange brown.	DW	M		MODERATE RESISTANCE
									REFER TO CORED BOREHOLE LOG				
						4							
						5							
						6							
						7							

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CORED BOREHOLE LOG

Borehole No. **1** **2/2**

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Core Size:** NMLC **R.L. Surface:** ≈ 44.0m

Date: 14-11-12 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK350 **Bearing:** **Logged/Checked by:** I.S./P.S

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain character-istics, 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 3.75m					
		4		SANDSTONE: fine grained, orange brown.	DW	H			- J,45°,P,Is - Be,0-20°,U,Is - J,60°,P,R - J,80-90°,U,R clay in surface - Be,U,0-5°,R,Is - J,80-90°,U,R,Is - Be,0°,P,R
		5		CORE LOSS: 1.0m					
		6		SANDSTONE: fine grained orange brown.	XW DW	EL H L			- Cs,10mm.t. - Be,0-5°,U,R,Is - J,45° - Be,5°,U,R - J,80°,U,R
		7		SANDSTONE: fine grained, grey.	SW	H			
		8		END OF BOREHOLE AT 7.9m					
		9							

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BOREHOLE LOG

Borehole No. 2
1/2

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 14-11-12

Method: SPIRAL AUGER
JK350

R.L. Surface: ≈ 42.5m
Datum: AHD

Logged/Checked by: I.S./P.S

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 COMPLE -TION						0			ASHPHALT: 80mm.t.				
									FILL: Gravelly sand, fine to medium grained, grey brown with medium igneous gravel.	M	-		APPEARS MODERATLY COMPACTED
					N >15 6,15				FILL: Gravelly silty sand, dark brown, with fine igneous and sandstone gravel, trace of ash and brick.		-		
					REFUSAL	1		-	SANDSTONE: fine grained, orange brown with iron indurated bands.	DW	M	-	HIGH 'TC' BIT RESISTANCE MODERATE WITH HIGH BANDS
						2							
								CL	SILTY CLAY: low plasticity, white.	MC<PL	H		VERY LOW RESISTANCE POSSIBLE DYKE
						3			SANDSTONE: fine grained, orange brown.	DW	M		MODERATE RESISTANCE
									SANDSTONE: fine grained, light grey brown.	SW	H		HIGH RESISTANCE
						4			REFER TO CORED BOREHOLE LOG				
						5							
						6							
						7							

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CORED BOREHOLE LOG

Borehole No. **2** **2/2**

Client: NSW HEALTH INFRASTRUCTURE
Project: PROPOSED NEW CAR PARK
Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Core Size:** NMLC **R.L. Surface:** ≈ 42.5m
Date: 14-11-12 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK350 **Bearing:** **Logged/Checked by:** I.S./P.S

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
		4		START CORING AT 4.3m					
		5		SANDSTONE: fine grained, brown.	DW	H			- J,45°,U,R clay - Be,0°,P,S,ls - J,U,45°,R,ls
				as above, but with coarse gravel size clast inclusions.					- XWS,20mm.t - XWS,140mm.t - XWS,20mm.t
				CORE LOSS: 0.36m					
		6		SANDSTONE: fine grained brown.	DW	VL			- XWS,20mm.t
						M			- J,90°,P,R,ls - Be,U,0-5°,ls - J,90,P,R,ls
		7		SANDSTONE: fine grained, grey.	SW	H			- Be,0-10°,U,R - Cr,10mm
		8							- Be,5°,U,R
		9							- Be,5°,U,R
				END OF BOREHOLE AT 9.12m					
		10							

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BOREHOLE LOG

Borehole No. 3
1/2

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 15-11-12

Method: SPIRAL AUGER
JK350

R.L. Surface: ≈ 42.0m
Datum: AHD

Logged/Checked by: I.S./P.S

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 COMPLE-TION OF AUGER-ING						0			ASHPHALT: 100mm.t.		-		
								-	FILL: Clayey sandy silt, dark brown, trace brick and charcoal, organic odour.	MC≈PL	-		APPEARS MODERATELY COMPACTED
					N = 10 1,1,9				FILL: Silty sand, fine grained, brown, trace brick and sandstone gravel.	M			
						1		-	SANDSTONE: fine grained, light grey mottled orange brown.	DW	M-H		MODERATE 'TC' BIT RESISTANCE
						2			SANDSTONE: fine grained, orange brown with light grey extremely weathered bands.		VL		VERY LOW TO LOW RESISTANCE
▼ AFTER CORING						3							
						4			SANDSTONE: fine grained, grey brown.		M		MODERATE RESISTANCE
									REFER TO CORED BOREHOLE LOG				
						5							
						6							
						7							

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CORED BOREHOLE LOG

Borehole No. **3** **2/2**

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Core Size:** NMLC **R.L. Surface:** ≈ 42.0m

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

Drill Type: JK350 **Bearing:** **Logged/Checked by:** I.S./P.S

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain character-istics, 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
		4		START CORING AT 4.55m					
		5		SANDSTONE: fine grained, orange brown and light grey.	DW	H			- J,45°,U,R - J,45°,P,R,clay seams - Be,0-5°,U,R,ls - XWS,10mm.t - XWS,10mm.t - J ,45°,P,R,ls - Be,0°,U,R,ls - J,60°,U,R - J,U,80°,R,ls - XWS,10mm.t - Cs,10mm.t - Be,0-20°,U,R,ls
		6		SANDSTONE: fine grained, brown, with coarse gravel size clast inclusions.	XW	EL			
				CORE LOSS: 0.38m					
		7		SANDSTONE: fine grained, orange brown and light grey.	XW DW XW DW	EL L EL M			- Be,U,0-5°,R,ls - Be,U,0-20°,S,ls - Be,0-5°,U,R,ls - healed joint - Be,0-10°,U,R
		8		CORE LOSS: 0.15m					
		9		SANDSTONE: fine to medium grained orange brown.	EL DW	XW M			- Be,0°,P,C,ls - J,45°,P,R - Be,5°,P,R,ls - Cr,S,40mm - XWS,40mm - J,45°,P,S,ls - J,45°,P,S,ls - J,80°,P,R - XWS,40mm - J,70,P,R - XWS,20mm
		10		END OF BOREHOLE AT 9.92m					

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BOREHOLE LOG

Borehole No. 4
1/3

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 15-11-12

Method: SPIRAL AUGER
JK350

R.L. Surface: ≈ 39.8m
Datum: AHD

Logged/Checked by: I.S./P.S

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
						0			ASHPHALT: 100mm.t.		-		
								-	FILL: Gravelly sand, fine to medium grained, fine igneous gravel.	M	-	-	
									FILL: Silty sand, fine grained dark brown, trace charcoal and ash.	M	-		
					N = 5 3,2,3	1							
									as above, but with trace sandstone gravel.				
					N >13 13/100mm				SANDSTONE: fine grained, orange brown with iron indurated bands.	XW	EL		
						2				DW	L-M		LOW 'TC' BIT RESISTANCE WITH MODERATE BANDS
						3				XW	EL		VERY LOW RESISTANCE BANDS
						4			SANDSTONE: fine grained, grey and orange brown.	DW	L-M		LOW TO MODERATE RESISTANCE
▼ ON COMPLE -TION OF CORING						5							
						6			as above, but with grey extremely weathered seams.		VL		VERY LOW RESISTANCE WITH MODERATE BANDS.
						7							

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BOREHOLE LOG

Borehole No. 4
2/3

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 15-11-12

Method: SPIRAL AUGER
JK350

R.L. Surface: ≈ 39.8m
Datum: AHD

Logged/Checked by: I.S./P.S

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
						8		-	SANDSTONE: fine grained, brown with extremely weathered seams.	DW	VL		VERY LOW TO LOW RESISTANCE WITH MODERATE BANDS
						9							
						10							
ON COMPLETION OF AUGERING.						11			SANDSTONE: fine grained, light grey.	SW	M		
						12			REFER TO CORED BOREHOLE LOG				
						13							
						14							

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CORED BOREHOLE LOG

Borehole No. **4** **3/3**

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Core Size:** NMLC **R.L. Surface:** ≈ 39.8m

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

Drill Type: JK350 **Bearing:** **Logged/Checked by:** I.S./P.S

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 DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		11		START CORING AT 11.7m					
		12		SANDSTONE: fine grained, grey.	F	H			- J,45°,U,R - XWS,30mm.
		13							- Be,U,0-5°,Is
		14							
				END OF BOREHOLE AT 14.45m					
		15							
		16							
		17							

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BOREHOLE LOG

Borehole No. **5** 1/3

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Method:** SPIRAL AUGER JK350 **R.L. Surface:** ≈ 33.0m

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

Logged/Checked by: I.S./P.S

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
						0			ASHPHALT: 80mm.t.				
	■							-	FILL: Gravelly sand, fine to medium grained igneous gravel.	D	-		
	■			■	N = 15 7,8,7			CL	SILTY CLAY: medium plasticity, light grey and orange brown mottled brown.	MC≈PL	VSt	400 470 390	RESIDUAL
						1							
				■	N = 35 11,17,16			CL	SANDY CLAY: low plasticity, light grey mottled red brown and orange brown.		VSt- H	370 410 450	
						2							
				■	N = 25 9,10,15					MC<PL	H	400 510 >600	
▼ AFTER CORING						3							
									SANDY CLAY: low plasticity, orange brown with sandstone gravel.				
▼ ON COMPLE -TION OF AUGER -ING				■	N = SPT 12/130mm	4		-	SANDSTONE: fine grained, brown.	DW	VL	-	VERY LOW 'TC' BIT RESISTANCE
						5							
						6							
						7			SANDSTONE: fine grained, grey.		L		LOW RESISTANCE

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BOREHOLE LOG

Borehole No. **5** 2/3

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Method:** SPIRAL AUGER JK350 **R.L. Surface:** ≈ 33.0m

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

Logged/Checked by: I.S./P.S

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
				■					SANDSTONE: fine grained, grey.	SW	M		MODERATE RESISTANCE
						8			REFER TO CORED BOREHOLE LOG				
						9							
						10							
						11							
						12							
						13							
						14							

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CORED BOREHOLE LOG

Borehole No. **5** **3/3**

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Core Size:** NMLC **R.L. Surface:** ≈ 33.0m

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

Drill Type: JK350 **Bearing:** **Logged/Checked by:** I.S./P.S

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 DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		7		START CORING AT 7.68					
		8		SANDSTONE: fine grained, light grey and orange brown.	DW	M			- xws,20mm.t
						L			- Be,20°,P,R,Is
						M			
					XW	EL			- J,45,P,R
				SANDSTONE: fine grained, light grey.	SW	M			-Healed J,90°
		9							- J,40°,U,R
		10				H			- J,45°,U,R
				END OF BOREHOLE AT 10.45m					- 50mm,shale band high strength
		11							
		12							
		13							

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BOREHOLE LOG

Borehole No. 6
1/2

Client: NSW HEALTH INFRASTRUCTURE
Project: PROPOSED NEW CAR PARK
Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 16-11-12
Method: SPIRAL AUGER JK350
R.L. Surface: ≈ 37.0m
Datum: AHD
Logged/Checked by: I.S./P.S

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
						0			ASHPHALT: 400mm.t.				
					N = 30 7,18,12	1		CL	SANDY GRAVELLY CLAY: medium plasticity, red brown and light grey, with medium to coarse sandstone gravel.	MC<PL	H	500 500 >600	
▼ AFTER CORING						2		-	SANDSTONE: fine grained, brown and grey.	DW	M		MODERATE 'TC' BIT RESISTANCE
									SANDSTONE: fine grained, light grey.		H		MODERATE TO HIGH RESISTANCE
						3			REFER TO CORED BOREHOLE LOG				
						4							
						5							
						6							
						7							

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CORED BOREHOLE LOG

Borehole No. 6
2/2

Client: NSW HEALTH INFRASTRUCTURE
Project: PROPOSED NEW CAR PARK
Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S | **Core Size:** NMLC | **R.L. Surface:** ≈ 37.0m
Date: 16-11-12 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK350 | **Bearing:** | **Logged/Checked by:** I.S./P.S

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain character-istics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		2		START CORING AT 2.96m					
		3		SANDSTONE: fine grained, light grey.	F	H			
		4			SW F				- Be,10°,U,R,Is
		5			SW	M			- Be,U,0-5°,U - Be,0-5°,U,R,Is - Be,0-5°,U,R,Is
					F	H			
		6		END OF BOREHOLE AT 5.97m					
		7							
		8							
		9							

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BOREHOLE LOG

Borehole No. 7
1/2

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S
Date: 16-11-12

Method: SPIRAL AUGER
JK350

R.L. Surface: ≈ 35.4m
Datum: AHD

Logged/Checked by: I.S./P.S

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 COMPLE-TION OF AUGER-ING						0			ASHPHALT: 250mm.t.				
					N = 4 2,2,2			-	FILL: Silty clay, red brown, trace of clinker and fine brick.	MC>PL	-		
						1		CL	SILTY CLAY: low to medium plasticity, brown.	MC>PL	S-F		RESIDUAL
					N = 12 2,6,6			CL	SANDY CLAY: low plasticity, orange brown, trace sandstone gravel.	MC≈PL	VSt	350 350 400	
▼ AFTER CORING						2		-	SANDSTONE: fine grained, orange brown.	DW	VL-L		LOW 'TC' BIT RESISTANCE
						3					M		
									SANDSTONE: fine grained, light grey.		H		MODERATE TO HIGH RESISTANCE
									REFER TO CORED BOREHOLE LOG				
						4							
						5							
						6							
						7							

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CORED BOREHOLE LOG

Borehole No. 7
2/2

Client: NSW HEALTH INFRASTRUCTURE
Project: PROPOSED NEW CAR PARK
Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S | **Core Size:** NMLC | **R.L. Surface:** ≈ 35.4m
Date: 16-11-12 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK350 | **Bearing:** | **Logged/Checked by:** I.S./P.S

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 DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		3		START CORING AT 3.8m					
		4		SANDSTONE: fine grained, grey.	F	H			
		5							
		6							
		7		END OF BOREHOLE AT 6.87m					
		8							
		9							

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BOREHOLE LOG

Borehole No. **8** 1/1

Client: NSW HEALTH INFRASTRUCTURE

Project: PROPOSED NEW CAR PARK

Location: WOLLONGONG HOSPITAL, 3-15 DUDLEY STREET, WOLLONGONG, NSW

Job No. 26129S **Method:** HAND AUGER **R.L. Surface:** ≈ 40.5m

Date: 16-11-12 **Datum:** AHD

Logged/Checked by: I.S./P.S

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
	■					0			FILL: Silty sand, fine grained, trace brick and root.	D			
									HAND AUGER REFUSAL AT 0.4m				
						1							
						2							
						3							
						4							
						5							
						6							
						7							

REPORT EXPLANATION NOTES

INTRODUCTION

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

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

DESCRIPTION AND CLASSIFICATION METHODS

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

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

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

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

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

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

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

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

SAMPLING

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

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

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

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

INVESTIGATION METHODS

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

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

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

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

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

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

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

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

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

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

The test results are reported in the following form:

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

  N = 13
  4, 6, 7

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

  N>30
  15, 30/40mm

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

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

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

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

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

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

The information provided on the charts comprise:

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

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

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

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

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

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

Two relatively similar tests are used:

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

LOGS

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

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

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

GROUNDWATER

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

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

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

FILL

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

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

LABORATORY TESTING

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

ENGINEERING REPORTS

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

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

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

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

SITE ANOMALIES

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

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

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

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

REVIEW OF DESIGN

Where major civil or structural developments are proposed 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.

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

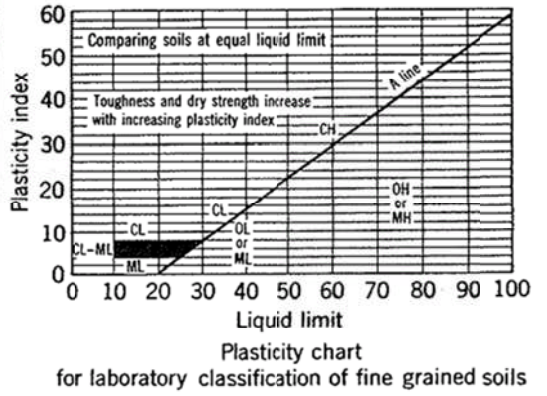

ORGANIC MATERIAL

OTHER MATERIALS


CONCRETE


BITUMINOUS CONCRETE, COAL


COLLUVIUM

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 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*)	Use grain size curve in identifying the fractions as given under field identification Determine percentages of gravel and sand from grain size curve Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP* More than 12% *GM, GC, SM, SC* 5% to 12% *Borderline* cases requiring use of dual symbols $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 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 $C_U = \frac{D_{60}}{D_{10}}$ 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
		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		
			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		
Fine-grained soils More than half of material is *smaller* than 75 μm sieve size (The 75 μm sieve size is about the smallest particle visible to naked eye)	Identification Procedures on Fraction Smaller than 380 μm Sieve Size					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*)	 Plasticity chart for laboratory classification of fine grained soils
	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	
		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	

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. 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.

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 (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 0-4
	L	Loose 15-35 4-10
	MD	Medium Dense 35-65 10-30
	D	Dense 65-85 30-50
	VD	Very Dense >85 >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

LOG SYMBOLS continued

ROCK MATERIAL WEATHERING CLASSIFICATION

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

ROCK STRENGTH

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

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

ABBREVIATIONS USED IN DEFECT DESCRIPTION

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

APPENDIX B

Laboratory Reports and Chain of Custody Documents

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

CERTIFICATE OF ANALYSIS 81831

Client:

Environmental Investigation Services
PO Box 976
North Ryde BC
NSW 1670

Attention: Brendan Page

Sample log in details:

Your Reference:	**E26129KP, Wollongong**
No. of samples:	27 Soils
Date samples received / completed instructions received	19/11/2012 / 19/11/2012

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	26/11/12 / 22/11/12
Date of Preliminary Report:	Not issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Nancy Zhang
Chemist

Rhian Morgan
Reporting Supervisor

Lulu Guo
Approved Signatory

ACCREDITED FOR TECHNICAL COMPETENCE

vTRH & BTEX in Soil						
Our Reference:	UNITS	81831-1	81831-3	81831-4	81831-6	81831-7
Your Reference	----------	BH1	BH2	BH2	BH3	BH3
Depth	----------	0.2-0.4	0.2-0.3	0.5-0.7	0.2-0.4	0.6-0.8
Date Sampled		14/11/2012	14/11/2012	14/11/2012	15/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
vTRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	104	120	111	102	106

vTRH & BTEX in Soil						
Our Reference:	UNITS	81831-8	81831-10	81831-13	81831-14	81831-15
Your Reference	----------	BH3	BH4	BH5	BH5	BH6
Depth	----------	1.0-1.2	0.5-0.7	0.2-0.4	0.5-0.7	0.4-0.5
Date Sampled		15/11/2012	15/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
vTRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	114	121	121	112	122

vTRH & BTEX in Soil						
Our Reference:	UNITS	81831-17	81831-21	81831-23	81831-26	81831-27
Your Reference	----------	BH7	BH8	DUP1	Trip Blank	TS
Depth	----------	0.3-0.4	0-0.1	-	-	-
Date Sampled		16/11/2012	16/11/2012	16/11/2012	16/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
vTRH C_6 - C_9	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	99%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	99%
Ethylbenzene	mg/kg	<1	<1	<1	<1	99%
m+p-xylene	mg/kg	<2	<2	<2	<2	99%
o-Xylene	mg/kg	<1	<1	<1	<1	100%
Surrogate aaa-Trifluorotoluene	%	116	118	102	116	100

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	81831-1	81831-3	81831-4	81831-6	81831-7
Your Reference	----------	BH1	BH2	BH2	BH3	BH3
Depth	----------	0.2-0.4	0.2-0.3	0.5-0.7	0.2-0.4	0.6-0.8
Date Sampled		14/11/2012	14/11/2012	14/11/2012	15/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	340
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	240
Surrogate o-Terphenyl	%	84	85	86	88	102

sTRH in Soil (C10-C36)						
Our Reference:	UNITS	81831-8	81831-10	81831-13	81831-14	81831-15
Your Reference	----------	BH3	BH4	BH5	BH5	BH6
Depth	----------	1.0-1.2	0.5-0.7	0.2-0.4	0.5-0.7	0.4-0.5
Date Sampled		15/11/2012	15/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	120	<100	<100
Surrogate o-Terphenyl	%	85	84	91	88	84

sTRH in Soil (C10-C36)				
Our Reference:	UNITS	81831-17	81831-21	81831-23
Your Reference	----------	BH7	BH8	DUP1
Depth	----------	0.3-0.4	0-0.1	-
Date Sampled		16/11/2012	16/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100
Surrogate o-Terphenyl	%	85	82	80

PAHs in Soil						
Our Reference:	UNITS	81831-1	81831-3	81831-4	81831-6	81831-7
Your Reference	----------	BH1	BH2	BH2	BH3	BH3
Depth	----------	0.2-0.4	0.2-0.3	0.5-0.7	0.2-0.4	0.6-0.8
Date Sampled		14/11/2012	14/11/2012	14/11/2012	15/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	22/11/2012	22/11/2012	22/11/2012	22/11/2012	22/11/2012
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	0.3	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	0.3	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	0.3	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	0.2	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	0.3	<0.1
Benzo(b+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	0.4	<0.2
Benzo(a)pyrene	mg/kg	0.05	<0.05	<0.05	0.24	<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	0.2	<0.1
Surrogate p-Terphenyl-d_{14}	%	92	93	91	93	95

PAHs in Soil						
Our Reference:	UNITS	81831-8	81831-10	81831-13	81831-14	81831-15
Your Reference	----------	BH3	BH4	BH5	BH5	BH6
Depth	----------	1.0-1.2	0.5-0.7	0.2-0.4	0.5-0.7	0.4-0.5
Date Sampled		15/11/2012	15/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	22/11/2012	22/11/2012	22/11/2012	22/11/2012	22/11/2012
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}	%	95	91	91	96	91

PAHs in Soil				
Our Reference:	UNITS	81831-17	81831-21	81831-23
Your Reference	----------	BH7	BH8	DUP1
Depth	----------	0.3-0.4	0-0.1	-
Date Sampled		16/11/2012	16/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	22/11/2012	22/11/2012	22/11/2012
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	0.07	<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}	%	93	89	89

Organochlorine Pesticides in soil						
Our Reference:	UNITS	81831-1	81831-4	81831-6	81831-8	81831-15
Your Reference	----------	BH1	BH2	BH3	BH3	BH6
Depth	----------	0.2-0.4	0.5-0.7	0.2-0.4	1.0-1.2	0.4-0.5
Date Sampled		14/11/2012	14/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
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 TCMX	%	80	89	89	82	81

Organochlorine Pesticides in soil			
Our Reference:	UNITS	81831-17	81831-21
Your Reference	----------	BH7	BH8
Depth	----------	0.3-0.4	0-0.1
Date Sampled		16/11/2012	16/11/2012
Type of sample		Soil	Soil
Date extracted	-	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012
HCB	mg/kg	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1
Surrogate TCMX	%	84	79

Organophosphorus Pesticides						
Our Reference:	UNITS	81831-1	81831-4	81831-6	81831-8	81831-15
Your Reference	----------	BH1	BH2	BH3	BH3	BH6
Depth	----------	0.2-0.4	0.5-0.7	0.2-0.4	1.0-1.2	0.4-0.5
Date Sampled		14/11/2012	14/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
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 TCMX	%	80	89	89	82	81

Organophosphorus Pesticides			
Our Reference:	UNITS	81831-17	81831-21
Your Reference	----------	BH7	BH8
Depth	----------	0.3-0.4	0-0.1
Date Sampled		16/11/2012	16/11/2012
Type of sample		Soil	Soil
Date extracted	-	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012
Diazinon	mg/kg	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1
Surrogate TCMX	%	84	79

PCBs in Soil						
Our Reference:	UNITS	81831-1	81831-4	81831-6	81831-8	81831-15
Your Reference	----------	BH1	BH2	BH3	BH3	BH6
Depth	----------	0.2-0.4	0.5-0.7	0.2-0.4	1.0-1.2	0.4-0.5
Date Sampled		14/11/2012	14/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
Arochlor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Arochlor 1221	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	%	80	89	89	82	81

PCBs in Soil			
Our Reference:	UNITS	81831-17	81831-21
Your Reference	----------	BH7	BH8
Depth	----------	0.3-0.4	0-0.1
Date Sampled		16/11/2012	16/11/2012
Type of sample		Soil	Soil
Date extracted	-	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012
Arochlor 1016	mg/kg	<0.1	<0.1
Arochlor 1221	mg/kg	<0.1	<0.1
Arochlor 1232	mg/kg	<0.1	<0.1
Arochlor 1242	mg/kg	<0.1	<0.1
Arochlor 1248	mg/kg	<0.1	<0.1
Arochlor 1254	mg/kg	<0.1	<0.1
Arochlor 1260	mg/kg	<0.1	<0.1
Surrogate TCLMX	%	84	79

Acid Extractable metals in soil						
Our Reference:	UNITS	81831-1	81831-3	81831-4	81831-6	81831-7
Your Reference	----------	BH1	BH2	BH2	BH3	BH3
Depth	----------	0.2-0.4	0.2-0.3	0.5-0.7	0.2-0.4	0.6-0.8
Date Sampled		14/11/2012	14/11/2012	14/11/2012	15/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Arsenic	mg/kg	5	<4	14	16	9
Cadmium	mg/kg	<0.5	<0.5	<0.5	1	<0.5
Chromium	mg/kg	13	4	9	23	18
Copper	mg/kg	17	270	140	100	7
Lead	mg/kg	12	8	150	310	7
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	4	7	7	10	2
Zinc	mg/kg	30	51	170	560	24

Acid Extractable metals in soil						
Our Reference:	UNITS	81831-8	81831-10	81831-13	81831-14	81831-15
Your Reference	----------	BH3	BH4	BH5	BH5	BH6
Depth	----------	1.0-1.2	0.5-0.7	0.2-0.4	0.5-0.7	0.4-0.5
Date Sampled		15/11/2012	15/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Arsenic	mg/kg	6	8	<4	<4	5
Cadmium	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	10	16	27	11	14
Copper	mg/kg	8	6	18	9	11
Lead	mg/kg	8	7	<1	10	10
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	1	2	1	<1	2
Zinc	mg/kg	17	22	5	4	12

Acid Extractable metals in soil					
Our Reference:	UNITS	81831-17	81831-21	81831-23	81831-28
Your Reference	----------	BH7	BH8	DUP1	BH5 Triplicate
Depth	----------	0.3-0.4	0-0.1	-	0.5-0.7
Date Sampled		16/11/2012	16/11/2012	16/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil
Date digested	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Arsenic	mg/kg	7	7	6	6
Cadmium	mg/kg	<0.5	1.0	<0.5	<0.5
Chromium	mg/kg	29	15	13	16
Copper	mg/kg	16	56	23	8
Lead	mg/kg	12	160	9	12
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	7	5	<1
Zinc	mg/kg	20	250	29	2

Moisture						
Our Reference:	UNITS	81831-1	81831-3	81831-4	81831-6	81831-7
Your Reference	----------	BH1	BH2	BH2	BH3	BH3
Depth	----------	0.2-0.4	0.2-0.3	0.5-0.7	0.2-0.4	0.6-0.8
Date Sampled		14/11/2012	14/11/2012	14/11/2012	15/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
Moisture	%	19	6.8	12	23	16

Moisture						
Our Reference:	UNITS	81831-8	81831-10	81831-13	81831-14	81831-15
Your Reference	----------	BH3	BH4	BH5	BH5	BH6
Depth	----------	1.0-1.2	0.5-0.7	0.2-0.4	0.5-0.7	0.4-0.5
Date Sampled		15/11/2012	15/11/2012	15/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	20/11/2012	20/11/2012	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012	21/11/2012	21/11/2012
Moisture	%	6.9	15	10	18	14

Moisture				
Our Reference:	UNITS	81831-17	81831-21	81831-23
Your Reference	----------	BH7	BH8	DUP1
Depth	----------	0.3-0.4	0-0.1	-
Date Sampled		16/11/2012	16/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil
Date prepared	-	20/11/2012	20/11/2012	20/11/2012
Date analysed	-	21/11/2012	21/11/2012	21/11/2012
Moisture	%	23	11	18

Asbestos ID - soils						
Our Reference:	UNITS	81831-1	81831-3	81831-4	81831-6	81831-7
Your Reference	----------	BH1	BH2	BH2	BH3	BH3
Depth	----------	0.2-0.4	0.2-0.3	0.5-0.7	0.2-0.4	0.6-0.8
Date Sampled		14/11/2012	14/11/2012	14/11/2012	15/11/2012	15/11/2012
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	22/11/2012	22/11/2012	22/11/2012	22/11/2012	22/11/2012
Sample mass tested	g	Approx 25g	Approx 55g	Approx 40g	Approx 30g	Approx 45g
Sample Description	-	Brown fine-grained soil & rocks	Grey fine-grained soil & rocks	Dark brown fine-grained soil & rocks	Dark grey fine-grained soil & rocks	Brown fine-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected

Asbestos ID - soils					
Our Reference:	UNITS	81831-10	81831-13	81831-17	81831-21
Your Reference	----------	BH4	BH5	BH7	BH8
Depth	----------	0.5-0.7	0.2-0.4	0.3-0.4	0-0.1
Date Sampled		15/11/2012	15/11/2012	16/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	22/11/2012	22/11/2012	22/11/2012	22/11/2012
Sample mass tested	g	Approx 30g	Approx 45g	Approx 35g	Approx 20g
Sample Description	-	Dark grey fine-grained soil & rocks	Light grey fine-grained soil & rocks	Orange brown fine-grained clay soil	Dark grey fine-grained soil
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg	No asbestos detected at reporting limit of 0.1g/kg
Trace Analysis	-	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected	No respirable fibres detected

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-008	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-6	20/11/2012
Date analysed	-			21/11/2012	81831-1	21/11/2012 || 21/11/2012	LCS-6	21/11/2012
vTRH C_6 - C_9	mg/kg	25	Org-016	<25	81831-1	<25 || <25	LCS-6	100%
Benzene	mg/kg	0.2	Org-016	<0.2	81831-1	<0.2 || <0.2	LCS-6	103%
Toluene	mg/kg	0.5	Org-016	<0.5	81831-1	<0.5 || <0.5	LCS-6	99%
Ethylbenzene	mg/kg	1	Org-016	<1	81831-1	<1 || <1	LCS-6	96%
m+p-xylene	mg/kg	2	Org-016	<2	81831-1	<2 || <2	LCS-6	102%
o-Xylene	mg/kg	1	Org-016	<1	81831-1	<1 || <1	LCS-6	98%
Surrogate aaa-Trifluorotoluene	%		Org-016	124	81831-1	104 || 109 || RPD: 5	LCS-6	112%
QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-6	20/11/2012
Date analysed	-			21/11/2012	81831-1	21/11/2012 || 21/11/2012	LCS-6	21/11/2012
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	81831-1	<50 || <50	LCS-6	81%
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	81831-1	<100 || <100	LCS-6	89%
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	81831-1	<100 || <100	LCS-6	97%
Surrogate o-Terphenyl	%		Org-003	60	81831-1	84 || 85 || RPD: 1	LCS-6	93%
QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-6	20/11/2012
Date analysed	-			22/11/2012	81831-1	22/11/2012 || 22/11/2012	LCS-6	22/11/2012
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	LCS-6	99%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	LCS-6	94%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	LCS-6	92%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	0.1 || <0.1	LCS-6	91%
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	0.1 || <0.1	LCS-6	92%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	LCS-6	94%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Benzo(b+k)fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	81831-1	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	81831-1	0.05 || <0.05	LCS-6	99%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		Org-012 subset	91	81831-1	92 || 98 || RPD: 6	LCS-6	70%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-1	20/11/2012
Date analysed	-			21/11/2012	81831-1	21/11/2012 || 21/11/2012	LCS-1	21/11/2012
HCB	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	79%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	82%
Heptachlor	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	79%
delta-BHC	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	84%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	84%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	88%
Dieldrin	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	87%
Endrin	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	82%
pp-DDD	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	95%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	LCS-1	87%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	69	81831-1	80 || 83 || RPD: 4	LCS-1	80%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-1	20/11/2012
Date analysed	-			21/11/2012	81831-1	21/11/2012 || 21/11/2012	LCS-1	21/11/2012
Diazinon	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Dimethoate	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Ronnel	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	LCS-1	81%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	LCS-1	89%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	81831-1	<0.1 || <0.1	LCS-1	85%
Surrogate TCMX	%		Org-008	69	81831-1	80 || 83 || RPD: 4	LCS-1	80%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-1	20/11/2012
Date analysed	-			21/11/2012	81831-1	21/11/2012 || 21/11/2012	LCS-1	21/11/2012
Arochlor 1016	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	LCS-1	102%
Arochlor 1260	mg/kg	0.1	Org-006	<0.1	81831-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	69	81831-1	80 || 83 || RPD: 4	LCS-1	78%

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	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-1	20/11/2012
Date analysed	-			20/11/2012	81831-1	20/11/2012 || 20/11/2012	LCS-1	20/11/2012
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	81831-1	5 || 5 || RPD: 0	LCS-1	104%
Cadmium	mg/kg	0.5	Metals-020 ICP-AES	<0.5	81831-1	<0.5 || <0.5	LCS-1	106%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	81831-1	13 || 12 || RPD: 8	LCS-1	106%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	81831-1	17 || 20 || RPD: 16	LCS-1	104%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	81831-1	12 || 13 || RPD: 8	LCS-1	104%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	81831-1	<0.1 || <0.1	LCS-1	94%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	81831-1	4 || 4 || RPD: 0	LCS-1	104%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	81831-1	30 || 34 || RPD: 12	LCS-1	105%

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

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

QUALITY CONTROL vTRH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	81831-14	20/11/2012 || 20/11/2012	81831-2	20/11/2012
Date analysed	-	81831-14	21/11/2012 || 21/11/2012	81831-2	21/11/2012
vTRH C_6 - C_9	mg/kg	81831-14	<25 || <25	81831-2	98%
Benzene	mg/kg	81831-14	<0.2 || <0.2	81831-2	100%
Toluene	mg/kg	81831-14	<0.5 || <0.5	81831-2	96%
Ethylbenzene	mg/kg	81831-14	<1 || <1	81831-2	94%
m+p-xylene	mg/kg	81831-14	<2 || <2	81831-2	101%
o-Xylene	mg/kg	81831-14	<1 || <1	81831-2	96%
Surrogate aaa-Trifluorotoluene	%	81831-14	112 || 119 || RPD: 6	81831-2	120%

QUALITY CONTROL sTRH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	81831-14	20/11/2012 || 20/11/2012	81831-3	20/11/2012
Date analysed	-	81831-14	21/11/2012 || 21/11/2012	81831-3	21/11/2012
TRH C_{10} - C_{14}	mg/kg	81831-14	<50 || <50	81831-3	91%
TRH C_{15} - C_{28}	mg/kg	81831-14	<100 || <100	81831-3	103%
TRH C_{29} - C_{36}	mg/kg	81831-14	<100 || <100	81831-3	104%
Surrogate o-Terphenyl	%	81831-14	88 || 85 || RPD: 3	81831-3	116%

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	81831-14	20/11/2012 || 20/11/2012	81831-3	20/11/2012
Date analysed	-	81831-14	22/11/2012 || 22/11/2012	81831-3	22/11/2012
Naphthalene	mg/kg	81831-14	<0.1 || <0.1	81831-3	104%
Acenaphthylene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	81831-14	<0.1 || <0.1	81831-3	100%
Phenanthrene	mg/kg	81831-14	<0.1 || <0.1	81831-3	99%
Anthracene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Fluoranthene	mg/kg	81831-14	<0.1 || <0.1	81831-3	101%
Pyrene	mg/kg	81831-14	<0.1 || <0.1	81831-3	102%
Benzo(a)anthracene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	81831-14	<0.1 || <0.1	81831-3	96%
Benzo(b+k)fluoranthene	mg/kg	81831-14	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	81831-14	<0.05 || <0.05	81831-3	104%
Indeno(1,2,3-c,d)pyrene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	81831-14	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	81831-14	96 || 92 || RPD: 4	81831-3	88%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	81831-14	20/11/2012 || 20/11/2012	81831-3	20/11/2012
Date analysed	-	81831-14	20/11/2012 || 20/11/2012	81831-3	20/11/2012
Arsenic	mg/kg	81831-14	<4 || 10	81831-3	92%
Cadmium	mg/kg	81831-14	<0.5 || <0.5	81831-3	92%
Chromium	mg/kg	81831-14	11 || 18 || RPD: 48	81831-3	98%
Copper	mg/kg	81831-14	9 || 18 || RPD: 67	81831-3	#
Lead	mg/kg	81831-14	10 || 12 || RPD: 18	81831-3	88%
Mercury	mg/kg	81831-14	<0.1 || <0.1	81831-3	89%
Nickel	mg/kg	81831-14	<1 || 2	81831-3	88%
Zinc	mg/kg	81831-14	4 || 18 || RPD: 127	81831-3	78%

Report Comments:

Acid Extractable Metals in Soil:# Percent recovery is not possible to report due to the inhomogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Acid Extractable Metals in Soil:Acid Extractable Metals in Soil: The laboratory RPD acceptance criteriae has been exceeded for 81831-14 for Cu,Zn. Therefore a triplicate result has been issued as laboratory sample number 81831-28.

Asbestos:

All samples analysed as received. However, sample 81831-1,6,10,17&21 are below the recommended volume of 40-50g (50mL) as per AS4964-2004. This insufficient sample size may lead to inaccurate interpretation of the result as it may not be representative of the sampled area.

Asbestos ID was analysed by Approved Identifier: Lulu Guo
Asbestos ID was authorised by Approved Signatory: Lulu Guo

INS: Insufficient sample for this test
NA: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

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

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

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

SAMPLE RECEIPT ADVICE

Client:

Environmental Investigation Services
PO Box 976
North Ryde BC NSW 1670

ph: 02 9888 5000
Fax: 02 9888 5001

Attention: Brendan Page

Sample log in details:

Your reference:	**E26129KP, Wollongong**
Envirolab Reference:	**81831**
Date received:	19/11/2012
Date results expected to be reported:	**26/11/12**

Samples received in appropriate condition for analysis:	YES
No. of samples provided	27 Soils
Turnaround time requested:	Standard
Temperature on receipt	Cool
Cooling Method:	Ice Pack
Sampling Date Provided:	YES

Comments:

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

Contact details:

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

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
Envirolab Services Pty Ltd 12 Ashley Street Chatswood NSW 2067 Phone: (02) 99106200 Fax: (02) 99106201 Attention: Aileen	EIS Job Number: E26129KP Date Results Required: Standard Sheet 1 / 2	Environmental Investigation Services Rear 115 Wicks Road Macquarie Park NSW 2113 Phone: (02) 9888 5000 Fax: (02) 9888 5004 Contact: Brendan Page

Project: Proposed Development
Location: Wollongong
Sampler: IS

Sample Preservation: In esky on ice

Tests Required

Date Sampled	Lab Ref:	Borehole/ Sample Number	Depth (m)	Sample Container	PID	Sample Description Soil	#6	#6a	#3a	#3		BTEX				TCLP 6 Metals	TCLP PAHs	
14-11-12	1)	BH 1	0.2/0.4	Glass jar + Asb Bag	0	Fill (F)		X										
	2)	BH 1	0.5/0.7	Glass jar + Asb Bag	0	Natural (N)												
	3)	BH 2	0.2/0.3	Glass jar + Asb Bag	0	F			X									
	4)	BH2	0.5/0.7	Glass jar + Asb Bag	0	F		X										
	5)	BH2	1.0/1.2	Glass jar + Asb Bag	0	N												
15-11-12	6)	BH3	0.2/0.4	Glass jar + Asb Bag	0	F		X										
	7)	BH3	0.4/0.8	Glass jar + Asb Bag	0	F			X									
	8)	BH3	1.0/1.2	Glass jar + Asb Bag	0	N	X											
	9)	BH4	0.1/0.3	Glass jar + Asb Bag	0	F												
	10)	BH4	0.5/0.7	Glass jar + Asb Bag	0	F			X									
	11)	BH4	1/1.2	Glass jar + Asb Bag	0	F												
	12)	BH4	1.5/1.2	Glass jar + Asb Bag	0	N												
	13)	BH5	0.2/0.4	Glass jar + Asb Bag	0	F			X									
	14)	BH5	0.5/0.7	Glass jar + Asb Bag	0	N				X								
16-11-12	15)	BH6	0.4/0.5	Glass jar + Asb Bag	0	N	X											
	16)	BH6	0.5/0.7	Glass jar + Asb Bag	0	N												
	17)	BH7	0.3/0.4	Glass jar + Asb Bag	0	F		X										
	18)	BH7	0.6/0.8	Glass jar + Asb Bag	0	F												
	19)	BH7	1.0/1.2	Glass jar + Asb Bag	0	N												
	20)	BH7	1.5/1.8	Glass jar + Asb Bag	0	N												
	21)	BH8	0/0.1	Glass jar + Asb Bag	0	F		X										
	22)	BH8	0.3/0.4	Glass jar + Asb Bag	0	F												
-	23)	Dup 1	-	Glass jar + ~~Asb Bag~~	-	-				X								
-	24)	Dup 2	-	Glass jar + ~~Asb Bag~~	-	-												
-	25)	Dup 3	-	Glass jar + ~~Asb Bag~~	-	-												

ENVIROLAB

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

Job No: 8831

Date Received: 19/11/12
Time Received: 14:45
Received by: PT
Temp: Cool / Ambient
Cooling: Ice/icepack
Security: Intact / Broken / None

Remarks (comments/detection limits required):

Relinquished By:	Date:	Time:	Received By:	
BP	19/11/12	10:30am	Phat	19/11/12 14:45

SAMPLE AND CHAIN OF CUSTODY FORM

TO:		FROM:
Envirolab Services Pty Ltd 12 Ashley Street Chatswood NSW 2067 Phone: (02) 99106200 Fax: (02) 99106201 Attention: Aileen	EIS Job Number: E26129KP Date Results Required: Standard Sheet 2 / 2	Environmental Investigation Services Rear 115 Wicks Road Macquarie Park NSW 2113 Phone: (02) 9888 5000 Fax: (02) 9888 5004 Contact: Brendan Page

Project: Proposed Development		Sample Preservation:
Location: Wollongong		In esky on ice
Sampler: IS	Tests Required	

Date Sampled	Lab Ref:	Borehole/ Sample Number	Depth (m)	Sample Container	PID	Sample Description	#6	#6a	#3a	#3		BTEX				TCLP 6 Metals	TCLP PAHs	
14-16-11-12	26	Trip Blank	–	Glass jar + ~~Asb Bag~~	–	Sand blank						X						
↓	27	T.S	–	Glass jar + ~~Asb Bag~~	–	Soil spike						X						
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
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				Glass jar + Asb Bag														
				Glass jar + Asb Bag														
				Glass jar + Asb Bag														

Remarks (comments/detection limits required): 81831

Relinquished By:	Date:	Time:	Received By:	
BP	19/11/12	10:30am	Pcat	19/11/12 14:45

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

CERTIFICATE OF ANALYSIS 81831-A

Client:

Environmental Investigation Services
PO Box 976
North Ryde BC
NSW 1670

Attention: Brendan Page

Sample log in details:

Your Reference:	**E26129KP, Wollongong**
No. of samples:	Additional testing on 3 soils
Date samples received / completed instructions received	19/11/2012 / 23/11/12

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	30/11/12 / 27/11/12
Date of Preliminary Report:	Not issued

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

Results Approved By:

Rhian Morgan
Reporting Supervisor

Metals in TCLP USEPA1311				
Our Reference:	UNITS	81831-A-4	81831-A-6	81831-A-21
Your Reference	----------	BH2	BH3	BH8
Depth	----------	0.5-0.7	0.2-0.4	0-0.1
Date Sampled		14/11/2012	15/11/2012	16/11/2012
Type of sample		Soil	Soil	Soil
Date extracted	-	26/11/2012	26/11/2012	26/11/2012
Date analysed	-	26/11/2012	26/11/2012	26/11/2012
pH of soil for fluid# determ.	pH units	6.9	8.6	8.3
pH of soil for fluid # determ. (acid)	pH units	1.6	1.7	1.6
Extraction fluid used	-	1	1	1
pH of final Leachate	pH units	5.1	5.7	5.0
Lead in TCLP	mg/L	0.1	0.08	<0.03

Method ID	Methodology Summary
Inorg-004	Toxicity Characteristic Leaching Procedure (TCLP) using AS 4439 and USEPA 1311.
EXTRACT.7	Toxicity Characteristic Leaching Procedure (TCLP).
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.

QUALITY CONTROL Metals in TCLP USEPA1311	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			26/11/2012	[NT]	[NT]	LCS-W1	26/11/2012
Date analysed	-			26/11/2012	[NT]	[NT]	LCS-W1	26/11/2012
Lead in TCLP	mg/L	0.03	Metals-020 ICP-AES	<0.03	[NT]	[NT]	LCS-W1	94%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

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

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

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

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

Aileen Hie

From: Brendan Page [bpage@jkgroup.net.au]
Sent: Friday, 23 November 2012 6:47 AM
To: Aileen Hie
Subject: Additional Analysis 81831 (E26129KP, Wollongong)

Hi Aileen,

Could you please arrange for the following additional analysis to be undertaken on the soil samples in Envirolabs custody:

TCLP (acid) lead on samples

81831-4
81831-6
81831-21

Standard turnaround

81831 A
std T/A
due 30/11

Thanks ☺

Regards,

Brendan Page
Senior Environmental Scientist

EIS Environmental investigation Services
CONSULTING ENVIRONMENTAL ENGINEERS AND SCIENTISTS

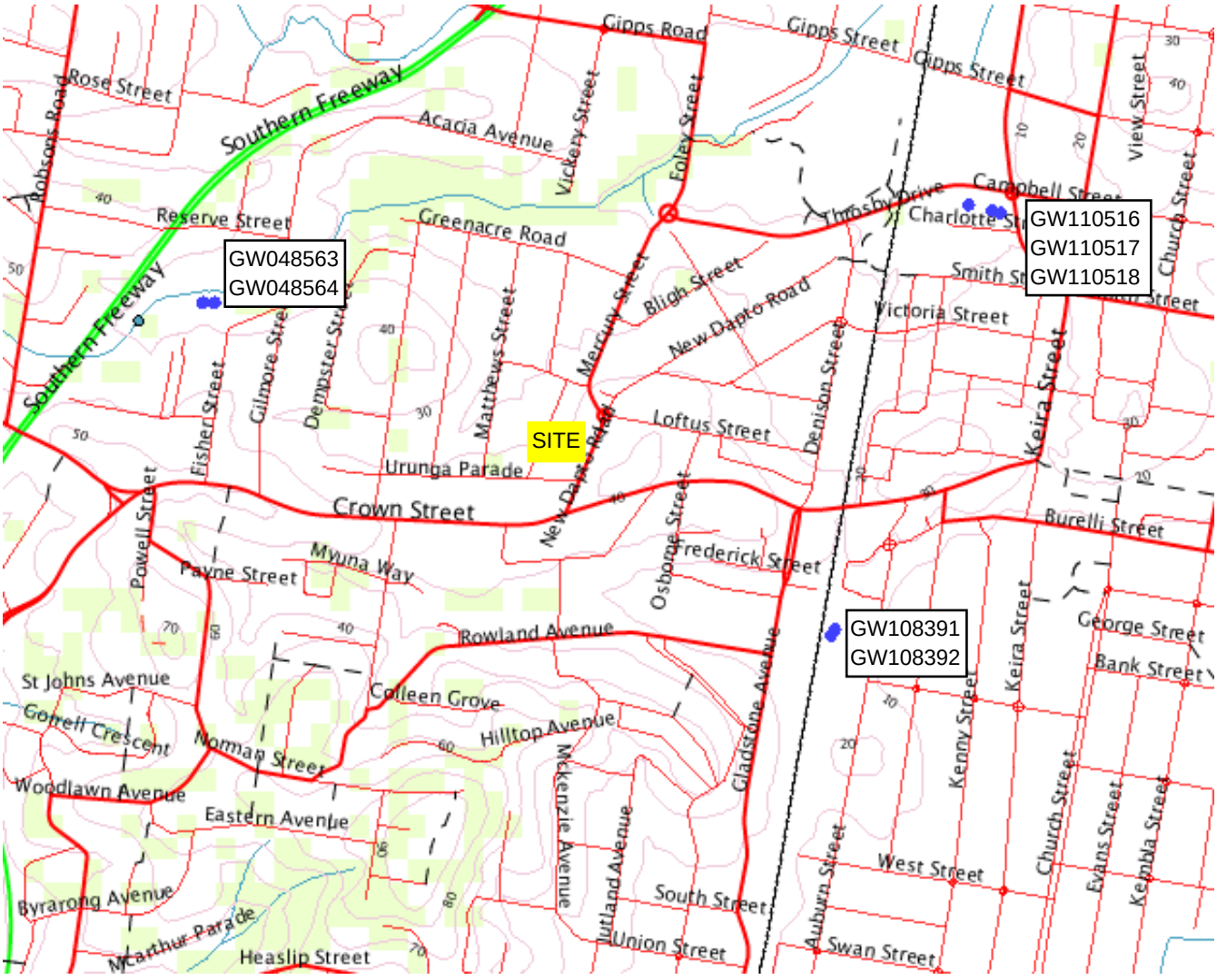
Tel: 02 9888 5000 PO Box 976 115 Wicks Road
Fax: 02 9888 5001 North Ryde BC NSW 1670 Macquarie Park NSW 2113
bpage@jkgroup.net.au
www.jkgeotechnics.com.au

APPENDIX C1

Groundwater Bore Records

E26129KP Wollongong

Map created with NSW Natural Resource Atlas - http://www.nratlas.nsw.gov.au
Friday, November 30, 2012



0 2 Km

Legend

Symbol	Layer	Custodian
	Towns	
	Groundwater Bores	
	Catchment Management Authority boundaries	
	Major rivers	
Primary/arterial road Motorway/freeway Railway Runway Contour Background	Topographic base map	

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW048563

Works Details (top)

GROUNDWATER NUMBER	GW048563
LIC-NUM	10WA105911
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Well
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1966-01-01
FINAL-DEPTH (metres)	30.50
DRILLED-DEPTH (metres)	30.50
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	214 - WOLLONGONG COAST
AREA-DISTRICT	
CMA-MAP	9029-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6189120.00
EASTING	304544.00

LATITUDE	34 25' 15"
LONGITUDE	150 52' 23"
GS-MAP	0075D2
AMG-ZONE	56
COORD-SOURCE	PR.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	146//7135

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	P+ Port 48

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
30.50	30.50	0.00	(Unknown)			0.00			501-1000 ppm

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW048564

Works Details (top)

GROUNDWATER NUMBER	GW048564
LIC-NUM	10WA105910
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1966-01-01
FINAL-DEPTH (metres)	30.50
DRILLED-DEPTH (metres)	30.50
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	214 - WOLLONGONG COAST
AREA-DISTRICT	
CMA-MAP	9029-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6189120.00
EASTING	304570.00

LATITUDE	34 25' 15"
LONGITUDE	150 52' 24"
GS-MAP	0075D2
AMG-ZONE	56
COORD-SOURCE	PR.,ACC.MAP
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	146//7135

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	P+ Port 48

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
30.50	30.50	0.00	(Unknown)			0.00			(Unknown)

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW108391

Works Details (top)

GROUNDWATER NUMBER	GW108391
LIC-NUM	10BL600472
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	2007-09-28
FINAL-DEPTH (metres)	6.20
DRILLED-DEPTH (metres)	6.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	RAIL CORP
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	6188265.00
EASTING	305945.00

LATITUDE	34 25' 44"
LONGITUDE	150 53' 17"
GS-MAP	
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	3//1001500

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	2 1001500

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	6.20	100			Auger - Solid Flight
1	1	Casing	PVC Class 18	0.00	1.50	60			Screwed
1	1	Opening	Slots - Horizontal	1.50	6.00	60			PVC Class 18; Slotted In Hole; SL: .08mm; A: .4mm
1		Annulus	Waterworn/Rounded	0.00	0.00				Graded; GS: 2-5mm

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.40	0.40	FILL , GRAVEL		
0.40	1.50	1.10	FILL SAND		
1.50	2.50	1.00	CLAY		

2.50	6.20	3.70	CLAY

Warning To Clients: This raw data has been supplied to the Department of Infrastructure, Planning and Natural Resources (DIPNR) by drillers, licensees and other sources. The DIPNR does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW108392

Works Details (top)

GROUNDWATER NUMBER	GW108392
LIC-NUM	10BL600472
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	Other
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	2007-09-28
FINAL-DEPTH (metres)	6.00
DRILLED-DEPTH (metres)	6.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	RAIL CORP
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	5.83
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6188281.00
EASTING	305953.00

LATITUDE	34 25' 43"
LONGITUDE	150 53' 18"
GS-MAP	
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	2//1001500

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	2 1001500

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	6.00	100			Auger - Solid Flight
1	1	Casing	PVC Class 18	0.00	1.50	60			Screwed
1	1	Opening	Slots - Horizontal	1.50	6.00	60			PVC Class 18; Slotted On Site; SL: .08mm; A: .4mm
1		Annulus	Waterworn/Rounded	0.00	0.00				Graded; GS: 2-5mm

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.30	0.30	FILL,GRAVEL		
0.30	1.00	0.70	FILL. SAND		
1.00	1.90	0.90	CLAY BROWN		

1.90	6.00	4.10	CLAY DARK,BROWN

Warning To Clients: This raw data has been supplied to the Department of Infrastructure, Planning and Natural Resources (DIPNR) by drillers, licensees and other sources. The DIPNR does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW110516

Works Details (top)

GROUNDWATER NUMBER	GW110516
LIC-NUM	10BL600001
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Well
WORK-STATUS	
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2004-12-15
FINAL-DEPTH (metres)	6.00
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HERTZ AUST P/L
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	2.50
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6189395.00
EASTING	306295.00

LATITUDE	34 25' 8"
LONGITUDE	150 53' 32"
GS-MAP	
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1//504449

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1 504449

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	6.00	100			Auger - Solid Flight
1	1	Casing	PVC Class 12	0.00	2.00	50	44		Screwed; Seated on Bottom; End cap
1	1	Opening	Slots - Horizontal	2.00	6.00	50			PVC Class 12; Casing - Machine Slotted; Screwed
1		Annulus	Waterworn/Rounded	1.70	6.00				Graded; GS: 2-5mm

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
2.50	6.00	3.50		2.50					

Drillers Log (top)

no details

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Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW110517

Works Details (top)

GROUNDWATER NUMBER	GW110517
LIC-NUM	10BL600001
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Well
WORK-STATUS	
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2004-12-15
FINAL-DEPTH (metres)	5.00
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HERTZ AUST P/L
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	4.00
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6189401.00
EASTING	306276.00

LATITUDE	34 25' 7"
LONGITUDE	150 53' 31"
GS-MAP	
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1//504449

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1 504449

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	5.00	100			Auger - Solid Flight
1	1	Casing	PVC Class 12	0.00	0.70	50	44		Screwed; Seated on Bottom; Open End
1	1	Opening	Slots	0.70	5.00	50			PVC Class 12; Sawn; Screwed
1		Annulus	Waterworn/Rounded	0.50	5.00				Graded; GS: 2-5mm

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
4.00	5.00	1.00		4.00					

Drillers Log (top)

no details

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Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Friday, November 30, 2012

Print Report

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

Work Requested -- GW110518

Works Details (top)

GROUNDWATER NUMBER	GW110518
LIC-NUM	10BL600001
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Well
WORK-STATUS	
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2004-12-15
FINAL-DEPTH (metres)	6.00
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	HERTZ AUST P/L
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	4.00
SALINITY	
YIELD	

Site Details (top)

REGION	10 - SYDNEY SOUTH COAST
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6189415.00
EASTING	306224.00

LATITUDE	34 25' 7"
LONGITUDE	150 53' 29"
GS-MAP	
AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1//504449

Licensed (top)

COUNTY	CAMDEN
PARISH	WOLLONGONG
PORTION-LOT-DP	1 504449

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	6.00	100			Auger - Solid Flight
1	1	Casing	PVC Class 12	0.00	2.70	50	44		Screwed; Seated on Bottom; End cap
1	1	Opening	Slots - Horizontal	2.70	6.00	50			PVC Class 12; Casing - Machine Slotted; Screwed
1		Annulus	Waterworn/Rounded	0.50	6.00				Graded; GS: 2-5mm

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
4.00	6.00	2.00		4.00					

Drillers Log (top)

no details

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APPENDIX C2

Site History Documents – WorkCover Records

WorkCover
NEW SOUTH WALES

BP

23 NOV 2012

Our Ref: D12/174231
Your Ref: Brendan Page

21 November 2012

Attention: Brendan Page
Environmental Investigation Services
PO Box 976
North Ryde BC NSW 1670

Dear Mr Page,

RE SITE: 3-15 Dudley St Wollongong NSW

I refer to your site search request received by WorkCover NSW on 15 November 2012 requesting information on licences to keep dangerous goods for the above site.

Enclosed are copies of the documents that WorkCover NSW holds on Dangerous Goods Licences 35/003201 relating to the storage of dangerous goods at the above-mentioned premises, as listed on the Stored Chemical Information Database (SCID).

If you have any further queries please contact the Dangerous Goods Licensing Team on (02) 4321 5500.

Yours Sincerely

Brent Jones
Senior Licensing Officer
Dangerous Goods Notification Team

CONTACT FOR NOTIFICATION INQUIRIES

Title: (Mr) / Miss / Ms / Mrs / Other (please specify) _____ **Family name** HURD

Given name JEFFREY **Other names** WAYNE

Business phone 42225255 **Business fax number** 42225609

Business email address Jeff.Hurd@sesiahs.health.nsw.gov.au

Previous Licence Number or Acknowledgement Number (if known)

35/003201

Previous Occupier (if known)

South Eastern Sydney Illawarra Area Health

Site on which dangerous goods are to be kept

Number | Street

CROWN ST

Suburb/Town/Locality | Postcode

Wollongong | 2500

Nearest cross Street

New Dapto Road

Lot and DP if no street number

Is the site staffed? If yes state number of employees approx 2000

Site staffing: Hours per day 24 Days per week 7

Site Emergency Contact

Phone number | **Name**

( ) 0414 421 743 | JEFF HURD

Nature of site (eg petrol station, warehouse etc)

Hospital

Nature of primary business activity

Patient/Health Care

ABN Number (if any) | Website details (if any)

What is the ANSZIC code most applicable to your business? (see guide for list of codes and further information)

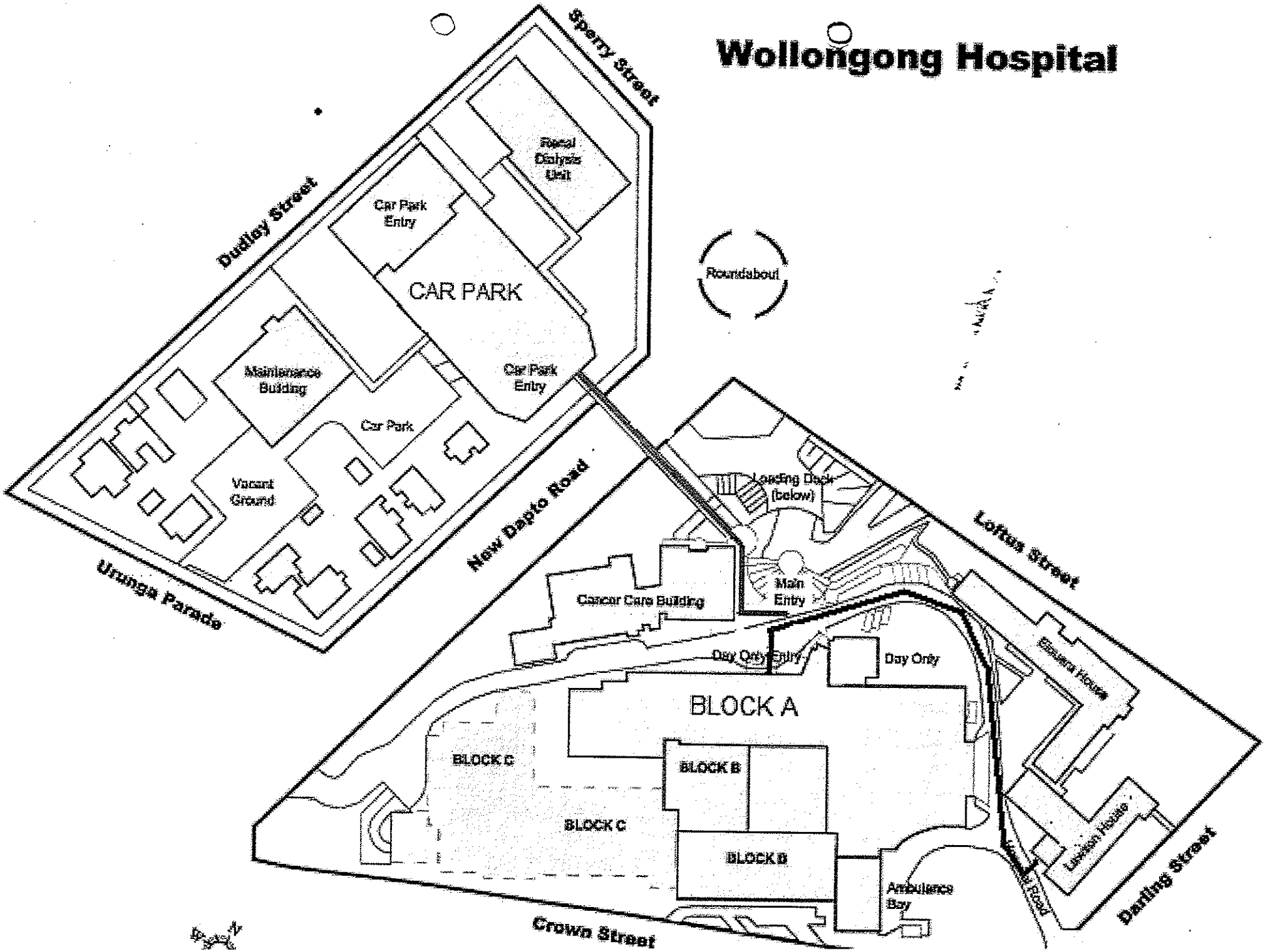
Code | Description

861 | Hospitals & Nursing ~~Care~~ Homes

Attach a site sketch(s) of the premises. Refer to the Guide GDG01 for information on the requirements for the site sketch.

Attach a legible photocopy page from a local Street Directory or other map showing the locality of the premises. Mark the location of the premises with an X.

Wollongong Hospital



List the dangerous goods that will be stored and/or processed on these premises (refer to Guide GDG01). Copy this page and attach additional sheets if there is insufficient space.

Depot No	Type of storage location or process	Class	Maximum Storage Capacity (L, kg)
1A	Above ground tank	2.2	12,645L

UN Number	Proper Shipping Name	Class	PG (I, II, III)	Product or Common Name	HazChem Code	Typical Qty	Unit eg L, kg
1073	Refridgerated Liquid	2.2		Oxygen		12,645	L

Depot No	Type of storage location or process	Class	Maximum Storage Capacity (L, kg)
1B	Above grand tank	2.2	1011.6 L

UN Number	Proper Shipping Name	Class	PG (I, II, III)	Product or Common Name	HazChem Code	Typical Qty	Unit eg L, kg
1073	Refridgerated liquid	2.2		Oxygen		1011.6	L

Depot No	Type of storage location or process	Class	Maximum Storage Capacity (L, kg)
2	Underground tank	C1	12,000 L

UN Number	Proper Shipping Name	Class	PG (I, II, III)	Product or Common Name	HazChem Code	Typical Qty	Unit eg L, kg
0001	Diesel	C1		Diesel		12000	L

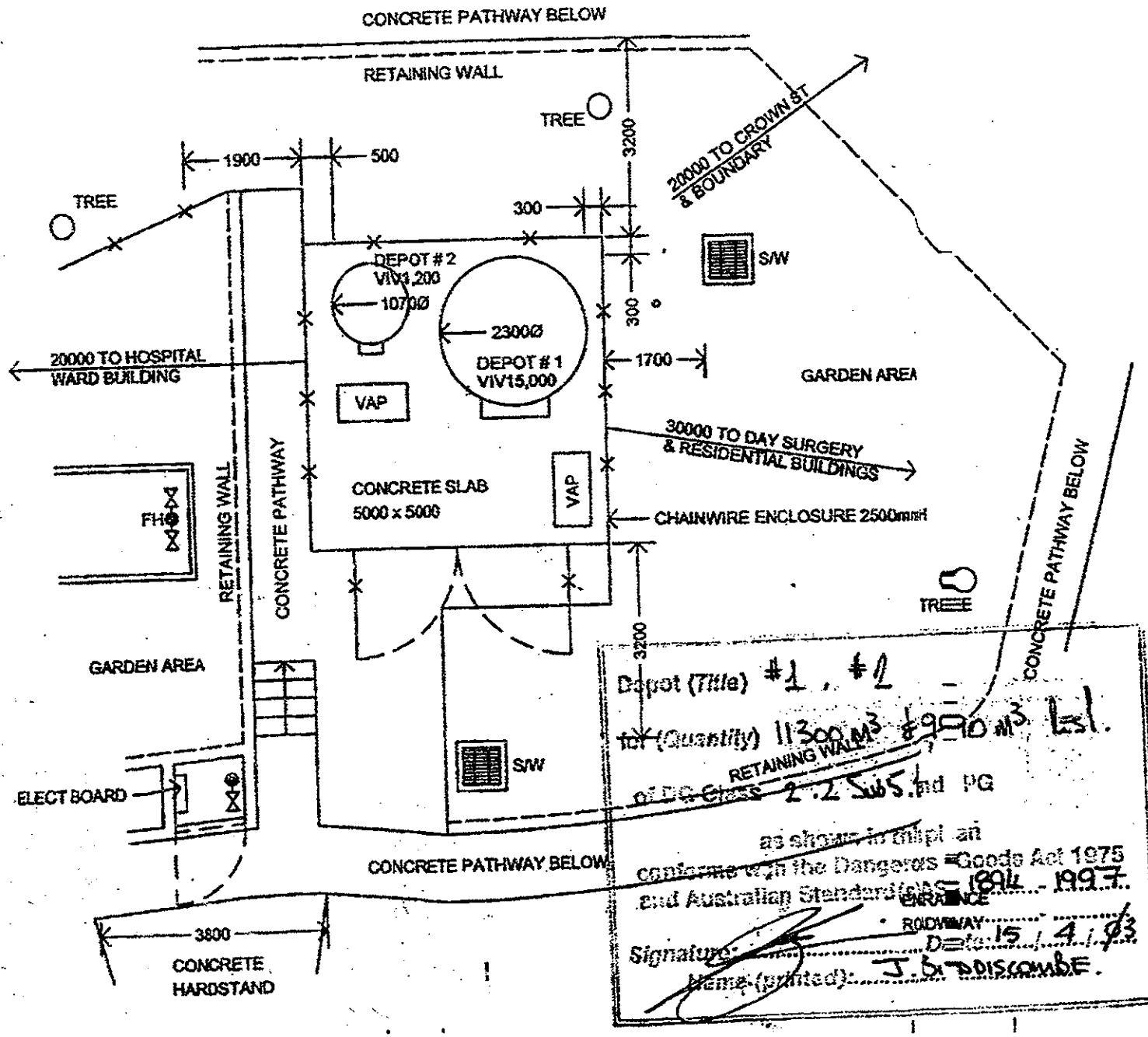
Depot No	Type of storage location or process	Class	Maximum Storage Capacity (L, kg)

UN Number	Proper Shipping Name	Class	PG (I, II, III)	Product or Common Name	HazChem Code	Typical Qty	Unit eg L, kg

Depot No	Type of storage location or process	Class	Maximum Storage Capacity (L, kg)

UN Number	Proper Shipping Name	Class	PG (I, II, III)	Product or Common Name	HazChem Code	Typical Qty	Unit eg L, kg

351003201



DEPOT # 1
LIQUID OXYGEN STORAGE VESSEL TO AS1210
DANGEROUS GOODS CLASS 2.2UB 5. 1
REGISTERED #
UN NUMBER 1073
MAX CAPACITY 11,300 Nm3
DIAMETER 2300
HEIGHT 7000

DEPOT # 2
LIQUID OXYGEN STORAGE VESSEL TO AS1210
DANGEROUS GOODS CLASS 2.2UB 5. 1
REGISTERED #
UN NUMBER 1073
MAX CAPACITY 990 Nm3
DIAMETER 1070
HEIGHT 2600

Depot (Title) #1 . #1
for (Quantity) 11300M3 #990 M3 Est.
of DG Class 2.2 Sub 5.1 nd PG
as shown in this plan
conforms with the Dangerous Goods Act 1975
and Australian Standard(s) AS 1894 - 1997.
Signature:
Date: 15 / 4 / 03
Name (printed): J. Broadscombe.

Project
WOLLONGONG HISPITAL

Subject
PLAN DEPOT # 1 &2 - LIQUID OXYGEN VESSELS

Date	Scale	Draing N-o.	Rev.
09.04.03	1:100	ALH01	1

AIR LIQUIDE Healthcare
AIR LIQUIDE Healthcare
PH +612 9680 5888
FX +612 9680 5755

Quality Endorsed Company

WorkCover New South Wales 400 Kent Street Sydney 2000 Telephone 9370 5000 ALL MAIL TO G.P.O. BOX 5364 SYDNEY 2001

Licence No. 35/003201

WORKCOVER NEW SOUTH WALES

APPLICATION FOR RENEWAL
OF LICENCE TO KEEP DANGEROUS GOODS

ISSUED UNDER AND SUBJECT TO THE PROVISIONS OF THE DANGEROUS GOODS ACT, 1975 AND REGULATION THEREUNDER

DECLARATION: Please renew licence number 35/003201 to 3/08/2000 . I confirm that all the licence details shown below are correct (amend if necessary).

R. Wayne Johnston ..... R. Wayne Johnston ..... 6 - 7 - 99

(Signature) *(Please print name)* *(Date signed)*

for: ILLAWARRA REGIONAL HOSPITAL

THIS SIGNED DECLARATION SHOULD BE RETURNED TO:

WorkCover New South Wales
Dangerous Goods Licensing Section
GPO BOX 5364
SYDNEY 2001

Enquiries: ph (02) 9370 5187
fax (02) 9370 6105

Details of licence on 28 June 1999

Licence Number 35/003201 **Expiry Date** 4/08/1999

Licensee ~~ILLAWARRA REGIONAL HOSPITAL~~ WOLLONGONG ~~CAMPUS~~ HOSPITAL *

Postal Address: WOLLONGONG CAMPUS LOCKED BAG 8808 SOUTH COAST MAIL CENTRE NSW 2521

Licensee Contact WAYNE JOHNSTON Ph. ~~0242 225 338~~ (02) 42225000 * Fax. ~~0242 225 313~~ (02) 4222 5538 *

Promises Licensed to Keep Dangerous Goods
ILLAWARRA REGIONAL HOSPITAL WOLLONGONG CAMPUS
CROWN ST WOLLONGONG 2500

Nature of Site HOSPITALS (EXCEPT PSYCHIATRIC HOSPITALS)

Major Supplier of Dangerous Goods BOC

Emergency Contact for this Site ~~JOHN BURROWS Ph. 0242 298 233~~ Grade elsewhere PA 02 42225000 *

Site staffing 24 HRS 7 DAYS *

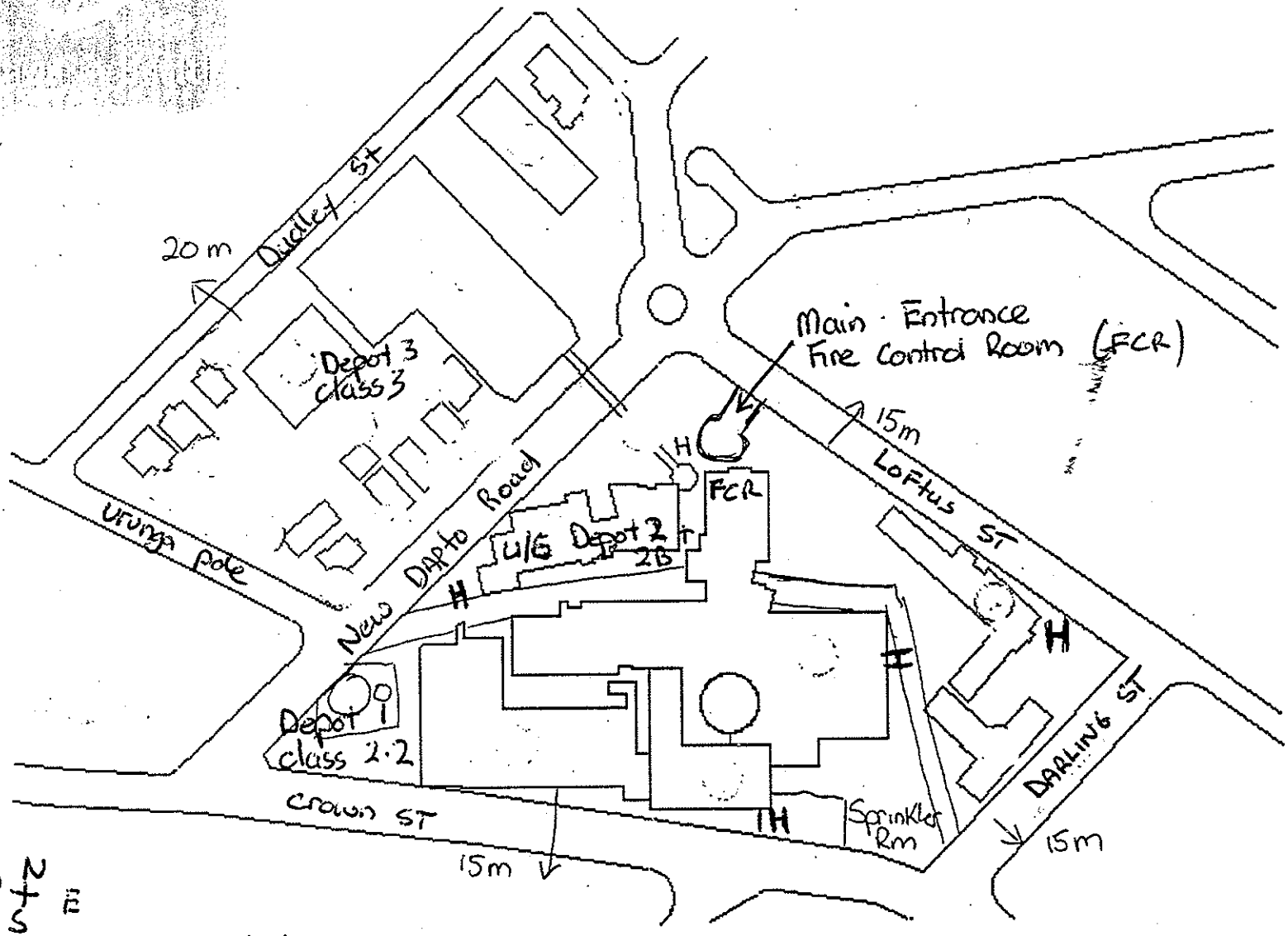
Details of Depots

Depot No.	Depot Type	Goods Stored in Depot	Qty
1	ABOVE-GROUND TANK	Class 2.2	7000 L
	UN 1073 OXYGEN, REFRIGERATED LIQUID		7000 L
2	EXEMPT - U/G TANK	Class C1	12000 L
	UN 00C1 DIESEL		12000 L
2B	EXEMPT - A/G TANK	Class C1	300 L
	UN 00C1 DIESEL		300 L
3	EXEMPT - STORAGE AREA	Class 3	100 L
	UN 1170 ETHANOL (ETHYL ALCOHOL)		50 L
	UN 1263 PAINT, (ZINC RICH KIT)		50 L

Form DG10

*** END OF DOCUMENT ***

ILLAWARRA HEALTH



H = Hydrant

Aper
Build
A B
D E
G H
J K
M N
P Q
S T
2_Site: Hosp W

35/003201

orkCover New South Wales, 400 Kent Street, Sydney 2000. Tel: (02) 9370 5000 ALL MAIL TO LOCKED BAG 10 CLARENCE STREET, SYDNEY 2000
DX 10067, MARKET ST SYDNEY

WORKCOVER NEW SOUTH WALES

Reference

APPLICATION FOR RENEWAL
OF LICENCE TO KEEP DANGEROUS GOODS

ISSUED UNDER AND SUBJECT TO THE PROVISIONS OF THE DANGEROUS GOODS ACT, 1975 AND REGULATION THEREUNDER

DECLARATION: *Please renew licence number 35/003201 to 1998. I confirm that all the licence details shown below are correct (amend if necessary).*

R Wayne Johnston ..... R. Wayne Johnston 18-6-97

(Signature) *(Please print name)* *(Date signed)*

for: ILLAWARRA REGIONAL HOSPITAL

THIS SIGNED DECLARATION SHOULD BE RETURNED TO:

WorkCover New South Wales
Dangerous Goods Licensing Section (Level 3)
Locked Bag 10
P O CLARENCE STREET 2000

Enquiries: ph (02) 9370 5187
fax (02) 9370 6105

Details of licence on 13 June 1997

Licence Number 35/003201 **Expiry Date** 04/08/97

Licensee ILLAWARRA REGIONAL HOSPITAL
WOLLONGONG CAMPUS

Postal Address LOCKED BAG 8808, SOUTH COAST MAIL CENTRE 2521

Licensee Contact WAYNE JOHNSTON Ph. 042 201 338 Fax. 042 201 313

Premises Licensed to Keep Dangerous Goods
CROWN ST
WOLLONGONG 2500

Nature of Site Hospitals **Major Supplier of Dangerous Goods** BOC

Emergency Contact for this Site JOHN BURROWS ph. 042 298 233

Site staffing 24 hrs 7 days

Details of Depots

Depot No.	Depot Type	Goods Stored in Depot	Qty
1	ABOVE-GROUND TANK	Class 2.2	7000 L
		UN 1073 OXYGEN, REFRIGERATED L	7000 L
2	Exempt - U/G tank	Class c1	12000 L
		UN 00C1 DIESEL	12000 L
2B	Exempt - A/G tank	Class c1	300 L
		UN 00C1 DIESEL	300 L
3	Exempt - Storage area	Class 3	100 L
		UN 1263 PAINT RELATED MATERIAL	50 L
		UN 1170 ETHANOL (ETHYL ALCOHOL	50 L

Please note attached changes to Building Plans

Scott M
24/6/97

Form DG10

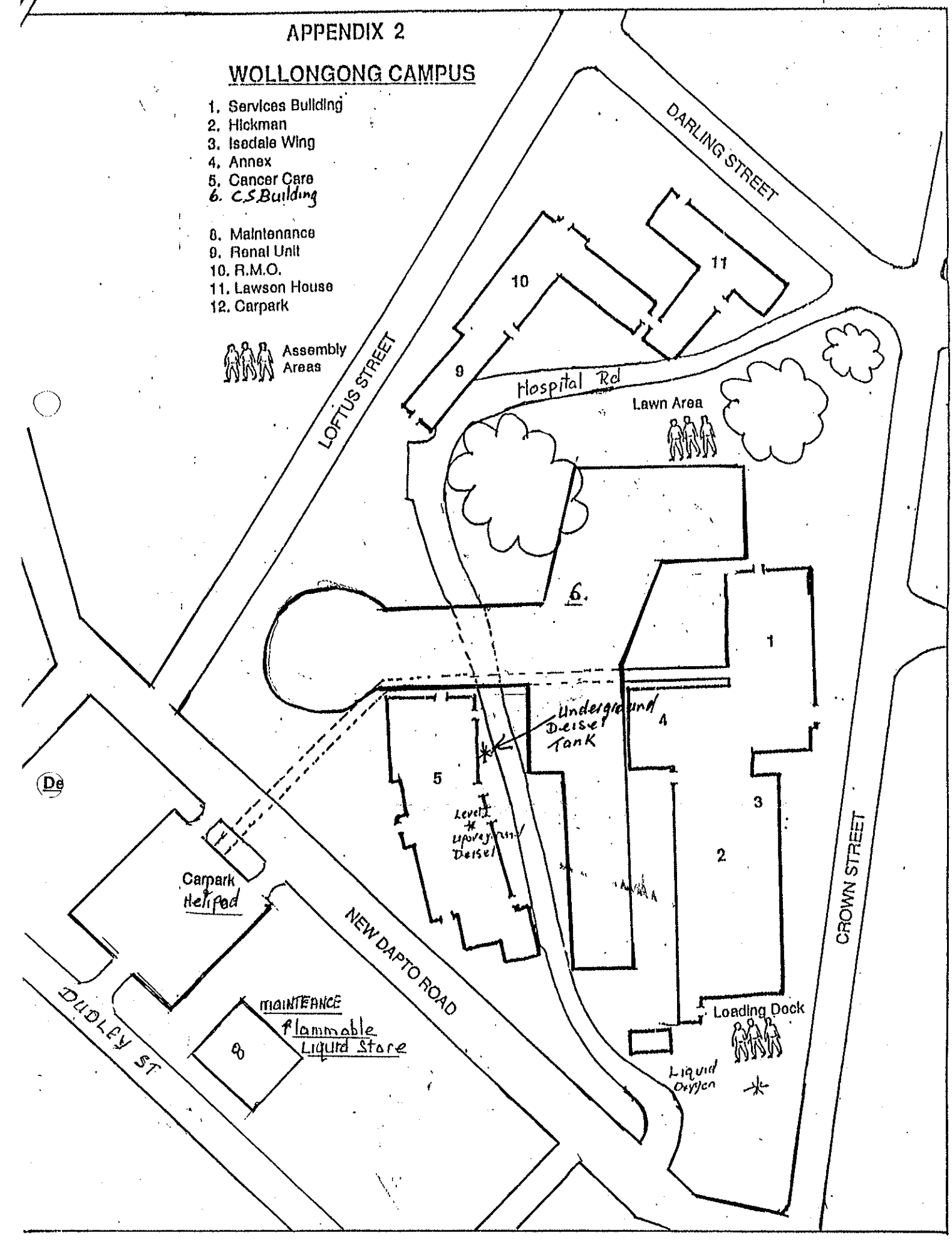
35/003201

APPENDIX 2

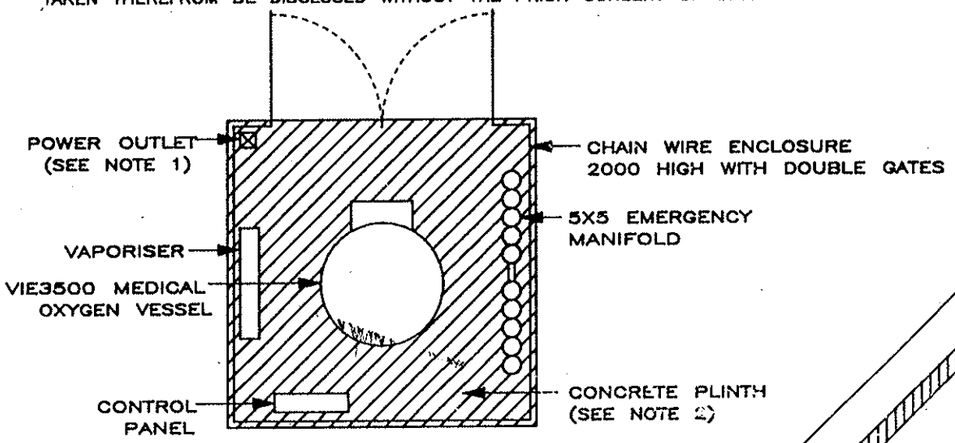
WOLLONGONG CAMPUS

1. Services Building
2. Hickman
3. Isedale Wing
4. Annex
5. Cancer Care
6. C.S.Building
8. Maintenance
9. Renal Unit
10. R.M.O.
11. Lawson House
12. Carpark

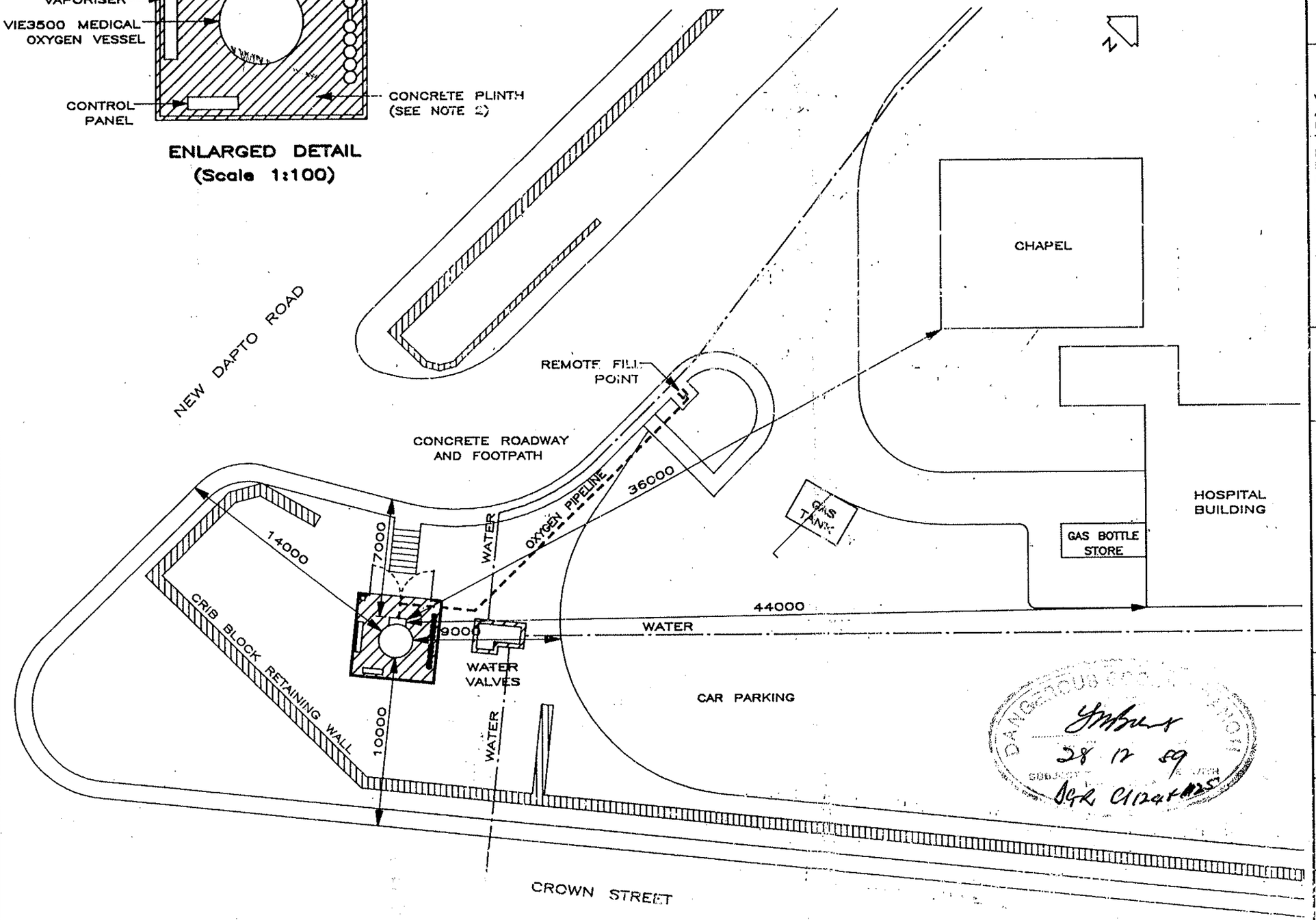
Assembly Areas



DO NOT SCALE DRG — IF IN DOUBT ASK



ENLARGED DETAIL
(Scale 1:100)



No.	Revision	Date

NOTES

1. INSTALL AN ELECTRICAL POWER OUTLET FOR VESSEL OF 415V 3 PHASE 30 AMP 4 WIRE USING A ROWCO XD9430 SOCKET WITH SWITCH (OR EQUIVALENT). MOTOR STARTER FUSE LINKS TIA30/50A IN 30 AMP FUSE HOLDERS IS ALSO NECESSARY. THE POWER OUTLET IS TO BE INSTALLED 1000 ABOVE GROUND LEVEL AND NOT MORE THAN 3000 FROM VESSEL CONTROLS.

2. CONCRETE PLINTH — GRADE 25 MPA WITH A 28 DAY CURE OR 40 MPA WITH A 7 DAY CURE. REINFORCED — F82 MESH TOP AND BOTTOM WITH 50MM COVER.
VESSEL SLAB TO BE 5000 X 5000 X 300 THICK.

Project
WOLLONGONG HOSPITAL,
CROWN STREET,
WEST WOLLONGONG, 2500.

CIG
GASES

GASES DIVISION — N.S.W.
INSTALLATIONS DEPARTMENT

Scale	Date
1:250	4TH DEC. 1989
Drawn by: L.J. DRAFTING	Prepared for: T. ANDERSON
Checked	Approved

Drawing Title
RELOCATION OF VIE3500 MEDICAL OXYGEN VESSEL INSTALLATION

Drawing No.	Rev.
A3-89/3300	

Application is hereby made for— *a licence (or amendment of the licence) *the transfer of the licence described below.

OPERATOR ONE

for the keeping of dangerous goods in or on the premises

(*delete whichever is not required)

FEE: $10.00 per Depot for new licence. $10.00 for amendment or transfer.

Name of Applicant in full (see over)	WOLLONGONG HOSPITAL
Trading name or occupier's name (if any)	
Postal address	PFP.O. BOX 1798, WOLLONGONG Postcode 2500
Address of the premises including street number (if any)	3163 4/09/85 03A CROWN ST., WOLLONGONG Postcode 2500
Nature of premises (see over)	PUBLIC HOSPITAL
Telephone number of applicant	STD Code 042 Number 298233

Particulars of type of depots and maximum quantities of dangerous goods to be kept at any one time.

Depot number	Type of depot (see over)	Storage capacity	Dangerous goods: Product being stored	C & C Office use only
			DD	004 060 2
1	EXTERNAL PACKAGE STORE	5000 L	FLAMMABLE LIQUIDS	6 020 53
2	INTERNAL PACKAGE STORE	200 L	" "	6 020 22
3	UNDERGROUND TANK	40,000 L	PETROL	2 020 44
4	ABOVE GROUND TANK	3000	OXYGEN	1 040 33
5				
6				
7				
8				
9				
10				
11				
12				

DEPARTMENT OF INDUSTRIAL RELATIONS WOLLONGONG 23 JUL 1985 RECEIVED No. DG 0586

Has site plan been approved? Yes ~~No~~ If yes, no plans required. If no, please attach site plan.

Have premises previously been licensed? Yes ~~No~~ If yes, state name of previous occupier. ~~HEATING MAINT ONLY~~ + RENEWAL ONLY.

Name of company supplying flammable liquid (if any)

Signature of applicant ... Date 11 July 85.

For external explosives magazine(s), please fill in side 2.

FOR OFFICE USE ONLY

CERTIFICATE OF INSPECTION

I, Wallace being an Inspector under the Dangerous Goods Act, 1975, do hereby certify that the premises described above do comply with the requirements of the Dangerous Goods Act, 1975, and the Dangerous Goods Regulation with regard to their situation and construction for the keeping of dangerous goods of the nature and in the quantity specified.

Signature of Inspector ... Date 18.9.85

128 RECEIPT No. 67916 DATE 23.7.85 AMOUNT $60.00

No.

rs Clerk. Accounts

premises described below.

(*delete whichever is not required)

FEE: $10.00 per Depot

0746 20/12/77 038

Name of Applicant in full (see over)	Surname LAWRENCE Given Names WILLIAM G.
Trading name or occupier's name (if any)	THE WOLLONGONG HOSPITAL
Postal address	CROWN STREET, WOLLONGONG Postcode 2500
Telephone number of applicant	STD Code 042 Number 298233
Address of the premises in or on which the depot or depots are situated (including street number, if any)	CROWN STREET, WOLLONGONG Postcode 2500
Nature of premises (see over)	PUBLIC HOSPITAL.

PLEASE ~~ATTACH SITE PLAN~~

Particulars of type of depots and maximum quantities of dangerous goods to be kept at any one time.

Depot number	Type of depot (see over)	Storage capacity	Dangerous goods: Product being stored	Dangerous goods: C & C Office use only
1	ROOFED DEPOT	5000	M/S - M/O	6.020.53
2	INTERNAL DEPOT	200	D6 3.1. 3.2. 3.3. 3.4. 3.5	6.020.22
3	UNDERGROUND TANK	5000	M/S	2.020.53
4	ABOVE GROUND TANK	2773	BULK OXYGEN	1.040.33
5				
6				
7				
8				
9				
10				
11				
12				

Name of company supplying flammable liquid (if any) AMPOL

Have premises previously been licensed? YES

If known, state name of previous occupier AMENDMENT ONLY. Licence No. 321.

Signature of applicant W.G. Lawrence
p.p. WILLIAM G. LAWRENCE
CHIEF EXECUTIVE OFFICER. Date 26/10/78.

For external explosives magazine(s), please fill in side 2.

FOR OFFICE USE ONLY

CERTIFICATE OF INSPECTION

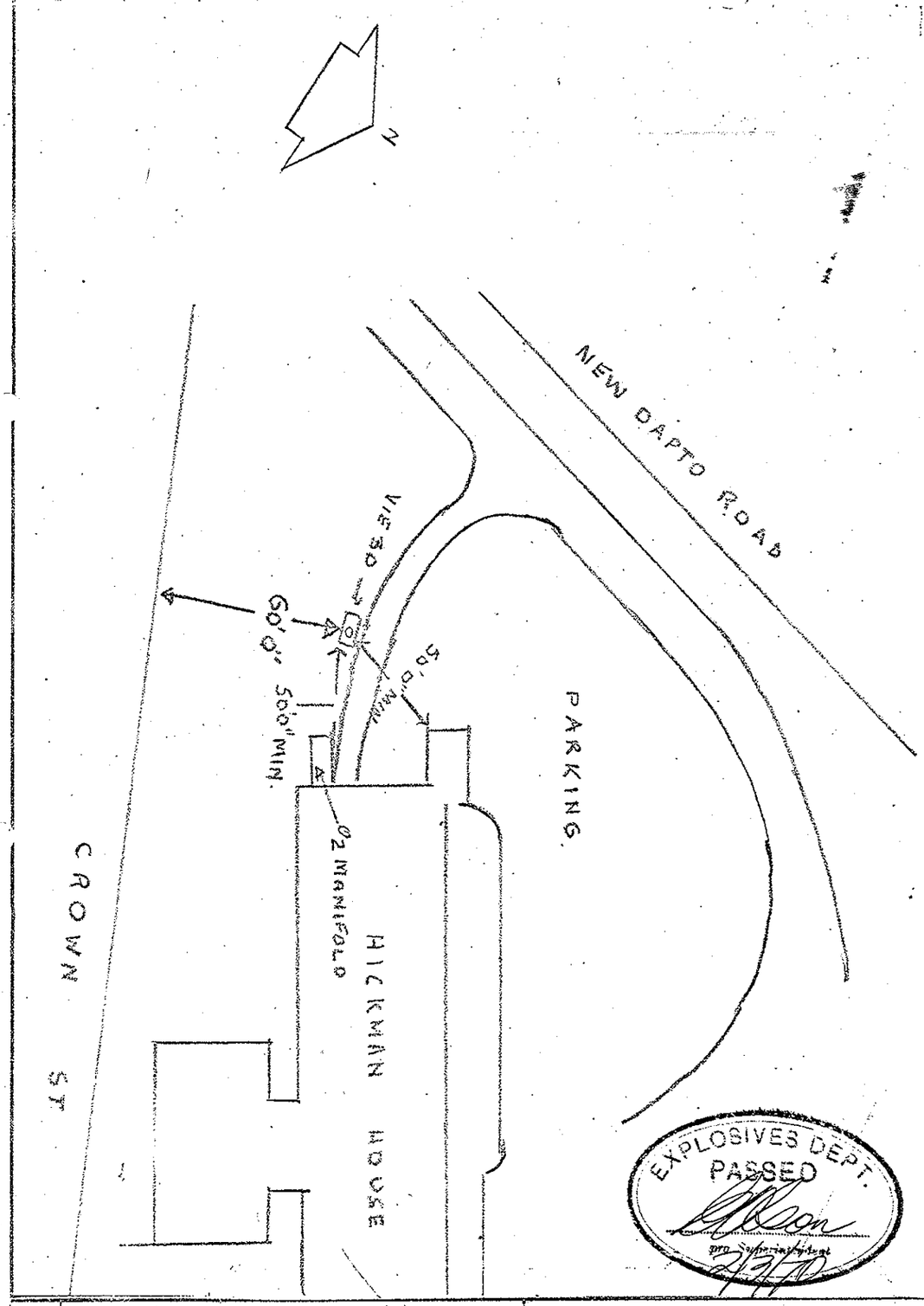
I, Wallace R being an Inspector under the Dangerous Goods Act, 1975, do hereby certify that the premises described above do comply with the requirements of the Dangerous Goods Act, 1975, and the Dangerous Goods Regulation with regard to their situation and construction for the keeping of dangerous goods of the nature and in the quantity specified.

Signature of Inspector

Date 27.10.78

S1 618-1 D. WEST, GOVERNMENT PRINTER

FOR EXPLANATION OF NOTES, DIMENSIONS, SYMBOLS, ETC., SEE B.S. 308–1953.



EXPLOSIVES DEPT. PASSED

REVISIONS		THE COMMONWEALTH INDUSTRIAL GASES LIMITED INSTALLATIONS DEPARTMENT ALEXANDRIA, N.S.W.	
EXCEPT AS STATED	SCALE		WOLLONGONG HOSPITAL PROPOSED LOCATION VIE 50
SURFACE FINISH ✓ALL OVER	DATE		
TOLERANCE ON FRACTIONAL DIMENSIONS ±1/64"	DRAWN		
	CHECKED		
	PASSED		

SEE PAGE 4 FOR DETAILS OF FEES PAYABLE AND DISTANCES FROM PROTECTED WORKS

"Amend"

DIRECTIONS

1. Applications must be forwarded to the Chief Inspector of Inflammable Liquid, Explosives Department, Box R.216, Royal change Sydney, N.S.W. 2000 and must be accompanied by the prescribed fee.

Registration of Premises – For quantities not exceeding 300 gallons of mineral oil and 100 gallons of mineral spirit, if kept together; or 800 gallons of mineral oil and 100 gallons of mineral spirit, if kept in separate depots; or 500 gallons of mineral spirit, if kept in an underground tank depot; or 800 gallons of mineral oil and 500 gallons of mineral spirit, if mineral spirit is kept in an underground tank depot.

In addition to, or in lieu of the above, similar quantities of Dangerous Goods of Classes 1 and 2 may be kept under the like conditions; reading Dangerous Goods of Class 1 for the words Mineral Spirit and Dangerous Goods of Class 2 for the words Mineral Oil

Store Licence, Div. A – For quantities in excess of those stated above, but not exceeding 4,000 gallons mineral oil and/or mineral spirit, and/or Dangerous Goods of Classes 1, 2 and 9.

Store Licence, Div. B (Fee, See Regulation 7) – For quantities exceeding 4,000 gallons of mineral spirit, and/or Dangerous Goods of Classes 1 and 2, and/or Dangerous Goods of Class 3.

For the keeping of Dangerous Goods of Classes 3 and/or 4.

To 15.8.75.

2. Name of occupier including full christian names.	X The Wollongong Hospital Crown Street, Wollongong
3. Trading Name (if any)	As above
4. Locality of the premises in which the depot or depots are situated	No. or Name The Wollongong Hospital Street Crown Street, Town Wollongong.
4. Postal address	Box.1798, Wollongong. Postcode 2500
5. Occupation	Public Hospital
6. Nature of premises (dwelling, garage etc.)	X Public Hospital

Particulars of construction of depots and maximum quantities of inflammable liquid and/or Dangerous Goods to be kept at any one time.

PLEASE ATTACH PLAN OF PREMISES

Depot No.	Construction of depots*			Inflammable liquid		Dangerous goods						
	Walls	Roof	Floor	Mineral spirit gallons	Mineral oil gallons	Class 1 gallons	Class 2 gallons	Class 3 lb	Class 4 cu ft	Class 5A water gal	Class 5B water gal	Class 9 gallons
1	BRICK	CONCRETE	CONCRETE		5000 Litres							
2	UNDERGROUND TANK.			5000 Litres								
3	BRICK.	CONCRETE	CONCRETE		500 Litres.				(PATH LABS).			
4												
5												
6												
7												
8												
9												
10												

PUBLIC REVENUE A/c
chq 18 9-00
17/9/74
(Date)
Receipt No. 5096

*If product is kept in tanks describe depots as underground or aboveground tanks.

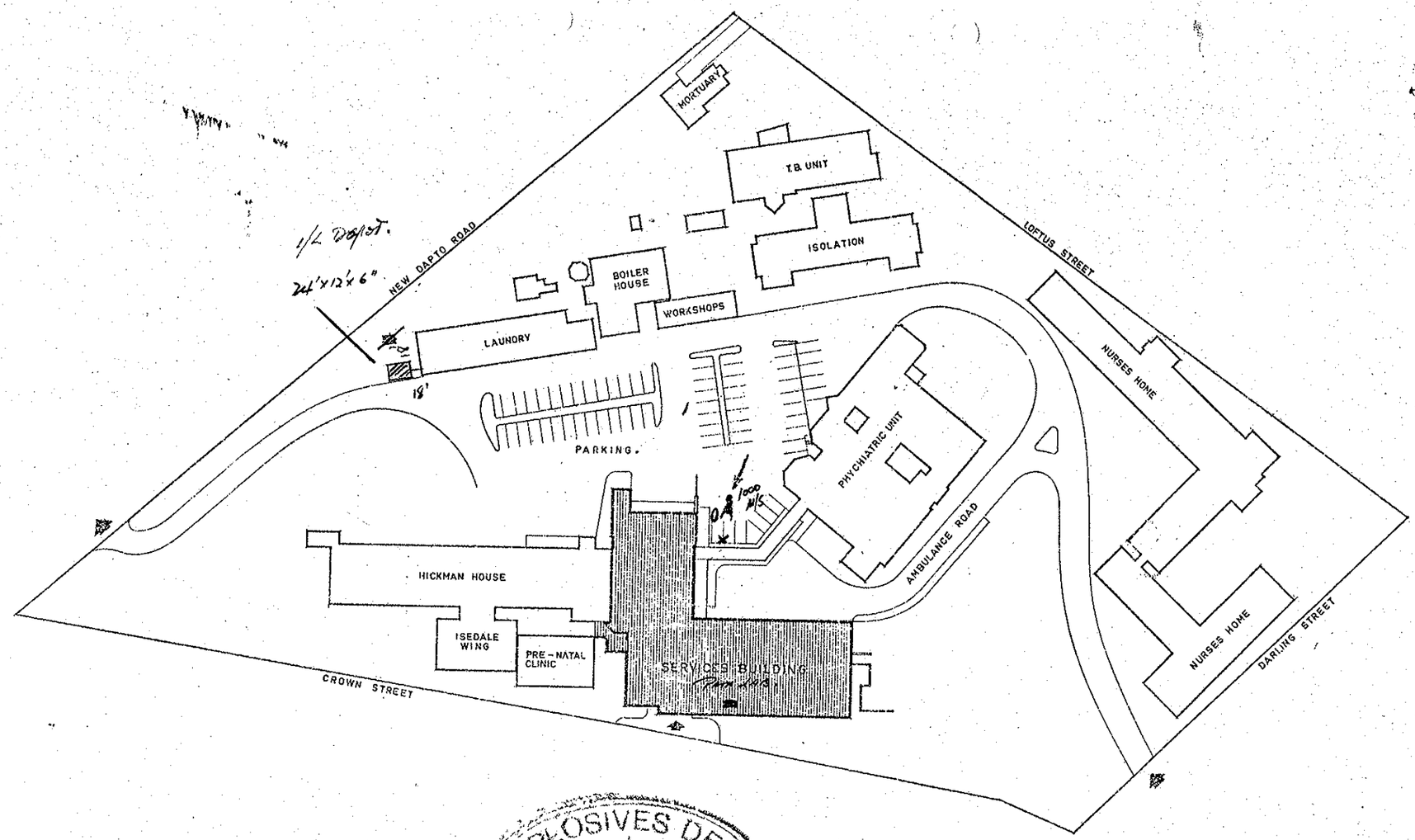
THE WOLLONGONG HOSPITAL
Signature of applicant X
CHIEF EXECUTIVE OFFICER

Date of application 11/9/, 19 70

CERTIFICATE OF INSPECTION

I, Wallace Bell being an Inspector under the Inflammable Liquid Act, 1915 (as amended), do hereby certify that the premises or store herein referred to and described is suitable with regard to its situation and construction for the safe keeping of inflammable liquid and/or dangerous goods in quantity and nature specified.

Place Wollongong Signature of Inspector



EXPLOSIVES DEPT.
PASSED
Supt. Superintendent.
15/10/73

7'x12'x6"

SITE PLAN

THE WOLLONGONG HOSPITAL SERVICES BUILDING

PRIESTLEY AND LUMSDAINE ARCHITECTS 1971 · Drg No 205-412

APPENDIX D

Abbreviations, Sampling Protocols and QA/QC Definitions

ABBREVIATIONS

AEC	Area of Environmental Concern
AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ALTPQL	All Less than PQL
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulfate Soil
BA/DA	Building Approval and Development Application
B(a)P	Benzo(a)pyrene
BGL	Below Ground Level
BH	Borehole
BOM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COC	Chain of Custody documentation
CLM	Contaminated Land Management
CMP	Construction Management Plan
CSM	Conceptual Site Model
CT	Contamination Threshold
DBYD	Dial Before You Dig
DEC	Department of Environment and Conservation (now part of OEH)
DECC	Department of Environment and Climate Change (now part of OEH)
DECCW	Department of Environment, Climate Change and Water (now part of OEH)
DWE	NSW Department of Water and Energy
DO	Dissolved Oxygen
DP	Deposited Plan
DQIs	Data Quality Indicators
DQOs	Data Quality Objective
EC	Electrical Conductivity
Eh	Redox Potential
EILs	Ecological Investigation Levels
ENM	Excavated Natural Material
EMP	Environmental Management Plan
ESA	Environmental Site Assessment
FR	Field Rinsate
GAI	General Approvals of Immobilisation
GILs	Groundwater Investigation Levels
GPS	Global Positioning System
Hazmat	Hazardous Materials Assessment
HILs	Health Based Investigation Level
HM	Heavy Metals
HMTVs	Hardness Modified Trigger Values
LNAPLs	Light Non-Aqueous Phase Liquids
NATA	National Association of Testing Authorities
NDLR	Not Detected at Limit of Reporting
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
NSW EPA	Environmental Protection Authority of NSW
MGA	Map Grid of Australia
OCPs	Organochlorine Pesticides
OEH	NSW Office of Environment and Heritage
OPPs	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbons

ABBREVIATIONS

PASS	Potential ASS
PCC	Primary Contaminants of Concern
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
POEO	Protection of Environmental Operations
PPIL	Provisional Phyto-toxicity Investigation Levels
PQL	Practical Quantitation Limit
RAP	Remediation Action Plan
RL	Reduced Level
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percentage Difference
SAC	Site Assessment Criteria
SAQP	Sampling, Analysis and Quality Plan
SAS	Site Audit Statement
SCC	Specific Contamination Concentration
SD	Standard Deviation
SEPP	State Environmental Planning Policy
sPOCAS	suspension Peroxide Oxidation Combined Acidity and Sulfate
SPT	Standard Penetration Test
SVOCs	Semi-Volatile Organic Compounds
SWL	Standing Water Level
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
TS	Trip Spike
USEPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UPSS	Underground Petroleum Storage Systems
UST	Underground Storage Tank
VENM	Virgin Excavated Natural Material
VOCs	Volatile Organic Compounds
WC	Waste Classification
WHS	Workplace, Health and Safety

SOIL AND GROUNDWATER SAMPLING PROTOCOLS

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

Soil Sampling

a) Prepare a test pit/borehole log.
b) Layout sampling equipment on clean plastic sheeting to prevent direct contact with ground surface. The work area should be at a distance from the drill/rig excavator such that the drill rig/excavator can operate in a safe manner.
c) Ensure all sampling equipment has been decontaminated prior to use.
d) Remove any surface debris from the immediate area of the sampling location.
e) Collect samples and place in glass jar with a Teflon seal. This should be undertaken as quickly as possibly to prevent the loss of volatiles. If possible, fill the glass jars completely.
f) Collect samples for asbestos analysis and place in a zip-lock plastic bag.
g) Label the jar and/or bag with the EIS job number, sample location (eg. BH1), sampling depth interval and date. If more than one sample container is used, this should also be indicated (eg. 2 = Sample jar 1 of 2 jars).
h) Photoionisation detector (PID) screening of volatile organic compounds (VOCs) should be undertaken on samples using the soil sample headspace method. Headspace measurements are taken following equilibration of the headspace gasses in partly filled zip-lock plastic bags. PID headspace data is recorded on the borehole/test pit log and the chain of custody forms.
i) Record the lithology of the sample and sample depth on the borehole/test pit log in accordance with AS1726-1993[41].
j) Store the sample in a sample container cooled with ice or chill packs. On completion of the sampling the sample container should be delivered to the lab immediately or stored in the refrigerator prior to delivery to the lab. All samples are preserved in accordance with AS 4482.1:2005, AS 4482.2:1999 and AS/NZS 5667.1:1998.
k) Check for the presence of groundwater after completion of each borehole using an electronic dip metre or water whistle. Boreholes should be left open until the end of fieldwork. All groundwater levels in the boreholes should be rechecked on the completion of the fieldwork.
l) Backfill the boreholes/test pits with the excavation cuttings or clean sand prior to leaving the site.

Decontamination Procedures for Soil Sampling Equipment

a) All of the equipment associated with the soil sampling procedure should be decontaminated between every sampling location.
b) The following equipment and materials are required for the decontamination procedure:
   - Phosphate free detergent (Decon 90)
   - Potable water
   - Stiff brushes
   - Plastic sheets
c) Ensure the decontamination materials are clean prior to proceeding with the decontamination.
d) Fill both buckets with clean potable water and add phosphate free detergent to one bucket.
e) In the bucket containing the detergent scrub the sampling equipment until all the material attached to the equipment has been removed.
f) Rinse sampling equipment in the bucket containing potable water.

---

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

g) Place cleaned equipment on clean plastic sheets.

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

Groundwater Sampling

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

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

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

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

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

d) Purging and sampling of piezometers/monitoring wells is done on the same site visit when using micro-purge (or low flow) techniques. Layout and organize all equipment associated with groundwater sampling in a location where they will not interfere with the sampling procedure and will not pose a risk of contaminating samples. Equipment generally required includes:
   - Micropore filtration system or Stericup single-use filters (for heavy metals samples).
   - Filter paper for Micropore filtration system.
   - Bucket with volume increments.
   - Sample containers: teflon bottles with 1 ml nitric acid, 75mL glass vials with 1 mL hydrochloric acid, 1 L amber glass bottles.
   - Bucket with volume increments.
   - Flow cell.
   - pH/EC/Eh/T meters.
   - Plastic drums used for transportation of purged water.
   - Esky and ice.
   - Nitrile gloves.
   - Distilled water (for cleaning).
   - Electronic dip meter.
   - Micro-purge pump pack and pump head.
   - Air and water tubing for Micro-purge.
   - Groundwater sampling forms.

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

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

g) Disposable gloves should be used whenever samples are taken to protect the sampler and to assist in avoidance of contamination.
h) Groundwater samples are obtained from the monitoring wells using low flow/micro-purge sampling equipment to reduce the disturbance of the water column and loss of volatiles.
i) During pumping to purge the well, the pH, temperature, conductivity, dissolved oxygen, redox potential and groundwater levels are monitored (where possible) using calibrated field instruments to assess the development of steady state conditions. Steady state conditions are generally considered to have been achieved when the difference in the pH measurements was less than 0.2 units and the difference in conductivity was less than 10%.
j) All measurements are recorded on specific data sheets.
k) Once steady state conditions are considered to have been achieved, groundwater samples are obtained directly from the pump tubing and placed in appropriate glass bottles, BTEX vials or plastic bottles.
l) All samples are preserved in accordance with water sampling requirements detailed in the NEPM 1999 and placed in an insulated container with ice. Groundwater samples are preserved by immediate storage in an insulated sample container with ice in accordance with AS/NZS 5667.1:1998.
m) Record the sample on the appropriate log in accordance with AS1726:1993. At the end of each water sampling complete a chain of custody form.

Decontamination Procedures for Groundwater Sampling Equipment

a) All of the equipment associated with the groundwater sampling procedure (other than single-use items) should be decontaminated between every sampling location.
b) The following equipment and materials are required for the decontamination procedure:
   - Phosphate free detergent.
   - Potable water.
   - Distilled water
   - Plastic Sheets or bulk bags (plastic bags)
c) Fill one bucket with clean potable water and phosphate free detergent, and one bucket with distilled water.
d) Flush potable water and detergent through pump head. Wash sampling equipment and pump head using brushes in the bucket containing detergent until all materials attached to the equipment are removed.
e) Flush pump head with distilled water.
f) Change water and detergent solution after each sampling location.
g) Rinse sampling equipment in the bucket containing distilled water.
h) Place cleaned equipment on clean plastic sheets.
i) If all materials are not removed by this procedure that equipment should not be used until it has been thoroughly cleaned

QA/QC DEFINITIONS

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994[42]) methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (H. Keith 1991[43]).

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

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

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

Precision

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

Accuracy

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

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

Representativeness

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

Completeness

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

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

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

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

Comparability

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

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

Blanks

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

Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula below. Acceptable recovery limits are 70% to 130%.

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

Surrogate Spikes

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

Duplicates

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

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