Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Supplementary Contamination Investigation

Proposed Chau Chak Wing Museum
Part of The University of Sydney, Camperdown, NSW

Prepared for
The University of Sydney

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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1. Introduction

This report presents the results of a supplementary contamination investigation (SCI) undertaken for the proposed Chau Chak Wing Museum at Part of The University of Sydney, Camperdown, NSW. The investigation was commissioned in an email dated 9 August 2017 from Mr Christopher Burns of The University of Sydney and was undertaken in accordance with Douglas Partners' proposal SYD170937 Rev1 dated 8 August 2017.

It is understood that the proposed development comprises demolition of the existing tennis courts and the construction of a museum building equivalent to three levels above ground and four basement levels. The lowest ground level is given as RL 20.7 m. The site area is understood to be approximately 0.28 ha.

Douglas Partners Pty Ltd (DP) previously prepared three reports for the site (in relation to contamination) and one for the larger University of Sydney site, some of which were submitted to The University of Sydney as part of the development consent process. This report aims to address comments made by the NSW EPA following development application lodgement. The comments were as follows:

Recommendation 1

The proponent be required to revise the Detailed Site Investigation Report to -

(a) verify area of the development site, and

(b) include additional sampling data which meets the relevant data quality objectives

Note: The EP&A submission highlights concerns with the following contained in the EIS Appendix 17 Detailed Site Investigation (OSI)

- *page 17 of the OSI Report confirms that the site assessment 'was not strictly completed in accordance with SEPP55' and thus does not meet the EIS requirement to assess the site suitability in relation to SEPP55 (EIS p7)',*
- *section 3.1 of the OSI Report describes the area of the development site area as 0.28 hectares however section 6.3 reports the site area as 2.8 hectares with such a discrepancy thwarting a proper assessment of whether the sampling density is adequate,*
- *section 4.3 of the OSI Report notes that preliminary in-situ waste classification was undertaken and no building materials were reported (Appendix 17, section 9) however the borehole investigation methodology used is not the preferred methodology for identifying the presence of asbestos in fill materials,*

OSI Report sections 6.2 and 12 confirm respectively that no Quality Assurance samples were collected and "... no comment can be made regarding the field QA" however the quality of the data

was not assessed and data quality that does not meet the minimum data quality requirements of the assessment should not have been reported,

- *Table C1_Summary of Results to the OSI Report indicates that combined statistical analysis was undertaken on fill and natural soils however fill and natural soils should be considered to be separate populations of data and thus are not appropriate for combined statistical analysis,*
- *the OSI is unclear whether the 'organic odour' referred to in Borehole 'Log #1O' is an organic contaminant (such as hydrocarbon, volatile organic compound) odour or another odour, and previous investigations did not include required ground water sampling and analysis*

2. Scope of Works

In order to address the comments made by the EPA (see Section 1), the following scope was completed to address the comments:

- The University of Sydney indicated in an email dated 4 August 2017 that the area of the site is approximately 0.28 ha;
- Additional sampling was undertaken which met the DQO and the required sampling density;
- The additional sampling was undertaken by the excavation of test pits, rather than drilling boreholes, as test pitting is the preferred method to visually assess the presence of asbestos in fill material;
- 10% quality assurance samples were collected which meets the minimum data quality requirements for the additional sampling undertaken;
- Two rows have been added to Table C1 which present the statistical results for the filling samples only in relation to the B(a)P concentrations; and
- In relation to the 'organic odour' noted on Borehole Log 10, all results for the sample collected from this location at a depth of 1.0 m indicated that no organic analytes were detected above laboratory detection limits, indicating that contamination is not associated with this 'odour'. No other signs of gross contamination have been noted in the previous or current investigation. Thus the odour is not considered to be significant or warrant any further investigation in this area of the site.

The scope of works was as follows:

- Review of previous reports prepared by DP;
- Conduct services location scan, using an electromagnetic sweep and Dial-Before-You-Dig plans as a precautionary measure;
- Three test pits were excavated using a 5 tonne excavator fitted with a rock-toothed bucket to depths of between 0.5 m and 1.0 m below ground level (bgl);
- Five soil samples (plus one QA/QC sample) for analysis of a combination of the following at a NATA accredited laboratory:
  - Eight priority metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc);
  - Total recoverable hydrocarbons (TRH);
  - Benzene, toluene, ethylbenzene and xylenes – (BTEX);

- Polycyclic aromatic hydrocarbons (PAH);
- Total phenols;
- Organochlorine pesticides (OCP);
- Organophosphorus pesticides (OPP);
- Polychlorinated biphenyls (PCB);
- Asbestos ID; and
- Soil trip spike and trip blank for BTEX.

- Preparation of this report.

3. Site Information

3.1 Site Identification, Location and Description

The site is located within the grounds of the University of Sydney around the area of tennis courts previously known as Women's Tennis Courts and is identified as part of Lot 1 in Deposited Plan 1171804.

The site covers a near rectangular shaped area of approximately 0.28 ha and is surrounded by University Avenue to the south and east, University Place to the west and Parramatta Road to the north.

A site plan and locality map is included as Drawing 1, Appendix A.

3.2 Geology and Acid Sulfate Soil

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

Reference to the Acid Sulphate Soil Risk Map published by the Department of Land and Water Conservation indicates that the site is in an area of no known occurrence of acid sulphate soil conditions.

3.3 Groundwater

An observation of the local topography suggests that groundwater flow would be to the north-east, ultimately to Rozelle and Blackwattle Bays.

4. Review of Previous Reports

The following report was prepared by DP for the entire University of Sydney site, including the subject site.

- *Preliminary Site Investigation, Proposed Campus Improvement Program, Camperdown and Darlington Campus, University of Sydney*, prepared for University of Sydney – Campus Infrastructure and Services, dated 25 November 2013 (DP Project Number 73716) (DP, 2013).

The following three reports were prepared by DP for the site:

- *Report on Geotechnical Investigation, Chau Chak Wing Museum, Parramatta Road, Camperdown*, prepared for the University of Sydney, dated 21 October 2016 (DP Project Number 85385.01) (DP, 2016a);
- *Preliminary Waste Classification, Chau Chak Wing Museum, Parramatta Road, Camperdown*, prepared for The University of Sydney, dated 31 October 2016 (DP Project Number 85385.01) (DP2016b); and
- *Report on Detailed Site Investigation, Proposed Chau Chak Wing Museum, Part of the University of Sydney, Camperdown, NSW,* prepared for The University of Sydney, dated 13 April 2017 (DP Project Number 85385.03) (DP, 2017).

The relevant sections of these reports are summarised in the following sections.

4.1 PSI (DP, 2013)

The investigation was a desktop study of past and present activities within the campus. No intrusive sampling was conducted as part of the scope of work. The site history was summarised as follows:

- Aerial photographs for the years 1930, 1943, 1951, 1968, 1970, 1986, 2000 and 2009 were examined and revealed that the subject site has been occupied by tennis courts since 1930.
- The title deed search did not include the relevant lot for the subject site (part of Lot 1 of Deposited Plan 1171804), however, *based on results for other Lots within the Campus, the entire Campus appears to have been largely used as a mixture of residential and university purposes for the past 100 years* (DP, 2013).
- A WorkCover (now SAFEWORK NSW) dangerous goods search did not indicate that any dangerous goods have been registered for the subject site. The search revealed that other areas of the Campus have registered dangerous goods.
- The Section 149 (2) and (5) planning certificate for 3 Parramatta Road, including part of Lot 1 of Deposited Plan 1171804 (the subject site), dated November 2013, indicated that
    - *The land does not include or comprise critical habitat under the Sydney Local Environment Plan 2012 (Sydney LEP 2012);*
    - *The land is not located within a conservation area;*
    - *The land is identified as being within a heritage conservation area;*
    - *The land is not considered bushfire prone land; and*

- *The land is not identified as contaminated as prescribed under section 59(2) of the CLM Act 1997. The land is subject to a site audit statement, and the subject site contains or has contained contaminants identified in one or more reports or records held by Council.*

- A search of NSW EPA public database was conducted on 1 November 2013 and revealed that the entire Campus site is not listed. A search was also undertaken of sites reported to the EPA under Section 60 of the CLM Act which deals with the duty to report contaminated sites. The entire Campus site was not listed as having previously been reported to the EPA. A search of the register indicated that there were no licences registered for the entire Campus site.
- The areas of environmental concern (AEC) identified which would be relevant to the subject site are importation of filling, asbestos on surface soils and previous agricultural land use.
- The report concluded that a detailed site investigation (DSI), including intrusive investigation should be undertaken prior to any future development works to investigate the AEC identified. Any soils removed off-site must be assessed against appropriate NSW EPA guidelines.

4.2 Geotechnical Investigation (DP, 2016a)

The geotechnical investigation comprised 12 boreholes to depths of between 10 m and 15 m bgl. The bores identified a generally sub-surface profile comprising:

- Topsoil – 100 mm to 300 mm of silty clay topsoils;
- Filling – clay and crushed sandstone filling to depths between 0.5 m and 2.2 m;
- Clay – stiff to hard clay to depths ranging from 1.8 m to 3.4 m; and
- Laminite – extremely low strength and very low strength laminate grading into medium strength laminate at depths between 3.4 m and 8.0 m. The medium strength laminite was generally fractured and slightly fractured. Some high strength laminate and shale were encountered in the deeper bores. Some joints, dipping in the range of 30^{o} to 70^{o}, were observed in the core samples.

The report provided recommendations for the geotechnical elements of the project. No sampling was completed for contamination purposes.

4.3 Preliminary Waste Classification (DP, 2016b)

The preliminary *in situ* waste classification was based on laboratory testing of samples collected from the geotechnical boreholes of DP (2016a) and the results are summarised in Table 1.

Table 1: Summary of Waste Classification

Material Identification	In ground fill and natural materials
Approximate Area	2,800 m^2 as shown on Drawing 1, Appendix A. It is noted that The University of Sydney indicated in an email dated 4 August 2017 that the area of the site is approximately 0.28 ha.
Material Description	Fill comprising dark brown and orange clay and crushed sandstone fill to depths between of 0.2 m and 2.2 m; Fill comprising brown crushed sandstone fill to 0.6 m depth; and Natural soil and weathered rock comprising light grey and red clay and shaly clay to depths of between 1.1 m to 4.3 m, and light grey-brown shale and light grey brown laminite to depths of between 10.0 m and 15.1 m.
Preliminary Classification	Fill: General Solid Waste (non-putrescible) (GSW) for dark brown and orange clay and crushed sandstone filling to depths of between 0.5 m and 1.7 m; Fill: Restricted Solid Waste (non-putrescible) (RSW) for brown crushed sandstone fill a depth of 0.6 m in the vicinity of BH12; and Natural soil and weathered rock: Virgin Excavated Natural Material (VENM)
Conditions	Appropriate segregation and validation of overlying fill including RSW (BH12) and GSW overlying the VENM
References	NSW EPA *Waste Classification Guidelines* (2014) *Protection of the Environment Operations Act 1997* (POEO Act) NSW EPA web site

The report concluded that:

The various waste classifications should be subject to appropriate segregation and validation of overlying fill. Segregation and validation of RSW should be undertaken prior to bulk excavation of GSW. This process should also apply following removal and validation of GSW prior to VENM excavation.

4.4 Detailed Site Investigation (DP, 2017)

DP, 2017 was prepared retrospectively, based on the results of DP, 2013, DP, 2016a and DP, 2016b. No updated historical information was obtained since the DP, 2013 however historical aerial photographs and anecdotal information suggests that the subject site use and condition had not changed since 2013.

DP, 2017 results indicated:

All contaminant concentrations in the soil samples analysed were within the adopted ecological investigation and screening levels (ESL) with the exception of B(a)P in filling samples collected from BH4 and BH12 at a depth of 0.5 m measured at 1.8 mg/kg and 20 mg/kg, respectively, compared to the ecological screening level of 1.4 mg/kg. Leachability (TCLP) testing was conducted on both

samples (for waste classification purposes) and found the leachability to be below the laboratory reporting limit (<0.001 mg/L).

It should be noted that the analytical requirements for waste classification purposes differ to those required for DSI purposes. For example NEPM stipulates threshold concentrations for various chemical analytes which were not included in the testing previously completed for waste classification purposes. However, overall, the analytical results suggest a low risk to human health.

Asbestos was not identified in any of the samples tested.

DP, 2017 conclusions and recommendations stated:

Based on the findings of this retrospective DSI, the site is considered to be suitable, from an environmental perspective, for the proposed museum development.

The exceedances of the B(a)P ESL in two filling samples is not considered significant given that leachability results were below laboratory reporting limit and that the material is likely to be removed as part of the excavation of the proposed basement.

An unexpected finds protocol (UFP) must form part of any excavation contractor's standard work method statements / construction management plans such that there is a plan of action to deal with finds of potential contamination not encountered by the current investigations. The UFP must include inter alia methods for identifying, investigating and managing asbestos on site if found.

The recommendations of the preliminary waste classification (DP, 2013) should be followed as per Section 4.3 of this report.

Please note that because this is a retrospective DSI based on results which were obtained for geotechnical and waste classification purposes, the following limitations should be noted:

- *The historical information presented is limited;*
- *No field QA was completed, hence no comment can be made regarding field QA;*
- *Groundwater testing was not completed, however, given that no significant soil contamination was found, groundwater contamination is considered unlikely; and*
- *This DSI was not strictly completed in accordance with SEPP55 due to the above mentioned limitations.*

Overall, it is further understood that since the DA was lodged, the NSW EPA has indicated that the limitations noted in DP, 2017 need to be addressed. Therefore, this report (Supplementary Contamination Assessment) aims to address the above limitations and comments made by the EPA.

5. Preliminary Conceptual Site Model

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

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

The following CSM was prepared as part of DP, 2017.

5.1 Potential Contamination Sources and Contaminants of Concern

Based on site history review (DP, 2013), the potential contamination sources are considered to be:

S1 Imported filling;

S2 Asbestos in surface soils (filling); and

S3 Historical agricultural land use.

The contaminants of potential concern are considered to be metals, TRH, BTEX, PAH, PCB, OCP, OPP, phenols and asbestos.

5.2 Potential Receptors

5.2.1 Human Health Receptors

R1 Current site users (workers and tennis players);

R2 Construction and maintenance workers;

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

R4 Land users in adjacent areas (commercial / educational).

5.2.2 Environmental Receptors

R5 Groundwater; and

R6 Surface water (urban drainage ultimately into Rozelle and Blackwattle Bays).

5.2.3 Potential Pathways

Potential pathways for contamination to impact the identified receptors include the following:

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

P2 Inhalation of dust and / or vapours;

P3 Leaching of contaminants and vertical migration into groundwater;

P4 Surface water run-off; and

P5 Lateral migration of groundwater.

5.3 Summary of Preliminary CSM

A 'source – pathway – receptor' approach has been used to assess the potential risk of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1 to S3) and receptors (R1 to R6) are provided in Table 2.

Table 2: Preliminary Conceptual Site Model

Potential Sources	Pathways	Receptors
S1 - Imported fill S2 - Asbestos in surface soils (filling) S3 - Historic agricultural land use.	P1 – Direct contact P2 – Inhalation P3 – Leaching	R1 - Current site users (workers and tennis players) R2 - Construction and maintenance workers R3 - Final end users (commercial users with limited soil access) R4 - Land users in adjacent areas (commercial / educational) R5 - Groundwater R6 Surface water (urban drainage ultimately into Rozelle and Blackwattle Bays)

6. Fieldwork and Analysis

6.1 Data Quality Objectives and Project Quality Procedures

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

- State the problem;
- Identify the decision;
- Identify inputs into the decision;
- Define the boundary of the assessment;
- Develop a decision rule;
- Specify acceptable limits on decision errors; and
- Optimise the design for obtaining data.

Referenced sections for the respective DQOs listed above are provided in Appendix C.

6.2 Data Quality Indicators

The performance of the assessment in achieving the DQO was assessed through the application of data quality indicators (DQI) as defined by:

Precision: A quantitative measure of the variability (reproducibility) of data;

Accuracy: A quantitative measure of the closeness of reported data to the "true" value;

Representativeness: The confidence (expressed qualitatively) that data are representative of each media present on the site;

Completeness: A measure of the useable data from a data collection activity; and

Comparability: The confidence (expressed qualitatively) that data can be considered equivalent for each sampling and analytical event.

Further comments on the DQIs are presented in Appendix C.

6.3 Soil Sampling Locations and Rationale

Three test pits were excavated in accessible areas of the site to provide an indication of subsurface conditions.

Under the NSW EPA *Sampling Design Guidelines* 1997, a minimum of 15 sampling locations is recommended to characterise a site of this size (0.28 ha). It should be noted that The University of Sydney indicated in an email dated 4 August 2017 that the area of the site is approximately 0.28 ha. A total of 12 boreholes were completed in previous investigations (see Section 4 of this report). The additional three test pits complete the total of 15 sample locations.

Test pits were completed as it is the preferred method to visually identify potential asbestos in filling.

Intrusive works were conducted on 16 August 2017 at the locations shown in Drawing 1, Appendix A.

6.4 Soil Sampling Procedures

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

- Decontamination of re-useable sampling equipment using a 3% phosphate free detergent (Decon90) and distilled water prior to collecting each sample or use of disposable sampling equipment;
- Use of disposable sampling equipment including nitrile gloves;
- Transfer of samples into laboratory prepared glass jars and capping immediately with Teflon lined lids;

- Labelling of sampling containers with individual and unique identification, including project number, sample identification and sample depth; and
- Placement of sample containers and bags into a cooled, insulated and sealed container for transport to the laboratory; and
- COC was maintained at all times and countersigned by the receiving laboratory on transfer of samples.

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

6.5 Analytical Rationale

The analytical scheme was designed to obtain an indication of the potential presence and possible distribution of identified COPC based on information obtained in the previous investigations and the preliminary CSM. The primary contaminants of concern as identified in Section 5 are metals, TRH, BTEX, PAH, PCB, OCP, OPP, phenols and asbestos. Soil samples were selected for analysis based on site observations (i.e. odour, staining etc.), and their location within the subsoil strata (i.e. fill or natural), with an emphasis on fill and near surface samples where it would be expected that the bulk of identified COPC would be present.

7. Proposed Development

It is understood that the proposed development comprises demolition of the existing tennis courts and the construction of a museum building equivalent to three levels above ground and four basement levels. The lowest ground level is given as RL 20.7 m. The site area is understood to be approximately 0.28 ha.

8. Assessment Criteria

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

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

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

Table 3 shows the HILs that have been adopted by NEPC (2013) Schedule B1, Table 1A (1) for assessing the human health risk from a contaminant via relevant pathways of exposure, as detailed in

the CSM. Table 3 only includes contaminants analysed during this assessment, not the full list provided in NEPC (2013).

The proposed development will comprise a museum building equivalent to three levels above ground and four basement levels; hence the adopted SAC were for commercial / industrial land use.

Table 3: Health Investigation Levels (Non-petroleum Chemical Contaminants)

Contaminant	HIL D Commercial / Industrial (mg/kg)
Metals and Inorganics	
Arsenic	3,000
Cadmium	900
Chromium (IV)	3,600
Copper	240,000
Lead	1,500
Mercury (inorganic)	730
Nickel	6,000
Zinc	400,000
PAH	
Carcinogenic PAH (as benzo(a)pyrene TEQ)	40
Total PAH	4,000
Phenols	
Phenol	240,000
OCP	
DDT + DDD + DDE	3,600
Aldrin + Dieldrin	45
Chlordane	530
Endosulfan (total)	2,000
Endrin	100
Hepatchlor	50
HCB	80
Methoxychlor	2,500
Other Organics	
PCB	7

8.2 Petroleum Contaminants (Health Screening Levels and Management Limits)

Health Screening Levels

Table 4 shows petroleum hydrocarbon compounds adopted from NEPC (2013) Schedule B1, Table 1A(3) and are based on the exposure to petroleum hydrocarbons through the dominant vapour inhalation exposure pathway. The screening levels are adopted given the exposure risk identified

during the CSM. Based on the proposed development, the relevant and adopted HSL is HSL D, commercial / industrial.

The HSLs are based on overlying soil type and depth. HSLs for sand have been used as they are most conservative. Using the most conservative values, the depth range of 0 m to <1 m has been used.

Table 4: Soil Health Screening Levels for Vapour Intrusion

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

NL- Not limiting

Direct Contact Screening Levels

Direct contact HSLs have also been considered for the future land use, considering that minimal parts of the site will not be occupied by buildings and may be available for direct contact such as grassed areas or in garden beds and vegetated areas. These are provided in Table 5.

Table 5: Direct Contact Health Screening Levels

Contaminant	HSL D Commercial / Industrial	Intrusive Maintenance Worker
Toluene	99,000	120,000
Ethylbenzene	27,000	85,000
Xylenes	81,000	130,000
Naphthalene	11,000	29,000
Benzene	430	1,100
C_6-C_{10}	26,000	82,000
>C_{10}-C_{16}	20,000	62,000
>C_{16}-C_{34}	27,000	85,000
>C_{34}-C_{40}	38,000	120,000

Management Limits (TRH Only)

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

- Formation of non-aqueous phase liquids (LNAPL);
- Fire and explosive hazards; and

- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

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

Management limits for coarse material are presented in Table 6, since the coarse texture management limits are more conservative of the two management limits available.

Table 6: Management Limits for TRH Fractions in Soil

TRH Fraction	Soil Texture	Management Limit: Commercial and industrial (mg/kg)
C_6-C_9 [F1]	Coarse	700
>C_{10}-C_{16} [F2]	Coarse	1,000
>C_{16}-C_{34} [F3]	Coarse	3,500
>C_{34}-C_{40} [F4]	Coarse	10,000

8.3 Ecological Investigation Levels

Ecological Investigation Levels (EIL) have been derived for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems (NEPC, 2013). EIL depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant based on the sum of the ambient background concentration (ABC) and an added contaminant limit (ACL). The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g. motor vehicle emissions). The ACL is the added concentration (above the ABC) of a contaminant above which further appropriate investigation and evaluation of the impact on ecological values is required.

The EIL is calculated using the following formula:

EIL = ABC + ACL,

The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al *Trace element concentrations in soils from rural and urban areas of Australia*, Contaminated Sites monograph no. 4, South Australian Health Commission, Adelaide, Australia 1995 (Olszowy, 1995) or Hamon et al, *Geochemical indices allow estimation of heavy metal background concentrations in soils*, Global Biogeochemical Cycles, vol. 18, GB1014, (Hamon, 2004). ACL is based on the soil characteristics of pH, CEC and clay content.
EIL (and ACLs where appropriate) have been derived in NEPC (2013) for only a short list of contaminants comprising As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel)*

Calculation Spreadsheet may be used for calculating site-specific EIL for these contaminants, and has been provided in the ASC NEPM Toolbox available on the SCEW (Standing Council on Environment and Water) website (http://www.scew.gov.au/node/941).
The adopted EIL, derived from Tables 1B (1) to 1B(5), Schedule B1 of NEPC (2013) the *Interactive (Excel) Calculation Spreadsheet* are shown in the following Table 7. The following site specific data and assumptions have been used to determine the EILs:

- The EILs will apply to the top 2 m of the soil profile;
- Given the likely source of soil contaminants (i.e. historical site use/fill) the contamination is considered as "aged" (>2 years); and
- ABCs have been derived using the *Interactive (Excel) Calculation Spreadsheet* using input parameters of aged soil, average CEC of 8 and average pH of 6.8 for the State in which the site is located, and high for traffic volumes.

Table 7: Ecological Investigation Levels (EIL) in mg/kg

Analyte		EIL	Comments
Metals	Arsenic	160	Adopted pH of 6.8 and CEC of 8 $cmol_c/kg$]; assumed clay content 5%
	Copper	280	
	Nickel	290	
	Chromium III	530	
	Lead	1,800	
	Zinc	620	
PAH	Naphthalene	370	
OCP	DDT	640	

8.4 Ecological Screening Levels – Petroleum Hydrocarbons

Ecological Screening Levels (ESL) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESL apply to the top 2 m of the soil profile as for EIL.

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and Benzo(a)pyrene. Site specific data and assumptions as summarised in Table 8 have been used to determine the ESL. The adopted ESL, from Table 1B(6), Schedule B1 of NEPC (2013) are shown in Table 9.

Table 8: Inputs to the Derivation of ESL

Variable	Input	Rationale
Depth of ESL application	Top 2 m of the soil profile	The top 2 m depth below ground level corresponds to the root zone and habitation zone of many species.
Land use	University (Commercial)	University use
Soil Texture	Coarse	

Table 9: Ecological Screening Levels (ESL) in mg/kg

Analyte		ESL	Comments
TRH	C6 – C10 (less BTEX) [F1]	215*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	>C10-C16 (less Naphthalene) [F2]	170*	
	>C16-C34 [F3]	1,700	
	>C34-C40 [F4]	3,300	
BTEX	Benzene	75	
	Toluene	135	
	Ethylbenzene	165	
	Xylenes	180	
PAH	Benzo(a)pyrene	1.4	

8.5 Asbestos

Presence / absence testing for asbestos has been conducted as a screening assessment using the laboratory detection limit of 0.1 g / kg. It should be noted that if further asbestos or indicators of asbestos (e.g. significant inclusions of building debris) are observed during future excavations / construction activity, then further assessment and / or management for asbestos in accordance with NEPC (2013) would be recommended.

8.6 Contaminants with No Assessment Criteria

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

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

The referenced criteria are provided in Table C1, Appendix C.

9. Fieldwork Observations

The test pit locations are shown in Drawing 1 in Appendix A. The test pit logs and the previous borehole logs are provided in Appendix B along with notes on descriptive terms and symbols.

The subsurface conditions encountered in the test pits comprised brown silty clay filling to depths of between 0.3 m and 0.8 m, then red brown, orange brown and grey silty clay to target depths of between 0.5 m and 1.0 m.

No free groundwater was encountered in the test pits.
There were no obvious indications of gross contamination (e.g. staining or odours) or anthropogenic materials within the test pits.

The conditions encountered in the test pits were consistent with those found during the previous investigations. Previous investigations indicate that the filling and clay soils are underlain by shaly clay and then shale and laminite bedrock.

10. Analytical Results

The results of the current and previous laboratory analysis are presented in Table C1, Appendix C. The NATA laboratory reports together with the chain-of-custody and sample receipt information are presented in Appendix C.

11. Discussion of Results

The laboratory results (Table C1) indicate that all contaminant concentrations in the soil samples analysed during the previous and current investigations (nine filling and eight natural samples) were within the adopted assessment criteria with the exception of benzo(a)pyrene in the following three filling samples:

- BH4/0.5 m (previous investigations) result of 1.8 mg/kg;
- BH12/0.5 m (previous investigations) results of 20 mg/kg; and
- TP2/0-0.1 m (current investigation) results of 3.3 mg/kg.

The above three results all exceeded the ecological screening level (ESL) of 1.4 mg/kg. However, as stated in the DSI (DP, 2017), leachability (TCLP) testing was conducted on both samples from the previous investigations (BH4 and BH12) (for waste classification purposes) and found the leachability to be below the laboratory reporting limit (<0.001 mg/L).

Asbestos was not identified in any of the samples tested from the previous or current investigations.

12. Conclusion and Recommendations

Based on the findings of the previous and current investigations, the site is considered to be suitable, from an environmental perspective, for the proposed museum development.

The exceedances of the B(a)P ESL in three filling samples is not considered significant given that leachability results were below laboratory reporting limit and that the material is to be removed as part of the excavation of the proposed basement.

An unexpected finds protocol (UFP) must form part of any excavation contractor's standard work method statements / construction management plans such that there is a plan of action to deal with finds of potential contamination not encountered by the current investigations. The UFP must include *inter alia* methods for identifying, investigating and managing asbestos, or any other contaminants, on site if found.

The recommendations of the preliminary waste classification (DP, 2016b) should be followed as per Section 4.3 of this report.

13. Limitations

Douglas Partners (DP) has prepared this report for the proposed Chau Chak Wing Museum at part of the University of Sydney Campus, Camperdown, NSW in accordance with DP proposal SYD170937 Rev1 dated 8 August and acceptance email from Mr Christopher Burns of The University of Sydney dated 9 August 2017. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of The University of Sydney for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

Douglas Partners Pty Ltd

Appendix A

About This Report

Drawing 1

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

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

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

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

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole 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. They may not be the same at the time of construction as are indicated in the report; and
- 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 first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or 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 a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP 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 and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

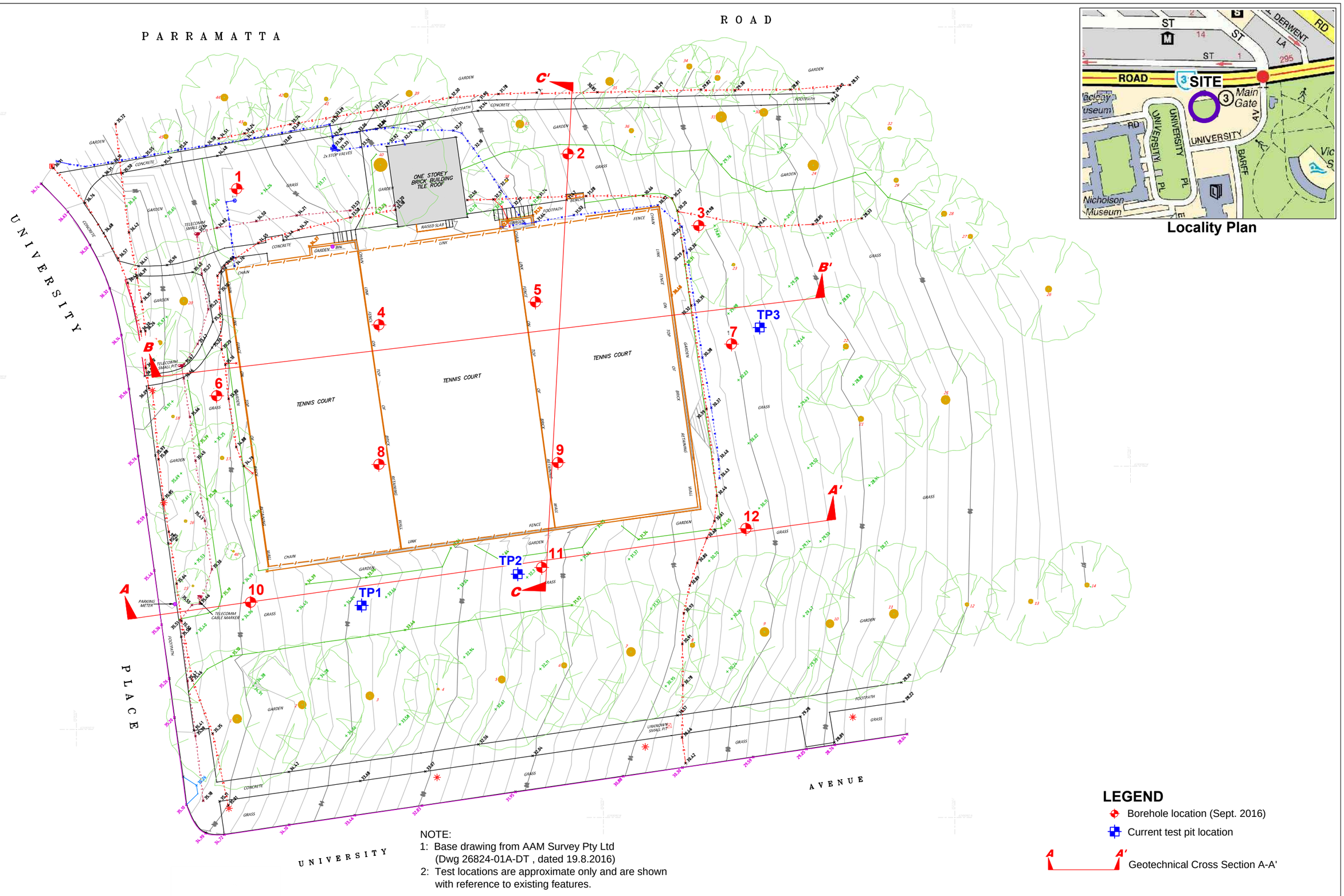
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later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

Information for Contractual Purposes

Where information obtained from this report 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. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.



Locality Plan

LEGEND

- Borehole location (Sept. 2016)
- Current test pit location
- A A' Geotechnical Cross Section A-A'

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Geotechnics / Environment / Groundwater

CLIENT: The University of Sydney		TITLE: **Location of Tests**	PROJECT No: 85385.03
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Chau Chak Wing Museum**	DRAWING No: 1
SCALE: 1:400 @ A3	DATE: 17.8.2017	**Part of The University of Sydney, CAMPERDOWN**	REVISION: 0

Appendix B

Descriptive Notes

Test Pit Logs

Borehole Logs (from previous Investigations)

Sampling Methods

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Sampling

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

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil 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.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud 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 the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils 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 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm 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 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

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

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This 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.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

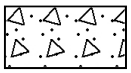
Symbols & Abbreviations

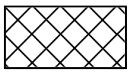
Graphic Symbols for Soil and Rock

General

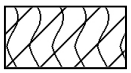

Asphalt

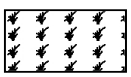

Road base

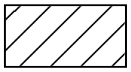

Concrete

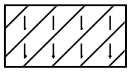

Filling

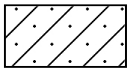
Soils


Topsoil

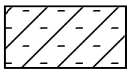

Peat

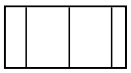

Clay

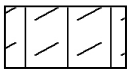

Silty clay

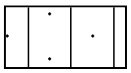

Sandy clay

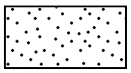

Gravelly clay

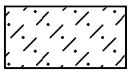

Shaly clay

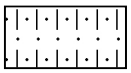

Silt


Clayey silt


Sandy silt

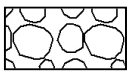

Sand

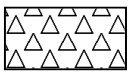

Clayey sand


Silty sand


Gravel

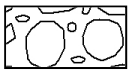

Sandy gravel


Cobbles, boulders

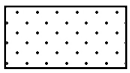

Talus

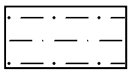
Sedimentary Rocks

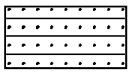

Boulder conglomerate

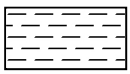

Conglomerate


Conglomeratic sandstone

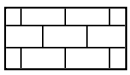

Sandstone


Siltstone

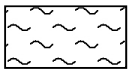

Laminite

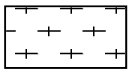

Mudstone, claystone, shale

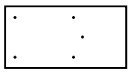

Coal


Limestone

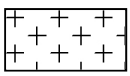
Metamorphic Rocks

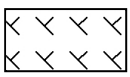

Slate, phyllite, schist

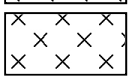

Gneiss

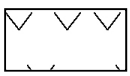

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

TEST PIT LOG

CLIENT: The University of Sydney
PROJECT: Proposed Chau Chak Wing Museum
LOCATION: University of Sydney, Camperdown

SURFACE LEVEL: 34.5 AHD^
EASTING: 332638
NORTHING: 6249067

PIT No: TP1
PROJECT No: 85385.03
DATE: 16/8/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
									5 10 15 20
		FILLING - brown silty clay filling with some fine to medium gravel and rootlets		A	0.0				
					0.1				
	0.3	SILTY CLAY - red-brown mottled grey, silty clay with some fine to medium gravel and rootlets							
34				A	0.4				
					0.5				
		0.7m: becoming mottled red and pale grey							
				A	0.9				
	1.0	Pit discontinued at 1.0m - target depth reached			1.0				1
33									

RIG: 5 tonne excavator with rock - toothed bucket

LOGGED: CL

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ^Levels interpolated from Dwg 26824-OIA-DT, dated 19/8/2016

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: The University of Sydney
PROJECT: Proposed Chau Chak Wing Museum
LOCATION: University of Sydney, Camperdown

SURFACE LEVEL: 32.5 AHD^
EASTING: 332653
NORTHING: 6249068

PIT No: TP2
PROJECT No: 85385.03
DATE: 16/8/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
		FILLING - dark brown silty clay filling with some fine to medium gravel and rootlets		A	0.0				
					0.1				
		0.3m: becoming light brown							
	0.4	SILTY CLAY - brown silty clay with some fine to medium gravel and shale		A	0.4				
32	0.5	Pit discontinued at 0.5m - target depth reached			0.5				
	1								1
31									

Dynamic Penetrometer Test (blows per mm): 5, 10, 15, 20

RIG: 5 tonne excavator with rock - toothed bucket

LOGGED: CL

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: ^Levels interpolated from Dwg 26824-OIA-DT, dated 19/8/2016

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: The University of Sydney
PROJECT: Proposed Chau Chak Wing Museum
LOCATION: University of Sydney, Camperdown

SURFACE LEVEL: 29.7 AHD^
EASTING: 338171
NORTHING: 6249907

PIT No: TP3
PROJECT No: 85385.03
DATE: 16/8/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
29	0.0	FILLING - dark brown silty clay filling with some fine to medium gravel and rootlets		A	0.0				
					0.1				
		0.3m: becoming light brown							
				A	0.4				
					0.5				
	0.8	SILTY CLAY - orange-brown silty clay with some fine to medium gravel and shale							
				A*	0.9				
28	1.0	Pit discontinued at 1.0m - target depth reached			1.0				

RIG: 5 tonne excavator with rock - toothed bucket

LOGGED: CL

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD1/16082017 duplicate collected at 0.9m to 1.0m. ^Levels interpolated from Dwg 26824-OIA-DT, dated 19/8/2016

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 34.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 85385.01
DATE: 27/7/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
34	0.3	FILLING - dark brown clayey sand filling with some medium to coarse sandstone gravel and some tree and grass rootlets, moist							A			
	0.6	FILLING - brown and orange clay filling with some fine to medium sand, moist							A			
33	1	CLAY - stiff to very stiff, grey mottled red clay with some fine to medium ironstone gravel, moist							A / S			4,7,8 N = 15
	1.4	CLAY - very hard, light grey clay with trace of ironstone bands						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
32	2											
	2.5	SHALE - extremely low strength, extremely to highly weathered, fragmented, light grey-brown shale with some low and medium strength iron-cemented bands							C	100	0	
31	3								C	100	0	
30	4											
29	5							5.2m: CORE LOSS: 1300mm	C	55	0	
28	6											
	6.5											
27	6.9	LAMINITE - medium strength, slightly weathered, fractured and slightly fractured, dark grey and light grey laminite with approximately 25% fine sandstone lamination and some clay bands						7.1m: Cs, 50mm 7.28m: Cs, 10mm 7.41m: Cs, 10mm 7.61m: J90°, pl,sm,cly co 7.64m: B0°, pl,sm,fe stn 7.69m: Cs, 10mm 7.72m: Cs, 80mm 7.83m: Cs, 100mm 7.99m: Cs, 10mm 8.17m: Cs, 10mm 8.3m: B5°,pl,sm,fe stn 8.61m: B0°, pl, sm, fe 8.9m: J30°, pl, sm, fe 8.92m: J45°- 90°, cu, he, fe stn 8.97m: Cs, 30mm 9.17m: Cs, 10mm 9.55m: Cs, 10mm	C	100	75	PL(A) = 0.58
	7.83	LAMINITE - medium strength, slightly weathered, slightly fractured, grey-brown laminite										PL(A) = 0.35
26	8											
25	9								C	100	95	PL(A) = 0.52
	10.0	Bore discontinued at 10.0m										

RIG: Bobcat **DRILLER:** GM **LOGGED:** JN/SI **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.5m; Rotary (water) to 2.5m; NMLC-Coring to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Well installed to 10.0m (backfill to 6.0m; bentonite to 6.5m; gravel to 10.0m; screen 7.0-10.0m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 31.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 85385.01
DATE: 11/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
31	0.1	FILLING - dark grey silt topsoil, rootlets present, traces of gravel, moist							A			
	0.8	FILLING - soft, dark grey-dark brown clay, traces of ironstone gravel, moist							A			
30	1	CLAY - very stiff, grey-brown clay with a trace of ironstone gravel, damp						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			3,5,13 N = 18
									A			
29	2.0	LAMINITE - very low strength, extremely to highly weathered, fragmented to fractured, light grey-brown laminite with some medium strength iron-cemented bands						2.0-2.4m: fg 2.4m: J45°, pl, ro, cln 2.6m: J45°, pl, ro, cln & J70°, st, ro, cln 2.72m: J35°, un, ro, cln 2.9m: J, sv, un, ro, cly 3.12-3.14m: Cs 3.25-3.3m: Cs	C	100	10	
28	3.4	LAMINITE - medium strength, highly then moderately to slightly weathered, fractured and slightly fractured, grey-brown laminite with approximately 30% fine sandstone laminations and some very low strength bands						3.48-3.81m: B (x3) 0°, cly, 5mm 3.88-3.92m: fg, cly 4m: B0°, cly 4.06-4.12m: fg 4.12m: J60°, pl, ro, cln 4.45-4.6m: J (x3) 70°-85°, un, ro, fe 4.63-4.8m: fg	C	100	25	PL(A) = 1.02 PL(A) = 0.59
27	5							5.0-5.1m: fg 5.3-6.4m: B's 0°- 5°, fe, cly	C	100	22	PL(A) = 0.64
26	6.34	LAMINITE - low to medium then medium strength, slightly weathered, slightly fractured, grey laminite with approximately 40% fine sandstone laminations						6.4-7.4m: B (x4) 5°, fe	C	100	94	PL(A) = 0.32 PL(A) = 0.28
24	7							7.4-7.8m: J85°, he, fe 7.62m: J30°, pl, ro, fe				
23	8							8.1m: J70°, pl, ro, cln 8.28m: J70°, he/fe 8.35m: J70°, 40°, st, ro, cln 8.53-8.65m: Cs				PL(A) = 0.5
22	8.65	LAMINITE - high strength, fresh, slightly fractured, grey laminite with approximately 20% fine sandstone laminations						9.25-9.35m: J (x3) 30° & 70°, st, ro, cln 9.45m: J45°, pl, sm, cln 9.6-9.75m: J (x3) 30°-45°, pl, sm, cln	C	100	85	PL(A) = 1.14
	10.0	Bore discontinued at 10.0m										

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.5m; NMLC-Coring to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 30.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 85385.01
DATE: 2/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low / Very Low / Low / Medium / High / Very High / Ex High		0.01 / 0.05 / 0.10 / 0.50 / 1.00	B - Bedding J - Joint S - Shear F - Fault				
30	0.2	FILLING - dark grey silt topsoil, rootlets present, traces of sand and ironstone gravel, moist							A			
	0.5	FILLING - apparently stiff, red-brown clay, moist							A			
29	1	CLAY - very stiff, grey-brown clay, traces of ironstone gravel, moist, MC<PL							A S			4,7,9 N = 16
								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
28	2											
	2.5	LAMINITE - high strength, highly then slightly weathered, fractured to slightly fractured, light grey-brown laminite										PL(A) = 1.13
27	3							2.95m: J70°, pl, ro, cln 2.5-2.7m: fg 3.18 & 3.22m: B0°, cly co, 2-3mm 3.26m: J60°, pl, ro, cly 3.45m: J70°, un, ro, cly 3.53m: J80°, partially he 3.88m: J45°, pl, ro, cln 4.06m: B5°, fe	C	100	60	PL(A) = 1.39
26	4											
	4.1	LAMINITE - low strength, slightly weathered, slightly fractured, grey laminite with approximately 30% fine sandstone laminations										PL(A) = 0.21
								4.5m: J45°, pl, ro, fe 4.75m: CORE LOSS: 150mm				
25	4.9 5											PL(A) = 0.2
								5.22-5.24m: Cs 5.32m: J60°, un, ro, fe 5.45m: F45°, cly	C	95	25	
24	6							6.08m: J85°, pl, ro, cln 6.4m: J60°, pl, sm, cln				PL(A) = 0.18
23	7.0 7	LAMINITE - medium strength, slightly weathered then fresh, fractured and slightly fractured, grey laminite with approximately 20% fine sandstone laminations						7.12m: J70°, un/he, ro				
								7.67m: J70°, pl, ro, cln 7.88m: J70° & 30°, st				PL(A) = 0.79
22	8							8.05m: J65°, pl, ro, cln 8.22m: J80°, pl, ro, fe 8.35m: J45°, pl, ro, cln 8.52m: J80°, pl, sm, cln 8.65m: J35°, pl, ro, cln 8.8-8.95m: J (x3) 35°-55°, pl, ro, cln	C	100	53	PL(A) = 0.84
21	9							9.06-9.15m: fg 9.15m: J45°, un, ro, cln 9.25m: J30°, Cz, 60mm 9.32m: J70°, ti 9.55m: J35°, pl, sm, cln 9.6m: J45°, pl, sm, Cz, 20mm 9.7m: J70°, pl, ro, cln	C	100	40	PL(A) = 0.72
20	10 10.0	Bore discontinued at 10.0m										

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; NMLC-Coring to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 33.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 85385.01
DATE: 15/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
33	0.1	FILLING - concrete slab filling							A			
	0.3	FILLING - brown medium grained clayey and filling with trace of fine sandstone gravel, moist							A			
	0.5	FILLING - dark brown silty clay filling with some medium grained sand, moist							A			
32	0.8	CLAY - stiff, orange-brown clay with some organic matter, moist							S			4,9,17 N = 26
	1.1	CLAY - stiff to very stiff, light grey mottled brown clay with some ironstone gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
31	2	SHALE - extremely low strength extremely weathered light grey shale										
	2.64	LAMINITE - very low strength, highly weathered fractured, light grey and brown laminite with some extremely low strength bands						2.92m: B0°, pl, sm, cly 2mm	C	100	0	PL(A) = 0.06
30	3							3.37m: J60°, lr, sm, fe, stn 3.41 to 4.17m: fg 3.49m: cs, 30mm 3.66m: cs, 30mm				PL(A) = 0.23
29	4							4.17m: J60°, pl, sm, cly, co	C	100	43	
	4.3	LAMINITE - medium strength, slightly weathered then fresh, slightly fractured, grey laminite with approximately 25% light grey fine grained sandstone laminations						4.58m: cs, 40mm 4.87m: B0°, pl, sm, fe, stn				PL(A) = 0.5
28	5							5.04m: J80°, pl, ro, cln 5.36m: J80°, pl, ro, cln				PL(A) = 0.73
27	6							5.66 to 6.73m: B's, 0°, fe 6.05m: J60°, pl, he, fe, 6.26m: cs, 60mm	C	100	80	
26	7							6.9m: J5°, pl, partially healed	C	100	91	PL(A) = 0.6 PL(A) = 0.74
25	8							7.94m: J60°, pl, ro, cln				PL(A) = 0.57
24	9							8.43 to 8.52m: J(x4), 20°-30°, pl,ro, cln 8.54m: J65°, pl, sm, cln 8.72m: J85°, cln, he 9.08m: J75°, pl, sm, cln 9.21m: J, 40°, un, ro, cln 9.42m: B,0°, fg, 10mm	C	100	71	
								9.91m: J, 45°, pl,sm,cln	C	100	86	PL(A) = 0.57

RIG: Bobcat **DRILLER:** GM **LOGGED:** JP/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; NMLC-Coring to 15.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 33.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 85385.01
DATE: 15/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
23		LAMINITE *(continued)*						10m: J45°, pl, sm, cln 10.21m: J45°, pl, sm, cln, partially healed 10.27m: J45°, pl, sm, cln, partially healed 10.33m: J45°, pl, sm, cln, partially healed	C	100	86	PL(A) = 0.83
22	10.5 11	LAMINITE - high strength, fresh, slightly fractured and unbroken, dark grey laminite with approximately 20% light grey fine grained sandstone laminations						11.52m: J30°, pl, sm, cln	C	100	100	PL(A) = 1.71 PL(A) = 1.58
21	12											
20	13							12.95m: J45°, un, sm, cln 13.1m: J60°, un, sm, cln 13.36m: J45°, pl, sm, cln 13.4m: J45°, pl, sm, cln 13.45m: J45°, pl, sm, cln 13.6m: J70°, pl, sm, cln	C	100	97	PL(A) = 1.4 PL(A) = 1.43
19	14							14.3m: J70°, pl, sm cln				
18	15 15.05	Bore discontinued at 15.05m							C	100	100	
17	16											
16	17											
15	18											
14	19											

RIG: Bobcat **DRILLER:** GM **LOGGED:** JP/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; NMLC-Coring to 15.05m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 31.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 85385.01
DATE: 15/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
31	0.09	FILLING - concrete slab filling							A			
		FILLING - brown clay filling with some medium grained sand, moist							A			
	0.6	CLAY - very stiff, light grey mottled brown clay with some ironstone gravel, moist							A			7,8,13 N = 21
30	1.3	SHALE - extremely low to very low strength, extremely weathered light grey shale with some iron-cemented bands						Unless otherwise stated rock is fractured along bedding planes dipping 0° to10°	S			
29									S			7,25/70 refusal
28	3.53	LAMINATE - low then medium strength, highly weathered, fractured to slightly fractured light grey brown laminite with approximately 30% light grey fine grained sandstone laminations and some iron cemented bands						3.61m: J70°-90°, cu, sm, fe, stn 3.9m: J45°, un, sm, cly, co	C	100	55	PL(A) = 0.11 PL(A) = 0.49
27								4.6m: J30°-45°, ir, sm, fe, stn 5.08m: cs, 50mm 5.16m: J30°, pl, sm, fe, stn 5.46m: cs, 40mm 5.62m: cs, 230mm	C	100	61	PL(A) = 0.83
26	5.9	LAMINATE - medium strength, moderately to slightly weathered, fractured to slightly fractured, grey laminite with approximately 40% light grey fine grained sandstone laminations						6.26m: cs, 20mm 6.37m: B5°, pl, sm, cly, co 6.47m: J, 85, un, ro, cln 6.56m: J45°, pl, sm, cly, co 7.06m: J30°, pl, sm, cly, co, fe, stn 7.5m: J45°, pl, sm ,cln 7.75m: J70°, pl, sm, cly, co 7.80-8.00m: J70°-90°, cu, sm, cln	C	100	79	PL(A) = 0.49 PL(A) = 0.54
25												
24												
23	8.0	LAMINITE - medium and high strength, slightly weathered, fractured to slightly fractured and unbroken, grey-brown laminite with approximately 20% fine sandstone laminations										PL(A) = 1.14
22								9.2m: J45°, pl, sm, cln 9.53m: B, 0, cly co 9.54m: J60°, pl, he 9.87-10.40m: J90°, pl,	C	100	99	PL(A) = 0.71

RIG: Bobcat **DRILLER:** GM **LOGGED:** JN/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 3.3m; NMLC-Coring to 15.00m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 31.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 85385.01
DATE: 15/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
21	11	LAMINITE - medium and high strength, slightly weathered, fractured to slightly fractured and unbroken, grey-brown laminite with approximately 20% fine sandstone laminations *(continued)*						sm, cln 10.13m: J45°, pl, sm, cln 10.82-11.70m: J80°-90°, pl, sm, cln	C	100	99	PL(A) = 0.48
20	12							11.65m: J30°, un, sm, cln 11.93m: J30°, un, sm, cln 12.06m: B0°, pl, sm, cly 5mm	C	100	92	PL(A) = 1.26
19	12.5	SHALE - high strength, fresh, slightly fractured, dark grey shale with a trace of fine sandstone laminations						12.3m: J60°, pl, sm, ch 12.4m: J60°, pl, sm, ch	C	100	96	PL(A) = 1.19 PL(A) = 2.1
18	13							13.60-13.75m: J 45°-70°, cu, sm ,cln				
17	14							14.33m: J60°, pl, sm, cln 14.60-15m : J30°, pl, sm, cln 14.75m: J45°& 80°, st, sm, cln	C	100	100	PL(A) = 2.28
16	15 15.0	Bore discontinued at 15.0m										
15	16											
14	17											
13	18											
12	19											

RIG: Bobcat **DRILLER:** GM **LOGGED:** JN/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 3.3m; NMLC-Coring to 15.00m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 35.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 85385.01
DATE: 2/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
35		FILLING - grey brown silty clay filling with a trace of road base gravel, moist							A			
									A			
	0.7	CLAY - stiff, red brown clay with ironstone grave, moist							A			
34	1								S			2,7,8 N = 15
	1.3	SHALY CLAY - very stiff then hard, light grey-brown to grey shaley clay and ironstone bands										
33	2								A			
									S			12,14,25 N = 39
32	3											
								Note: Unless otherwise stated, rock is fractured along bedding plane dipping at 0 to 10°				
31	4								S			14,25/140 refusal
	4.3	SHALE - very low strength, grey shale										
	4.75	SHALE - extremely low to low strength, extremely to highly weathered, fragmented, light grey shale with some low strength bands						4.83m: Cs, 80mm 4.91-5.0m: B, pl, fe, stn 5.07m: B0°, ir, ro, fe stn 5.12m: Cs, 40mm 5.21m: Ds, 140mm 5.36m: J30°, pl, ro, fe stn 5.37m: Ds, 70mm 5.68m: Cs, 60mm 5.76m: J30°, cu, ro, fe, stn 5.78m: J30°, cu, ro, fe, stn 6.2m: B0°, pl, ro, fe stn 6.25m: B0°, pl, ro, fe stn 6.5m: Cs, 60mm 6.6m: J30°, st, ro, fe stn 6.85m: J45°, pl, ro, cly co 6.97m: Cs, 110mm 7.2m: Cs, 60mm 7.3m: J, 30, pl, ro, cln 7.33m: CORE LOSS: 130mm 8.27m: Cs, 10mm 8.83m: J, 45, pl, ro, cln 8.97m: B, 0, fe 9.35m: B,0, cly vn, ti 10.03m: Cs, 10mm	C	100	0	
30	5											
									C	100	21.9	
29	6											
28	7											
	7.46											
	7.57	LAMINITE - low then medium strength, moderately and slightly weathered, fractured, grey laminite with approximately 25% fine sandstone laminations							C	91.2	52.7	PL(A) = 0.2
27	8											
												PL(A) = 0.2
26	9								C	100	73	PL(A) = 0.6
25	10											PL(A) = 0.6
	10.14	Bore discontinued at 10.14m										

RIG: Bobcat **DRILLER:** GM **LOGGED:** JP/SI **CASING:** HW to 2.4m; HW to 2.75m

TYPE OF BORING: Solid flight auger to (TC-bit) 2.5m; Rotary t o 4.75m; NMLC-Coring to 10.14m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 30.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 85385.01
DATE: 1/8/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
30	0.3	FILLING - dark brown clay topsoil filling with some tree and grass rootlets, moist							A			
	0.5	FILLING - brown crushed sandstone filling, moist							A			
29	1	FILLING - moderately compacted, brown-orange clay filling with some fine to medium ironstone gravel, moist							S			4,5,12 N = 17
	1.7	CLAY - very stiff, light grey clay with trace of ironstone bands, moist							A			
28	2							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	2.6	LAMINITE - very low strength, light grey-brown laminite							S			6,25/120mm refusal
27	3											
	3.25	LAMINITE - low strength, highly then moderately weathered, fractured and slightly fractured, brown and grey laminite with approximately 25% fine sandstone laminations nd some clay bands						3.36m: B0°- 5°, pl, sm, cly 3.68 to 4.56m: B's, 10°, fe 3.75m: J60°, pl, sm, cln 4.15m: J30°, un, sm, cly, 10mm	C	100	94	PL(A) = 0.18
26	4											
25	5							4.73 to 5.4m: B's, 5°-10°, fe 5.35-5.5m: J90°, pl, sm, cln 5.53m: J70°, pl, sm, cln 5.78m: J60°, pl, sm, cln 5.92m: J, 20°, pl, ro, cln	C	100	80	PL(A) = 0.22
24	6											
	6.0	LAMINITE - medium and high strength, slightly weathered then fresh, slightly fractured and unbroken, dark grey and light grey laminite with approximately 20% fine sandstone laminations						6.2m: J60°, pl, sm, cly, 10mm 6.3m: Cs, 20mm 6.4m: J45°, pl, ro, fe stn 6.46m: J45°, pl, he, fe stn 6.55m: J45°, pl, sm, cln 6.6m: J45°, pl, sm, cln 6.69m: J45°, pl, sm, cln 6.71m: B5°, pl, sm, fe stn 7.17m: J,70°, pl, sm, cln				PL(A) = 0.67 PL(A) = 0.76
23	7											
22	8											PL(A) = 1.26
21	9							8.42m: J, 30°, pl, sm, cln 8.67m: J45°, pl, sm, cln 8.7m: J45°, pl, sm, cln 8.77m: J80°, pl, sm, cln 9.26m: J0°- 45°, st, sm, cln 9.7m: J45°, pl, sm, cln 9.9-10.12m: J90°, pl, sm, cln	C	100	97	PL(A) = 0.88

RIG: Bobcat **DRILLER:** GM **LOGGED:** JN/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 3.25m; NMLC-Coring to 10.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 30.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 85385.01
DATE: 1/8/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
20		LAMINITE *(continued)*							C	100	97	PL(A) = 1.1
	10.45	Bore discontinued at 10.45m						10.37m: J45°, pl, sm, cln 10.42m: J45°, pl, sm, cln				
19	11											
18	12											
17	13											
16	14											
15	15											
14	16											
13	17											
12	18											
11	19											

RIG: Bobcat **DRILLER:** GM **LOGGED:** JN/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 3.25m; NMLC-Coring to 10.45m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 34.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 85385.01
DATE: 20/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
34	0.1	CONCRETE										
		FILLING - grey brown, silty clay filling with a trace of concrete gravel							A			
	0.6	CLAY - stiff, light grey-brown to brown clay with a trace of ironstone gravel							A			
33	1								A			5,5,7 N = 12
									S			
									A			
32	2	2.0m: becoming very stiff						Unless otherwise stated rock is fractured along rough planar bedding dipping at 0°-10°				
									S			10,25/100 refusal
	2.6	SHALE - extremely low to very low strength, light grey-brown shale										
31	3							2.8m: CORE LOSS: 700mm				
	3.5	SHALE - very low strength, extremely to highly weathered, fragmented, light grey-brown shale							C	50	0	
30	4								C	100	50	
29	5								C	100	100	
	5.47	LAMINITE - low to medium strength moderately weathered, fragmented, grey laminite										
28	6							5.7m: J35°, pl, sm, fe 5.85m: B0°, cly 10mm 6.21m: J 45°, pl, ro, cly, co 6.53m: J45°, pl, sm , fg, stn	C	100	100	PL(A) = 0.3
27	7							6.75m: J70°, pl, ro, cln				PL(A) = 0.3
	7.11	LAMINITE - medium then high strength, slightly weathered then fresh, slightly fractured and unbroken, grey brown laminite with approximately 20% fine sandstone laminations						7.0-7.13m: J60°, pl, he, fe, stn 7.15m: Cs, 20mm 7.50-7.60m: J70°, pl, sm, fe, stn				PL(A) = 0.7
26	8								C	100	75	
												PL(A) = 0.2
25	9							9.01-9.27m: J85°, pl, sm, cly, co 9.27m: Cs, 10mm				PL(A) = 0.9
									C	100	100	

RIG: Bobcat **DRILLER:** GM **LOGGED:** JP/SI **CASING:** HW 2.5-5.6m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 2.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: water loss at 3.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 34.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 85385.01
DATE: 20/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
24		LAMINITE - medium then high strength, slightly weathered then fresh, slightly fractured and unbroken, grey brown laminite with approximately 20% fine sandstone laminations *(continued)*						>>	C	100	100	PL(A) = 0.92 PL(A) = 1.61 PL(A) = 1.14
23	11											
22	12											
21	13							12.91m: J60°, pl, sm, cln 13.15m: J60°, pl, ro, cln				
	13.15	LAMINITE - high strength, fresh, highly fractured, grey laminite						13.35m: J70°, pl, sm, cln 13.64m: Ds, 40mm 13.71-13.74m: J60°, pl, ro, cly, co, 5mm 14.02-14.44m: J45°, pl, ro, cln	C	100	95	PL(A) = 1.52
20	14											
19	15							14.45m: J60°, pl, ro, cln 14.60-14.70m: J85°, pl, ro, cln 14.7m: J45°, pl, ro, cln	C	100	100	PL(A) = 1.12
	15.1	Bore discontinued at 15.1m										
18	16											
17	17											
16	18											
15	19											

RIG: Bobcat **DRILLER:** GM **LOGGED:** JP/SI **CASING:** HW 2.5-5.6m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 2.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: water loss at 3.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 31.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 85385.01
DATE: 8/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
31	0.09	CONCRETE SLAB							A			
	0.5	FILLING - grey sandy clay filling with a trace of fine angular road base gravel, moist							A			
30	1.0	SILTY CLAY - stiff, brown silty clay with a trace of ironstone gravel, moist							A			
		SHALY CLAY - very stiff, light brown shaly clay with ironstone bands, damp							S			3,7,11 N = 18
29	2.1	LAMINITE - very low strength, light grey-brown laminite						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			18,25/50mm refusal
28	2.9	LAMINITE - alternate bands of very low and high strength, highly weathered, fragmented to fractured and slightly fractured, light grey and red-brown laminate						2.9m: CORE LOSS: 180mm 3.36-3.45m: cs 3.53m: J70° & 45°, st,un, ro, fe	C	88	0	PL(A) = 1.63
27	3.08							4.02m: B0°, cly 10m 4.1m: J45°, pl, sm, cly 4.5-4.52m: cs 4.6m: J70°, in, ro, fe 4.7m: J45°, pl, ro, fe 4.75-4.77m:cs 4.88-4.92m: cs 5.08m: CORE LOSS: 370mm	C	73	0	PL(A) = 1.25
26	5.45							5.5-5.6m: cs				
25	5.7	LAMINITE - medium strength, highly to moderately weathered, slightly fractured, light grey brown then light grey to grey laminite with approximately 25% fine sandstone lamination						5.82m: J30°, ti 6.12-6.17m: cs 6.3m: J45°, he, fe 6.35-6.37m: cs 6.51-6.60m: cs 6.75-7.1m: J(x2) 30° & 85°, st, ro, cln	C	100	86	PL(A) = 0.57
24								7.5-7.5m: J80°, partially he, un, ro, fe 7.7m: J45°, pl, ro, cln 7.93m: J40°, he, fe	C	100	100	PL(A) = 0.41
23	8.6	LAMINITE - high strength, fresh, fractured and slightly fractured, grey laminate with approximately 20% fine sandstone lamination						8.4m: J60°, pl, ro, cln 8.6m: J30°, pl, ro, cln 9.12m: J60°, pl, sm, cln 9.3-9.5m: J75°, pl, sm, fe 9.52m: J35°, pl, sm. cln 9.621m: J60°, pl, ro, cln 9.8m: J80°, pl, ro, cln	C	100	36	PL(A) = 0.67 PL(A) = 1.7
22	9											

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) 2.5m; Rotary (water) to 2.9m; NMLC-Coring to 15.06m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 31.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 85385.01
DATE: 8/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
21	11	LAMINITE - high strength, fresh, fractured and slightly fractured, grey laminate with approximately 20% fine sandstone lamination *(continued)*						9.92m: sz, 20mm 10.04m: J35°, pl, ro., cln 10.12-10.12m: sz	C	100	36	
20								J(60°-80°), cu, sm, cln 10.35m: J45°, pl, sm, cln 10.5m: J70°, he, ti	C	100	100	PL(A) = 1.67
								10.93m: J45°, pl, sm ,cln 11m: J80°, pl, ro, cln	C	100	100	
19	12 12.0	SHALE - high strength, fresh, fractured then slightly fractured, grey shale with a trace of fine sandstone lamination						11.55-11.65m: J(x3) 20°-30°, pl, ro , cln 11.65m: J75°, un, ro, cln 11.70-11.92m: fg 12.1m: J70°, un, ro, cz 20mm 12.2m: J35°, pl, sm , cln 12.36-12.7m: J80°, pl, sm, fe	C	100	71	PL(A) = 1.009 PL(A) = 1.2
18	13							13.06m: J70°, pl, ro, cly 13.1-13.14m: sz, 40m				
17	14							14.22m: J45°, pl, sn, cln 14.28m: J45°, pl, sm, cz, 10m	C	100	100	PL(A) = 1.14
16	15 15.06	Bore discontinued at 15.06m										
15	16											
14	17											
13	18											
12	19											

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) 2.5m; Rotary (water) to 2.9m; NMLC-Coring to 15.06m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 34.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 85385.01
DATE: 11/8/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
34	0.2	FILLING - dark grey silt, topsoil, rootlets present, organic odour, moist							A			
		CLAY - apparently stiff, brown clay, moist							A			
	0.8	CLAY - hard, grey-red clay with ironstone gravel present, moist							A			
33	1								S			5,12,22 N = 34
	1.8	SHALE - extremely low strength, brown grey shale							A			
32	2							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			11,25/120mm refusal
	3											
	3.4	SHALE - extremely low to very low strength, extremely and highly weathered, fragmented to fractured, light grey-brown shale with some medium and low strength iron-cemented bands						3.2-3.73m: fg	C	100	0	PL(A) = 0.53
31	4											
30	5							4.65m: J80°, pl, ro, fe 4.7m: J40°, un, ro, fe	C	97	0	PL(A) = 0.21
	5.56							5.53m: CORE LOSS: 30mm	C	100	0	
29	6							6.32-6.4m: J70°, un, ro, fe 6.6-6.75m: J, sv (85°-90°) un, ro, fe				PL(A) = 0.52
	6.45	LAMINITE - medium strength, slightly weathered, fragmented and slightly fractured, grey-brown laminite with approximately 30% fine sandstone laminations						6.9-7.05m: J90°, pl, ro, fe 7.1-7.45m: fg, fe	C	100	60	PL(A) = 0.54
28	7											
	7.5	LAMINITE - low and medium strength, slightly weathered then fresh, slightly fractured, grey brown laminite with approximately 20% fine sandstone laminations						7.65m: J80°, he, fe 7.7m: J30°, pl, ro, fe 8.0-8.1m: fg				
27	8							8.42m: B0°, fe				PL(A) = 0.43
26	9							9.2-9.42m: J, sv (85°-90°) un, ro, cln	C	100		PL(A) = 0.67
25								9.9 & 9.95m: J (x2) 35°-45°, pl, sm, cln	C	100		

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (T-bit) to 2.5m; Rotary (water) to 3.4m; NMLC-Coring to 10.33m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 34.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 85385.01
DATE: 11/8/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		LAMINITE - *continued*							C	100		PL(A) = 0.78
	10.33	Bore discontinued at 10.33m						10.15m: J45°, pl, sm, cln 10.2m: J30°, pl, sm, cln				

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (T-bit) to 2.5m; Rotary (water) to 3.4m; NMLC-Coring to 10.33m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 32.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 85385.01
DATE: 11/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
32	0.3	FILLING - dark grey, silty clay topsoil, presence of rootlets and gravel							A			
	0.5	FILLING - dark grey-red, sandy clay filling with some silt particles, damp							A			
31	1	FILLING - stiff, grey-brown clay filling with some ironstone gravel and dark grey silt							A			
									S			3,5,8 N = 13
	2								A			
30	2.2	LAMINITE - extremely low strength, grey laminite							A			
								Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			8,17,25/120mm refusal
29	3											
	3.4	LAMINITE - low to medium strength, highly weathered, fragmented to fractured, light grey and brown laminite						3.6m: J30°, pl, ro, fe 3.77m: J45°, pl, ro, cln 3.86m: J30°, pl, sm, cly	C	100	40	PL(A) = 0.36
28	4											
	4.2	LAMINITE - extremely low to very low strength, extremely to highly weathered, fragmented to fractured, light grey laminite						4.25-4.5M: Cz 4.5-4.7M: Cs	C	100	25	
27	4.95	LAMINITE - low to medium then very low strength, highly weathered, slightly fractured, light grey to grey laminite with approximately 30% fine sandstone laminations						4.83m: J45°, pl, sm, cln 4.92m: B10°, cly co, 5mm 5.12-5.16m: J (x2) 55°-60°, pl, ro, fe				PL(A) = 0.13
	5											
	6	6.2-7.3m: high angle (30° to 35°) bedding						6.08m: B0°, fe	C	100	0	PL(A) = 0.12
26												
	7								C	100	20	PL(A) = 0.12
25												
	8											
	8.0	LAMINITE - medium then low to medium strength, slightly weathered, slightly fractured, light grey to grey laminite with approximately 30% fine sandstone laminations						8.1-8.55m: B (x3) 0°, fe 8.76m: J35°, he, fe 9.13m: B0°, cly, 10mm 9.4m: B0°, cly, 5m	C	100	94	PL(A) = 0.72 PL(A) = 0.3
24	9											
	10											
23	10.15	Bore discontinued at 10.15m						10.07m: B0°, fe				PL(A) = 0.36
22												

RIG: Bobcat **DRILLER:** GM **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; Rotary (water) to 3.4m; NMLC-Coring to 10.33m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: Chau Chak Wing Museum
LOCATION: Parramatta Road, Camperdown

SURFACE LEVEL: 30.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 85385.01
DATE: 1/8/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
30	0.2	FILLING - grey and brown clay topsoil filling with some tree and grass rootlets, moist							A			
	0.6	FILLING - brown crushed sandstone filling, moist							A			
29	1	CLAY - hard, grey mottled red clay with some fine to medium ironstone gravel, moist							A			
	1.5	CLAY - very hard, light grey clay with trace of ironstone bands, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			3,6,8 N = 14
28	2											
	2.75	LAMINITE - very low strength, moderately weathered, fractured and slightly fractured, brown and grey laminite with some extremely low strength bands, with approximately 30% fine sandstone laminations							S			11,25/90mm refusal
27	3							3.05m: J45°, pl, ro, fe stn, cly 3.1m: Cs, 10mm 3.19m: Cs, 10mm 3.24m: Cs, 10mm 3.4m: B0°- 20°, un, sm, cly, 5mm 3.66m: Cs, 20mm 3.74m: J45°, pl, sm, cly co	C	100	79	PL(A) = 0.14
26	4							3.9m: Cs, 10mm 4.34m: B0°- 5°, pl, sm, fe stn, cly 4.38m: Cs, 50mm 4.48-4.6m: J90°, pl, sm, cly	C	100		PL(A) = 0.1
25	5							5.34m: J60°, pl, sm, cln				
	5.7	LAMINITE - low strength, slightly weathered, slightly fractured, grey-brown laminite with approximately 30% fine sandstone laminations						5.68m: J45°, pl, sm, cly co 5.86m: J60°, pl, sm, cly 5.88m: J60°, pl, sm, cly 5.91m: J60°, pl, sm, cly 6.2m: J60°, pl, sm, cly	C	100	95	PL(A) = 0.18
24	6							6.65m: J45°, pl, sm, cly				PL(A) = 0.2
	7											
	7.2	LAMINITE - medium strength, fresh, fractured and slightly fractured, dark grey and light grey laminite with approximately 20% fine sandstone laminations						7.58m: J45°- 60°, cu, sm, cln 7.75-7.85m: J90°, pl, sm, cly				PL(A) = 0.12
23	8											
22	9							8.5m: J30°, pl, sm, cln 8.57m: J45°, cu, sm, cln	C	100	91	PL(A) = 0.37
	10.0	Bore discontinued at 10.0m						9.1m: J45°, pl, sm, cly 9.15m: J45°, pl, sm, cly 9.2m: J45°, pl, sm, cly 9.53m: J60°, cu, sm, cln 9.58m: J60°, cu, sm, cln 9.6m: J60°, cu, sm, cln				PL(A) = 0.59
21												

RIG: Bobcat **DRILLER:** GM **LOGGED:** JN/SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.5m; NMLC-Coring to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Well installed to 10.0m (backfill to 6.0m; bentonite to 6.5m; gravel to 10.0m; screen 7.0-10.0m)

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Appendix C

TableC1

Laboratory Reports

Data Quality Assessment

Table C1_Summary of Results

	8 metals in soil								Asbestos ID - soils		Orga									
	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Asbestos fibres	Phenolics Total	4,4-DDE	a-BHC	Aldrin	b-BHC	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	4	0.4	1	1	1	0.1	1	1		5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Assessment Criteria																			
Health Based Investigation Levels	3000	900	3600	240,000	1500	730	6000	40,000		240,000					530				
Petroleum Contaminants																			
Ecological Investigation Levels	160		530	280	1800		290	620											370
Ecological Screening Levels																			
Resullts from Previous Investigations																			
Field_ID	**Sample_Depth_Range**	**Sampled_Date-Time**	**Matrix_Description**	**Lab_Report_Number**																
1	1	27/07/2016	clay	153582	4	<0.4	16	2	18	<0.1	<1	3	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3	0.5	2/08/2016	filling	153582	6	<0.4	16	9	15	<0.1	5	16	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4	0.5	9/09/2016	filling	153582	12	<0.4	29	52	77	0.2	10	190	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4	1.5	9/09/2016	clay	153582	<4	<0.4	11	12	45	<0.1	4	17	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
5	0.5	7/09/2016	filling	153582	27	<0.4	17	29	46	0.1	6	62	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
5	1.5	7/09/2016	clay	153582	12	<0.4	8	14	20	<0.1	1	6	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
8	0.5	10/09/2016	filling	153582	10	<0.4	22	23	47	0.1	6	59	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
8	2	10/09/2016	clay	153582	<4	<0.4	5	6	21	<0.1	<1	<1	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
9	0.5	8/09/2016	filling	153582	9	<0.4	26	6	25	<0.1	4	61	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
9	1.5	8/09/2016	clay	153582	5	<0.4	21	2	24	<0.1	1	3	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
10	1	11/08/2016	clay	153582	12	<0.4	8	5	25	<0.1	<1	<1	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
12	0.5	1/08/2016	filling	153582	6	<0.4	13	14	37	<0.1	6	65	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Resullts from Current Investigation																				
TP1	0-0.1	16/08/2017	filling	173584	<4	<0.4	48	58	67	0.2	22	110	No asbestos detected at the reporting limit of 0.1g/kg	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TP2	0-0.1	16/08/2017	filling	173584	11	<0.4	26	58	130	0.4	15	180	No asbestos detected at the reporting limit of 0.1g/kg	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TP2	0.4-0.5	16/08/2017	silty clay	173584	12	<0.4	22	3	21	<0.1	3	5	No asbestos detected at the reporting limit of 0.1g/kg	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TP3	0-0.1	16/08/2017	filling	173584	6	<0.4	18	44	83	0.2	6	76	No asbestos detected at the reporting limit of 0.1g/kg	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TP3	0.9-1.0	16/08/2017	silty clay	173584	6	<0.4	17	1	17	<0.1	1	3	No asbestos detected at the reporting limit of 0.1g/kg	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BD1/06082017		16/08/2017	Replicate of TP3/0.9-1.0	173584	7	<0.4	20	1	18	<0.1	1	2											
Statistical Summary																				
Number of Results	18	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17	17	17	
Number of Detects	15	0	18	18	18	6	15	16	17	0	0	0	0	0	0	0	0	0	0	
Minimum Concentration	<4	<0.4	5	1	15	<0.1	<1	<1	0	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Minimum Detect	4	ND	5	1	15	0.1	1	2	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Maximum Concentration	27	<0.4	48	58	130	0.4	22	190	0.1	<5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Maximum Detect	27	ND	48	58	130	0.4	22	190	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Average Concentration	8.4	0.2	19	19	41	0.1	5.1	48	0.029	2.5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Median Concentration	6.5	0.2	17.5	10.5	25	0.05	4	16.5	0	2.5	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
Standard Deviation	5.9	0	9.8	20	31	0.094	5.7	60	0.047	0	0	0	0	0	0	0	0	0	0	
Number of Guideline Exceedances	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Number of Guideline Exceedances(Detects Only)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Average Concentration - Filling Only
Standard Deviation - Filling Only

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Table C1_Summary of Results

	Chlorinated Pesticides											Organophosphorus Pesticides											PAHs in Soil											
	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Azinophos methyl	Bromophos-ethyl	Chlorpyrifos	Chlorpyrifos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	TCLP B(a)P mg/L	Benzo(a)pyrene TEQ calc (zero)	Benzo(a)pyrene TEQ calc(half)	Benzo(a)pyrene TEQ calc(PQL)	Benzo(b,j+k)fluoranthene	Benzo(g,h,i)perylene	Chrysene
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.001	0.5	0.5	0.5	0.2	0.1	0.1
Assessment Criteria																																			
Health Based Investigation Levels		50						50		80	2500																								
Petroleum Contaminants																																			
Ecological Investigation Levels																																			
Ecological Screening Levels																												1.4							
Resullts from Previous Investigations																																			
1	1	27/07/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
3	0.5	2/08/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
4	0.5	9/09/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.2	1.2	**1.8**	<0.001	2.5	2.5	2.5	3.1	1.3	1.5
4	1.5	9/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
5	0.5	7/09/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.7	0.93	<0.001	1.3	1.3	1.3	2	0.7	0.8
5	1.5	7/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
8	0.5	10/09/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	1.1	1.4	<0.001	2.1	2.1	2.1	2.5	1	1.4
8	2	10/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
9	0.5	8/09/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
9	1.5	8/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
10	1	11/08/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
12	0.5	1/08/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.7	6.8	8.2	19	**20**	<0.001	29	29	29	31	11	20
Resullts from Current Investigation																																			
TP1	0-0.1	16/08/2017	filling	173584	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.3	1	1		1.5	1.5	1.5	2	2	1
TP2	0-0.1	16/08/2017	filling	173584	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.9	0.7	3.7	**3.3**		5	5	5	6	6	3.2
TP2	0.4-0.5	16/08/2017	silty clay	173584	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.06		<0.5	<0.5	<0.5	<0.2	<0.2	<0.1
TP3	0-0.1	16/08/2017	filling	173584	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.7	0.73		1.1	1.1	1.1	1	1	0.7
TP3	0.9-1.0	16/08/2017	silty clay	173584	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.2	<0.1
BD1/06082017		16/08/2017	Replicate of TP3/0.9-1.0	173584																															
Statistical Summary																																			
Number of Results	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17		17	17	17	17	17	17
Number of Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6	7	7	8		7	7	7	7	7	7
Minimum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.5	<0.5	<0.5	<0.2	<0.1	<0.1
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	0.1	0.1	0.7	0.06		1.1	1.1	1.1	1	0.7	0.7
Maximum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.7	6.8	8.2	19	20		29	29	29	31	11	20
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	6.8	8.2	19	20		29	29	29	31	11	20
Average Concentration	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.097	0.53	0.61	1.6	1.7		2.6	2.6	2.6	2.9	1.4	1.7
Median Concentration	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.025		0.25	0.25	0.25	0.1	0.1	0.05
Standard Deviation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.16	1.6	2	4.6	4.8		6.9	6.9	6.9	7.4	2.9	4.8
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6		0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6		0	0	0	0	0	0
Average Concentration - Filling Only																												1.6767							
Standard Deviation - Filling Only																												1.2677							

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Table C1_Summary of Results

											PCBs in Soil							TRH Soil C10-C40 NEPM							vTRH & BTEXN in Soil NEPM								
	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Pyrene	Total Positive PAHs	TCLP PAH mg/L	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	C10-C16	C16-C34	C34-C40	F2-NAPHTHALENE	C10 - C14	C15 - C28	C29-C36	Benzene	Ethylbenzene	Naphthalene	Toluene	C6 - C9	Xylene (m & p)	Xylene (o)	C6-C10 less BTEX (F1)	C6-C10
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.1	0.1	0.1	0.1	0.1	0.1	0.1			0.1	0.1	0.1	0.1	0.1	0.1	0.1	50	100	100	50	50	100	100	0.2	1	1	0.5	25	2	1	25	25
Assessment Criteria																																
Health Based Investigation Levels								4000		Total - 7														3					230		260	
Petroleum Contaminants																						20,000		430	27,000	11,000	99,000		81,000			26,000
Ecological Investigation Levels					370																											
Ecological Screening Levels																		1700	3300	170				75	165		135		180		215	

Resullts from Previous Investigations

Field_ID	Sample_Depth_Range	Sampled_Date-Time	Matrix_Description	Lab_Report_Nu																													
1	1	27/07/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
3	0.5	2/08/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
4	0.5	9/09/2016	filling	153582	0.2	2.3	<0.1	1.2	<0.1	0.6	2.5	16	NIL+VE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
4	1.5	9/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
5	0.5	7/09/2016	filling	153582	0.1	1.3	<0.1	0.6	<0.1	0.3	1.4	8.6	NIL+VE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
5	1.5	7/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
8	0.5	10/09/2016	filling	153582	0.1	2.4	<0.1	1	<0.1	0.9	2.5	15	NIL+VE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
8	2	10/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
9	0.5	8/09/2016	filling	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
9	1.5	8/09/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
10	1	11/08/2016	clay	153582	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
12	0.5	1/08/2016	filling	153582	2.6	41	4.2	11	1.1	36	39	250	0.006	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	51	1200	190	51	<50	920	420	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25

Resullts from Current Investigation

TP1	0-0.1	16/08/2017	filling	173584	0.2	2.4	<0.1	0.5	<0.1	1.4	2.2	13		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
TP2	0-0.1	16/08/2017	filling	173584	0.5	7.2	0.2	1.8	0.1	3.5	6.9	40		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	180	<100	<50	<50	100	110	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
TP2	0.4-0.5	16/08/2017	silty clay	173584	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.1	0.4		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
TP3	0-0.1	16/08/2017	filling	173584	0.1	1.3	<0.1	0.4	<0.1	0.5	1.3	7.8		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
TP3	0.9-1.0	16/08/2017	silty clay	173584	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
BD1/06082017		16/08/2017	Replicate of TP3/0.9-1.0	173584																														

Statistical Summary

Number of Results	17	17	17	17	17	17	17	17		17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
Number of Detects	7	8	2	7	2	7	8	16		0	0	0	0	0	0	0	1	2	1	1	0	2	2	0	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<50	<100	<100	<50	<50	<100	<100	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
Minimum Detect	0.1	0.2	0.2	0.4	0.1	0.3	0.1	0.4		ND	ND	ND	ND	ND	ND	ND	51	180	190	51	ND	100	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	2.6	41	4.2	11	1.1	36	39	250		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	51	1200	190	51	<50	920	420	<0.2	<1	<1	<0.5	<25	<2	<1	<25	<25
Maximum Detect	2.6	41	4.2	11	1.1	36	39	250		ND	ND	ND	ND	ND	ND	ND	51	1200	190	51	ND	920	420	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.25	3.4	0.3	1	0.11	2.6	3.3	21		0.05	0.05	0.05	0.05	0.05	0.05	0.05	27	125	58	27	25	104	75	0.1	0.5	0.5	0.25	13	1	0.5	13	13
Median Concentration	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.025		0.05	0.05	0.05	0.05	0.05	0.05	0.05	25	50	50	25	25	50	50	0.1	0.5	0.5	0.25	12.5	1	0.5	12.5	12.5
Standard Deviation	0.62	9.8	1	2.6	0.25	8.7	9.4	60		0	0	0	0	0	0	0	6.3	279	34	6.3	0	211	90	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances	0	0	0	0	0	0	0	0		#VALUE!	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0		#VALUE!	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Average Concentration - Filling Only
Standard Deviation - Filling Only

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CERTIFICATE OF ANALYSIS 173584

Client Details

Client	Douglas Partners Pty Ltd
Attention	Jessica Paulsen
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**85385.03 / Museum, Uni Syd**
Number of Samples	8 Soil
Date samples received	16/08/2017
Date completed instructions received	16/08/2017

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.

Report Details

Date results requested by	23/08/2017
Date of Issue	23/08/2017

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Report Comments

Asbestos: Excessive sample volume was provided for asbestos analysis. A portion of the supplied sample was sub-sampled according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample. Envirolab recommends supplying 40-50g (50mL) of sample in its own container as per AS4964-2004.
Note: Samples 173584-1 to 5 were sub-sampled from bags provided by the client.

Asbestos Approved By
Analysed by Asbestos Approved Identifier: Lucy Zhu
Authorised by Asbestos Approved Signatory: Lulu Scott

Results Approved By
Jeremy Faircloth, Organics Supervisor
Long Pham, Team Leader, Metals
Nick Sarlamis, Inorganics Supervisor
Paul Ching, Senior Analyst
Steven Luong, Chemist

Authorised By

David Springer, General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	21/08/2017	21/08/2017	21/08/2017	21/08/2017	21/08/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	98	106	94	99	101

vTRH(C6-C10)/BTEXN in Soil			
Our Reference		173584-7	173584-8
Your Reference	UNITS	Trip Spike	Trip Blank
Depth		-	-
Date Sampled		16/08/2017	16/08/2017
Type of sample		Soil	Soil
Date extracted	-	18/08/2017	18/08/2017
Date analysed	-	21/08/2017	21/08/2017
TRH C_6 - C_9	mg/kg	[NA]	<25
TRH C_6 - C_{10}	mg/kg	[NA]	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	[NA]	<25
Benzene	mg/kg	96%	<0.2
Toluene	mg/kg	98%	<0.5
Ethylbenzene	mg/kg	99%	<1
m+p-xylene	mg/kg	97%	<2
o-Xylene	mg/kg	98%	<1
Total +ve Xylenes	mg/kg	[NA]	<1
naphthalene	mg/kg	[NA]	<1
Surrogate aaa-Trifluorotoluene	%	97	113

svTRH (C10-C40) in Soil						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	19/08/2017	19/08/2017	19/08/2017	19/08/2017	19/08/2017
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	100	<100	<100	<100
TRH C_{29} - C_{36}	mg/kg	<100	110	<100	<100	<100
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	180	<100	<100	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	180	<50	<50	<50
Surrogate o-Terphenyl	%	87	89	91	86	87

PAHs in Soil						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	21/08/2017	21/08/2017	21/08/2017	21/08/2017	21/08/2017
Naphthalene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.3	0.9	<0.1	0.1	<0.1
Acenaphthene	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	1.4	3.5	<0.1	0.5	<0.1
Anthracene	mg/kg	0.3	0.7	<0.1	0.1	<0.1
Fluoranthene	mg/kg	2.4	7.2	0.2	1.3	<0.1
Pyrene	mg/kg	2.2	6.9	0.1	1.3	<0.1
Benzo(a)anthracene	mg/kg	1.0	3.7	<0.1	0.7	<0.1
Chrysene	mg/kg	1.0	3.2	<0.1	0.7	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	2	6.0	<0.2	1	<0.2
Benzo(a)pyrene	mg/kg	1.0	3.3	0.06	0.73	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	0.5	1.8	<0.1	0.4	<0.1
Dibenzo(a,h)anthracene	mg/kg	0.2	0.5	<0.1	0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.6	2.0	<0.1	0.5	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	1.5	5.0	<0.5	1.1	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	1.5	5.0	<0.5	1.1	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	1.5	5.0	<0.5	1.1	<0.5
Total +ve PAH's	mg/kg	13	40	0.4	7.8	<0.05
Surrogate p-Terphenyl-d14	%	89	93	94	90	96

PAHs in Soil		
Our Reference		173584-6
Your Reference	UNITS	BD1/16082017
Depth		-
Date Sampled		16/08/2017
Type of sample		Soil
Date extracted	-	18/08/2017
Date analysed	-	21/08/2017
Naphthalene	mg/kg	<0.1
Acenaphthylene	mg/kg	<0.1
Acenaphthene	mg/kg	<0.1
Fluorene	mg/kg	<0.1
Phenanthrene	mg/kg	<0.1
Anthracene	mg/kg	<0.1
Fluoranthene	mg/kg	<0.1
Pyrene	mg/kg	<0.1
Benzo(a)anthracene	mg/kg	<0.1
Chrysene	mg/kg	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2
Benzo(a)pyrene	mg/kg	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5
Total +ve PAH's	mg/kg	<0.05
Surrogate p-Terphenyl-d14	%	93

Organochlorine Pesticides in soil						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
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
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	103	102	103	106	104

Organophosphorus Pesticides						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Azinphos-methyl (Guthion)	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
Chlorpyriphos	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
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	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
Ethion	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
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	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
Surrogate TCMX	%	103	102	103	106	104

PCBs in Soil						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	103	102	103	106	104

Acid Extractable metals in soil						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Arsenic	mg/kg	<4	11	12	6	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	48	26	22	18	17
Copper	mg/kg	58	58	3	44	1
Lead	mg/kg	67	130	21	83	17
Mercury	mg/kg	0.2	0.4	<0.1	0.2	<0.1
Nickel	mg/kg	22	15	3	6	1
Zinc	mg/kg	110	180	5	76	3

Acid Extractable metals in soil		
Our Reference		173584-6
Your Reference	UNITS	BD1/16082017
Depth		-
Date Sampled		16/08/2017
Type of sample		Soil
Date prepared	-	18/08/2017
Date analysed	-	18/08/2017
Arsenic	mg/kg	7
Cadmium	mg/kg	<0.4
Chromium	mg/kg	20
Copper	mg/kg	1
Lead	mg/kg	18
Mercury	mg/kg	<0.1
Nickel	mg/kg	1
Zinc	mg/kg	2

Misc Soil - Inorg						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	21/08/2017	21/08/2017	21/08/2017	21/08/2017	21/08/2017
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Moisture						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Date analysed	-	21/08/2017	21/08/2017	21/08/2017	21/08/2017	21/08/2017
Moisture	%	14	18	19	22	23

Moisture		
Our Reference		173584-6
Your Reference	UNITS	BD1/16082017
Depth		-
Date Sampled		16/08/2017
Type of sample		Soil
Date prepared	-	18/08/2017
Date analysed	-	21/08/2017
Moisture	%	23

Asbestos ID - soils						
Our Reference		173584-1	173584-2	173584-3	173584-4	173584-5
Your Reference	UNITS	TP1	TP2	TP2	TP3	TP3
Depth		0-0.1	0-0.1	0.4-0.5	0-0.1	0.9-1.0
Date Sampled		16/08/2017	16/08/2017	16/08/2017	16/08/2017	16/08/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	18/08/2017	18/08/2017	18/08/2017	18/08/2017	18/08/2017
Sample mass tested	g	Approx. 35g	Approx. 40g	Approx. 30g	Approx. 25g	Approx. 40g
Sample Description	-	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks	Brown coarse-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			21/08/2017	5	21/08/2017	21/08/2017		21/08/2017	[NT]
TRH C_6 - C_9	mg/kg	25	Org-016	<25	5	<25	<25	0	97	[NT]
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	5	<25	<25	0	97	[NT]
Benzene	mg/kg	0.2	Org-016	<0.2	5	<0.2	<0.2	0	108	[NT]
Toluene	mg/kg	0.5	Org-016	<0.5	5	<0.5	<0.5	0	100	[NT]
Ethylbenzene	mg/kg	1	Org-016	<1	5	<1	<1	0	94	[NT]
m+p-xylene	mg/kg	2	Org-016	<2	5	<2	<2	0	91	[NT]
o-Xylene	mg/kg	1	Org-016	<1	5	<1	<1	0	93	[NT]
naphthalene	mg/kg	1	Org-014	<1	5	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-016	114	5	101	105	4	110	[NT]

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			18/08/2017	5	19/08/2017	19/08/2017		18/08/2017	[NT]
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	5	<50	<50	0	99	[NT]
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	5	<100	<100	0	104	[NT]
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	5	<100	<100	0	106	[NT]
TRH >C_{10} -C_{16}	mg/kg	50	Org-003	<50	5	<50	<50	0	99	[NT]
TRH >C_{16} -C_{34}	mg/kg	100	Org-003	<100	5	<100	<100	0	104	[NT]
TRH >C_{34} -C_{40}	mg/kg	100	Org-003	<100	5	<100	<100	0	106	[NT]
Surrogate o-Terphenyl	%		Org-003	90	5	87	88	1	96	[NT]

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			21/08/2017	5	21/08/2017	21/08/2017		21/08/2017	[NT]
Naphthalene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	89	[NT]
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Fluorene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	102	[NT]
Phenanthrene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	102	[NT]
Anthracene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	99	[NT]
Pyrene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	101	[NT]
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	101	[NT]
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-012	<0.2	5	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	5	<0.05	<0.05	0	87	[NT]
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-012	96	5	96	91	5	79	[NT]

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
HCB	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	81	[NT]
gamma-BHC	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	92	[NT]
Heptachlor	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	86	[NT]
delta-BHC	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	98	[NT]
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	90	[NT]
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	99	[NT]
Dieldrin	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	101	[NT]
Endrin	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	77	[NT]
pp-DDD	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	86	[NT]
Endosulfan II	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	70	[NT]
Methoxychlor	mg/kg	0.1	Org-005	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-005	102	5	104	102	2	124	[NT]

QUALITY CONTROL: Organophosphorus Pesticides						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	96	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	102	[NT]
Dimethoate	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	107	[NT]
Fenitrothion	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	110	[NT]
Malathion	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	75	[NT]
Parathion	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	96	[NT]
Ronnel	mg/kg	0.1	Org-008	<0.1	5	<0.1	<0.1	0	105	[NT]
Surrogate TCMX	%		Org-008	102	5	104	102	2	100	[NT]

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date extracted	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	100	[NT]
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	5	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCLMX	%		Org-006	102	5	104	102	2	100	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Date analysed	-			18/08/2017	5	18/08/2017	18/08/2017		18/08/2017	[NT]
Arsenic	mg/kg	4	Metals-020	<4	5	6	7	15	100	[NT]
Cadmium	mg/kg	0.4	Metals-020	<0.4	5	<0.4	<0.4	0	87	[NT]
Chromium	mg/kg	1	Metals-020	<1	5	17	18	6	93	[NT]
Copper	mg/kg	1	Metals-020	<1	5	1	2	67	107	[NT]
Lead	mg/kg	1	Metals-020	<1	5	17	17	0	104	[NT]
Mercury	mg/kg	0.1	Metals-021	<0.1	5	<0.1	<0.1	0	108	[NT]
Nickel	mg/kg	1	Metals-020	<1	5	1	1	0	106	[NT]
Zinc	mg/kg	1	Metals-020	<1	5	3	2	40	99	[NT]

QUALITY CONTROL: Misc Soil - Inorg						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			21/08/2017	1	18/08/2017	18/08/2017		21/08/2017	[NT]
Date analysed	-			21/08/2017	1	21/08/2017	21/08/2017		21/08/2017	[NT]
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	1	<5	<5	0	102	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

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

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client: Douglas Partners	**Project Number** 85385.03	**To:**	Envirolab Services
Contact Person: Jessica Paulsen	**Project Name:** Museum, Uni Syd	**Contact Person:**	Aileen Hie
Project Mgr: Jessica Paulsen	**PO No.:** 134153	**Address:**	12 Ashley Street
	lab Quote No. : 2016-2017 List		Chatswood NSW 2068
Address: 96 Hermitage Road	**Date results required:** STANDARD	**Phone:**	02 9910 6200
West Ryde NSW 2114		**Fax:**	02 9910 6201
	Note: Inform lab in advance if urgent turnaround is required - surcharges apply	**Email:**	ahie@envirolab.com.au
Phone: 9809 0666 **Mob:**	**Report format:** Esdat/PDF / Excel	**Laboratory Report No:**	
Email: jessica.paulsen@douglaspartners.com.au	**Comments:**	**Lab Comments:**	

Sample information						Tests Required											Comments
Lab Sample ID	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	Combo 8A	Replicates Metals & PAH	Trips BTEX								Combo	Provide as much information about the sample as you can
1	TP1	0-0.1	16/08/2017	G/Bag	soil	1											
2	TP2	0-0.1	16/08/2017	G/Bag	soil	1											
3	TP2	0.4-0.5	16/08/2017	G/Bag	soil	1											
4	TP3	0-0.1	16/08/2017	G/Bag	soil	1											
5	TP3	0.9-1.0	16/08/2017	G/Bag	soil	1											
6	BD1/16082017		16/08/2017	G	soil		1										
7	Trip Spike		16/08/2017	G	soil			1									
8	Trip Blank		16/08/2017	G	soil			1									

ENVIROLAB GROUP

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

Job No: 173584
Date Received: 16/8/17
Time Received: 15:00
Received by: DW
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***
Courier (by whom)	**Received by (Company):** ELS	**Samples Received:** Cool or Ambient (circle one)
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** DW	**Temperature Received at:** 11.3 **(if applicable)**
Temperature (if Applicable):	**Date & Time:** 16/8 1	**Transported by:** Hand delivered / courier
Print Name: Jessica Paulsen	**Signature:**	
Date & Time: 16/8/2017		
Signature:		

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

SAMPLE RECEIPT ADVICE

Client Details

Client	Douglas Partners Pty Ltd
Attention	Jessica Paulsen

Sample Login Details

Your reference	85385.03 / Museum, Uni Syd
Envirolab Reference	173584
Date Sample Received	16/08/2017
Date Instructions Received	16/08/2017
Date Results Expected to be Reported	23/08/2017

Sample Condition

Samples received in appropriate condition for analysis	YES
No. of Samples Provided	8 Soil
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	11.3
Cooling Method	Ice Pack
Sampling Date Provided	YES

Comments

Nil

Please direct any queries to:

Aileen Hie	Jacinta Hurst
Phone: 02 9910 6200	**Phone: 02 9910 6200**
Fax: 02 9910 6201	**Fax: 02 9910 6201**
Email: ahie@envirolab.com.au	**Email: jhurst@envirolab.com.au**

Analysis Underway, details on the following page:

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

Sample ID	vTRH(C6-C10)/BTEXN in Soil	svTRH (C10-C40) in Soil	PAHs in Soil	Organochlorine Pesticidesin soil	Organophosphorus Pesticides	PCBsin Soil	Acid Extractable metalsin soil	Misc Soil - Inorg	Asbestos ID - soils
TP1-0-0.1	✓	✓	✓	✓	✓	✓	✓	✓	✓
TP2-0-0.1	✓	✓	✓	✓	✓	✓	✓	✓	✓
TP2-0.4-0.5	✓	✓	✓	✓	✓	✓	✓	✓	✓
TP3-0-0.1	✓	✓	✓	✓	✓	✓	✓	✓	✓
TP3-0.9-1.0	✓	✓	✓	✓	✓	✓	✓	✓	✓
BD1/16082017			✓				✓		
Trip Spike	✓								
Trip Blank	✓								

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.

QA/QC PROCEDURES AND RESULTS

Q1. FIELD QUALITY ASSURANCE AND QUALITY CONTROL

The field QC procedures for sampling as prescribed in Douglas Partners' *Field Procedures Manual* were followed at all times during the assessment.

Q1.1 Sampling Team

Field sampling was undertaken by DP Environmental Engineer, Celine Li. Site works were undertaken on 16 August 2017. Sampling was typically undertaken during fine weather conditions. The Engineer was instructed by the Project Manager regarding the sampling processes to be adopted.

Q1.2 Sample Collection

Soil samples were collected from the excavator bucket. Further details of the sampling methodology is presented in Section 6 of the report. The QA/QC samples collected during the course of soil sampling comprised the following:

- Collection of a minimum of 10% replicate samples (10% intra-laboratory replicates) for QA/QC purposes, with a minimum of one replicate sample collected for each day of fieldwork; and
- Collection of a minimum one trip spike and one trip blank per day of sampling.

Q1.3 Logs and Field Sheets

Logs for each soil sampling location were recorded in the field. The individual samples were recorded on the field logs along with the sample identity, location, depth, initials of sampler, replicate locations, replicate type, site observations. Analysis to be performed on each sample and the dispatch courier were recorded on the COC, Appendix C. Logs are presented in Appendix B.

Q1.4 Chain of Custody

Chain of custody information was recorded on the Chain-of-Custody (COC) sheets and accompanied samples to the analytical laboratory. Signed copies of COCs are presented in Appendix C, following the laboratory certificates of analysis.

Q1.5 Sample Splitting Techniques

Replicate samples were collected in the field as a measure of accuracy, precision and repeatability of the results.

Q1.6 Replicate Frequency

Field sampling included collection of a minimum of 10% replicate samples (10% intra-laboratory replicates) for QA/QC purposes, with a minimum of one replicate sample collected per day of sampling.

Q1.7 Trip Spike

In accordance with the *NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (2011)*, laboratory prepared trip spike results for volatile analytes are included in this report. The purpose of a trip spike is to assess the potential loss of volatile analytes that may have occurred between the time of collection and transfer of the sample to the laboratory. For the current investigation, a trip spike was taken into the field on the day of sampling with BTEX being the volatile assessed.

Laboratory preparation of the soil trip spike involved putting 1mL of BTEX (using a 1500ppm BTEX trip spike standard) into two jars which are cross referenced and labelled 'trip spike' and 'control'. Both jars were sealed with electrical tape. The trip spike was taken onto site and subject to the same jar storage and transfer as the field samples. The control stayed refrigerated in the laboratory. Following receipt of the trip spike and field samples, the trip spike and corresponding control are both analysed with results of the trip spike being expressed as the % difference from the control sample.

A similar procedure is used for water trip spikes by injecting 220uL of BTEX into the trip spike. Results are then analysed and expressed as % of theoretical value of a 50ppb standard.

The acceptance limit for trip spikes is 60-140% in difference compared to the control or standard.

The result of the laboratory analysis for the trip spike is shown in Table Q1. A total of one soil trip spike was analysed over the course of the investigation.

Table Q1: Trip Spike Results – Soil (%)

Sample ID	Benzene	Toluene	Ethylbenzene	M + P Xylene	O Xylene
Trip Spike	96	98	99	97	98

Q1.8 Relative Percentage Difference

A measure of the consistency of results for field samples is derived by the calculation of relative percentage differences (RPDs) for replicate samples. A RPD of +/- 30% is generally considered typically acceptable for inorganic analytes by NSW EPA, although in general a wider RPD range (50%) may be acceptable for organic analytes. RPDs have only been considered where a concentration is greater than five times the PQL. High RPDs (if applicable) are shown in **bold and shaded** on the relevant tables below.

Replicate samples were collected at a rate of approximately one replicate sample for every ten original samples collected and also analysed at a rate of 10% of primary samples analysed (10% intra-laboratory replicates), generally with a minimum of one replicate sample collected for each day of sampling.

Q1.8.1 Intra-Laboratory Analysis

Intra-laboratory replicates were analysed as an internal check of the reproducibility within the primary laboratory (Envirolab Pty Ltd) and as a measure of consistency of sampling techniques.

A total of five primary soil samples were analysed to one intra-laboratory replicate (20%). Therefore the 5% intra-laboratory replicate sampling requirement was met.

The comparative results of analysis between original and replicate samples are summarised in Table Q2.

Table Q2: Intra-laboratory Results – Soil (mg/kg)

Analyte	Primary Sample ID	Replicate Sample ID	Difference	RPD
As	TP3/0.9-1.0	BD1/16082017	1	15
Cd			0	0
Cr			3	16
Cu			0	0
Pb			1	6
Hg			0	0
Ni			0	0
Zn			1	40

The RPD values were within the acceptable range of ≤ 30 for inorganic analytes (≤50% for organic) with the exception of the zinc result. However, this is not considered to be significant because:

- The typically low actual differences in the concentrations of the replicate pairs where some RPD exceedances occurred;
- The majority of RPDs within a replicate pair being within the acceptable limits; and
- All other QA/QC parameters met the DQIs.

Q1.9 Field Blanks

Laboratory prepared soil field blanks were taken out to the field unopened on each day of sampling, subjected to the same preservation methods as the field samples, then analysed for the purposes of determining whether transfer of contaminants into the blank sample had occurred prior to reaching the laboratory. If this is confirmed then there is also a potential for other samples in the batch to have been impacted. The result of the laboratory analysis for the field blank is shown in Table Q3. A total of one soil blank was analysed over the course of the investigation.

Table Q3: Trip Blank Results – Soil (mg/kg)

Sample ID	Benzene	Toluene	Ethylbenzene	M + P Xylene	O Xylene
Trip Blank	<0.2	<0.5	<1	<2	<1

Levels of analytes were all below detection limits indicating that the potential that significant cross contamination had not occurred during the course of the round trip from the site to the laboratory.

Q2. LABORATORY QUALITY ASSURANCE AND QUALITY CONTROL

Q2.1 Chain of Custody

Chain-of-custody procedures are discussed in Section Q1.4.

Q2.2 Holding Times

A review of the laboratory certificates of analysis and chain-of-custody documentation indicated that holding times were met.

Q2.3 Analytical Laboratory

Samples were submitted to the Envirolab Services (ELS) for analysis. The laboratory is NATA accredited for the analysis undertaken. ELS's accreditation number is 2901 and is accredited for compliance with ISO/IEC 17025. ELS's tests comply with NATA and NEPC (2013). In-house procedures are employed by ELS in the absence of documented standards.

It is noted, however, that some of the test methods adopted are not NATA accredited. Where no NATA accredited method exists, however, the best international practice was adopted in the analytical methods and standard international analytical methods adopted. It is not considered that this will affect the validity of the results for this assessment.

Q2.4 Analytical Methods

The laboratory analytical methods are provided on the laboratory certificates of analysis in Appendix C.

Q2.5 Results of Laboratory QA/QC Procedures

The following QA/QC procedures were conducted by the laboratory. The results are included in the laboratory certificates of analysis in Appendix C.

Q2.5.1 Surrogate Spike

This sample is prepared by adding a known amount of surrogate, which behaves similarly to the analyte, prior to analysis to each sample. The recovery result indicates the proportion of the known concentration of the surrogate that is detected during analysis. These results are within acceptance limits as specified by ELS, indicating that the extraction technique was effective.

The laboratory QC for surrogate spikes was within the acceptance standards.

Q2.5.2 Practical Quantitation Limits - PQLs

The PQL is the lowest quantity of an analyte which can be measured with a high degree of confidence that the analyte is present at or above that concentration. PQLs at different analytical laboratories can differ based on the analytical techniques.

Q2.5.3 Reference and Daily Check Sample Results – Laboratory Control Sample (LCS)

This sample comprises spiking either a standard reference material or a control matrix (such as a blank of sand or water) with a known concentration of specific analytes. The LCS is then analysed and results compared against each other to determine how the laboratory has performed with regard to sample preparation and analytical procedure. LCSs are analysed at a frequency of 1 in 20, with a minimum of one analysed per batch.

The laboratory QC for LCS was within the acceptance standards.

Q2.5.4 Laboratory Replicate Results

These are additional portions of a sample which are analysed in exactly the same manner as all other samples. The laboratory acceptance criteria for replicate samples is: in cases where the level is <5xPQL – any RPD is acceptable; and in cases where the level is >5xPQL – 0-50% RPD is acceptable.

The laboratory QC for laboratory replicate results was within the acceptance standards.

Q2.5.5 Laboratory Blank Results

The laboratory blank, sometimes referred to as the method blank or reagent blank is the sample prepared and analysed at the beginning of every analytical run, following calibration of the analytical apparatus. This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, it can be determined by processing solvents and reagents in exactly the same manner as for samples. Laboratory blanks are analysed at a frequency of 1 in 20, with a minimum of one per batch.

The laboratory QC for method blanks was within the acceptance standards.

Q2.5.6 Matrix Spike

This is a sample replicate prepared by adding a known amount of analyte prior to analysis, and then treated exactly the same as all other samples. The recovery result indicates the proportion of the known concentration of the analyte that is detected during analysis. The laboratory acceptance criteria for matrix spike samples is generally 70-130% for inorganic/metals; and 60-140% for organics; and 10-140% for SVOC and speciated phenols.

The laboratory QC for matrix spikes were within the acceptance standards.

Q2.6 Laboratory Comments

The laboratory QC for surrogate spikes, LCS, laboratory replicate results, method blanks and matrix spikes were within the acceptance standards.

The majority of the laboratory quality control samples were within the laboratory acceptance criteria. The QC failures, where they occurred, are not considered to have significantly impacted the quality of the results overall as the number of failures were minor compared to the overall QC data. It is considered that an acceptable level of laboratory precision and consistency was achieved and that surrogate spikes, LCS, laboratory replicate results, method blanks and matrix spike results were of an acceptable level overall. On the basis of this assessment, the laboratory data sets are considered to be reliable and useable for this assessment.

3. QA/QC DATA EVALUATION

Based on the above, it is considered that the DQIs have been complied with, and field and laboratory QA/QC was completed, and all other indicators were complied with.

As such, it is concluded that the field and laboratory test data obtained are reliable and useable for this assessment.