ENVIRONMENTAL INVESTIGATION SERVICES

# REPORT

TO

# LORETO KIRRIBILLI

ON

# PRELIMINARY STAGE 2 ENVIRONMENTAL SITE ASSESSMENT AND REMEDIATION ACTION PLAN

FOR

# PROPOSED SCHOOL DEVELOPMENT

AT

# LORETO KIRRIBILLI,
# 85-87 CARABELLA STREET, KIRRIBILLI, NSW

27 SEPTEMBER 2017

REF: E30067KMrpt2

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# EXECUTIVE SUMMARY

Loreto Kirribilli commissioned EIS to undertake a Preliminary Stage 2 Environmental Site Assessment (ESA) for the proposed development at the school. The assessment was confined to accessible areas of the site where soil disturbance is scheduled to occur during the initial stages of the proposed development works, as shown on Figure 2.

Potential contamination sources at the site include imported fill material, the use of pesticides and hazardous building materials. Soil samples were collected from 10 sampling points and analysed for contaminants of potential concern. The subsurface conditions at the site generally consisted of relatively shallow fill material directly overlying sandstone bedrock or concrete slabs. A stockpile of fill material was located to the west of the Gymnasium.

The soil analytical results were compared to site assessment criteria (SAC), which were established with reference to relevant guidelines and regulations. The results indicated that lead, polycyclic aromatic hydrocarbons (PAHs) and/or total recoverable hydrocarbons (TRH) were present in concentrations exceeding the human health SAC in 60% of the sample locations. As a conservative measure, all fill material in the proposed development areas is considered to be potentially contaminated and should be treated accordingly.

EIS consider that the site can be made suitable for the proposed development provided that the following recommendations are implemented to minimise the risks:

1. Undertake a Hazardous Materials Assessment (Hazmat) for the existing buildings prior to the commencement of demolition work;
2. Prepare a Remediation Action Plan (RAP) to outline remedial measures for the site; and
3. Prepare a Validation Assessment report on completion of remediation.

The goal of the remediation is to render the site suitable for the proposed development. Following consideration of the available options, EIS are of the opinion that the removal of contaminated material to an appropriate facility and reinstatement with clean material is the best option for remediating the site. The remedial works would generally be able to be conducted in conjunction with the construction works.

A Remediation Action Plan (RAP) is detailed, which includes:

- Roles and responsibilities for the implementation of the RAP, and contact details of those parties already appointed (Section 16.2);
- A strategy for remediating the proposed development areas (Section 16.2);
- Validation sampling requirements (Section 16.3);
- Validation assessment criteria (Section 17.2);
- Material importation requirements (Section 17.3);
- A contingency plan (Section 18); and
- A site management plan for remediation works (Section 19).

In the event unexpected conditions are encountered during development work or between sampling locations that may pose a contamination risk, all works should stop and an environmental consultant should be engaged to inspect the site and address the issue.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of the report.

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# ABBREVIATIONS

| | |
|---|---|
| Ambient Background Concentrations | **ABC** |
| Added Contaminant Limits | **ACL** |
| Asbestos Containing Material | **ACM** |
| Australian Drinking Water Guidelines | **ADWG** |
| Area of Environmental Concern | **AEC** |
| Australian Height Datum | **AHD** |
| Asbestos Health Screening Levels | **ASL** |
| Acid Sulfate Soil | **ASS** |
| Above-Ground Storage Tank | **AST** |
| Below Ground Level | **BGL** |
| Bureau of Meteorology | **BOM** |
| Benzene, Toluene, Ethylbenzene, Xylene | **BTEX** |
| Benzene, Toluene, Ethylbenzene, Xylene, Naphthalene | **BTEXN** |
| Cation Exchange Capacity | **CEC** |
| Contaminated Land Management | **CLM** |
| Construction Management Plan | **CMP** |
| Contaminant(s) of Potential Concern | **CoPC** |
| Chain of Custody | **COC** |
| Conceptual Site Model | **CSM** |
| Data Quality Indicator | **DQI** |
| Data Quality Objective | **DQO** |
| Detailed Site Investigation | **DSI** |
| Ecological Assessment Criteria | **EAC** |
| Ecological Investigation Levels | **EILs** |
| Ecological Screening Level | **ESL** |
| Environmental Management Plan | **EMP** |
| Excavated Natural Material | **ENM** |
| Environmental Protection Agency | **EPA** |
| Environmental Site Assessment | **ESA** |
| Ecological Screening Level | **ESL** |
| Fibre Cement Fragments | **FCF** |
| General Approvals of Immobilisation | **GAI** |
| General Solid Waste | **GSW** |
| Health Investigation Level | **HILs** |
| Hardness Modified Trigger Values | **HMTV** |
| Health Screening Level | **HSLs** |
| International Organisation of Standardisation | **ISO** |
| Lab Control Spike | **LCS** |
| Light Non-Aqueous Phase Liquid | **LNAPL** |
| Local Government Authority | **LGA** |
| Map Grid of Australia | **MGA** |
| National Association of Testing Authorities | **NATA** |
| National Environmental Protection Measure | **NEPM** |
| Organochlorine Pesticides | **OCP** |
| Organophosphate Pesticides | **OPP** |
| Polycyclic Aromatic Hydrocarbons | **PAH** |

# ABBREVIATIONS

| | |
|---|---|
| Photo-ionisation Detector | **PID** |
| Practical Quantitation Limit | **PQL** |
| Preliminary Site Investigation | **PSI** |
| Primary Contaminant of Concern | **PCC** |
| Quality Assurance | **QA** |
| Quality Control | **QC** |
| Remediation Action Plan | **RAP** |
| Relative Percentage Difference | **RPD** |
| Restricted Solid Waste | **RSW** |
| Site Assessment Criteria | **SAC** |
| Sampling, Analysis and Quality Plan | **SAQP** |
| Site Audit Statement | **SAS** |
| Site Audit Report | **SAR** |
| Specific Contamination Concentration | **SCC** |
| Standard Penetration Test | **SPT** |
| Semi-Volatile Organic Compounds | **sVOC** |
| Standard Sampling Procedure | **SSP** |
| Standing Water Level | **SWL** |
| Standard Sampling Procedure | **SSP** |
| Trip Blank | **TB** |
| Toxicity Characteristic Leaching Procedure | **TCLP** |
| Total Recoverable Hydrocarbons | **TRH** |
| Trip Spike | **TS** |
| Upper Confidence Limit | **UCL** |
| United States Environmental Protection Agency | **USEPA** |
| Underground Storage Tank | **UST** |
| Virgin Excavated Natural Material | **VENM** |
| Volatile Organic Compounds | **VOC** |
| Work Health and Safety | **WHS** |

## 1 INTRODUCTION

Loreto Kirribilli ('the client') commissioned Environmental Investigation Services (EIS)[1] to undertake a Preliminary Stage 2 Environmental Site Assessment (ESA) for the proposed development at the school. The site location is shown on Figure 1 and the assessment was confined to accessible areas of the site where soil disturbance is scheduled to occur during the initial stages of the proposed development works, as shown on Figure 2.

### 1.1 Proposed Development Details

We understand that the proposed masterplan development is comprised of the following:

- Western Precinct:
    - Demolition of the existing B-Block and construction of an Innovation Centre and Gymnasium extension; and
    - Partial demolition of external stairs, landings, walkways and planters in between the Gymnasium, Centenary Hall and the Junior School. Following demolition, construction of external covered walkways and extension of the Junior School play terrace.
- Northern Precinct:
    - Partial demolition of external stairs, landings, walkways and planters in between the Science Building and Centenary Hall. Construction of a six-storey vertical connector pod.
- Eastern Precinct:
    - Partial demolition of external stairs, landings, walkways and planters in between the Science Building, Elamang Administration Building, Music and Performing Arts Building and Mary Ward Building. Construction of a six-story vertical connector pod; and
    - Demolition of the Music and Performing Arts and Mary Ward Buildings and construction of a new four-storey building and two-storey car park.
- Southern Precinct:
    - Partial demolition of external stairs, landings, walkways and planters in between the Chapel and J-Block. Construction of a five-storey vertical connector pod; and
    - Demolition of the Junior School, excavation to Centenary Hall level and construction of a new five-storey building.

### 1.2 Aims of the Preliminary Stage 2 ESA Assessment

The aims of the assessment were to:

- Provide an assessment of the soil contamination conditions within the target areas; and
- Provide a preliminary waste classification for the off-site disposal of in-situ soil within the target areas.

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[1] Environmental consulting division of Jeffery & Katauskas Pty Ltd (J&K)

## 1.3 Scope of Work

The assessment was undertaken generally in accordance with an EIS proposal (Ref: EP45644KM) of 30 August 2017 and written acceptance from the client of 31 August 2017. The scope of work included the following:

- A review of available site information, including the EIS *Stage 1 Preliminary Environmental Site Assessment*[2];
- Soil sampling from an additional eight sampling points (BH4 to BH11) as shown on the attached Figure 2;
- Analysis of selected soil samples at a NATA-accredited laboratory;
- Interpretation of the analytical results against the adopted site assessment criteria (SAC);
- Assessment of data quality; and
- Preparation of a report presenting the results of the assessment.

The report was prepared with reference to regulations and guidelines outlined in the table below. Individual guidelines are also referenced within the text of the report.

Table 1-1: Guidelines

| **Guidelines/Regulations/Documents** |
|---|
| Contaminated Land Management Act (1997)[3] |
| State Environmental Planning Policy No.55 – Remediation of Land (1998)[4] |
| Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)[5] |
| Guidelines for Consultants Reporting on Contaminated Sites (2011)[6] |
| Guidelines for the NSW Site Auditor Scheme, 2nd Edition (2006)[7] |
| National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)[8] |

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[2] EIS (2017) *Stage 1 Preliminary Environmental Site Assessment for Proposed School Development at Loreto Kirribilli, 85-87 Carabella St, Kirribilli* (Ref: E30067KMprt dated 23 March 2017)

[3] NSW Government Legislation, (1997). *Contaminated Land Management Act 1997.* (referred to as CLM Act 1997)

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

[5] Department of Urban Affairs and Planning, and Environment Protection Authority, (1998). *Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land*. (SEPP55 Planning Guidelines)

[6] NSW Office of Environment and Heritage (OEH), (2011). *Guidelines for Consultants Reporting on Contaminated Sites.* (referred to as Reporting Guidelines 2011)

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

[8] National Environment Protection Council, (2013). *National Environmental Protection (Assessment of Site Contamination) Amendment Measure 1999* (as amended 2013). (referred to as NEPM 2013)

# 2 SITE INFORMATION

## 2.1 Background

### 2.1.1 Preliminary Environmental Site Assessment

In March 2017 EIS conducted a *Stage 1 Preliminary Environmental Site Assessment* at the site, henceforth referred to as the Stage 1 ESA. An assessment of the site's history indicated that the majority of the site has been used as a school since 1907. Some sections appeared to have previously been used for residential purposes and as a hotel and Y.W.C.A. prior to their purchase by Loreto for school use. Potential contamination sources at the site included imported fill material used during construction, the use of pesticides around the site, and hazardous building materials. Contaminants of potential concern (CoPC) included heavy metals, petroleum hydrocarbons, BTEX (benzene, toluene, ethylbenzene and xylenes), polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs) and asbestos. Potential human receptors included site occupants, construction workers and intrusive maintenance workers. Potential ecological receptors included terrestrial organisms and plants within unpaved areas and marine ecology in Careening Cove.

A preliminary soil contamination assessment was undertaken in a concrete car park area located between the Marian Centre and B-Block. Three boreholes (BH1-BH3) were drilled in the car park area with a hand auger and soil samples were collected for analysis for CoPC. The analytical results have been incorporated into the current *Preliminary Stage 2 ESA* report.

Based on the assessment, EIS concluded that there was a moderate potential for site contamination, and that the historical land uses and potential sources of contamination identified would not preclude the proposed development. The following actions were recommended to better assess the risks associated with the CoPC:

- A Stage 2 investigation should be undertaken to characterise the site contamination conditions; and
- A hazardous building materials survey should be undertaken prior to demolition of the buildings. Following demolition of the buildings an asbestos clearance certificate should be provided.

### 2.1.2 JK Geotechnics Investigation[9]

One borehole was drilled at the rear of the Marian Centre to a depth of 17.83m below ground surface. Subsurface conditions at the drilling location consisted of concrete to a depth of 0.18m underlain by approximately 0.15m of clayey sand fill material over sandstone bedrock.

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[9] JK Geotechnics (January 2015) *Geotechnical Investigation for Proposed Masterplan and Development SSD at Loreto, 85 Carabella Street, Kirribilli, NSW* (Ref: 30067Srpt dated 11/1/17)

### 2.1.3 JK Geotechnics Assessment[10]

An assessment of geotechnical conditions at the site was provided by reviewing the information contained in several earlier geotechnical investigations around the site, including the previous JK investigation. The assessment indicated that fill material may vary in depth across the site from approximately 0.5m to 3m in depth, generally consisting of sandy material with inclusions of clay, silt, gravel, ash and slag. Only minor amounts of sandy residual soil were present in some locations, with sandstone bedrock generally encountered directly below the fill material.

The groundwater table was not encountered in any of the investigations, although groundwater seepage was observed along the soil-rock interface and through defects in the rock mass. The maximum borehole depth was 17.83m.

## 2.2 Site Identification

Table 2-1: Site Identification

| | |
|---|---|
| Current Site Owner: | Trustees of the Loreto Property Association |
| Site Address: | 85-87 Carabella Street, Kirribilli |
| Lot & Deposited Plan: | Lot 200 DP1166282 |
| Current Land Use: | School |
| Proposed Land Use: | School |
| Local Government Authority: | North Sydney Council |
| Total Site Area: | 1.816 ha |
| RL (AHD) (approx.): | 9m – 26m |
| Geographical Location (decimal degrees) (approx.): | Latitude: -33.847049°; Longitude: 151.216313° |

## 2.3 Site Location and Regional Setting

The site is located in a predominantly residential area of Kirribilli and is bound by Elamang Avenue to the north and Carabella Street to the south. The site is located approximately 60m south-west of Careening Cove at its closest point.

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[10] JK Geotechnics (February 2017) *Geotechnical Assessment for Proposed Masterplan at Loreto Kirribilli, 85 Carabella Street, Kirribilli, NSW* (Ref: 30067Srpt2 dated 7/2/17)

## 2.4 Topography

The site is situated within relatively hilly coastal topography with slopes generally falling in a north-easterly direction towards Careening Cove. The site itself is located roughly mid-slope of a north-easterly facing hill sloping down at approximately 8° to 10°.

## 2.5 Site Inspection

A walkover inspection of the site was undertaken by EIS during the Stage 1 ESA on 20 February 2017 and during the Stage 2 ESA on 5 September 2017. The inspection was limited to accessible areas of the site and immediate surrounds. An internal inspection of buildings was not undertaken.

At the time of the assessment, the site contained a variety of school buildings and facilities. The Marian Centre in the north-west of the site was a three to five storey brick building. A concrete driveway to the east of the building provided access to a car parking area located between the Marian Centre and B-Block. B-Block was a three-storey brick building located north-east of the Marian Centre. On the northern side of B-Block was a relatively level grassed area beyond which the ground stepped down across a sandstone block retaining wall to a tennis court. Below the tennis court was the Gymnasium. A criblock wall approximately 7m high was situated at the western corner of the Gymnasium on a vertical sandstone cut face. Below the Gymnasium on the north-eastern side was a steep batter slope leading down to Elamang Avenue.

To the east of the Marian Centre and B-Block was the Junior School which consisted of a two storey concrete-rendered building. In the south-western section of the site were several adjoining buildings: the Presbytery, the Chapel, an Administration Building and J-Block, a four-storey brick and concrete building.

The eastern section of the site contained a three-storey brick and concrete Music and Performing Arts Building. In the north-eastern section of the site there were two tennis courts located over the Centenary Hall and the Science Building.

A variety of trees and grassed and landscaped areas were located on-site. Pavements and roadways were also located around the site and appeared to be in good condition.

The general layout of the site at the time of the inspection is shown in the aerial photograph contained in Figure 1 and in the sample location plan in Figure 2.

## 2.6 Surrounding Land Use

During the site inspection, EIS observed the following land uses in the immediate surrounds:

- North – residential;
- South – residential;
- East – residential; and
- West – residential.

EIS did not observe any land uses in the immediate surrounds that were identified as potential contamination sources for the site.

## 2.7 Underground Services

The 'Dial Before You Dig' (DBYD) plans were reviewed for the assessment in order to establish whether any major underground services exist at the site or in the immediate vicinity that could act as a preferential pathway for contamination migration.

The Sydney Water plan indicates that a sewer main extends from the north-western boundary towards the centre of the site. The North Sydney Council plan indicates that a stormwater drainage pipe extends from the eastern section of the site towards the north-east, draining into Careening Cove. The Telstra plan indicates that underground telecommunications cables are present at various locations across the site. Copies of these plans are attached in the appendices.

If contamination is present there is potential for the service trenches to act as preferential pathways for the migration of contamination.

## 2.8 Section 149 Planning Certificate

The Section 149 (2 and 5) planning certificate was reviewed for the Stage 1 ESA. A summary of the relevant information is outlined below:

- The site is not deemed to be:
    - significantly contaminated;
    - subject to a management order;
    - the subject of an approved voluntary management proposal; or
    - subject to an on-going management order under the provisions of the CLM Act 1997.
- The site is not known to be the subject to a Site Audit Statement (SAS).
- The land containing the site is considered to be within a heritage conservation area and to be a heritage item.

# 3 GEOLOGY AND HYDROGEOLOGY

## 3.1 Regional Geology

A review of the regional geological map of Sydney (1983[11]) indicated that the site is underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses.

## 3.2 Acid Sulfate Soil Risk and Planning

The site is not located in an acid sulfate soil (ASS) risk area according to the risk maps prepared by the Department of Land and Water Conservation.

## 3.3 Hydrogeology

Hydrogeological information reviewed for the Stage 1 ESA indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were three registered bores within 500m of the site. The three bores were located approximately 170m-190m south-east and downgradient of the site. The wells were registered for monitoring purposes and appeared to be located in a park just to the north-west of Kirribilli Wharf. The driller's log information from the three bores indicated that fill material was present to depths ranging from 0.8m to 1.7m and was underlain by sandstone bedrock. The standing water levels in the wells ranged from 1.2m to 6.2m.

The information reviewed for this assessment indicated that the subsurface conditions at the site are likely to consist of fill material or residual soils overlying shallow bedrock. The potential for viable groundwater abstraction and use of groundwater under these conditions is considered to be low.

## 3.4 Receiving Water Bodies

The site location and regional topography indicated that excess surface water flows have the potential to enter Careening Cove located 60m-70m north-east of the site. The Cove could be a potential receptor.

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

## 4 SITE HISTORY INFORMATION

A review of site history information was undertaken for the Stage 1 ESA. The available information indicated that the school has been in its current location since 1907, expanding into adjacent properties at various times. The Junior School is understood to have been constructed in 1961. The Marian Centre appears to have been purchased by the school in 2010, and formerly operated as a private hotel and a Y.W.C.A. (Young Women’s Christian Association).

Historical land title records did not identify any particular land uses which could have resulted in significant contamination. A search of SafeWork NSW records did not identify any licences to store dangerous goods including underground fuel storage tanks (USTs) or aboveground storage tanks (ASTs) at the site. NSW EPA records indicated that there were no notices for the site under Section 58 of the CLM Act 1997, the site was not listed on the NSW EPA List of Contaminated Sites, and there were no notices for the site on the Protection of the Environmental Operations (POEO) register.

# 5 PRELIMINARY CONCEPTUAL SITE MODEL

NEPM (2013) defines a Conceptual Site Model (CSM) as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. A preliminary CSM for the site is presented in the following sub-sections and is based on the site information obtained during the Stage 1 ESA.

## 5.1 Potential Contamination Sources, AEC and CoPC

The potential contamination sources, areas of environmental concern (AEC) and contaminants of potential concern (CoPC) are presented in the following table:

Table 5-1: Potential Contamination Sources, AEC and CoPC

| Source / AEC | CoPC |
|---|---|
| Fill material – Sections of the site appear to have been filled to achieve the existing levels. This was confirmed during previous geotechnical assessments. The fill may have been imported from a variety of sources and could be contaminated. | Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphate pesticides (OPPs), polychlorinated biphenyls (PCBs) and asbestos |
| Use of pesticides – Pesticides may have been used beneath the buildings and/or around the site. | Heavy metals, OCPs and OPPs |
| Hazardous Building Material – Hazardous building materials may be present as a result of former building and demolition activities. These materials may also be present in the existing buildings on site. | Asbestos, lead and PCBs |

## 5.2 Mechanism for Contamination, Affected Media, Receptors and Exposure Pathways

The mechanisms for contamination, affected media, receptors and exposure pathways relevant to the potential contamination sources are outlined in the following PCSM table:

Table 5-2: PCSM

| | |
|---|---|
| Potential mechanism for contamination | Potential mechanisms for contamination include:<br>• Fill material – importation of impacted material, top-down impacts (e.g. leaching from surficial material), or sub-surface release (e.g. impacts from buried material);<br>• Use of pesticides – top-down and spills (e.g. during normal use, application and/or improper storage);<br>• Hazardous building materials – top-down (e.g. demolition resulting in surficial impacts in unpaved areas). |
| Affected media | Soil, soil vapour and groundwater have been identified as potentially affected media. |
| Receptor identification | Potential human receptors include site occupants, construction workers and intrusive maintenance workers. Potential off-site human receptors include adjacent land users and recreational water users within Careening Cove.<br>Potential ecological receptors include terrestrial organisms and plants within unpaved areas and marine ecology in Careening Cove. |
| Potential Exposure pathways | Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants) and vapours (volatile TRH, naphthalene and BTEX). The potential for exposure would typically be associated with the construction and excavation works, the use of unpaved areas and basements (i.e. vapour inhalation or incidental contact with groundwater seepage).<br>Potential exposure pathways for ecological receptors include primary contact and ingestion. |
| Presence of preferential pathways for contaminant movement | The sewer, stormwater and other underground service trenches and the associated trench backfill are potential preferential pathways for contaminant migration. This could occur via groundwater or seepage if present, or via soil and soil vapour migration through the trench backfill. |

# 6 SAMPLING, ANALYSIS AND QUALITY PLAN

## 6.1 Data Quality Objectives (DQO)

The NEPM 2013 defines the DQO process as a seven-step iterative planning tool used to define the type, quantity and quality of data needed to inform decisions relating to the environmental condition of the site. The DQO process is detailed in the Site Auditor Guidelines 2006 and the USEPA documents *Data Quality Objectives Processes for Hazardous Waste Site Investigations* (2000) and *Guidance on Systematic Planning Using the Data Quality Objectives Process* (2006). These seven steps are applicable to this assessment as summarised in the table below:

Table 6-1: DQOs – Seven Steps

| Step | Input |
|---|---|
| State the Problem | The PCSM has identified AEC at the site which may pose a risk to the site receptors. An intrusive investigation is required to assess the risk and comment on the suitability of the site for the proposed development. |
| Identify the Decisions/ Goal of the Study | The data collection is project specific and has been designed based on the following information:<br>• Review of site information including site history;<br>• AEC, CoPC, receptors, pathways and media identified in the PCSM;<br>• Development of SAC for each medium; and<br>• The use of decision statements outlined below:<br><br>The decisions of the study are:<br>1. Are any results above the SAC?<br>2. Do the results represent a risk to human or ecological receptors?<br>3. Is the site suitable for the proposed use?<br><br>The data will be assessed in the following manner:<br><br>1) Statistical analysis will be used to assess the laboratory data against the SAC. The following criteria will be adopted:<br>➢ The 95% Upper Confidence Limit (UCL) value of the arithmetic mean concentration of each contaminant should be less than the SAC;<br>➢ The standard deviation (SD) of the results must be less than 50% of the SAC; and<br>➢ No single value exceeds 250% of the relevant SAC.<br><br>2) Statistical calculations will not be undertaken if all results are below the SAC; and<br><br>3) Statistical calculations will not be undertaken on the following:<br>➢ Health Screening Levels (HSLs) – elevated point source contamination associated with petroleum hydrocarbons can pose a vapour risk to receptors; and<br>➢ Groundwater Investigation Levels (GILs) – elevated GILs can indicate a wider groundwater contamination risk. |

| Step | Input |
|---|---|
| Identify Information Inputs | The following information will be collected:<br>• Soil samples based on subsurface conditions;<br>• The SAC will be designed based on the criteria outlined in NEPM 2013. Other criteria will be used as required and detailed in this report;<br>• The samples will be analysed in accordance with the analytical methods outlined in NEPM 2013;<br>• Field screening information (i.e. PID data, presence of hydrocarbons etc.) will be taken into consideration in selecting the analytical schedule; and<br>• Any additional information that may arise during the field work will also be used as data inputs. |
| Define the Study Boundary | The sampling will be confined to accessible areas of the site where soil disturbance is scheduled to occur during the initial stages of the proposed development work, as shown in Figure 2.<br>Fill has been identified as an AEC. The source of fill has not been established. Fill is considered to be heterogeneous material with CoPC occurring in random pockets or layers. The presence of CoPC in between sampling points cannot be measured.<br>The areas excluded from the investigation are outlined in the data gaps. |
| Develop the analytical approach (or decision rule) | The following acceptable limits will be adopted for the data quality assessment:<br>• The following acceptance criteria will be used to assess the RPD results:<br>➢ results > 10 times the practical quantitation limit (PQL), RPDs < 50% are acceptable;<br>➢ results between 5 and 10 times PQL, RPDs < 75% are acceptable;<br>➢ results < 5 times PQL, RPDs < 100% are acceptable; and<br>➢ An explanation is provided if RPD results are outside the acceptance criteria.<br>• Acceptable concentrations in trip spike (TS), trip blank (TB) and field rinsate (FR) samples. Non-compliance to be documented in the report;<br>• The following acceptance criteria will be used to assess the primary laboratory QA/QC results. Non-compliance to be documented:<br>➢ <u>RPDs</u>:<br>- Results that are < 5 times the PQL, any RPD is acceptable; and<br>- Results > 5 times the PQL, RPDs between 0-50% are acceptable;<br>➢ <u>LCS recovery and matrix spikes</u>:<br>- 70-130% recovery acceptable for metals and inorganics;<br>- 60-140% recovery acceptable for organics; and<br>- 10-140% recovery acceptable for VOCs;<br>➢ <u>Surrogate spike recovery</u>:<br>- 60-140% recovery acceptable for general organics; and<br>- 10-140% recovery acceptable for VOCs;<br>➢ <u>Blanks</u>: All less than PQL. |

| Step | Input |
|---|---|
| Specify the performance or acceptance criteria | NEPM 2013 defines decision errors as "*incorrect decisions caused by using data which is not representative of site conditions*". This can arise from errors during sampling or analytical testing. A combination of these errors is referred to as "*total study error*". The study error can be managed through the correct choice of sample design and measurement.<br>Decision errors can be controlled through the use of hypothesis testing. The test can be used to show either that the baseline condition is false or that there is insufficient evidence to indicate that the baseline condition is false.<br>The null hypothesis is an assumption that is assumed to be true in the absence of contrary evidence. In this case, for example, the CoPC identified in the PCSM are considered to pose a risk to receptors unless proven not to. The null hypothesis has been adopted for this assessment. |
| Optimise the design for obtaining data | The most resource-effective design will be used in an optimum manner to achieve the assessment objectives. |

## 6.2 Soil Sampling Plan and Methodology

The soil sampling plan and methodology adopted for this assessment are outlined in the table below:

Table 6-2: Soil Sampling Plan and Methodology

| Aspect | Input |
|---|---|
| Sampling Plan and Density | The NSW EPA Contaminated Sites Sampling Design Guidelines (1995[12]) recommend a sampling density for an environmental assessment based on the size of the investigation area. The guideline provides a minimum number of sampling points required for the investigation on a systematic sampling pattern.<br>For the entire school area of 1.816ha, the guidelines recommend sampling from a minimum of 28 evenly spaced sampling points. As it is not proposed to develop the entire school area in the short-term, samples for this investigation were obtained from 10 sampling points in accessible areas of the site where soil disturbance is scheduled to occur during the initial stages of the proposed development works, as shown on the attached Figure 2. |
| Exclusion Areas (Data Gaps) | Sampling was not undertaken in inaccessible areas of the site such as beneath existing buildings. These areas have been excluded from the investigation. |

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[12] NSW EPA, (1995), *Contaminated Sites Sampling Design Guidelines.* (referred to as EPA Sampling Design Guidelines 1995)

| Aspect | Input |
|---|---|
| Sampling Equipment | Soil samples were obtained on 20 February 2017 (BH2-BH3) and on 5 September 2017 (BH4-BH11) in accordance with the standard sampling procedure (SSP) attached in the appendices. All sampling locations were cleared for underground services by an external contractor prior to sampling as outlined in the SSP.<br>The sample locations were drilled using a hand auger. |
| Sampling Collection and Field QA/QC | Soil samples were collected from the fill profiles based on field observations. The sampling depths are shown on the bore logs attached in the appendices.<br>During sampling, soil at selected depths was split into primary and duplicate samples for field QA/QC analysis.<br>Samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags.<br>Sampling personnel used disposable nitrile gloves during sampling activities. The samples were labelled with the job number, sampling location, sampling depth and date in accordance with the SSP. |
| Field PID Screening for VOCs | A portable photoionisation detector (PID) was used to screen the samples for the presence of VOCs and to assist with selection of samples for hydrocarbon analysis. The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source.<br>The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents.<br>PID screening for VOCs was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. |
| Decontamination and Sample Preservation | The decontamination procedure adopted during sampling is outlined in the SSP. The sampling equipment was decontaminated using a scrubbing brush and potable water and Decon 90 solution (phosphate-free detergent) followed by double-rinsing with potable water. Rinsate samples were obtained during the decontamination process as part of the field QA/QC.<br>Soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with the SSP.<br>On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA-registered laboratory for analysis under standard COC procedures. |

## 6.3 Analytical Schedule

The analytical schedule is outlined in the following table:

Table 6-3: Analytical Schedule

| CoPC | Fill Samples |
|---|---|
| Heavy Metals | 19 |
| TRH/BTEXN | 19 |
| PAHs | 19 |
| OCPs/OPPs | 11 |
| PCBs | 11 |
| Asbestos | 19 |
| TCLP lead | 19 |
| TCLP arsenic, cadmium, chromium, mercury, nickel | 16 |
| TCLP PAHs | 16 |

### 6.3.1 Laboratory Analysis

The samples were analysed by NATA-accredited laboratories using the analytical methods detailed in Schedule B(3) of NEPM 2013. Reference should be made to the laboratory reports attached in the appendices for further details.

Table 6-4: Laboratory Details

| Samples | Laboratory | Report Reference |
|---|---|---|
| All primary samples and field QA/QC samples including (intra-laboratory duplicates, trip blanks, trip spikes and field rinsate samples) | Envirolab Services Pty Ltd NSW, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance) | #162413, #175050 |
| Inter-laboratory duplicates | Envirolab Services Pty Ltd VIC, NATA Accreditation Number – 2901 (ISO/IEC 17025 compliance) | #11722 |

## 7 SITE ASSESSMENT CRITERIA (SAC)

The SAC adopted for the assessment are outlined in the table below. The SAC have been derived from the NEPM 2013 and other guidelines as applicable. The guideline values for individual contaminants are presented in the attached report tables.

Table 7-1: SAC Adopted for this Investigation

| Guideline | Applicability |
|---|---|
| Health Investigation Levels (HILs)<br>(NEPM 2013) | The HIL-A criteria for 'residential with accessible soil' have been adopted for this assessment. These criteria also apply to primary schools. |
| Health Screening Levels (HSLs)<br>(NEPM 2013) | The HSL-A criteria for 'residential with accessible soil' have been adopted for this assessment. These criteria also apply to primary schools and to secondary school buildings. |
| Ecological Assessment Criteria (EAC)<br>(NEPM 2013) | A preliminary screening of ecological risk has been undertaken based on the information available at this stage. The EAC criteria for 'urban residential and public open space (URPOS)' exposure setting have been adopted. Soil parameters: pH; cation exchange capacity (CEC); and clay content have not been analysed for the assessment. On this basis, the EIL and ESL calculations have taken the 'worst case' scenario in order to generate the EAC.<br><br>The EILs for selected metals have been derived using the ambient background concentration (ABC) values for high traffic (25th percentiles) areas for old suburbs of NSW published in Olszowy et. al. (1995[13]). |
| Asbestos in Soil | As a conservative measure the 'presence/absence' of asbestos in soil has been adopted as the criterion for the assessment. |
| Waste Classification (WC) Criteria | The criteria outlined in the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014[14]) have been adopted to classify the material for off-site disposal. |

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[13] Olszowy, H., Torr, P., and Imray, P., (1995), *Trace Element Concentrations in Soils from Rural and Urban Areas of Australia. Contaminated Sites Monograph Series No. 4*. Department of Human Services and Health, Environment Protection Agency, and South Australian Health Commission.

[14] NSW EPA, (2014), *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

# 8 INVESTIGATION RESULTS

## 8.1 Subsurface Conditions

A summary of the subsurface conditions encountered during the investigation and in previous geotechnical assessments is presented in the table below. Reference should be made to the borehole logs attached in the appendices for further details.

Table 8-1: Summary of Subsurface Conditions

| Profile | Description (m in bgl) |
|---|---|
| Pavement | Concrete pavement was encountered in the three boreholes drilled between the Marian Centre and B-Block, BH2, BH3 and BH5, to depths ranging from 0.15m to 0.17m. |
| Fill | Fill material was encountered at the surface or beneath the pavement in all boreholes. All boreholes were terminated due to auger refusal on what was inferred to be either sandstone bedrock or buried concrete slabs.<br>The fill typically comprised of silty sand or silty clayey sand and contained inclusions of slag (BH6, BH7), rags (BH8), plastic (BH10, BH11) and organic material (BH10, BH11).<br>BH9 was drilled in a fill mound/stockpile that was located to the west of the Gymnasium between the Gymnasium wall and the fence marking the western boundary of the site. The fill mound was estimated to be approximately 20m long, 4m wide and 2m to 2.5m high. The material in the mound appeared to generally consist of silty clayey sand with gravel, concrete fragments and sandstone and shale cobbles and boulders. |
| Natural Soil | Natural soils were not encountered during this assessment. The JK Geotechnical Assessment (2017) indicated that only very minor bands of residual soils were encountered on-site, as “typically the profile comprised of fill directly overlying sandstone bedrock”. |
| Bedrock | The JK Geotechnical Assessment (2017) indicated that sandstone bedrock appears to gradually step down the hillside from Carabella Street to Elamang Avenue. |
| Groundwater | The groundwater table was not encountered during this assessment or the previous geotechnical assessments. The JK Geotechnical Assessment (2017) indicated that groundwater seepage was observed to be occurring along the soil-rock interface and through defects within the rock mass. |

## 8.2 Field Screening

A summary of the field screening results is presented in the table below.

Table 8-2: Summary of Field Screening

| Aspect | Details (m in bgl) |
|---|---|
| PID Screening of Soil Samples for VOCs | PID soil sample headspace readings are presented in the attached report tables and the COC documents attached in the appendices. All results were 0ppm equivalent isobutylene which indicates a lack of PID-detectable VOCs. |

## 8.3 Soil Laboratory Results

The soil laboratory results are compared to the relevant SAC in the attached report tables. Statistical calculations undertaken on the results using ProUCL (version 5) are attached in the appendices. A summary of the results assessed against the SAC is presented below.

Table 8-3: Summary of Soil Laboratory Results

<table>
<tr><th>Analyte</th><th>Results Compared to SAC</th></tr>
<tr><td>Heavy Metals</td><td><b><u>HILs:</u></b><br>Elevated concentrations of lead were encountered above the HIL-A criterion of 300mg/kg as outlined below. The remainder of the heavy metal concentrations were below the corresponding HILs.
<table>
<tr><td>Borehole</td><td>Sample Depth</td><td>Lead Concentration</td></tr>
<tr><td>BH2</td><td>0.17m-0.23m</td><td>310 mg/kg</td></tr>
<tr><td>BH5</td><td>0.2m-0.4m</td><td>310 mg/kg</td></tr>
<tr><td>BH7</td><td>0.9m-1.1m</td><td>330 mg/kg</td></tr>
<tr><td>BH11</td><td>0.1m-0.2m</td><td>490 mg/kg</td></tr>
<tr><td>BH11</td><td>0.3m-0.4m</td><td>580 mg/kg</td></tr>
</table>
<u>Summary of Statistical Calculation:</u><br>No results were above 250% of the SAC. The 95% UCL was calculated using the lead data from the fill soil samples (see Appendix E). The 95% UCL for lead was 258mg/kg which was below the HIL-A criterion of 300mg/kg. The standard deviation of 152.7mg/kg was marginally above 50% of the SAC.</td></tr>
</table>

| **Analyte** | **Results Compared to SAC** |
|---|---|

**EILs:**

Elevated concentrations of copper and zinc were encountered above the EIL-URPOS as outlined in the following table (note: those that did not exceed the EIL-URPOS are italicised). The remainder of the heavy metal concentrations were below the corresponding EILs.

| Borehole | Sample Depth | EIL – copper | Copper concentration | EIL – zinc | Zinc concentration |
|---|---|---|---|---|---|
| BH8 | 0.15m-0.25m | 88mg/kg | *23mg/kg* | 192mg/kg | 200mg/kg |
| BH10 | 0.1m-0.2m | 88mg/kg | 130mg/kg | 192mg/kg | 560mg/kg |
| BH10 | 0.25m-0.35m | 88mg/kg | 120mg/kg | 192mg/kg | 480mg/kg |
| BH11 | 0.1m-0.2m | 88mg/kg | 190mg/kg | 192mg/kg | 480mg/kg |
| BH11 | 0.3m-0.4m | 88mg/kg | 170mg/kg | 192mg/kg | 520mg/kg |

**Waste Classification:**

Lead exceeded the CT1 criterion but was below the SCC1 criterion in thirteen of the nineteen samples analysed. The remainder of the heavy metal results were less than the CT1 and SCC1 criteria. TCLP leachates were prepared from all of the samples and analysed for lead. The results were less than the TCLP1 criteria.

TRH

**HSLs:**

All TRH results were below the HSL-A criteria with the exception of TRH $>C_{10}$-$C_{16}$ (F2) which exceeded the HSL in two samples as detailed below:

| Borehole | Sample Depth | HSL | F2 concentration |
|---|---|---|---|
| BH11 | 0.1m-0.2m | 110mg/kg | 240mg/kg |
| BH11 | 0.3m-0.4m | 110mg/kg | 280mg/kg |

**ESLs:**

Elevated concentrations of F2 and F3 (TRH $>C_{16}$ – $C_{34}$) were encountered as detailed in the table below (note: those that did not exceed the EIL-URPOS are italicised). All remaining TRH results were below the ESL-URPOS criteria.

| Borehole | Sample Depth | ESL – F2 | F2 concentration | ESL – F3 | F3 concentration |
|---|---|---|---|---|---|
| BH7 | 0.3m-0.5m | 120mg/kg | *LPQL* | 300mg/kg | 400mg/kg |
| BH9 | 0.0m-0.1m | 120mg/kg | *76mg/kg* | 300mg/kg | 1500mg/kg |
| BH10 | 0.1m-0.2m | 120mg/kg | *LPQL* | 300mg/kg | 430mg/kg |
| BH11 | 0.1m-0.2m | 120mg/kg | 240mg/kg | 300mg/kg | 1700mg/kg |
| BH11 | 0.3m-0.4m | 120mg/kg | 280mg/kg | 300mg/kg | 3100mg/kg |

**Waste Classification:**

All TRH results were less than the relevant CT1 and SCC1 criteria.

<table>
<tr><th>Analyte</th><th>Results Compared to SAC</th></tr>
<tr><td>BTEX</td><td>
**HSLs:**<br>All BTEX results were below the HSL-A criteria.<br>
**ESLs:**<br>All BTEX results were below the ESL-URPOS criteria.<br>
**Waste Classification:**<br>All BTEX results were less than the relevant CT1 and SCC1 criteria.
</td></tr>
<tr><td>PAHs</td><td>
**HILs:**<br>Elevated concentrations of PAHs were encountered above the HIL-A criteria as outlined in the table below (note: those that did not exceed the EIL-URPOS are italicised). The remainder of the PAH concentrations were below the corresponding HILs.
<table>
<tr><th>Borehole</th><th>Sample Depth</th><th>HIL – Total PAHs</th><th>Total PAH concentration</th><th>HIL – B(a)P TEQ</th><th>B(a)P TEQ concentration</th></tr>
<tr><td>BH7</td><td>0.0m-0.1m</td><td>300mg/kg</td><td>*27mg/kg*</td><td>3mg/kg</td><td>4.7mg/kg</td></tr>
<tr><td>BH7</td><td>0.3m-0.5m</td><td>300mg/kg</td><td>*100mg/kg*</td><td>3mg/kg</td><td>14mg/kg</td></tr>
<tr><td>BH7</td><td>0.9m-1.1m</td><td>300mg/kg</td><td>*49mg/kg*</td><td>3mg/kg</td><td>5.7mg/kg</td></tr>
<tr><td>BH8</td><td>0.15-0.25</td><td>300mg/kg</td><td>*59mg/kg*</td><td>3mg/kg</td><td>6.8mg/kg</td></tr>
<tr><td>BH9</td><td>0.0-0.1</td><td>300mg/kg</td><td>360mg/kg</td><td>3mg/kg</td><td>24mg/kg</td></tr>
<tr><td>BH11</td><td>0.3-0.4</td><td>300mg/kg</td><td>350mg/kg</td><td>3mg/kg</td><td>30mg/kg</td></tr>
</table>
Statistical calculations for PAHs were not undertaken on the samples as the concentrations of B(a)P TEQ in three of the samples exceeded 250% of the SAC.<br>
**HSLs:**<br>All naphthalene results were below the HSL-A criteria.<br>
**ESLs:**<br>All benzo(a)pyrene results were below the ESL-URPOS criteria.<br>
**EILs:**<br>All naphthalene results were below the EIL-URPOS criteria.<br>
**Waste Classification:**<br>Total PAH and benzo(a)pyrene concentrations exceeded the CT1, CT2 and/or SCC1 criteria as indicated in the attached Table D. TCLP leachates were prepared from the corresponding samples and analysed for PAHs. All of the TCLP results were less than the TCLP1 criterion.
</td></tr>
</table>

| Analyte | Results Compared to SAC |
|---|---|
| OCPs & OPPs | **<u>HILs:</u>**<br>All OCP and OPP results were below the HIL-A criteria.<br>**<u>EILs:</u>**<br>All DDT results were below the EIL-URPOS criteria.<br>**<u>Waste Classification:</u>**<br>All OCP and OPP results were less than the relevant CT1 and SCC1 criteria. |
| PCBs | **<u>HILs:</u>**<br>All PCB results were below the HIL-A criterion.<br>**<u>Waste Classification:</u>**<br>All PCB results were less than the SCC1 criterion. |
| Asbestos | Asbestos was not detected in the samples analysed for the investigation. |

## 9 DATA QUALITY ASSESSMENT

As part of the data quality assessment the following data quality indicators (DQIs) were assessed: precision, accuracy, representativeness, completeness and comparability as outlined in the table below. Reference should be made to the appendices for an explanation of the individual DQI.

Table 9-1: Assessment of DQIs

**Completeness**

Field Considerations:

- The investigation was designed as a preliminary screening and sampling was confined to accessible areas of the site (see Figure 2);
- Samples were obtained from various depths based on the subsurface conditions encountered at the sampling locations. All samples were recorded on the borehole logs. All sampling points are shown on the attached Figure 2; and
- The investigation was undertaken by trained staff in accordance with the SSP.

Laboratory Considerations:

- Selected samples were analysed for a range of CoPC;
- All samples were analysed by NATA-registered laboratories in accordance with the analytical methods outlined in NEPM 2013;
- Appropriate analytical methods and PQLs were used by the laboratories. The PQLs for PCBs, OCPs and OPPs were raised in some samples due to interference from other analytes (see page 41 of lab report #175050). However as the raised PQLs remained below the SAC, the interpretation of the results is not affected; and
- Appropriate sample preservation, handling, holding time and COC procedures were adopted for the investigation.

**Comparability**

Field Considerations:

- The investigation was undertaken by trained staff in accordance with the SSP;
- The climate conditions encountered during the field work were noted on the site description record maintained in the job file; and
- Consistency was maintained during sampling in accordance with the SSP.

Laboratory Considerations:

- All samples were analysed in accordance with the analytical methods outlined in NEPM 2013;
- Appropriate PQLs were used by the laboratories for all analysis;
- All primary, intra-laboratory duplicate and QA/QC samples were analysed by the same laboratory; and
- The same units were used by the laboratories for all of the analysis.

**Representativeness**

Field Considerations:

- The investigation was designed to obtain appropriate media encountered during the field work as outlined in the SAQP; and
- All media identified in the SAQP was sampled.

Laboratory Considerations:

- All samples were analysed in accordance with the SAQP.

**Precision**

Field Considerations:

- The investigation was undertaken in accordance with the SSP.

Laboratory Considerations:

- Analysis of field QA/QC samples including inter and intra-laboratory duplicates, trip blanks, field rinsates and trip spikes as outlined below;
- The field QA/QC frequency adopted for the investigation is outlined below;
- Calculation of the Relative Percentage Difference (RPD) from the primary and duplicate results (the RPD calculation equation is outlined in the attached appendices);
- Assessment of RPD results against the acceptance criteria outlined in **Section 6.1.**

Intra-laboratory RPD Results:

Soil intra-laboratory duplicate samples were analysed at a frequency of 5.3% of the primary samples. DUP1 is a soil duplicate of BH2 (0.17-0.23).

The intra-laboratory results are presented in the attached report tables. The results indicated that field precision was acceptable. The RPD value for one PAH (anthracene) was outside the acceptance criteria. This can be attributed to sample heterogeneity and the difficulties associated with obtaining homogenous duplicate samples of heterogeneous matrices As both the primary and duplicate sample results were less than the SAC, the exceedances are not considered to have had an adverse impact on the data set as a whole.

Inter-laboratory RPD Results:

Soil inter-laboratory duplicate samples were analysed at a frequency of 5.3% of the primary samples. DUP-X is a soil duplicate of primary sample BH5 (0.2-0.4).

The inter-laboratory results are presented in the attached report tables. The results indicated that field precision was acceptable.

Trip Spike:

One soil trip spike transported with the samples obtained on 5 September 2017 was analysed for BTEX. The results are presented in the attached report tables. The results ranged from 93% to 95% and indicated that field preservation methods were appropriate.

Field Rinsate:

One field rinsate sample obtained from the hand auger decontamination process on 20 February 2017 was analysed for BTEX, and one field rinsate sample obtained from the hand auger decontamination process on 5 September 2017 was analysed for heavy metals. The results are presented in the attached report tables. All results were below the PQLs which indicates that cross-contamination artefacts associated with sampling equipment were not present.

Trip Blank (TB):

Two soil trip blank samples were analysed for BTEX at a frequency of one blank per batch of volatiles. The results are presented in the attached report tables. The results were all less than the PQLs.

**Accuracy**

Field Considerations:

- The investigation was undertaken in accordance with the SSP.

Laboratory Considerations:

- The analytical quality assessment adopted by the laboratories was in accordance with the NATA and NEPM 2013 requirements as outlined in the analytical reports; and
- A review of the reports indicates that the analytical results were generally within the acceptance criteria adopted by the laboratories. The laboratory RPD acceptance criteria was exceeded in one sample for TRH $C_{10}$-$C_{40}$ and PAHs. A triplicate result was issued to account for this. Percentage recovery was not possible in some samples due to matrix interference. However, an acceptable recovery was achieved for the LCS.

# 10 PRELIMINARY WASTE CLASSIFICATION OF SOIL FOR OFF-SITE DISPOSAL

## 10.1 Waste Classification of Fill

Due to the presence of slag within the fill material, it has been classified in accordance with the *General Approvals of Immobilisation* (GAI) (2009/07). The SCC limits for the following contaminants outlined in the *Waste Classification Guidelines 2014* do not apply for the assessment of this waste stream: beryllium, chromium (VI), lead, nickel, PAHs and benzo(a)pyrene. The material can be classified according to their leachable concentration (TCLP) values alone.

Therefore, based on the results of the assessment, and at the time of reporting, the fill material within the assessment areas is classified as **General Solid Waste (non-putrescible)**. Excavated fill should be disposed of to a landfill that is licensed by the NSW EPA to receive material classified under the GAI. The landfill should be contacted to obtain the required approvals prior to commencement of excavation.

## 10.2 Classification of Natural Soil and Bedrock

Natural soil and bedrock were not analysed for this assessment. Based on the results of the assessment, EIS considers it likely that the natural material will meet the criteria for Virgin Excavated Natural Material (VENM). However, this should be confirmed by analysis should any natural material require excavating and off-site disposal during the proposed development.

## 11 TIER 1 RISK ASSESSMENT AND REVIEW OF PCSM

For a contaminant to represent a risk to a receptor, the following three conditions must be present:

1. Source – The presence of a contaminant;
2. Pathway – A mechanism or action by which a receptor can become exposed to the contaminant; and
3. Receptor – The human or ecological entity which may be adversely impacted following exposure to contamination.

If one of the above components is missing, the potential for adverse risks is relatively low.

The assessment has identified the following contamination issues at the site:

Table 11-1: Tier 1 Risk Assessment and Review of PCSM

| **Primary Contaminant of Concern (PCC)** | **Receptor and Exposure Pathway** | **Discussion and Risk Rating** |
|---|---|---|
| Lead | <u>Human Receptors:</u><br>Dermal contact, ingestion and inhalation via dust | Lead was encountered at concentrations above the HILs adopted for the investigation in BH2, BH5, BH7 and BH11.<br><br>EIS are of the opinion that the risk posed to human receptors is moderate and will require remediation and/or management. |
| Copper and zinc | <u>Environmental Receptors:</u><br>Direct exposure to plants and animals | Copper and zinc were encountered above the EILs adopted for the assessment.<br><br>In the vicinity of BH8, the concentration of zinc detected (200mg/kg) only marginally exceeded the EIL of 192mg/kg and is considered to present a low risk to potential environmental receptors.<br><br>In the vicinity of BH10 and BH11, which were drilled in the paved courtyard area south of the Elamang Building, concentrations of copper and zinc exceeded the EILs. The proposed development in this area is a new landscaped courtyard. Assuming that the majority of the courtyard will be paved, EIS are of the opinion that the risk posed to potential environmental receptors is low and will not require remediation or management. |

| Primary Contaminant of Concern (PCC) | Receptor and Exposure Pathway | Discussion and Risk Rating |
|---|---|---|
| PAHs | Human Receptors:<br>Dermal Contact, ingestion and inhalation via dust | Total PAHs and benzo(a)pyrene TEQ (a measure of the toxicity of a group of carcinogenic PAHs relative to benzo(a)pyrene) were encountered at concentrations exceeding the adopted HILs in BH7, BH8, BH9 and BH11. BH7 was drilled within the proposed landscaped area north of B-Block. BH8 was drilled within a proposed landscaped area north of the Gymnasium. BH9 was drilled within the fill mound west of the Gymnasium. BH10 and BH11 were drilled within the paved courtyard area as noted above.<br>EIS are of the opinion that the risk posed to human receptors is moderate and will require remediation and/or management. |
| Total recoverable hydrocarbons (TRH) | Human Receptors:<br>Direct contact and inhalation | TRH was encountered in BH11 at concentrations exceeding the HSL adopted for the assessment. As noted above, the proposed development in this area is for a landscaped courtyard.<br>EIS are of the opinion that the risk posed to human receptors is low to moderate. The fill material in this area appears to be relatively shallow (approximately 0.35m to 0.4m). We recommend that the area be remediated. |
| TRH | Environmental Receptors:<br>Direct exposure to plants and animals | TRH was encountered in BH7, BH9, BH10 and BH11 at concentrations exceeding the ESLs. BH7 was drilled within a proposed landscaped area north of B-Block. BH9 was drilled within the fill mound west of the Gymnasium. BH10 and BH11 were drilled within the proposed courtyard area as noted above.<br>EIS are of the opinion that the risk posed to potential environmental receptors is low to moderate and may require remediation and/or management. |

## 11.1 Source and Extent of Contamination

### 11.1.1 Sources

The source of the heavy metals, PAHs and TRH contamination is considered most likely to be associated with the importation of contaminated fill material used during construction activities. Potentially contaminated material was often used as fill during construction activities in Sydney during the 19th and 20th centuries. EIS considers that is unlikely that the contamination was caused by school activities.

### 11.1.2 Known Extent

Of the ten boreholes in which samples were analysed for this assessment (BH2-BH11), contamination at concentrations exceeding the human health SAC was encountered in 60% of the boreholes (BH2, BH5, BH7, BH8, BH9 and BH11). Due to the heterogeneous nature of the fill material and extent of contamination, no distinct hotspots can be identified at the site. As a conservative measure, all fill material in the proposed development areas is considered to be potentially contaminated and should be treated accordingly.

### 11.1.3 Unknown Extent

Soil sampling was not undertaken beneath the existing buildings, therefore the extent of contamination beneath the buildings is currently unknown.

### 11.1.4 Hazardous Building Materials in Existing Buildings

There is a possibility of the presence of hazardous building materials in the existing buildings at the site. This is considered to pose a relatively low risk to the receptors provided that the demolition works are undertaken in accordance with the relevant codes and standards.

### 11.1.5 Groundwater

As groundwater was not encountered during the various geotechnical assessments undertaken at the site, the depth to groundwater is expected to be relatively deep. Based on the available data, EIS considers that it is unlikely that significant groundwater contamination has occurred at the site. However as groundwater sampling has not been undertaken, the status of potential groundwater contamination is currently unknown.

## 11.2 Fate and Transport of Contaminants

The potential fate and transport of COPC identified at the site is summarised in the following table:

Table 11-2: Fate and Transport of CoPC

| CoPC | Fate and Transport |
|---|---|
| Non-volatile contaminants including: metals, heavy-fraction TRHs and heavy-fraction PAHs | Non-volatile contaminants are predominantly confined to the soil and groundwater medium. The mobility of these contaminants varies depending on: the nature and type of contaminant present (e.g. leachability, viscosity etc.); soil type/porosity; surface water infiltration; groundwater levels; and the rate of groundwater movement. |

| CoPC | Fate and Transport |
|---|---|
| | **Presence of Ash and Slag**<br>Non-volatile contaminants associated with ash and slag waste (some heavy metals, heavy fraction PAHs, and heavy fraction TRHs) are bound within a relatively insoluble matrix. Slag and ash are usually formed as a by-product of combustion at high temperatures which 'locks in' the contaminants within the matrix.<br>**Site Conditions**<br>Surface water has the potential to infiltrate into the subsurface at the site via garden beds, grassed areas, unlined water retention facilities etc. Surface water infiltration could increase the migration potential of certain contaminants. |

# 12 CONCLUSIONS OF THE PRELIMINARY STAGE 2 ESA

EIS consider that the report objectives outlined in **Section 1.2** have been addressed.

The decisions of the study are addressed as follows:

1. Are any results above the SAC?
   - Yes, some analytical results were above the SAC, as detailed in Section 8.3.

2. Do the results represent a risk to human or ecological receptors?
   - Yes, EIS considers that the results represent a risk to the potential human and ecological receptors, as detailed in Table 11.1.

3. Is the site suitable for the proposed use?
   - EIS consider that the site can be made suitable for the proposed development provided that the following recommendations are implemented to minimise the risks:

## 12.1 Recommendations

1. Undertake a Hazardous Materials Assessment (Hazmat) for the existing buildings prior to the commencement of demolition work;

2. Prepare a Remediation Action Plan (RAP) to outline remedial measures for the site. A RAP is detailed in the following sections of this report; and

3. Prepare a Validation Assessment report on completion of remediation.

# 13 REMEDIATION ACTION PLAN (RAP)

## 13.1 Remediation Goal and Objectives of the RAP

The goal of the remediation is to render the site suitable for the proposed development.

The objectives of the RAP are to:

- Provide a methodology to remediate and validate the site with regard to the primary contaminants of concern (PCC), being lead, PAHs, and TRH;
- Provide a contingency plan for the remediation works;
- Outline site management procedures to be implemented during remediation work; and
- Provide an unexpected finds protocol to be implemented during the remediation and development works.

## 14 REMEDIATION EXTENT

### 14.1 Known Extent

As detailed in Section 11.1 of this report, 60% of the sample locations from which soil samples were analysed during the Preliminary Stage 2 assessment contained concentrations of contaminants that exceeded the adopted human health site assessment criteria. Accordingly, EIS considers that all fill material present within the proposed development areas is potentially contaminated and should be treated accordingly.

### 14.2 Unknown Extent

The status of soil contamination beneath the buildings is currently unknown. If fill material is present beneath the buildings, EIS considers that it is likely to be contaminated with similar contaminants as those detected in the sample locations.

# 15 REMEDIATION OPTIONS

## 15.1 Soil Remediation

The NSW EPA follows the *ANZECC/NHMRC Guidelines for the Assessment and Management of Contaminated Sites* (1992) published hierarchy for the remediation of contaminated sites. The preferred order for soil remediation and management is as follows:

1. On-site treatment of soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated material so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;
3. Removal of contaminated material to an approved site or facility, followed where necessary by replacement with clean material; and
4. Consolidation and isolation of the soil on-site by containment within a properly designed barrier.

The Site Auditor Guidelines 2006 provide the following additional requirements to be taken into consideration:

- Remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed; and
- Where there are large quantities of soil with low levels of contamination, alternative strategies should be considered or developed.

## 15.2 Consideration of Soil Remediation Options

### 15.2.1 Option 1: On-Site Treatment of Contaminated Soil

On-site treatment provides a mechanism to reuse the processed material and in some instances, to avoid the need for large scale earthworks. Some of the treatment options include:

- Bio-remediation: Addition of oxygen and nutrient compounds to accelerate the natural process of organic compound decay within the environment. Soils require excavation and stockpiling prior to treatment. Not suitable for all contaminants.
- Soil Washing: Soil is stripped of contaminants via a leaching process and the concentrated contaminated liquid product retained for disposal or additional treatment.
- Air Sparging and Extraction: Air is forced through the contaminated soil to volatilise organic contaminants. The air is then extracted and captured for treatment leaving reduced contaminant concentrations within the sub-strata.
- Thermal Desorption: Contaminated soils are heated within an incinerator to volatilise or combust the contaminants. Contaminants are either broken down to water and carbon dioxide or alternatively trapped within an air filtration system.

Licenses are necessary for specific individual waste streams due to the potential for air pollution and the formation of harmful by-products during the incineration process.

Applicability to the Site:
On-site treatment options are generally very expensive and time-consuming. They are generally applicable for large scale remediation work of sites with large areas impacted by contaminants that can be treated.

The PCC at this site include lead, heavy-fraction PAHs and heavy-fraction TRH. The majority of these compounds are difficult to treat as they don't break down easily or at all. Considering the potential cost and the nature of the PCC at the site, this option is not considerable to be viable.

### 15.2.2 Option 2: Off-site Treatment of Contaminated Soil

Contaminated soils are excavated, transported to an approved and licensed treatment facility, treated to remove and/or stabilise the contaminants, then returned to the subject site, transported to an alternative site or disposed of to an approved landfill facility.

This option provides for a relatively short program of on-site works, however there may be some delays if the material is to be returned to the site following treatment.

The cost per tonne for transport to and from the site and for treatment is considered to be relatively high. The material would also have to be assessed in terms of suitability for reuse as part of the proposed development works.

Applicability to the Site:
Off-site treatment of soil is very expensive and is not considered a preferred option. Material which leaves the site as a waste stream can only be taken to a facility licensed by the NSW EPA to receive the waste stream. The treated material cannot be brought back onto the site as it will be classified as a waste stream.

### 15.2.3 Option 3: Removal of contaminated material to an appropriate facility and reinstatement with clean material

Contaminated soils would be classified in accordance with NSW EPA guidelines for waste disposal, excavated and disposed of off-site to a NSW EPA licensed landfill.

The material would have to meet the requirements for landfill disposal. Landfill gate fees would apply in addition to transport costs.

Applicability to the Site:
This is considered to be a viable option for the site and could be conducted in conjunction with the construction works.

### 15.2.4 Option 4: Consolidation and isolation of impacted soil by cap and containment

This would include the placement of an impermeable barrier such as concrete, or a warning barrier and non-contaminated soil material, over the existing ground surface to isolate the contaminated material and thereby reduce the health risk to future site users.

This action may also reduce the transport of contamination via surface water movement, dust generation and potentially groundwater infiltration, however, environmental issues would need to be evaluated.

Such an option should only be considered where other preferred approaches from the NSW EPA hierarchy are not applicable. The capping and/or containment must be appropriate for the specific contaminants of concern.

An ongoing environmental management plan (EMP) would be required and site identification documentation, possibly including the Section 149 council planning certificate and/or the land title, would be modified to note the presence of the contamination. This may impact upon development approval conditions and limit the future potential land value.

Applicability to the Site:
This is considered to be a viable option for the site.

## 15.3 Selection of Remediation Option

EIS considers that Option 3, the removal of contaminated material to an appropriate facility and reinstatement with clean material, is the best option for remediating the site for the following reasons:

- In most areas of the site, the depth of fill material appears to be relatively shallow. Therefore the total volume of fill material to be disposed is not expected to be excessive;
- The remedial works would generally be able to be conducted in conjunction with the construction works; and
- Removing the contaminated soil from the site would avoid the need to prepare an EMP for the site and the need to provide ongoing management of the contamination.

## 16 REMEDIATION DETAILS

Prior to commencement of remediation work, the site management plan for remediation works (see Section 19) should be reviewed and implemented by the Remediation and Construction Contractor.

### 16.1 Roles and Responsibility

The roles and responsibilities for the implementation of this RAP are outlined in the table below.

Table 16-1: Roles and Responsibilities

| Role | Responsibility |
|---|---|
| Project Manager (PM) | Artazan Property Group (APG)<br>Address: Level 8, 210 George Street, Sydney, NSW, 2000<br>Contact: Cian Fitzgerald<br>Phone: (02) 8035 5450<br>Email: cian@apg.com.au<br>The PM is required to provide all investigation reports including this plan to the Remediation and Construction Contractor (RCC) prior to commencement of remediation work. The PM needs to ensure that the RCC has understood the plan and will implement it in its totality. Further details are outlined in the sections below. |
| Remediation & Construction Contractor (RCC) | Contact details: to be advised upon appointment<br>The RCC is required to review all documents prepared for the project and implement the procedures outlined in this RAP. The RCC is required to collect all necessary documentation and forward them onto the PM and Environmental Consultant as they become available. Further details are outlined in the sections below. |
| Earthworks-Sub Contactor | Contact details: to be advised upon appointment<br>The earthworks sub-contractor working on the project should be made aware of the site contamination and this RAP. The sub-contractor is required to review this document and implement the procedures outlined in the RAP.<br>The sub-contractor is required to collect all necessary documentation and forward them onto the PM and Environmental Consultant as they become available. Further details are outlined in the sections below. |
| Environmental Consultant (EC) | Environmental Investigation Services (EIS)<br>Address: 115 Wicks Road, Macquarie Park, NSW, 2113<br>Contact: Rob Muller<br>Phone: (02) 9888 5000<br>Email: rmuller@jkgroup.net.au |

| | |
|---|---|
| | The EC provides consulting advice on the ongoing remediation work at the site. The EC is required to review any deviation to this plan or in the event of unexpected finds if and when encountered during the site work. If a site auditor is appointed, the EC is required to liaise with the auditor on all matters pertaining to the site contamination and remediation. Further details are outlined in the sections below. |
| Other Consultants & Contractors (e.g. landscaping contractors) | Contact details: to be advised upon appointment<br>Other consultants and contractors who may become involved in the project from time to time should be made aware of this RAP. The contractors are required to review this plan and implement the procedures outlined. The contractors are required to collect all necessary documentation and forward them onto the PM and Environmental Consultant as they become available. Further details are outlined in the sections below. |

## 16.2 Remediation of Development Areas

The remediation details for the proposed development areas are described in the table below:

Table 16-2: Remediation Strategy

| Step | Procedure | Responsibility |
|---|---|---|
| 1. | Mark the Area:<br>Prior to the commencement of excavation, the remediation area should be clearly marked with spray paint and/or pegs. | Remediation and Construction Contractor |
| 2. | PPE and WHS:<br>Check PPE and WHS requirements prior to commencement of remediation works. The minimum PPE required for the remediation includes a hard hat, long-sleeved clothing and steel-toed boots.<br>Workers who may be handling contaminated soil, such as the Environmental Consultant, should wear disposable nitrile gloves. | All personnel who have access to the site |
| 3. | Site Preparation:<br>Any pavement within remediation areas should be removed with care using an excavator or similar. Care should be taken not to track over the area with heavy machinery. | Remediation and Construction Contractor |
| 4. | Address Stability Issues:<br>Geotechnical advice should be sought regarding the stability of the adjacent structures and/or adjacent areas prior to commencing the excavation (as required). | Remediation and Construction Contractor to address the requirement for geotechnical advice |

| Step | Procedure | Responsibility |
|---|---|---|
| 5. | Excavation and Removal of the Fill Material:<br>• Prior to the commencement of excavation, a suitable NSW landfill facility (with an appropriate license to accept the waste stream) should be contacted and the necessary approvals should be obtained for disposal;<br>• The fill material should be excavated, and either<br>1. Stockpiled on site for sampling and waste classification prior to disposal; or<br>2. If the Environmental Consultant has already classified the material, it can be directly loaded onto trucks for transport to the landfill.<br>• Landfill disposal dockets should be retained and forwarded to the Environmental Consultant for documentation;<br>• The Environmental Consultant should obtain validation samples from the walls and base of the excavation (see the following validation plan for more details);<br>• If required, backfill the excavation with appropriately validated material (see Section 17.3) which should be compacted to the requirements of the proposed development; and<br>• All documents including landfill dockets should be retained and forwarded to the client for inclusion in the validation report prepared by the Environmental Consultant. | Remediation and Construction Contractor<br>Environmental Consultant to complete validation sampling and reporting |
| 6. | Contingency Plan:<br>The contingency measures outlined in the RAP should be implemented in the event of unexpected finds or validation failure. | Remediation and Construction Contractor |
| 7. | Validation Report:<br>A validation report will be prepared documenting the remediation works. The validation report will include documentation of waste disposal, waste tracking, results of the validation testing and other information as applicable. | Environmental Consultant |

## 16.3 Validation Sampling

As a minimum the following validation samples should be obtained from the remediation area:

Table 16-3: Validation Sampling

| Sampling Frequency | Sampling Method | Laboratory Analytical Schedule |
|---|---|---|
| Validation samples should be undertaken as outlined below:<br>Excavation Base:<br>1 sample per $100m^2$ (10m grid spacing)<br>Excavation Walls:<br>1 sample per 10m of wall length, per metre of wall depth (e.g. for a wall 10m long and 1.5m deep, two samples should be collected) | Samples will be obtained using hand equipment or directly from the excavator bucket<br>Appropriate field QA/QC samples should be obtained as outlined in the validation plan. | Samples will be analysed for heavy metals including lead, PAHs and TRH.<br>The results will be assessed against the Validation Assessment Criteria (VAC) outlined in Section 17.2. |

## 17 VALIDATION PLAN

Validation is necessary to demonstrate that the remedial measures described in this RAP have been successful and that the site is suitable for the intended land use.

### 17.1 Sampling Program

The sampling program for the validation is outlined in Section 16. This is the minimum requirement based on conditions known to exist at the site. Additional validation sampling may be required based on site observations made during remediation.

Site observations will also be used as a validation tool to assess the extent of site contamination. Visual indicators such as the presence of ash and slag material, and odours will be used to assist the validation process.

In the event that validation sampling indicates that contamination is likely to extend beneath adjacent properties, validation should be completed to the extent practical and the client advised of the findings. If contamination is thought to extend beneath neighbouring properties, the site owner should inform adjacent property owners that contamination may be present.

### 17.2 Validation Assessment Criteria (VAC)

The site specific VAC to be adopted for the validation assessment are outlined in the table below. The VAC have been derived from NEPM 2013 and other guidelines as outlined in Section 1.3.

Table 17-1: VAC Adopted for this Investigation

| Guideline | Applicability |
|---|---|
| Health Investigation Levels (HILs) (NEPM 2013) | The HIL-A criteria for 'residential with accessible soil' will be adopted for this assessment. These criteria also apply to primary schools. |
| Health Screening Levels (HSLs) (NEPM 2013) | The HSL-A criteria for 'residential with accessible soil' will be adopted for this assessment. These criteria also apply to primary schools and to secondary school buildings. |
| Ecological Assessment Criteria (EAC) (NEPM 2013) | The EAC criteria for 'urban residential and public open space (URPOS)' exposure setting will be adopted for any landscaped areas. |
| Direct Contact Limits for TRH (NEPM 2013) | These guidelines will be used after considering the relevant HSLs for adverse effects of TRH contamination where necessary. |

| Guideline | Applicability |
|---|---|
| Waste Classification Criteria | The criteria outlined in the NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014[15]) will be adopted to classify the material for off-site disposal. |

## 17.3 Material Importation Requirements

The importation criteria outlined in this section of the report should be used as a guide for an initial assessment. Marginal elevations of individual compounds should be assessed by the Environmental Consultant on a case by case basis.

Table 17-2: Material Importation Requirements

| Aspect | Sampling | Analysis | Observations and Documentation |
|---|---|---|---|
| Imported VENM backfill | Minimum of three samples per source | Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRH/BTEX, PAHs, OCPs, OPPs, PCBs and asbestos | VENM documentation/report required (should include source site history to demonstrate analytes are appropriate). Additional analysis may be required depending on site history.<br>Material to be inspected upon importation to confirm it is free of visible and olfactory indicators of contamination and is consistent with documentation. |
| Imported engineering materials such as recycled aggregate, road base etc. | Minimum of three samples per source or material type | Heavy metals (as above), TRH/ BTEX, PAHs, OCPs, OPPs, PCBs and asbestos | Documentation required to confirm material has been classified with reference to a relevant exemption and is fit for purpose on site.<br>Material to be inspected upon importation to confirm it is free of visible and olfactory indicators of contamination and is consistent with documentation.<br>Dockets for imported material to be provided. |

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[15] NSW EPA, (2014), '*Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

| Aspect | Sampling | Analysis | Observations and Documentation |
|---|---|---|---|
| Imported engineering materials comprising only natural quarried products such as blue metal etc. | At the Environmental Consultant's discretion based on supplier documentation | At the Environmental Consultant's discretion based on supplier documentation | Documentation to be provided from the supplier confirming the material is a product comprising only VENM (i.e. quarried product).<br>Review of quarry licence.<br>Material to be inspected upon importation to confirm it is free of anthropogenic materials, visible and olfactory indicators of contamination, and is consistent with documentation.<br>Dockets for imported material to be provided. |
| Imported landscaping materials | Minimum of three samples per source/material type | Heavy metals (as above), TRH/ BTEX, PAHs, OCPs, OPPs, PCBs and asbestos | Documentation required to confirm material has been produced under an appropriate standard and is fit for purpose on site.<br>Material to be inspected upon importation to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation.<br>Dockets for imported material to be provided. |

### 17.4 Validation Report

As part of the validation process, a site validation report will be prepared by the Environmental Consultant. The report will outline the remediation work undertaken at the site and any deviations to the remediation strategy. The report will summarise the results of the validation assessment and will be prepared in accordance with the *Guidelines for Consultants Reporting on Contaminated Sites* 2011.

The report will include:

- A summary of the remediation works undertaken at the site;
- The sampling, analysis and quality plan (SAQP) adopted for the validation assessment;
- A summary of the validation results including the analytical results assessed against the VAC;
- A summary of fill disposal analysis and a review of contractor documentation;
- Data Quality Assessment; and
- Discussion and conclusion.

## 18 CONTINGENCY PLAN

A review of the proposed remediation works has indicated that the greatest risk that may affect the success of the remediation is an unexpected find during earthworks.

### 18.1 Unexpected Finds

There is a possibility that additional hazards exist at the site. The extent of the contamination has been interpreted from point source data and a documented process of reviewing historical site activities. However, ground conditions may vary between sampling locations and additional hazards may arise as a result.

Residual hazards that may exist at the site would generally be expected to be detectable through visual or olfactory means. At this site, these types of hazards may include asbestos fragments, friable asbestos, odorous or stained hydrocarbon impacted soils, demolition waste or ash and slag contaminated soils.

The procedure to be followed in the event of an unexpected find is presented below:
- All work in the immediate vicinity should cease and the client and Environmental Consultant should be contacted immediately;
- Temporary barricades should be erected to isolate the area from access to the public and works;
- In the event that potentially friable asbestos material is encountered, a qualified occupational hygienist and/or asbestos consultant should be contacted;
- The Environmental Consultant should attend the site and assess the extent of remediation that may be required;
- In the event remediation is required, the procedures outlined within this report should be adopted where appropriate. Alternatively an addendum to the RAP should be prepared;
- A sampling and analytical rationale should be established by the Environmental Consultant and should be implemented with reference to the relevant guideline documents; and
- Appropriate validation sampling should be undertaken and the results should be included in the validation report.

### 18.2 Continual Validation Failure

Where validation sampling indicates that the contaminated material extends further than anticipated, there are two options:
- Re-excavate and re-sample until the validation sample results meet the VAC; or
- If possible, revise the remedial strategy to include the cap and contain approach (remedial option 4).

## 18.3 Importation Failure for VENM or Landscaping Soil Materials

Where material to be imported onto the site does not meet the importation acceptance criteria specified in Section 17, the material should not be accepted. Alternative material should be sourced that meets the importation requirements.

## 18.4 Disposal of Hazardous Waste

If any material is classified as Hazardous Waste, it may require further assessment and stabilisation prior to off-site disposal. Disposal approval may also be required from the NSW EPA and EPA-licensed landfill facility. The presence of Hazardous Waste may result in significant delays and additional cost to the project.

It is noted that the available data does not indicate the presence of Hazardous Waste at the site.

## 18.5 Groundwater Seepage and Dewatering

In the event that groundwater is intercepted during excavation works, dewatering may be required. Council and other relevant approvals will be required prior to disposal of groundwater into the stormwater system. Contaminated groundwater may require treatment prior to disposal.

## 19 SITE MANAGEMENT PLAN FOR REMEDIATION WORKS

The information outlined in this section of the RAP is for the remediation work only. The client should contact the local consent authority for specific site management requirements for the overall development of the site.

### 19.1 Interim Site Management

Prior to the commencement of development and remediation works, the following procedures should be undertaken:

- Install fences to prevent access to the remediation areas;
- Entrances to the site should be locked to prevent unauthorised access, tipping or dumping on the site; and
- Appropriate warning signage should be erected as required which outline the PPE required for remediation work.

### 19.2 Site Soil and Water Management Plan

The Earthworks Contractor should prepare a detailed soil and water management plan prior to the commencement of site works. Silt fences should be used to control the surface water runoff at all appropriate locations of the site.

All stockpiled materials should be placed within an erosion containment boundary with silt fences and sandbags employed to limit sediment movement. The containment area should be located away from drainage lines, gutters, stormwater pits and inlets and the site boundary. No liquid waste or runoff should be discharged to the stormwater or sewerage system without the approval of the appropriate authorities.

### 19.3 Noise and Vibration Control Plan

The guidelines for minimisation of noise on construction sites outlined in Australian Standard AS-2460 (2002[16]) should be adopted. Other measures specified in the consent conditions should also be complied with. Noise producing machinery and equipment should only be operated between the hours approved by Council.

All practicable measures should be taken to reduce the generation of noise and vibration to within acceptable limits. In the event that short-term noisy operations are necessary, and where these are likely to affect residences, notifications should be provided to the relevant authorities and the residents.

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[16] Australian Standard, (2002), *AS2460: Acoustics - Measurement of the Reverberation Time in Rooms.*

### 19.4 Dust Control Plan

All practicable measures should be taken to reduce dust emanating from the site. Factors that contribute to dust production are:

- Wind over a cleared surface;
- Wind over stockpiled material; and
- Movement of machinery in unpaved areas.

Visible dust should not be present at the site boundary. Measures to minimise the potential for dust generation include:

- Use of water sprays on unsealed or exposed soil surfaces;
- Covering of stockpiled materials and excavation faces (particularly during periods of site inactivity and/or during windy conditions) or alternatively the erection of hessian fences around stockpiled soil or large exposed areas of soil;
- Establishment of dust screens consisting of a 2m high shade cloth or similar material secured to a chain wire fence;
- Maintenance of dust control measures to keep the facilities in good operating condition;
- Concrete surfaces brushed or washed to remove dust;
- Stopping work during strong winds;
- Loading or unloading of dry soil as close as possible to stockpiles to prevent spreading of loose material around the site; and
- The expanse of cleared land should be kept to a minimum.

If stockpiles are to remain on-site or an excavation remains open for a period of longer than 3 days, dust monitoring should be undertaken at the site. If excessive dust is generated all site activities should cease until either wind conditions are more acceptable or a revised method of excavation and remediation is developed.

Dust is also produced during the transfer of material to and from the site. All material should be covered during transport and should be properly disposed of on delivery. No material is to be left in an exposed, un-monitored condition.

All equipment and machinery should be brushed or washed down before leaving the site to limit dust and sediment movement off-site. In the event of prolonged rain and lack of paved areas all vehicles should be washed down prior to exit from the site, and any soil or dirt on the wheels of the vehicles removed. Water used to clean the vehicles should be collected and tested prior to appropriate disposal under the Waste Classification Guidelines 2014.

## 19.5 Odour Control Plan

All activities undertaken at the site should be completed in a manner that minimises emissions of smoke, fumes and vapour into the atmosphere and any odours arising from the works or stockpiled material should be controlled. Control measures may include:

- Maintenance of construction equipment so that exhaust emissions comply with the Clean Air Regulations issued under the POEO Act 1997[17];
- Demolition materials and other combustible waste should not be burnt on site;
- The spraying of a solution of Biosolve™ or other appropriate product if required to suppress any odours that may be generated by excavated materials; and
- Use of protective covers (e.g. HDPE).

All practicable measures should be taken to reduce fugitive emissions emanating from the site so that associated odours do not constitute a nuisance and that the ambient air quality is not adversely impacted.

Disturbance of hydrocarbon contaminated soils may result in odorous conditions. The following odour management plan should be implemented to limit the exposure of site personnel and surrounding residents to unpleasant odours:

- Excavation and stockpiling of material should be scheduled during periods with low winds if possible;
- Biosolve or a similar product should be sprayed on material during excavation and following stockpiling to reduce odours;
- All complaints from workers and neighbours should be logged and a response provided. Work should be rescheduled as necessary to minimise odour problems;
- The site foreman should consider the following odour control measures as outlined in NEPM 2013:
  - ➢ reduce the exposed surface of the odorous materials;
  - ➢ time excavation activities to reduce off-site nuisance (particularly during strong winds); and
  - ➢ cover exposed excavation faces overnight or during periods of low excavation activity.
- If continued complaints are received, alternative odour management strategies should be considered and implemented.

## 19.6 Health and Safety Plan

A site specific work, health and safety (WHS) plan should be prepared by the contractor for all work to be undertaken at the site. The WHS plan should meet all the requirements outlined in NSW SafeWork WHS regulations.

All excavations should be clearly marked with coloured tape to reduce the risk to site personnel from injury by falling into open excavations.

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[17] NSW Government, (1997), *Protection of Environment Operations Act.* (referred to as POEO Act 1997)

Washroom and lunchroom facilities should also be provided to allow workers to remove potential contamination from their hands and clothing prior to eating or drinking.

### 19.7 Hours of Operation

Hours of operation should be between those approved by Council under the development approval process. Reference should also be made to any specific conditions imposed by other consent authorities.

# 20 CONCLUSION

EIS are of the opinion that the site can be made suitable for the proposed development provided the recommendations in this RAP are successfully implemented.

## 20.1 Regulatory Requirements

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

Table 20-1: Regulatory Requirements

| Guideline | Applicability |
|---|---|
| Duty to Report Contamination 2015[18] | At this stage, EIS consider that there is no requirement to notify the NSW EPA of the site contamination. After successful implementation of the RAP, the site contamination is unlikely to meet the Notification Triggers. |
| POEO Act 1997 | Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. |

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[18] NSW EPA, (2015), *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997.* (referred to as Duty to Report Contamination 2015)

## 21 LIMITATIONS

The report limitations are outlined below:

- EIS accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the EIS proposal; and terms of contract between EIS and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated in the report;
- EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- EIS accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- EIS have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or land use. EIS should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

# LIST OF IN-TEXT TABLES

# IMPORTANT INFORMATION ABOUT THIS REPORT

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

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

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

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

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

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

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

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

**Misinterpretation of Site Assessments by Design Professionals**

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

**Logs Should not be Separated from the Assessment Report**

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

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

**Read Responsibility Clauses Closely**

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

# SITE PHOTOGRAPHS

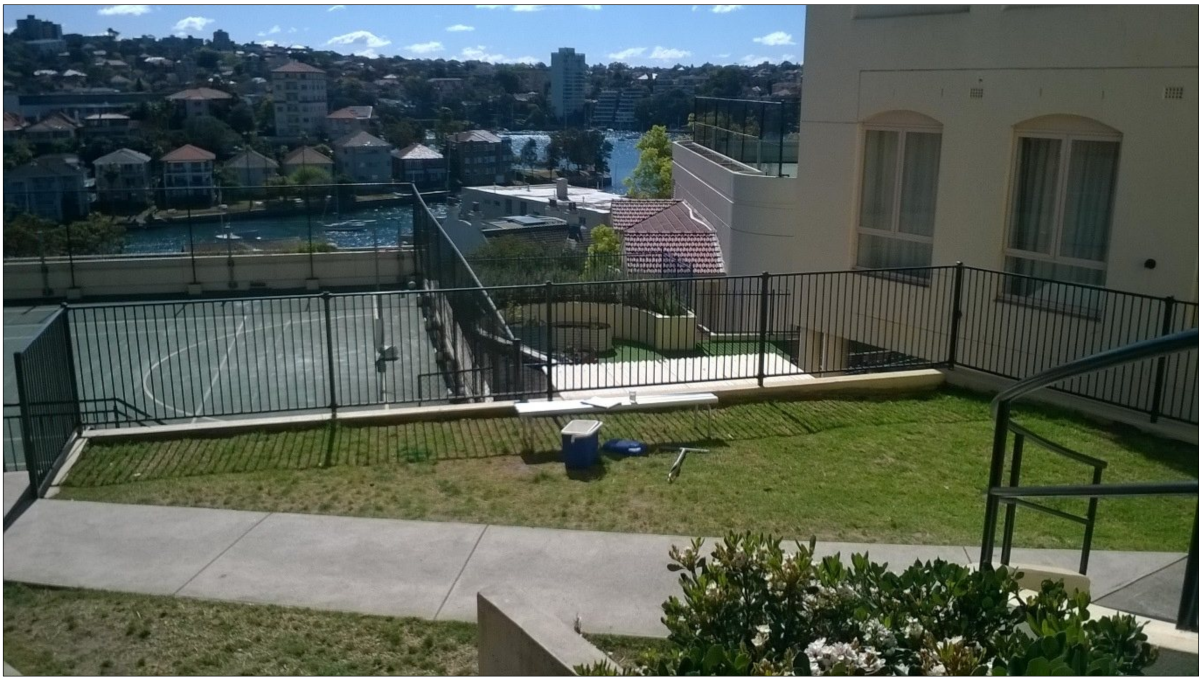


**Plate 1:** the location of BH4 between the Junior School and the Gymnasium.

**Plate 2:** the location of BH5 between the Marian Centre and B-Block.  BH2 and BH3 were drilled close to this area

**Plate 3:** the grassy area where BH6 and BH7 were located, viewed facing west with B-Block in the left of the photograph.

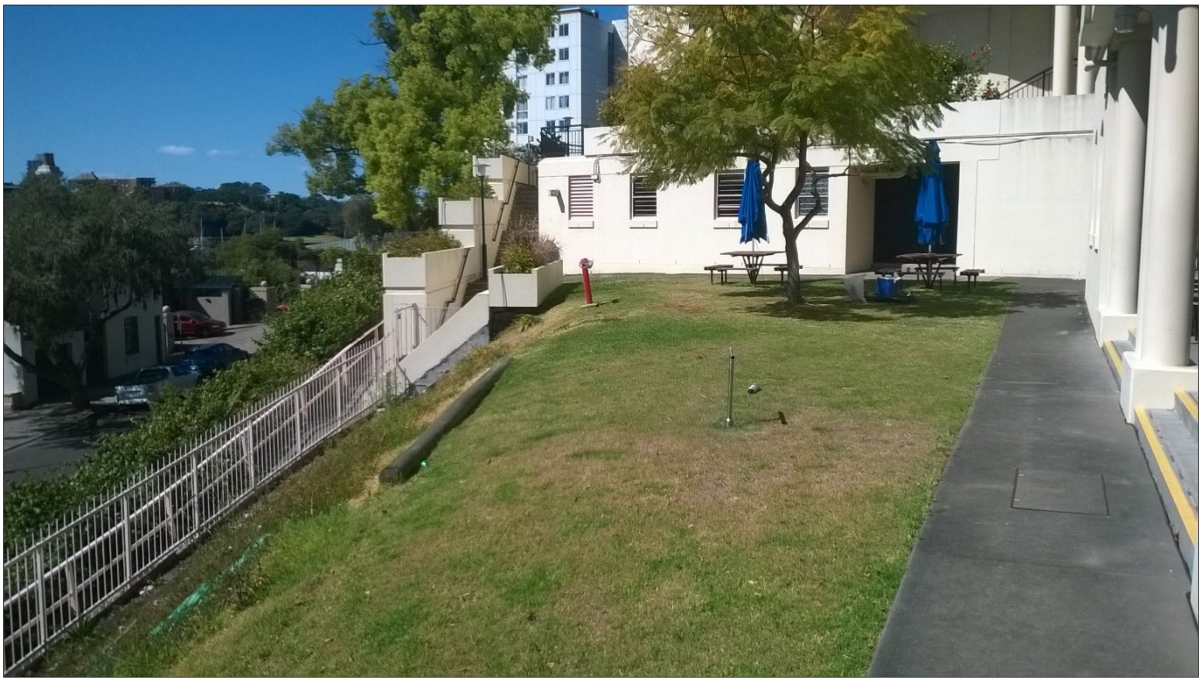
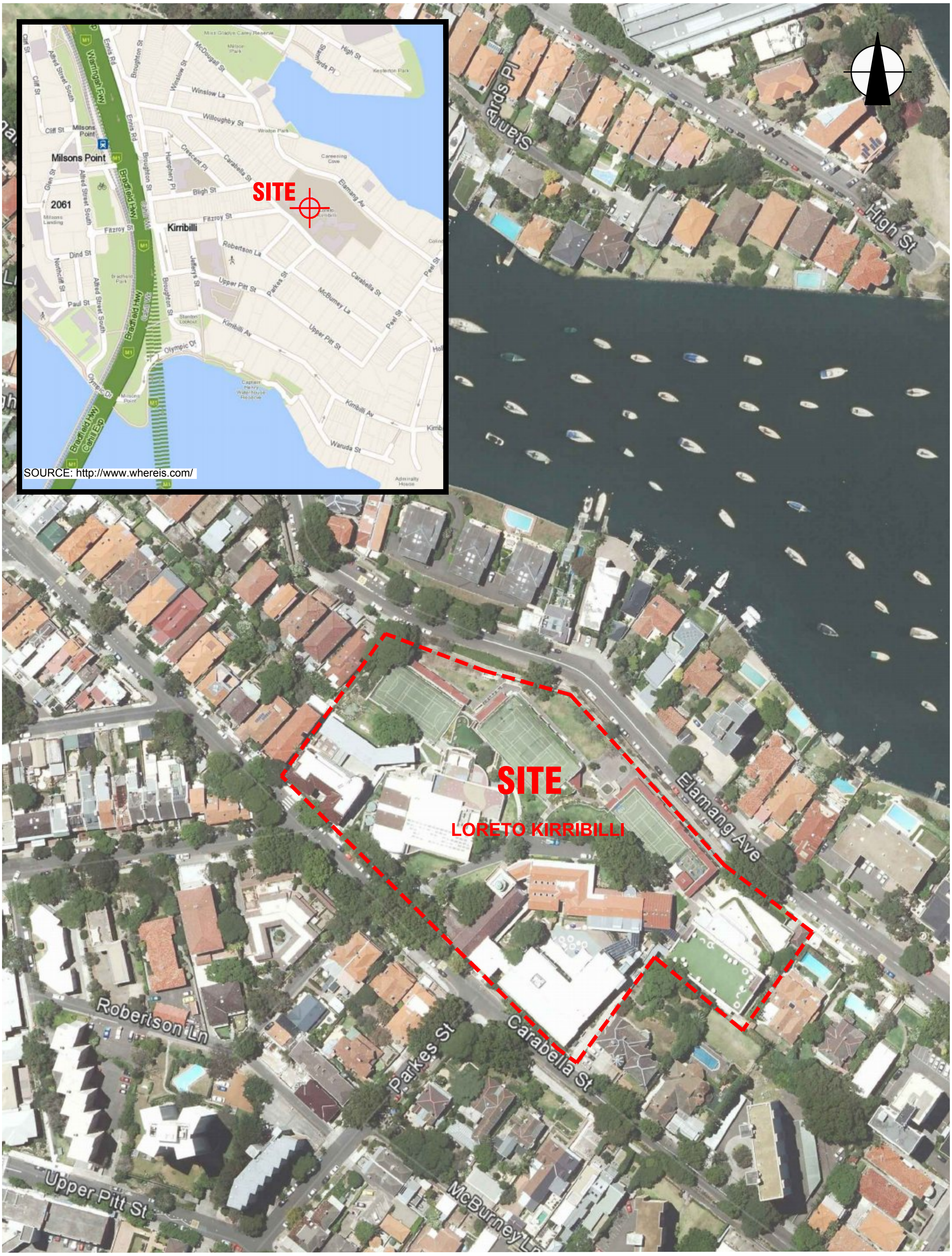


**Plate 4:** the grassy area where BH8 was located, viewed facing east with the Gymnasium in the right of the photograph and Centenary Hall in the background.

**Plate 5:** the fill mound located to the west of the Gymnasium, where BH9 was located.

**Plate 6:** the paved courtyard area where BH10 and BH11 were drilled. The safety cones show the location of BH11.

# REPORT FIGURES



SOURCE: http://www.whereis.com/

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.5.1557
AERIAL IMAGE ©: 2015 GOOGLE INC.

This plan should be read in conjunction with the EIS report.

Title:

## SITE LOCATION PLAN

Location: LORETO, 85 CARABELLA STREET
KIRRIBILLI, NSW

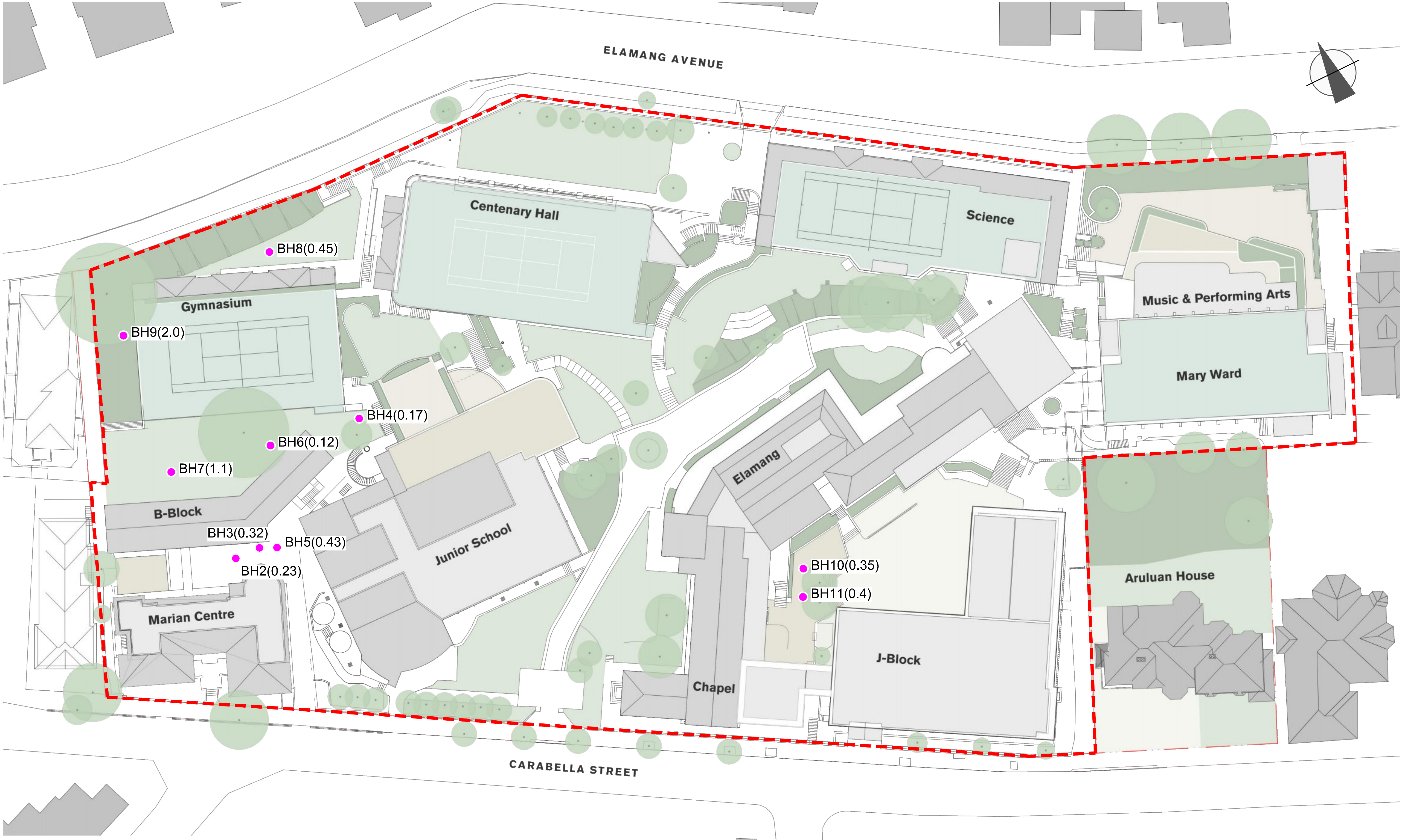
Report No: E30067KM

Figure No: 1

**ENVIRONMENTAL INVESTIGATION SERVICES**

EIS

PLOT DATE: 23/03/2017 11:37:41 AM DWG FILE: S:\5 EIS\5C EIS JOBS\30000'S\E30067KM KIRRIBILLI\CAD\E30067KM.DWG



LEGEND

| | |
|---|---|
| ▬ ▬ ▬ | APPROXIMATE SITE BOUNDARY |
| ● BH (Fill Depth) | BOREHOLE LOCATION, NUMBER AND<br>TERMINATION DEPTH OF BOREHOLE |

0 6 12 18 24 30

SCALE 1:600 @A3 METRES

This plan should be read in conjunction with the EIS report.

Title:

**SAMPLE LOCATION PLAN**

Location: LORETO, 85 CARABELLA STREET
KIRRIBILLI, NSW

Report No: E30067KM

Figure No: 2

**ENVIRONMENTAL INVESTIGATION SERVICES**

EIS

PLOT DATE: 21/09/2017 12:56:48 PM DWG FILE: S:\5 EIS\5C EIS JOBS\30000'S\E30067KM KIRRIBILLI\CAD\E30067KM.DWG

# LABORATORY SUMMARY TABLES

## TABLE A
## SOIL LABORATORY RESULTS COMPARED TO HILs
**All data in mg/kg unless stated otherwise**

| | | | HEAVY METALS | | | | | | | | | PAHs | | ORGANOCHLORINE PESTICIDES (OCPs) | | | | | | | OP PESTICIDES (OPPs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arsenic | Beryllium | Cadmium | Chromium VI [2] | Copper | Lead | Mercury | Nickel | Zinc | Total PAHs | B(a)P TEQ [3] | HCB | Endosulfan | Methoxychlor | Aldrin & Dieldrin | Chlordane | DDT, DDD & DDE | Heptachlor | Chlorpyrifos | TOTAL PCBs | ASBESTOS FIBRES |
| PQL - Envirolab Services | | | 4 | 1 | 0.4 | 1 | 1 | 1 | 0.1 | 1 | 1 | - | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 100 |
| Site Assessment Criteria (SAC) [1] | | | 100 | 60 | 20 | 100 | 6000 | 300 | 40 | 400 | 7400 | 300 | 3 | 10 | 270 | 300 | 6 | 50 | 240 | 6 | 160 | 1 | Detected/Not Detected |
| **Sample Reference** | **Sample Depth** | **Sample Description** | | | | | | | | | | | | | | | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | LPQL | NA | LPQL | 11 | 21 | **310** | LPQL | 5 | 50 | 4.1 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH3 | 0.15-0.26 | Fill: clayey sand | LPQL | NA | LPQL | 10 | 57 | 160 | 0.1 | 7 | 78 | 3 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH3 | 0.26-0.32 | Fill: clayey sand | LPQL | NA | LPQL | 15 | 14 | 210 | LPQL | 6 | 93 | 4.7 | 0.5 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH4 | 0.0-0.1 | Fill: silty sand | 4 | LPQL | LPQL | 7 | 29 | 42 | LPQL | 6 | 76 | 0.71 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | 5 | LPQL | LPQL | 16 | 33 | **310** | 0.5 | 7 | 140 | 8.3 | 1.1 | LPQL | LPQL | LPQL | LPQL | 0.2 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH6 | 0.0-0.1 | Fill: silty sand | 4 | LPQL | LPQL | 9 | 12 | 27 | LPQL | 6 | 44 | 1.1 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH7 | 0.0-0.1 | Fill: silty sand | 6 | LPQL | LPQL | 13 | 25 | 120 | 0.1 | 7 | 120 | 27 | **4.7** | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH7 | 0.3-0.5 | Fill: silty sand | 5 | LPQL | LPQL | 17 | 16 | 270 | 0.3 | 8 | 75 | 100 | **14** | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH7 | 0.9-1.1 | Fill: silty sand | 4 | LPQL | LPQL | 13 | 17 | **330** | 0.4 | 6 | 81 | 49 | **5.7** | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | 9 | 15 | 41 | 0.1 | 5 | 81 | 12 | 1.5 | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | 8 | LPQL | LPQL | 24 | 23 | 99 | 0.1 | 16 | 200 | 59 | **6.8** | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | 10 | LPQL | LPQL | 23 | 44 | 140 | 0.2 | 15 | 170 | 22 | 2.8 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | 6 | LPQL | LPQL | 9 | 15 | 110 | LPQL | 7 | 80 | **360** | **24** | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | 9 | 13 | 77 | 0.1 | 5 | 71 | 8.9 | 0.9 | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | LPQL | LPQL | LPQL | 8 | 19 | 61 | 0.1 | 8 | 79 | 7.6 | 0.9 | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH10 | 0.1-0.2 | Fill: silty sand | LPQL | LPQL | 1 | 27 | 130 | 200 | 0.9 | 19 | 560 | 5 | 0.8 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH10 | 0.25-0.35 | Fill: silty sand | LPQL | LPQL | 1 | 27 | 120 | 170 | 0.6 | 22 | 480 | 5.5 | 0.8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| BH11 | 0.1-0.2 | Fill: silty sand | 4 | LPQL | 1 | 47 | 190 | **490** | 1.4 | 17 | 480 | 9.6 | 1.2 | LPQL | LPQL | LPQL | 0.2 | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH11 | 0.3-0.4 | Fill: silty sand | 4 | LPQL | 4 | 59 | 170 | **580** | 1.4 | 19 | 520 | **350** | **30** | NA | NA | NA | NA | NA | NA | NA | NA | NA | Not detected |
| **Total Number of Samples** | | | 19 | 16 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 19 |
| **Maximum Value** | | | 10 | LPQL | 4 | 59 | 190 | 580 | 1.4 | 22 | 560 | 360 | 30 | LPQL | LPQL | LPQL | 0.2 | 0.2 | LPQL | LPQL | LPQL | LPQL | NC |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Statistical Analysis on Fill Samples** | | | | | | | | | | | | | | | | | | | | | | | |
| **Number of Fill Samples [4]** | | | NC | NC | NC | NC | NC | 19 | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **Mean Value [4]** | | | NC | NC | NC | NC | NC | 197 | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **Standard Deviation [4]** | | | NC | NC | NC | NC | NC | 152.7 | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **% UCL [4]** | | | NC | NC | NC | NC | NC | 95% | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| **UCL Value [4]** | | | NC | NC | NC | NC | NC | 258 | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |

**Explanation:**

1 - Site Assessment Criteria (SAC): NEPM 2013, HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

2 - The results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.

3 - B(a)P TEQ - Benzo(a)pyrene Toxicity Equivalence Quotient has been calculated based on 8 carcinogenic PAHs and their Toxic Equivalence Factors (TEFs) outlined in NEPM 2013

4 - Statistical calculation undertaken using ProUCL version 5.0 (USEPA). Statistical calculation has only been undertaken using data from fill samples

Concentration above the SAC **VALUE**

Standard deviation exceeds data assessment criteria VALUE

**Abbreviations:**

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OPP: Organophosphorus Pesticides
OCP: Organochlorine Pesticides
PCBs: Polychlorinated Biphenyls
UCL: Upper Level Confidence Limit on Mean Value
HILs: Health Investigation Levels
NA: Not Analysed
NC: Not Calculated
NSL: No Set Limit
SAC: Site Assessment Criteria
NEPM: National Environmental Protection Measure

## TABLE B
## SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

| | | | | | $C_6$-$C_{10}$ (F1) | >$C_{10}$-$C_{16}$ (F2) | Benzene | Toluene | Ethylbenzene | Xylenes | Naphthalene | PID [2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PQL - Envirolab Services | | | | | 25 | 50 | 0.2 | 0.5 | 1 | 3 | 1 | |
| HSL Land Use Category [1] | | | | | RESIDENTIAL WITH ACCESSIBLE SOIL | | | | | | | |
| **Sample Reference** | **Sample Depth** | **Sample Description** | **Depth Category** | **Soil Category** | | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH3 | 0.15-0.26 | Fill: clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH3 | 0.26-0.32 | Fill: clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH4 | 0.0-0.1 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH6 | 0.0-0.1 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH7 | 0.0-0.1 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH7 | 0.3-0.5 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH7 | 0.9-1.1 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | 0m to < 1m | Sand | LPQL | 76 | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | 1m to <2m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | 1m to <2m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH10 | 0.1-0.2 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH10 | 0.25-0.35 | Fill: silty sand | 0m to < 1m | Sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH11 | 0.1-0.2 | Fill: silty sand | 0m to < 1m | Sand | LPQL | 240 | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| BH11 | 0.3-0.4 | Fill: silty sand | 0m to < 1m | Sand | LPQL | 280 | LPQL | LPQL | LPQL | LPQL | LPQL | 0 |
| | | | | | | | | | | | | |
| **Total Number of Samples** | | | | | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| **Maximum Value** | | | | | LPQL | 280 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |

**Explanation:**

1 - Site Assessment Criteria (SAC): NEPM 2013
2 - Field PID values obtained during the investigation

Concentration above the SAC **VALUE**
The guideline corresponding to the elevated value is highlighted in grey in the Site Assessment Criteria Table below

**Abbreviations:**

| | | |
|---|---|---|
| UCL: Upper Level Confidence Limit on Mean Value | NC: Not Calculated | PQL: Practical Quantitation Limit |
| HSLs: Health Screening Levels | NL: Not Limiting | LPQL: Less than PQL |
| NA: Not Analysed | SAC: Site Assessment Criteria | NEPM: National Environmental Protection Measure |

SITE ASSESSMENT CRITERIA

| | | | | | $C_6$-$C_{10}$ (F1) | >$C_{10}$-$C_{16}$ (F2) | Benzene | Toluene | Ethylbenzene | Xylenes | Naphthalene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PQL - Envirolab Services | | | | | 25 | 50 | 0.2 | 0.5 | 1 | 3 | 1 |
| HSL Land Use Category [1] | | | | | RESIDENTIAL WITH ACCESSIBLE SOIL | | | | | | |
| **Sample Reference** | **Sample Depth** | **Sample Description** | **Depth Category** | **Soil Category** | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH3 | 0.15-0.26 | Fill: clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH3 | 0.26-0.32 | Fill: clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH4 | 0.0-0.1 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH6 | 0.0-0.1 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH7 | 0.0-0.1 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH7 | 0.3-0.5 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH7 | 0.9-1.1 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | 1m to <2m | Sand | 70 | 240 | 0.5 | 220 | NL | 60 | NL |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | 1m to <2m | Sand | 70 | 240 | 0.5 | 220 | NL | 60 | NL |
| BH10 | 0.1-0.2 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH10 | 0.25-0.35 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH11 | 0.1-0.2 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |
| BH11 | 0.3-0.4 | Fill: silty sand | 0m to < 1m | Sand | 45 | 110 | 0.5 | 160 | 55 | 40 | 3 |

### TABLE C
### SOIL LABORATORY RESULTS COMPARED TO EILs AND ESLs
**All data in mg/kg unless stated otherwise**

| Land Use Category [1] | | | | URBAN RESIDENTIAL AND PUBLIC OPEN SPACE | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | AGED HEAVY METALS-EILs | | | | | | EILs | | ESLs | | | | | | | | |
| | | | | pH | CEC ($cmol_c$/kg) | Clay Content (% clay) | Arsenic | Chromium | Copper | Lead | Nickel | Zinc | Naphthalene | DDT | $C_6$-$C_{10}$ (F1) | >$C_{10}$-$C_{16}$ (F2) | >$C_{16}$-$C_{34}$ (F3) | >$C_{34}$-$C_{40}$ (F4) | Benzene | Toluene | Ethylbenzene | Total Xylenes | B(a)P |
| PQL - Envirolab Services | | | | - | 1 | - | 4 | 1 | 1 | 1 | 1 | 1 | 0.1 | 0.1 | 25 | 50 | 100 | 100 | 0.2 | 0.5 | 1 | 3 | 0.05 |
| Ambient Background Concentration (ABC) [2] | | | | - | - | - | NSL | 13 | 28 | 163 | 5 | 122 | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL |
| **Sample Reference** | **Sample Depth** | **Sample Description** | **Soil Texture** | | | | | | | | | | | | | | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | Coarse | NA | NA | NA | LPQL | 11 | 21 | 310 | 5 | 50 | 0.1 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.2 |
| BH3 | 0.15-0.26 | Fill: clayey sand | Coarse | NA | NA | NA | LPQL | 10 | 57 | 160 | 7 | 78 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.2 |
| BH3 | 0.26-0.32 | Fill: clayey sand | Coarse | NA | NA | NA | LPQL | 15 | 14 | 210 | 6 | 93 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.4 |
| BH4 | 0.0-0.1 | Fill: silty sand | Coarse | NA | NA | NA | 4 | 7 | 29 | 42 | 6 | 76 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.09 |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | Coarse | NA | NA | NA | 5 | 16 | 33 | 310 | 7 | 140 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.84 |
| BH6 | 0.0-0.1 | Fill: silty sand | Coarse | NA | NA | NA | 4 | 9 | 12 | 27 | 6 | 44 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.1 |
| BH7 | 0.0-0.1 | Fill: silty sand | Coarse | NA | NA | NA | 6 | 13 | 25 | 120 | 7 | 120 | LPQL | NA | LPQL | LPQL | 150 | LPQL | LPQL | LPQL | LPQL | LPQL | 3.4 |
| BH7 | 0.3-0.5 | Fill: silty sand | Coarse | NA | NA | NA | 5 | 17 | 16 | 270 | 8 | 75 | 0.2 | NA | LPQL | LPQL | 400 | 110 | LPQL | LPQL | LPQL | LPQL | 9.3 |
| BH7 | 0.9-1.1 | Fill: silty sand | Coarse | NA | NA | NA | 4 | 13 | 17 | 330 | 6 | 81 | 0.2 | LPQL | LPQL | LPQL | 180 | LPQL | LPQL | LPQL | LPQL | LPQL | 4 |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | Coarse | NA | NA | NA | LPQL | 9 | 15 | 41 | 5 | 81 | 0.1 | NA | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.99 |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | Coarse | NA | NA | NA | 8 | 24 | 23 | 99 | 16 | 200 | 0.2 | NA | LPQL | LPQL | 260 | LPQL | LPQL | LPQL | LPQL | LPQL | 4.9 |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | Coarse | NA | NA | NA | 10 | 23 | 44 | 140 | 15 | 170 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 1.9 |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | Coarse | NA | NA | NA | 6 | 9 | 15 | 110 | 7 | 80 | 2.4 | LPQL | LPQL | 76 | 1500 | 240 | LPQL | LPQL | LPQL | LPQL | 14 |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | Coarse | NA | NA | NA | LPQL | 9 | 13 | 77 | 5 | 71 | LPQL | NA | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.68 |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | Coarse | NA | NA | NA | LPQL | 8 | 19 | 61 | 8 | 79 | LPQL | NA | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 0.69 |
| BH10 | 0.1-0.2 | Fill: silty sand | Coarse | NA | NA | NA | LPQL | 27 | 130 | 200 | 19 | 560 | LPQL | LPQL | LPQL | LPQL | 430 | 190 | LPQL | LPQL | LPQL | LPQL | 0.57 |
| BH10 | 0.25-0.35 | Fill: silty sand | Coarse | NA | NA | NA | LPQL | 27 | 120 | 170 | 22 | 480 | LPQL | NA | LPQL | LPQL | 290 | 140 | LPQL | LPQL | LPQL | LPQL | 0.57 |
| BH11 | 0.1-0.2 | Fill: silty sand | Coarse | NA | NA | NA | 4 | 47 | 190 | 490 | 17 | 480 | LPQL | LPQL | LPQL | 240 | 1700 | 620 | LPQL | LPQL | LPQL | LPQL | 0.87 |
| BH11 | 0.3-0.4 | Fill: silty sand | Coarse | NA | NA | NA | 4 | 59 | 170 | 580 | 19 | 520 | 3.2 | NA | LPQL | 280 | 3100 | 720 | LPQL | LPQL | LPQL | LPQL | 21 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Number of Samples** | | | | 0 | 0 | 0 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 11 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| **Maximum Value** | | | | LPQL | LPQL | LPQL | 10 | 59 | 190 | 580 | 22 | 560 | 3.2 | LPQL | LPQL | 280 | 3100 | 720 | LPQL | LPQL | LPQL | LPQL | 21 |

**Explanation:**

1 - Site Assessment Criteria (SAC): NEPM 2013

2 - ABC Values for selected metals has been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted)

Concentration above the SAC 🟩 VALUE

The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

**Abbreviations:**

| | | | |
|---|---|---|---|
| EILs: Ecological Investigation Levels | UCL: Upper Level Confidence Limit on Mean Value | LPQL: Less than PQL | NC: Not Calculated |
| B(a)P: Benzo(a)pyrene | ESLs: Ecological Screening Levels | SAC: Site Assessment Criteria | NSL: No Set Limit |
| PQL: Practical Quantitation Limit | NA: Not Analysed | NEPM: National Environmental Protection Measure | ABC: Ambient Background Concentration |

EIL AND ESL ASSESSMENT CRITERIA

| Land Use Category [1] | | | | URBAN RESIDENTIAL AND PUBLIC OPEN SPACE | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | AGED HEAVY METALS-EILs | | | | | | EILs | | ESLs | | | | | | | | |
| | | | | pH | CEC ($cmol_c$/kg) | Clay Content (% clay) | Arsenic | Chromium | Copper | Lead | Nickel | Zinc | Naphthalene | DDT | $C_6$-$C_{10}$ (F1) | >$C_{10}$-$C_{16}$ (F2) | >$C_{16}$-$C_{34}$ (F3) | >$C_{34}$-$C_{40}$ (F4) | Benzene | Toluene | Ethylbenzene | Total Xylenes | B(a)P |
| PQL - Envirolab Services | | | | - | 1 | - | 4 | 1 | 1 | 1 | 1 | 1 | 0.1 | 0.1 | 25 | 50 | 100 | 100 | 0.2 | 0.5 | 1 | 3 | 0.05 |
| Ambient Background Concentration (ABC) [2] | | | | - | - | - | NSL | 13 | 28 | 163 | 5 | 122 | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL | NSL |
| **Sample Reference** | **Sample Depth** | **Sample Description** | **Soil Texture** | | | | | | | | | | | | | | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH3 | 0.15-0.26 | Fill: clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH3 | 0.26-0.32 | Fill: clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH4 | 0.0-0.1 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH6 | 0.0-0.1 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH7 | 0.0-0.1 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH7 | 0.3-0.5 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH7 | 0.9-1.1 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH10 | 0.1-0.2 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH10 | 0.25-0.35 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH11 | 0.1-0.2 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | 180 | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |
| BH11 | 0.3-0.4 | Fill: silty sand | Coarse | NA | NA | NA | 100 | 203 | 88 | 1263 | 35 | 192 | 170 | -- | 180 | 120 | 300 | 2800 | 50 | 85 | 70 | 105 | 33 |

### TABLE D
### SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
**All data in mg/kg unless stated otherwise**

| | | | HEAVY METALS | | | | | | | | | PAHs | | OC/OP PESTICIDES | | | | Total PCBs | TRH | | | | | BTEX COMPOUNDS | | | | ASBESTOS FIBRES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arsenic | Beryllium | Cadmium | Chromium | Copper | Lead | Mercury | Nickel | Zinc | Total PAHs | B(a)P | Total Endosulfans | Chloropyrifos | Total Moderately Harmful [2] | Total Scheduled[3] | | $C_6$-$C_9$ | $C_{10}$-$C_{14}$ | $C_{15}$-$C_{28}$ | $C_{29}$-$C_{36}$ | Total $C_{10}$-$C_{36}$ | Benzene | Toluene | Ethyl benzene | Total Xylenes | |
| PQL - Envirolab Services | | | 4 | 1 | 0.4 | 1 | 1 | 1 | 0.1 | 1 | 1 | - | 0.05 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 25 | 50 | 100 | 100 | 250 | 0.2 | 0.5 | 1 | 3 | 100 |
| General Solid Waste CT1 [1] | | | 100 | 20 | 20 | 100 | NSL | 100 | 4 | 40 | NSL | 200 | 0.8 | 60 | 4 | 250 | <50 | <50 | 650 | NSL | | | 10,000 | 10 | 288 | 600 | 1,000 | - |
| General Solid Waste SCC1 [1] | | | 500 | 100 | 100 | 1900 | NSL | 1500 | 50 | 1050 | NSL | 200 | 10 | 108 | 7.5 | 250 | <50 | <50 | 650 | NSL | | | 10,000 | 18 | 518 | 1,080 | 1,800 | - |
| Restricted Solid Waste CT2 [1] | | | 400 | 80 | 80 | 400 | NSL | 400 | 16 | 160 | NSL | 800 | 3.2 | 240 | 16 | 1000 | <50 | <50 | 2600 | NSL | | | 40,000 | 40 | 1,152 | 2,400 | 4,000 | - |
| Restricted Solid Waste SCC2 [1] | | | 2000 | 400 | 400 | 7600 | NSL | 6000 | 200 | 4200 | NSL | 800 | 23 | 432 | 30 | 1000 | <50 | <50 | 2600 | NSL | | | 40,000 | 72 | 2,073 | 4,320 | 7,200 | - |
| **Sample Reference** | **Sample Depth** | **Sample Description** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | LPQL | NA | LPQL | 11 | 21 | **310** | LPQL | 5 | 50 | 4.1 | 0.2 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH3 | 0.15-0.26 | Fill: clayey sand | LPQL | NA | LPQL | 10 | 57 | **160** | 0.1 | 7 | 78 | 3 | 0.2 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH3 | 0.26-0.32 | Fill: clayey sand | LPQL | NA | LPQL | 15 | 14 | **210** | LPQL | 6 | 93 | 4.7 | 0.4 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH4 | 0.0-0.1 | Fill: silty sand | 4 | LPQL | LPQL | 7 | 29 | 42 | LPQL | 6 | 76 | 0.71 | 0.09 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | 5 | LPQL | LPQL | 16 | 33 | **310** | 0.5 | 7 | 140 | 8.3 | **0.84** | LPQL | LPQL | LPQL | 0.2 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH6 | 0.0-0.1 | Fill: silty sand | 4 | LPQL | LPQL | 9 | 12 | 27 | LPQL | 6 | 44 | 1.1 | 0.1 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH7 | 0.0-0.1 | Fill: silty sand | 6 | LPQL | LPQL | 13 | 25 | **120** | 0.1 | 7 | 120 | 27 | **3.4** | NA | NA | NA | NA | NA | LPQL | LPQL | LPQL | 110 | 110 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH7 | 0.3-0.5 | Fill: silty sand | 5 | LPQL | LPQL | 17 | 16 | **270** | 0.3 | 8 | 75 | 100 | **9.3** | NA | NA | NA | NA | NA | LPQL | LPQL | 270 | 190 | 460 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH7 | 0.9-1.1 | Fill: silty sand | 4 | LPQL | LPQL | 13 | 17 | **330** | 0.4 | 6 | 81 | 49 | **4** | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 120 | LPQL | 120 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | 9 | 15 | 41 | 0.1 | 5 | 81 | 12 | **0.99** | NA | NA | NA | NA | NA | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | 8 | LPQL | LPQL | 24 | 23 | 99 | 0.1 | 16 | 200 | 59 | **4.9** | NA | NA | NA | NA | NA | LPQL | LPQL | 180 | 120 | 300 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | 10 | LPQL | LPQL | 23 | 44 | **140** | 0.2 | 15 | 170 | 22 | **1.9** | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | 6 | LPQL | LPQL | 9 | 15 | **110** | LPQL | 7 | 80 | **360** | **14** | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 1100 | 480 | 1580 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | 9 | 13 | 77 | 0.1 | 5 | 71 | 8.9 | 0.68 | NA | NA | NA | NA | NA | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | LPQL | LPQL | LPQL | 8 | 19 | 61 | 0.1 | 8 | 79 | 7.6 | 0.69 | NA | NA | NA | NA | NA | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH10 | 0.1-0.2 | Fill: silty sand | LPQL | LPQL | 1 | 27 | 130 | **200** | 0.9 | 19 | 560 | 5 | 0.57 | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | 230 | 330 | 560 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH10 | 0.25-0.35 | Fill: silty sand | LPQL | LPQL | 1 | 27 | 120 | **170** | 0.6 | 22 | 480 | 5.5 | 0.57 | NA | NA | NA | NA | NA | LPQL | LPQL | 160 | 210 | 370 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH11 | 0.1-0.2 | Fill: silty sand | 4 | LPQL | 1 | 47 | 190 | **490** | 1.4 | 17 | 480 | 9.6 | **0.87** | LPQL | LPQL | LPQL | 0.2 | LPQL | LPQL | 200 | 1100 | 960 | 2260 | LPQL | LPQL | LPQL | LPQL | Not detected |
| BH11 | 0.3-0.4 | Fill: silty sand | 4 | LPQL | 4 | 59 | 170 | **580** | 1.4 | 19 | 520 | **350** | **21** | NA | NA | NA | NA | NA | LPQL | 170 | 2200 | 1400 | 3770 | LPQL | LPQL | LPQL | LPQL | Not detected |
| **Total Number of samples** | | | 19 | 16 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 11 | 11 | 11 | 11 | 11 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| **Maximum Value** | | | 10 | LPQL | 4 | 59 | 190 | 580 | 1.4 | 22 | 560 | 360 | 21 | LPQL | LPQL | LPQL | 0.2 | LPQL | LPQL | 200 | 2200 | 1400 | 3770 | LPQL | LPQL | LPQL | LPQL | NC |

**Explanation:**

[1] - NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014)

[2] - Assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion

[3] - Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde

| | |
|---|---|
| Concentration above the CT1 | 🟩 **VALUE** |
| Concentration above SCC1 | 🟧 **VALUE** |
| Concentration above the SCC2 | 🟥 **VALUE** |

**Abbreviations:**

| | | |
|---|---|---|
| PAHs: Polycyclic Aromatic Hydrocarbons | UCL: Upper Level Confidence Limit on Mean Value | CT: Contaminant Threshold |
| B(a)P: Benzo(a)pyrene | NA: Not Analysed | SCC: Specific Contaminant Concentration |
| PQL: Practical Quantitation Limit | NC: Not Calculated | HILs: Health Investigation Levels |
| LPQL: Less than PQL | NSL: No Set Limit | NEPM: National Environmental Protection Measure |
| PID: Photoionisation Detector | SAC: Site Assessment Criteria | BTEX: Monocyclic Aromatic Hydrocarbons |
| PCBs: Polychlorinated Biphenyls | TRH: Total Recoverable Hydrocarbons | |

## TABLE E
## SOIL LABORATORY TCLP RESULTS
**All data in mg/L unless stated otherwise**

| | | | Arsenic | Beryllium | Cadmium | Chromium | Lead | Mercury | Nickel | B(a)P |
|---|---|---|---|---|---|---|---|---|---|---|
| PQL - Envirolab Services | | | 0.05 | 0.01 | 0.01 | 0.01 | 0.03 | 0.0005 | 0.02 | 0.001 |
| TCLP1 - General Solid Waste [1] | | | 5 | 1 | 1 | 5 | 5 | 0.2 | 2 | 0.04 |
| TCLP2 - Restricted Solid Waste [1] | | | 20 | 4 | 4 | 20 | 20 | 0.8 | 8 | 0.16 |
| TCLP3 - Hazardous Waste [1] | | | >20 | >4 | >4 | >20 | >20 | >0.8 | >8 | >0.16 |
| **Sample Reference** | **Sample Depth** | **Sample Description** | | | | | | | | |
| BH2 | 0.17-0.23 | Fill: clayey sand | NA | NA | NA | NA | 1.4 | NA | NA | NA |
| BH3 | 0.15-0.26 | Fill: clayey sand | NA | NA | NA | NA | 0.38 | NA | NA | NA |
| BH3 | 0.26-0.32 | Fill: clayey sand | NA | NA | NA | NA | 0.63 | NA | NA | NA |
| BH4 | 0.0-0.1 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |
| BH5 | 0.2-0.4 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | 0.1 | LPQL | LPQL | LPQL |
| BH6 | 0.0-0.1 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |
| BH7 | 0.0-0.1 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | 0.07 | LPQL | LPQL | LPQL |
| BH7 | 0.3-0.5 | Fill: silty sand | 0.07 | LPQL | LPQL | LPQL | 0.92 | LPQL | LPQL | LPQL |
| BH7 | 0.9-1.1 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | 0.4 | LPQL | LPQL | LPQL |
| BH8 | 0.0-0.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |
| BH8 | 0.15-0.25 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | 0.06 | LPQL | LPQL | LPQL |
| BH8 | 0.35-0.45 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | 0.09 | LPQL | LPQL | LPQL |
| BH9 | 0.0-0.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | 0.07 | LPQL | LPQL | LPQL |
| BH9 | 1.0-1.1 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | 0.06 | LPQL | LPQL | LPQL |
| BH9 | 1.9-2.0 | Fill: silty clayey sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |
| BH10 | 0.1-0.2 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |
| BH10 | 0.25-0.35 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL | LPQL |
| BH11 | 0.1-0.2 | Fill: silty sand | LPQL | LPQL | LPQL | LPQL | 0.1 | LPQL | LPQL | LPQL |
| BH11 | 0.3-0.4 | Fill: silty sand | LPQL | LPQL | LPQL | 0.01 | 0.1 | LPQL | LPQL | LPQL |
| **Total Number of samples** | | | 16 | 16 | 16 | 16 | 19 | 16 | 16 | 16 |
| **Maximum Value** | | | 0.07 | LPQL | LPQL | 0.01 | 1.4 | LPQL | LPQL | LPQL |

**Explanation:**

1 - NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014)

| | |
|---|---|
| General Solid Waste | **VALUE** |
| Restricted Solid Waste | 🟧 **VALUE** |
| Hazardous Waste | 🟥 **VALUE** |

**Abbreviations:**

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