NSW Site Auditor Scheme

# Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

## Part I: Site audit identification

Site audit statement no. *JC-NSW26b*

This site audit is a:

☐ ~~statutory audit~~

☑ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

### Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name [redacted]

Company *Senversa Pty Ltd*

Address *Level 5, The Grafton Bond Building*

*201 Kent Street, Sydney NSW* Postcode: *2000*

Phone [redacted]

Email [redacted]

### Site details

Address: *IASB Addition, Randwick Campus Redevelopment Site, bound by*

*Hospital Road, Magill Street, Botany Street and Stage 2, Randwick* Postcode *2031*

## Property description

(Attach a separate list if several properties are included in the site audit.)

*Part Lots 6 to 11 on Deposited Plan 13995 and part Lot 1 on Deposited Plan 870720*

Local government area: *Randwick City Council*

Area of site (include units, e.g. hectares): *Approximately 2,000 square metres*

Current zoning: *'SP2 – Health Services Facility' under the Randwick LEP (2012).*

## Regulation and notification

To the best of my knowledge:

- ☐ ~~**the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985,* as follows: (provide the no. if applicable)~~
  - ☐ ~~Declaration no.~~
  - ☐ ~~Order no.~~
  - ☐ ~~Proposal no.~~
  - ☐ ~~Notice no.~~
- ☑ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

- ☐ ~~the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*~~
- ☑ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.

## Site audit commissioned by

[redacted]

Company: *Lendlease Building Pty Ltd*

Address: *Level 14, Tower Three, International Towers Sydney, 300 Barangaroo Avenue*

*Barangaroo, NSW* Postcode *2000*

Phone: [redacted]

Email: [redacted]

## Contact details for contact person (if different from above)

Name *As above*

Phone *As above*

Email *As above*

**Nature of statutory requirements** (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)

☐ Requirements imposed by an environmental planning instrument (please specify, including date of issue)

☐ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)

☐ Requirements under other legislation (please specify, including date of issue)

## Purpose of site audit

~~☐ **A1** To determine land use suitability~~

~~Intended uses of the land:~~

~~OR~~

~~**A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan~~

~~Intended uses of the land:~~

OR

(Tick all that apply)

☑ **B1** To determine the nature and extent of contamination

☑ **B2** To determine the appropriateness of:

~~☐ an investigation plan~~

☑ a remediation plan

~~☐ a management plan~~

~~☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

~~☐ **B4** To determine the compliance with an approved:~~

~~☐ **voluntary management proposal** or~~

~~☐ **management order** under the *Contaminated Land Management Act 1997*~~

☑ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land: *the development is proposed to include ten levels of primarily laboratory and research space as part of the Prince of Wales Hospital expansion, including landscaping and bulk excavation of Hospital Road.*

## Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

*Douglas Partners Pty Ltd*

Titles of reports reviewed:

1. *Douglas Partners (2018b). Report on Preliminary Site Investigation for Contamination: Randwick Campus Redevelopment, bound by Hospital Road, High, Magill and Botany Streets, Randwick. Referenced 72505.12.R.001.Rev2.PSI and dated 8 February 2018.*
2. *Douglas Partners (2019a). Report on Spoil Management Plan: Randwick Campus*

*Redevelopment, bound by High, Magill, Hospital and Botany Street, Randwick. Referenced 72505.15.R.005.DftB and dated 6 February 2019.*

3. *Douglas Partners (2019b). Sampling and Analysis Quality Plan for Data Gap and Waste Classification Investigation: Randwick Campus Redevelopment, bound by High, Magill, Hospital and Botany Street, Randwick. Referenced 72505.15.R.003.Rev0.Randwick SAQP and dated 11 February 2019.*
4. *Douglas Partners (2019c). Report on Detailed Site Investigation: Randwick Campus Redevelopment, bound by High, Magill, Hospital and Botany Street, Randwick. Referenced 72505.14.R.001.Rev2. and dated 21 February 2019.*
5. *Douglas Partners (2019d). Waste Classification Assessment Stockpile EE-SP1, Prince of Wales Hospital Redevelopment, Randwick Bounded by High, Magill, Botany Streets and Hospital, Randwick. Referenced 72505.15.R.013.Rev0 and dated 15 March 2019.*
6. *Douglas Partners (2019e). Report on Detailed Site Investigation, IASB Addition – Randwick Campus Redevelopment, Hospital Road, Randwick. Referenced 72505.16.R.001.Rev0 and dated 17 September 2019.*
7. *Douglas Partners (2019f). Remediation Action Plan: Randwick Campus Redevelopment, Stage 1 and IASB Addition, Botany and Magill Streets and Hospital Road, Randwick. Referenced 72505.14.R002.Rev9.RAP and dated 18 September 2019.*

Other information reviewed, including previous site audit reports and statements relating to the site:

1. *Randwick City Council (2012). Local Environmental Plan.*
2. *NSW EPA (2019a). 'List of Notified Sites 1 August 2019' accessed 11 August 2019.*
3. *NSW EPA (2019b). 'Contaminated Land Record' accessed 11 August 2019.*

## Site audit report details

Title: *IASB Addition, Randwick Campus Redevelopment, Hospital Road, Magill Street, Eurimbla Avenue and Botany Street, Randwick, NSW 2031*

*Report no.: S16895_SAR_JC-NSW26b_20September2019*

Date: *20 September 2019*

# Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
  - (B1) the nature and extent of contamination, and/or
  - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
  - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
  - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
  - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

## Section A1

**I certify that, in my opinion:**

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry
- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other (please specify):

_____

**OR**

- ☐ I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.

Overall comments:

_____

_____

_____

_____

_____

_____

## Section A2

### I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry
- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other (please specify):

_____

### EMP details

Title _____

Author _____

Date _____ No. of pages _____

### EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

- ☐ requires operation and/or maintenance of **active** control systems[3]
- ☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

~~Purpose of the EMP:~~

~~Description of the nature of the residual contamination:~~

~~Summary of the actions required by the EMP:~~

~~How the EMP can reasonably be made to be legally enforceable:~~

~~How there will be appropriate public notification:~~

~~Overall comments:~~

## Section B

Purpose of the plan[4] which is the subject of this audit:

*Remedial Action Plan, Douglas Partners (2019f) – to remediate the IASB Addition site and make it suitable for, primarily laboratory and research space as part of the Prince of Wales Hospital expansion, including landscaping and bulk excavation of Hospital Road.*

### I certify that, in my opinion:

(B1)

☑ The nature and extent of the contamination **has** been appropriately determined

~~☐ The nature and extent of the contamination **has not** been appropriately determined~~

AND/OR (B2)

☑ The ~~investigation,~~ remediation ~~or management~~ plan (*Douglas Partners, 2019f*) **is** appropriate for the purpose stated above

~~☐ The investigation, remediation or management plan **is not** appropriate for the purpose stated above~~

~~AND/OR (B3)~~

~~☐ The site testing plan:~~

~~☐ **is** appropriate to determine~~

~~☐ **is not** appropriate to determine~~

~~if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

~~AND/OR (B4)~~

~~☐ The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):~~

~~☐ **have** been complied with~~

~~☐ **have not** been complied with.~~

~~*voluntary management proposal no.~~

~~**management order no.~~

AND/OR (B5)

☑ The site **can be made suitable** for the following uses:

~~(Tick all appropriate uses and strike out those not applicable.)~~

~~☐ Residential, including substantial vegetable garden and poultry~~

~~☐ Residential, including substantial vegetable garden, excluding poultry~~

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

- ~~❑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ~~❑ Day care centre, preschool, primary school~~
- ~~❑ Residential with minimal opportunity for soil access, including units~~
- ~~❑ Secondary school~~
- ~~❑ Park, recreational open space, playing field~~
- ~~❑ Commercial/industrial~~
- ☑ Other (please specify): Primarily laboratory and research space as part of the Prince of Wales Hospital expansion, including landscaping and bulk excavation of Hospital Road.

IF the site is remediated~~/managed*~~ in accordance with the following plan (**attached**):

Plan title: *Remediation Action Plan: Randwick Campus Redevelopment, Stage 1 and IASB Addition, Botany and Magill Streets and Hospital Road, Randwick.*

*Referenced 72505.14.R002.Rev9.RAP*

Plan author: *Douglas Partners*

Plan date: *18 September 2019* No. of pages: 111

SUBJECT to compliance with the following condition(s):

1. *The auditor should be provided with the Groundwater Management Plan for review, once completed.*
2. *Following execution of the RAP a suitably qualified consultant should produce a Remediation Validation Report for the auditor's approval. A Site Audit Report and section A Site Audit Statement must then be produced prior to issuance of any occupation certificate.*
3. *If any asbestos containing material (or other significant contamination) is to be retained on-site at concentrations above the screening criteria, the auditor must be informed prior to placement and details forwarded for review, an EMP should be prepared for auditor approval prior to any material retention. The auditor would discuss the acceptability and legal enforceability of the EMP with the relevant authorities prior to issuing a site audit statement.*

Overall comments:

*The auditor notes that the southern boundary of the IASB Addition footprint has not been definitively described at this time. The boundary appears differently on the Douglas Partners drawings and the development plan (SYD180227). However, this is not considered to be a significant issue at this stage in the audit given that the investigations completed around the southern portion of the IASB Addition covered the area in question. This discrepancy will have to be clarified before remediation commences such that the eventuating Section A Site Audit Statement and Site Audit Report address the appropriate site area. The Remediation Action Plan (Douglas Partners, 2019f) is appended to this site audit statement.*

# Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no. *0801*

**I certify that:**

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed 

Date *20 September 2019*

# Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

## How to complete this form

### Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

### Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

### Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

### Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

*Environmental management plan*

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

*Active or passive control systems*

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

*Auditor's comments*

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

## Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

### Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

## Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

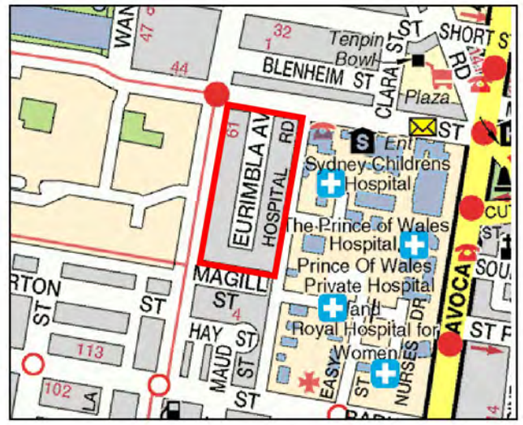
- the **NSW Environment Protection Authority**: nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND

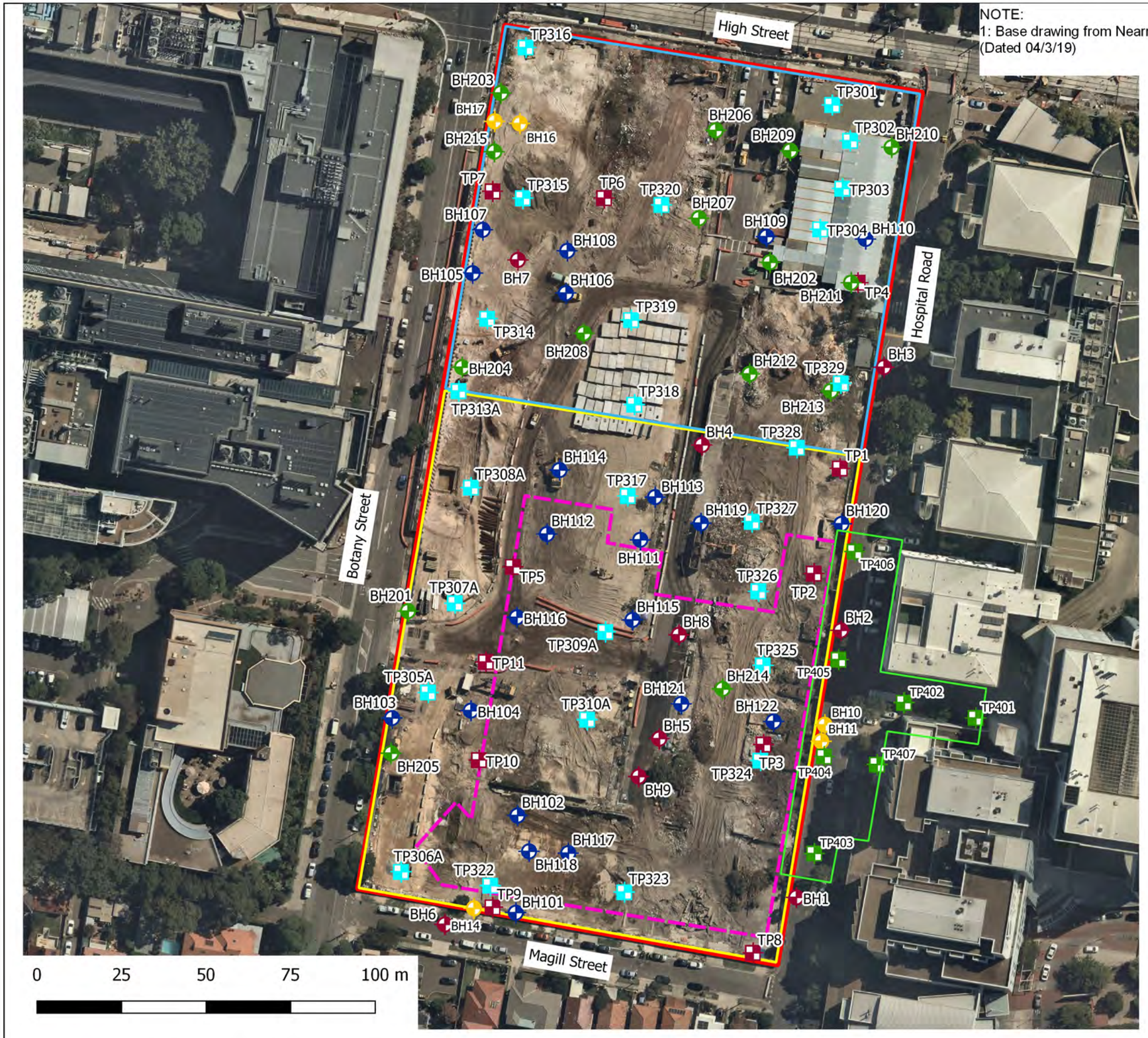
- the **local council** for the land which is the subject of the audit.

## Appendix A: Site Plans

NOTE:
1: Base drawing from Nearmap.com
(Dated 04/3/19)




**Locality Plan**




## Legend

- RCR Project Area Boundary
- Acute Services Building
- IASB Addition Boundary
- Stage 1 Boundary
- Stage 2 Boundary

Test Locations

- Post Demolition Test Pit (Current Investigation)
- DP Borehole Location (June, 2018)
- DP Borehole Location (Oct. 2017)
- DP Environmental Borehole (Jan. 2018)
- DP Test Pit Location (Aug. 2018)
- IASB Addition Test Pits (Aug. 2019)
- Existing Groundwater Wells

Douglas Partners
Geotechnics / Environment / Groundwater

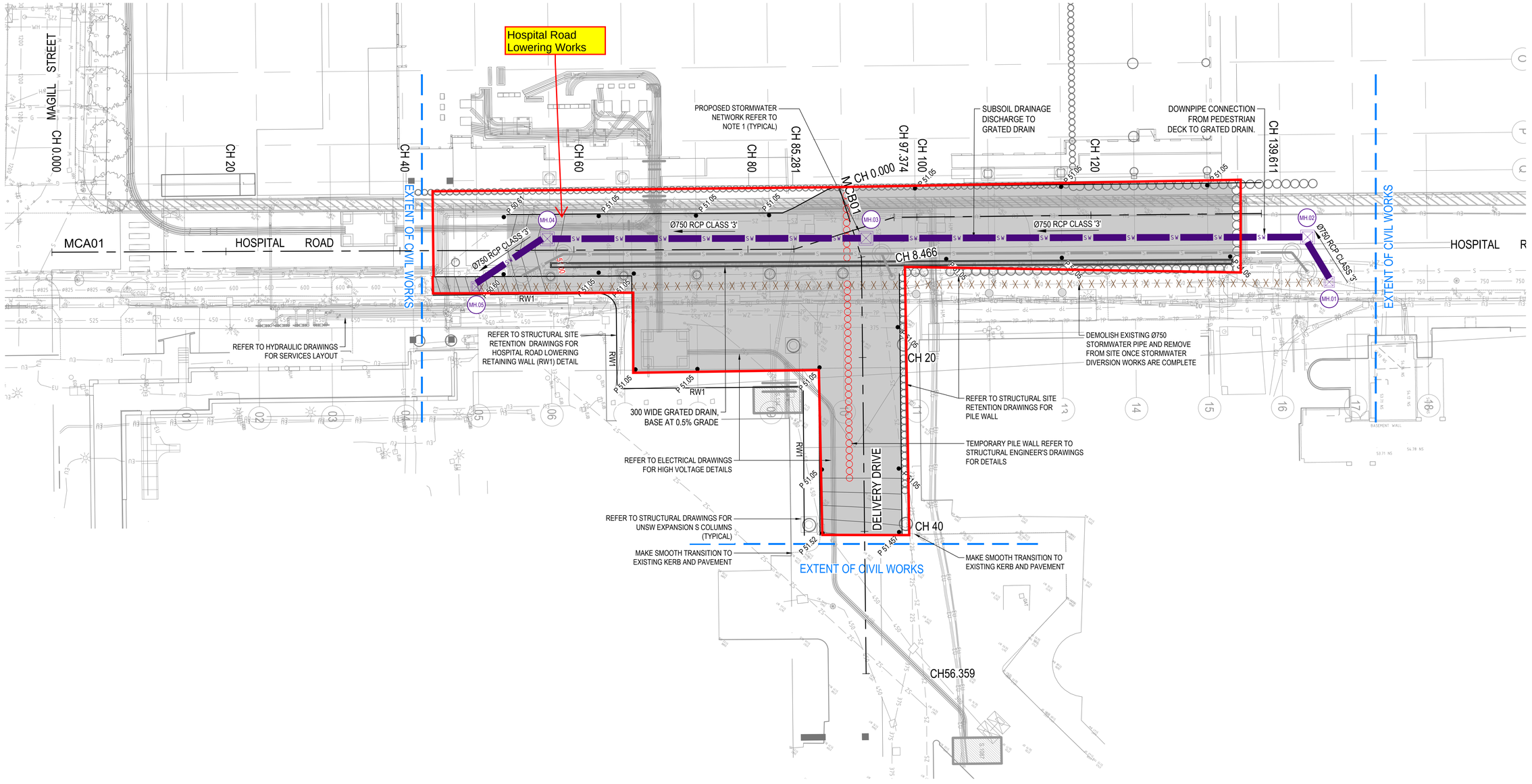
| | | | |
|---|---|---|---|
| CLIENT: | Lend Lease Building Pty Ltd | | |
| OFFICE: | Sydney | DRAWN BY: | AD |
| SCALE: | As shown | DATE: | 4/9/2019 |

TITLE: **Sample Locations**
**Randwick Campus Redevelopment**
**Randwick, NSW**

| | |
|---|---|
| PROJECT No: | 72505.14 |
| DRAWING No: | 1 |
| REVISION: | 0 |

## NOTE

1. REFER TO STORMWATER STANDARD DETAILS DRAWING RCR-ACR-CV-00-DWG-00-602 AND STORMWATER LONGSECTION AND PIT SCHEDULE DRAWING RCR-ACR-CV-00-DWG-00-950.




CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

CONSULTANT

[redacted]

NOTE
CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

| ISSUE | DATE | FOR |
|---|---|---|
| A | 23.11.18 | SCHEMATIC DESIGN |
| B | 20.12.18 | ISSUE FOR PRICING |
| C | 15.05.19 | DRAFT SSDA |
| D | 04.07.19 | ISSUE FOR SSDA |
| E | 11.09.19 | ISSUE FOR COORDINATION |

[redacted]

ELECTRICAL [redacted]
DON

[redacted]

CLIENT

NSW GOVERNMENT Health Infrastructure

PROJECT
HOSPITAL ROAD
LOWERING
RANDWICK NSW AUSTRALIA

ACOR PROJECT NUMBER
SY180053

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

SCALE
1:200 [redacted] DO NOT SCALE

STATUS
DESIGN

DRAWING
GENERAL ARRANGEMENT
SHEET 1

| DRAWING NUMBER | ISSUE |
|---|---|
| RCR-ACR-CV-00-DWG-00-101 | E |

## Appendix B: Remediation Action Plan (Douglas Partners, 2019f)

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

# Remediation Action Plan

Randwick Campus Redevelopment
Stage 1 and IASB Addition
Botany and Magill Streets, and Hospital Road,
Randwick

Prepared for
LendLease Building Pty Limited

Project 72505.14
September 2019

Douglas Partners
Geotechnics / Environment / Groundwater

## Document History

Document details

| | | | |
|---|---|---|---|
| Project No. | 72505.14 | Document No. | R.002.Rev9 |
| Document title | Remediation Action Plan<br>Randwick Campus Redevelopment | | |
| Site address | Botany Street, Magill Street, and Hospital Road, Randwick | | |
| Report prepared for | LendLease Building Pty Limited | | |
| File name | 72505.14.R.002.Rev9.RAP | | |

Document status and review

| Status | Prepared by | Reviewed by | Date issued |
|---|---|---|---|
| Revision 1 | Paula Maurici | Paul Gorman | 20 November 2018 |
| Revision 2 | Paula Maurici | Paul Gorman | 22 February 2019 |
| Revision 3 | Paula Maurici | Paul Gorman | 26 February 2019 |
| Revision 4 | Paula Maurici | Paul Gorman | 27 February 2019 |
| Revision 5 | Paula Maurici | Paul Gorman | 7 August 2019 |
| Revision 6 | Paula Maurici | Paul Gorman | 15 August 2019 |
| Revision 7 | Paula Maurici | Paul Gorman | 4 September 2019 |
| Revision 8 | Paula Maurici | Paul Gorman | 17 September 2019 |
| Revision 9 | Paula Maurici | Paul Gorman | 17 September 2019 |

Distribution of copies

| Status | Electronic | [redacted] | [redacted] |
|---|---|---|---|
| [redacted] | [redacted] | [redacted] | Danny Finn, LendLease Building Pty Limited |
| Revision 2 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |
| Revision 3 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |
| Revision 4 | 1 | 0 | Dan[redacted] Finn, LendLease Building Pty Limited |
| Revision 5 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |
| Revision 6 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |
| Revision 7 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |
| Revision 8 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |
| Revision 9 | 1 | 0 | Danny Finn, LendLease Building Pty Limited |

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

| | Signature | Date |
|---|---|---|
| Author | | 18 September 2019 |
| Reviewer | P. Gorman | 18 September 2019 |

bsi. ISO 9001 Quality Management
FS 604853

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# Table of Contents

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# Remediation Action Plan
# Randwick Campus Redevelopment – Stage 1 and IASB Addition
# Botany and Magill Streets, and Hospital Road, Randwick

## 1. Introduction

Douglas Partners Pty Ltd (DP) was commissioned by LendLease Building Pty Ltd to prepare a remediation action plan (RAP) for the Randwick Campus Redevelopment (RCR) project – Stage 1 and IASB Addition, bound by Hospital Road, Botany Street and Magill Street (as shown on Drawing 1, Appendix A – labelled "Stage 1 Boundary" and "IASB Addition Boundary"). The RAP was prepared in accordance with DP's initial proposal SYD180227 dated 4 June 2018, and subsequent proposal SYD181172 dated 18 January 2019.

It is understood that the RCR project will be undertaken in two stages (Stage 1 and Stage 2). Stage 1 is proposed to include development of a new multi-storey Acute Services Building (ASB) with associated landscaping. The core elements of the IASB Addition include the University of New South Wales (UNSW) Eastern Extension (base building only), associated modifications within the ASB, lowering of Hospital Road and Delivery Drive, and limited landscaping. Further details of the proposed development are provided in Section 4.

At the time of preparing this RAP, the development details associated with Stage 2 of the campus redevelopment (refer Drawing 1, Appendix A – labelled "Stage 2 Boundary") were not finalised. As such, this RAP focusses on the Stage 1 and IASB Addition works only, as detailed in the State Significant Development applications. Remediation requirements for Stage 2 will need to be documented in a separate RAP once the development details are known.

For ease of reference, from herein the terms "site" refers to the combined Stage 1 and IASB Addition, whilst the whole of the RCR project is referred to as "RCR Project Area".

The site is being audited by Jason Clay, a NSW Environment Protection Authority (EPA) accredited site auditor. It is understood that this RAP will be used to facilitate the issue of a site audit statement (SAS) Part B, confirming the Stage 1 and IASB Addition areas can be made suitable for the proposed development.

In the preparation of this RAP, reference has been made to the following guidelines:

- National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (as amended in 2013), (NEPC, 2013);
- NSW EPA, *Sampling Design Guidelines* (EPA, 1995);
- NSW OEH, *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011);
- NSW EPA (2017) *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* 3rd Edition (EPA, 2017);

- NSW EPA *Waste Classification Guidelines, Part 1: Classifying Waste* (EPA, 2014a);
- NSW EPA *Waste Classification Guidelines Part 2: Immobilisation of Waste* (EPA, 2014b);
- State Environmental Planning Policy 55 (SEPP55) - Remediation of Land; and
- WA DOH (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*.

The overall objective of the remediation programme outlined in the RAP is to render the site suitable, from a contamination perspective, for the proposed development. The objectives of the RAP are listed in Section 2.

# 2. Scope of Works

The scope of the RAP has been established on the basis of the findings of the previous investigations, site observations and proposed development details.

The objective of the RAP is to remove and/or to mitigate associated risks of potential environmental and human health impacts posed by identified contamination and contamination uncovered during earthworks (as unexpected finds) such that the site can be rendered suitable for the proposed development.

In this regard, the objectives of this RAP are to:

- Establish an appropriate remedial strategy so as to render the site suitable, from a contamination perspective, for the proposed development;
- Establish the remediation acceptance criteria to be adopted for the remediation of the site and the validation requirements to verify the successful implementation of the remediation strategy;
- Establish appropriate environmental safeguards required to complete the remediation works in an environmentally acceptable manner;
- Establish appropriate occupational, health and safety (OH&S) procedures required to complete the remediation works in a manner that would not pose a threat to the health of site workers or users; and
- Establish a framework to minimise environmental risk on the site and the surrounding environment.

# 3. Site Information

## 3.1 Site Identification

The site is located approximately 7 km southeast of the Sydney CBD (Drawing 1, Appendix A). The site is bordered by the remainder of the RCR Development Area to the north, Hospital Road and the existing hospital to the east, Magill Street to the south and Botany Street to the west. Eurimbla Avenue

runs through the centre of Stage 1 of the site, extending north through the remainder of the RCR Development Area to High Street.

To the east of Hospital Road is the existing Randwick Hospital Campus (the Hospital), currently occupied by numerous multi-storey buildings, a number of car parks, and open space and courtyard areas. Buildings across the Hospital include the Sydney Children's Hospital and Ronald McDonald House, The Prince of Wales Public and Private Hospitals including patient wings, operating theatres and palliative care, and campus services such as staff residences, ambulance station, and childcare facilities. The existing hospital occupies a total area of approximately 13.5 hectares (ha).

General site information is provided in Table 1 below.

**Table 1: General Site Information**

| Item | Description |
|---|---|
| Site Name/ Occupier: | Health Infrastructure |
| Site Address | Bordered by Hospital Road and the existing hospital to the east, Magill Street to the south and Botany Street to the west. Eurimbla Avenue runs through the centre of the site (Drawing 1, Appendix A). |

| Item | Description |
|---|---|
| Deposited Plans | Refer Drawing U1-XX-03, Appendix B for Stage 1 lots.<br>Lot 35 DP7745; Lot 1 DP12909; Lot 2 DP12909; Lot A P102029 Lot B DP102029; Lot B DP303478; Lot A DP303478; Lot D DP304806; Lot C DP304806; Lot B DP304806; Lot A DP304806<br>Lot 1 DP13995; Lot 2 DP13995; Lot 3 DP13995; Lot 4 DP13995; Lot 5 DP13995; Lot 6 DP13995; Lot 7 DP13995; Lot 8 DP13995; Lot 9 DP13995; Lot 10 DP13995; Lot 11 DP13995; Lot 12 DP13995; Lot Y DP445567; Lot X DP445567; Lot A DP439756; Lot B DP439756; Lot 1 DP300666; Lot 32 DP667518; Lot 3 P667518; Lot 4 DP667518; Lot 5 DP667518; Lot 6 DP667518; Lot 7 DP667518; Lot 4 DP667518; Lot 9 DP667518; Lot 10 DP667518; Lot 11 DP667518; Lot 12 DP667518; Lot 13 P667518; Lot 14 DP667518; Lot B DP6441943; Lot A P6441943; Lot 1 DP1182570; Lot 2 DP1182570; Lot 23A P434935; Lot 23B DP434935; Lot 1 DP522586; Lot 2 DP522586; Lot 1 DP501682; Lot 2 DP501682; Lot 3 DP513339; Lot 4 DP513339; Lot 19 DP7745; Lot 18 DP7745; Lot 11 DP806091; Lot 1 DP74860; Lot 7 DP 975640; Lot 1 DP307266; Lot 12 DP806091; Lot 1 DP11351; Lot 2 DP11351; Lot 3 DP11351; Lot 1 DP590480; Lot 2 DP590480; Lot A DP440501; Lot B DP440501; Lot C DP440501; Lot D DP440501; Lot 1 DP13997; Lot 2 DP13997; Lot 3 DP13997; Lot 4 DP13997; Lot 5 DP13997; Lot 6 DP13997; Lot 7 DP13997; Lot A DP167106; Lot B DP167106; Lot C DP167106; Lot D DP167106; Lot A DP33161; Lot B DP33161; Lot C DP33161; Lot D DP33161; Lot E DP33161; Lot F DP33161; Lot 1 DP741639; Lot 2 DP1134643; Lot A DP439101; Lot B DP439101; Lot 3 DP302329.<br>The IASB Addition covers part Lots 6-11 DP 13995 and part Lot 1 DP870720 (Prince of Wales Hospitals Campus), Hospital Road, Randwick. |
| Geographical Co-ordinates (SSD Area (Stage 1), refer Drawing RCR-BVN-ARC-00-DRW-01A-NL00011B, Appendix B)) | NW corner 336970.92 m E, 6245569.83 m S<br>NE corner 337087.17 m E, 6245551.42 m S<br>SW corner 336949.89 m E, 6245437.09 m S<br>SE corner 337066.14 m E, 6245418.68 m S<br>IASB Addition Coordinates not shown. |
| Local Government Authority | Randwick City Council |
| County/Parish | Parish of Alexandria and the County of Cumberland |
| Total Site Area | Approximately 2.1 ha |
| Current Zoning (Stage 1) | R2 – Low density residential; and<br>R3 – Medium density residential |

| Item | Description |
|---|---|
| Current Zoning (IASB Addition) | SP2 – Health Services Facility |
| Recent Site Use | Stage 1 - Multiple single dwelling urban residential allotments, undergoing demolition and early civil works at the time of preparing this RAP.<br>IASB Addition – Existing Hospital Road, part existing hospital buildings and car parking spaces. |
| Proposed Future Land Use | Acute Services Buildings (part of the existing hospital expansion).<br>IASB Addition (part of the hospital redevelopment) |

The land uses surrounding the site include:

- *North* – The remainder of the RCR Development Area, currently occupied by some remaining dwellings (in the process of demolition), some vacant lots where demolition has been completed, and the site compound in the north east corner;
- *East* – Hospital Road and Randwick Hospital (described above) followed by Avoca Street located to the east. Beyond this is open space parkland, located at the junction of Avoca Street and Belmore Road. Residential properties are also located to the east of Avoca Street. Further east is Brigidine College, comprising a number of multi-storey buildings and open space areas;
- *South* – Magill Street located to the south of the site is predominantly residential; and
- *West* – Botany Street is located to the west followed by the University of NSW, Biomedical Campus which has been the subject of previous investigations by DP and was previously part of the larger university site which had previously been quarried for igneous clays from a dyke/ diatreme previously identified at the site. The quarry was subsequently backfilled. The historical aerial photographs indicated that the quarry/landfill extends beyond the boundary of the current development. Following completion of quarrying (to depths of approximately 4.5 m to 9.0 m based on field observations), the area appears to have been backfilled in an uncontrolled manner and has since been used for internal roadways and parking by the university. To DP's knowledge, the quarry was backfilled with inert solid wastes and soil, with variable anthropogenics. There were no known organics buried in the quarry. As such, the backfilled quarry is not considered to be a source of hazardous ground gases.

## 3.2 Topography, Geology and Hydrogeology

Reference to the Sydney 1:250,000 Series Geological Sheet indicates that the Randwick area is located mainly on Quaternary aged alluvium, gravel, sand silt and clay, with some areas also being located on Triassic aged Hawkesbury Sandstone, comprising sandstone and quartz with some shale.

The Tasman Sea lies to the east of the site. Eastlakes and Mill Pond lie to the south west of the site, leading into Botany Bay. The anticipated groundwater flow direction from the site, on this basis, is west to south west. However, previous investigations by DP in the vicinity of the site suggest that a south-easterly groundwater flow direction is also possible.

Drillers logs supplied indicated that the lithology across the area was generally comprised of topsoil or fill, followed by either sand or clay, and sandstone. Coffee rock and peat was noted at some locations. DP has previously undertaken works on the adjacent UNSW site to the west. The general finding close to the site is that the depth to rock varied from 0.7 m to >5 m bgl. While no free groundwater was observed in these bores, DP expects that this observation may be dependent on the drilling method used during fieldwork.

A groundwater bore search of the Department of Water and Energy website database (previously held by the Department of Natural Resources) was conducted on 11 September 2017. Forty-seven groundwater bores were located within a 1 km radius of the site. The bores were used for monitoring, remediation, recreation, domestic, commercial, and industrial. The standing water levels for the majority of groundwater wells were found to range from 2.5 to 5 metres below ground level (bgl), with measurements of 8.6,10, 16.5, 20 and 27 m bgl also recorded.

In the investigation conducted by DP in the Randwick Hospital site to the east, groundwater was observed at depths of 3.7 m (RL 40.5 m) and 4.7 m (RL 44.4 m) in two boreholes. No groundwater was observed during auger drilling in the remaining boreholes. The use of water for rock coring purposes precluded any further observation of groundwater.

Measured groundwater levels in wells installed previously by DP, in relation to the RCR Development Area, showed groundwater levels generally between 3 m and 6 m bgl. In relation to the site, the following groundwater levels were measured in the wells:

| | |
|---|---|
| Topographic up-gradient of Stage 1: | BH202 – 4 m bgl; BH204 – 6 m bgl; |
| Topographic cross gradient of Stage 1: | BH11 – 5.2 m bgl; and |
| Topographic down-gradient of Stage 1: | BH14 – 3.5 m bgl. |

The groundwater flow direction at the site (and the RCR Development Area) is generally towards the south.

## 3.3 Site Description

At the time of conducting the initial investigations in 2017, then in 2018, the RCR Development Area comprised a collection of about 92 urban residential properties and a public road (Eurimbla Avenue), part of which is shown on Drawing 1, Appendix A.

As of early 2019, the RCR Development Area has undergone significant demolition works with the majority of the low-density residential houses in the area being demolished and removed. All previous residents within the site have relocated and the entire RCR Development Area declared a construction area.

At the time of preparing this report, several parts of the RCR Development Area had been stripped of surface soils for waste classification and disposal, and the site compound was under construction in the north-eastern portion of the site.

At the time of preparing this report, the site was similarly largely cleared of former structures, with some demolition continuing on the eastern side, and Eurimbla Avenue still intact.

The IASB Addition area had not been subject to any changes under the redevelopment at the time of preparing this report. The area comprised part of Hospital Road, portions of several existing hospital buildings, car parking spaces and landscaping, as shown on the aerial photograph base of Drawing 1, Appendix A.

## 4. Proposed Development

It is understood that the proposed Randwick Campus Redevelopment will include:

**Stage 1 (State Significant Development):**

- A new multi-storey ASB within Stage 1, with two basement levels (Level 02 extending to RL 47 m), requiring excavations to depths of around 8 m. The outline of the proposed building and basement is shown on Drawing RCR-ENS-STR-50-DRW-002, Appendix B; and
- Surrounding the building will be pedestrian footpaths and general landscaping, as shown on Drawing 01A-NL00013 in Appendix B.

**IASB Addition:**

The core elements of the IASB Addition are as follows:

- University of New South Wales (UNSW) Eastern Extension (base building only);
- Associated modifications within the ASB;
- Lowering of Hospital Road; and
- Landscaping.

**Stage 2:**

It is understood that a future expansion area, located immediately north of the proposed ASB site and extending up to High Street (Stage 2), is also being considered. No details of this future development are known at this stage. However, it is likely that the future development may include multi-storey buildings, new internal roads and utilities. It is also understood that the north-western part of Stage 2 is likely to be utilised for educational purposes (UNSW) whist the north east portion is likely to include a hospital expansion.

## 5. Review of Previous Reports

Previous reports reviewed as part of this RAP include:

- Douglas Partners *Report on Preliminary Geotechnical Investigation, Randwick Campus Redevelopment* Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Health Infrastructure, Project 72505.11 dated February 2018 (DP, 2018a);

- Douglas Partners *Report on Preliminary Site Investigation for Contamination, Randwick Campus Redevelopment,* Hospital Road and High, Magill and Botany Streets, Randwick, Project 72505.12.R.001.Rev2 dated February 2018 (DP, 2018b);
- Douglas Partners *Report on Supplementary Geotechnical Investigation*, Randwick Campus Redevelopment Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Lendlease Building Pty Ltd Project 72505.13 dated June, 2018 (DP, 2018c);
- Douglas Partners *Groundwater Monitoring Round 2,* Randwick Campus Redevelopment Project No. 72505.13 R.002.Rev0 dated 20 June 2018 (DP, 2018d);
- Douglas Partners *Sampling and Analysis Quality Plan (SAQP)*, Randwick Campus Redevelopment Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Lendlease Building Pty Ltd Project 72505.15 dated February, 2019 (DP, 2019a);
- Douglas Partners *Spoil Management Plan*, Randwick Campus Redevelopment Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Lendlease Building Pty Ltd Project 72505.15 dated February, 2019 (DP, 2019b);
- Douglas Partners *Report on Detailed Site Investigation for Contamination, Randwick Campus Redevelopment,* Hospital Road and High, Magill and Botany Streets, Randwick, Project 72505.14.R.001.Revision 2 dated February 2019 (DP, 2019c);
- Douglas Partners *Report on Detailed Site Investigation, IASB Addition - Randwick Campus Redevelopment, Hospital Road, Randwick* Project 72505.16.R.001.DftA dated 4 September 2019 (DP, 2019d)*;* and
- Various Hazardous Building Materials reports prepared by Property Risk Australia.

## 5.1 DP, 2018a

A preliminary geotechnical investigation was undertaken by DP in February 2018 and included the drilling of nine boreholes, installation of one groundwater monitoring well and laboratory testing for geotechnical purposes. The geotechnical investigation was conducted in conjunction DP (2018b).

## 5.2 DP, 2018b

DP (2018b) was carried for the RCR Development Area (referred to as *the site* in this section only).

DP undertook a preliminary site investigation (PSI) which included a review of site history information, a site walkover, intrusive investigation, laboratory analysis and reporting. Due to access restrictions, it was not possible to complete all proposed bore locations.

Aerials photographs from 1943 to 2014 were reviewed to provide an indication of past land uses and identify possible sources of contamination. The review indicated that the residential properties along Eurimbla Ave, Botany Street and Hospital Road were built during or prior to 1943, with little change observed over the years. In 1991, a number of properties on the site were extended to the rear, with more extensions observed in the 2000 aerial. The overall layout however remained much the same as in previous years.

With regards to the surrounding land, in the 1943 aerial, residential properties were evident to the north and south of the site. To the west, the UNSW site appeared to be vacant, and the large quarried areas to the west of Botany Street appeared to have been filled. To the east, parts of the hospital site were undeveloped. In 1955, an increased density of housing was observed to the south of the site, and construction works were noted within the UNSW site in 1961. Over the years 1970 to 2014, further commercial/ industrial development was evident throughout the surrounding subdivision, notably the continued development of the hospital and UNSW sites.

A historical title deeds search was conducted on selected lots within the site, which were selected based on having potential for commercial / retail land use. Records dating as far back as 1910 indicated that the potential land activities were predominately residential, with some commercial / medical, education and health institution land use.

A number of state and local heritage items were listed in the vicinity of the site, the closest being:

- The Cotswold, late Victorian cottage – 50 m South of the site; and
- Blenheim House and outbuilding - 82 m North East of the site.

The closest dry cleaners and motor garages, considered to be high risk in terms of contamination were more than 180 m from the site, and therefore were not considered to be a source of contamination to the site.

A search of the NSW EPA website on 5 October 2018 indicated that:

- No notices or orders made under the CLM Act have been issued for the site or adjacent properties; and
- No licences under Schedule 1 of the POEO Act have been issued for the site or adjacent properties.

Full access was not possible to the various residences at the time of the DP (2018b) investigation; therefore, observations were limited to the property exteriors from street view. The walkover was undertaken by a DP environmental scientist on 10 October 2017. In summary, the properties were mainly single storey with a few double storey and bungalow-style properties. The structures were generally constructed of brick / rendered brick with terracotta roofing. Possible fibro eaves / fibro carport were observed in some properties. A commercial-style building with aluminium roofing and consolidated commercial medical rooms (orthodontics) were also noted during the walkover.

Intrusive investigations as part of DP (2018b) were undertaken in two stages. The initial fieldwork (undertaken in September and October 2017) in conjunction DP 2018a and as such, the bore locations were positioned primarily for geotechnical investigation purposes in areas where access was available. A total of seven boreholes (BH1 to BH7) were drilled in the initial round, with one of the bores (BH7) converted into a groundwater monitoring well. Bores were drilled to depths of between 16 m and 20.5 m bgl using a bobcat-mounted or truck- mounted drilling rig using solid flight auger and rotary drilling. Bores were located within the existing roads, except BH7 which was drilled within a residential property and a groundwater sample was taken and analysed.

A second round of fieldwork was undertaken on 9 – 11 January 2018 and involved hand augering of 22 boreholes (BH101 to BH122) across 11 properties. Two boreholes were augured at each property,

one in the front yard and one in the backyard, to depths of 1.5 m or the top of natural. In addition, two boreholes (BH8 and BH9) were drilled and sampled.

The following exceedances were registered:

*Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TPH were below laboratory limits of reporting (LOR) for all soil samples. Metal concentrations were either less than the LOR and/or less than the adopted SAC with the exception of:*

- *Nickel in BH3/0.1-0.2 (79 mg/kg) and BH110/0-0.2 (26 mg/kg) which exceeded the EIL for commercial industrial (10mg/kg) and residential/open space (9 mg/kg);*
- *Copper in BH102/0-0.3 m (83 mg/kg) and BH112/0-0.2 (110 mg/kg) which exceeded the EIL for commercial industrial (80mg/kg) and residential/open space (65 mg/kg); and*
- *Zinc in BH104/0-0.3 (250 mg/kg), BH105/ 0.5-0.7 (310 mg/kg), BH111/0-0.2 (390 mg/kg), BH115/0.5-0.7 (310 mg/kg) and BH118/0.5-0.6 (510 mg/kg) which exceeded the EIL for residential/open space (240 mg/kg) and/or commercial / industrial (300 mg/kg).*

*A number of exceedances of ESL were noted for B(a)P in samples BH102/0-0,3, BH103/0-0.3, BH105/0.3-0.5, BH105/0.5-0.7, BH106/0-0.2, BH106/0.5-0.7, BH107/0-0.2, BH108/0-0.2, BH109/0-0.2, BH110/0-0.2, BH111/0-0.2, BH113/0.5-0.7, BH114/0.5-0.7, BH115/0.5-0.7, BH116/0-0.2.*

*There was also an exceedance of BaP TEQ in sample BH111 (8.197 mg/kg) which exceeded the HIL B (4 mg/kg) and HIL C (3 mg/kg).*

*Exceedances were noted for various contaminants in the roadbase sample taken from BH4/0.07-0.15 (noted as having a strong hydrocarbon odour) and BH8/0.4-0.5. Exceedances included:*

- *Copper – 100 mg/kg in BH4 exceeded EILs for commercial / industrial (80 mg/kg) and residential/open space (65 mg/kg);*
- *TRH C10-C16 – 1700 mg/kg in BH8 exceeded management limits (1000 mg/kg);*
- *TRH C16-C34 – 6600 mg/kg in BH4 and 11,000 mg/kg in BH8 exceeded ESLs for urban residential (300 mg/kg) and industrial / commercial (1700 mg/kg) and management limits (10000 mg/kg);*
- *TRH F2-naphthalene – 170 mg/kg in BH4 and 1600 mg/kg in BH8 exceeded NEPM (2013) Table 1A(3) Res A/B Soil HSL for vapour intrusion, Sand (0-1m) (110 mg/kg) and NEPM (2013) Table 1B(6) ESLs for Urban Res, Coarse Soil (120 mg/kg);*
- *Benzo(a)pyrene – 57 mg/kg in BH4 exceeded ESLs for urban residential (0.7 mg/kg) and industrial / commercial (1.4 mg/kg);*
- *Total PAH – 740 mg/kg in BH4 exceeded the HIL B (400 mg/kg) and HIL C (300 mg/kg); and*
- *Carcinogenic PAH – 77 mg/kg in BH4 exceeded HIL B (4 mg/kg), HIL C (3 mg/kg) and HIL D (40 mg/kg), Naphthalene of 150 mg/kg in BH8 exceeded the HSL A & B – vapour intrusion (3 mg/kg).*

*The fragment of fibreboard discovered during hand-augering in BH106 was analysed and Chrysotile asbestos was confirmed in laboratory testing to be present in this material.*

Based on the desktop study, field and analytical results reported in DP (2018b), it was considered that the site in general has a low potential for contamination with respect to the proposed hospital development.

DP (2018b) recommended the following:

- Further testing on properties located within the site and owned by Health Infrastructure and/or UNSW to determine if there are any hazardous substances which may influence waste classification (explosives, gases, flammable solids, oxidising agents, organic peroxides, toxic substances or corrosive substances);
- Pre-demolition hazardous building materials survey of the building structures which comprise the site. It is noted that many of the premises appear to contain some asbestos and other hazardous materials;
- Post demolition clearance for surface asbestos containing materials (ACM) by an experienced occupational hygienist;
- Additional soil and groundwater sampling and testing across the site to more thoroughly:
  - Assess the presence of complete source-pathway-receptor linkages under the CSM;
  - Assess the suitability of any fill/natural material to remain under the proposed development. DP notes the majority of the fill at the site will be removed during excavation works to reach final levels;
  - To remain under the proposed development;
  - Determine the need for any soil or groundwater remediation; and
  - Assess the re-use potential and/or waste classification of roadbase, filling and natural soils.

Apart from additional groundwater monitoring bores, DP (2018b) recommended that the post-demolition investigations be undertaken using test pits rather than bores to enable a more thorough visual assessment of the potential for the existence and spread of asbestos impact in the soils.

All bore locations referred to above are shown on Drawing 1, Appendix A.

### 5.3 DP, 2018c

DP (2018c) was carried for the RCR Development Area (referred to as *the site* in this section only).

The geotechnical investigation included a desktop study, drilling of 16 boreholes across the site (where access was readily available to drilling rigs) and installation of 11 groundwater monitoring wells to monitor the groundwater levels, permeability tests in soil and rock, and laboratory tests for geotechnical purposes.

No environmental sampling was undertaken as part of this investigation.

All bore locations referred to above are shown on Drawing 1, Appendix A.

## 5.4 DP, 2018d

The results of the groundwater levels obtained from the dataloggers between 1 May 2018 and 17 June 2018 were provided in this report, together with a plot of daily rainfall records. No environmental sampling was undertaken as part of this investigation.

## 5.5 DP, 2019a

DP (2019a) was carried for the RCR Development Area (referred to as *the site* in this section only).

A *Sampling, Analysis and Quality Plan (SAQP)* was issued to document the sampling and testing protocols to address the data gaps identified in the PSI and early version of the DSI (Rev0). In addition, the SAQP outlines a progressive waste classification process for soils to be removed from the site, the assessment of virgin excavated natural material (VENM), the assessment of road materials in Eurimbla Avenue, and the assessment of imported materials.

The SAQP reconsidered the proposed land use scenarios (i.e. hospital and education) and adopted site assessment criteria comprising:

- Health Investigation Levels – Residential B;
- Health screening levels– Residential B and Intrusive Maintenance Worker;
- Ecological Investigation Levels Ecological Screening Levels for urban residential / public open space; and
- Management Limits for residential / public open space.

These site assessment criteria are provided in Section 8.

## 5.6 DP, 2019b

DP (2019b) was carried for the RCR Development Area (referred to as *the site* in this section only).

A *Spoil Management Plan* was prepared by DP to address the following objectives:

- Document the protocol for finds of asbestos in or on soil;
- Document the protocol for when soils showing signs of other forms of contamination are identified;
- Provide the inspection, sampling and laboratory testing requirements to determine the waste classification of soil for off-site disposal as well as to assess for potential re-use of soil at the site from a contamination perspective; and
- List control measures to be employed to minimise environmental effects from spoil management.

The protocols outlined in DP (2019d) have largely been adopted in this RAP.

## 5.7 DP, 2019c

DP (2019c) was carried for the RCR Development Area (referred to as *the site* in this section only).

Intrusive investigations were undertaken in various stages throughout 2018 and 2019. Earlier versions of the DSI report have not been reviewed as the Updated DSI dated February 2019 is a compendium of the previous versions.
Table A of NSW EPA (1995) *Sampling Design Guidelines* recommends a minimum of 43 sampling points for a site of 3.3 ha for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern. This updated DSI report provides the results for DP investigations including 82 sample locations across the site viz:

- DP (2018a): BH1 to BH9 – 9 boreholes;
- DP (2018a): BH101 to BH122 – 22 boreholes;
- DP (2018b): BH201, BH205 to BH215 – 12 boreholes;
- DP (2018b): BH202, BH204 (hand augers) – two boreholes;
- DP (2018b): TP1 to TP11 – 11 test pits; and
- DP (2019): BH301- TP304, BH305A- TP310A, TP313A, TP314, TP314A, TP315-TP320, TP322-TP329 - 26 test pits.

In addition, an assessment of compliance of the asphalt and road base in Eurimbla Avenue, with the recovered aggregate order 2014. Ten test pits (EA1 to EA10) were excavated into Eurimbla Avenue for that purposes.

The subsurface profile encountered in the bores and test pits across the site (excluding Eurimbla Avenue) are summarised below:

- PAVEMENT/SLAB: A 30 – 70 mm thick asphaltic concrete surfacing overlying roadbase gravel to depths of between 0.2 m and 0.4 m was encountered in BH1 to BH6, BH8 and BH9. In the current investigation, brick pavement was encountered in BH201, and concrete pavers/slab was observed in BH202, BH204, BH205, BH208, BH212, BH214 and TP3 to depths of up to 0.1 m;
- FILLING: (topsoil): dark brown, fine to medium slightly silty sand topsoil was encountered in BH101, BH113, BH121, BH207, BH209, TP1- TP3 and TP7 to depths of between 0.05 m and 0.3 m; In some test pits (TP301-304) this dark grey sand filling contained sandstone boulders, terracotta, glass, brick fragments and some slag and tile fragments;

  FILLING: Sandy filling with fine to medium gravel and trace of rootlets was encountered in BH101 to BH122 and TP1 to TP11, to depths of between 0.2 m and 1.4 m. Sandy filling and/or ripped sandstone was encountered in BH1 to BH9 to depths of between 0.2 m and 2.3 m. Sandy filling was observed in all boreholes at depths of up to 1.0 m in June/August 2018 investigations. A trace of charcoal, clinker/slag was observed in BH201, BH213 and TP10, and anthropogenic material including brick, terracotta and glass fragments, metal sheeting, and asphaltic gravels were noted in BH201, BH202, BH205, BH207 to BH209, BH211, TP1, TP4, TP6, TP8, TP9, TP301-TP304. Two distinct sandy fill layers were observed in BH201, BH202, BH207 to BH209, and BH215;
- SAND: In DP (2018), fine to medium dense yellow sand was encountered in all boreholes and test pits. Clayey sand was encountered in BH117 and BH118 at depths of 1.4 m and 1.0 m

respectively. Dense clayey sand or possibly extremely low strength sandstone was encountered in BH6 below a depth of 5.2 m. A 0.5 m thick band of stiff silty clay/clay was encountered in BH9 below a depth of 5.5 m. In the current investigation, sand varying from grey/brown and yellow, fine to medium grained, was encountered in BH201 - BH207, BH209 – BH215 at depths of 0.35 to 4.7 m. A trace of charcoal was observed in BH211. Sandy silt/silty sand with a trace of charcoal was observed in BH207 and BH208 at depths of 0.9 m and 0.7 m, respectively, to borehole termination; and

- BEDROCK: In boreholes BH1 to BH9, the top of bedrock ranged between depths of 1.5 m (RL 53.1 m) and 6.9 m (RL 40.7 m). The upper rock profile included variably extremely low to low strength sandstone. More consistent medium and high strength sandstone was encountered in all boreholes at depths ranging between 3.9 m (RL 44.6 m) and 8.8 m (RL 38.8 m). Some very low and low strength siltstone and laminite bands were interbedded within the sandstone in BH1, BH2, BH5, BH6, BH8 and BH9. The rock discontinuities were predominantly along bedding planes dipping between 0° and 20° below the horizontal with the occasional rock joint dipping between 30° and 70°. In the current investigation, very low to low strength sandstone was encountered in BH202 and BH204 at depths of 3.0 m and 4.7 m, respectively, to borehole termination.

***Field Observations***

- Individual suspected asbestos containing material (ACM) fragments were located in BH106, TP 315, 318, 326, 329 at a depth of 0.0 – 0.2 m and TP10 at a depth of 0.0 - 0.1 m. Additionally, ACM was observed in TP9 and TP319 at a depth of 0.4 - 0.5 m. The locations where ACM was located either through visual observation or during sieving of 10L samples is indicated on Drawing 2 (Appendix A);
- The recovered potential ACM fragments and additional 500ml soil samples from each of the locations were sent to the laboratory for analysis for ACM and Asbestos Fines (AF) and Fibrous Asbestos (FA). Chrysotile asbestos was confirmed in laboratory testing to be present in the material collected from BH106, whilst chrysotile, amosite and crocidolite were detected in the fragments collected from TP9 and TP10;
- Surficial ACM was observed at multiple locations in between test locations as indicated on Drawing 2 (Appendix A);
- All PID readings were <3 ppm; and
- Refusal was met at BH 120 due to limited access to soil.

***Soil***

Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TPH were below laboratory limits of reporting (LOR) for all soil samples. Metal concentrations were either less than the laboratory limit of reporting LOR and/or less than the adopted SAC with the exception of:

- Nickel in BH3/0.1-0.2 (79 mg/kg) and BH110/0-0.2 (26 mg/kg) which exceeded the EIL for residential/open space (9 mg/kg);
- Copper in BH208/0.3-0.4 (85 mg/kg), BH102/0-0.3 m (83 mg/kg) and BH112/0-0.2 (110 mg/kg) which exceeded the EIL for residential/open space (65 mg/kg);

- Zinc in BH213/0.1-0.2 (300 mg/kg), BH104/0-0.3 (250 mg/kg), BH105/ 0.5-0.7 (310 mg/kg), BH111/0-0.2 (390 mg/kg), BH115/0.5-0.7 (310 mg/kg) and BH118/0.5-0.6 (510 mg/kg) which exceeded the EIL for residential/open space (240 mg/kg);
- Lead in TP9/0-0.1 (890 mg/kg) which exceeded the HIL for residential (600 mg/kg); and
- PCB in BH206 (1.6 mg/kg) which exceeded the HIL B (1 mg/kg).

A number of exceedances of ESL (urban residential) (0.7 mg/kg) were noted including:

- B(a)P in samples TP302/0.5-0.6, TP309A/0.0-0.2, TP309A/0.5-0.0.6, TP315/0.0-0.2, TP315/1.0-1.1, TP318/0.0-0.2, TP319/0.0-0.2. TP319/0.4-0.0.5, BH201/0.2-0.3, BH202/0.3-0.4, BH205/0.1-0.2, BH206/0.3-0.4, BH207/0.1-0.2, BH208/0.3-0.4, BH209/0.1-0.2, BH210/0.2-0.3, BH215/0.1-0.2, TP9/0-0.1, BH102/0-0,3, BH103/0-0.3, BH105/0.3-0.5, BH105/0.5-0.7, BH106/0-0.2, BH106/0.5-0.7, BH107/0-0.2, BH108/0-0.2, BH109/0-0.2, BH110/0-0.2, BH111/0-0.2, BH113/0.5-0.7, BH114/0.5-0.7, BH115/0.5-0.7, BH116/0-0.2 which exceeded the ESL for urban residential (0.7 mg/kg); and
- TRH (C16 -C34) in sample TP310A/0.0-0.2 (410 mg/kg) which exceeded the ESL (urban residential) of 300 mg/kg.

The exceedance of Health based investigation Levels (Residential B) were noted in the following samples:

- Carcinogenic PAH at TP302/0.5-0.6 (6.3 mg/kg), BH208/0.3-0.4 (4.3 mg/kg), BH215/0.1-0.2 (4.5 mg/kg), BH4/0.07-0.15 (77 mg/kg) and BH111/0-0.2 (8.2 mg/kg) which exceeded the Health Based Investigation Guideline for Residential B of 4 mg/kg.

As evident in the results, much of the polycyclic aromatic hydrocarbon (PAH) and total recoverable hydrocarbon (TRH) exceedances are associated with the roadbase material, which was recommended to be managed separately as Recovered Aggregate.

The statistical assessment of the data was undertaken for two main fill horizons (0 – 0.3 m and 0.3 m to the natural soil) to determine the upper 95% confidence level of mean concentrations. Statistics were run in excel for all contaminants with the exception of copper, lead, nickel, zinc, B(a)P, B(a)P TEQ and total PAH which were run in ProUCL.

Results for roadbase and asphalt were not included in the statistical calculations.

The results for the fill horizons included:

- 0-0.3 m depth – statistical calculations (95% UCL of the mean concentration) for all chemical analytics results (not including asbestos) for fill from 0-0.3 m are below the SAC with the exception of B(a)P in the top 0.3 m which is 1.066 mg/kg and exceeds the ESL (urban residential) of 0.7 mg/kg; and
- Below 0.3 m to top of natural – the statistical calculations (95% UCL of the mean concentration) for all chemical analytics results for fill below 0.3m and to the top of natural are below the assessment criteria for the site with the exception of B(a)P in the fill which is 0.818 mg/kg and marginally exceeds the ESL (urban residential) of 0.7 mg/kg.

The observed asbestos impacts are shown on Drawing 2, Appendix A, whilst the benzo(a)pyrene impacts are shown on Drawing 3, Appendix A.

***Groundwater***

Groundwater results revealed no phase separated hydrocarbons (PSH) were observed or detected by the interface meter during well development or sampling. Concentrations of all contaminants were either below the detection limit or the SAC, with the exception of the following:

- Cadmium in sample BH14 (0.006 mg/L) which exceeded the GIL of 0.005 mg/L;
- Copper in samples BH14 (0.007 mg/L), GW7 and the duplicate (0.007 mg/L), BH202 (0.002 mg/L), BH204 (0.008 mg/L), BH11 (0.005 mg/L), BH14 (0.007 mg/L), and BH17 (0.003 mg/L) which exceeded the GIL of 0.0014 mg/L; and
- Zinc in sample GW7 (0.022 mg/L) and the duplicate (0.024mg/L), BH202 (0.031 mg/L), BH204 (0.028 mg/L), BH11 (0.013 mg/L), BH14 (0.055 mg/L) and BD1 (0.026 mg/kg) which exceeded the GIL of 0.008 mg/L.

These results are however considered to be typical of groundwater conditions in urban settings.

***Preliminary Waste Classification***

The preliminary waste classification results are presented in the DSI (2019c). In summary, based on the results, the filling encountered in the bores at the site is preliminarily classified for off-site disposal purposes as General Solid Waste (non-putrescible), with the exception of the following areas:

- Asphalt and roadbase from Eurimbla Avenue, which are assessed in accordance with the recovered aggregate order 2014 (Order); and
- Fill in the vicinity of TP9, TP10, BH106, TP315, TP318, TP319, TP326, TP329 and four areas (depicted in Drawing 2 with yellow shading) which have been confirmed or suspected to contain asbestos. Other fill soils, particularly in the surface, may be impacted with ACM not observed during this current investigation. As a minimum, soils impacted with asbestos would be classified as Special Waste – Asbestos for off-site disposal purposes.

Furthermore, natural sand samples in some of the bores (BH105, BH106, BH108, BH110, BH112, BH113, BH115 and BH117) had concentrations of lead and/or PAH falling within the general solid waste (non-putrescible) classification.

***Recovered Aggregate Order***

The results for the asphalt and roadbase of Eurimbla Avenue were assessed for compliance with the recovered aggregate order 2014 (Order). In total 10 composite samples were recovered and analysed for heavy metals, electrical conductivity, metal, plaster, other foreign material and coal tar.

All results were found to be within the average and maximum criteria and all coal tar results were below the practical quantitative limit for the laboratory.

Based on these results, DP considers the asphalt and roadbase of Eurimbla Avenue are suitable to be processed for re-used in land application as described under the Order.

Results specific to Stage 1 and the IASB Addition are discussed in detail in Section 9.1.

## 5.8 DP, 2019d

DP (2019d) was carried for the IASB Addition area only. The IASB Addition (addition to Stage 1) component of the RCR sits adjoining and to the east of Stage 1.

DP carried out the following scope of work as part of DP (2019d):

- Review of previous DP reports (see references in Section 13) and relevant site history documents associated with the Prince of Wales (POW) hospital site;
- Concrete coring to remove the concrete slab and/or asphaltic concrete in all locations;
- Excavation of seven test pits (TP401 to TP407) to a minimum depth of 0.5 m into natural soil or prior refusal using a combination of non-destructive drilling and hand auger;
- Collection of soil samples from the test pits at regular depth intervals and Laboratory analysis of selected soil samples by a National Association of Testing Authorities (NATA) accredited laboratory for contaminants of potential concern (COPC);
- Inclusion of industry standard QA/QC including replicates, trip spike and trip blank samples;
- Interpretation of results in accordance with current NSW Environment Protection Authority (EPA) endorsed guidelines; and
- Preparation of a DSI report.

***Site History***

A review of land titles from Lot 1 DP 870720 - Randwick Hospital site revealed the site was appropriated as a site for Destitute Children's Asylum in 1854 and in 1916 was transferred to the Crown to be used as a hospital for invalided and wounded soldiers and sailors or such other purposes as the Governor may determine. In 1917 the site was requisitioned by Commonwealth for Hospitals & Convalescent accommodation from 25 August 1915 until 12 months after the termination of the war and has been used as a hospital since this time.

DP reviewed the Safework NSW search document for the Randwick Hospital site, dated 12 May 2015 and the following were located in Building 16, off-site and adjacent to Delivery Drive (to the southeast):

- DG03 – diesel generator / above ground tank (10,600L) in Building 16 basement dock 5;
- GM01 – roofed cylinder store (5400L) in Building 16 basement; and
- GM02 – roofed cylinder store (1800L) in Building 16 basement.

Aerial photographs were reviewed with the following general observations:

- 'Zig-zag shaped features' were noted on the 1943 image indicating air raid bunker/shelters may have been present on site. Similar shaped features were also evident at nearby High Cross Park. These were confirmed as air raid shelters uncovered during south east light rail construction works in 2017 by archaeologists;

- Between 1961 and 1970 the western boundary of the site was developed into a road with additional development of the building that partly covered the eastern side of the site. The area directly south east of the site was developed for hospital/commercial use;
- Between 1986 and 2005, major developments across the hospital to the east, although there appeared to be no significant changes to the site. The building adjacent to the north east part of the site were demolished and converted into a car parking area within the hospital which was later developed as an additional building to the Children's hospital; and
- The new building (Building 1C) adjacent to the IASB Addition area appears to have been constructed following October 2011. Prior to this time the site appears to have been used as a carpark associated with the Sydney Children's Hospital. The high-rise hospital building (Building 1C – extension of Sydney Children's Hospital) was constructed between October 2011 and October 2012.

The subsurface profile encountered in the bores (BH1, BH2, BH10, BH11) and test pits (TP401 to TP407) across the IASB Addition have been summarised below:

- **PAVEMENT/SLAB**: A 30 – 70 mm thick asphaltic concrete surfacing; overlying
- **FILL (ROADBASE):** dark brown medium grained sand with fine to coarse igneous gravel and medium grained sandstone gravel from 0.2-0.3 or 0.45 m in BH1, BH2, BH10, BH11, TP401, TP402, TP403, TP404, TP405, and TP406. In test pits TP401, TP405 and TP406 fill (roadbase) was encountered directly above natural sand. No roadbase was encountered in TP407;
- **FILL:** yellow fine to medium grained sand with fine to coarse sandstone gravel and igneous gravel with plastic, crushed cement, crushed brick to depths of between 0.45 and 0.95m depth; A hydrocarbon odour was noted in TP402. Trace ash and charcoal were noted in TP407 at 0.35-0.4m depth. At a depth below 0.55m in TP407, large sandstone cobbles were observed with cement gravel inclusions;
- **SAND:** yellow and orange and white fine to medium sand with some fine to coarse sandstone gravel (some igneous gravel), becoming mottled white in TP402; roots and organic staining were noted in TP405; yellow sand with some coffee rock noted in TP406 at 0.4m depth; medium dense sand encountered in BH1, BH2, BH10 and BH11; and
- **BEDROCK**: Sandstone encountered in TP401 at 0.7m depth and at depths of between 3.4 m and 6 m in BH1, BH2, BH10 and BH11.

Hydrocarbon odour was noted in TP402. Ash and charcoal were noted in TP407. Asbestos was not observed during fieldwork however the presence of building rubble was considered a possible indicator or potential asbestos in fill at the site.

***Soil***

Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TRH were below laboratory limits of reporting (LOR) for all soil samples. Metal concentrations were either less than the limit of reporting (LOR) and/or less than the adopted SAC for all samples tested.

The exceedance of Health based investigation Levels (Residential B) were noted in the following roadbase (fill) samples:

- Carcinogenic PAH at TP401/0.2 (5.2 mg/kg), TP402/0.2-0.25 (4.2 mg/kg) and BD1/20190823 (4.2 mg/kg) which exceeded the HSL B of 4 mg/kg.

A number of exceedances of ESL (urban residential) were noted in roadbase samples including:

- B(a)P in samples TP401/0.2 (3.6 mg/kg), TP402/0.2-0.25 (2.9 mg/kg) and BD1/20190823 (2.8 mg/kg) which exceeded the ESL (urban residential) of 0.7 mg/kg; and
- TRH (C16 -C34) in samples TP401/0.2 (370 mg/kg), TP402/0.2-0.25 (400 mg/kg) and BD1/20190823 (400 mg/kg) which exceeded the ESL (urban residential) of 300 mg/kg.

Chrysotile, amosite and crocidolite asbestos was detected in the roadbase sample from TP402/0.2-0.25 and AF/FA results were 0.0328 %w/w which exceeded the HSL (B) of 0.001%w/w. The asbestos is likely to be associated with building rubble in roadbase at this location.

Delineation samples were analysed to delineate the vertical and lateral extent of the asbestos detected. No further asbestos was detected in the samples at 0.5 and 1.0m in TP402 or the surrounding surficial samples at TP401, TP407, TP404 and TP405.

Results for selected explosive analytes were below detected in all samples analysed. Ammonia was above detection in one sample (TP407/0.35) however the level did not exceed the screening level adopted for the site (50 mg/kg).

***Preliminary Waste Classification***

Based on the analytical results (including TCLP), the filling encountered in the test pits at the site was preliminarily classified for off-site disposal purposes as General Solid Waste (non-putrescible), with the exception of the following areas:

- Roadbase in the vicinity of TP402 (confirmed to contain asbestos). Other roadbase or fill soils, particularly in the surface, may be impacted with ACM not observed during this current investigation. As a minimum, soils impacted with asbestos would be classified as Special Waste – Asbestos for off-site disposal purposes.

DP stated that this classification of soils was preliminary only and subject to further waste classification confirmation prior to disposal, as detailed in the RAP.

## 5.9 Hazardous Materials Surveys

The hazardous materials survey reports prepared by Property Risk Australia have identified various hazardous materials in the 92 properties that comprised the RCR Development Area. The following is a summary of the finds as a percentage of the 92 properties surveyed:

- 69% of the houses contain bonded ACM;
- 19% contain friable ACM;
- 90% contain bonded Synthetic Mineral Fibre (SMF);
- 1% contain un-bonded SMF;
- 14% contain PCBs;

- 66% contain lead paint;
- 77% contain lead dust; and
- 17% contain ozone depleting substances.

## 6. Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present of in the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

Based on the previous investigations, the following potential sources of contamination and associated contaminants of concern have been identified (Table 2).

**Table 2: Potential Contamination Sources and Contaminants of Concern**

| Potential Source | Description of Potential Contaminating Activity | Contaminants of Concern |
|---|---|---|
| Imported fill of unknown origin (S1) | Uncontrolled filling: Associated with disturbed terrain in the local area and from the demolition of former buildings/structures on site. Previous investigations have identified an average fill thickness of about 0.5 m across the site. | Heavy metals, TPH, BTEX, PAH, phenols, PCB, OCP, and asbestos.<br><br>Previous investigations have identified the presence of the above contaminants to varying degrees, with the exception of most metals, BTEX, OCP and phenols. |
| Hazardous building materials in existing buildings (S2) | Presence of hazardous building materials within the building fabric of the some of the existing buildings. | Asbestos, synthetic mineral fibre (SMF), lead and PCB |
| Industrial/commercial activities at the site or nearby (S3) | Storage of chemicals or equipment associated with former butcher/ medical practices and orthodontist. | Heavy metals, TRH, BTEX, PAH, phenols, PFAS, VOCs, ammonia and asbestos. |
| Neighbouring sites (S4) | Potential migration of contamination associated with the backfilled quarry at the UNSW site. Current operations at the new Biomed building at UNSW. | Asbestos, metals, hydrocarbons (TPH/BTEX) and pharmaceutical solvents (VOCs). |

Notes: TRH - total petroleum hydrocarbon
BTEX - benzene, toluene, ethylbenzene, xylene

PAH - polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyls
OCP - organochlorine pesticides
OPP - organophosphorus pesticides
VOC - volatile organic compounds
PFAS- Perfluorinated Alkylated Substances

The potential contamination sources (S) on the site are therefore as follows:

S1 Fill of unknown origin;

S2 Hazardous building materials;

S3 Previous industrial/commercial activities at the site; and

S4 Neighbouring sites (hospital and UNSW).

## 6.1 Potential Receptors

### 6.1.1 Human Health Receptors

R1 Current site users (residents, site workers and visitors);

R2 Construction and maintenance workers;

R3 Final end users (site workers and visitors); and

R4 Land users in adjacent areas (university / hospital / residential / commercial).

### 6.1.2 Environmental Receptors

R5 Groundwater;

R6 Surface water (Botany Bay); and

R7 Terrestrial ecosystems (neighbouring areas of conservation such as Centennial Park, Queens Park and Eastlakes, and landscaped areas under the future development).

### 6.1.3 Potential Pathways

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

P1 Ingestion and dermal contact;

P2 Inhalation of dust and/or vapour;

P3 Leaching of contaminants and vertical migration into groundwater (Eastlakes/Botany Bay);

P4 Surface water run-off (Centennial Park/Coogee);

P5 Lateral migration of groundwater; and

P6 Contact with terrestrial ecology (Centennial Park).

## 6.2 Summary of Preliminary CSM

A ‘source – pathway – receptor’ approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1 to S4) and receptors (R1 to R7) are provided in Table 3 below.

**Table 3: Potential Complete Pathways**

| Source | Pathway | Receptor |
|---|---|---|
| S1 Fill of unknown origin<br>S3 Previous industrial/commercial activities at the site (road, delivery dock, possible air raid bunker/shelter within IASB Addition) S3 Vehicles and cars within the building footprint<br>S4 | P1: Ingestion and dermal contact | R1: Current site users<br>R2: Construction and maintenance workers<br>R3: Final end users |
| | P2: Inhalation of dust and/or vapour | R1: Current site users<br>R2: Construction and maintenance workers<br>R3: Final end users (educational/hospital)<br>R4: Land users in adjacent areas (educational/hospital/ residential/commercial/industrial) |
| | P3: Leaching of contaminants and vertical migration into groundwater | R5: Groundwater |
| | P4: Surface water run-off<br>P5: Lateral migration of groundwater | R6: Surface water |
| | P6: Contact with terrestrial ecology | R7: Terrestrial ecology |
| S2 Hazardous building materials | P1: Ingestion and dermal contact<br>P2: Inhalation of dust and/or vapour | R1: Current site users<br>R2: Construction and maintenance workers<br>R3: Final end users |
| S4 Neighbouring sites (hospital and UNSW) | P2: Inhalation of vapour generated by contaminated groundwater. | R1: Current site users<br>R2: Construction and maintenance workers<br>R3: Final end users<br>R4: Land users in adjacent areas |
| | P3: Lateral migration of contaminated groundwater from up-gradient sites | R5: Groundwater<br>R6: Surface water |
| | P6: Contact with terrestrial ecology | R7: Terrestrial ecology |

# 7. Data Quality Objectives

In order to attain the remediation objective as set out in Section 2 the following seven step data quality objective (DQO) process, as defined in Australian Standard *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 2005) has been adopted. The DQO process is outlined as follows:

### (a) State the Problem

The 'problem' under consideration is the implementation of an appropriate remediation action plan to ensure any previously identified contamination and unexpected finds and waste classification/disposal procedures are managed appropriately to ensure that the remediated site will be suitable for the proposed development and that the remedial works pose no unacceptable risks to human health or to the environment.

The various parties involved in this decision process, include:

- The site owner (Health Infrastructure);
- The principal's representative (Lendlease);
- The planning authority (Randwick Council); and
- The environmental consultant (DP) for the investigation and remediation planning works.

### (b) Identify the Decision

Based on the findings of the previous assessments, site observations and the proposed development details, the principal decision is to adopt an appropriate remediation strategy to address the problem. The proposed strategy needs to be developed following the consideration of viable options. Assessment and classification requirements for imported soil will also be outlined in this RAP.

### (c) Identify Inputs to the Decision

Inputs to the decision include:

- Previous reports cited in Section 5;
- Guidelines cited in Section 1;
- Australian Water Quality Guidelines 2000 (AWQG);
- Australian Drinking Water Guidelines 2017 (ADWG, for reference only as the groundwater at the site is not considered a drinking water source); and
- National water quality management strategy. Australia and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC and ARMCANZ).

The primary inputs in adopting a remediation strategy are as follows:

- The areas of potential contamination derived from known historical site activities identified from the site history review outlined in previous DP reports;
- The investigation findings reported previously, as outlined in Sections 5 and 9;
- The adopted SAC for Stage 1 and IASB Addition;

- The limitations associated with the construction site (e.g. available space and timing); and
- Proposed land use and design of the proposed development.

**(d) Define the Boundary of the Assessment**

The site is bordered by Hospital Road and the existing hospital to the east, Magill Street to the south and Botany Street to the west. Eurimbla Avenue runs through the centre of the Stage 1 part of the site. The Stage 1 and IASB Addition boundaries are shown on Drawing 1, Appendix A.

**(e) Develop a Decision Rule**

The successful implementation of the RAP is assessed on the basis of the remediation acceptance criteria (RAC) provided in Section 8. The decision rule is the comparison of the analytical results against the relevant guidelines and background concentrations where relevant.

**(f) Specify Acceptable Limits on Decision Errors**

Specific limits for this project will generally be in accordance with the appropriate guidelines from NEPC (2013) for the collection of environmental samples. In order that the results are accurate and reproducible, appropriate and adequate quality assurance and quality control (QA/QC) measures and evaluations will be incorporated into the validation sampling and testing regime.

**(g) Optimize the Design for Obtaining Data**

In order to ensure the collection of representative data as part of the validation process, the sampling regime is based on the areas and their extent of environmental concern. In addition, in order to attain an acceptable level of data quality, QA/QC procedures will be adopted as part of the RAP requirements.

If the DQOs are not met, then the reasons as to why they were not achieved will be critically examined. If the situation cannot be easily rectified or is unique to the site, then consultation with the Site Auditor will take place, and assessment of future actions required will be discussed and implemented where applicable.

## 7.1 Data Quality Indicators

DP's quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme (validation) to ensure sampling precision and accuracy and prevent cross contamination.

The quality controls of documentation completeness, data completeness, data comparability, data representativeness, precision and accuracy for sampling and analysis, if required, are described in Table 4.

**Table 4: Data Quality Indicators**

| Quality Control | Achievement Evaluation Procedure |
|---|---|
| Documentation completeness | Completion of field and laboratory chain of custody documentation, completion of validation sample plans. |
| Data completeness | Sampling density according to provisions in the approved RAP, and analysis of appropriate determinants based on site history and on-site observation. |
| Data comparability and representativeness | Use of NATA accredited laboratories, use of consistent sampling technique. |
| Precision and accuracy for sampling and analysis | Achievement of 30-50% RPD for heavy metals and organics respectively for replicate analysis, acceptable levels for laboratory QC criteria. |

## 8. Remediation Acceptance Criteria

The remediation works will be validated as meeting an acceptable standard for the proposed land use. The validation will be undertaken by the environmental consultant by means of visual inspection, field screening, recovery and analysis of samples and review of any available plans, as discussed below.

This section provides remediation acceptance criteria (RAC), which will be used to judge the success or otherwise of the remediation by the consultant.

Analytical results from laboratory testing will be assessed against the (Tier 1) investigation and screening levels sourced from Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management* (CLM) *Act* 1997. Schedule B of NEPC (2013) provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination. The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2 or Tier 3) should be undertaken.

Stage 1 is proposed for the new ASB, whilst the IASB Addition comprises works associated with the hospital redevelopment. This land use does not fall within the generic land uses established in NEPC (2013). However, for the purpose of the investigation a land use scenario of “B” (residential within minimal opportunities for soil access) has been adopted for the following reasons:

- The proposed development will be substantially covered in a multi-level building, with basement levels, similar to the existing adjacent hospital;
- There are likely to be pockets of open space (paved or lawn - landscaping) within the development footprint, primarily on the peripheries;
- There is likely to be frequent visiting to the hospital by sensitive receptors such as children and the elderly, however access to open space areas would be minimal; and
- At this stage there is no proposed child care facility as part of the development.

## 8.1 Soils

### 8.1.1 Health Investigation and Screening Levels

The health investigation levels (HIL) and health screening levels (HSL) are scientifically-based generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential human health risk from chronic exposure to contaminants.

HIL are applicable to assessing health risk arising via all relevant pathways of exposure for a range of metals and organic substances. The HIL are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. Site-specific conditions may determine the depth to which HIL apply for other land uses.

HSL are applicable to selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact pathways. HSL have been developed for different land uses, soil types and depths to contamination.

Given the assumed land use scenario the adopted HIL and HSL are:

- **HIL-B and HSLA/ B**; and
- **HSL – Intrusive Maintenance Worker** (shallow trench).

The following table shows the HILs that have been adopted by NEPC (2013) Schedule B1, Table 1A(1) for the investigation.

**Table 5: Health Investigation Levels**

| Contaminant | HIL B (mg/kg) |
|---|---|
| **Metals and Inorganics** | |
| Arsenic | 500 |
| Cadmium | 150 |
| Chromium (IV) | 500 |
| Copper | 30,000 |
| Lead | 1200 |
| Mercury (inorganic) | 120 |
| Nickel | 1200 |
| Zinc | 60,000 |
| **PAH** | |
| Carcinogenic PAH (as benzo(a)pyrene TEQ) [1] | 4 |
| Total PAH | 400 |
| **Phenols** | |
| Pentachlorophenol (used as an initial screen) | 130 |
| **OCP** | 600 |
| DDT + DDD + DDE | 10 |
| Aldrin + Dieldrin | 90 |
| Chlordane | 400 |
| Endosulfan (total) | 20 |
| Endrin | 10 |
| Hepatchlor | 15 |
| HCB | 500 |
| Methoxychlor | |
| **Other Pesticides** | |
| Chlorpyrifos | 340 |
| **Other Organics** | |
| PCB [2] | 1 |

Notes:

1 sum of carcinogenic PAH

2 non dioxin-like PCBs only

The table below shows the HSLs that have been adopted by NEPC (2013) Schedule B1, Table 1A(3) for the investigation. Based on previous investigations, the dominant soil type encountered at the site is sands, therefore the HSL criteria for sand has been selected. Furthermore, given the general depth of fill encountered in the previous investigations, the depth range of 0 m to <1 m has been applied. The vapour intrusion pathway is considered to be applicable to the proposed development and is the most conservative of the exposure scenarios. The adopted HSLs are also therefore protective of the direct contact exposure scenario.

**Table 6: Soil Health Screening Levels for Vapour Intrusion**

| Contaminant | Soil Type | HSL A / B (mg/kg) | Intrusive Maintenance Worker (mg/kg) |
|---|---|---|---|
| | | Depth 0 m to <1m | Depth 0 m to <1m |
| Toluene | Sand | 160 | NL |
| Ethylbenzene | | 55 | NL |
| Xylenes | | 40 | NL |
| Naphthalene | | 3 | NL |
| Benzene | | 0.5 | 77 |
| TRH $C_6$-$C_{10}$ less BTEX [F1] | | 45 | NL |
| TRH >$C_{10}$-$C_{16}$ less naphthalene [F2] | | 110 | NL |

NL = Not Limiting

### 8.1.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EIL) and Ecological Screening Levels (ESL) will apply to areas of Stage 1 outside of the building basement footprint, where landscaping will be established.

The EILs listed in the DSI are shown in the following Table 7. The following site specific data and assumptions have been used to determine the EILs:

- The EILs will apply to the top 2 m of the soil profile;
- Given the likely source of soil contaminants (i.e. historical site use/fill) the contamination is considered as “aged” (>2 years) and
- ABCs have been derived using the *Interactive (Excel) Calculation Spreadsheet* using input parameters of aged soil, CEC of 2.4 $cmol_c$/kg (site average) and pH of 7 with high traffic and clay content of 15%.

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

| Analyte | | EIL Residential Open Space | Comments |
|---|---|---|---|
| **Metals** | Arsenic | 100 | Adopted pH of 7 and CEC of 2.4 $cmol_c$/kg]; assumed clay content 15% High traffic area (NSW) |
| | Chromium III | 200 | |
| | Copper | 65 | |
| | Lead | 1100 | |
| | Nickel | 9 | |
| | Zinc | 240 | |
| **PAH** | Naphthalene | 170 | |

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and Benzo(a)pyrene. The inputs into the ESL derivation are presented in Table 8 below, and the adopted ESL values based on Table 1B(6) of NEPM (2013) are shown in Table 9.

**Table 8: Inputs to the Derivation of ESL**

| Variable | Input | Rationale |
|---|---|---|
| Depth of ESL application | Top 2 m of the soil profile | The top 2 m depth below ground level corresponds to the root zone and habitation zone of many species. |
| Land use | Residential B | As discussed in Section 10 |
| Soil Texture | Coarse | Based on dominant soil type at the site (sand) |

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

| Analyte | | ESL (Residential and open space) | Comments |
|---|---|---|---|
| **TRH** | C6 – C10 (less BTEX) [F1] | 180* | All ESLs are low reliability apart from those marked with * which are moderate reliability |
| | >C10-C16 (less Naphthalene) [F2] | 120* | |
| | >C16-C34 [F3] | 300 | |
| | >C34-C40 [F4] | 2800 | |
| **BTEX** | Benzene | 50 | |
| | Toluene | 85 | |
| | Ethylbenzene | 70 | |
| | Xylenes | 105 | |
| **PAH** | Benzo(a)pyrene | 0.7 | |

### 8.1.3 Management Limits

In addition to the application of HSL and ESL, a further screening measure is applicable to petroleum hydrocarbons, which takes into account policy considerations and reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL),
- Fire and explosive hazards and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management Limits have been adopted in NEPC (2013) as interim Tier 1 guidance to avoid or minimise these potential effects. The criteria have been developed for petroleum fractions F1 to F4. The adopted Management Limits, extracted from Table 1B(7), Schedule B1 of NEPC (2013) are

shown in Table 10 below. The following site specific data and assumptions have been used to determine the Management Limits:

- The Management Limits will apply to any depth within the soil profile; and
- A sand (i.e. coarse texture) has been adopted, based on the dominant soil type at the site.

**Table 10: Management Limits for TRH Fractions in Soil**

| TRH Fraction | Soil Texture | Management Limit: Residential / Open Space (mg/kg) |
|---|---|---|
| $C_6$-$C_{10}$ [F1] | Coarse | 700 |
| >$C_{10}$-$C_{16}$ [F2] | Coarse | 1,000 |
| >$C_{16}$-$C_{34}$ [F3] | Coarse | 2,500 |
| >$C_{34}$-$C_{40}$ [F4] | Coarse | 10,000 |

### 8.1.4 Asbestos in Soil

Bonded asbestos-containing material (ACM) is the most common form of asbestos contamination across Australia, generally arising from:

- Inadequate removal and disposal practices during demolition of buildings containing asbestos products;
- Widespread dumping of asbestos products and asbestos containing fill on vacant land and development sites; and
- Importation of asbestos contaminated building products from China.

Asbestos only poses a risk to human health when asbestos fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage. Bonded ACM in sound condition represents a low human health risk, whilst both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres. Consequently, FA and AF must be carefully managed to prevent the release of asbestos fibres into the air.

Where an assessment of asbestos to NEPC (2013) is undertaken, the RAC will be as shown on the following Table 11.

**Table 11: Asbestos HSLs**

| Health Screening levels (w/w) | |
|---|---|
| | HSL B |
| Bonded ACM | 0.04% |
| FA and AF (friable asbestos) | 0.001% |
| All Forms of Asbestos | No visible asbestos in surface soil |

Bonded ACM: Asbestos containing material which is in sound condition, bound in a matrix of cement or resin, and cannot pass a 7 mm x 7 mm sieve.

FA: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically unbonded or was previously bonded and is now significantly degraded and crumbling.

AF: Asbestos fines including free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.

### 8.1.5 Classification Assessment for Off-Site Disposal

All wastes will be assessed in accordance with the POEO Act (1997).

For disposal to landfill, this will comprise assessment in accordance with the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines* (2014).

For re-use off-site, soil will be assessed in accordance with other EPA guidance or licences under the POEO Act, and may include:

- Resource recovery orders issued by EPA under the *Protection of the Environment Operations (Waste) Regulation* 2014; and
- Guidance on assessment of VENM.

It is also noted that recycling facilities with an appropriate Environment Protection License (EPL) may accept some of the soils that comply with their EPL conditions.

## 8.2 Groundwater

### 8.2.1 Groundwater Investigation Levels

The Groundwater Investigation Levels (GIL) are the freshwater default guideline values (DGV) for a slightly to moderately disturbed system from Australian and New Zealand Governments (ANZG), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, 2018 (ANZG, 2018).

**Table 12: Groundwater Investigation Levels (DGV)**

| Contaminant | | GIL for Freshwater (µg/L) |
|---|---|---|
| **Metals** | Arsenic (III) | 24 |
| | Arsenic (V) | 13 |
| | Cadmium | 0.5 # |
| | Chromium (III) | 8.2 # |
| | Chromium (VI) | 0.4 |
| | Copper | 1.4 |
| | Lead | 14 # |
| | Mercury | 0.06 |
| | Nickel | 28 # |
| | Zinc | 21 # |
| **PAH** | Anthracene | 0.4 |
| | Naphthalene | 16 |
| | Fluoranthene | 1 |
| | Benzo(a)pyrene | 0.1 |
| | Phenanthrene | 0.6 |
| **BTEX and VOC** | Benzene | 950 |
| | Toluene | 180 |
| | Ethylbenzene | 80 |
| | m-xylene | 75 |
| | o-xylene | 350 |
| | p-xylene | 200 |
| | Isopropylbenzene | 30 |
| | Tetrachloroethene | 70 |
| | Trichloroethene | 330 |
| | 1,1-Dichloroethene | 700 |
| | 1,3-Dichloropropene | 0.1 |
| | Chloroethene (vinyl chloride) | 100 |
| | Chlorobenzene | 55 |
| | 1,2,3-Trichlorobenzene | 3 |
| | 1,2,4-Trichlorobenzene | 85 |
| | 1,2-Dichlorobenzene | 160 |
| | 1,3-Dichlorobenzene | 260 |
| | 1,4-Dichlorobenzene | 60 |
| | 1,1,2,2-Tetrachloroethane | 400 |
| | 1,1,2-Trichloroethane | 6500 |
| | 1,2-Dichloroethane | 1900 |
| | Carbon tetrachloride | 240 |
| | Chloroform | 370 |
| | Dibromochloromethane | 4000 |
| | 1,2-Dichloropropane | 900 |
| | 1,3-Dichloropropane | 1100 |

| Contaminant | | GIL for Freshwater (µg/L) |
|---|---|---|
| **OCP** | Andrin | 0.001 |
| | Chlordane | 0.03 |
| | DDE | 0.03 |
| | DDT | 0.006 |
| | Dieldrin | 0.01 |
| | Endosulfan | 0.03 |
| | Endrin | 0.01 |
| | Heptachlor | 0.01 |
| | Lindane | 0.2 |
| | Methoxychlor | 0.005 |
| **OPP** | Azinphos methyl | 0.01 |
| | Chlorpyrifos | 0.01 |
| | Diazinon | 0.01 |
| | Dimethoate | 0.15 |
| | Fenitrothion | 0.2 |
| | Malathion | 0.05 |
| **PCB** | Aroclor 1242 | 0.3 |
| | Aroclor 1254 | 0.01 |

Note: #Adjusted for a hardness which is the lowest (most conservative) hardness value obtained from groundwater sampling in DP (2018b).

### 8.2.2 Health Screening Levels and Volatile Contaminants

The generic HSLs published in NEPC (2013) and CRC CARE (2011) are considered to be appropriate for the assessment of contamination in groundwater at the site in general. Given the proposed land use the adopted HSL are:

- **HSL B** – high density residential; and
- **HSL** - Intrusive Maintenance Worker (shallow trench).

The inputs to the derivation of the HSL are given in Table 13.

**Table 13: Inputs to the Derivation of HSLs**

| Variable | Input | Rationale |
|---|---|---|
| Potential exposure pathway | Vapour intrusion (inhalation) with contaminated groundwater as the source | The basement level is expected to intercept groundwater, which may be perched. |
| Soil Type | Sand | The intrusive investigations on site, as shown in the logs, show a subsurface comprised predominantly of sand |
| Depth to contamination | 2 m to <4 m | Used as an initial screen. The detection of volatile contaminants in the groundwater may trigger the need for a site-specific risk assessment given the proposed basement depths at the location of the proposed building. |

The adopted groundwater HSL for vapour intrusion, from Table 1A(4), Schedule B1 of NEPC (2013) are shown in the following Table 14.

**Table 14: Groundwater Health Screening Levels (HSL) for Vapour Intrusion (mg/L)**

| Analyte | | HSL-B | HSL – Intrusive Maintenance Worker |
|---|---|---|---|
| **TRH** | $C_6$ – $C_{10}$ (less BTEX) [F1] | 1 | NL |
| | >$C_{10}$-$C_{16}$ (less Naphthalene) [F2] | 1 | NL |
| **BTEX** | Benzene | 0.8 | NL |
| | Toluene | NL | NL |
| | Ethylbenzene | NL | NL |
| | Xylene | NL | NL |
| **PAH** | Naphthalene | NL | NL |

Note: *NL – Not limiting.*

## 8.3 Aesthetics

Clause 3.6, Schedule B1 of NEPC (2013) outlines aesthetic considerations when undertaking a site assessment. Some examples of characteristics or situations that may need to be considered in the assessment outcome include odorous soils, hydrocarbon sheen (e.g. surface water), soil staining and putrescible refuse.

The assessment of such finds at the site will be as stated in the unexpected finds protocol in Section 12. If the assessment identified no real human health or ecological risk, the find might be removed on the grounds of aesthetics or relocated (e.g. at depth).

## 8.4 Imported VENM

The POEO Act defines virgin excavated natural material (VENM) as:

'*natural material (such as clay, gravel, sand, soil or rock fines):*

*(a) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities and*

*(b) that does not contain any sulfidic ores or soils or any other waste*

*and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.*'

VENM is a waste that has been pre-classified as general solid waste (non-putrescible) under EPA (2014).

Additional advice is provided on the EPA web site [http://www.epa.nsw.gov.au/waste/virgin-material.htm] entitled 'Virgin Excavated Natural Material'. This advice states:

- Generators of VENM must assess the past and present activities on the site. The possibility that a previous land use has caused contamination of a site must be considered when assessing whether an excavated material is VENM. Land uses that could result in contaminants being present in an excavated material are listed on the web site. The list is not exhaustive and an excavated material may still be contaminated even where none of these activities have previously occurred on a site. Activities not directly related to a site may also lead to contamination, including diffuse sources of pollution such as contaminated groundwater that migrates under a site, or dust settling out from industrial emissions. Generators of VENM must consider these factors;
- Generators of excavated material should review the applicable Acid Sulfate Soil Risk Maps to determine the probability of acid sulfate soils being present at the site at which VENM excavation is proposed. The waste cannot be classified as VENM if the Acid Sulfate Soil Risk Maps identify a high probability of occurrence of acid sulfate soils or potential acid sulfate soils, unless it has undergone chemical assessment in accordance with the *Acid Sulfate Soils Assessment Guidelines* and the updated *Acid Sulfate Soils Laboratory Method Guidelines Version 2.1* - June 2004;
- By definition, VENM cannot contain any other waste, or be 'made' from processed soils. Excavated material that has been processed in any way cannot be classified as VENM; and
- Classification of excavated material as VENM requires certainty that all aspects of the definition are met. Chemical testing may be required to ascertain whether an excavated material is contaminated with manufactured chemicals or process residues, or whether it contains sulfidic ores or soils.

As a means of assessing the presence of manufactured chemicals or process residues, the analytical data for samples of natural soils are typically compared against published background concentrations, including Olszowy et al (1995) - Urban Soils (0-150mm), and Berkman 4th Edition (2001) - Field Geologists Manual 5.

Imported VENM will also be required to meet the RAC as listed in Section 8.1. It is noted that natural soils with organics concentrations exceeding the limit of reporting, and/or metals concentrations exceeding background concentrations would not classify as VENM. A process for confirming the VENM classification of natural soils is outlined in Section 13.5.

Sampling requirements for imported material are outlined in Section 13.7.

## 8.5 Imported Material under a Resource Recovery Order

As stated in Section 13.6, all proposed imported materials (including DGB, landscaping and temporary filling for platforms) will be assessed as being legally able to be imported to the site, and suitable

under the proposed development. Material proposed to be imported to the site must comprise one of the following:

- VENM; or
- Materials complying with a Resource Recovery Order (RRO) allowing land application.

Materials meeting an appropriate RRO must also meet the RAC as listed in Section 8.1.

# 9. Remedial Action Plan

## 9.1 Stage 1 and IASB Addition Contamination Status

Based on the site history information provided in DP (2018b and 2019d) and the field and laboratory results (DP 2019c), it is considered that the site in general has a low to moderate potential for contamination with respect to the proposed development.

Exceedances of health investigation and screening levels (HIL/HSL) and management limits from the previous investigations, for Stage 1 and IASB Addition, are provided in the following Table 15.

**Table 15: Exceedances of HILs/HSL in Stage 1 and IASB Addition**

| Location | Contaminant | Concentration | Guideline exceeded |
|---|---|---|---|
| TP401/0.2 | Carcinogenic PAH | 5.2 mg/kg | HIL B (4 mg/kg) |
| TP402/0.2-0.25 | Carcinogenic PAH | 4.2 mg/kg | HIL B (4 mg/kg) |
| TP402/0.2-0.25 | Chrysotile, amosite and crocidolite asbestos | 0.0328% | HSL B (0.001%) |
| BH4/0.07-0.15 (roadbase) | TRH F2-naphthalene | 170 mg/kg | Res A/B Soil HSL for vapour intrusion, Sand (0-1m) (110 mg/kg) and hydrocarbon odour |
| BH4/0.07-0.15 (roadbase) | TRH C16-C34 | 6600 mg/kg | Management Limits for residential parkland (2500 mg/kg) |
| BH4/0.07-0.15 (roadbase) | carcinogenic PAH | 77 mg/kg | HIL B (4 mg/kg) |
| BH4/0.07-0.15 (roadbase) | Total PAH | 740 mg/kg | HIL B (400 mg/kg) |
| BH8/0.4-0.5 (roadbase) | TRH C10-C16 | 1700 mg/kg | Management limit residential parkland (1000 mg/kg) |
| BH8/0.4-0.5 (roadbase) | TRH F2-naphthalene | 1600 mg/kg | Res A/B Soil HSL for vapour intrusion, Sand (0-1m) (110 mg/kg) |
| BH8/0.4-0.5 (roadbase) | Total PAH | 11,000 mg/kg | HIL B (400 mg/kg) |

| Location | Contaminant | Concentration | Guideline exceeded |
|---|---|---|---|
| BH8/0.4-0.5 (roadbase) | naphthalene | 150 mg/kg | HSL A/B – vapour intrusion (3 mg/kg) |
| BH111/0-0.2 | carcinogenic PAH | 8.2 mg/kg | HIL B (4 mg/kg) |
| TP9/0.0–0.2 m | asbestos | present | fragments |
| TP10/0–0.2 m | asbestos | present | fragments |
| TP326/0.0–0.2 m | asbestos | present | fragments |

Areas of asbestos contamination requiring remediation are shown on Drawing 2, Appendix A.

A number of exceedances of ESL (urban residential) / EIL (residential/open space) were noted within the site including:

- B(a)P in samples TP401/0.2 (3.6 mg/kg), TP402/0.2-0.25 (2.9 mg/kg) and BD1/20190823 (2.8 mg/kg), TP309A/0.0-0.2, TP309A/0.5-0.0.6, BH201/0.2-0.3, BH205/0.1-0.2, TP9/0-0.1, BH102/0-0,3, BH103/0-0.3, BH111/0-0.2, BH113/0.5-0.7, BH114/0.5-0.7, BH115/0.5-0.7, BH116/0-0.2 which exceeded the ESL for urban residential (0.7 mg/kg); and
- TRH (C16 -C34) in sample TP401/0.2 (370 mg/kg), TP402/0.2-0.25 (400 mg/kg), BD1/20190823 (400 mg/kg) and TP310A/0.0-0.2 (410 mg/kg) which exceeded the ESL (urban residential) of 300 mg/kg.

Given the identification of ACM in surface soils, and the higher risk of ACM being present in shallow soils (given the number of dwellings demolished) it was considered that the surface soils (to a nominal depth of 0.3 m) and deeper fill could be separated for assessment and remediation purposes.

The analytical data for soils within the site are included on Table C1, Appendix C, along with the SAC and statistics on the soil horizons 0-0.3 m and 0.3 m to the top of natural soils. The results show:

- Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TPH were below LOR;
- Metal concentrations were either less than the LOR and/or less than the adopted SAC with the exception of those listed in Table 15;
- With the exception of BH111, TP401 (including duplicate sample) and TP402 the PAH and TRH exceedances (Table 15) are associated with the roadbase material, which is recommended to be managed separately as recovered aggregate;
- Statistical calculations (95% UCL of the mean concentration) for all chemical analytical results (not including asbestos) for fill from 0-0.3 m are below the SAC with the exception of B(a)P in the top 0.3 m which exceeds the ESL; and
- Statistical calculations (95% UCL of the mean concentration) for all chemical analytics results for fill below 0.3 m and to the top of natural are below the SAC for the site.

As noted in DP (2019c) the preliminary waste classification for the filling encountered in the bores and test pits at the site is preliminarily classified for off-site disposal purposes as General Solid Waste (non-putrescible), with the exception of the following areas (as applicable to Stage 1):

- Asphalt and roadbase from Eurimbla Avenue and Hospital Road, which are to be assessed in accordance with the recovered aggregate order 2014 (Order); and
- Fill in the vicinity of TP402, TP9, TP10, TP326 and areas (depicted in Drawing 2 with yellow shading) which have been confirmed or suspected to contain asbestos. Other fill soils, particularly in the surface, may be impacted with ACM not observed during this current investigation. As a minimum, soils impacted with asbestos would be classified as Special Waste – Asbestos for off-site disposal purposes.

The analytical data relevant to the preliminary waste classification assessment for fill in Stage 1 and IASB Addition are shown on Table C3, Appendix C.

It is noted that natural soils with organics concentrations exceeding the limit of reporting, and/or metals concentrations exceeding background concentrations would not classify as VENM. A process for confirming the VENM classification of natural soils is outlined in Section 13.5.

With regards to groundwater, based on the results reported in DP (2019c), it is considered that further investigation and/or remediation of groundwater is not required. However, it is likely that ongoing monitoring of groundwater quality will be required under a dewatering management plan and/or license. The groundwater data relevant to Stage 1 and IASB Addition (i.e. just up-gradient, cross-gradient and down-gradient) are presented in Table C2, Appendix C.

As also noted in DP (2019c) the Eurimbla Avenue pavement materials are considered to comply with the recovered aggregate order (2014) and may therefore be processed and applied to land outside of the site, in accordance with the conditions of the recovered aggregate order. The analytical data relevant to Stage 1 and IASB Addition is presented in Table C4, Appendix C, including previous sample locations.

## 9.2 Remediation Goal

The remediation goal is to remove and/or to mitigate associated risks of potential environmental and human health impacts posed by identified contamination and contamination uncovered during earthworks (as unexpected finds) such that the site can be rendered suitable for the proposed development.

## 9.3 Extent of Remediation

On the basis of the summary outlined in Section 9.1, the remediation strategy outlined in this section applies to the following:

- Further assessment and management of asbestos impacts in soils, which applies to the whole of the site. An isolation and delineation process has not been considered due to the sporadic distribution and the potential for ACM to be present between sampled locations;
- Management of fill in relation to potential ecological impacts. An isolation and delineation process has not been considered due to the distribution of EIL and ESL exceedances across the site;

- Waste classification protocols for surplus soils (e.g. basement excavation) and/or soils requiring off-site disposal due to contamination and/or other factors;
- The management of the existing asphalt and road base in Eurimbla Avenue and Hospital Road, within the site;
- The assessment of materials proposed for import to the site; and
- Materials tracking processes both within the site and off-site.

An unexpected finds protocol has also been developed to manage finds not falling into the above categories.

## 9.4 Typical Remedial Options Available

A number of remedial options were reviewed based on the soil contaminants identified to date (i.e. asbestos and EIL/ESL exceedances for PAH and TRH). The suitability of the remedial options was examined in accordance with a number of relevant documents, including, *inter alia*, the following:

- NSW EPA, *Contaminated Land Management, Guidelines for the NSW Site Auditor Scheme (3rd edition)*;
- NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure (as amended 2013)*; and
- NSW Department of Environment and Climate Change (DECC) *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (UPSS Regulation)*.

Possible remedial options to achieve the remedial objectives are identified as follows:

- No action;
- Further assessment of material for on-site re-use;
- On-site treatment of contaminated material for on-site re-use;
- On-site burial of contaminated material under a suitable physical barrier (cap); and
- Removal of contaminated material to landfill.

### 9.4.1 No Action

The “No Action” option involves no remedial response to the contamination identified on the subject site. This option was not considered appropriate for the following reasons:

- The proposed development will include basement excavations and therefore a management strategy for excavated soils is required; and
- Appropriate management arrangements and procedures would be required to manage/alleviate the impacts due to asbestos contamination, as a minimum.

### 9.4.2 Further Assessment for On-site Re-use

Further assessment of fill soils at the site can be undertaken as below.

It is understood that approval for further assessment is required from Health Infrastructure prior to proceeding.

**Asbestos**

To assess the suitability of fill impacted (or potentially impacted) with asbestos, an assessment of asbestos concentrations WA Department of Health (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* can be conducted. The guideline is recognised in NEPC (2013) as an appropriate approach for the assessment of asbestos contamination.

Soils sampled, screened and analysed in accordance with WA DoH (2009), and meeting the HSLs listed in Section 8.1.4 of this RAP, could be assessed as being suitable to retain within the site, either with no additional management, or beneath a nominal surface layer of topsoil or fill (as the HSL requires no visible asbestos in the surface).

Unless fill soils are to be removed from site to landfill under an assigned waste classification, the above process is documented in Section 13 (validation) and will apply for any such soils proposed to be retained at the site.

**EIL / ESL Exceedances**

At the completion of basement excavation, existing soils retained in areas of proposed landscaping may be re-assessed for suitability through additional sampling and assessment against the EILs and ESLs. If found to be suitable, the soils could remain without any further action. Otherwise the soils could be removed and relocated to other areas of the site not subject to landscaping.

Alternatively, a horticulturalist will be consulted to advise on suitable plant species or soil mixes that can be used to manage potential impacts on plant growth.

### 9.4.3 On-site Treatment of Contaminated Material

On-site treatment of contaminated material within the site could involve the following.

**Asbestos**

Provided no friable asbestos is present in the soils, material impacted with bonded asbestos can be treated through a process of “emu picking” in the presence of an occupational hygienist or environmental consultant to removed observed fragments of bonded ACM. The materials would then be validated through the process outlined in Section 9.3.2.

This process has the benefit of retaining suitable soils on site, rather than adding to the landfill volumes and transporting asbestos impacted soils on public roads.

This process has limitations including:

- Available space on site to spread soils (in batches) for the emu picking process;
- Available space for stockpiling treated soils (in batches);

- The potential for dust generation carrying asbestos fines, noting residential, hospital and educational receptors nearby, in addition to pedestrians at the site boundary and workers within the site;
- The requirement for asbestos air monitoring and reporting; and
- The additional time required to implement the process.

**EIL / ESL Exceedances**

There is no treatment process that could reduce the relatively low levels of PAH and TRH identified in the fill at the site.

### 9.4.4 On-site Burial and Capping

Physical barrier (or encapsulation) systems involve the placement/installation of a layer of suitable capping material such as validated soils or permanent pavement over the contaminated filling that would limit the exposure of site users to the contaminants.

This option is considered to be viable given the following:

- Physical, non-leaching contamination (e.g. asbestos, low level PAH); and
- Generally low level contamination.

However, this option requires available space at depth (accounting for final design levels that need to accommodate the capping thickness) for placement of the impacted material, and the excavation and management of the material removed to accommodate the impacted material.

The process also requires diligent tracking of material to avoid cross-contamination, and the accurate surveying of the burial area and final capping construction.

On the basis of the proposed development details for Stage 1 and IASB Addition, being excavation to depths of up to 8 m, all fill within the IASB basement footprint and Hospital Road will be excavated and removed from Stage 1 and the IASB Addition. As such, any materials from these areas that are proposed for on-site burial will most likely have to be planned for burial within Stage 2. This encumbrance on the future development of Stage 2 needs to be considered if this option is to be undertaken.

This option requires a long-term environmental management plan and notation on title.

### 9.4.5 Removal of Contaminated Material to Landfill

Off-site disposal of contaminated material is considered a suitable option for managing human health and environmental impacts from the contaminated materials, particularly in view of the extent of bulk excavation required for the construction of basement car park and the lowering of Hospital Road as part of the IASB Addition.

The removal of material to landfill would involve a formal waste classification and transport of contaminated material to an EPA licensed landfill. Tracking and disposal records would need to be retained for inclusion in the site validation report.

This option is viable for all soils at the site.

This option general has higher cost implications, fills available landfill space, and requires the transporting of contaminated materials on public roads.

## 9.5 Remediation Approach

### 9.5.1 Hazardous Building Materials

The proposed works within the IASB Addition area will include the re-working of some of the existing hospital building to accommodate connectivity with the ASB building. Prior to undertaking any such works a hazardous building materials survey will be conducted and reported. Should hazardous building materials be identified, these will be removed and managed under the procedure outlined in Section 10.1.

### 9.5.2 Preferred Remediation Approach

On the basis of the discussion of remediation options above, and taking into considered instructions from the end client in terms of soil management, requiring the retention of soils on site where possible, and the preference to dispose surplus soils as virgin excavated natural material (VENM), the adopted remediation approach is as follows:

- At the completion of building demolition, a licensed asbestos removal contractor will remove and double bag any observed bonded ACM on the ground surface;
- A qualified occupational hygienist will inspect the surface for potential bonded ACM and issue a clearance certificate;
- Where bonded ACM is observed on the ground surface elsewhere (e.g. as shown on Drawing 2, Appendix A), a licensed asbestos contractor will remove and double bag the bonded ACM and a qualified occupational hygienist will prepare a clearance report;
- Stripping initially of the upper 0.3 m of fill soil in zones across the site and stockpiling for re-assessment. Deeper fill will also be stripped and stockpiled separately for the same assessment;
- Where sufficient *in situ* test data (chemical analysis) exists, assessment of the stockpile in accordance with WA DoH (2009) for asbestos concentrations (gravimetric analysis) and for waste classification purposes as detailed in Section 10.1:
  - If asbestos concentrations meet the RAC, the stockpile will be relocated for on-site re-use (Lendlease will keep the tracking records;
  - If asbestos concentrations exceed the RAC, but no friable (AF/FA) asbestos is found, the process of “emu picking” will be undertaken as detailed in Section 10.3. The stockpile will be re-assessed in accordance with WA DoH (2009) and relocated as above;
  - If friable (AF/FA) asbestos is found in the stockpile, the stockpile will either be:
    - Disposed off-site under a formal waste classification; or
    - Relocated within the site for burial and capping, as detailed in Section 10.4.

- Where insufficient *in situ* test data exists, assessment of the soils against the WA DoH (2009) guidelines and appropriate testing for contaminants of concern identified in the CSM, to aid in the waste classification process.

EIL and ESL exceedances in retained soil will be assessed at the areas of proposed landscaping in accordance with Section 13.4.

Fill materials below a depth of 0.3 m will be stripped and assessed for either re-use within the site, or disposed off-site under a waste classification. Any observed bonded ACM during this process will be managed under the UFP in Section 12.

At the completion of fill removal, the exposed natural soils or bedrock will be assessed against the VENM criteria as listed in Section 13 of this RAP.

Asphalt and road-base in Eurimbla Avenue and Hospital Road will be stripped and processed for land application either on-site or off-site in accordance with the requirements of the recovered aggregate order 2014.

# 10. Remediation Procedures and Sequence

The proposed development is declared to be an SSDA as a “hospital” in accordance with Clause 14 of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development*) 2011 (SRD SEPP) Part 4, Division 4.7 of the EP&A Act which establishes an assessment framework for SSDAs. As such, the remediation works as part of the Randwick Campus Redevelopment are considered to be Category 1 in accordance with Clause 4.4.1 of the *Managing Land Contamination Planning Guidelines, SEPP 55 – Remediation of Land*, which defines Category 1 works as works which require consent under another SEPP or a regional environmental plan (as one of a number of possible triggers).

The detailed procedures and sequence for the remediation work will rest with the Contractor and will depend upon the equipment to be used and the overall sequence of the demolition and development.

The Principal and/ or Contractor must obtain all required approvals, licences and permissions prior to commencement of remediation works, and implement relevant conditions.

The requirements for the management of asbestos are detailed in Section 11.

The following sub-sections provide the details for each of the steps outlined in Section 9.4, as well as the steps to be implemented (and as implemented to date) to manage hazardous building materials in structures being demolished.

## 10.1 Management of Hazardous Building Materials

Hazardous materials identified in buildings will be management and removed under the control of the Randwick Campus Redevelopment – Acute Services Building Demolition Control Plan (DCP). The

DCP has been prepared by the Demolition Contractor, Demolition Environmental Civil Contractors (DECC) and is approved by the Principal Contractor (Lendlease).

The DCP incorporates the following:

- Management Plans;
- Installation and maintenance of silt controls;
- Hazardous materials removal;
- Salvage of some items and materials for resale or use;
- Strip out; and
- Structural demolition.

An Asbestos Removal Control Plan (ARCP) has been prepared in accordance with Safe Work Australia *How to Safely Remove Asbestos Code of Practice* 2016; Safe Work Australia *How to manage and Control Asbestos in the Workplace Code of Practice* 2016 of friable and non-friable asbestos material. Similarly, a Lead Removal Control Plan (LRCP) was prepared by Asbestos Solutions Professional Pty Ltd (ASP) for the demolition and describes the technical requirements for the safe remediation of lead contaminated dust to a number of areas within the RCR Development Area.

A notice of intent to commence demolition work was issued and accepted by SafeWork NSW. A licenced asbestos removal company holding a Class A asbestos removal license, issued by SafeWork NSW, will remove friable asbestos material as required by NSW WHS Regulations. As required by the NSW WHS Regulations, a Licensed Asbestos Assessor (LAA) will undertake air monitoring and clearance inspections.

Hazardous materials removal will involve the following:

- Prior to the commencement of works, a walkthrough inspection shall be undertaken with the asbestos register with ASP's nominated LAA;
- All items within the register shall be visually confirmed as to its status of containing asbestos or not; where it is unclear as to its status, or where items likely to contain asbestos this shall be brought to the attention of DECC Pty Ltd;
- Some salvage and loose item strip out may take place before the hazardous materials removal where it is possible without disturbing the hazardous materials;
- Hazardous materials removal to be undertaken as further outlined in the ARCP and LRCP. The ceiling, flooring and any other lining will be removed by the hazmat contractor to access the hazardous materials where applicable. Daily air monitoring will be implemented during asbestos and lead dust removal work;
- A clearance certificate confirming the removal of asbestos based materials will be received from the occupational hygienist prior to further demolition work;
- Normal demolition practices for the salvage and removal of building materials;
- A final visual inspection of the containment area is to be carried out by SWE at completion of lead remediation works. The visual clearance will certify whether the containment area is free from dust and to document the lead remediation work. The visual clearance will allow general access

to the containment area. The clearance certificate must state the extent of the lead removal meaning either a full removal or partial removal;

- Surface swabs will be collected to assess if there has been a significant impact on the removal area and surrounding areas and if normal use of the area is permissible. The sample is then sent to a NATA accredited analytical laboratory for determination of the amount of lead by AAS or ICP; and
- Clearance Certificate to be issued for lead removal, asbestos, unexpected finds & post demolition handover to remediation contractor.

**Unexpected finds:**

If suspected asbestos materials are encountered during works not associated within the asbestos removal area, workers are to follow the following procedures:

- Immediately stop work and notify the Site Supervisor;
- Move away (minimum 10 m) from the suspicious materials, and leave all tools;
- Site supervisor to create exclusion zone around the suspicious materials and erect signage “Danger Asbestos – Do Not Enter”;
- Licensed asbestos assessor to inspect/sample the material to confirm if asbestos or not. LAA can instruct works to continue in a different area of the building if deemed safe to do so;
- If asbestos; ASP will continue to remove the ACM (once all hazards & risks assessed), decontaminate area, obtain clearance certificate from LAA and dispose of material to a licensed landfill facility, in accordance with this ARCP;
- LAA to inspect building for other “similar” areas throughout (i.e. wet areas, risers) to confirm that no other unidentified asbestos present; and
- Following issue of a clearance certificate, workers can resume work under normal conditions.

In addition to the above, JBS&G Australia Pty Ltd (JBS&G) was engaged by Health Infrastructure, care of Pricewaterhouse Coopers Australia (PwC) to undertake an audit of the hazardous materials process currently being implemented to clean-up the houses prior to demolition, including identification, removal, control measures and monitoring. JBS&G stated that “*the removal methodologies implemented by the hazardous removal contractors at the time of the inspection appeared to be compliant with regulatory requirements and standard industry practices*”, as documented in their Hazardous Materials Audit 01 Report (Ref: 55357-117764), dated 11 December 2018.

## 10.2 Stockpile Assessment

Following the stripping of the upper 0.3 m of soil (and deeper soils separately where present) from a zone nominated by Lendlease (usually determined by the demolition and occupational hygienist clearance progress), the following assessment process will apply for the resultant stockpile:

- Determine the volume of the stockpile requiring investigation;
- Visually inspect the surface of the stockpile for bonded ACM;

- Identify the source of the stockpile and conduct a walkover that area;
- Determine the appropriate number of samples in accordance with WA DoH (2009), which is typically a sampling density of one sample per 70 $m^3$, or a minimum of three samples per single stockpile. Select sample locations from within the test pits, with an intentional bias towards areas with observed bonded ACM;
- Excavate test pits into the stockpile to visually assess the homogeneity of the soils and the presence or spread of bonded ACM;
- Collect ~10 L bulk samples from each sampling location;
- Manual on-site screening of each ~10 L bulk sample through a 7 mm sieve, and weighing recovered ACM retained on the sieve;
- Calculate the asbestos %w/w for each 10 L bulk sample, and compare against the RAC;
- Collect a 500 ml sub-sample for each ~10 L sample for laboratory analysis of AF and FA to calculate the asbestos %w/w and compare against the RAC. This sample may only be analysed where ACM is found in the bulk sample and/or there is a suspicion of potential AF or FA (at the discretion of the environmental consultant); and
- Collect additional samples (three per stockpile) for confirmatory chemical testing of contaminants identified in DP (2019c) as exceeding health or ecological based investigation or screening levels (i.e. metals, TRH, PAH).

The environmental consultant will produce a report (or memorandum) following the completion of the investigation of each stockpile. The report will incorporate *in situ* test results applicable to the source of the stockpile. The report will include an assessment of the stockpile against the RAC, and will provide recommendations for management of the stockpile on the basis of this RAP.

The report will also include a waste classification for the event that the stockpile requires off-site disposal. The waste classification will be conducted with reference to the NSW EPA (2014) *Waste Classification Guidelines*.

The report will not include details of where the stockpile should be placed, but will include details of any conditions or requirements on the relocation. Determination of the actual area for relocation rests with Lendlease.

The report will be submitted to the Site Auditor for review and comment prior to any action being taken with respect to that stockpile.

No soils will leave the site without a formal waste classification.

## 10.3 Emu Picking

The emu picking process (if adopted) and validation will be as follows:

a) Designation by Lendlease of a location for the spreading and treatment of the impacted soils. The area must have sufficient space for stockpiling and treatment of the asbestos impacted filling as described below;

b) It is preferable for the treatment area to be hardstand. Otherwise, the surface soils beneath would need to be stripped at the end of the process and managed in the same way as the treated materials;

c) The treatment area must be managed in accordance with the general site management requirements, including fencing to prevent unauthorised access, implementation of a dust management system, suitable locations selected for asbestos air monitoring, and provision of an asbestos decontamination area (if considered warranted by the occupational hygienist or environmental consultant);

d) Progressive excavation of manageable volumes from the stockpile by the asbestos contractor and spreading in the treatment area to a nominal thickness of 0.1 m;

e) The licensed asbestos contractor will inspect the layered soil by walking on a 1 m transect grid. Observed ACM will be removed by hand, double bagged and stored on site in the secure designated ACM waste storage area;

f) The occupational hygienist / asbestos assessor will inspect the soil and mark any observed ACM. The marked ACM will be removed by the asbestos contractor;

g) Steps (e) and (f) will be repeated until no ACM is observed during three consecutive inspections / passes;

h) All ACM collected will be disposed off site at a licensed landfill facility, with disposal records retained for confirmation and inclusion in the site validation report;

i) The asbestos contactor will stockpile the treated material in a designated area separate from the treatment area for later re-assessment; and

j) The environmental consultant will undertake validation assessment of each stockpile in accordance with Section 10.1.

In addition, the footprint of the treatment area, at the completion of all treatment works, will be validated in accordance with Section 13.

## 10.4 Burial and Capping

Any soils identified to require on-site retention beneath the physical barrier (capping) system will most likely require temporary stockpiling prior to creation of the burial area(s). Such stockpiles will be covered with a durable geofabric and surrounded with sediment control measures.

A specific capping design is not provided in this RAP given that any such requirements are likely to be associated with the Stage 2 area, for which the development design is not yet known. The physical barrier system design may be developed for areas of:

- New building slabs;
- Paved areas (including service trenches);
- Landscaped areas (including service trenches);
- Trees to be retained; and/or
- New trees and shrubs.

The various physical barrier system designs will need to be included as either an addendum to this RAP, or a stand-alone RAP for Stage 2.

In general, the formation of the physical barrier system will entail the following:

- Excavation or placement of the existing contaminated fill to a nominal depth of 500 mm below the design final ground level (or less if a concrete slab or hardstand will form the cap);
- The exposed materials will be compacted as required;
- The contaminated materials will be placed and compacted as required;
- A marker layer will be placed over the area containing the contaminated fill. The marker layer will comprise a durable matted material which permits soil infiltration, and acts as a warning layer if there is any excavation in the future;
- The capping material(s) will be placed over the contaminated materials;
- The plan and vertical dimensions / locations of the contained and capped soils will be surveyed; and
- A long term EMP will be prepared by the environmental consultant to manage the integrity of the physical barrier system into the future.

# 11. Asbestos Management

## 11.1 Regulatory Framework

In New South Wales (NSW), occupational health and safety is regulated under the NSW Work Health and Safety Act 2011 (WHS Act) and the NSW Work Health and Safety Regulation 2017 (WHS Regulation).

The WHS Act and the WHS Regulation place a broad range of responsibilities on key stakeholders to promote and secure the safety and health of persons in the workplace. The WHS Regulation also outlines an array of requirements pertaining to the identification, assessment and control of asbestos and ACM in the workplace.

In addition to the WHS Act and WHS Regulation there are a range of National Codes of Practice and Guidance Notes, Australian Standards and other guidelines relating to the management of asbestos and ACM in the workplace.

Safe Work Australia (SWA) has issued the following codes of practice that have been adopted in NSW:

- Code of Practice: *How to Safely Remove Asbestos*, Safe Work Australia, 2016 (SWA, 2016a);
- Code of Practice: *How to Manage and Control Asbestos in the Workplace*, Safe Work Australia, 2016 (SWA, 2016b); and
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* 2nd Edition [NOHSC:3003(2005)].

These codes and guidance note detail the requirements for the identification, assessment and management of ACM in the workplace, including the specific controls required for asbestos and ACM removal. Electronic copies of these documents are available on the SWA website (www.safeworkaustralia.gov.au).

Asbestos waste is regulated under the *Protection of the Environment Operations* (POEO) Act 1997 and POEO (Waste) Regulation 2014, which are administered by the Environment and Protection Authority (EPA).

Wastes, including those containing asbestos, must be classified for disposal in accordance with the NSW EPA *Waste Classification Guidelines, Part 1: Classifying Waste,* November 2014 (EPA, 2014)

The Dangerous Goods (Road and Rail Transport) Regulation 2008 adopts uniform national requirements for the transport of dangerous goods (e.g. asbestos) including the requirements of the Australian Dangerous Goods Code.

Asbestos transporters and facilities receiving asbestos waste must report the movement of asbestos waste to the EPA. Entities involved with the transport or disposal of asbestos waste in NSW, or arranging the transport of asbestos waste in NSW, must use the EPA's online tool, WasteLocate.

All works must be conducted in accordance with the development consent conditions.

All works must be also undertaken in accordance with the relevant regulatory criteria, including *inter alia*;

- NSW *Work Health and Safety Act* 2011 (WHS Act);
- NSW *Work Health and Safety Regulation* 2011 (WHS Regulation);
- NSW *Environmental Planning and Assessment Act* 1979;
- NSW *Environmental Protection and Biodiversity Conservation Act* 1999;
- NSW *Environmental Offences and Penalties Act* 1996;
- NSW *Environmentally Hazardous Chemicals Act* 1985;
- NSW *Protection of the Environment Operations Act* 1997 (POEO Act);
- NSW *Contaminated Land Management Act* 1997;
- NSW *Dangerous Goods (Road and Rail Transport) Act 2008; and*
- NSW *Dangerous Goods (Road and Rail Transport) Regulation* 2009.

Reference to relevant Codes of Practice, Australian Standards and industry standards should also be made in determining appropriate safe work practices. These include, *inter alia:*

- National Occupational Health and Safety Commission (NOHSC) *Code of Practice for the Safe Removal of Asbestos* [2002(2005)];
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition* [NOHSC:300392005)];

- NOHSC *Code of Practice for the Management and Control of Asbestos in the Workplace* [NOHSC:2018(2005)];
- NOHSC *Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:3008 (1995)] 3rd edition;
- AS/NZS 1715:2009 *Selection, Use and Maintenance of Respiratory Protective Devices;*
- AS/NZS 1716:2012 *Respiratory Protective Devices;*
- AS/NZS 1716:2003/Amdt 1:2005: *Respiratory protective devices;*
- WorkCover NSW: *Working with Asbestos: Guide 2008;*
- WorkCover NSW: *How to manage and control asbestos in the workplace: Code of practice; and*
- WorkCover NSW: *How to safely remove asbestos: Code of practice.*

## 11.2 Notification

SafeWork NSW must be notified 5 days in advance of any asbestos works.

The asbestos contractor must, before commencing the licensed asbestos removal work, inform the following people that asbestos removal works are to be conducted and the date the work will commence:

- The person with management or control of the workplace and any adjacent occupied buildings; and
- The entity/person who commissioned the asbestos removal work.

The person with management of control of the workplace must inform workers and any other persons in the workplace.

## 11.3 WHS Plans

The asbestos contractor will prepare the following plans complying with regulatory requirements, including the WHS Regulation and WorkCover NSW requirements:

- Safe Work Method Statements (SWMS); and
- Asbestos Removal Control Plan (ARCP). The ARCP must:
  - Be provided to the person who commissioned the work;
  - Include details of how the asbestos removal will be carried out, including the method to be used and the tools, equipment and personal protective equipment to be used;
  - Include details of the asbestos to be removed, including the location, type and condition of the asbestos; and
  - Be kept by the licensed asbestos contractor in accordance with the WHS Regulations.

## 11.4 Licensed Contractor Training

All asbestos workers at the site must be appropriately trained in asbestos works and in the Asbestos Removal Control Plan. The training must include information on health risks associated with asbestos, and the rights of asbestos workers under the WHS Regulation.

The licensed asbestos removalist must keep records of all training works.

## 11.5 Restriction of Access

Access to the asbestos works area will be restricted to:

- Workers engaged in asbestos removal work;
- Other persons associated with the asbestos removal work; and
- Anyone allowed under the WHS Regulation or another law to be in the asbestos removal area.

## 11.6 Airborne Asbestos Monitoring

Monitoring for airborne asbestos fibres is to be carried out by the independent competent person or licenced asbestos assessor during asbestos removal works, as required, to meet WHS (2011) and SafeWork NSW requirements. The competent person or licensed asbestos assessor will be responsible for determining when air monitoring is required, and an appropriate scope of monitoring for the works.

## 11.7 Personal Protection Equipment

The following personal protective equipment (PPE), in addition to standard construction PPE, should be worn during works involving the handling and/or removal of soils impacted by asbestos (e.g. emu picking):

- Half-face P1/P2 respirator;
- Disposable coveralls (Tyvek suit or equivalent);
- Gloves; and
- Safety glasses or safety goggles.

## 11.8 Decontamination and Asbestos Clearance

At the direction of the competent person or licenced asbestos assessor, facilities must be provided to decontaminate:

- The asbestos removal area;
- Any plant used in the asbestos removal area;

- Workers carrying out asbestos removal work; and
- Other persons who have access to the asbestos removal area.

# 12. Unexpected Finds Protocol

## 12.1 General Unexpected Finds

An "Unexpected Finds Protocol" has been established to deal with unexpected findings and/or unplanned situations. This protocol is also applicable to any unexpected finds relating to potentially contaminated soils with a historical uncertainty that may be encountered during excavation works with the site. The protocol is as follows:

1. The contractor(s) undertaking any remediation, civil or construction works will be provided with a copy of the RAP (plus any amendment or addendum), including this UFP. The contractor(s) will nominate their site (project) manager who will be responsible for implementing the UFP;
2. Upon discovery of suspected (unexpected) contaminated material, the site (project) manager is to be notified and the affected area closed off by the use of barrier tape and warning signs (if appropriate) and sediment controls. Warning signs shall be specific to the findings and potential hazards and shall comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;
3. A qualified environmental consultant is to be notified by the site manager to inspect the area and confirm the presence or otherwise of hazards or contamination, and to determine the method and extent of investigation or remediation works to be undertaken. A report detailing this information will be compiled by the environmental consultant and provided to the site manager, who will disseminate to the Principal (or their representative);
4. All work associated with the contaminated soil will be undertaken by an appropriately licensed contractor, as stipulated by the environmental consultant;
5. All works must comply with the provisions of the relevant legislation and guidelines;
6. Documentary evidence (weighbridge dockets) of appropriate disposal of the material is to be provided to the Principal (or their representative) if disposal occurs;
7. Details of all relevant activities are to be recorded in the site record system; and
8. Details of the remediation and validation works undertaken with respect to the unexpected find must be incorporated into the final validation report as prepared by the environmental consultant.

## 12.2 Underground Storage Tanks

In the event that an underground storage tank (UST) is unexpectedly discovered during site remediation or excavation works the following procedure will be followed:

1. Works in the area will cease and the Site Manager informed;
2. The area will be closed off by the use of barrier tape and warning signs that comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;

3. Prior to the removal of the UST, any residual product (liquid/vapour) will be removed from the tank and disposed of appropriately in accordance with Australian Standard (AS 4976 – 2008 *The Removal and Disposal of Petroleum Underground Storage Tanks*). Records of disposal will be provided for the validation report;
4. The UST will be exposed and examined for potential leaks and general condition. The environmental consultant will be engaged to inspect the UST prior to its removal;
5. The UST will be removed and the structures disposed of by a qualified contractor in accordance with AS 4976 – 2008. Disposal records will be provided to the environmental consultant for inclusion in the validation report;
6. All associated infrastructure (i.e. the remnants including fuel lines etc) will be removed and disposed in a similar manner if present;
7. Excavate and stockpile impacted materials (based on field observations) as directed by the environmental consultant. Once stockpiled, the material will be sampled and tested by the environmental consultant for either on-site re-use or off-site disposal (i.e. waste classification);
8. Land farming of impacted soils may be considered upon further advice from the environmental consultant based on the nature and extent of impacted soils;
9. Collect validation samples from the tank pit at a minimum rate of one location per side wall or one sample per soil type and at the depth of observed groundwater, whichever is the greater and at least one sample in the excavation base. Note that the actual number of samples may vary depending on the size of the tank pit excavation and the degree of contamination, the soil profile encountered and the presence of groundwater;
10. Collect validation samples below the fuel lines (following removal). Validation samples will be collected at a rate of one sample per 5 m linear metres of the fuel lines;
11. The validation samples will be analysed at a NATA accredited laboratory for lead, TRH, BTEX, PAH. Additional analysis may be required as advised by the environmental consultant based on the contents of the tank;
12. If evidence of leaks is observed in the tank and/or tank pit then groundwater monitoring wells may be required. Groundwater samples will be tested for TRH, BTEX, PAH, heavy metals and VOC. Additional analysis may be required subject to the determination of the product stored in the tank; and
13. The above works will be documented in the site validation report.

# 13. Validation

## 13.1 Site Inspections

The Environmental Consultant is to conduct periodic site inspections during remediation works, when any issue of concern is identified under the UFP, and to assess the progress of remediation. A record of the inspections and observations, including a photographic record, will be provided as part of the validation assessment report.

## 13.2 Remedial Excavation Testing Requirements

Where an unexpected find of contaminated fill is removed from the site and either disposed off-site or relocated to Stage 2 for containment and capping, systematic validation samples are to be collected from the exposed surface of remedial excavations and analysed at the frequencies shown below:

- Base of excavation – One sample should be collected from the floor of the excavation for small excavations, or at a minimum of 1 sample per 25 m for large excavations;
- Side walls of excavation – samples must be collected from the excavation walls at a minimum rate of one location per side wall or one sample per 20-25 m, whichever is the greater. Note that the actual number of samples may vary depending on the size of the it excavation and the degree of contamination, the soil profile encountered and the presence of groundwater (to be determined by the environmental consultant);
- Every sample will be analysed for the contaminants of concern at that location;
- Testing to include gravimetric analysis given that friable asbestos and asbestos fines have been identified on Hospital Road, i.e.
  - Collect ~10 L bulk samples from each sampling location;
  - Manual on-site screening of each ~10 L bulk sample through a 7 mm sieve, and weighing recovered ACM retained on the sieve;
  - Calculate the asbestos %w/w for each 10 L bulk sample, and compare against the RAC; and
  - Collect a 500 ml sub-sample for each ~10 L sample for laboratory analysis of AF and FA to calculate the asbestos %w/w and compare against the RAC. This sample may only be analysed where ACM is found in the bulk sample and/or there is a suspicion of potential AF or FA (at the discretion of the environmental consultant).
- QA / QC analysis as per industry standards;

## 13.3 Stockpiles

Validation of the suitability of stockpiles to be retained within the site will be conducted as per Section 10.2.

## 13.4 Fill to be Retained

Given the disturbance of soils through the demolition, stripping of fill, the ASB building excavation, and Hospital Road excavation, any fill remaining within the site will be assessed for suitability to be retained in the landscaped areas outside the building excavation (noting that all fill will be removed from the building footprint due to the basement excavation). Validation of the suitability of the fill remaining within the site will be carried out as follows:

- Remaining fill will be identified by the environmental consultant;
- Test pits will be excavated on a nominal 20 m grid across the fill area, or as required under WA DoH (20092);

- Samples of fill will be recovered from the surface and at regular depth intervals not exceeding 1 m;
- Samples will be analysed for metals, TRH, PAH and asbestos (10L sieve and gravimetric analysis); and
- The analytical data will be assessed against the RAC, with statistics applied where appropriate.

If the concentrations fall within the RAC the fill will be deemed suitable to be retained *in situ*.

If the concentrations exceed the RAC, the following actions will be considered / enacted:

- The fill will be excavated and removed off site under an assigned waste classification; or
- If exceeding only EILs or ESLs, either:
    - A horticulturalist will be consulted to propose tolerant plant species and/or imported soil mixes to allow establishment of the proposed landscaping; or
    - The fill will be partially removed as above, with validated soil imported to form a suitable surface layer (nominally 0.5 m thickness, to be advised by a horticulturalist) for the establishment of the proposed landscaping.

## 13.5 Virgin Excavated Natural Material Assessment

A virgin excavated natural material (VENM) classification of natural materials will be required in areas where fill has been removed and deeper excavation is proposed (such as the ASB basement, Hospital Road excavation or services). The Environmental Consultant will conduct an assessment of the natural soils for VENM classification compliance through the following scope:

- Inspect the surface of the area to be assessed (ONLY AFTER FILL REMOVAL) to confirm the absence of formerly overlying fill;
- Recover samples on a grid of 1 per 30 m;
- Submit the soil samples (plus QC samples) for analysis of the chemical contaminants identified in the overlying fill (even if at low concentrations), comprising as a minimum the following:
    - Eight priority metals (arsenic, cadmium, chromium, copper lead, mercury, nickel, zinc);
    - TRH / BTEX;
    - PAH; and
    - Asbestos (identification only).
- Inclusion of industry standard QA/QC (refer Section 13.9); and
- Preparation of VENM classification reports (as required for off-site disposal).

## 13.6 Waste Classification

The Environmental Consultant will classify all soil and rock to be disposed off-site in accordance with the POEO Act.

Waste classification will be undertaken in general accordance with the EPA *Waste Classification Guidelines* 2014.

The scope of works for general waste classification purposes is as follows:

- Review of previous applicable results which will be included in the waste classification process;
- If considered necessary due to insufficient data, sampling from across the subject materials at various depths / locations to ensure collection of characteristic samples;
- Analysis of primary samples at a rate considered appropriate to classify the materials; and
- Quality assurance/ quality control (QA/QC) sampling and analysis in accordance with Section 13.9.

The analytical regime adopted will depend on the previous results available for the material, but should include the following approximate frequencies (including previous testing results):

- Asbestos for all samples collected, unless asbestos is clearly present, and the material is assumed to be Special Waste (asbestos);
- Heavy metals, TRH, BTEX and PAH for all samples collected;
- Phenols, PCB, OCP and OPP from a third of the number of samples collected;
- Additional analysis for any specific issues of concern (e.g. odorous or stained material); and
- Toxicity characteristic leaching procedure (TCLP) analysis as required based on total concentration results.

## 13.7 Imported Material Assessment

All proposed imported materials (including DGB, landscaping and temporary filling for platforms) will be assessed as being legally able to be imported to the site, and suitable under the proposed development. Material proposed to be imported to the site must comprise one of the following:

- Virgin excavated natural material (VENM); or
- Materials complying with a Resource Recovery Order (RRO) allowing land application; and
- Meeting the site acceptance criteria.

The scope of works for the assessment of imported materials is as follows:

- Lendlease to provide certification / reports confirming compliance with one of the above, prior to the materials being imported to the site;
- The Environmental Consultant will review the information made available for compliance with one of the above, prior to the materials being imported to the site;
- If the Environmental Consultant determines compliance, they will recover confirmatory samples of the material either on site or at the source site, at a rate of two samples (minimum) per source site;

- Analysis of the samples for a range of potential contaminants including metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols and Asbestos (gravimetric analysis method);
- The Environmental Consultant will inspect the materials upon delivery to site for compliance with the information provided;
- The Environmental Consultant will flag any concerns once identified; and
- The Environmental Consultant will issue an email or memorandum confirming acceptance (or otherwise) of the materials, prior to any materials being included in the works. The validation process will be documented in the final site validation report.

## 13.8 Sample Collection and Handling

Appropriate sampling procedures will be undertaken to ensure that cross contamination does not occur, these will include:

- Use of standard operating procedures to ensure consistency between samples;
- The use of stainless steel or disposable sampling equipment;
- Decontamination of sampling equipment prior to the collection each sample;
- Labelling of the sample containers with individual and unique identification;
- The use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory;
- Samples are stored under secure, temperature controlled conditions;
- The use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory; and
- Recording field observation, including location and dimensions of excavations and stockpiles, sample locations and descriptions, and signs of potential concern.

## 13.9 Quality Assurance Plan

Quality assurance (QA) and quality control (QC) procedures will be integral to the validation assessment and will include those detailed in the following sections.

### 13.9.1 Data Quality Indicators

Field and laboratory procedures will be assessed against the following data quality indicators (DQIs):

- Completeness – a measure of the amount of usable data from a data collection activity;
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event;
- Representativeness – the confidence (qualitative) of data representativeness of media present on-site;
- Precision – a measure of variability or reproducibility of data; and

- Accuracy – a measure of closeness of the data to the 'true' value.

### 13.9.2 Quality Assurance and Quality Control Samples

The following QA/QC samples will be collected and analysed:

- 5% Intra-laboratory replicate samples (for the same suite of analytes as the primary sample);
- 5% Inter-laboratory replicate samples (for the same suite of analytes as the primary sample);
- Rinsate samples (1 per day where re-usable sampling equipment used) (for the same suite of analytes as the primary samples); and
- Trip spikes and trip blanks for each batch of samples requiring analysis for volatile or semi-volatile contaminants (analysed for BTEX).

### 13.9.3 Field Quality Assurance and Quality Control

QA/QC procedures will be adopted throughout the field sampling program to ensure sampling precision and accuracy and prevent cross contamination.

This will comprise using sampling methods and collection and analysis of QA/QC samples in accordance with Section 13.7.2.

### 13.9.4 Laboratory Quality Assurance and Quality Control

NATA accredited laboratories will be used to conduct analysis where possible.

The laboratories will undertake in-house QA/QC procedures involving the routine testing of:-

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis;
- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

## 13.10 Documentation and Reporting

The following documents will be prepared/ obtained by the relevant party, and provided to other parties (the Principal, Contractor, Environmental Consultant and/ or Asbestos Assessor) as required. Documentation should be provided by the relevant parties in a timely manner to allow the works to be conducted efficiently.

### 13.10.1 Principal

The Principal will prepare/ obtain the following documents:

- Any licences and approvals required for the works which are not the responsibility of the Contractor to provide.

### 13.10.2 Contractor

The Contractor will prepare/ obtain the following documents:

- Any licences and approvals required for the works which are the responsibility of the Contractor to provide;
- Excavation and stockpiling records (i.e. tracking records): these will record the source of any stockpiled material, the date of excavation and any issues of concern;
- Transportation record: this will comprise a record of all truck loads of soil entering or leaving the site, including truck identification (e.g. registration number), date, time, load characteristics (i.e. classification, on-site source, destination);
- Tip dockets: these comprise dockets of receipt provided by the receiving waste facility. Where the receiving site is not a waste facility (e.g. if VENM from the site is accepted for re-use on another site), a record of receipt from the receiving site will be supplied; and
- Incident reports: any WHS or environmental incidents which occur during the works will be documented and the PR and appropriate regulatory authority will be informed in accordance with regulatory requirements.

### 13.10.3 Environmental Consultant

The Environmental Consultant will prepare the following documents:

- Stockpile site suitability reports;
- Waste classification reports (as required);
- Advice on the suitability of soil proposed to be imported onto the site (if required); and
- Validation report, including records the remediation and validation work undertaken, and the results of the work.

### 13.10.4 Asbestos Assessor/ Occupational Hygienist

The Asbestos Assessor – occupational hygienist will prepare the following documents:

- Airborne asbestos monitoring records; and
- Visual clearance of asbestos removal.

## 13.11 Validation Reporting

In addition to those listed in Section 13.7, the following documents will need to be reviewed as part of the validation assessment by the environmental consultant at the completion of all remediation works. These are to include and be provided to the environmental consultant by the relevant parties:

- Records relating to any unexpected finds and contingency plans implemented;

- Laboratory certificates and chain-of-custody documentation; and
- Letters/ memos as required which provide instruction or information to the principal or contractor.

The purpose of the documentation is to ensure the works are conducted in accordance with all applicable regulations and that appropriate records of the works are kept for future reference. Documentation should be provided by the relevant parties in a timely manner to allow the works to be conducted efficiently.

A validation assessment report will be prepared for the site by the environmental consultant in accordance with NSW Office of Environment and Heritage (OEH) *Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites* (reprinted 2011) and other appropriate guidance documentation. The validation report shall detail the methodology, results and conclusion of the assessment and make a clear statement regarding the suitability of the site for the proposed land use.

## 14. General Environmental Management Plan

General environmental management at the site will be undertaken in accordance with the following documents:

- Lendlease Randwick Campus Redevelopment, Project EHS Management Plan, Issue No.4, dated 16 July 2018;
- Lendlease Randwick Campus Redevelopment, Management Plan - Contamination, Issue No.2.2, dated 4 December 2018; and
- Lendlease Randwick Campus Redevelopment, Management Plan - Waste, Issue No.2.3, dated 4 December 2018.The Contractors will undertake the work with due regard to the minimisation of environmental effects and to meet regulatory and statutory requirements.

## 15. Roles and Responsibilities

**Principal**

The Principal (Health Infrastructure) is responsible for the environmental performance of the proposed remediation works, including implementation of acceptable environmental controls during all site works. The Principal will retain the overall responsibility for ensuring this RAP is appropriately implemented. The Principal is to nominate a representative (Lendlease), who is responsible for overseeing the implementation of this RAP. The actual implementation of the RAP will, however, be conducted by the Contractor on behalf of the Principal.

The Principal will also be responsible for acquiring all necessary approvals for the remediation works proposed, including approval from the consent authority.

**Contractor and Site Manager**

The Contractor (Lendlease) is foreseen to be the party responsible for the day to day implementation of this RAP and shall fulfil the responsibilities of the Principal Contractor as defined by WorkCover. It is noted that the Contractor may appoint appropriately qualified sub-contractors or sub-consultants to assist in fulfilling the requirements of the procedures.

The Contractor will nominate a Site Manager who will be responsible for day to day site management and first response to any unexpected finds encountered during works.

**Site Auditor**

The site auditor will be responsible for the preparation of interim audit advice notices as required during the works and review of reports produced by the Environmental Consultant and submitted to the auditor for review. The auditor will be responsible for the preparation of a Site Audit Statement (if required) for works under the development consent conditions.

**Asbestos Contractor**

The Asbestos Contractor will be responsible for undertaking all asbestos works and will hold either a Class A or B licence (issued by WorkCover NSW) as appropriate. For friable (Class A) works a certified supervisor must be present at all times, for bonded works > 10 $m^2$ (Class B) a certified supervisor must be readily available to the certified removalist workers.

The Asbestos Contractor and Contractor can be the same entity.

**Environmental Consultant (EC)**

The Environmental Consultant will provide advice on implementing this RAP and validate that the site has been appropriately remediated. In general terms, the Environmental Consultant will:

- Provide advice to their client as required for the remediation works;
- Identify the extents of remediation areas, as outlined in Section 7;
- Undertake all validation assessment work, including inspections, sampling and reporting outlined in Section 13;
- Provide advice and recommendations arising from inspections/observations;
- Notify their client with the results of any assessments and any observed non-conformances in a timely manner;
- Undertake the required waste classification assessments for disposal of liquid and solid wastes;
- Attend to unexpected finds as outlined in Section 12; and
- Validate and approve the use on any imported materials used in the civil works.

**Occupational Hygienist**

The Occupational Hygienist will provide advice on WHS issues related to the asbestos works. The Occupational Hygienist will be suitably qualified / licenced in accordance with the WHS Regulations 2011.

The Occupational Hygienist will:

- Prepare any WHS plans and advice requested by the Contractor;
- Undertake airborne asbestos monitoring (as required);
- Undertake visual clearance inspections;
- Provide advice and recommendations arising from monitoring and/or inspections;
- Notify their client with the results of any assessments and any observed non-conformances in a timely manner; and
- Issue clearance certification.

The Environmental Consultant and Occupational Hygienist can be the same entity.

**Contact Details**

The following table provides a list of personnel and contact details relevant to the remediation. The list should be filled in as relevant personnel are appointed to the project.

**Table 16: Contact Details**

| Role | Personnel / Contact | Contact Details (phone) |
|---|---|---|
| Principal | Health Infrastructure | |
| Principal Contractor | Lendlease Building | [redacted] |
| Site Manager | | |
| Environmental Consultant | Douglas Partners | [redacted] |
| Regulator | NSW EPA (pollution line) | 131 555 |
| | NSW EPA (general enquiries) | 131 555 |
| Consent Authority | Randwick City Council | (02) 9093 6000 |
| Utility Provider | Sydney Water | 13 20 92 |
| Utility Provider | Power | |
| Utility Provider | Gas | |

Note: Table to be completed when the contact details are known.

## 16. Conclusions

It is considered that Stage 1 and the IASB Addition site can be rendered suitable for the proposed development subject to proper implementation of the remediation procedures, unexpected finds protocols and completion of the validation assessment detailed in this RAP.

It is understood that a Groundwater Management Plan will be prepared at the direction of Lendlease for inclusion in a dewatering license application to NSW Water.

## 17. Limitations

Douglas Partners (DP) has prepared this report for the proposed Randwick Campus Redevelopment in accordance with DP's proposal and acceptance received from Lendlease Building Pty Ltd. This report is provided for the exclusive use of Lendlease Building Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

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

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

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

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the discussions section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Asbestos has not been detected by observation or by laboratory analysis, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Although the sampling plan

adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints. It is therefore considered possible that hazardous building materials, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

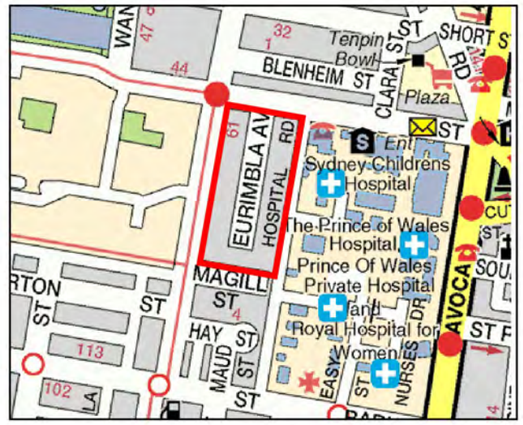
**Douglas Partners Pty Ltd**

# Appendix A

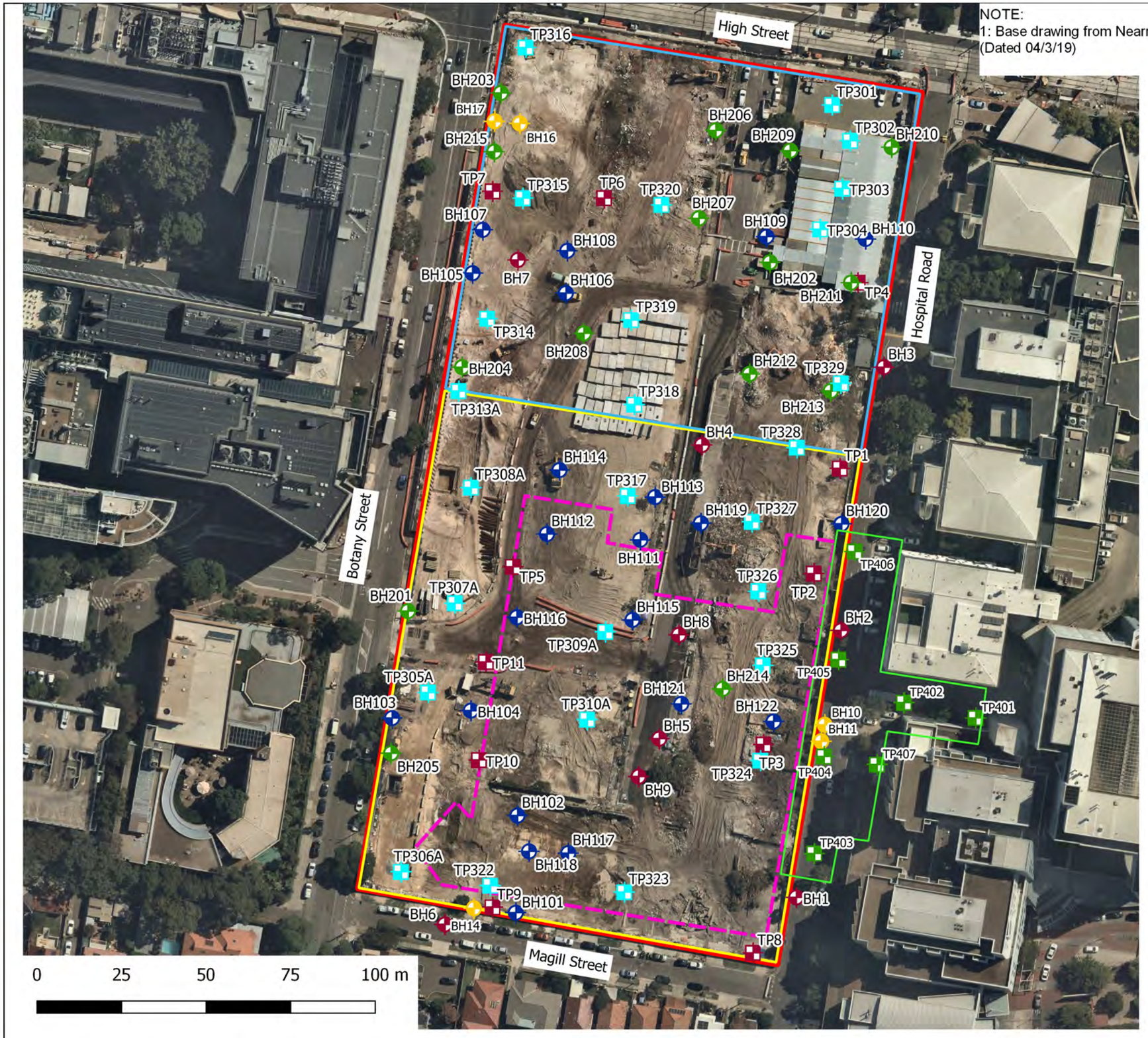
Drawings

About This Report

NOTE:
1: Base drawing from Nearmap.com
(Dated 04/3/19)




**Locality Plan**




## Legend

- RCR Project Area Boundary
- Acute Services Building
- IASB Addition Boundary
- Stage 1 Boundary
- Stage 2 Boundary

Test Locations

- Post Demolition Test Pit (Current Investigation)
- DP Borehole Location (June, 2018)
- DP Borehole Location (Oct. 2017)
- DP Environmental Borehole (Jan. 2018)
- DP Test Pit Location (Aug. 2018)
- IASB Addition Test Pits (Aug. 2019)
- Existing Groundwater Wells

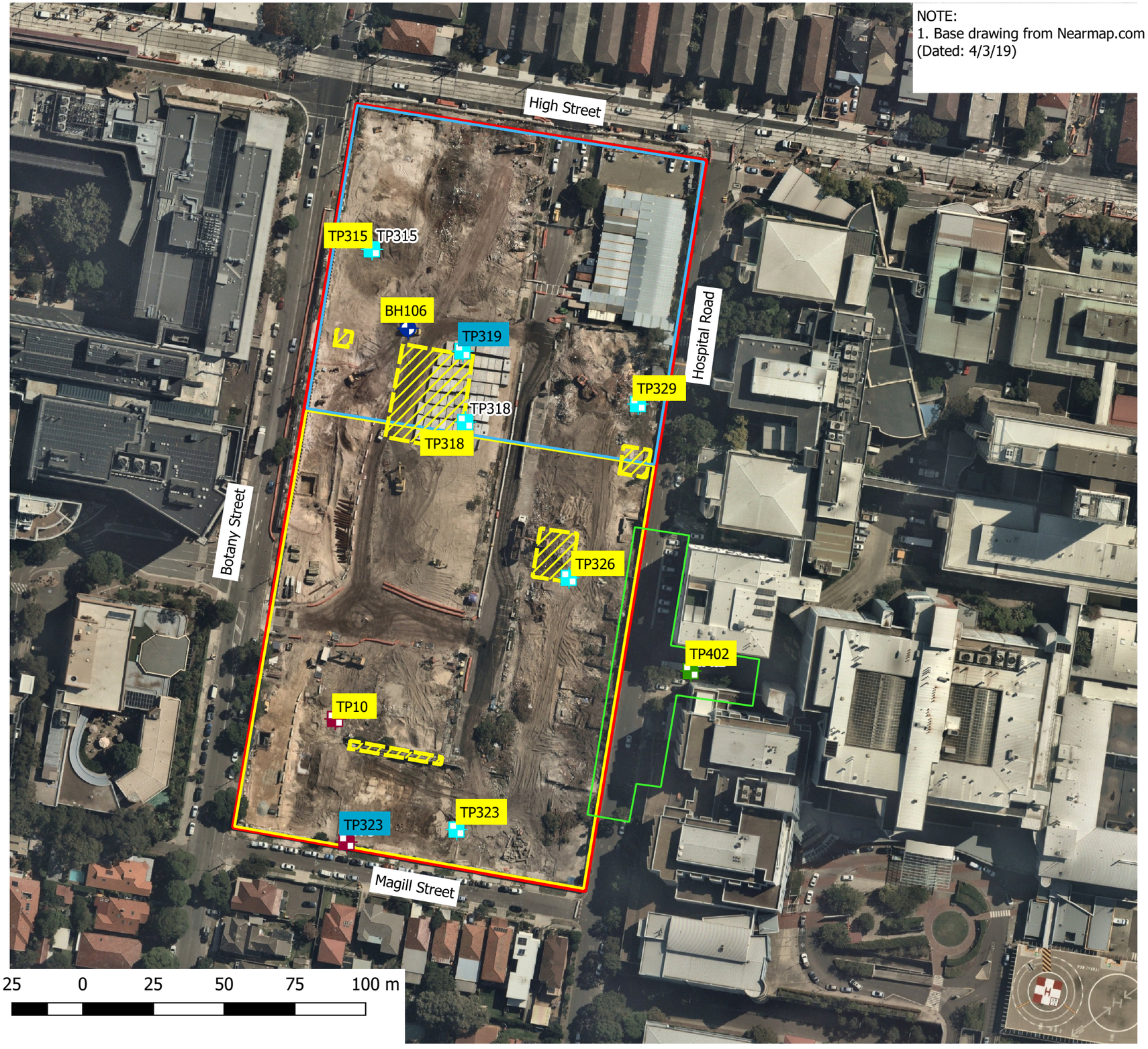
Douglas Partners
Geotechnics / Environment / Groundwater

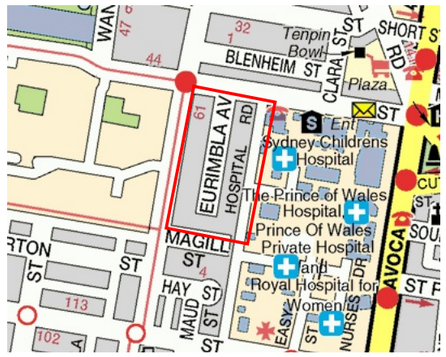
| | | | |
|---|---|---|---|
| CLIENT: | Lend Lease Building Pty Ltd | | |
| OFFICE: | Sydney | DRAWN BY: | AD |
| SCALE: | As shown | DATE: | 4/9/2019 |

TITLE: **Sample Locations**
**Randwick Campus Redevelopment**
**Randwick, NSW**

| | |
|---|---|
| PROJECT No: | 72505.14 |
| DRAWING No: | 1 |
| REVISION: | 0 |

NOTE:
1. Base drawing from Nearmap.com (Dated: 4/3/19)




## Legend

- Greater RCR Boundary
- Stage 1 Boundary
- Stage 2 Boundary
- Approximate Observed Surface ACM Areas
- IASB Addition

Test Locations in which ACM was observed

- Post Demolition Test Pit (Current Investigation)
- DP Environmental Borehole (Jan. 2018)
- DP Test Pit Location (Aug. 2018)
- IASB Addition Test Pit Location (Aug. 2019)

- ACM observed at test location/during seiving (0-0.25m depth), between 9/1/2018 and 13/2/2019
- ACM observed at test location/during seiving (0.4-0.5m depth), between 8/8/2018 and 11/2/2019

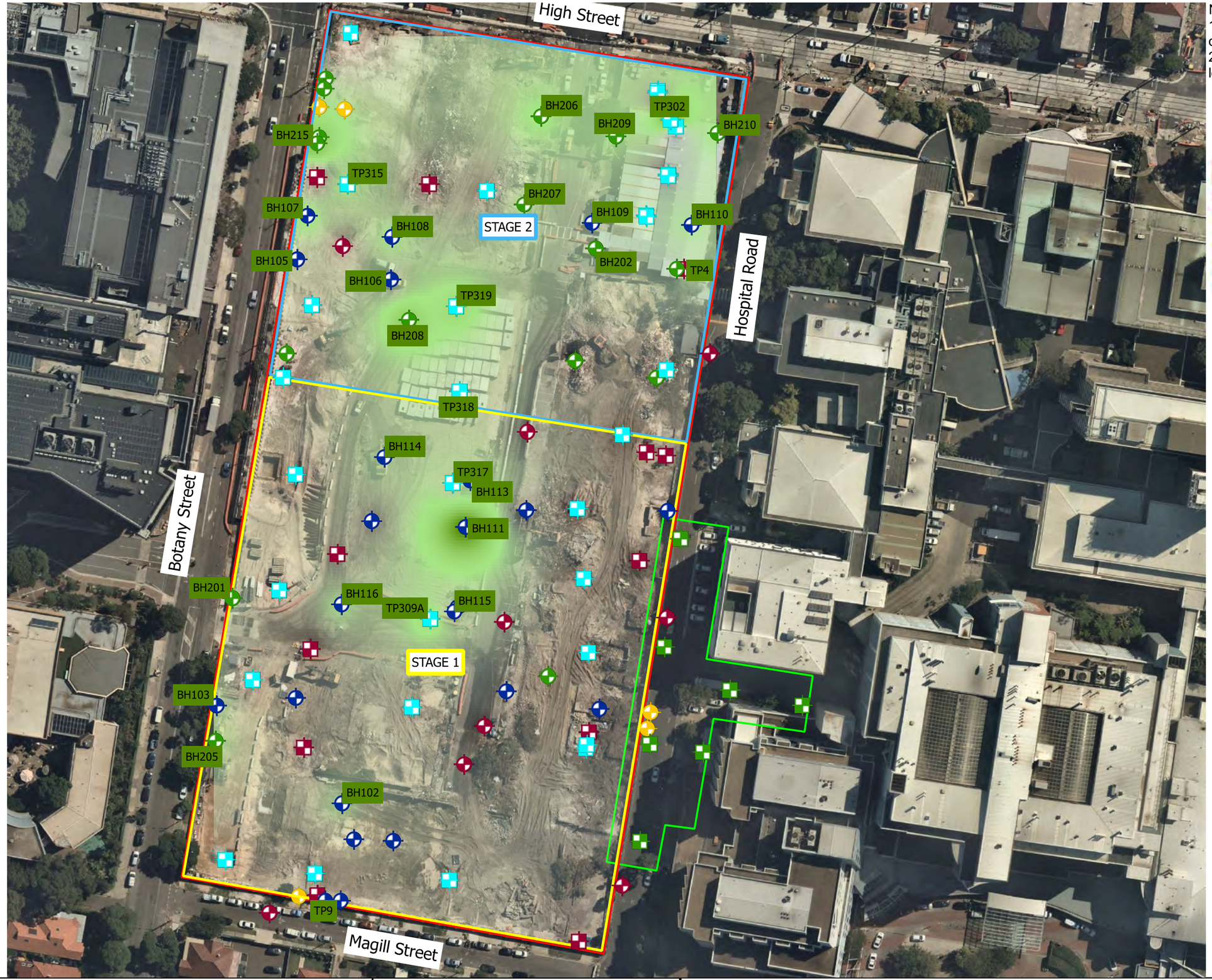
Douglas Partners
Geotechnics / Environment / Groundwater

| | | |
|---|---|---|
| CLIENT: | Lend Lease Building | |
| OFFICE: | Sydney | DRAWN BY: AD |
| SCALE: | 1:1250 | DATE: 4/9/2019 |

TITLE: **Asbestos Containing Material Finds**
**Randwick Campus Redevelopment**
**Randwick, NSW**

N

| | |
|---|---|
| PROJECT No: | 72505.14 |
| DRAWING No: | 2 |
| REVISION: | 0 |




NOTE:
1: Detected B(a)P concentrations for soils up to 1 m depth
2: Interpolation of concentrations between test locations is approximate only

## Legend

- RCR Project Area Boundary
- Acute Services Building
- IASB Addition Boundary
- Stage 1 Boundary
- Stage 2 Boundary

B(a)P Concentration (mg/kg)

- 0
- 1.60
- 3.25
- 4.90
- 6.50

Test Locations

- Post Demolition Test Pit (Current Investigation)
- DP Test Tit Location (Aug. 2018)
- DP Environmental Borehole (Jan. 2018)
- DP Borehole Bocation (Oct. 2017)
- DP Borehole Location (June, 2018)
- IASB Addition Test Pit Locations (Aug.2019)
- Existing Groundwater Well
- B(a)P Detected Above 0.7 mg/kg

0 25 50 75 m

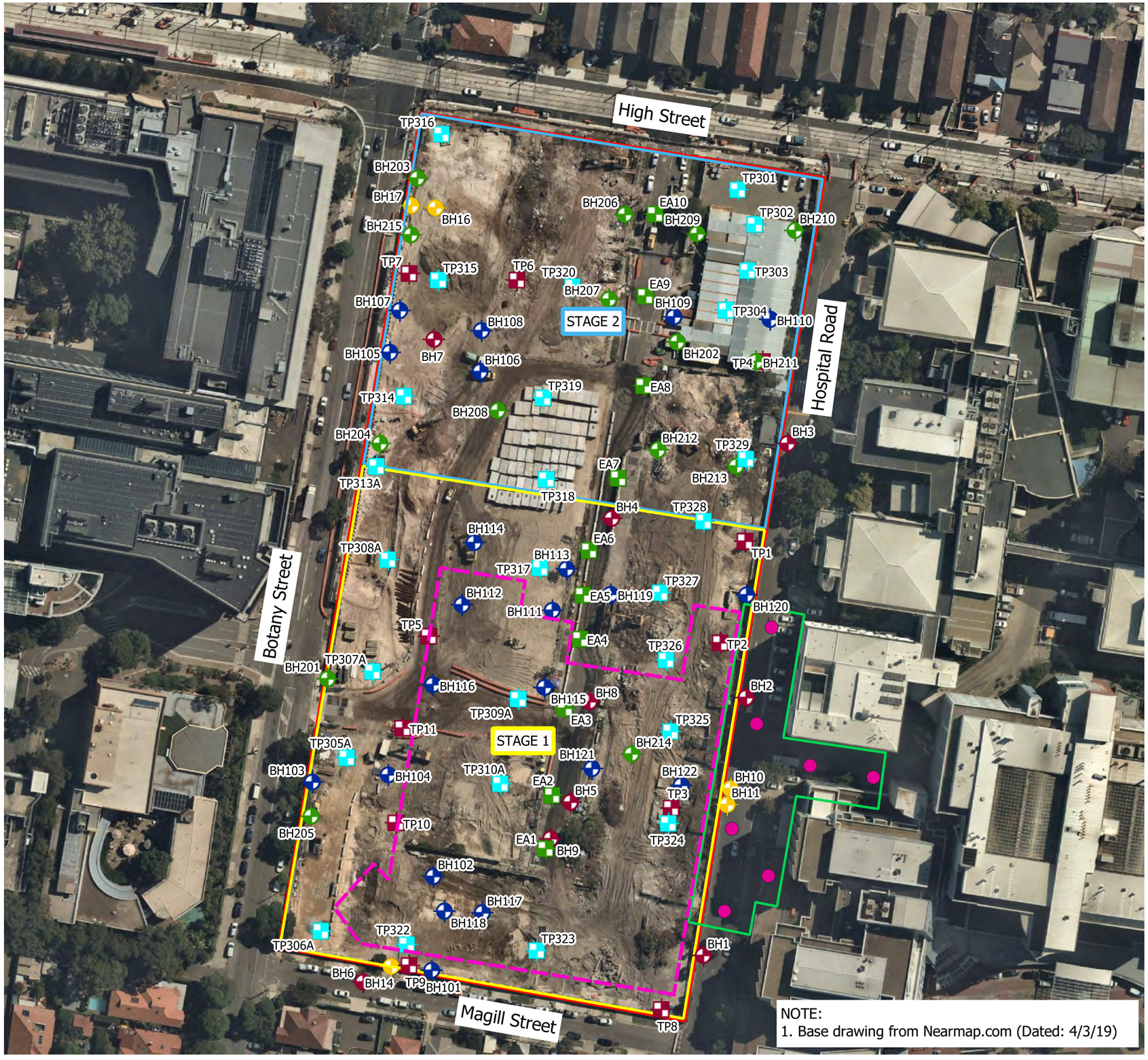
Douglas Partners
Geotechnics / Environment / Groundwater

| | | | |
|---|---|---|---|
| CLIENT: | Lend Lease Building | | |
| OFFICE: | Sydney | DRAWN BY: | AD |
| SCALE: | 1:1250 | DATE: | 4/9/2019 |

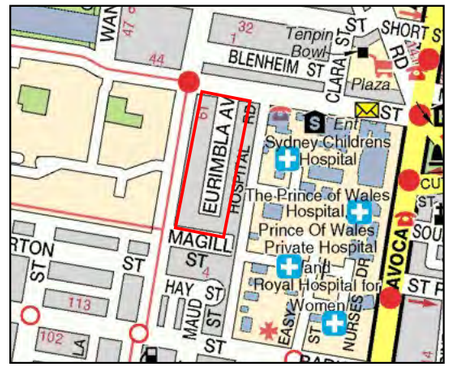
TITLE: **Benzo(a)Pyrene In Soils**
**Randwick Campus Development**
**Randwick, NSW**

N

| | |
|---|---|
| PROJECT No: | 72505.14 |
| DRAWING No: | 3 |
| REVISION: | 0 |




NOTE:
1. Base drawing from Nearmap.com (Dated: 4/3/19)




**Locality Plan**

## Legend

- RCR Project Area Boundary
- Stage 1 Boundary
- Stage 2 Boundary
- Proposed Acute Services Building
- IASB Addition Boundary
- Aggregrate Sampling Test Pits (Feb. 2019)
- Post Demolition Test Pit (Feb. 2019)
- DP test pit location (Aug. 2018)
- DP Environmental borehole (Jan. 2018)
- DP borehole location (Oct. 2017)
- DP borehole location (Jun. 2018)
- Existing Groundwater Well
- Proposed Sampling Locations

0 25 50 75 100 m

Douglas Partners
Geotechnics | Environment | Groundwater

| | | | |
|---|---|---|---|
| CLIENT: | Lend Lease Building | | |
| OFFICE: | Sydney | DRAWN BY: | LT |
| SCALE: | 1:1250 | DATE: | 14.08.2019 |

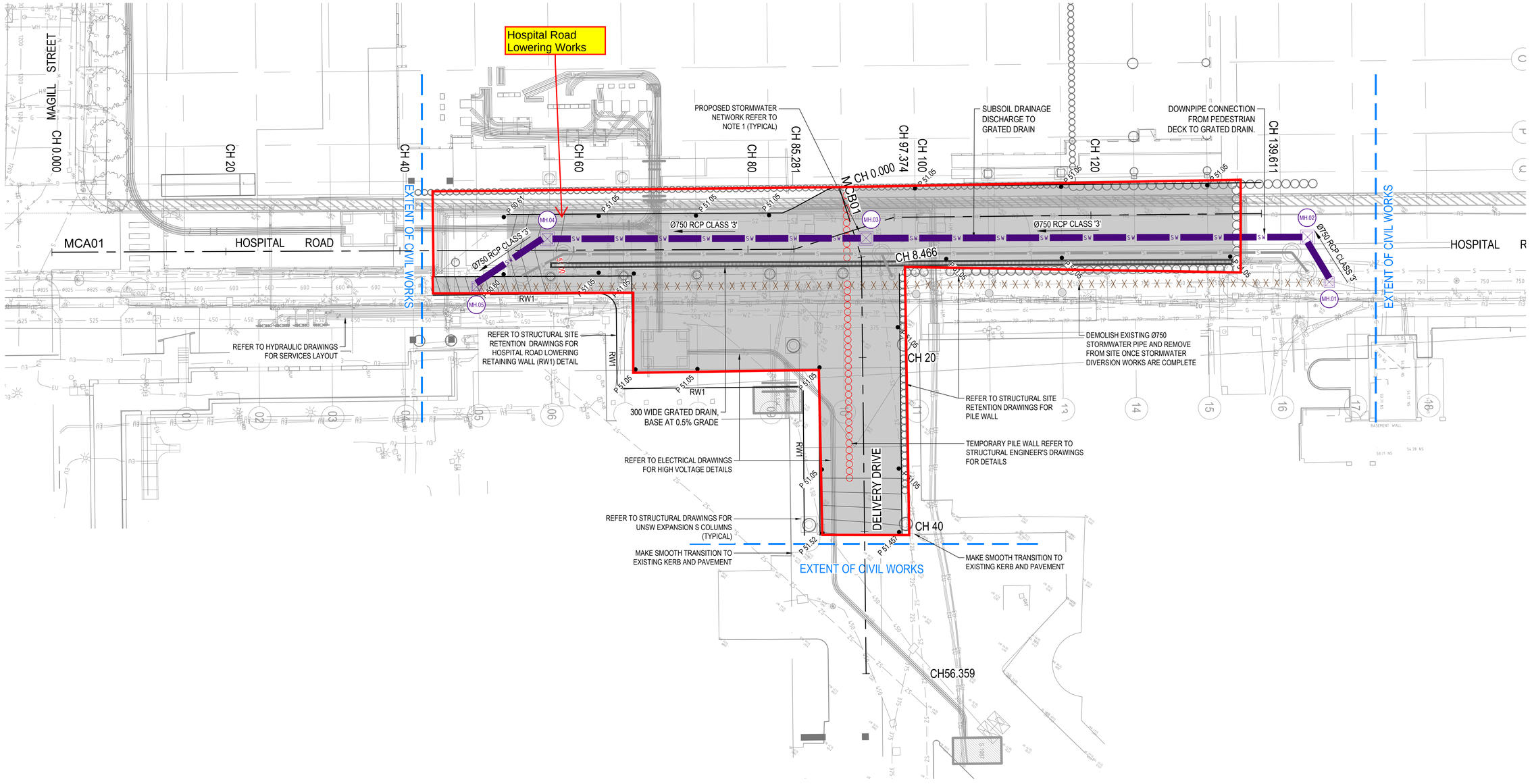
TITLE: **Proposed Sampling Locations**
**Randwick Campus Development - IASB Addition**
**Hospital Road, High, Magill and Botany Streets, Randwick, NSW**

N

| | |
|---|---|
| PROJECT No: | 72505.14 |
| DRAWING No: | 4A |
| REVISION: | 0 |

## NOTE

1. REFER TO STORMWATER STANDARD DETAILS DRAWING RCR-ACR-CV-00-DWG-00-602 AND STORMWATER LONGSECTION AND PIT SCHEDULE DRAWING RCR-ACR-CV-00-DWG-00-950.

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NOTE
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| ISSUE | DATE | FOR |
|---|---|---|
| A | 23.11.18 | SCHEMATIC DESIGN |
| B | 20.12.18 | ISSUE FOR PRICING |
| C | 15.05.19 | DRAFT SSDA |
| D | 04.07.19 | ISSUE FOR SSDA |
| E | 11.09.19 | ISSUE FOR COORDINATION |

PROJECT MANAGEMENT
PWC

STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
FREDON AIR

ELECTRICAL ENGINEERING
FREDON

HYDRAULIC ENGINEERING
CP CONSULTANTS

CLIENT
NSW GOVERNMENT Health Infrastructure

PROJECT
HOSPITAL ROAD
LOWERING
RANDWICK NSW AUSTRALIA

ACOR PROJECT NUMBER
SY180053

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
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STATUS
DESIGN

DRAWING
GENERAL ARRANGEMENT
SHEET 1

| DRAWING NUMBER | ISSUE |
|---|---|
| RCR-ACR-CV-00-DWG-00-101 | E |

# About this Report

Douglas Partners

## Introduction

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

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

## Copyright



## Borehole and Test Pit Logs

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

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

## Groundwater

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

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

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

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

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

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

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

# *About this Report*

## Site Anomalies

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

## Information for Contractual Purposes

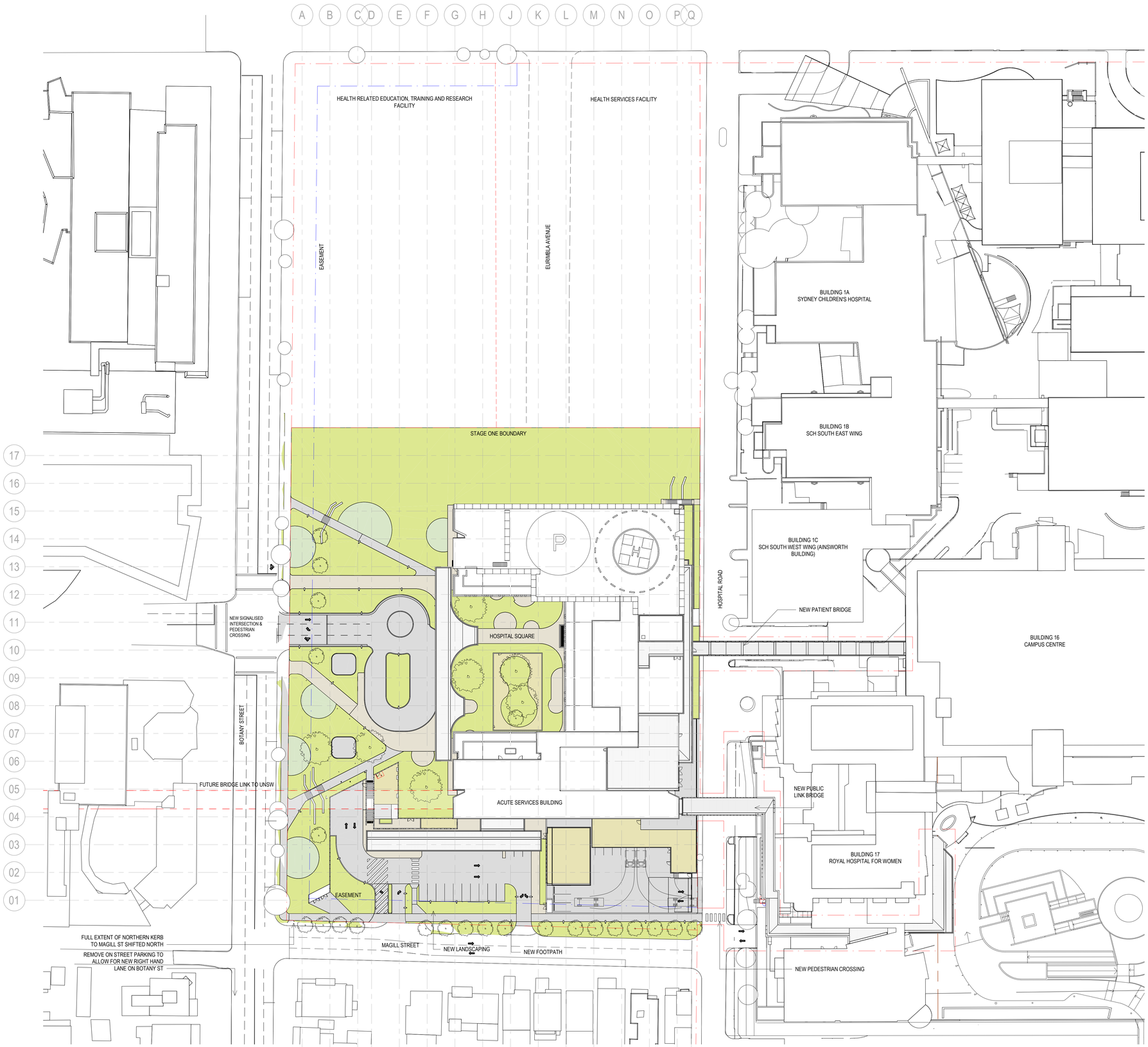
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## Site Inspection

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

# Appendix B

Proposed Development Plans

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NOTE

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| ISSUE | DATE | FOR |
|---|---|---|
| A | 20/04/18 | FOR INFORMATION |
| B | 27/04/18 | FOR INFORMATION |
| C | 10/05/18 | FOR INFORMATION |
| D | 16/05/18 | FOR INFORMATION |
| E | 08/08/18 | FOR INFORMATION |
| F | 14/09/18 | DD 100% UPDATE |

PROJECT MANAGEMENT
PWC

CIVIL AND STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSTRUCTION MANAGER
lendlease

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE
CLIENT NUMBER

130487
PROJECT

RANDWICK CAMPUS REDEVELOPMENT

BARKER ST
RANDWICK NSW 2031
AUSTRALIA
BVN PROJECT NUMBER

s1606008
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000
SCALE

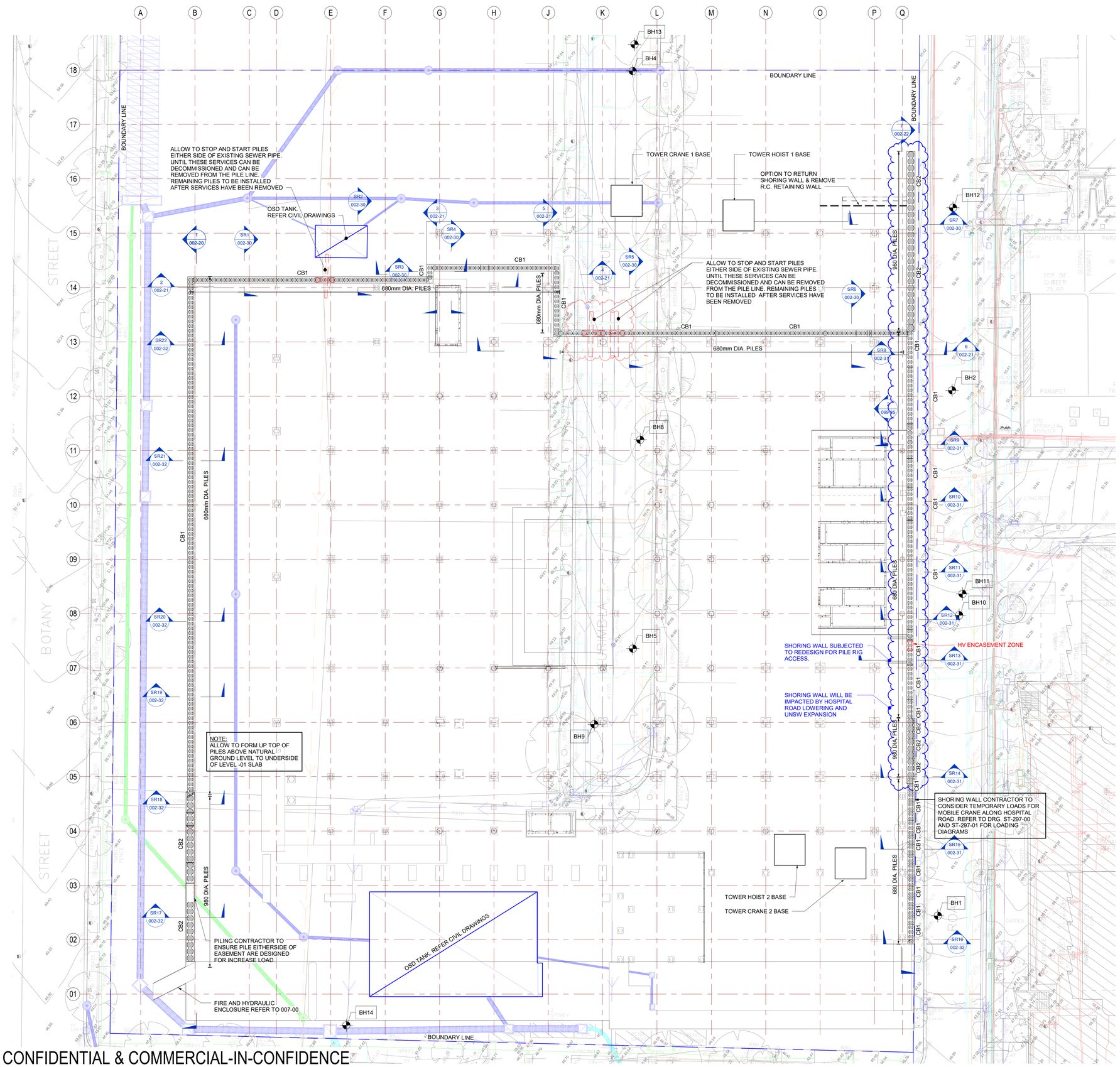
1 : 500@B1 DO NOT SCALE
STATUS

FOR INFORMATION
DRAWING

# SITE PLAN

RCR-BVN-ARC-00-DRW-01A-NL00013 ISSUE F

FOR GENERAL NOTES REFER TO DRAWING RCR-ENS-STR-50-DRW-001-01




## SHORING NOTES

GEOTECHNICAL REPORT
- THE CONTRACTOR SHALL OBTAIN A COPY OF THE GEOTECHNICAL REPORT 72505.11.R.001 REVISION 2 AND SUPPLEMENTARY REPORT 72505.13.R.001 JUNE 18 BY DOUGLAS PARTNERS AND ADHERE TO THE RECOMMENDATIONS CONTAINED THEREIN.
- REFER TO GEOTECHNICAL REPORT 72505.11.R.001 REVISION 2 BY DOUGLAS PARTNERS DATED JUNE 2017 AND SUPPLEMENTARY REPORT 72505.13.R.001 REVISION A DATED MAY 2018 FOR ALL GROUND CONDITIONS

SITE SURVEY
- SURVEY INFORMATION PROVIDED AS REFERENCE ONLY. PLEASE REFER TO LATEST SURVEY INFORMATION.

SPECIFICATION
- THESE NOTES ARE TO BE READ IN CONJUNCTION WITH THE STRUCTURAL AND OTHER SPECIFICATIONS.

DUST CONTROL
- THE CONTRACTOR IS TO ENSURE THAT THE DUST PREVENTION METHODS HE ADOPTS ARE SUFFICIENT TO MEET THE REQUIREMENTS OF THE SYDNEY CITY COUNCIL. IT IS THE CONTRACTORS' RESPONSIBILITY TO ACQUAINT HIMSELF WITH THE REQUIREMENTS.

SITE SETOUT
- REFER TO THE ARCHITECTS DRAWINGS FOR THE ACCURATE SETOUT OF ALL BUILDINGS, DRIVEWAYS, PARKING AREAS ETC. NOTE BULK EARTHWORKS PLAN IS INDICATIVE ONLY. CALCULATE AND CUT BATTERS FROM ARCHITECT'S PLANS AND SURVEY. CROSSOVER PROFILES TO COUNCIL REQUIREMENTS.

GENERALLY
- PROCEED WITH BULK EARTHWORKS AND SHORING TO PROVIDE A STABLE SUBGRADE AND WORK SPACE FOR THE CONSTRUCTION OF THE PROPOSED DEVELOPMENT. REDUCE SITE TO LEVELS INDICATED AND DISPOSE OF ALL UNWANTED MATERIAL LEGALLY.

SITE RETENTION
- RETAINING WALLS HAVE NOT BEEN DESIGNED FOR HYDROSTATIC PRESSURE. HYDRAULIC ENGINEER AND CONTRACTOR TO PROVIDE STRIP DRAINS TO PREVENT ANY WATER PRESSURE BUILD UP.

SUPERVISION
- A GEOTECHNICAL ENGINEER IS TO PROVIDE LEVEL 1 SUPERVISION (AS3798) FOR ALL EARTHWORKS DURING THE COURSE OF CONSTRUCTION. AT THE COMPLETION OF THE BULK EXCAVATION CONTRACT, THE GEOTECHNICAL ENGINEER IS TO PROVIDE CERTIFICATION THAT THE WORKS HAVE BEEN CARRIED OUT IN ACCORDANCE WITH BULK EARTHWORKS SPECIFICATION.
- GEOTECHNICAL SUPERVISION AND ROCK MAPPING OF ALL EXCAVATION FACES IS TO BE UNDERTAKEN

DRAINAGE DURING CONSTRUCTION
- PROVIDE ADEQUATE DRAINAGE DURING CONSTRUCTION TO ENSURE MINIMUM DISRUPTION FROM RAIN.

SERVICES
- DURING EXCAVATION COORDINATE WITH ALL SERVICES INCLUDING SEWER, GAS AND POWER.
- THE CONTRACTOR IS TO OBTAIN A COPY OF SERVICES LOCATOR DRAWINGS AND ENSURE ALL ANCHORS AVOID ALL SERVICES.

BULK EARTHWORKS PROCEDURE AND SPECIFICATION
- AT THE COMPLETION OF THE BULK EARTHWORKS, THE CONTRACTOR SHALL PROVIDE TEMPORARY OR PERMANENT DRAINAGE TO ENSURE NO SURFACE WATER IS RETAINED ON THE SITE, OR THAT SURFACE WATER FLOW DETRIMENTALLY SCOURS THE PREPARED BASE.

GEOTECHNICAL ENGINEER NOTES:
- EXCAVATION TO BE CARRIED OUT UNDER GEOTECHNICAL ENGINEER'S SUPERVISION.
- GEOTECHNICAL ENGINEER TO COMMENT ON SUITABILITY OF THE SUBCONTRACTOR'S METHOD OF EXCAVATION AS REMOVAL PROCEEDS.

HYDRAULICS ENGINEER
- DURING EXCAVATION COORDINATE WITH ALL HYDRAULIC ENGINEERS REQUIREMENTS FOR SEWER, GAS AND STORMWATER LINES.

AS-BUILT DRAWING
- PROVIDE AN AS-BUILT DRAWING PREPARED BY A REGISTERED SURVEYOR TO CONFIRM BULK EARTHWORKS IS COMPLETED TO REQUIRED DIMENSIONS AND LEVELS.

DILAPIDATION REPORT
- THE APPROVED SHORING WALL CONTRACTOR SHALL PREPARE A DILAPIDATION REPORT OF STREET, FOOTPATH AND ROAD FEATURES PRIOR TO INSTALLATION OF SHORING WALL.

COMPACTION NOTES
- COMPACTION BEHIND INTERNAL FORMED RETAINING WALL BY EXCAVATION CONTRACTOR USING HAND HELD RAMMERS TO ACHIEVE 98% MODIFIED DENSITY.
- COMPACT IN MAXIMUM 300mm THICK LAYERS AT OPTIMUM MOISTURE CONTENT OF ±3%.

CONTRACTORS NOTES
- INFERRED SUBSURFACE CONDITIONS HAVE BEEN ASSUMED OR PREPARED BY INTERPOLATION AND/OR EXTRAPOLATION FROM DISCRETE TEST HOLE DATA AND AS SUCH THE CONDITIONS SHOWN ARE AN INTERPRETATION AND MUST BE CONSIDERED AS A GUIDE ONLY. LOCAL VARIATIONS OR ANOMALIES IN GROUND CONDITIONS CAN OCCUR IN THE NATURAL ENVIRONMENT, PARTICULARLY BETWEEN DISCRETE TEST HOLE LOCATIONS.
- SPECIFIC SUPPORT REQUIREMENTS CAN ONLY BE ASSESSED DURING EXCAVATION. VERIFICATION OF THE GEOTECHNICAL ASSUMPTIONS AND/OR MODEL AND SITE RETENTION SYSTEM IS AN INTEGRAL PART OF THE DESIGN PROCESS. THE CONTRACTOR SHALL MAKE ALLOWANCE TO ENGAGE THE ABOVE MENTIONED GEOTECHNICAL ENGINEER TO CARRY OUT FULL TIME INSPECTIONS AS THE EXCAVATION PROGRESSES FOR THE PURPOSE OF INVESTIGATION, CONSTRUCTION VERIFICATION AND PERFORMANCE MONITORING.
- DESIGN OF GROUND ANCHORS TO BE D&C BY THE CONTRACTOR. DETAILS AND CALCULATIONS TO BE SUBMITTED FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- SOIL/ROCK RL'S ARE BASED ON DOUGLAS PARTNERS INVESTIGATION REPORT, REFER TO ABOVE MENTIONED DOCUMENT. THIS MAY VARY FROM ACTUAL SITE CONDITIONS
- CONTRACTOR TO LOCATE ALL SERVICES ON AND AROUND THE SITE AND ENSURE ALL GROUND ANCHORS AND ROCK BOLTS AVOID ALL SERVICES.
- CONTRACTOR TO DEVELOP SEQUENCING OF WORKS ALLOWING FOR ALL SERVICES RELOCATION REQUIREMENTS AND SUBMIT SEQUENCING METHODOLOGY FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- ALL GROUND ANCHORS TO BE LOCATED TO AVOID NEW BUILD FLOOR AND COLUMN STRUCTURES SHOWN ON THE ELEVATIONS.
- REFER TO GEOTECHNICAL ADVICE FOR EXCAVATION AND METHODOLOGY AND MONITORING REQUIREMENTS.

LEGEND

DENOTES BORE HOLE LOCATIONS

REFER TO DRG. ST-002-10 FOR TYPICAL SITE RETENTION DETAILS

REFER TO DRG. ST-003-00 TO ST-003-01 FOUNDATION GENERAL ARRANGEMENTS

SHORING DESIGN & DETAILS BY CONTRACTOR

REFER TO GEOTECHNICAL REPORT 72505.11.R.001 REVISION 2 BY DOUGLAS PARTNERS DATED NOVEMBER 2017 AND SUPPLEMENTARY REPORT 72505.13.R.001 DATED JUNE 2018 FOR ALL GROUND CONDITIONS

## SITE RETENTION - GENERAL ARRANGEMENT

SCALE 1 : 250

CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

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enstruct

enstruct group pty ltd

Level 4, 2 Glen Street
Milsons Point NSW 2061
Australia

Telephone (02) 8904 1444
Facsimile (02) 8904 1555
http: //www.enstruct.com.au


NOTE
CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

| ISSUE | DATE | FOR |
|---|---|---|
| A | 11.10.17 | 70% SD ISSUE |
| B | 13.11.17 | DRAFT 95% SD ISSUE |
| C | 30.11.17 | 95% SD ISSUE |
| D | 31.01.18 | 100% SD ISSUE |
| E | 01.02.18 | 100% SD ISSUE UPDATE |
| F | 05.02.18 | 100% SD ISSUE UPDATE |
| G | 16.02.18 | 100% SD ISSUE UPDATE |
| H | 01.06.18 | ISSUED FOR COODINATION |
| I | 05.06.18 | ISSUED FOR COORDINATION |
| J | 28.06.18 | 50% DD ISSUE |
| K | 03.08.18 | ISSUED FOR COODINATION |
| L | 20.08.18 | 100% DD ISSUE |
| M | 31.08.18 | 100% DD UPDATES |
| N | 07.09.18 | 100% DD UPDATES |
| O | 14.09.18 | 100% DD UPDATES |
| 1 | 11.12.18 | ISSUED FOR CONSTRUCTION |
| 2 | 21.12.18 | ISSUED FOR CONSTRUCTION |

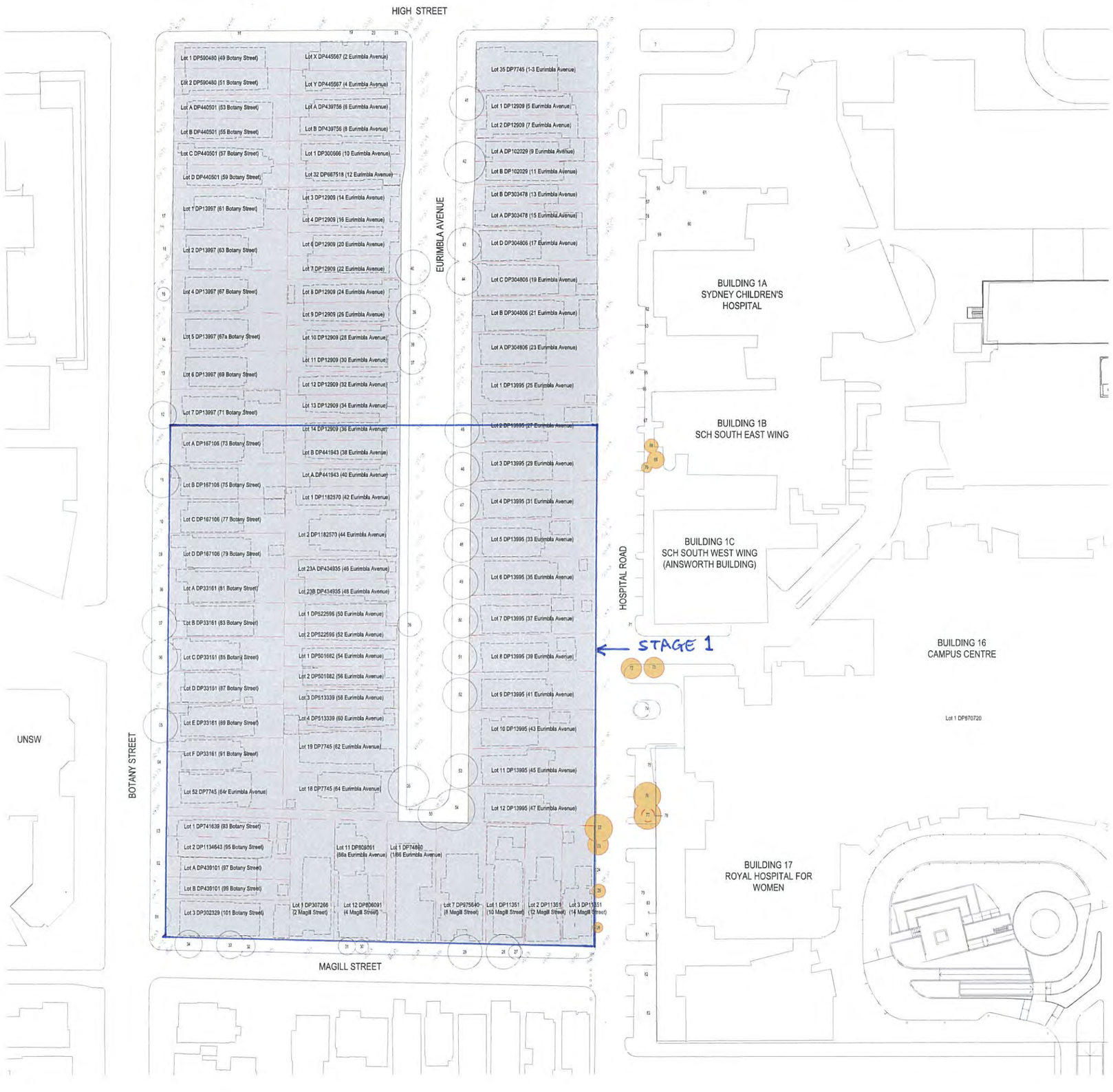
DRAWINGS DO NOT INCLUDE ANY ALLOWANCE FOR UNSW EXPANSION

PROJECT MANAGEMENT
PWC
ARCHITECTS
BVN / TERROIR
MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL
ELECTRICAL ENGINEERING
WOOD & GRIEVE ENGINEERS
HYDRAULIC ENGINEERING
ACOR CONSULTANTS
CONSTRUCTION MANAGER
lendlease
CLIENT
NSW GOVERNMENT Health Infrastructure
HEALTH INFRASTRUCTURE
CLIENT NUMBER
130487
PROJECT
RANDWICK CAMPUS REDEVELOPMENT
BAKER ST
RANDWICK NSW 2031
AUSTRALIA
ENSTRUCT PROJECT NUMBER
5385
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000
SCALE
As indicated@B1 DO NOT SCALE
STATUS
FOR CONSTRUCTION
DRAWING
BUILDING 50
SITE RETENTION GENERAL ARRANGEMENT

| DRAWING NUMBER | ISSUE |
|---|---|
| RCR-ENS-STR-50-DRW-002-00 | 2 |




DEVELOPMENT APPLICATION
**208/2018**
Randwick City Council
18 April 2018
Records Received

BVN TERROIR

Telephone: +61 2 8297 7200
Facsimile: +61 2 8297 7299
www.bvn.com.au



NOTE
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| ISSUE | DATE | FOR |
|---|---|---|
| A | 14.03.2018 | FOR INFORMATION |

PROJECT MANAGEMENT
AURECON

CIVIL AND STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
AECOM AUSTRALIA

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSULTANT
PROJECT MANAGER

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE
CLIENT NUMBER

130487
PROJECT

POW REDEVELOPMENT
BAKER ST
RANDWICK NSW
AUSTRALIA
BVN PROJECT NUMBER

s1605008
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000
SCALE

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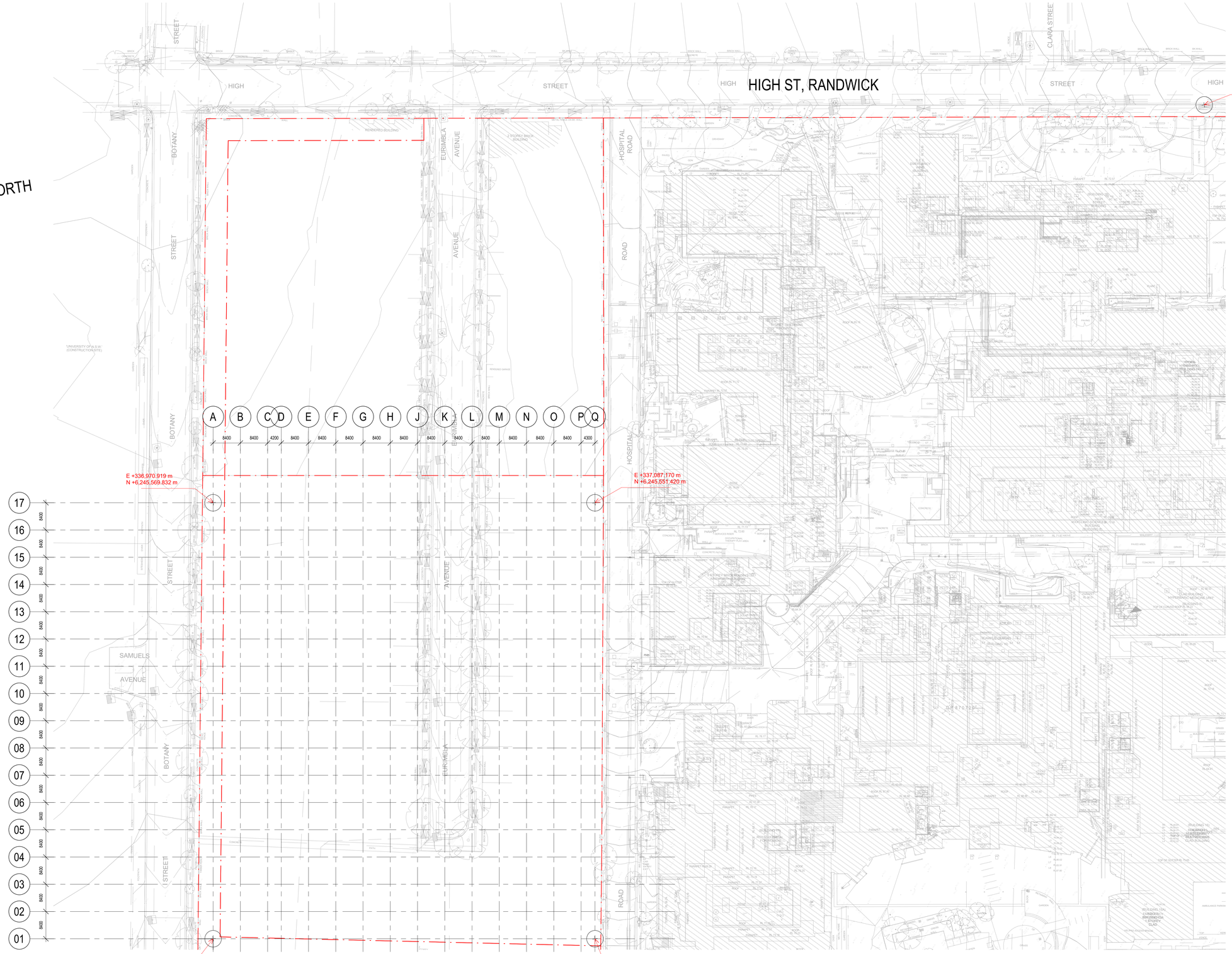
STATUS

DRAWING
DEMOLITION PLAN - DEVELOPMENT APPLICATION

RCR-BVN-AR-00-DWG-U1-XX-03
ISSUE A

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| ISSUE | DATE | FOR |
|---|---|---|
| A | 21/03/18 | FOR INFORMATION |
| B | 14/09/18 | DD 100% UPDATE |

PROJECT MANAGEMENT
PWC

CIVIL AND STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSTRUCTION MANAGER
lendlease

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE
CLIENT NUMBER

130487
PROJECT

RANDWICK CAMPUS REDEVELOPMENT

BARKER ST
RANDWICK NSW 2031
AUSTRALIA
BVN PROJECT NUMBER

s1606008
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 10000 25000
SCALE
1 : 500@B1 DO NOT SCALE
STATUS
FOR INFORMATION
DRAWING

# GRID SETOUT

RCR-BVN-ARC-00-DRW-01A-NL00011 ISSUE B

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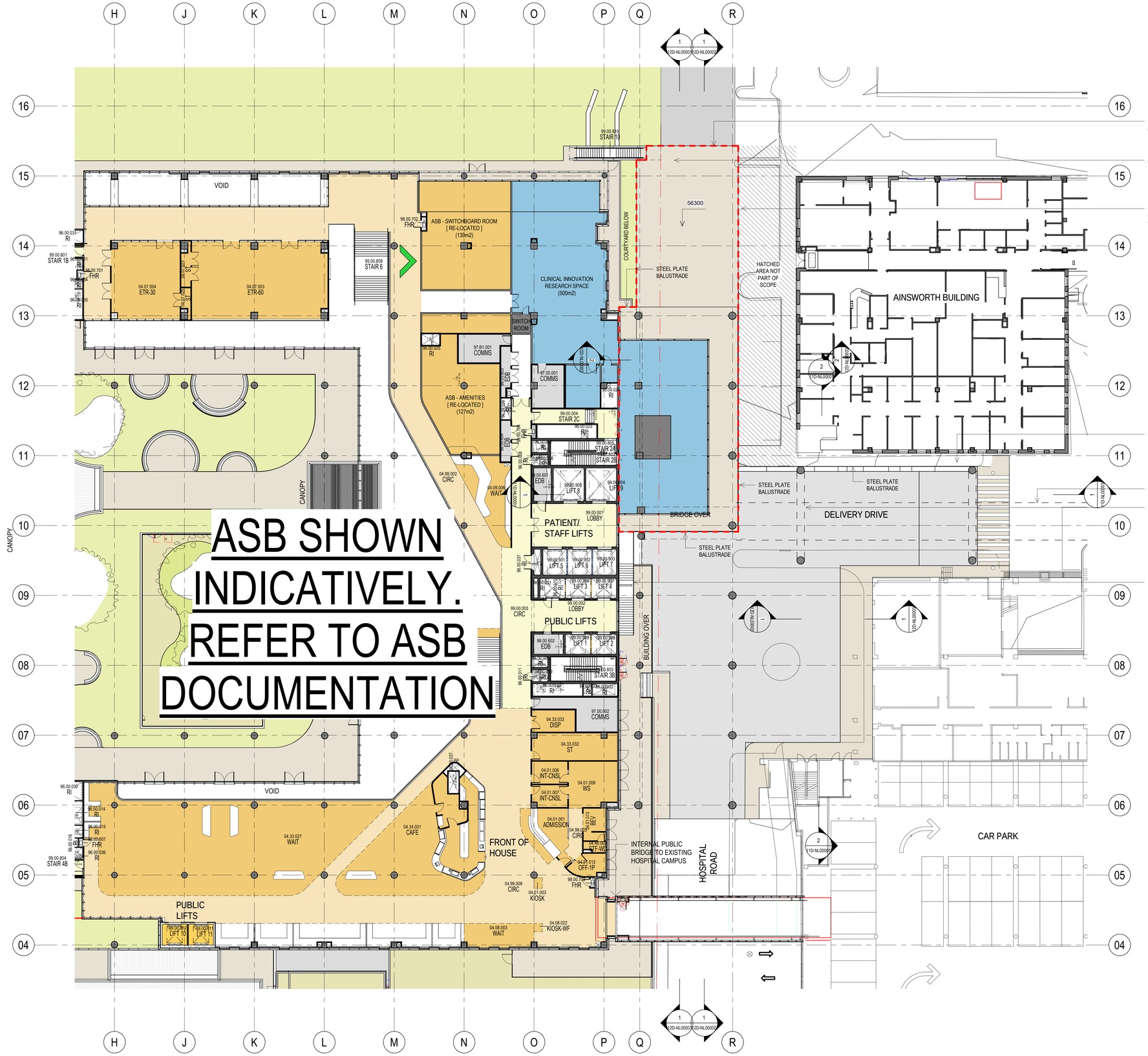


## Legend:

Exclusions

The following areas are excluded from the Stage 1 Hospital Road lowering works:

- Landscaping to public deck
- Interface zone between new public deck and existing Ainsworth Building
- Future lowering works north of Stair 10

Associated documents

Read inconjunction with

- UNSW East Integration drawings
- Services and structural engineer's drawings

Key

Fire separation wall. 2hr Fire rating assumed


BVN TERROIR

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Facsimile +61 2 8297 7299
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NOTE

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| ISSUE | DATE | FOR |
|---|---|---|
| A | 20/12/18 | FOR INFORMATION |

CLIENT

NSW GOVERNMENT Health Infrastructure

CONSTRUCTION MANAGER

lendlease

PROJECT

ASB/UNSW EAST INTEGRATION
e.g. 255 PITT STREET,
SYDNEY NSW
AUSTRALIA

BVN PROJECT NUMBER

s1606008

KEYPLAN

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 200@B1 DO NOT SCALE

STATUS

DESIGN DEVELOPMENT

DRAWING

# HOSPITAL ROAD WORKS - LEVEL 00

RCR-BVN-ARC-00-DRW-11B-0000001 | ISSUE A

# ASB SHOWN INDICATIVELY. REFER TO ASB DOCUMENTATION

AINSWORTH BUILDING

FUTURE SCH TUNNEL TO BE LOCATED NORTH OF STAGE 1 LOWERING WORKS

HATCHED AREA POTENTIALLY AVAILABLE FOR LEVEL -01 EXPANSION

EXISTING FOOTPATH

PERMANENT BRIDGE SUPPORTS

NEW PEDESTRIAN CROSSING

FIRE ISOLATED PASSAGEWAY

NEW STAIR AND HANDRAIL

EGRESS PATH

NEW STAIR. HANDRAIL AND STEEL PLATE BALUSTRADE

LEVEL AREA FOR RHW SUBSTATION ACCESS

NEW STAIR. HANDRAIL AND STEEL PLATE BALUSTRADE

HATCHED AREA INDICATES EXTENT OF EXISTING FOOTPATH SLAB TO BE MADE GOOD AND EXTENDED AS REQUIRED

NEW FOOTPATH

RED DASHED LINE INDICATES EXTENT OF LOWERING WORKS

DELIVERY DRIVE

CAR PARK

HOSPITAL ROAD

BRIDGE OVER

BOLLARD

STEEL PLATE BALUSTRADE

STEEL PLATE BALUSTRADE REMOVABLE AS REQUIRED

EXTEND REMOVABLE STEEL PLATE BALUSTRADE TO NEW STAIR

RETAINING WALL AND STEEL PLATE BALUSTRADE

RETAINING WALL AND STEEL PLATE BALUSTRADE

LEVEL 00 OVER

CANOPY OVER

CANOPY BELOW

PLANTER

COURTYARD

EXTENT OF MEZZANINE OVER

PEBBLES ON MEMBRANE

8335

51050

51450

1:20

52300

52000

51205

2095

## Legend:

Exclusions

The following areas are excluded from the Stage 1 Hospital Road lowering works:

- Landscaping to public deck
- Interface zone between new public deck and existing Ainsworth Building
- Future lowering works north of Stair 10

Associated documents

Read inconjunction with

- UNSW East Integration drawings
- Services and structural engineer's drawings

Key

Fire separation wall. 2hr Fire rating assumed


BVN TERROIR

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NOTE

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| ISSUE | DATE | FOR |
|---|---|---|
| A | 20/12/18 | FOR INFORMATION |

CLIENT

NSW GOVERNMENT Health Infrastructure

CONSTRUCTION MANAGER

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PROJECT

ASB/UNSW EAST INTEGRATION
e.g. 255 PITT STREET,
SYDNEY NSW
AUSTRALIA

BVN PROJECT NUMBER

s1606008

KEYPLAN

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 200@B1 DO NOT SCALE

STATUS

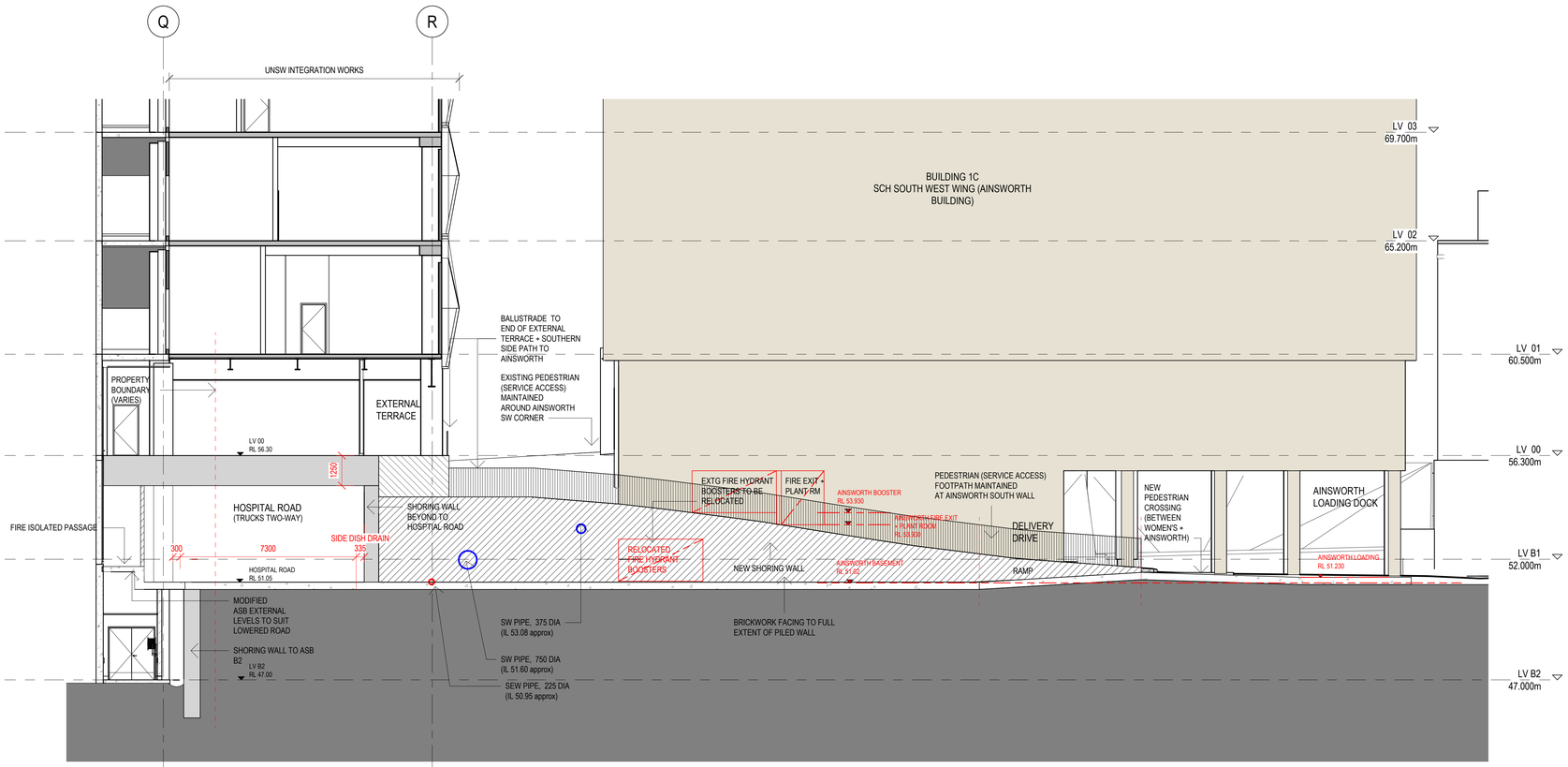
DESIGN DEVELOPMENT

DRAWING

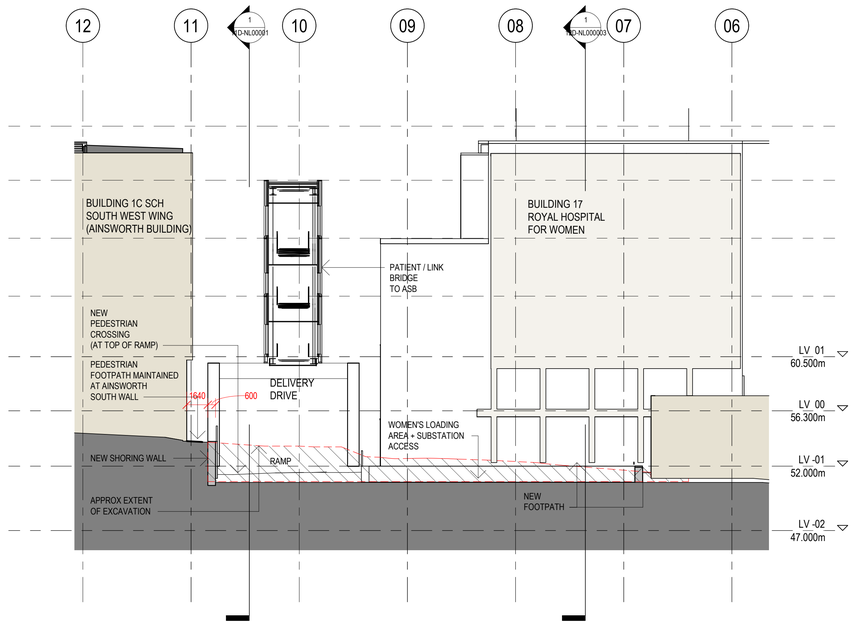
HOSPITAL ROAD WORKS - LEVEL -01

RCR-BVN-ARC-00-DRW-11B-B100001

ISSUE A




1 HOSPITAL ROAD - SECTION_AINSWORTH SOUTH ELEVATION
10B-0000001 1 : 100




2 DELIVERY DRIVE - SECTION_AINSWORTH + WOMEN'S
10B-0000001 1 : 200

BVN TERROIR

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NOTE
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| ISSUE | DATE | FOR |
|---|---|---|
| A | 23/11/18 | FOR INFORMATION |
| B | 20/12/18 | FOR INFORMATION |

CLIENT
NSW GOVERNMENT Health Infrastructure

CONSTRUCTION MANAGER
lendlease

PROJECT
RANDWICK CAMPUS
REDEVELOPMENT
BARKER ST
RANDWICK NSW 2031
AUSTRALIA

BVN PROJECT NUMBER
s1606008

KEYPLAN

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 4000 10000

SCALE
As indicated@B1 DO NOT SCALE

STATUS
DESIGN DEVELOPMENT

DRAWING
HOSPITAL ROAD WORKS - SECTIONS - SHEET 1

RCR-BVN-ARC-00-DRW-11D-NL00001 ISSUE B

# Appendix C

Previous Results

**Table C1 - Summary of Soil Laboratory Analysis - Stage 1 (All results in mg/kg unless otherwise stated)**

| Test Pit/ Sample ID | Depth | Sampling Date | Soil Type* | Metals | | | | | | | | | | | | | | | | PAH | | | | | | Phenols | Total Recoverable Hydrocarbons | | | | | BTEX | | | | | Organochlorine Pesticides (OCP) | | | | | | | | | OPP | PCB | Asbestos | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Arsenic | Arsenic TCLP | Cadmium | Cadmium TCLP | Chromium (III+VI) | Chromium (III+VI) TCLP | Copper | Copper TCLP | Lead | Lead TCLP | Mercury | Mercury TCLP | Nickel | Nickel TCLP | Zinc | Zinc TCLP | Naphthalene | Benzo(a)Pyrene (BaP) | Benzo(b)Pyrene+Benzo(k)Pyrene (BbF+BkF) TCLP | BaP TEQ | Total PAH | Phenol | TRH $C_6$-$C_9$ | TRH $C_{10}$-$C_{14}$ | $C_{15}$-$C_{28}$ | $C_{29}$-$C_{36}$ | F2 - Naphthalene | Benzene | Toluene | Ethylbenzene | Total xylenes | DDT + DDD + DDE | Aldrin + Dieldrin | Chlordane | Endosulfan | Endrin | Heptachlor | HCB | Methoxychlor | Chlorpyrifos | PCB | Asbestos ID | FA and AF % w/w |
| | Practical Quantitation Limit (PQL) | | | 4 | 0.1 | 0.4 | 0.1 | 1 | 0.1 | 1 | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 1 | 0.2 | 0.1 | 0.05 | 0.005 | 0.5 | 0.05 | 5 | 25 | 50 | 100 | 25 | 50 | 0.2 | 0.5 | 1 | 3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.7 | | 0.001 |
| Site Assessment Criteria (SAC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HILs (Res B) | | | | 500 | | 150 | | | | 30000 | | 1200 | | 120 | | 1200 | | 60000 | | | | | 4 | 400 | 130 | | | | | | | | | 600 | 10 | 90 | 400 | 20 | 10 | 15 | 500 | 340 | 1 | | |
| HSL A&B - vapour intrusion (Sand) | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | 45 | 110 | 0.5 | 160 | 55 | 40 | | | | | | | | | | | |
| EIL (Res/Open Space) | | | | 100 | | | | 200 | | 65 | | 1100 | | | | 9 | | 240 | | 170 | | | | | | | | | | | | | | | | | | | | | | | | | |
| ESL (Urban Res) | | | | | | | | | | | | | | | | | | | | | 0.7 | | | | | | | | 300 | 180 | 120 | 50 | 85 | 70 | 105 | | | | | | | | | |
| Management Limits (Res, Parkland) | | | | | | | | | | | | | | | | | | | | | | | | | 700 | 1000 | 2500 | | | | | | | | | | | | | | | | | | |
| IA3B Addition | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP401 | 0.2-0.25 | 23/08/2019 | Roadbase | 4 | - | <0.4 | - | 9 | - | 24 | - | 240 | <0.03 | 0.3 | - | 6 | - | 130 | - | <0.1 | 3.6 | <0.001 | 5.2 | 33 | <5 | <25 | <50 | 370 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | - | <0.001 |
| BD1/20190823 | - | 23/08/2019 | Roadbase | <4 | - | <0.4 | - | 11 | - | 42 | - | 170 | <0.03 | 0.3 | - | 7 | - | 270 | - | <0.1 | 2.8 | <0.001 | 4.2 | 27 | - | <25 | <50 | 400 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP401 | 0.65-0.7 | 23/08/2019 | Natural | <4 | - | <0.4 | - | 3 | - | 1 | - | 2 | - | <0.1 | - | <1 | - | <1 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP402 | 0.2-0.25 | 23/08/2019 | Roadbase | <4 | - | <0.4 | - | 12 | - | 47 | - | 150 | <0.03 | 0.2 | - | 7 | - | 120 | - | <0.1 | 2.9 | <0.001 | 4.2 | 28 | <5 | <25 | <50 | 400 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | - | 0.0328 |
| TP402 | 0.45-0.55 | 23/08/2019 | Roadbase | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 |
| TP402 | 0.95-1.05 | 23/08/2019 | Natural | <4 | - | <0.4 | - | 1 | - | <1 | - | 1 | - | <0.1 | - | <1 | - | <1 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP403 | 0.6-0.65 | 23/08/2019 | Fill | <4 | - | <0.4 | - | 1 | - | 2 | - | 16 | - | <0.1 | - | <1 | - | 11 | - | <0.1 | 0.05 | - | <0.5 | 0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP403 | 1.0-1.1 | 23/08/2019 | Natural | <4 | - | <0.4 | - | <1 | - | <1 | - | <1 | - | <0.1 | - | <1 | - | <1 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP404 | 0.45-0.55 | 23/08/2019 | Fill | <4 | - | <0.4 | - | 1 | - | <1 | - | 6 | - | <0.1 | - | <1 | - | 9 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP404 1.0 | 1.0-1.1 | 23/08/2019 | Natural | <4 | - | <0.4 | - | 1 | - | <1 | - | <1 | - | <0.1 | - | <1 | - | <1 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP405 0.5 | 0.4-0.5 | 24/08/2019 | Natural | <4 | - | <0.4 | - | <1 | - | <1 | - | 1 | - | <0.1 | - | <1 | - | 5 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.001 |
| TP405 1.0 | 1.0-1.1 | 24/08/2019 | Natural | <4 | - | <0.4 | - | 5 | - | 1 | - | 3 | - | <0.1 | - | 5 | - | 15 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP406 0.35 | 0.35-0.45 | 24/08/2019 | Natural | <4 | - | <0.4 | - | 1 | - | 2 | - | 12 | - | <0.1 | - | 1 | - | 17 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP406 0.5 | 0.55-0.65 | 24/08/2019 | Natural | <4 | - | <0.4 | - | 2 | - | <1 | - | 1 | - | <0.1 | - | 1 | - | 2 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP407 0.35 | 0.35-0.4 | 24/08/2019 | Natural | <4 | - | <0.4 | - | 8 | - | 6 | - | 11 | - | <0.1 | - | 5 | - | 20 | - | <0.1 | 0.2 | - | <0.5 | 1.5 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.001 |
| TP407 1.0 | 1.0-1.1 | 24/08/2019 | Natural | <4 | - | <0.4 | - | 3 | - | <1 | - | 4 | - | <0.1 | - | <1 | - | 4 | - | <0.1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | - | - |
| Stage 1 Remediation Works | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP305A | 0.0-0.2 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 5 | - | 6 | - | 40 | - | <0.1 | - | 2 | - | 56 | - | <1 | 0.2 | - | <0.5 | 1.4 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP305A | 0.5-0.6 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 2 | - | <1 | - | 3 | - | <0.1 | - | <1 | - | 4 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP305A | 1.0-1.1.1 | 12/02/2019 | Natural | <4 | - | <0.4 | - | 1 | - | <1 | - | 2 | - | <0.1 | - | <1 | - | 3 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP306A | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | <1 | - | 1 | - | 11 | - | 0.1 | - | <1 | - | 10 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP307A | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | 1 | - | 10 | - | <0.1 | - | <1 | - | 9 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP308A | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | 1 | - | 8 | - | <0.1 | - | <1 | - | 2 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP309A | 0.0-0.2 | 12/02/2019 | Fill | <4 | - | 0.4 | - | 4 | - | 7 | - | 45 | - | <0.1 | - | 1 | - | 72 | - | <1 | 2.1 | - | 2.8 | 15 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.1 | 0.2 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.5 | NAD | - |
| BD1/20190212 | 0.0-0.2 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 4 | - | 26 | - | 51 | - | <0.1 | - | 2 | - | 110 | - | <1 | 1.9 | - | 2.7 | 17 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP309A | 0.5-0.6 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 3 | - | 9 | - | 24 | - | <0.1 | - | 1 | - | 61 | - | <1 | 0.76 | - | 1.1 | 5.3 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP310A | 0.0-0.2 | 11/02/2019 | Fill | <4 | - | <0.4 | - | 4 | - | 7 | - | 47 | - | <0.1 | - | 2 | - | 73 | - | <1 | 0.4 | - | 0.6 | 3.5 | <5 | <25 | <50 | 410 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP310A | 0.5-0.6 | 11/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | <1 | - | 4 | - | <0.1 | - | <1 | - | 5 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP313A | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | <1 | - | <1 | - | <1 | - | <0.1 | - | <1 | - | 4 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP317 | 0.0-0.2 | 11/02/2019 | Fill | <4 | - | <0.4 | - | 4 | - | 14 | - | 60 | - | <0.1 | - | 2 | - | 65 | - | <1 | 1 | - | 1.4 | 8.6 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.2 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.4 | NAD | - |
| BD1/20190211* | 0.0-0.2 | 11/02/2019 | Fill | <4 | - | <0.4 | - | 5 | - | 18 | - | 180 | - | <0.1 | - | 3 | - | 92 | - | <1 | 2.2 | - | 3 | 22 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP317 | 0.5-0.6 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | <1 | - | 1 | - | <0.1 | - | <1 | - | 3 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP322 | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | 0.5 | - | 4 | - | 38 | - | 45 | - | 0.3 | - | 1 | - | 120 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP323 | 0.0-0.2 | 13/02/2019 | Fill | 4 | - | <0.4 | - | 7 | - | 22 | - | 130 | - | 0.7 | - | 2 | - | 130 | - | <1 | 0.4 | - | 0.6 | 3.6 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.1 | NAD | - |
| TP323 | 0.5-0.6 | 13/02/2019 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP324 | 0.1-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | 5 | - | 21 | - | <0.1 | - | <1 | - | 30 | - | <1 | 0.4 | - | 0.6 | 3.5 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.1 | NAD | - |
| TP324 | 0.5-0.6 | 13/02/2019 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP325 | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | <1 | - | 1 | - | <0.1 | - | <1 | - | <1 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP326 | 0.0-0.2 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | 2 | - | 7 | - | <0.1 | - | <1 | - | 12 | - | <1 | <0.05 | - | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP326 | 0.5-0.6 | 12/02/2019 | Natural | <4 | - | <0.4 | - | 1 | - | 1 | - | 2 | - | <0.1 | - | <1 | - | 12 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP327 | 0.0-0.2 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 2 | - | 1 | - | 7 | - | <0.1 | - | <1 | - | 21 | - | <1 | <0.05 | - | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.1 | 0.3 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP327 | 0.6-0.7 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 1 | - | <1 | - | 1 | - | <0.1 | - | <1 | - | 2 | - | <1 | <0.05 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP328 | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 2 | - | 5 | - | 35 | - | <0.1 | - | <1 | - | 47 | - | <1 | 0.05 | - | <0.5 | 0.2 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.2 | 0.3 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BD2/20190211* | 0.0-0.2 | 13/02/2019 | Fill | <4 | - | <0.4 | - | 3 | - | 8 | - | 58 | - | <0.1 | - | 2 | - | 76 | - | <1 | 0.98 | - | 1.4 | 7.7 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP328 | 0.5-0.6 | 12/02/2019 | Fill | <4 | - | <0.4 | - | 2 | - | 1 | - | 30 | - | <0.1 | - | <1 | - | 18 | - | <1 | 0.06 | - | <0.5 | 0.3 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |

| Test Pit/ Sample ID | Depth | Sampling Date | Soil Type* | Metals | | | | | | | | | | | | | | | | PAH | | | | | | Phenols | Total Recoverable Hydrocarbons | | | | BTEX | | | | Organochlorine Pesticides (OCP) | | | | | | | | OPP | PCB | Asbestos | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Arsenic | Arsenic TCLP | Cadmium | Cadmium TCLP | Chromium (III)* | Chromium (VI)* TCLP | Copper | Copper TCLP | Lead | Lead TCLP | Mercury | Mercury TCLP | Nickel | Nickel TCLP | Zinc | Zinc TCLP | Naphthalene | Benzo(a)Pyrene (BaP) | Benzo(b)Pyrene (BeP) TCLP | BaP TEQ | Total PAH | Phenol | TRH $C_6$-$C_{10}$ | TRH $>C_{10}$-$C_{16}$ | $C_{10}$-$C_{16}$ | $C_6$ - $C_{10}$ less BTEX (F1) | $>C_{16}$-$C_{34}$ Naphthalene + | Benzene | Toluene | Ethylbenzene | Total xylenes | BHC + DDD + DDE | Aldrin and Dieldrin | Chlordane | Endosulfan | Endrin | Heptachlor | HCB | Methoxychlor | Chlorpyrifos | PCB | Asbestos ID | FA and AF (% w/w) |
| Practical Quantitation Limit (PQL) | | | | 4 | 0.1 | 0.4 | 0.1 | 1 | 0.1 | 1 | 0.1 | 1 | 0.1 | 0.1 | 0.1 | 1 | 0.1 | 1 | 0.2 | 0.1 | 0.05 | 0.005 | 0.5 | 0.05 | 5 | 25 | 50 | 100 | 25 | 50 | 0.2 | 0.5 | 1 | 3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.7 | | 0.001 |
| Site Assessment Criteria (SAC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HILs (Res B) | | | | 500 | | 150 | | | | 30000 | | 1200 | | 120 | | 1200 | | 60000 | | | | | 4 | 400 | 130 | | | | | | | | | 600 | 10 | 90 | 400 | 20 | 10 | 15 | 500 | 340 | 1 | | |
| HSL A&B - vapour intrusion (Sand) | | | | | | | | | | | | | | | | | | | | 3 | | | | | | | | | | 45 | 110 | 0.5 | 160 | 55 | 40 | | | | | | | | | | | |
| EIL (Res/Open Space) | | | | 100 | | | | 200 | | 65 | | 1100 | | | | 9 | | 240 | | 170 | | | | | | | | | | | | | | | | | | | | | | | | | |
| ESL (Urban Res) | | | | | | | | | | | | | | | | | | | | | 0.7 | | | | | | | | 300 | 180 | 120 | 50 | 85 | 70 | 105 | | | | | | | | | | |
| Management Limits (Res, Parkland) | | | | | | | | | | | | | | | | | | | | | | | | | 700 | 1000 | 2500 | | | | | | | | | | | | | | | | | | |
| DP DID (2018) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH201 | 0.2-0.3 | 26/06/2018 | Fill | <4 | - | <0.4 | - | 4 | - | 17 | - | 130 | - | <0.1 | - | 3 | - | 88 | - | <0.1 | 0.83 | - | 1.3 | 6.9 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH205 | 0.1-0.2 | 25/06/2018 | Fill | <4 | - | <0.4 | - | 3 | - | 11 | - | 67 | - | <0.1 | - | 2 | - | 52 | - | <0.1 | 1.3 | - | 2 | 10 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH214 | 0.1-0.2 | 26/06/2018 | Fill | <4 | - | <0.4 | - | 3 | - | 4 | - | 29 | - | <0.1 | - | 1 | - | 15 | - | <0.1 | 0.07 | - | <0.5 | 0.2 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP1 | 0.3-0.4 | 07/08/2018 | Fill | - | - | - | - | - | - | - | - | 47 | - | - | - | - | - | - | - | <0.1 | 0.1 | - | <0.5 | 1.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP1 | 1.1-1.2 | 07/08/2018 | Natural | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP2 | 0-0.1 | 07/08/2018 | Fill | - | - | - | - | - | - | - | - | 91 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP2 | 1.3-1.4 | 07/08/2018 | Natural | - | - | - | - | - | - | - | - | <1 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP3 | 0.1-0.2 | 07/08/2018 | Fill | - | - | - | - | - | - | - | - | 22 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP3 | 1.0-1.1 | 07/08/2018 | Natural | - | - | - | - | - | - | - | - | <1 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP5 | 0.1-0.2 | 07/08/2018 | Fill | - | - | - | - | - | - | - | - | 140 | - | - | - | - | - | - | - | <0.1 | 0.5 | - | 0.9 | 5.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP5 | 0.9-1.0 | 07/08/2018 | Natural | - | - | - | - | - | - | - | - | 14 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP8 | 0.5-0.6 | 08/08/2018 | Fill | <4 | - | <0.4 | - | <1 | - | 4 | - | 19 | - | 0.4 | - | <1 | - | 26 | - | <0.1 | <0.1 | - | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP8 | 1.3-1.4 | 08/08/2018 | Natural | <4 | - | <0.4 | - | 2 | - | <1 | - | 2 | - | <0.1 | - | <1 | - | 22 | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | - |
| TP9 | 0-0.1 | 08/08/2018 | Fill | <4 | - | <0.4 | - | 8 | - | 37 | - | 890 | 0.54 | 0.2 | - | 4 | - | 200 | - | <0.1 | 0.8 | <0.001 | 1.7 | 10 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | <0.1 | 1.6 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP10 | 0.4-0.5 | 08/08/2018 | Fill | - | - | - | - | - | - | - | - | 110 | - | - | - | - | - | - | - | <0.1 | 0.2 | - | <0.5 | 2.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP10 | 0.9-1.0 | 08/08/2018 | Natural | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP10 | 0-0.1 | 08/08/2018 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP11 | 0-0.1 | 08/08/2018 | Fill | - | - | - | - | - | - | - | - | 180 | - | - | - | - | - | - | - | <0.1 | 0.1 | - | <0.5 | 2.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP11 | 0.4-0.5 | 08/08/2018 | Natural | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | <0.1 | <0.1 | - | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| DP (2019) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH1 | 0.5-0.6 | 18/09/2017 | Fill | <4 | - | <0.4 | - | 2 | - | 4 | - | 25 | - | <0.1 | - | 1 | - | 28 | - | <0.1 | 0.06 | - | 0.121 | 0.3 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH2 | 0.3-0.4 | 18/09/2017 | Fill | <4 | - | <0.4 | - | 4 | - | 2 | - | 16 | - | <0.1 | - | 2 | - | 37 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH4 | 0.07-0.15 | 18/09/2017 | Roadbase | <4 | - | <0.4 | - | <1 | - | 100 | - | 1 | - | <0.1 | - | 3 | - | 10 | - | <1 - 0.4 | 57 | - | 77 | 740 | <5 | <25 | 170 | 6600 | <25 | 170 | <0.2 | <0.5 | <1 | <1 | <1 | <2 | <2 | <3 | <1 | <1 | <1 | <1 | <1 | <1 | NAD | - |
| BH4 | 0.5-0.6 | 18/09/2017 | Fill | <4 | - | <0.4 | - | 3 | - | 2 | - | 10 | - | <0.1 | - | 2 | - | 10 | - | <0.1 | 0.52 | - | 0.647 | 4.5 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH5 | 0.4-0.5 | 19/09/2017 | Fill | <4 | - | <0.4 | - | <1 | - | <1 | - | 2 | - | <0.1 | - | <1 | - | 1 | - | <0.1 | <0.05 | - | <0.172 | 0.2 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH5 | 0.9-1 | 19/09/2017 | Natural Sand | <4 | - | <0.4 | - | <1 | - | <1 | - | <1 | - | <0.1 | - | <1 | - | <1 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| BH5 | 1.3-1.4 | 19/09/2017 | Natural Sand | <4 | - | <0.4 | - | 3 | - | <1 | - | 2 | - | <0.1 | - | 1 | - | 2 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| BH101 | 0.5-0.7 | 9/01/2018 | Fill | <4 | - | <0.4 | - | 4 | - | 5 | - | 34 | - | 0.1 | - | <1 | - | 30 | - | <0.1 | 0.1 | - | 0.1665 | 0.94 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH101 | 1.4-1.6 | 9/01/2018 | Natural Sand | <4 | - | <0.4 | - | 9 | - | <1 | - | 4 | - | <0.1 | - | 2 | - | 22 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH102 | 0.3 | 9/01/2018 | Fill | <4 | - | 0.5 | - | 9 | - | 83 | - | 450 | - | 0.2 | - | 3 | - | 150 | - | <0.1 | 1.2 | - | 1.59 | 12 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | 0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH103 | 0-0.3 | 9/01/2018 | Fill | <4 | - | <0.4 | - | 5 | - | 25 | - | 220 | - | 0.1 | - | 3 | - | 99 | - | <0.1 | 1.2 | - | 1.59 | 11 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH103 | 0.5-0.7 | 9/01/2018 | Natural Sand | <4 | - | <0.4 | - | 3 | - | 14 | - | 20 | - | <0.1 | - | 2 | - | 29 | - | <0.1 | 0.63 | - | 0.759 | 4.8 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH104 | 0-0.3 | 9/01/2018 | Fill | <4 | - | 0.5 | - | 4 | - | 24 | - | 110 | - | 0.1 | - | 2 | - | 250 | - | <0.1 | 0.3 | - | 0.395 | 2.6 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH111 | 0-0.2 | 10/01/2018 | Fill | 7 | - | 0.8 | - | 18 | - | 50 | - | 470 | - | 0.2 | - | 5 | - | 390 | - | <1 - 0.3 | 6.4 | - | 8.197 | 61 | <5 | <25 | <50 | 480 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | NAD | - |
| BH112 | 0-0.2 | 10/01/2018 | Natural Sand | 6 | - | 2 | - | 20 | - | 110 | - | 440 | - | 0.2 | - | 5 | - | 230 | - | <0.1 | 0.5 | - | 0.628 | 4.2 | <5 | <25 | <50 | 110 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.2 | NAD | - |
| BH112 | 0.6-0.7 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 1 | - | 4 | - | 8 | - | <0.1 | - | <1 | - | 58 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH113 | 0.1-0.3 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 2 | - | 7 | - | 28 | - | <0.1 | - | <1 | - | 31 | - | <0.1 | 0.2 | - | 0.284 | 2.1 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH113 | 0.5-0.7 | 10/01/2018 | Natural Sand | <4 | - | <0.4 | - | 14 | - | 37 | - | 350 | - | 0.1 | - | 4 | - | 130 | - | <0.1 | 1.2 | - | 1.588 | 11 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH114 | 0.5-0.7 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 5 | - | 19 | - | 130 | - | 0.1 | - | 2 | - | 38 | - | <0.1 | 1.1 | - | 1.478 | 11 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH115 | 0-0.2 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 2 | - | 4 | - | 10 | - | <0.1 | - | 1 | - | 53 | - | <0.1 | 0.09 | - | 0.151 | 0.4 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH115 | 0.5-0.7 | 10/01/2018 | Natural Sand | <4 | - | <0.4 | - | 9 | - | 30 | - | 360 | - | 0.2 | - | 4 | - | 310 | - | <0.1 | 0.89 | - | 1.124 | 7.9 | - | <25 | <50 | 100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH116 | 0-0.2 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 7 | - | 26 | - | 360 | - | 0.2 | - | 4 | - | 160 | - | <0.1 | 1.4 | - | 1.851 | 16 | <5 | <25 | <50 | 110 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | 0.1 | 2.05 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH117 | 0.6-0.8 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 11 | - | <1 | - | 6 | - | <0.1 | - | 2 | - | 220 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH117 | 1.5-1.6 | 10/01/2018 | Natural Sand | <4 | - | <0.4 | - | 4 | - | 14 | - | 270 | - | 0.3 | - | 2 | - | 220 | - | <0.1 | 0.52 | - | 0.657 | 5.3 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH118 | 0.5-0.6 | 10/01/2018 | Fill | <4 | - | 0.8 | - | 9 | - | 43 | - | 350 | - | 0.2 | - | 3 | - | 510 | - | <0.1 | 0.6 | - | 0.739 | 5.5 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH119 | 0.5-0.6 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 6 | - | 12 | - | 100 | - | <0.1 | - | 3 | - | 72 | - | <0.1 | 0.3 | - | 0.395 | 2.5 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH119 | 1-1.1 | 10/01/2018 | Natural Sand | <4 | - | <0.4 | - | 2 | - | 4 | - | 13 | - | <0.1 | - | 1 | - | 12 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH120 | 0-0.1 | 10/01/2018 | Fill | 13 | - | <0.4 | - | 13 | - | 35 | - | 21 | - | 0.2 | - | 4 | - | 85 | - | <0.1 | 0.07 | - | 0.131 | 0.3 | <5 | <25 | <50 | 210 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| BH121 | 0-0.05 | 10/01/2018 | Fill | 4 | - | <0.4 | - | 9 | - | 31 | - | 290 | - | <0.1 | - | 4 | - | 160 | - | <0.1 | 0.2 | - | 0.294 | 2.2 | 8 | <25 | 63 | 520 | <25 | 63 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | NAD | - |
| BH122 | 0-0.1 | 10/01/2018 | Fill | <4 | - | <0.4 | - | 6 | - | 9 | - | 69 | - | <0.1 | - | 1 | - | 31 | - | <0.1 | 0.1 | - | 0.161 | 0.63 | - | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH122 | 0.5-0.6 | 10/01/2018 | Natural Sand | <4 | - | <0.4 | - | 3 | - | 3 | - | 15 | - | <0.1 | - | 1 | - | 7 | - | <0.1 | <0.05 | - | <0.172 | <0.05 | <5 | <25 | <50 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| Statistical Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fill to depths of 0.3 m (excluding roadbase) | Number of Samples | | | 29 | 0 | 29 | 0 | 29 | 0 | 29 | 0 | 33 | 1 | 29 | 0 | 29 | 0 | 29 | 0 | 32 | 33 | 1 | 33 | 33 | 19 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 17 | 19 | - | - |
| | Mean | | | 4.00 | - | 0.43 | - | 3.40 | - | 9.85 | - | 63.27 | - | 0.13 | - | 1.50 | - | 64.65 | - | 0.35 | 0.25 | - | 0.54 | 2.13 | 5.00 | 25.00 | 50.00 | 100.00 | 25.00 | 50.00 | 0.20 | 0.50 | 1.00 | 1.30 | 0.13 | 0.19 | 0.19 | 0.29 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | - | - |
| | Std. Deviation | | | 1.74 | - | 0.08 | - | 3.77 | - | 13.54 | - | 175.09 | - | 0.12 | - | 1.18 | - | 78.49 | - | 0.45 | 1.21 | - | 1.49 | 11.48 | 0.00 | 0.00 | 0.00 | 90.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.70 | 0.00 | 0.53 | 0.06 | 0.10 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.14 | - | - |
| | 95% UCL | | | 4.66 | - | 0.45 | - | 4.84 | - | 19.80 | - | 163.40 | - | 0.17 | - | 2.85 | - | 108.10 | - | 0.51 | 1.62 | - | 2.29 | 6.20 | - | - | - | 134.48 | - | - | 0.20 | - | - | 1.57 | 0.13 | 0.45 | 0.22 | 0.34 | 0.10 | 0.12 | 0.10 | 0.10 | 0.10 | 0.17 | - | - |
| Fill from depths of 0.3 m to top of natural soils (excluding roadbase) | Number of Samples | | | | 0 | 20 | 0 | 20 | 0 | 20 | 0 | 22 | 0 | 20 | 0 | 20 | 0 | 20 | 0 | 22 | 22 | 0 | 22 | 22 | 14 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | - | - |
| | Mean | | | 4.00 | - | 0.43 | - | 3.40 | - | 9.85 | - | 63.27 | - | 0.13 | - | 1.50 | - | 64.65 | - | 0.35 | 0.25 | - | 0.54 | 2.13 | 5.00 | 25.00 | 50.00 | 100.00 | 25.00 | 50.00 | 0.20 | 0.50 | 1.00 | 1.30 | 0.13 | 0.19 | 0.19 | 0.29 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | - | - |
| | Std. Deviation | | | 0.00 | - | 0.09 | - | 3.10 | - | 19.84 | - | 115.99 | - | 0.07 | - | 0.76 | - | 118.22 | - | 0.41 | 0.35 | - | 0.39 | 3.51 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.07 | 0.03 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | - |
| | 95% UCL | | | - | - | 0.47 | - | 4.85 | - | 29.18 | - | 122.00 | - | 0.16 | - | 1.79 | - | 124.70 | - | 0.53 | 0.58 | - | 0.91 | 3.69 | - | - | - | - | - | - | 0.20 | - | - | 1.64 | 0.17 | 0.21 | 0.21 | 0.32 | - | - | - | - | - | - | - | - |

**Notes**

| | |
|---|---|
| <PQL | Concentration comprises of sum of a number of individual analytes. All individual analytes below reported PQL |
| a | Replicate of sample directly below |
| b | All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment |
| c | 95% UCL Caclulated using ProUCL |
| HIL/HSL | HIL / HSL for soil contaminants - NEPC 2013, Schedule B1 |
| EIL / ESL | EIL / ESL soil for soil contaminant - NEPC 2013, Schedule B1. |
| NAD | No asbestos detected |
| - | Not Analysed |

Douglas Partners
Geotechnics | Environment | Groundwater

Table C2 - Groundwater results

| | | Metals | | | | | | | | TRH | | MAH | | | | | | VOCs | | | | | | | | | | | | | | | | PAH | | Phenols |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Arsenic (Filtered) | Cadmium (Filtered) | Chromium (III+VI) (Filtered) | Copper (Filtered) | Lead (Filtered) | Mercury (Filtered) | Nickel (Filtered) | Zinc (Filtered) | F2-NAPHTHALENE | C6-C10 less BTEX (F1) | Benzene | Ethylbenzene | Toluene | Xylene (m&p) | Xylene (o) | Styrene | 1,1,2-trichloroethane | 1,1-dichloroethene | 1,2-dichloroethane | Carbon tetrachloride | Chloroform | Hexachlorobutadiene | Tetrachloroethene | Vinyl chloride | 1,2,3-trichlorobenzene | 1,2,4-trichlorobenzene | 1,2-dichlorobenzene | 1,3-dichlorobenzene | 1,4-dichlorobenzene | Chlorobenzene | Benzo(a) pyrene | Naphthalene | Phenol |
| | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| EQL | | 0.001 | 0.0001 | 0.001 | 0.001 | 0.001 | 0.00005 | 0.001 | 0.001 | 0.05 | 0.01 | 0.001 | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.01 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.0001 | 0.0002 | 0.05 |
| NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-4m | | | | | | | | | | 1 | 1 | 0.8 | NL | NL | | | | | | | | | | | | | | | | | | | NL | |
| ANZG 2018 DGV GILs, Freshwater, slightly to moderately disturbed system | | 0.024 | 0.0005 | 0.0004 | 0.0014 | 0.0014 | 0.00006 | 0.028 | 0.021 | - | - | 0.95 | - | - | 0.075 | 0.35 | - | 6.5 | - | - | - | - | | - | - | 0.003 | 0.085 | 0.16 | 0.26 | 0.06 | - | 0.0001 | 0.016 | - |
| **Field ID** | **Sampled Date** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **DP (2019)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH14 | 12/02/2019 | <0.001 | 0.0006 | <0.001 | 0.007 | <0.001 | <0.00005 | 0.002 | <0.001 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.05 |
| BH10 | 12/02/2019 | <0.001 | <0.1 | <0.001 | <0.001 | <0.001 | <0.00005 | <0.001 | 0.008 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.05 |
| **DP (2018b)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH202 | | <0.001 | 0.0001 | <0.001 | 0.002 | <0.001 | <0.00005 | 0.005 | 0.031 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| BH204 | | <0.001 | <0.0001 | <0.001 | 0.008 | <0.001 | <0.00005 | 0.002 | 0.028 | <0.05 | 0.039 | <0.001 | 0.001 | <0.001 | 0.009 | 0.004 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| BH11 | | <0.001 | <0.0001 | <0.001 | 0.005 | <0.001 | <0.00005 | <0.001 | 0.013 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| BH14 | | <0.001 | 0.0001 | <0.001 | 0.007 | <0.001 | <0.00005 | <0.001 | 0.055 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| BH16 | | <0.001 | <0.0001 | <0.001 | 0.012 | <0.001 | <0.00005 | 0.001 | 0.007 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| BH17 | | <0.001 | <0.0001 | <0.001 | 0.003 | <0.001 | <0.00005 | <0.001 | 0.008 | 0.074 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| BD1/20180706 | | <0.001 | 0.0001 | <0.001 | 0.001 | <0.001 | <0.00005 | 0.004 | 0.026 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - |
| **DP (2018)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BD13102017 | 13/10/2017 | <0.001 | <0.0001 | <0.001 | 0.007 | <0.001 | <0.00005 | 0.002 | 0.022 | <0.05 | 0.012 | <0.001 | <0.001 | 0.001 | <0.002 | <0.001 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.0002 | <0.05 |
| GW7 | 13/10/2017 | <0.001 | <0.0001 | <0.001 | 0.007 | <0.001 | <0.00005 | 0.002 | 0.024 | <0.05 | 0.013 | <0.001 | <0.001 | 0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.004 | <0.001 | <0.001 | <0.01 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.0001 | <0.0002 | <0.05 |

Douglas Partners

Table C3 - Waste Classification Table (All results in mg/kg unless otherwise stated)

| Test Pit/ Sample ID[a] | Sampling Depth | Soil Type | Metals | | | | | | | PAH | | | Phenols | Total Petroleum Hydrocarbons | | | | BTEX | | | | OCP | OPP | PCB | Asbestos |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arsenic | Cadmium | Chromium (VI)[b] | Lead | Lead (TCLP) | Mercury | Nickel | Benzo(a) Pyrene (BaP) | BaP (TCLP) | Total PAH | Phenol | C6 - C9 | C10 - C14 | C15-C28 | C29 - C36 | Benzene | Toluene | Ethylbenzene | Xylenes | Endosulfan | Chlorpyrifos | PCB * | Asbestos |
| PQL | | | 4 | 0.4 | 1 | 1 | | 0.1 | 1 | 0.05 | 0.04 | 0.05 | 5 | 25 | 50 | 100 | 100 | 0.2 | 0.5 | 1 | 3 | 0.3 | 0.1 | 0.7 | 0.1g /kg |
| **Site Assessment Criteria (SAC)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| NSW EPA (2014) CT1 (mg/kg) General Solid Waste | | | 100 | 20 | 100 | 100 | - | 4 | 40 | 0.8 | - | 200 | 288 | 650 | 10 000 | | | 10 | 288 | 600 | 1000 | 60 | 4 | <50 | NAD |
| NSW EPA (2014) SCC1 with TCLP | | | 500 | 100 | 1900 | 1500 | 5 | 50 | 1050 | 10 | 0.04 | 200 | 518 | 650 | 10 000 | | | 18 | 518 | 1080 | 1800 | 108 | | <50 | NAD |
| NSW EPA (2014) CT2 (mg/kg) Restricted Solid Waste | | | 400 | 80 | 400 | 400 | - | 16 | 160 | 3.2 | - | 800 | 1152 | 2600 | 40 000 | | | 40 | 1152 | 2400 | 4000 | 240 | 16 | <50 | NAD |
| NSW EPA (2014) Restricted Solid Waste with TCLP | | | 2000 | 400 | 7600 | 6000 | 20 | 200 | 4200 | 23 | 0.16 | 800 | 2073 | 2600 | 40 000 | | | 72 | 2073 | 4320 | 7200 | 432 | 30 | <50 | NAD |
| **Current Investigation** | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP305A | 0.0-0.2 | Fill | <4 | <0.4 | 5 | 40 | - | <0.1 | 2 | 0.2 | - | 1.4 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP305A | 0.5-0.6 | Fill | <4 | <0.4 | 2 | 3 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP305A | 1.0-1.1.1 | Natural | <4 | <0.4 | 1 | 2 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | |
| TP309A | 0.0-0.2 | Fill | <4 | 0.4 | 4 | 45 | - | <0.1 | 1 | 2.1 | - | 15 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.5 | NAD |
| BD1/20190212 | 0.0-0.2 | Fill | <4 | <0.4 | 4 | 51 | - | <0.1 | 2 | 1.9 | - | 17 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | - |
| TP309A | 0.5-0.6 | Fill | <4 | <0.4 | 3 | 24 | - | <0.1 | 1 | 0.76 | - | 5.3 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP310A | 0.0-0.2 | Fill | <4 | <0.4 | 4 | 47 | - | <0.1 | 2 | 0.4 | - | 3.5 | <5 | <25 | <50 | 190 | 270 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP310A | 0.5-0.6 | Fill | <4 | <0.4 | 1 | 4 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP317 | 0.0-0.2 | Fill | <4 | <0.4 | 4 | 60 | - | <0.1 | 2 | 1 | - | 8.6 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | 0.4 | NAD |
| BD1/20190211[a] | 0.0-0.2 | Fill | <4 | <0.4 | 5 | 180 | - | <0.1 | 3 | 2.2 | - | 22 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | - |
| TP317 | 0.5-0.6 | Fill | <4 | <0.4 | 1 | 1 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP326 | 0.0-0.2 | Fill | <4 | <0.4 | 1 | 7 | - | <0.1 | <1 | <0.05 | - | <0.05 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP326 | 0.5-0.6 | Natural | <4 | <0.4 | 1 | 2 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | - |
| TP327 | 0.0-0.2 | Fill | <4 | <0.4 | 2 | 7 | - | <0.1 | <1 | <0.05 | - | <0.05 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP327 | 0.6-0.7 | Fill | <4 | <0.4 | 1 | 1 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP328 | 0.0-0.2 | Fill | <4 | <0.4 | 2 | 35 | - | <0.1 | <1 | 0.05 | - | 0.2 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BD2/20190211[a] | 0.0-0.2 | Fill | <4 | <0.4 | 3 | 58 | - | <0.1 | 2 | 0.98 | - | 7.7 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | - |
| TP328 | 0.5-0.6 | Fill | <4 | <0.4 | 2 | 30 | - | <0.1 | <1 | 0.06 | - | 0.3 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP306A | 0.0-0.2 | Fill | <4 | <0.4 | <1 | 11 | - | 0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP307A | 0.0-0.2 | Fill | <4 | <0.4 | 1 | 10 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP308A | 0.0-0.2 | Fill | <4 | <0.4 | 1 | 8 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP313A | 0.0-0.2 | Fill | <4 | <0.4 | <1 | <1 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP322 | 0.0-0.2 | Fill | <4 | 0.5 | 4 | 45 | - | 0.3 | 1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP323 | 0.0-0.2 | Fill | 4 | <0.4 | 7 | 130 | - | 0.7 | 2 | 0.4 | - | 3.6 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | - | <0.1 | NAD |
| TP323 | 0.5-0.6 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| TP324 | 0.1-0.2 | Fill | <4 | <0.4 | 1 | 21 | - | <0.1 | <1 | 0.4 | - | 3.5 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | - | <0.1 | NAD |
| TP324 | 0.5-0.6 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| TP325 | 0.0-0.2 | Fill | <4 | <0.4 | 1 | 1 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| **DP (August 2018)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP1 | 0.3-0.4 | Fill | - | - | - | 47 | - | - | - | 0.1 | - | 1.4 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP1 | 1.1-1.2 | Natural Sand | - | - | - | 1 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP2 | 0-0.1 | Fill | - | - | - | 91 | - | - | - | 0.1 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP2 | 1.3-1.4 | Natural Sand | - | - | - | <1 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP3 | 0.1-0.2 | Fill | - | - | - | 22 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP3 | 1.0-1.1 | Natural Sand | - | - | - | <1 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP4 | 0.4-0.5 | Fill | - | - | - | 180 | - | - | - | 1.5 | - | 18 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| BD2/20180807 | - | Fill | - | - | - | 220 | - | - | - | 0.4 | - | 3.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP4 | 0.6-0.7 | Natural Sand | - | - | - | <1 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP5 | 0.1-0.2 | Fill | - | - | - | 140 | - | - | - | 0.63 | - | 5.6 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP5 | 0.9-1.0 | Natural Sand | - | - | - | 14 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP7 | 0.3-0.4 | Fill | - | - | - | 20 | - | - | - | 0.1 | - | 1.2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP7 | 0.7-0.8 | Natural Sand | - | - | - | <1 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP8 | 0.5-0.6 | Fill | <4 | <0.4 | <1 | 19 | - | 0.4 | <1 | <0.05 | - | <0.05 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| TP8 | 1.3-1.4 | Natural Sand | <4 | <0.4 | 2 | 2 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | - | - | - | - |
| TP9 | 0-0.1 | Fill | <4 | <0.4 | 8 | 890 | - | 0.2 | 4 | 1.2 | - | 10 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| TP9 | 0.4-0.5 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 |
| TP9 | 0.4-0.5A | Material | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | Chrysotile, Amosite & Crocidolite detected |
| TP10 | 0.4-0.5 | Fill | - | - | - | 110 | - | - | - | 0.3 | - | 2.5 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP10 | 0.9-1.0 | Natural Sand | - | - | - | 2 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP10 | 0-0.1 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 |
| TP10 | 0-0.1A | Material | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | Chrysotile, Amosite & Crocidolite detected |
| TP11 | 0-0.1 | Fill | - | - | - | 180 | - | - | - | 0.2 | - | 2.2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TP11 | 0.4-0.5 | Natural Sand | - | - | - | 3 | - | - | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **DP (June, 2018)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH201 | 0.2-0.3 | Fill | <4 | <0.4 | 4 | 130 | 0.1 | <0.1 | 3 | 0.83 | <0.001 | 6.9 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| BH205 | 0.1-0.2 | Fill | <4 | <0.4 | 3 | 67 | - | <0.1 | 2 | 1.3 | <0.001 | 10 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| BH206 | 0.3-0.4 | Fill | <4 | <0.4 | 4 | 140 | 0.1 | 0.1 | 2 | 1.7 | <0.001 | 16 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | 1.6 | NAD |
| BH207 | 0.1-0.2 | Fill | <4 | <0.4 | 4 | 98 | - | <0.1 | 2 | 1.2 | <0.001 | 17 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| BH208 | 0.3-0.4 | Fill | 7 | 0.6 | 7 | 270 | 0.38 | 0.2 | 3 | 2.9 | <0.001 | 31 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.5 | NAD |
| BH214 | 0.1-0.2 | Fill | <4 | <0.4 | 3 | 29 | - | <0.1 | 1 | 0.07 | - | 0.2 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| **DP (Oct 2017, Jan 2018) Investigation** | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH1 | 0.5-0.6 | Fill | <4 | <0.4 | 2 | 25 | - | <0.1 | 1 | 0.06 | | 0.81 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH2 | 0.3-0.4 | Fill | <4 | <0.4 | 4 | 16 | - | <0.1 | 2 | <0.05 | - | <1.35 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH4 | 0.07-0.15 | Roadbase | <4 | <0.4 | <1 | 1 | - | <0.1 | 3 | 57 | <0.001 | 634.3 | <5 | <25 | 66 | 4400 | 3000 | <0.2 | <0.5 | <1 | <1 | <1 | <1 | <1 | NAD |
| BH4 | 0.5-0.6 | Fill | <4 | <0.4 | 3 | 10 | - | <0.1 | 2 | 0.52 | - | 3.82 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH5 | 0.4-0.5 | Fill | <4 | <0.4 | <1 | 2 | - | <0.1 | <1 | <0.05 | - | 0.775 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH5 | 0.9-1 | Natural Sand | <4 | <0.4 | <1 | <1 | - | <0.1 | <1 | <0.05 | - | <1.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | - |
| BH5 | 1.3-1.4 | Natural Sand | <4 | <0.4 | 3 | 2 | - | <0.1 | 1 | <0.05 | - | <1.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | - |
| BH8 | 0.4-0.5 | Roadbase | <4 | <0.4 | 5 | 12 | - | <0.1 | 4 | - | - | 150 | <5 | <25 | 860 | 8500 | 3800 | <0.2 | <0.5 | <1 | <1 | <1 | <1 | <1 | NAD |
| BH8 | 0.6-0.7 | Fill | <4 | <0.4 | 1 | <1 | - | <0.1 | <1 | 0.2 | - | 3.45 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH9 | 0.6-0.7 | Fill | <4 | <0.4 | <1 | 8 | - | <0.1 | <1 | <0.05 | - | <1.35 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH9 | 1.4-1.5 | Fill | <4 | <0.4 | <1 | <1 | - | <0.1 | <1 | <0.05 | - | <1.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH101 | 0.5-0.7 | Fill | <4 | <0.4 | 4 | 34 | - | 0.1 | <1 | 0.1 | - | 1.15 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH101 | 1.4-1.6 | Natural Sand | <4 | <0.4 | 9 | 4 | - | <0.1 | 2 | <0.05 | - | <1.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |

| Test Pit/ Sample ID[a] | Sampling Depth | Soil Type | Metals | | | | | | | PAH | | | Phenols | Total Petroleum Hydrocarbons | | | | BTEX | | | | OCP | OPP | PCB | Asbestos |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arsenic | Cadmium | Chromium (VI)[b] | Lead | Lead (TCLP) | Mercury | Nickel | Benzo(a) Pyrene (BaP) | BaP (TCLP) | Total PAH | Phenol | C6 - C9 | C10 - C14 | C15-C28 | C29 - C36 | Benzene | Toluene | Ethylbenzene | Xylenes | Endosulfan | Chlorpyrifos | PCB * | Asbestos |
| BH102 | 0.3 | Fill | 5 | <0.4 | 6 | 53 | 1.4 | 0.2 | 2 | 0.2 | <0.001 | 2.7 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH103 | 0-0.3 | Fill | <4 | 0.5 | 9 | 450 | 0.3 | 0.2 | 3 | 1.2 | <0.001 | 9.85 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH103 | 0.5-0.7 | Natural Sand | 5 | <0.4 | 26 | 77 | - | 0.1 | 26 | 1.4 | - | 11.45 | - | <25 | <50 | 100 | 110 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH104 | 0-0.3 | Fill | <4 | <0.4 | 3 | 20 | 0.1 | <0.1 | 2 | 0.63 | - | 4.03 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH111 | 0-0.2 | Fill | 7 | 0.8 | 18 | 470 | 0.3 | 0.2 | 5 | 6.4 | <0.001 | 50.75 | <5 | <25 | <50 | 280 | 260 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.5 | NAD |
| BH112 | 0-0.2 | Natural Sand | 6 | 2 | 20 | 440 | 0.1 | 0.2 | 5 | 0.5 | <0.001 | 3.8 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | 0.2 | NAD |
| BH112 | 0.6-0.7 | Fill | <4 | <0.4 | 1 | 8 | - | <0.1 | <1 | <0.05 | - | <1.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH113 | 0.1-0.3 | Fill | <4 | <0.4 | 2 | 28 | - | <0.1 | <1 | 0.2 | - | 2 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH113 | 0.5-0.7 | Natural Sand | <4 | <0.4 | 14 | 350 | 0.2 | 0.1 | 4 | 1.2 | <0.001 | 9.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH114 | 0.5-0.7 | Fill | <4 | <0.4 | 5 | 130 | 0.2 | 0.1 | 2 | 1.1 | <0.001 | 9.75 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH115 | 0-0.2 | Fill | <4 | <0.4 | 2 | 10 | - | <0.1 | 1 | 0.09 | - | 0.84 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH115 | 0.5-0.7 | Natural Sand | <4 | <0.4 | 9 | 360 | 0.1 | 0.2 | 4 | 0.89 | <0.001 | 6.59 | - | <25 | <50 | <100 | 100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH116 | 0-0.2 | Fill | <4 | <0.4 | 7 | 360 | 0.2 | 0.2 | 4 | 1.4 | - | 14.3 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH117 | 0.6-0.8 | Fill | <4 | <0.4 | 11 | 6 | - | <0.1 | 2 | <0.05 | - | <1.35 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH117 | 1.5-1.6 | Natural Sand | <4 | <0.4 | 4 | 270 | 0.32 | 0.3 | 2 | 0.52 | <0.001 | 4.72 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH118 | 0.5-0.6 | Fill | <4 | 0.8 | 9 | 350 | 0.39 | 0.2 | 3 | 0.6 | <0.001 | 4.75 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH119 | 0.5-0.6 | Fill | <4 | <0.4 | 6 | 100 | 0.08 | <0.1 | 3 | 0.3 | - | 2.4 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH119 | 1-1.1 | Natural Sand | <4 | <0.4 | 2 | 13 | - | <0.1 | 1 | <0.05 | - | <1.35 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH120 | 0-0.1 | Fill | 13 | <0.4 | 13 | 21 | - | 0.2 | 4 | 0.07 | - | 0.82 | <5 | <25 | <50 | <100 | 180 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| BH121 | 0-0.05 | Fill | 4 | <0.4 | 9 | 290 | 0.06 | <0.1 | 4 | 0.2 | - | 1.95 | 8 | <25 | <50 | 270 | 410 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.5 | NAD |
| BH122 | 0-0.1 | Fill | <4 | <0.4 | 6 | 69 | - | <0.1 | 1 | 0.1 | - | 1.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| BH122 | 0.5-0.6 | Natural Sand | <4 | <0.4 | 3 | 15 | - | <0.1 | 1 | <0.05 | - | <1.35 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |

**Notes**

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

[a] Duplicate sample is listed below primary sample

NAD Not detected at the laboratory reporting limit of 0.1g/kg

* PCBs must be managed in accordance with the EPA's PCB Chemical Control Order 1997.

Table C4 - Summary of Recovered Aggregate Results (All results in mg/kg unless otherwise stated)

| | | | Metals | | | | | | | | Foreign Materials | | | | | Coal Tar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arsenic | Cadmium | Chromium (III+VI) | Copper | Lead | Mercury | Nickel | Zinc | Metal | Plaster | Rubber, plastic, paper, cloth, paint, wood and other vegetable matter | Electrical conductivity | pH (aqueous extract) | |
| | | | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | % | % | % | µS/cm | pH_Units | mg/filter |
| EQL | | | 4 | 0.4 | | 1 | 1 | 0.1 | 1 | 1 | | | | | | |
| Recovered Aggregate Order (2014) Maximum Average Concentration for Characterisation | | | 20 | 0.5 | 60 | 60 | 75 | 0.5 | 40 | 200 | 1 | 0.25 | 0.2 | 1500 | | - |
| Recovered Aggregate Order (2014) Maximum Average Concentration for Routine Testing | | | | 0.5 | 60 | 60 | 75 | | | 200 | 1 | 0.25 | 0.2 | 1500 | | - |
| Recovered Aggregate Order (2014) Absolute Maximum Concentration | | | 40 | 1.5 | 120 | 150 | 150 | 1 | 80 | 350 | 2 | 0.5 | 0.3 | 3000 | | |
| | | | | | | | | | | | | | | | | |
| **Field_ID** | **Sample_Depth_Range** | **Sampled_Date-Time** | | | | | | | | | | | | | | |
| **Current Investigation - Stage 1 only** | | | | | | | | | | | | | | | | |
| EA1 | 0.1-0.3 | 12/02/2019 | <4 | <0.4 | 5 | 52 | 13 | <0.1 | 6 | 37 | <0.1 | <0.1 | <0.1 | 35 | 8.1 | <0.5 |
| EA2 | 0.1-0.3 | 12/02/2019 | <4 | <0.4 | 4 | 51 | 15 | <0.1 | 5 | 31 | <0.1 | <0.1 | <0.1 | 29 | 9.3 | <0.5 |
| EA3 | 0.1-0.3 | 12/02/2019 | <4 | <0.4 | 5 | 66 | 21 | <0.1 | 6 | 54 | <0.1 | <0.1 | <0.1 | 69 | 9.1 | <0.5 |
| EA4 | 0.1-0.3 | 12/02/2019 | <4 | <0.4 | 10 | 28 | 22 | <0.1 | 10 | 40 | <0.1 | <0.1 | <0.1 | 290 | 10.6 | <0.5 |
| EA5 | 0.1-0.3 | 12/02/2019 | <4 | <0.4 | 8 | 49 | 56 | <0.1 | 7 | 67 | <0.1 | <0.1 | <0.1 | 470 | 9 | <0.5 |
| EA6 | 0.1-0.3 | 12/02/2019 | <4 | <0.4 | 8 | 110 | 10 | <0.1 | 5 | 32 | <0.1 | <0.1 | <0.1 | 58 | 9.4 | <0.5 |
| **Previous Investigations - Stage 1 only** | | | | | | | | | | | | | | | | |
| BH4 | 0.07-0.15 | 18/09/2017 | <4 | <0.4 | <1 | 100 | 1 | <0.1 | 3 | 10 | - | - | - | - | - | - |

## UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.13/09/2019 2:59:30 PM |
| From File | WorkSheet.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Copper**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 20 | Number of Distinct Observations | 9 |
| | | Number of Missing Observations | 0 |
| Minimum | 1 | Mean | 9.85 |
| Maximum | 83 | Median | 2 |
| SD | 19.84 | Std. Error of Mean | 4.436 |
| Coefficient of Variation | 2.014 | Skewness | 3.153 |

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.509 | **Shapiro Wilk GOF Test** |
| 5% Shapiro Wilk Critical Value | 0.905 | Data Not Normal at 5% Significance Level |
| Lilliefors Test Statistic | 0.347 | **Lilliefors GOF Test** |
| 5% Lilliefors Critical Value | 0.192 | Data Not Normal at 5% Significance Level |

**Data Not Normal at 5% Significance Level**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 17.52 | 95% Adjusted-CLT UCL (Chen-1995) | 20.49 |
| | | 95% Modified-t UCL (Johnson-1978) | 18.04 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 1.981 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.797 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.249 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.204 | Data Not Gamma Distributed at 5% Significance Level |

**Data Not Gamma Distributed at 5% Significance Level**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 0.564 | k star (bias corrected MLE) | 0.513 |
| Theta hat (MLE) | 17.45 | Theta star (bias corrected MLE) | 19.2 |
| nu hat (MLE) | 22.58 | nu star (bias corrected) | 20.52 |
| MLE Mean (bias corrected) | 9.85 | MLE Sd (bias corrected) | 13.75 |
| | | Approximate Chi Square Value (0.05) | 11.24 |
| Adjusted Level of Significance | 0.038 | Adjusted Chi Square Value | 10.7 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL (use when n>=50)) | 17.99 | 95% Adjusted Gamma UCL (use when n<50) | 18.9 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.837 | **Shapiro Wilk Lognormal GOF Test** |
| 5% Shapiro Wilk Critical Value | 0.905 | Data Not Lognormal at 5% Significance Level |
| Lilliefors Test Statistic | 0.208 | **Lilliefors Lognormal GOF Test** |
| 5% Lilliefors Critical Value | 0.192 | Data Not Lognormal at 5% Significance Level |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | **Lognormal Statistics** | | | | | | | | | | | |
| 59 | | | | | | Minimum of Logged Data | 0 | | | Mean of logged Data | 1.183 | |
| 60 | | | | | | Maximum of Logged Data | 4.419 | | | SD of logged Data | 1.36 | |
| 61 | | | | | | | | | | | | |
| 62 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 63 | | | | | | 95% H-UCL | 22.3 | | | 90% Chebyshev (MVUE) UCL | 15.77 | |
| 64 | | | | | | 95% Chebyshev (MVUE) UCL | 19.47 | | | 97.5% Chebyshev (MVUE) UCL | 24.6 | |
| 65 | | | | | | 99% Chebyshev (MVUE) UCL | 34.69 | | | | | |
| 66 | | | | | | | | | | | | |
| 67 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 68 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 69 | | | | | | | | | | | | |
| 70 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 71 | | | | | | 95% CLT UCL | 17.15 | | | 95% Jackknife UCL | 17.52 | |
| 72 | | | | | | 95% Standard Bootstrap UCL | 16.85 | | | 95% Bootstrap-t UCL | 36.96 | |
| 73 | | | | | | 95% Hall's Bootstrap UCL | 46.38 | | | 95% Percentile Bootstrap UCL | 17.75 | |
| 74 | | | | | | 95% BCA Bootstrap UCL | 20.95 | | | | | |
| 75 | | | | | | 90% Chebyshev(Mean, Sd) UCL | 23.16 | | | 95% Chebyshev(Mean, Sd) UCL | 29.18 | |
| 76 | | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 37.55 | | | 99% Chebyshev(Mean, Sd) UCL | 53.98 | |
| 77 | | | | | | | | | | | | |
| 78 | **Suggested UCL to Use** | | | | | | | | | | | |
| 79 | | | | | | 95% Chebyshev (Mean, Sd) UCL | 29.18 | | | | | |
| 80 | | | | | | | | | | | | |
| 81 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 82 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 83 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 84 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 85 | | | | | | | | | | | | |
| 86 | | | | | | | | | | | | |
| 87 | **Lead** | | | | | | | | | | | |
| 88 | | | | | | | | | | | | |
| 89 | **General Statistics** | | | | | | | | | | | |
| 90 | | | | | | Total Number of Observations | 22 | | | Number of Distinct Observations | 19 | |
| 91 | | | | | | | | | | Number of Missing Observations | 0 | |
| 92 | | | | | | Minimum | 1 | | | Mean | 63.27 | |
| 93 | | | | | | Maximum | 450 | | | Median | 17.5 | |
| 94 | | | | | | SD | 116 | | | Std. Error of Mean | 24.73 | |
| 95 | | | | | | Coefficient of Variation | 1.833 | | | Skewness | 2.67 | |
| 96 | | | | | | | | | | | | |
| 97 | **Normal GOF Test** | | | | | | | | | | | |
| 98 | | | | | | Shapiro Wilk Test Statistic | 0.57 | | | **Shapiro Wilk GOF Test** | | |
| 99 | | | | | | 5% Shapiro Wilk Critical Value | 0.911 | | | Data Not Normal at 5% Significance Level | | |
| 100 | | | | | | Lilliefors Test Statistic | 0.329 | | | **Lilliefors GOF Test** | | |
| 101 | | | | | | 5% Lilliefors Critical Value | 0.184 | | | Data Not Normal at 5% Significance Level | | |
| 102 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 103 | | | | | | | | | | | | |
| 104 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 105 | **95% Normal UCL** | | | | | | | | | **95% UCLs (Adjusted for Skewness)** | | |
| 106 | | | | | | 95% Student's-t UCL | 105.8 | | | 95% Adjusted-CLT UCL (Chen-1995) | 119 | |
| 107 | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | 108.2 | |
| 108 | | | | | | | | | | | | |
| 109 | **Gamma GOF Test** | | | | | | | | | | | |
| 110 | | | | | | A-D Test Statistic | 0.831 | | | **Anderson-Darling Gamma GOF Test** | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 111 | | | | 5% A-D Critical Value | 0.805 | Data Not Gamma Distributed at 5% Significance Level | | | | | | |
| 112 | | | | K-S Test Statistic | 0.189 | **Kolmogorov-Smirnov Gamma GOF Test** | | | | | | |
| 113 | | | | 5% K-S Critical Value | 0.196 | Detected data appear Gamma Distributed at 5% Significance Level | | | | | | |
| 114 | **Detected data follow Appr. Gamma Distribution at 5% Significance Level** | | | | | | | | | | | |
| 115 | | | | | | | | | | | | |
| 116 | **Gamma Statistics** | | | | | | | | | | | |
| 117 | | | | k hat (MLE) | 0.495 | k star (bias corrected MLE) | 0.458 | | | | | |
| 118 | | | | Theta hat (MLE) | 127.9 | Theta star (bias corrected MLE) | 138.3 | | | | | |
| 119 | | | | nu hat (MLE) | 21.77 | nu star (bias corrected) | 20.13 | | | | | |
| 120 | | | | MLE Mean (bias corrected) | 63.27 | MLE Sd (bias corrected) | 93.54 | | | | | |
| 121 | | | | | | Approximate Chi Square Value (0.05) | 10.95 | | | | | |
| 122 | | | | Adjusted Level of Significance | 0.0386 | Adjusted Chi Square Value | 10.44 | | | | | |
| 123 | | | | | | | | | | | | |
| 124 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 125 | | | 95% Approximate Gamma UCL (use when n>=50) | | 116.3 | 95% Adjusted Gamma UCL (use when n<50) | 122 | | | | | |
| 126 | | | | | | | | | | | | |
| 127 | **Lognormal GOF Test** | | | | | | | | | | | |
| 128 | | | | Shapiro Wilk Test Statistic | 0.976 | **Shapiro Wilk Lognormal GOF Test** | | | | | | |
| 129 | | | | 5% Shapiro Wilk Critical Value | 0.911 | Data appear Lognormal at 5% Significance Level | | | | | | |
| 130 | | | | Lilliefors Test Statistic | 0.0761 | **Lilliefors Lognormal GOF Test** | | | | | | |
| 131 | | | | 5% Lilliefors Critical Value | 0.184 | Data appear Lognormal at 5% Significance Level | | | | | | |
| 132 | **Data appear Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 133 | | | | | | | | | | | | |
| 134 | **Lognormal Statistics** | | | | | | | | | | | |
| 135 | | | | Minimum of Logged Data | 0 | Mean of logged Data | 2.861 | | | | | |
| 136 | | | | Maximum of Logged Data | 6.109 | SD of logged Data | 1.711 | | | | | |
| 137 | | | | | | | | | | | | |
| 138 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 139 | | | | 95% H-UCL | 300.2 | 90% Chebyshev (MVUE) UCL | 154.7 | | | | | |
| 140 | | | | 95% Chebyshev (MVUE) UCL | 195.1 | 97.5% Chebyshev (MVUE) UCL | 251 | | | | | |
| 141 | | | | 99% Chebyshev (MVUE) UCL | 361 | | | | | | | |
| 142 | | | | | | | | | | | | |
| 143 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 144 | **Data appear to follow a Discernible Distribution at 5% Significance Level** | | | | | | | | | | | |
| 145 | | | | | | | | | | | | |
| 146 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 147 | | | | 95% CLT UCL | 103.9 | 95% Jackknife UCL | 105.8 | | | | | |
| 148 | | | | 95% Standard Bootstrap UCL | 103.6 | 95% Bootstrap-t UCL | 176 | | | | | |
| 149 | | | | 95% Hall's Bootstrap UCL | 281.5 | 95% Percentile Bootstrap UCL | 104.6 | | | | | |
| 150 | | | | 95% BCA Bootstrap UCL | 118.7 | | | | | | | |
| 151 | | | | 90% Chebyshev(Mean, Sd) UCL | 137.5 | 95% Chebyshev(Mean, Sd) UCL | 171.1 | | | | | |
| 152 | | | | 97.5% Chebyshev(Mean, Sd) UCL | 217.7 | 99% Chebyshev(Mean, Sd) UCL | 309.3 | | | | | |
| 153 | | | | | | | | | | | | |
| 154 | **Suggested UCL to Use** | | | | | | | | | | | |
| 155 | | | | 95% Adjusted Gamma UCL | 122 | | | | | | | |
| 156 | | | | | | | | | | | | |
| 157 | When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test | | | | | | | | | | | |
| 158 | When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL | | | | | | | | | | | |
| 159 | | | | | | | | | | | | |
| 160 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 161 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 162 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 163 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 164 | | | | | | | | | | | | |
| 165 | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 166 | **Nickel** | | | | | | | | | | | |
| 167 | | | | | | | | | | | | |
| 168 | **General Statistics** | | | | | | | | | | | |
| 169 | | | | | Total Number of Observations | 20 | | | | Number of Distinct Observations | | 3 |
| 170 | | | | | | | | | | Number of Missing Observations | | 0 |
| 171 | | | | | Minimum | 1 | | | | Mean | | 1.5 |
| 172 | | | | | Maximum | 3 | | | | Median | | 1 |
| 173 | | | | | SD | 0.761 | | | | Std. Error of Mean | | 0.17 |
| 174 | | | | | Coefficient of Variation | 0.507 | | | | Skewness | | 1.195 |
| 175 | | | | | | | | | | | | |
| 176 | **Normal GOF Test** | | | | | | | | | | | |
| 177 | | | | | Shapiro Wilk Test Statistic | 0.67 | | | | **Shapiro Wilk GOF Test** | | |
| 178 | | | | | 5% Shapiro Wilk Critical Value | 0.905 | | | | Data Not Normal at 5% Significance Level | | |
| 179 | | | | | Lilliefors Test Statistic | 0.394 | | | | **Lilliefors GOF Test** | | |
| 180 | | | | | 5% Lilliefors Critical Value | 0.192 | | | | Data Not Normal at 5% Significance Level | | |
| 181 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 182 | | | | | | | | | | | | |
| 183 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 184 | | | | | **95% Normal UCL** | | | | | **95% UCLs (Adjusted for Skewness)** | | |
| 185 | | | | | 95% Student's-t UCL | 1.794 | | | | 95% Adjusted-CLT UCL (Chen-1995) | | 1.828 |
| 186 | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | | 1.802 |
| 187 | | | | | | | | | | | | |
| 188 | **Gamma GOF Test** | | | | | | | | | | | |
| 189 | | | | | A-D Test Statistic | 3.163 | | | | **Anderson-Darling Gamma GOF Test** | | |
| 190 | | | | | 5% A-D Critical Value | 0.745 | | | | Data Not Gamma Distributed at 5% Significance Level | | |
| 191 | | | | | K-S Test Statistic | 0.408 | | | | **Kolmogorov-Smirnov Gamma GOF Test** | | |
| 192 | | | | | 5% K-S Critical Value | 0.194 | | | | Data Not Gamma Distributed at 5% Significance Level | | |
| 193 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 194 | | | | | | | | | | | | |
| 195 | **Gamma Statistics** | | | | | | | | | | | |
| 196 | | | | | k hat (MLE) | 5.061 | | | | k star (bias corrected MLE) | | 4.335 |
| 197 | | | | | Theta hat (MLE) | 0.296 | | | | Theta star (bias corrected MLE) | | 0.346 |
| 198 | | | | | nu hat (MLE) | 202.4 | | | | nu star (bias corrected) | | 173.4 |
| 199 | | | | | MLE Mean (bias corrected) | 1.5 | | | | MLE Sd (bias corrected) | | 0.72 |
| 200 | | | | | | | | | | Approximate Chi Square Value (0.05) | | 143.9 |
| 201 | | | | | Adjusted Level of Significance | 0.038 | | | | Adjusted Chi Square Value | | 141.8 |
| 202 | | | | | | | | | | | | |
| 203 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 204 | | | | | 95% Approximate Gamma UCL (use when n>=50)) | 1.807 | | | | 95% Adjusted Gamma UCL (use when n<50) | | 1.834 |
| 205 | | | | | | | | | | | | |
| 206 | **Lognormal GOF Test** | | | | | | | | | | | |
| 207 | | | | | Shapiro Wilk Test Statistic | 0.673 | | | | **Shapiro Wilk Lognormal GOF Test** | | |
| 208 | | | | | 5% Shapiro Wilk Critical Value | 0.905 | | | | Data Not Lognormal at 5% Significance Level | | |
| 209 | | | | | Lilliefors Test Statistic | 0.404 | | | | **Lilliefors Lognormal GOF Test** | | |
| 210 | | | | | 5% Lilliefors Critical Value | 0.192 | | | | Data Not Lognormal at 5% Significance Level | | |
| 211 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 212 | | | | | | | | | | | | |
| 213 | **Lognormal Statistics** | | | | | | | | | | | |
| 214 | | | | | Minimum of Logged Data | 0 | | | | Mean of logged Data | | 0.303 |
| 215 | | | | | Maximum of Logged Data | 1.099 | | | | SD of logged Data | | 0.441 |
| 216 | | | | | | | | | | | | |
| 217 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 218 | | | | | 95% H-UCL | 1.822 | | | | 90% Chebyshev (MVUE) UCL | | 1.938 |
| 219 | | | | | 95% Chebyshev (MVUE) UCL | 2.143 | | | | 97.5% Chebyshev (MVUE) UCL | | 2.427 |
| 220 | | | | | 99% Chebyshev (MVUE) UCL | 2.986 | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | | | | | | | | | | | | |
| 222 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 223 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 224 | | | | | | | | | | | | |
| 225 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 226 | | | | 95% CLT UCL | 1.78 | | | 95% Jackknife UCL | 1.794 | | | |
| 227 | | | | 95% Standard Bootstrap UCL | N/A | | | 95% Bootstrap-t UCL | N/A | | | |
| 228 | | | | 95% Hall's Bootstrap UCL | N/A | | | 95% Percentile Bootstrap UCL | N/A | | | |
| 229 | | | | 95% BCA Bootstrap UCL | N/A | | | | | | | |
| 230 | | | | 90% Chebyshev(Mean, Sd) UCL | 2.01 | | | 95% Chebyshev(Mean, Sd) UCL | 2.242 | | | |
| 231 | | | | 97.5% Chebyshev(Mean, Sd) UCL | 2.563 | | | 99% Chebyshev(Mean, Sd) UCL | 3.193 | | | |
| 232 | | | | | | | | | | | | |
| 233 | **Suggested UCL to Use** | | | | | | | | | | | |
| 234 | | | | 95% Student's-t UCL | 1.794 | | | or 95% Modified-t UCL | 1.802 | | | |
| 235 | | | | | | | | | | | | |
| 236 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 237 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 238 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 239 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 240 | | | | | | | | | | | | |
| 241 | | | | | | | | | | | | |
| 242 | **Zinc** | | | | | | | | | | | |
| 243 | | | | | | | | | | | | |
| 244 | **General Statistics** | | | | | | | | | | | |
| 245 | | | | Total Number of Observations | 20 | | | Number of Distinct Observations | 20 | | | |
| 246 | | | | | | | | Number of Missing Observations | 0 | | | |
| 247 | | | | Minimum | 1 | | | Mean | 64.65 | | | |
| 248 | | | | Maximum | 510 | | | Median | 27 | | | |
| 249 | | | | SD | 118.2 | | | Std. Error of Mean | 26.43 | | | |
| 250 | | | | Coefficient of Variation | 1.829 | | | Skewness | 3.212 | | | |
| 251 | | | | | | | | | | | | |
| 252 | **Normal GOF Test** | | | | | | | | | | | |
| 253 | | | | Shapiro Wilk Test Statistic | 0.555 | | | **Shapiro Wilk GOF Test** | | | | |
| 254 | | | | 5% Shapiro Wilk Critical Value | 0.905 | | | Data Not Normal at 5% Significance Level | | | | |
| 255 | | | | Lilliefors Test Statistic | 0.325 | | | **Lilliefors GOF Test** | | | | |
| 256 | | | | 5% Lilliefors Critical Value | 0.192 | | | Data Not Normal at 5% Significance Level | | | | |
| 257 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 258 | | | | | | | | | | | | |
| 259 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 260 | **95% Normal UCL** | | | | | | | **95% UCLs (Adjusted for Skewness)** | | | | |
| 261 | | | | 95% Student's-t UCL | 110.4 | | | 95% Adjusted-CLT UCL (Chen-1995) | 128.4 | | | |
| 262 | | | | | | | | 95% Modified-t UCL (Johnson-1978) | 113.5 | | | |
| 263 | | | | | | | | | | | | |
| 264 | **Gamma GOF Test** | | | | | | | | | | | |
| 265 | | | | A-D Test Statistic | 0.566 | | | **Anderson-Darling Gamma GOF Test** | | | | |
| 266 | | | | 5% A-D Critical Value | 0.797 | | | Detected data appear Gamma Distributed at 5% Significance Level | | | | |
| 267 | | | | K-S Test Statistic | 0.16 | | | **Kolmogorov-Smirnov Gamma GOF Test** | | | | |
| 268 | | | | 5% K-S Critical Value | 0.204 | | | Detected data appear Gamma Distributed at 5% Significance Level | | | | |
| 269 | **Detected data appear Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 270 | | | | | | | | | | | | |
| 271 | **Gamma Statistics** | | | | | | | | | | | |
| 272 | | | | k hat (MLE) | 0.556 | | | k star (bias corrected MLE) | 0.506 | | | |
| 273 | | | | Theta hat (MLE) | 116.3 | | | Theta star (bias corrected MLE) | 127.8 | | | |
| 274 | | | | nu hat (MLE) | 22.24 | | | nu star (bias corrected) | 20.24 | | | |
| 275 | | | | MLE Mean (bias corrected) | 64.65 | | | MLE Sd (bias corrected) | 90.89 | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 276 | | | | | | | | | | | Approximate Chi Square Value (0.05) | 11.03 |
| 277 | | | | | Adjusted Level of Significance | 0.038 | | | | | Adjusted Chi Square Value | 10.49 |
| 278 | | | | | | | | | | | | |
| 279 | | | | | **Assuming Gamma Distribution** | | | | | | | |
| 280 | | | | | 95% Approximate Gamma UCL (use when n>=50) | 118.7 | | | | | 95% Adjusted Gamma UCL (use when n<50) | 124.7 |
| 281 | | | | | | | | | | | | |
| 282 | | | | | **Lognormal GOF Test** | | | | | | | |
| 283 | | | | | Shapiro Wilk Test Statistic | 0.989 | | | | | **Shapiro Wilk Lognormal GOF Test** | |
| 284 | | | | | 5% Shapiro Wilk Critical Value | 0.905 | | | | | Data appear Lognormal at 5% Significance Level | |
| 285 | | | | | Lilliefors Test Statistic | 0.103 | | | | | **Lilliefors Lognormal GOF Test** | |
| 286 | | | | | 5% Lilliefors Critical Value | 0.192 | | | | | Data appear Lognormal at 5% Significance Level | |
| 287 | | | | | **Data appear Lognormal at 5% Significance Level** | | | | | | | |
| 288 | | | | | | | | | | | | |
| 289 | | | | | **Lognormal Statistics** | | | | | | | |
| 290 | | | | | Minimum of Logged Data | 0 | | | | | Mean of logged Data | 3.045 |
| 291 | | | | | Maximum of Logged Data | 6.234 | | | | | SD of logged Data | 1.61 |
| 292 | | | | | | | | | | | | |
| 293 | | | | | **Assuming Lognormal Distribution** | | | | | | | |
| 294 | | | | | 95% H-UCL | 292.2 | | | | | 90% Chebyshev (MVUE) UCL | 155.8 |
| 295 | | | | | 95% Chebyshev (MVUE) UCL | 195.8 | | | | | 97.5% Chebyshev (MVUE) UCL | 251.2 |
| 296 | | | | | 99% Chebyshev (MVUE) UCL | 360.2 | | | | | | |
| 297 | | | | | | | | | | | | |
| 298 | | | | | **Nonparametric Distribution Free UCL Statistics** | | | | | | | |
| 299 | | | | | **Data appear to follow a Discernible Distribution at 5% Significance Level** | | | | | | | |
| 300 | | | | | | | | | | | | |
| 301 | | | | | **Nonparametric Distribution Free UCLs** | | | | | | | |
| 302 | | | | | 95% CLT UCL | 108.1 | | | | | 95% Jackknife UCL | 110.4 |
| 303 | | | | | 95% Standard Bootstrap UCL | 107.6 | | | | | 95% Bootstrap-t UCL | 191.6 |
| 304 | | | | | 95% Hall's Bootstrap UCL | 259.8 | | | | | 95% Percentile Bootstrap UCL | 111.5 |
| 305 | | | | | 95% BCA Bootstrap UCL | 133.2 | | | | | | |
| 306 | | | | | 90% Chebyshev(Mean, Sd) UCL | 144 | | | | | 95% Chebyshev(Mean, Sd) UCL | 179.9 |
| 307 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 229.7 | | | | | 99% Chebyshev(Mean, Sd) UCL | 327.7 |
| 308 | | | | | | | | | | | | |
| 309 | | | | | **Suggested UCL to Use** | | | | | | | |
| 310 | | | | | 95% Adjusted Gamma UCL | 124.7 | | | | | | |
| 311 | | | | | | | | | | | | |
| 312 | | | | | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | |
| 313 | | | | | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | |
| 314 | | | | | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | |
| 315 | | | | | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | |
| 316 | | | | | | | | | | | | |
| 317 | | | | | | | | | | | | |
| 318 | **B(a)P** | | | | | | | | | | | |
| 319 | | | | | | | | | | | | |
| 320 | | | | | **General Statistics** | | | | | | | |
| 321 | | | | | Total Number of Observations | 22 | | | | | Number of Distinct Observations | 10 |
| 322 | | | | | | | | | | | Number of Missing Observations | 0 |
| 323 | | | | | Minimum | 0.05 | | | | | Mean | 0.255 |
| 324 | | | | | Maximum | 1.2 | | | | | Median | 0.06 |
| 325 | | | | | SD | 0.354 | | | | | Std. Error of Mean | 0.0754 |
| 326 | | | | | Coefficient of Variation | 1.389 | | | | | Skewness | 1.81 |
| 327 | | | | | | | | | | | | |
| 328 | | | | | **Normal GOF Test** | | | | | | | |
| 329 | | | | | Shapiro Wilk Test Statistic | 0.648 | | | | | **Shapiro Wilk GOF Test** | |
| 330 | | | | | 5% Shapiro Wilk Critical Value | 0.911 | | | | | Data Not Normal at 5% Significance Level | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 331 | | | | Lilliefors Test Statistic | 0.351 | **Lilliefors GOF Test** | | | | | | |
| 332 | | | | 5% Lilliefors Critical Value | 0.184 | Data Not Normal at 5% Significance Level | | | | | | |
| 333 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 334 | | | | | | | | | | | | |
| 335 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 336 | **95% Normal UCL** | | | | | **95% UCLs (Adjusted for Skewness)** | | | | | | |
| 337 | | | | 95% Student's-t UCL | 0.384 | 95% Adjusted-CLT UCL (Chen-1995) | | | | | | 0.41 |
| 338 | | | | | | 95% Modified-t UCL (Johnson-1978) | | | | | | 0.389 |
| 339 | | | | | | | | | | | | |
| 340 | **Gamma GOF Test** | | | | | | | | | | | |
| 341 | | | | A-D Test Statistic | 2.64 | **Anderson-Darling Gamma GOF Test** | | | | | | |
| 342 | | | | 5% A-D Critical Value | 0.781 | Data Not Gamma Distributed at 5% Significance Level | | | | | | |
| 343 | | | | K-S Test Statistic | 0.31 | **Kolmogorov-Smirnov Gamma GOF Test** | | | | | | |
| 344 | | | | 5% K-S Critical Value | 0.192 | Data Not Gamma Distributed at 5% Significance Level | | | | | | |
| 345 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 346 | | | | | | | | | | | | |
| 347 | **Gamma Statistics** | | | | | | | | | | | |
| 348 | | | | k hat (MLE) | 0.798 | k star (bias corrected MLE) | | | | | | 0.72 |
| 349 | | | | Theta hat (MLE) | 0.319 | Theta star (bias corrected MLE) | | | | | | 0.354 |
| 350 | | | | nu hat (MLE) | 35.12 | nu star (bias corrected) | | | | | | 31.66 |
| 351 | | | | MLE Mean (bias corrected) | 0.255 | MLE Sd (bias corrected) | | | | | | 0.3 |
| 352 | | | | | | Approximate Chi Square Value (0.05) | | | | | | 19.8 |
| 353 | | | | Adjusted Level of Significance | 0.0386 | Adjusted Chi Square Value | | | | | | 19.1 |
| 354 | | | | | | | | | | | | |
| 355 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 356 | 95% Approximate Gamma UCL (use when n>=50)) | | | | 0.407 | 95% Adjusted Gamma UCL (use when n<50) | | | | | | 0.422 |
| 357 | | | | | | | | | | | | |
| 358 | **Lognormal GOF Test** | | | | | | | | | | | |
| 359 | | | | Shapiro Wilk Test Statistic | 0.759 | **Shapiro Wilk Lognormal GOF Test** | | | | | | |
| 360 | | | | 5% Shapiro Wilk Critical Value | 0.911 | Data Not Lognormal at 5% Significance Level | | | | | | |
| 361 | | | | Lilliefors Test Statistic | 0.273 | **Lilliefors Lognormal GOF Test** | | | | | | |
| 362 | | | | 5% Lilliefors Critical Value | 0.184 | Data Not Lognormal at 5% Significance Level | | | | | | |
| 363 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 364 | | | | | | | | | | | | |
| 365 | **Lognormal Statistics** | | | | | | | | | | | |
| 366 | | | | Minimum of Logged Data | -2.996 | Mean of logged Data | | | | | | -2.112 |
| 367 | | | | Maximum of Logged Data | 0.182 | SD of logged Data | | | | | | 1.158 |
| 368 | | | | | | | | | | | | |
| 369 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 370 | | | | 95% H-UCL | 0.481 | 90% Chebyshev (MVUE) UCL | | | | | | 0.419 |
| 371 | | | | 95% Chebyshev (MVUE) UCL | 0.507 | 97.5% Chebyshev (MVUE) UCL | | | | | | 0.628 |
| 372 | | | | 99% Chebyshev (MVUE) UCL | 0.867 | | | | | | | |
| 373 | | | | | | | | | | | | |
| 374 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 375 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 376 | | | | | | | | | | | | |
| 377 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 378 | | | | 95% CLT UCL | 0.379 | 95% Jackknife UCL | | | | | | 0.384 |
| 379 | | | | 95% Standard Bootstrap UCL | 0.376 | 95% Bootstrap-t UCL | | | | | | 0.471 |
| 380 | | | | 95% Hall's Bootstrap UCL | 0.409 | 95% Percentile Bootstrap UCL | | | | | | 0.38 |
| 381 | | | | 95% BCA Bootstrap UCL | 0.419 | | | | | | | |
| 382 | | | | 90% Chebyshev(Mean, Sd) UCL | 0.481 | 95% Chebyshev(Mean, Sd) UCL | | | | | | 0.583 |
| 383 | | | | 97.5% Chebyshev(Mean, Sd) UCL | 0.725 | 99% Chebyshev(Mean, Sd) UCL | | | | | | 1.005 |
| 384 | | | | | | | | | | | | |
| 385 | **Suggested UCL to Use** | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 386 | | | | 95% Chebyshev (Mean, Sd) UCL | | 0.583 | | | | | | |
| 387 | | | | | | | | | | | | |
| 388 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 389 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 390 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 391 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 392 | | | | | | | | | | | | |
| 393 | | | | | | | | | | | | |
| 394 | **B(a)P TEQ** | | | | | | | | | | | |
| 395 | | | | | | | | | | | | |
| 396 | **General Statistics** | | | | | | | | | | | |
| 397 | | | | Total Number of Observations | | 22 | | Number of Distinct Observations | | | 10 | |
| 398 | | | | | | | | Number of Missing Observations | | | 0 | |
| 399 | | | | Minimum | | 0.121 | | Mean | | | 0.542 | |
| 400 | | | | Maximum | | 1.59 | | Median | | | 0.5 | |
| 401 | | | | SD | | 0.393 | | Std. Error of Mean | | | 0.0838 | |
| 402 | | | | Coefficient of Variation | | 0.725 | | Skewness | | | 1.572 | |
| 403 | | | | | | | | | | | | |
| 404 | **Normal GOF Test** | | | | | | | | | | | |
| 405 | | | | Shapiro Wilk Test Statistic | | 0.781 | | **Shapiro Wilk GOF Test** | | | | |
| 406 | | | | 5% Shapiro Wilk Critical Value | | 0.911 | | Data Not Normal at 5% Significance Level | | | | |
| 407 | | | | Lilliefors Test Statistic | | 0.315 | | **Lilliefors GOF Test** | | | | |
| 408 | | | | 5% Lilliefors Critical Value | | 0.184 | | Data Not Normal at 5% Significance Level | | | | |
| 409 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 410 | | | | | | | | | | | | |
| 411 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 412 | **95% Normal UCL** | | | | | | | **95% UCLs (Adjusted for Skewness)** | | | | |
| 413 | | | | 95% Student's-t UCL | | 0.686 | | 95% Adjusted-CLT UCL (Chen-1995) | | | 0.71 | |
| 414 | | | | | | | | 95% Modified-t UCL (Johnson-1978) | | | 0.691 | |
| 415 | | | | | | | | | | | | |
| 416 | **Gamma GOF Test** | | | | | | | | | | | |
| 417 | | | | A-D Test Statistic | | 1.276 | | **Anderson-Darling Gamma GOF Test** | | | | |
| 418 | | | | 5% A-D Critical Value | | 0.754 | | Data Not Gamma Distributed at 5% Significance Level | | | | |
| 419 | | | | K-S Test Statistic | | 0.232 | | **Kolmogorov-Smirnov Gamma GOF Test** | | | | |
| 420 | | | | 5% K-S Critical Value | | 0.188 | | Data Not Gamma Distributed at 5% Significance Level | | | | |
| 421 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 422 | | | | | | | | | | | | |
| 423 | **Gamma Statistics** | | | | | | | | | | | |
| 424 | | | | k hat (MLE) | | 2.301 | | k star (bias corrected MLE) | | | 2.018 | |
| 425 | | | | Theta hat (MLE) | | 0.236 | | Theta star (bias corrected MLE) | | | 0.269 | |
| 426 | | | | nu hat (MLE) | | 101.3 | | nu star (bias corrected) | | | 88.78 | |
| 427 | | | | MLE Mean (bias corrected) | | 0.542 | | MLE Sd (bias corrected) | | | 0.382 | |
| 428 | | | | | | | | Approximate Chi Square Value (0.05) | | | 68.05 | |
| 429 | | | | Adjusted Level of Significance | | 0.0386 | | Adjusted Chi Square Value | | | 66.7 | |
| 430 | | | | | | | | | | | | |
| 431 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 432 | | | | 95% Approximate Gamma UCL (use when n>=50)) | | 0.707 | | 95% Adjusted Gamma UCL (use when n<50) | | | 0.721 | |
| 433 | | | | | | | | | | | | |
| 434 | **Lognormal GOF Test** | | | | | | | | | | | |
| 435 | | | | Shapiro Wilk Test Statistic | | 0.885 | | **Shapiro Wilk Lognormal GOF Test** | | | | |
| 436 | | | | 5% Shapiro Wilk Critical Value | | 0.911 | | Data Not Lognormal at 5% Significance Level | | | | |
| 437 | | | | Lilliefors Test Statistic | | 0.266 | | **Lilliefors Lognormal GOF Test** | | | | |
| 438 | | | | 5% Lilliefors Critical Value | | 0.184 | | Data Not Lognormal at 5% Significance Level | | | | |
| 439 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 440 | | | | | | | | | | | | |

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 441 | **Lognormal Statistics** | | | | | | | | | | | |
| 442 | | | | | Minimum of Logged Data | -2.112 | | | | Mean of logged Data | | -0.845 |
| 443 | | | | | Maximum of Logged Data | 0.464 | | | | SD of logged Data | | 0.713 |
| 444 | | | | | | | | | | | | |
| 445 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 446 | | | | | 95% H-UCL | 0.782 | | | | 90% Chebyshev (MVUE) UCL | | 0.813 |
| 447 | | | | | 95% Chebyshev (MVUE) UCL | 0.934 | | | | 97.5% Chebyshev (MVUE) UCL | | 1.102 |
| 448 | | | | | 99% Chebyshev (MVUE) UCL | 1.433 | | | | | | |
| 449 | | | | | | | | | | | | |
| 450 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 451 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 452 | | | | | | | | | | | | |
| 453 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 454 | | | | | 95% CLT UCL | 0.68 | | | | 95% Jackknife UCL | | 0.686 |
| 455 | | | | | 95% Standard Bootstrap UCL | 0.683 | | | | 95% Bootstrap-t UCL | | 0.757 |
| 456 | | | | | 95% Hall's Bootstrap UCL | 0.773 | | | | 95% Percentile Bootstrap UCL | | 0.676 |
| 457 | | | | | 95% BCA Bootstrap UCL | 0.702 | | | | | | |
| 458 | | | | | 90% Chebyshev(Mean, Sd) UCL | 0.793 | | | | 95% Chebyshev(Mean, Sd) UCL | | 0.907 |
| 459 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 1.065 | | | | 99% Chebyshev(Mean, Sd) UCL | | 1.375 |
| 460 | | | | | | | | | | | | |
| 461 | **Suggested UCL to Use** | | | | | | | | | | | |
| 462 | | | | | 95% Chebyshev (Mean, Sd) UCL | 0.907 | | | | | | |
| 463 | | | | | | | | | | | | |
| 464 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 465 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 466 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 467 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 468 | | | | | | | | | | | | |

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **UCL Statistics for Uncensored Full Data Sets** | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | User Selected Options | | | | | | | | | | | |
| 4 | Date/Time of Computation | ProUCL 5.13/09/2019 2:56:40 PM | | | | | | | | | | |
| 5 | From File | WorkSheet.xls | | | | | | | | | | |
| 6 | Full Precision | OFF | | | | | | | | | | |
| 7 | Confidence Coefficient | 95% | | | | | | | | | | |
| 8 | Number of Bootstrap Operations | 2000 | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | **Copper** | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | **General Statistics** | | | | | | | | | | | |
| 14 | Total Number of Observations | 29 | | | | | Number of Distinct Observations | 19 | | | | |
| 15 | | | | | | | Number of Missing Observations | 0 | | | | |
| 16 | Minimum | 1 | | | | | Mean | 13.41 | | | | |
| 17 | Maximum | 50 | | | | | Median | 7 | | | | |
| 18 | SD | 13.54 | | | | | Std. Error of Mean | 2.514 | | | | |
| 19 | Coefficient of Variation | 1.009 | | | | | Skewness | 1.176 | | | | |
| 20 | | | | | | | | | | | | |
| 21 | **Normal GOF Test** | | | | | | | | | | | |
| 22 | Shapiro Wilk Test Statistic | 0.84 | | | | | **Shapiro Wilk GOF Test** | | | | | |
| 23 | 5% Shapiro Wilk Critical Value | 0.926 | | | | | Data Not Normal at 5% Significance Level | | | | | |
| 24 | Lilliefors Test Statistic | 0.214 | | | | | **Lilliefors GOF Test** | | | | | |
| 25 | 5% Lilliefors Critical Value | 0.161 | | | | | Data Not Normal at 5% Significance Level | | | | | |
| 26 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 29 | **95% Normal UCL** | | | | | | **95% UCLs (Adjusted for Skewness)** | | | | | |
| 30 | 95% Student's-t UCL | 17.69 | | | | | 95% Adjusted-CLT UCL (Chen-1995) | 18.14 | | | | |
| 31 | | | | | | | 95% Modified-t UCL (Johnson-1978) | 17.78 | | | | |
| 32 | | | | | | | | | | | | |
| 33 | **Gamma GOF Test** | | | | | | | | | | | |
| 34 | A-D Test Statistic | 0.543 | | | | | **Anderson-Darling Gamma GOF Test** | | | | | |
| 35 | 5% A-D Critical Value | 0.777 | | | | | Detected data appear Gamma Distributed at 5% Significance Level | | | | | |
| 36 | K-S Test Statistic | 0.122 | | | | | **Kolmogorov-Smirnov Gamma GOF Test** | | | | | |
| 37 | 5% K-S Critical Value | 0.168 | | | | | Detected data appear Gamma Distributed at 5% Significance Level | | | | | |
| 38 | **Detected data appear Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 39 | | | | | | | | | | | | |
| 40 | **Gamma Statistics** | | | | | | | | | | | |
| 41 | k hat (MLE) | 0.919 | | | | | k star (bias corrected MLE) | 0.847 | | | | |
| 42 | Theta hat (MLE) | 14.6 | | | | | Theta star (bias corrected MLE) | 15.84 | | | | |
| 43 | nu hat (MLE) | 53.31 | | | | | nu star (bias corrected) | 49.12 | | | | |
| 44 | MLE Mean (bias corrected) | 13.41 | | | | | MLE Sd (bias corrected) | 14.58 | | | | |
| 45 | | | | | | | Approximate Chi Square Value (0.05) | 34.03 | | | | |
| 46 | Adjusted Level of Significance | 0.0407 | | | | | Adjusted Chi Square Value | 33.28 | | | | |
| 47 | | | | | | | | | | | | |
| 48 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 49 | 95% Approximate Gamma UCL (use when n>=50) | 19.36 | | | | | 95% Adjusted Gamma UCL (use when n<50) | 19.8 | | | | |
| 50 | | | | | | | | | | | | |
| 51 | **Lognormal GOF Test** | | | | | | | | | | | |
| 52 | Shapiro Wilk Test Statistic | 0.909 | | | | | **Shapiro Wilk Lognormal GOF Test** | | | | | |
| 53 | 5% Shapiro Wilk Critical Value | 0.926 | | | | | Data Not Lognormal at 5% Significance Level | | | | | |
| 54 | Lilliefors Test Statistic | 0.144 | | | | | **Lilliefors Lognormal GOF Test** | | | | | |
| 55 | 5% Lilliefors Critical Value | 0.161 | | | | | Data appear Lognormal at 5% Significance Level | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | **Data appear Approximate Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | **Lognormal Statistics** | | | | | | | | | | | |
| 59 | | | | | Minimum of Logged Data | 0 | | | | Mean of logged Data | | 1.962 |
| 60 | | | | | Maximum of Logged Data | 3.912 | | | | SD of logged Data | | 1.283 |
| 61 | | | | | | | | | | | | |
| 62 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 63 | | | | | 95% H-UCL | 32.21 | | | | 90% Chebyshev (MVUE) UCL | | 28.79 |
| 64 | | | | | 95% Chebyshev (MVUE) UCL | 34.84 | | | | 97.5% Chebyshev (MVUE) UCL | | 43.23 |
| 65 | | | | | 99% Chebyshev (MVUE) UCL | 59.73 | | | | | | |
| 66 | | | | | | | | | | | | |
| 67 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 68 | **Data appear to follow a Discernible Distribution at 5% Significance Level** | | | | | | | | | | | |
| 69 | | | | | | | | | | | | |
| 70 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 71 | | | | | 95% CLT UCL | 17.55 | | | | 95% Jackknife UCL | | 17.69 |
| 72 | | | | | 95% Standard Bootstrap UCL | 17.44 | | | | 95% Bootstrap-t UCL | | 18.56 |
| 73 | | | | | 95% Hall's Bootstrap UCL | 18.11 | | | | 95% Percentile Bootstrap UCL | | 17.69 |
| 74 | | | | | 95% BCA Bootstrap UCL | 18.17 | | | | | | |
| 75 | | | | | 90% Chebyshev(Mean, Sd) UCL | 20.96 | | | | 95% Chebyshev(Mean, Sd) UCL | | 24.37 |
| 76 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 29.11 | | | | 99% Chebyshev(Mean, Sd) UCL | | 38.43 |
| 77 | | | | | | | | | | | | |
| 78 | **Suggested UCL to Use** | | | | | | | | | | | |
| 79 | | | | | 95% Adjusted Gamma UCL | 19.8 | | | | | | |
| 80 | | | | | | | | | | | | |
| 81 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 82 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 83 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 84 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 85 | | | | | | | | | | | | |
| 86 | | | | | | | | | | | | |
| 87 | **Lead** | | | | | | | | | | | |
| 88 | | | | | | | | | | | | |
| 89 | **General Statistics** | | | | | | | | | | | |
| 90 | | | | | Total Number of Observations | 33 | | | | Number of Distinct Observations | | 26 |
| 91 | | | | | | | | | | Number of Missing Observations | | 0 |
| 92 | | | | | Minimum | 1 | | | | Mean | | 105.6 |
| 93 | | | | | Maximum | 890 | | | | Median | | 45 |
| 94 | | | | | SD | 175.1 | | | | Std. Error of Mean | | 30.48 |
| 95 | | | | | Coefficient of Variation | 1.658 | | | | Skewness | | 3.333 |
| 96 | | | | | | | | | | | | |
| 97 | **Normal GOF Test** | | | | | | | | | | | |
| 98 | | | | | Shapiro Wilk Test Statistic | 0.588 | | | | **Shapiro Wilk GOF Test** | | |
| 99 | | | | | 5% Shapiro Wilk Critical Value | 0.931 | | | | Data Not Normal at 5% Significance Level | | |
| 100 | | | | | Lilliefors Test Statistic | 0.28 | | | | **Lilliefors GOF Test** | | |
| 101 | | | | | 5% Lilliefors Critical Value | 0.152 | | | | Data Not Normal at 5% Significance Level | | |
| 102 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 103 | | | | | | | | | | | | |
| 104 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 105 | | | | | **95% Normal UCL** | | | | | **95% UCLs (Adjusted for Skewness)** | | |
| 106 | | | | | 95% Student's-t UCL | 157.2 | | | | 95% Adjusted-CLT UCL (Chen-1995) | | 174.6 |
| 107 | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | | 160.2 |
| 108 | | | | | | | | | | | | |
| 109 | **Gamma GOF Test** | | | | | | | | | | | |
| 110 | | | | | A-D Test Statistic | 0.608 | | | | **Anderson-Darling Gamma GOF Test** | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 111 | | | | 5% A-D Critical Value | 0.798 | Detected data appear Gamma Distributed at 5% Significance Level | | | | | | |
| 112 | | | | K-S Test Statistic | 0.15 | **Kolmogorov-Smirnov Gamma GOF Test** | | | | | | |
| 113 | | | | 5% K-S Critical Value | 0.16 | Detected data appear Gamma Distributed at 5% Significance Level | | | | | | |
| 114 | **Detected data appear Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 115 | | | | | | | | | | | | |
| 116 | **Gamma Statistics** | | | | | | | | | | | |
| 117 | | | | k hat (MLE) | 0.634 | k star (bias corrected MLE) | 0.597 | | | | | |
| 118 | | | | Theta hat (MLE) | 166.4 | Theta star (bias corrected MLE) | 176.9 | | | | | |
| 119 | | | | nu hat (MLE) | 41.87 | nu star (bias corrected) | 39.4 | | | | | |
| 120 | | | | MLE Mean (bias corrected) | 105.6 | MLE Sd (bias corrected) | 136.6 | | | | | |
| 121 | | | | | | Approximate Chi Square Value (0.05) | 26.02 | | | | | |
| 122 | | | | Adjusted Level of Significance | 0.0419 | Adjusted Chi Square Value | 25.46 | | | | | |
| 123 | | | | | | | | | | | | |
| 124 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 125 | | | | 95% Approximate Gamma UCL (use when n>=50) | 159.9 | 95% Adjusted Gamma UCL (use when n<50) | 163.4 | | | | | |
| 126 | | | | | | | | | | | | |
| 127 | **Lognormal GOF Test** | | | | | | | | | | | |
| 128 | | | | Shapiro Wilk Test Statistic | 0.969 | **Shapiro Wilk Lognormal GOF Test** | | | | | | |
| 129 | | | | 5% Shapiro Wilk Critical Value | 0.931 | Data appear Lognormal at 5% Significance Level | | | | | | |
| 130 | | | | Lilliefors Test Statistic | 0.0952 | **Lilliefors Lognormal GOF Test** | | | | | | |
| 131 | | | | 5% Lilliefors Critical Value | 0.152 | Data appear Lognormal at 5% Significance Level | | | | | | |
| 132 | **Data appear Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 133 | | | | | | | | | | | | |
| 134 | **Lognormal Statistics** | | | | | | | | | | | |
| 135 | | | | Minimum of Logged Data | 0 | Mean of logged Data | 3.693 | | | | | |
| 136 | | | | Maximum of Logged Data | 6.791 | SD of logged Data | 1.549 | | | | | |
| 137 | | | | | | | | | | | | |
| 138 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 139 | | | | 95% H-UCL | 318.2 | 90% Chebyshev (MVUE) UCL | 253 | | | | | |
| 140 | | | | 95% Chebyshev (MVUE) UCL | 311.4 | 97.5% Chebyshev (MVUE) UCL | 392.6 | | | | | |
| 141 | | | | 99% Chebyshev (MVUE) UCL | 551.9 | | | | | | | |
| 142 | | | | | | | | | | | | |
| 143 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 144 | **Data appear to follow a Discernible Distribution at 5% Significance Level** | | | | | | | | | | | |
| 145 | | | | | | | | | | | | |
| 146 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 147 | | | | 95% CLT UCL | 155.7 | 95% Jackknife UCL | 157.2 | | | | | |
| 148 | | | | 95% Standard Bootstrap UCL | 155.1 | 95% Bootstrap-t UCL | 209.3 | | | | | |
| 149 | | | | 95% Hall's Bootstrap UCL | 351.7 | 95% Percentile Bootstrap UCL | 157.7 | | | | | |
| 150 | | | | 95% BCA Bootstrap UCL | 184 | | | | | | | |
| 151 | | | | 90% Chebyshev(Mean, Sd) UCL | 197 | 95% Chebyshev(Mean, Sd) UCL | 238.4 | | | | | |
| 152 | | | | 97.5% Chebyshev(Mean, Sd) UCL | 295.9 | 99% Chebyshev(Mean, Sd) UCL | 408.8 | | | | | |
| 153 | | | | | | | | | | | | |
| 154 | **Suggested UCL to Use** | | | | | | | | | | | |
| 155 | | | | 95% Adjusted Gamma UCL | 163.4 | | | | | | | |
| 156 | | | | | | | | | | | | |
| 157 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 158 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 159 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 160 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 161 | | | | | | | | | | | | |
| 162 | | | | | | | | | | | | |
| 163 | **Nickel** | | | | | | | | | | | |
| 164 | | | | | | | | | | | | |
| 165 | **General Statistics** | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 166 | | | | Total Number of Observations | | 29 | | | | Number of Distinct Observations | | 5 |
| 167 | | | | | | | | | | Number of Missing Observations | | 0 |
| 168 | | | | Minimum | | 1 | | | | Mean | | 1.897 |
| 169 | | | | Maximum | | 5 | | | | Median | | 1 |
| 170 | | | | SD | | 1.175 | | | | Std. Error of Mean | | 0.218 |
| 171 | | | | Coefficient of Variation | | 0.62 | | | | Skewness | | 1.205 |
| 172 | | | | | | | | | | | | |
| 173 | | | | | | **Normal GOF Test** | | | | | | |
| 174 | | | | Shapiro Wilk Test Statistic | | 0.765 | | | | **Shapiro Wilk GOF Test** | | |
| 175 | | | | 5% Shapiro Wilk Critical Value | | 0.926 | | | | Data Not Normal at 5% Significance Level | | |
| 176 | | | | Lilliefors Test Statistic | | 0.294 | | | | **Lilliefors GOF Test** | | |
| 177 | | | | 5% Lilliefors Critical Value | | 0.161 | | | | Data Not Normal at 5% Significance Level | | |
| 178 | | | | | | **Data Not Normal at 5% Significance Level** | | | | | | |
| 179 | | | | | | | | | | | | |
| 180 | | | | | | **Assuming Normal Distribution** | | | | | | |
| 181 | | | | **95% Normal UCL** | | | | | | **95% UCLs (Adjusted for Skewness)** | | |
| 182 | | | | 95% Student's-t UCL | | 2.268 | | | | 95% Adjusted-CLT UCL (Chen-1995) | | 2.308 |
| 183 | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | | 2.276 |
| 184 | | | | | | | | | | | | |
| 185 | | | | | | **Gamma GOF Test** | | | | | | |
| 186 | | | | A-D Test Statistic | | 2.688 | | | | **Anderson-Darling Gamma GOF Test** | | |
| 187 | | | | 5% A-D Critical Value | | 0.752 | | | | Data Not Gamma Distributed at 5% Significance Level | | |
| 188 | | | | K-S Test Statistic | | 0.321 | | | | **Kolmogorov-Smirnov Gamma GOF Test** | | |
| 189 | | | | 5% K-S Critical Value | | 0.164 | | | | Data Not Gamma Distributed at 5% Significance Level | | |
| 190 | | | | | | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | |
| 191 | | | | | | | | | | | | |
| 192 | | | | | | **Gamma Statistics** | | | | | | |
| 193 | | | | k hat (MLE) | | 3.279 | | | | k star (bias corrected MLE) | | 2.963 |
| 194 | | | | Theta hat (MLE) | | 0.578 | | | | Theta star (bias corrected MLE) | | 0.64 |
| 195 | | | | nu hat (MLE) | | 190.2 | | | | nu star (bias corrected) | | 171.8 |
| 196 | | | | MLE Mean (bias corrected) | | 1.897 | | | | MLE Sd (bias corrected) | | 1.102 |
| 197 | | | | | | | | | | Approximate Chi Square Value (0.05) | | 142.5 |
| 198 | | | | Adjusted Level of Significance | | 0.0407 | | | | Adjusted Chi Square Value | | 140.9 |
| 199 | | | | | | | | | | | | |
| 200 | | | | | | **Assuming Gamma Distribution** | | | | | | |
| 201 | | | | 95% Approximate Gamma UCL (use when n>=50)) | | 2.287 | | | | 95% Adjusted Gamma UCL (use when n<50) | | 2.312 |
| 202 | | | | | | | | | | | | |
| 203 | | | | | | **Lognormal GOF Test** | | | | | | |
| 204 | | | | Shapiro Wilk Test Statistic | | 0.782 | | | | **Shapiro Wilk Lognormal GOF Test** | | |
| 205 | | | | 5% Shapiro Wilk Critical Value | | 0.926 | | | | Data Not Lognormal at 5% Significance Level | | |
| 206 | | | | Lilliefors Test Statistic | | 0.323 | | | | **Lilliefors Lognormal GOF Test** | | |
| 207 | | | | 5% Lilliefors Critical Value | | 0.161 | | | | Data Not Lognormal at 5% Significance Level | | |
| 208 | | | | | | **Data Not Lognormal at 5% Significance Level** | | | | | | |
| 209 | | | | | | | | | | | | |
| 210 | | | | | | **Lognormal Statistics** | | | | | | |
| 211 | | | | Minimum of Logged Data | | 0 | | | | Mean of logged Data | | 0.48 |
| 212 | | | | Maximum of Logged Data | | 1.609 | | | | SD of logged Data | | 0.556 |
| 213 | | | | | | | | | | | | |
| 214 | | | | | | **Assuming Lognormal Distribution** | | | | | | |
| 215 | | | | 95% H-UCL | | 2.326 | | | | 90% Chebyshev (MVUE) UCL | | 2.486 |
| 216 | | | | 95% Chebyshev (MVUE) UCL | | 2.764 | | | | 97.5% Chebyshev (MVUE) UCL | | 3.148 |
| 217 | | | | 99% Chebyshev (MVUE) UCL | | 3.904 | | | | | | |
| 218 | | | | | | | | | | | | |
| 219 | | | | | | **Nonparametric Distribution Free UCL Statistics** | | | | | | |
| 220 | | | | | | **Data do not follow a Discernible Distribution (0.05)** | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | | | | | | | | | | | | |
| 222 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 223 | | | | | 95% CLT UCL | 2.256 | | | | 95% Jackknife UCL | 2.268 | |
| 224 | | | | | 95% Standard Bootstrap UCL | 2.254 | | | | 95% Bootstrap-t UCL | 2.363 | |
| 225 | | | | | 95% Hall's Bootstrap UCL | 2.317 | | | | 95% Percentile Bootstrap UCL | 2.276 | |
| 226 | | | | | 95% BCA Bootstrap UCL | 2.241 | | | | | | |
| 227 | | | | | 90% Chebyshev(Mean, Sd) UCL | 2.551 | | | | 95% Chebyshev(Mean, Sd) UCL | 2.848 | |
| 228 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 3.26 | | | | 99% Chebyshev(Mean, Sd) UCL | 4.068 | |
| 229 | | | | | | | | | | | | |
| 230 | **Suggested UCL to Use** | | | | | | | | | | | |
| 231 | | | | | 95% Chebyshev (Mean, Sd) UCL | 2.848 | | | | | | |
| 232 | | | | | | | | | | | | |
| 233 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 234 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 235 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 236 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 237 | | | | | | | | | | | | |
| 238 | | | | | | | | | | | | |
| 239 | **Zinc** | | | | | | | | | | | |
| 240 | | | | | | | | | | | | |
| 241 | **General Statistics** | | | | | | | | | | | |
| 242 | | | | | Total Number of Observations | 29 | | | | Number of Distinct Observations | 28 | |
| 243 | | | | | | | | | | Number of Missing Observations | 0 | |
| 244 | | | | | Minimum | 1 | | | | Mean | 73.59 | |
| 245 | | | | | Maximum | 390 | | | | Median | 56 | |
| 246 | | | | | SD | 78.49 | | | | Std. Error of Mean | 14.58 | |
| 247 | | | | | Coefficient of Variation | 1.067 | | | | Skewness | 2.556 | |
| 248 | | | | | | | | | | | | |
| 249 | **Normal GOF Test** | | | | | | | | | | | |
| 250 | | | | | Shapiro Wilk Test Statistic | 0.762 | | | | **Shapiro Wilk GOF Test** | | |
| 251 | | | | | 5% Shapiro Wilk Critical Value | 0.926 | | | | Data Not Normal at 5% Significance Level | | |
| 252 | | | | | Lilliefors Test Statistic | 0.178 | | | | **Lilliefors GOF Test** | | |
| 253 | | | | | 5% Lilliefors Critical Value | 0.161 | | | | Data Not Normal at 5% Significance Level | | |
| 254 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 255 | | | | | | | | | | | | |
| 256 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 257 | | | | | **95% Normal UCL** | | | | | **95% UCLs (Adjusted for Skewness)** | | |
| 258 | | | | | 95% Student's-t UCL | 98.38 | | | | 95% Adjusted-CLT UCL (Chen-1995) | 105 | |
| 259 | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | 99.53 | |
| 260 | | | | | | | | | | | | |
| 261 | **Gamma GOF Test** | | | | | | | | | | | |
| 262 | | | | | A-D Test Statistic | 0.273 | | | | **Anderson-Darling Gamma GOF Test** | | |
| 263 | | | | | 5% A-D Critical Value | 0.777 | | | | Detected data appear Gamma Distributed at 5% Significance Level | | |
| 264 | | | | | K-S Test Statistic | 0.102 | | | | **Kolmogorov-Smirnov Gamma GOF Test** | | |
| 265 | | | | | 5% K-S Critical Value | 0.168 | | | | Detected data appear Gamma Distributed at 5% Significance Level | | |
| 266 | **Detected data appear Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 267 | | | | | | | | | | | | |
| 268 | **Gamma Statistics** | | | | | | | | | | | |
| 269 | | | | | k hat (MLE) | 0.939 | | | | k star (bias corrected MLE) | 0.865 | |
| 270 | | | | | Theta hat (MLE) | 78.39 | | | | Theta star (bias corrected MLE) | 85.11 | |
| 271 | | | | | nu hat (MLE) | 54.44 | | | | nu star (bias corrected) | 50.14 | |
| 272 | | | | | MLE Mean (bias corrected) | 73.59 | | | | MLE Sd (bias corrected) | 79.14 | |
| 273 | | | | | | | | | | Approximate Chi Square Value (0.05) | 34.89 | |
| 274 | | | | | Adjusted Level of Significance | 0.0407 | | | | Adjusted Chi Square Value | 34.12 | |
| 275 | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 276 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 277 | 95% Approximate Gamma UCL (use when n>=50) | | | | | 105.8 | 95% Adjusted Gamma UCL (use when n<50) | | | | | 108.1 |
| 278 | | | | | | | | | | | | |
| 279 | **Lognormal GOF Test** | | | | | | | | | | | |
| 280 | Shapiro Wilk Test Statistic | | | | | 0.921 | **Shapiro Wilk Lognormal GOF Test** | | | | | |
| 281 | 5% Shapiro Wilk Critical Value | | | | | 0.926 | Data Not Lognormal at 5% Significance Level | | | | | |
| 282 | Lilliefors Test Statistic | | | | | 0.17 | **Lilliefors Lognormal GOF Test** | | | | | |
| 283 | 5% Lilliefors Critical Value | | | | | 0.161 | Data Not Lognormal at 5% Significance Level | | | | | |
| 284 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 285 | | | | | | | | | | | | |
| 286 | **Lognormal Statistics** | | | | | | | | | | | |
| 287 | Minimum of Logged Data | | | | | 0 | Mean of logged Data | | | | | 3.679 |
| 288 | Maximum of Logged Data | | | | | 5.966 | SD of logged Data | | | | | 1.372 |
| 289 | | | | | | | | | | | | |
| 290 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 291 | 95% H-UCL | | | | | 219 | 90% Chebyshev (MVUE) UCL | | | | | 186 |
| 292 | 95% Chebyshev (MVUE) UCL | | | | | 226.8 | 97.5% Chebyshev (MVUE) UCL | | | | | 283.5 |
| 293 | 99% Chebyshev (MVUE) UCL | | | | | 394.8 | | | | | | |
| 294 | | | | | | | | | | | | |
| 295 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 296 | **Data appear to follow a Discernible Distribution at 5% Significance Level** | | | | | | | | | | | |
| 297 | | | | | | | | | | | | |
| 298 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 299 | 95% CLT UCL | | | | | 97.56 | 95% Jackknife UCL | | | | | 98.38 |
| 300 | 95% Standard Bootstrap UCL | | | | | 97.82 | 95% Bootstrap-t UCL | | | | | 108.7 |
| 301 | 95% Hall's Bootstrap UCL | | | | | 206.2 | 95% Percentile Bootstrap UCL | | | | | 99.14 |
| 302 | 95% BCA Bootstrap UCL | | | | | 106.9 | | | | | | |
| 303 | 90% Chebyshev(Mean, Sd) UCL | | | | | 117.3 | 95% Chebyshev(Mean, Sd) UCL | | | | | 137.1 |
| 304 | 97.5% Chebyshev(Mean, Sd) UCL | | | | | 164.6 | 99% Chebyshev(Mean, Sd) UCL | | | | | 218.6 |
| 305 | | | | | | | | | | | | |
| 306 | **Suggested UCL to Use** | | | | | | | | | | | |
| 307 | 95% Adjusted Gamma UCL | | | | | 108.1 | | | | | | |
| 308 | | | | | | | | | | | | |
| 309 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 310 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 311 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 312 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 313 | | | | | | | | | | | | |
| 314 | | | | | | | | | | | | |
| 315 | **B(a)P** | | | | | | | | | | | |
| 316 | | | | | | | | | | | | |
| 317 | **General Statistics** | | | | | | | | | | | |
| 318 | Total Number of Observations | | | | | 33 | Number of Distinct Observations | | | | | 18 |
| 319 | | | | | | | Number of Missing Observations | | | | | 0 |
| 320 | Minimum | | | | | 0.05 | Mean | | | | | 0.706 |
| 321 | Maximum | | | | | 6.4 | Median | | | | | 0.2 |
| 322 | SD | | | | | 1.207 | Std. Error of Mean | | | | | 0.21 |
| 323 | Coefficient of Variation | | | | | 1.711 | Skewness | | | | | 3.564 |
| 324 | | | | | | | | | | | | |
| 325 | **Normal GOF Test** | | | | | | | | | | | |
| 326 | Shapiro Wilk Test Statistic | | | | | 0.581 | **Shapiro Wilk GOF Test** | | | | | |
| 327 | 5% Shapiro Wilk Critical Value | | | | | 0.931 | Data Not Normal at 5% Significance Level | | | | | |
| 328 | Lilliefors Test Statistic | | | | | 0.294 | **Lilliefors GOF Test** | | | | | |
| 329 | 5% Lilliefors Critical Value | | | | | 0.152 | Data Not Normal at 5% Significance Level | | | | | |
| 330 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 331 | | | | | | | | | | | | |
| 332 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 333 | **95% Normal UCL** | | | | | | **95% UCLs (Adjusted for Skewness)** | | | | | |
| 334 | | | | 95% Student's-t UCL | | 1.062 | | | | 95% Adjusted-CLT UCL (Chen-1995) | | 1.191 |
| 335 | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | | 1.084 |
| 336 | | | | | | | | | | | | |
| 337 | **Gamma GOF Test** | | | | | | | | | | | |
| 338 | | | | A-D Test Statistic | | 1.721 | **Anderson-Darling Gamma GOF Test** | | | | | |
| 339 | | | | 5% A-D Critical Value | | 0.803 | Data Not Gamma Distributed at 5% Significance Level | | | | | |
| 340 | | | | K-S Test Statistic | | 0.233 | **Kolmogorov-Smirnov Gamma GOF Test** | | | | | |
| 341 | | | | 5% K-S Critical Value | | 0.161 | Data Not Gamma Distributed at 5% Significance Level | | | | | |
| 342 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 343 | | | | | | | | | | | | |
| 344 | **Gamma Statistics** | | | | | | | | | | | |
| 345 | | | | k hat (MLE) | | 0.589 | | | | k star (bias corrected MLE) | | 0.556 |
| 346 | | | | Theta hat (MLE) | | 1.197 | | | | Theta star (bias corrected MLE) | | 1.269 |
| 347 | | | | nu hat (MLE) | | 38.91 | | | | nu star (bias corrected) | | 36.7 |
| 348 | | | | MLE Mean (bias corrected) | | 0.706 | | | | MLE Sd (bias corrected) | | 0.946 |
| 349 | | | | | | | | | | Approximate Chi Square Value (0.05) | | 23.84 |
| 350 | | | | Adjusted Level of Significance | | 0.0419 | | | | Adjusted Chi Square Value | | 23.3 |
| 351 | | | | | | | | | | | | |
| 352 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 353 | | | | 95% Approximate Gamma UCL (use when n>=50)) | | 1.087 | | | | 95% Adjusted Gamma UCL (use when n<50) | | 1.112 |
| 354 | | | | | | | | | | | | |
| 355 | **Lognormal GOF Test** | | | | | | | | | | | |
| 356 | | | | Shapiro Wilk Test Statistic | | 0.875 | **Shapiro Wilk Lognormal GOF Test** | | | | | |
| 357 | | | | 5% Shapiro Wilk Critical Value | | 0.931 | Data Not Lognormal at 5% Significance Level | | | | | |
| 358 | | | | Lilliefors Test Statistic | | 0.213 | **Lilliefors Lognormal GOF Test** | | | | | |
| 359 | | | | 5% Lilliefors Critical Value | | 0.152 | Data Not Lognormal at 5% Significance Level | | | | | |
| 360 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 361 | | | | | | | | | | | | |
| 362 | **Lognormal Statistics** | | | | | | | | | | | |
| 363 | | | | Minimum of Logged Data | | -2.996 | | | | Mean of logged Data | | -1.399 |
| 364 | | | | Maximum of Logged Data | | 1.856 | | | | SD of logged Data | | 1.488 |
| 365 | | | | | | | | | | | | |
| 366 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 367 | | | | 95% H-UCL | | 1.68 | | | | 90% Chebyshev (MVUE) UCL | | 1.39 |
| 368 | | | | 95% Chebyshev (MVUE) UCL | | 1.704 | | | | 97.5% Chebyshev (MVUE) UCL | | 2.138 |
| 369 | | | | 99% Chebyshev (MVUE) UCL | | 2.992 | | | | | | |
| 370 | | | | | | | | | | | | |
| 371 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 372 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 373 | | | | | | | | | | | | |
| 374 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 375 | | | | 95% CLT UCL | | 1.051 | | | | 95% Jackknife UCL | | 1.062 |
| 376 | | | | 95% Standard Bootstrap UCL | | 1.051 | | | | 95% Bootstrap-t UCL | | 1.351 |
| 377 | | | | 95% Hall's Bootstrap UCL | | 2.481 | | | | 95% Percentile Bootstrap UCL | | 1.07 |
| 378 | | | | 95% BCA Bootstrap UCL | | 1.213 | | | | | | |
| 379 | | | | 90% Chebyshev(Mean, Sd) UCL | | 1.336 | | | | 95% Chebyshev(Mean, Sd) UCL | | 1.622 |
| 380 | | | | 97.5% Chebyshev(Mean, Sd) UCL | | 2.018 | | | | 99% Chebyshev(Mean, Sd) UCL | | 2.797 |
| 381 | | | | | | | | | | | | |
| 382 | **Suggested UCL to Use** | | | | | | | | | | | |
| 383 | | | | 95% Chebyshev (Mean, Sd) UCL | | 1.622 | | | | | | |
| 384 | | | | | | | | | | | | |
| 385 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 386 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 387 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 388 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 389 | | | | | | | | | | | | |
| 390 | | | | | | | | | | | | |
| 391 | **B(a)P TEQ** | | | | | | | | | | | |
| 392 | | | | | | | | | | | | |
| 393 | **General Statistics** | | | | | | | | | | | |
| 394 | | | | | | Total Number of Observations | 33 | | | | Number of Distinct Observations | 17 |
| 395 | | | | | | | | | | | Number of Missing Observations | 0 |
| 396 | | | | | | Minimum | 0.131 | | | | Mean | 1.163 |
| 397 | | | | | | Maximum | 8.197 | | | | Median | 0.5 |
| 398 | | | | | | SD | 1.486 | | | | Std. Error of Mean | 0.259 |
| 399 | | | | | | Coefficient of Variation | 1.279 | | | | Skewness | 3.596 |
| 400 | | | | | | | | | | | | |
| 401 | **Normal GOF Test** | | | | | | | | | | | |
| 402 | | | | | | Shapiro Wilk Test Statistic | 0.588 | | | | **Shapiro Wilk GOF Test** | |
| 403 | | | | | | 5% Shapiro Wilk Critical Value | 0.931 | | | | Data Not Normal at 5% Significance Level | |
| 404 | | | | | | Lilliefors Test Statistic | 0.284 | | | | **Lilliefors GOF Test** | |
| 405 | | | | | | 5% Lilliefors Critical Value | 0.152 | | | | Data Not Normal at 5% Significance Level | |
| 406 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 407 | | | | | | | | | | | | |
| 408 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 409 | **95% Normal UCL** | | | | | | | | | | **95% UCLs (Adjusted for Skewness)** | |
| 410 | | | | | | 95% Student's-t UCL | 1.601 | | | | 95% Adjusted-CLT UCL (Chen-1995) | 1.761 |
| 411 | | | | | | | | | | | 95% Modified-t UCL (Johnson-1978) | 1.628 |
| 412 | | | | | | | | | | | | |
| 413 | **Gamma GOF Test** | | | | | | | | | | | |
| 414 | | | | | | A-D Test Statistic | 2.048 | | | | **Anderson-Darling Gamma GOF Test** | |
| 415 | | | | | | 5% A-D Critical Value | 0.77 | | | | Data Not Gamma Distributed at 5% Significance Level | |
| 416 | | | | | | K-S Test Statistic | 0.274 | | | | **Kolmogorov-Smirnov Gamma GOF Test** | |
| 417 | | | | | | 5% K-S Critical Value | 0.157 | | | | Data Not Gamma Distributed at 5% Significance Level | |
| 418 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 419 | | | | | | | | | | | | |
| 420 | **Gamma Statistics** | | | | | | | | | | | |
| 421 | | | | | | k hat (MLE) | 1.251 | | | | k star (bias corrected MLE) | 1.157 |
| 422 | | | | | | Theta hat (MLE) | 0.929 | | | | Theta star (bias corrected MLE) | 1.004 |
| 423 | | | | | | nu hat (MLE) | 82.56 | | | | nu star (bias corrected) | 76.39 |
| 424 | | | | | | MLE Mean (bias corrected) | 1.163 | | | | MLE Sd (bias corrected) | 1.081 |
| 425 | | | | | | | | | | | Approximate Chi Square Value (0.05) | 57.26 |
| 426 | | | | | | Adjusted Level of Significance | 0.0419 | | | | Adjusted Chi Square Value | 56.4 |
| 427 | | | | | | | | | | | | |
| 428 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 429 | | | | | | 95% Approximate Gamma UCL (use when n>=50)) | 1.551 | | | | 95% Adjusted Gamma UCL (use when n<50) | 1.574 |
| 430 | | | | | | | | | | | | |
| 431 | **Lognormal GOF Test** | | | | | | | | | | | |
| 432 | | | | | | Shapiro Wilk Test Statistic | 0.912 | | | | **Shapiro Wilk Lognormal GOF Test** | |
| 433 | | | | | | 5% Shapiro Wilk Critical Value | 0.931 | | | | Data Not Lognormal at 5% Significance Level | |
| 434 | | | | | | Lilliefors Test Statistic | 0.228 | | | | **Lilliefors Lognormal GOF Test** | |
| 435 | | | | | | 5% Lilliefors Critical Value | 0.152 | | | | Data Not Lognormal at 5% Significance Level | |
| 436 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 437 | | | | | | | | | | | | |
| 438 | **Lognormal Statistics** | | | | | | | | | | | |
| 439 | | | | | | Minimum of Logged Data | -2.033 | | | | Mean of logged Data | -0.3 |
| 440 | | | | | | Maximum of Logged Data | 2.104 | | | | SD of logged Data | 0.91 |

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| 441 | | | | | | | | | | | | |
| 442 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 443 | | | | | 95% H-UCL | 1.633 | | | 90% Chebyshev (MVUE) UCL | 1.696 | | |
| 444 | | | | | 95% Chebyshev (MVUE) UCL | 1.965 | | | 97.5% Chebyshev (MVUE) UCL | 2.338 | | |
| 445 | | | | | 99% Chebyshev (MVUE) UCL | 3.071 | | | | | | |
| 446 | | | | | | | | | | | | |
| 447 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 448 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 449 | | | | | | | | | | | | |
| 450 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 451 | | | | | 95% CLT UCL | 1.588 | | | 95% Jackknife UCL | 1.601 | | |
| 452 | | | | | 95% Standard Bootstrap UCL | 1.587 | | | 95% Bootstrap-t UCL | 1.987 | | |
| 453 | | | | | 95% Hall's Bootstrap UCL | 3.335 | | | 95% Percentile Bootstrap UCL | 1.626 | | |
| 454 | | | | | 95% BCA Bootstrap UCL | 1.861 | | | | | | |
| 455 | | | | | 90% Chebyshev(Mean, Sd) UCL | 1.939 | | | 95% Chebyshev(Mean, Sd) UCL | 2.291 | | |
| 456 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 2.779 | | | 99% Chebyshev(Mean, Sd) UCL | 3.737 | | |
| 457 | | | | | | | | | | | | |
| 458 | **Suggested UCL to Use** | | | | | | | | | | | |
| 459 | | | | | 95% Chebyshev (Mean, Sd) UCL | 2.291 | | | | | | |
| 460 | | | | | | | | | | | | |
| 461 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 462 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 463 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 464 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 465 | | | | | | | | | | | | |