



Site Audit Report
Student Accommodation Block
(W1), Darling Square

Prepared for:
Lend Lease Haymarket

Prepared by:
ENVIRON Australia Pty Ltd

Date:
June 2015

Project Number:
AS121806

Audit Number:
GN 479B-2

23 June 2015

Our Ref: AS121806

Lend Lease Haymarket
Attn: Paul Jerogin
The Bond, 30 Hickson Rd
Millers Point NSW 2000

Dear Paul

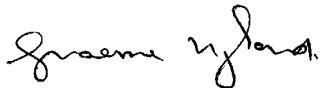
Re: Site Audit Report - Student Accommodation Block (W1), Darling Square

I have pleasure in submitting the Site Audit Report for the subject site. The Site Audit Statement, produced in accordance with the NSW Contaminated Land Management Act 1997 follows this letter. The audit was commissioned by Lend Lease Haymarket to assess the suitability of the site for its intended use.

This Site Audit Report is required as a condition of Development Consent SSD 6010 under the *Environmental Planning and Assessment Act 1979* and is therefore a statutory audit.

Thank you for giving me the opportunity to conduct this Audit. Please call me on 9954 8100 if you have any questions.

Yours faithfully,
ENVIRON Australia Pty Ltd



Graeme Nyland
EPA Accredited Site Auditor 9808

Cc: NSW EPA – Statement only
City of Sydney Council

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 31st October 2012. For more information about completing this form, go to Part IV.

PART I: Site audit identification

Site audit statement no. GN 479B-2

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: Graeme Nyland Company: ENVIRON Australia Pty Ltd

Address: Level 3, 100 Pacific Highway (PO Box 560)

North Sydney NSW

Postcode: 2060

Phone: 02 9954 8100

Fax: 02 9954 8150

Site details

Address: Darling Drive Plot, The Haymarket NSW

Postcode: 2000

Property description (*attach a list if several properties are included in the site audit*)

Student Accommodation Block (W1)

Part Lot 800 of Deposit Plan (DP) 1164281, Part Lot 331 of DP 1192146 (Stratum Lot within Lot 800 DP 1164281)

See Attachment at end of Part I of this Statement.

Local Government Area: City of Sydney

Area of site (e.g. hectares): 988.5 m²

Current zoning: The site is subject to the Darling Harbour Development Plan No. 1 which is deemed to be a State Environmental Planning Policy for the purposes of the Environmental Planning and Assessment Act 1979 (EP&A Act).

To the best of my knowledge, the site **is/is not*** the subject of a declaration, order, agreement or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

Declaration/Order/Agreement/Proposal/Notice* no(s): N/A

**Strike out as appropriate*

Site audit commissioned by

Name: Paul Jerogin Company: Lend Lease Haymarket

Address: The Bond, 30 Hickson Road, Millers Point NSW

Postcode: 2000

Phone: 9237 5793

Fax: 9383 8124

Name and phone number of contact person (if different from above)

Carlo Castello, 9237 5910

Purpose of site audit

- A. To determine land use suitability (*multistorey student accommodation*)

OR

- B(i) To determine the nature and extent of contamination, and/or
- B(ii) To determine the appropriateness of an **investigation/remedial action/management plan***, and/or
- B(iii) To determine if the land can be made suitable for a particular use or uses by implementation of a specified **remedial action plan/management plan*** (*please specify intended use[s]*)
-

Information sources for site audit

Consultancy(ies) which conducted the site investigation(s) and/or remediation

- Coffey Environments Australia Pty Ltd

Title(s) of report(s) reviewed:

- 'Supplementary Investigations- Haymarket Precinct, Sydney', 19 November 2014, Coffey Environments Australia Pty Ltd
- 'Validation Management Plan - Student Accommodation Block (W1), Haymarket, Sydney', 9 March 2015, Coffey Environments Australia Pty Ltd
- 'Darling Square, Site Validation Report: Student Accommodation Block (W1)', 28 May 2015, Coffey Environments Australia Pty Ltd
- Letter 'RE: Validation Report Addendum - Student Accommodation Block W1, Darling Square, Sydney NSW', 18 June 2015, Coffey Environments Australia Pty Ltd.

Other information reviewed (including previous site audit reports and statements relating to the site)

- 'Site Audit Report – Remedial Action Plan, PDA South (Haymarket)', prepared by ENVIRON dated 8 April 2014 and corresponding Site Audit Statement GN479A

Site audit report

Title: Site Audit Report – Student Accommodation Block (W1), Darling Square

Report no. GN 479B-2 (ENVIRON Ref: AS121806) Date: June 2015

PART II: Auditor's findings

Please complete either Section A or Section B, **not** both. (*Strike out the irrelevant section.*)

Use Section A where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land use(s).

Use Section B where the audit is to determine the nature and extent of contamination and/or the appropriateness of an investigation or remedial action or management plan and/or whether the site can be made suitable for a specified land use or uses subject to the successful implementation of a remedial action or management plan.

Section A

I certify that, in my opinion, the site is **SUITABLE** for the following use(s) (*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*)

Multistorey student accommodation (Student Accommodation Block W1)

The key elements of the development are:

- *No accommodation will be situated on the ground floor*
- *Ground floor uses are limited to building entry, office and building administration, display apartment/s, communal areas, garbage and bicycle stores and building services*
- *No basement will be constructed*
- *The building will be constructed on piles*
- *Areas surrounding the building footprint will comprise predominantly hard paved walkways*
- *Minimal landscaping will be established and will comprise a number of trees and shrubs in engineered tree pots and imported soil or planter boxes.*

subject to compliance with the following environmental management plan (*insert title, date and author of plan*) **in light of contamination remaining on the site:**

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:

A Site Audit is being conducted for the Haymarket Precinct which will be progressively developed. This Site Audit Statement and Summary Site Audit Report are for the Student Accommodation Block (W1) located on the western edge of the Haymarket precinct.

The Haymarket Precinct contains heterogeneous fill materials from land reclamation from the late 19th and early 20th centuries and has had a history of industrial land uses including mills, railway lines and yards, galvanising works and a council depot. The environmental consultant identified widespread polycyclic aromatic hydrocarbons and to a lesser extent other contaminants in the fill materials. Asbestos was also identified outside the boundary of the Student Accommodation (W1) site in various places across the Haymarket Precinct and the environmental consultant noted that further unidentified asbestos materials may be present in fill materials.

A remedial action plan (RAP) was prepared for the Haymarket Precinct and was the subject of a Section B Audit. The remediation and validation approach proposed in the RAP were concluded to be generally appropriate.

None of the Remediation Areas defined in the RAP and no open space areas or areas of significant landscaping are present within the Student Accommodation (W1) site. Thus no remediation or validation of open space areas was required.

Bulk earth works were conducted and further soil and groundwater investigations were undertaken to validate the site for the proposed student accommodation. No unexpected finds of volatile or leachable contamination were identified during these works.

A long-term (post construction during operation phase) Environmental Management Plan is not required for the proposed use.

It is recommended that an unexpected find protocol be adopted during development. A suitable unexpected finds protocol is provided in the RAP.

Odorous soils (petroleum hydrocarbon and "solvent-type" odours) and limited discoloration was observed between approximately 2 to 5 m above sandstone bedrock across the Student Accommodation (W1) site. This is not considered to pose a risk under the proposed land use while the material remains insitu. However, it is recommended that if any odorous or discoloured soils are excavated during development (such as during piling), that they be replaced at depth or disposed offsite.

Alluvial deposits at the Haymarket Precinct may contain potential or actual acid sulphate soils (PASS or AASS). Any PASS or AASS would need to be managed if disturbed during development.

Section B

Purpose of the plan¹ which is the subject of the audit ...

I certify that, in my opinion:

~~the nature and extent of the contamination HAS/HAS NOT* been appropriately determined~~

AND/OR

~~the investigation/remedial action plan/management plan* IS/IS NOT* appropriate for the purpose stated above~~

AND/OR

~~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~~
- ~~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)~~

if the site is remediated/managed* in accordance with the following remedial action plan/management plan* (insert title, date and author of plan)

...

subject to compliance with the following condition(s):

...

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

* Strike out as appropriate

Overall comments

...

PART III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority under the *Contaminated Land Management Act 1997* (Accreditation No. 9808).

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...

23/6/2015

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

The auditor is to complete either Section A or Section B of Part II, **not** both.

In **Section A** the auditor may conclude that the land is *suitable* for a specified use(s) 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 remediation or investigation of the site was needed to render the site fit for the specified use(s). Any **condition** imposed should be limited to implementation of an environmental management plan to help ensure the site remains safe for the specified use(s). The plan should be legally enforceable: for example a requirement of a notice under the *Contaminated Land Management Act 1997* (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*.

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.

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 whether land can be made suitable for a particular land use or uses upon implementation of a remedial action or management 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.

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.

In **Part III** the auditor certifies his/her 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:

EPA (NSW)

Contaminated Sites Section
PO Box A290, SYDNEY SOUTH NSW 1232
nswauditors@epa.nsw.gov.au

AND

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

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List of Abbreviations

ACM	Asbestos Containing Material
AHD	Australian Height Datum
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
ASLP	Australian Standard Leaching Procedure
AASS	Actual Acid Sulphate Soils
ASS	Acid Sulphate Soils
BACM	Bonded Asbestos Cement Sheet
BaP	Benzo(a)pyrene
BaP TEQ	Benzo(a)pyrene toxicity equivalence
BGL	below ground level
BTEX	Benzene, Toluene, Ethylbenzene & Xylenes (Monocyclic Aromatic Hydrocarbons)
CLM Act	NSW Contaminated Land Management Act 1997
CN	Cyanide (total or free)
COC	Chain of Custody
Council	City of Sydney Council
CICAD	Concise International Chemical Assessment Document
CT	Certificate of Title
DA	Development Application
DEC	Department of Environment and Conservation (former)
DECCW	Department of Environment, Climate Change and Water (former)
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EC	Electrical Conductivity
EHC	Environmental Health Criteria
EMP	Environmental Management Plan
Envirolab	Envirolab Services Pty Ltd
EP&A Act	Environmental Planning and Assessment ACT 1979
EPA	Environment Protection Authority (NSW)
ESA	Environmental Site Assessment report
GME	Groundwater Monitoring Event
HHERA	Human Health and Ecological Risk Assessment
HIL	Health Investigation Level
HSL	Health Screening Level
ha	Hectare
km	Kilometres
LOR	Limit of Reporting
m	Metres
MAH	Monocyclic Aromatic Hydrocarbons
Mercury	Inorganic mercury unless noted otherwise
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mbgl	Metres below ground level
µg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
ng/L	Nanograms per Litre
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
n	Number of Samples
NSW	New South Wales

OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OEHHA	Office of Environmental Health Hazard Assessment (Californian Government)
OH&S	Occupational Health & Safety
OCPs	Organochlorine Pesticides
OPPs	Organophosphorus Pesticides
PASS	Potential Acid Sulphate Soils
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
pH	a measure of acidity, hydrogen ion activity
PDA	Project Delivery Agreement
PID	Photoionisation Detector
ppm	Parts Per Million
PPP	Public Private Partnership
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbon
QA/QC	Quality Assurance/Quality Control
RAP	Remediation Action Plan
RL	Relative Level
RPD	Relative Per Cent Difference
RSL	Regional Screening Level
RWP	Remedial Works Plan
RfC	Reference Concentration
RfD	Reference Dose
SAQP	Sampling Analysis and Quality Plan
SAR	Site Audit Report
SAS	Site Audit Statement
SCEC	Sydney Convention and Exhibition Centre
SCR	Chromium Reducible Sulphur method
SEC	Sydney Entertainment Centre
SEEP	State Environmental Planning Policy
SICEEP	Sydney International Convention Exhibition and Entertainment Precinct
SILs	Soil Investigation Levels
SSTLs	Site specific target levels
SVOCs	Semi Volatile Organic Compounds
SWL	Standing Water Level
TC	Tolerable Concentration
TCLP	Toxicity Characteristic Leaching Procedure
TPHs	Total Petroleum Hydrocarbons
TV	Trigger Value
UCL	Upper Confidence Limit
UST	Underground Storage Tank
USEPA	United States Environment Protection Agency
VENM	Virgin Excavated Natural Material
VMP	Voluntary Management Proposal
VHCs	Volatile Halogenated Hydrocarbons
VOCs	Volatile Organic Compounds
WHO	World Health Organisation
-	On tables is "not calculated", "no criteria" or "not applicable"

1 Introduction

1.1 Background

A site contamination Audit has been conducted in relation to the Haymarket Precinct, NSW which lies to the southwest of Sydney's Central Business District. This site is part of a mixed commercial and residential development referred to as Darling Square. The Haymarket Precinct (approximately 3.8 ha) will be progressively developed. The site locality and Haymarket Precinct are shown on Attachment 1, Appendix A.

This Site Audit Report (SAR) covers the Student Accommodation Block (W1) referred to as "the site" for the purpose of this Audit, which is shown on Attachment 2, Appendix A.

The Audit was conducted to provide an independent review by an EPA Accredited Auditor of whether the land is suitable for any specified use or range of uses i.e. a "Site Audit" as defined in Section 4 (1) (b) (iii) of the NSW *Contaminated Land Management Act 1997* (the CLM Act).

The Audit was initiated to comply with Condition (B3) of the Development Consent SSD 6010 issued under Section 89E of the *Environmental Planning and Assessment Act 1979* by the NSW Department of Planning on 7 May 2014 is therefore a statutory audit. Notification of the site audit (GN479B) for the Haymarket Precinct was forwarded to the EPA on 20 January 2015 (EPA Ref: DOC15/21761). Condition B3 states *"Upon completion of the remediation works on the Site, the Applicant shall procure a site audit report and a site audit statement prepared by an accredited site auditor. The site audit report and site audit statement must verify that the land is suitable for the proposed uses and be provided to the PCA and SHFA prior to the issue of an occupation certificate."*

Details of the Audit are:

Requested by: Paul Jerogin on behalf of Lend Lease Haymarket (Lend Lease)

Request/Commencement Date: 21 February 2013

Auditor: Graeme Nyland

Accreditation No.: 9808

The scope of the audit included:

- Review of the following reports:
 - 'Supplementary Investigations- Haymarket Precinct, Sydney', 19 November 2014, Coffey Environments Australia Pty Ltd (Coffey 2014c)
 - 'Validation Management Plan - Student Accommodation Block (W1), Haymarket, Sydney', 9 March 2015, Coffey Environments Australia Pty Ltd (Coffey 2015a)
 - 'Darling Square, Site Validation Report: Student Accommodation Block (W1)', 28 May 2015, Coffey Environments Australia Pty Ltd (Coffey 2015b)

- Letter 'RE: Validation Report Addendum - Student Accommodation Block W1, Darling Square, Sydney NSW', 18 June 2015, Coffey Environments Australia Pty Ltd (Coffey 2015c).
- Site visits by the Auditor on 21 January 2014 and the Auditor's representative 16 April 2015 and 4 June 2015.
- Discussions with Lend Lease, EnRisk and Coffey.
- Reference to the following reports which were reviewed and documented in the previous Section B non-statutory Audit for the Haymarket Precinct (see Section 1.2):
 - 'Contamination Investigation, Sydney International Convention and Entertainment Centre,' 23 August 2011, Coffey Environments Australia Pty Ltd (Coffey 2011)
 - 'Geotechnical Investigation, Proposed Sydney International Conference Exhibition and Entertainment Precinct (SICEEP), Darling Harbour,' 25 May 2012, Coffey Geotechnics Pty Ltd (Coffey 2012a)
 - 'Stage 2 – Detailed Site Investigation, Sydney International Conference Exhibition and Entertainment Precinct (SICEEP), Darling Harbour, Sydney,' 1 June 2012, Coffey Geotechnics Pty Ltd (Coffey 2012b)
 - 'Stage 1 – Preliminary Environmental Investigation, Sydney International Conference Exhibition and Entertainment Precinct (SICEEP), Darling Harbour, Sydney,' 8 June 2012, Coffey Geotechnics Pty Ltd (Coffey 2012c)
 - 'Supplementary Site Investigation, Sydney International Conference Exhibition and Entertainment Precinct, Darling Harbour,' 17 August 2012, Coffey Geotechnics Pty Ltd (Coffey 2012d)
 - 'SICEEP SAQP Summary', Revision 01, 22 October 2012, AECOM Australia Pty Ltd
 - 'Supplementary Site Investigation: Factual Report, Sydney International Conference Exhibition and Entertainment Precinct, Darling Harbour,' 30 January 2013, Coffey Geotechnics Pty Ltd (Coffey 2013a)
 - 'Site Investigation: Factual Report, Haymarket Precinct, Darling Harbour, Sydney NSW,' 28 February 2013, Coffey Environments Australia Pty Ltd (Coffey 2013b)
 - 'Human Health and Ecological Risk Assessment', draft 3 April 2013, EnRisks
 - 'Site Specific Remedial Action Plan for the Haymarket Planning Application, Haymarket, Sydney NSW', draft 7 June 2013, Coffey Environments Australia Pty Ltd
 - 'Site Specific Remedial Action Plan for the Haymarket Planning Application, Haymarket, Sydney NSW,' 16 August 2013, Coffey Environments Australia Pty Ltd
 - Site Specific Human Health and Ecological Risk Assessment – The Haymarket (for the Haymarket Planning Applications), 1 October 2013, EnRisks

- 'Site Specific Human Health and Ecological Risk Assessment – The Haymarket (for the Haymarket Planning Applications), 15 November 2013, EnRisks (EnRisks 2013)
- 'Site Specific Remedial Action Plan for the Haymarket Planning Application, Haymarket, Sydney NSW,' 22 November 2013, Coffey Environments Australia Pty Ltd
- 'Site Specific Remedial Action Plan for the Haymarket Planning Application, Haymarket, Sydney NSW,' 3 December 2013, Coffey Environments Australia Pty Ltd
- 'Site Specific Remedial Action Plan for the Haymarket Planning Application, Haymarket, Sydney NSW,' 18 December 2013, Coffey Environments Australia Pty Ltd
- 'Site Specific Remedial Action Plan for the Haymarket Planning Application, Haymarket, Sydney NSW,' 13 January 2014, Coffey Environments Australia Pty Ltd (Coffey 2014a)
- Letter "RE: Reuse of Soils Derived from Remediation Areas – Haymarket", 17 March 2014, Coffey Environments Australia Pty Ltd (Coffey 2014b).
- Coffey (2014a) also refers to the following report:
 - 'Acid Sulfate Soil Assessment and Preliminary Management Plan; Haymarket Precinct, Darling Harbour, Sydney NSW,' March 2013, Coffey Environments Australia Pty Ltd (Coffey 2013d).

1.2 Previous Section B Audit

'Site Audit Report – Remedial Action Plan, PDA South (Haymarket)', and Site Audit Statement GN479A dated 8 April 2014 (the Section B Audit) was previously completed for the Haymarket Precinct. The Section B Audit concluded that the Haymarket Precinct could be made suitable for the Sydney International Convention, Exhibition and Entertainment Precinct development by implementation of the Site Specific Remedial Action Plan (Coffey 2014a) and clarifying letter (Coffey 2014b) ("the RAP").

The key outcomes of the Section B Audit were:

- The Haymarket Precinct contains heterogeneous fill materials from land reclamation from the late 19th and early 20th centuries and has had a history of industrial land uses including mills, railway lines and yards, galvanising works and a council depot. Investigations identified widespread polycyclic aromatic hydrocarbons and to a lesser extent other contaminants in the fill materials. Asbestos was also identified outside the boundary of the Student Accommodation (W1) site in various places across the Haymarket Precinct and the environmental consultant (Coffey) noted that further unidentified asbestos materials may be present in fill materials.
- The remediation and validation approach proposed in the RAP was concluded by the Auditor to be generally appropriate. The RAP was prepared to excavate the areas of the highest polycyclic aromatic hydrocarbon and lead concentrations and the

identified area of asbestos containing materials within fill materials in the Haymarket Precinct (referred to as Remediation Areas 1 to 5).

- The RAP provided a management framework for potential unidentified asbestos containing materials and unexpected finds of contamination that may be encountered during remediation and development.
- Further assessment and possible remediation would be required in the event of unexpected finds of potentially volatile or leachable material.
- Validation of open space areas to site specific criteria presented in the RAP was required. Site specific criteria were derived based on assumptions relating to the development including:
 - No permanent residential occupation at ground floor level. Ground floor uses may include residential lobbies, television studio, retail, commercial, access and egress and community uses.
 - No basements will be constructed.
 - Open space areas (including areas of paving, planting, turf or other cover) are limited to a small portion of the total site area (approximately 5%).
- Potential reuse of selected soil from some Remediation Areas is proposed. Such soil is to be reused beneath buildings only (i.e. not in open space areas) after assessment that the soil is suitable for this purpose.

None of the Remediation Areas defined in the RAP are present and no soil from Remediation Areas is proposed for use within the Student Accommodation (W1) site. Remediation Areas 1 to 5 are shown on Attachment 3, Appendix A.

1.3 The Audit Team

The Audit team is summarised in Table 1.1.

Table 1.1: Audit Team		
Role	Company	Details
Site Auditor	ENVIRON	Graeme Nyland
Expert Support (Risk Assessment)	ENVIRON	Emma Struik
Audit Assistant	ENVIRON	Xanthe Holford

2 Site Details

2.1 Location

The Haymarket Precinct currently comprises the Sydney Entertainment Centre (SEC), associated car park (currently under demolition) and the surrounding public realm. The locality and boundaries are shown on Attachment 1, Appendix A.

The Student Accommodation Block (W1) site details are as follows:

Street address: Darling Drive Plot, The Haymarket NSW 2000

Identifier: Part Lot 800 of Deposit Plan (DP) 1164281, Part Lot 331 of DP 1192146 (Stratum Lot within Lot 800 DP 1164281)

Local Government: City of Sydney

Owner: NSW Government

Site Area: 988.5 m² approximately

The boundary of the Student Accommodation Block (W1) is shown on Attachment 2, Appendix A. The site boundaries are generally not well defined on the ground.

2.2 Zoning

The site is subject to the Darling Harbour Development Plan No. 1 which is deemed to be a State Environmental Planning Policy for the purposes of the Environmental Planning and Assessment Act 1979 (EP&A Act).

2.3 Adjacent Uses

The site is located within the Haymarket area of Sydney's Central Business District which includes commercial, retail, residential and open space uses including Paddy's Markets, light rail corridor, Powerhouse Museum and University of Technology infrastructure.

The Sydney Convention Centre, Sydney Exhibition Centre and public areas (also under development) including Tumbalong Park (approximately 17.2 ha) is located adjacent to the site in the north (on the other side of Pier Street).

Cockle Bay is located approximately 500 m to the north of the site.

There are no known current adjacent uses with the potential to significantly contaminate the site.

2.4 Site Condition

Prior to bulk earthworks, the site was vacant and comprised a landscaped verge and the western part (north-bound lanes) of the existing Darling Drive. The site had been used to establish temporary site cabins and store scaffolding and formwork equipment for construction works within other parts of the Darling Square development as well as stockpiled soil materials from trench excavations undertaken by Lend Lease from other parts of the development.

Pre-construction levels currently range from approximately RL 3.62 mAHD in the northern corner to RL 5.10 mAHD adjacent to the central southwestern site boundary, with site levels falling from a west to east across the site.

After initial bulk earthworks by Lend Lease and at the time of Coffey (2015b), levels within the central and western part of the site had been reduced to approximately 3.7 mAHD, with the crest of soil stockpile at 4.4 mAHD (the stockpile was sampled and assessed during Coffey's investigations). Areas along the site boundary adjoining Darling Drive were approximately 3.6 mAHD.

Final earthworks were subsequently completed to level the site to the target grade of 3.7 mAHD. Coffey (2015c) reported that a small portion of the surplus soil materials stockpiled within the site were used to fill the eastern part of the site. The remainder of surplus soils were disposed offsite.

A Coffey environmental scientist attended site on the 1st June 2015 to observe final site conditions and observed the surface soil to comprise clayey sand with some gravels. This was consistent with observations made by the Auditor and Auditor's assistant during the site visits.

2.5 Proposed Development

The site is proposed for multistorey student accommodation. No accommodation will be situated on the ground floor. Ground floor uses are limited to office and building administration, garbage and bicycle stores and building services (fire pumps and meters). No basement is proposed. The building will be constructed on piles.

Areas surrounding the building footprint within the site shall comprise predominantly hard paved walkways. Although details have not been finalised, minimal landscaping will be established within the site, between building façade and site boundary. This is expected to comprise a number of trees and shrubs established within engineered tree pits and imported soil, or designated planter boxes, thereby maintaining minimal access to existing fill materials on the site.

Construction works will include foundation piling, construction of service trenches, building slabs, pavements and minor landscaping works.

For the purposes of this Audit, the 'residential with minimal soil access' land use scenario was generally assessed to be applicable based on descriptions provided in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 1999) and the subsequent 2013 amendment of this document (NEPC (1999) [2013]).

The Auditor is of the opinion that the proposed development is consistent with the assumptions used as the basis for the RAP and the site specific validation criteria.

3 Site History

The site history for the Haymarket Precinct was reviewed for the Section B Audit and was based on historical parish maps, aerial photographs, planning certificates, review of the Contaminated Land Register, search of the NSW WorkCover Licenses to Keep Dangerous Goods Database, and site walk over. The site history is summarised in Table 3.1.

Date	Activity
Late 19 th and early 20 th centuries	Progressive reclamation
1813	Dixon Steam Mill established within general area. It remains uncertain whether the footprint of the mill extended beneath the site at this time. The mill was reportedly used for milling grains such as wheat and corn. A reservoir was established for the mill and appears to encompass the majority of the site. Western parts of the site are reportedly mudflats.
1820-40s	Dixon Steam Mill diversifies into brewing and soap manufacture. An additional steam engine is added to the mill and the brewery was established on 'adjacent ground' though there is some uncertainty where the brewery was established relative to the site. The mill was located partly on the northeastern part of the site. The southern part of the site comprised the mill pond and reservoir. The remainder of the site remains part of the pond and/or undeveloped mudflats.
1840-60s	A railway line was constructed along the western foreshore of Cockle Bay. Fill resulting from excavation to form the Sydney Railway Terminus and associated yards was used to reclaim land. Reclamation subsumed Dixon's Wharf and millpond site by 1865.
1870s	The Zollner galvanising works is established. The southern edge of this factory is located immediately adjacent to the northeastern site boundary.
1880-90s	Expansion of Darling Harbour Goods Yard. Sydney's first hydraulic pumping station was established to the north of the site in 1891. The Ultimo Power House was built in 1898-99 immediately west of the site. Records reviewed for the Power Station indicate that the water intake, outtake and ash disposal conduits pass under the existing Sydney Convention and Exhibition Centre to the north of the site.
1900-10	Significant expansion of the railway and associated infrastructure occurred between 1903 and 1908 where a wheat store and coal handling plant were established within close proximity to the site.
1910-40s	The site is dissected by several roadways and is covered by various buildings and structures that appear to be commercial/industrial in nature. Rail yards, including railway sidings, are present to the immediate north/northwest of the site beyond Pier Street. A railway line is present to the immediate west of the site adjacent to the Ultimo Power Station. A Council Depot was established in the northwestern part of the site in 1932.
1949	City Markets No. 4 was established within the site.

Date	Activity
1950-80s	The site remains in use as a market place until the early 1980s when the SEC was established in 1983. Ultimo Power Station decommissioned in 1963 and converted to a museum in early 1980s.
1986 - present day	Development of Darling Harbour including current public uses

The former Ultimo Power Station was located to the north west of the Haymarket Precinct and operated from 1900 to 1961. Various other contaminating land uses have occurred on or in the vicinity of the Haymarket Precinct including galvanising works, railway uses, and a council depot.

In the Auditor's opinion, the site history for the Haymarket Precinct provides an adequate indication of potential past activities on the Student Accommodation (W1) site and general surrounds. Uncertainties include:

- Knowledge regarding filling history is limited but is likely to have occurred over a period of time between the 1880s and 1960s.
- Knowledge regarding the potential use of fill materials sourced from the former Ultimo Power Station and railway yards.
- Knowledge regarding the existence and/or location of potential above ground or underground fuel storage across the site is limited. Coffey (1 June 2012) stated "Information regarding the possible existence of underground fuel or chemical storage tanks was not available...the presence on the site of this common potential contamination source remains uncertain and must not be disregarded."
- Knowledge of the location and nature of specific railway workshop or other multiple commercial/industrial activities was limited and generally not provided in the reports.

The uncertainties in relation to the site history were considered by the Auditor when drawing conclusions in relation to evidence of contamination at the site, the proposed remediation and management approach reviewed for the Section B Audit and the subsequent validation.

4 Contaminants Of Concern

The various Coffey reports reviewed for the Section B Audit listed the contaminants of concern and potentially contaminating activities across the Haymarket Precinct and are summarised in Table 4.1.

Table 4.1: Contaminants of Concern	
Activity	Potential Contaminants (identifieded by Auditor based on Coffey reports)
Railway and associated ancillary activities, galvanising works and other general commercial/industrial activities Council depot	Metals, asbestos, fuels, lubrication oils (total petroleum hydrocarbons (TPH), benzene, toluene, ethyl benzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs)), herbicides, pesticides, other organic contaminants e.g. volatile organic compounds (VOCs), volatile halogenated compounds (VHCs) and semi volatile organic compounds (SVOCs).
Filling from unknown sources (may include material from the former Ultimo Power Station and railway yards)	Metals, asbestos, fuels, lubrication oils (TPH, BTEX, PAHs), combustion products such as clinker and ash (TPH, PAHs, metals), acid sulphate soils, other organic contaminants (e.g. VOCs, VHCs, SVOCs)

The contaminants of concern and the analyte list used by Coffey when assessing the wider Haymarket Precinct were consistent with the potential contaminants listed in Table 4.1. The Auditor was of the opinion that the analyte list used by Coffey adequately reflected the site history and condition and generally considered the uncertainties identified in Section 3.

The investigations across the Haymarket Precinct confirmed these to be the contaminants of concern (including at the Student Accommodation W1 site) and these were adopted in the RAP and for subsequent validation sampling.

5 Stratigraphy and Hydrogeology

5.1 Stratigraphy

Haymarket Precinct

Subsurface conditions of the Haymarket Precinct were reviewed for the Section B Audit. The sub-surface profile of the site is summarised in Table 5.1.

Table 5.1: Sub-surface profile		
Material/Origin	Depth to top of Unit (m)	Thickness of Unit (m)
<p>Fill</p> <p>Fill materials comprised heterogeneous mixtures of gravelly sand, sandy gravel, gravelly clay, clay and sandy clay/silt. The thickness of fill materials recorded at the site varied between 0.4 m and 5.5 m. Anthropogenic inclusions observed within the fill included discrete ash layers, concrete, brick, glass, porcelain/ceramic, and metal fragments. A fibrous board was also recorded in one location (BH119).</p> <p>Cobbles and occasional boulder sized fragments were observed.</p> <p>Surface cover of brick pavers, concrete and asphalt materials at most locations from 0.1 m to 0.3 m thick.</p>	0	0.4 to 5.5
<p>Alluvium</p> <p>Clayey sands and clays with occasional shell layers and organic matters.</p>	2.1 to 4.5	1.3 to 12 (where proven)
<p>Residual Soil</p> <p>Clayey sand or sandy clay derived from weathering of underlying sandstone.</p>	5.8 to 10.8	0.6 to 2.9
<p>Weathered Sandstone</p>	5.6 to 15.8	0.1 to >4

Coffey (2013b) reported that fill thicknesses typically ranged between 2 to 4 m although thicker fill deposits were recorded within the western edge of the SEC car park and central area of the site associated with the reclamation of the former Darling Harbour (ie outside the boundary of the Student Accommodation W1 site).

Buried concrete slabs underlying fill and/or fill and pavers or asphalt were encountered at various locations across the Haymarket Precinct up to a depth of approximately 1.8 m.

The Section B Audit noted that it is likely that filling has occurred in stages or during progressive reclamation. This may have resulted in “generations” or types of fill in different areas/depths. However, no distinctions in relation to fill materials have been identified by the consultant. Variations between logging events in drilling and sampling techniques and changes in field personnel should be considered when comparing logging data.

Student Accommodation (W1) Site

The stratigraphy encountered on the site during validation and reported in Coffey (2015b) was consistent with the wider Haymarket Precinct reviewed for the Section B Audit. The log for BH124 (Coffey 2012b) located within the north eastern portion of the Student Accommodation (W1) site reviewed for the Section B Audit indicated a thin layer of mulch, sawdust and topsoil over heterogeneous fill to a depth of approximately 3.8 m (RL 0.7 mAHD) below ground underlain by sand (possibly reworked natural) underlain by sandy clay alluvium. Sandstone was logged at a depth of 5.6 m (RL -0.9 mAHD). Subsequently similar conditions were encountered in the groundwater well (BHW1-1) to 9.8 m and the test pits between 2.8 and 4.9 m (Coffey 2015b).

5.2 Hydrogeology

Haymarket Precinct

Groundwater at the site is expected to flow to the north towards Cockle Bay and levels likely reflect the level in the vicinity of Cockle Bay.

This was confirmed through measurements by Coffey across the wider Haymarket precinct on several occasions between June 2011 and January 2013 which indicated depths to groundwater between 1.98 and 4.5 m with tidal fluctuations of approximately 1 m between separate sampling events in specific wells.

Coffey (2013b) reported groundwater levels are expected to be around -1.5 to 1.2 m AHD and were consistently higher during winter (August) period. The reported difference in groundwater levels between winter and summer measurements ranged between 0.15 m and 0.5 m.

Coffey (2011) stated that the observed water levels indicated flow to the north which was consistent with the expected flow direction.

Student Accommodation (W1) Site

MW124 installed previously at the site to a depth of 5.6 m (to the top of sandstone) located in the north eastern portion of the site was not gauged previously as it did not make sufficient water and appeared to have been destroyed during recent earthworks. Sand and alluvial soils were logged at a depth of approximately 5 m and sandstone was present at a depth 5.6 m at this location.

Coffey (2015b) installed BHW1-1 to a depth of 9.8 m and screened the well within sandstone from a depth of 7.5 to 10.5 m. Water ingress was not observed during drilling. However, standing water levels measured on 8 May 2015 indicated groundwater at a depth of 3.2 m (RL 0.42m AHD). This suggests groundwater is present in the sandstone and is under pressure.

5.3 Acid Sulphate Soils

Coffey (2011) states that review of the acid sulphate soil risk maps presented on the Austral Resource Information website indicate a low probability of the presence of acid sulphate soils beneath the site. The maps however indicate there is a high probability of ASS in the

sediments of Darling Harbour and Sydney Harbour. There is evidence that the site and surrounds have been reclaimed using harbour sediment possibly along with other sources of fill material. As such, it is possible that fill material at the site could contain ASS.

Subsequent testing by Coffey recorded the presence of potential ASS (PASS) and actual ASS (AASS) within the alluvial deposits.

No alluvial deposits were significantly disturbed during the bulk earthworks at of the Student Accommodation (W1) site. Alluvium is present beneath the site and was encountered at depths between approximately 2 to 5 m at the site extending to the top of the sandstone bedrock. PASS or AASS would need to managed if disturbed during construction.

6 Evaluation of Quality Assurance and Quality Control

6.1 Haymarket Precinct

The data reviewed for Section B Audit for the Haymarket Precinct are summarised in Table 6.1. Investigation locations are shown on Attachment 4, Appendix A.

Investigation and Reporting	Field Investigations	Analytical data obtained
Coffey (2012a) Geotechnical Investigation	Geotechnical investigations across Haymarket Precinct and Sydney Convention Centre, Sydney Exhibition Centre to the north. One borehole (NBH1) within Haymarket Precinct	No laboratory data relevant to contamination. Groundwater level data Geotechnical borehole logs and cross sections compiled
Coffey (2012b) Stage 2 – Detailed Site Investigation	Contamination investigations utilising the geotechnical investigation locations of Coffey (2012a) (NBH1). Auger drilling to 4.1m in sandstone	Two samples analysed from NBH1 (NBH1/0.5-0.6 m and NBH1/1.5-1.9 m) for PAHs, TPH, BTEX, metals.
Coffey (2012c) Stage 1 – Preliminary Environmental Investigation	Site walkover and desktop review across Haymarket Precinct and Sydney Convention Centre, Sydney Exhibition Centre to the north.	Nil (desktop only)
Coffey (2013a) Supplementary Factual Report	Contamination investigations across Haymarket Precinct and Sydney Convention Centre, Sydney Exhibition Centre to the north. Four boreholes (BH101, BH101A, BH102/MW102, BH103) within Haymarket Precinct Auger drilling to max. depth 3.25 m in sandstone.	Two to three samples per location (with six at BH103) including at the surface (approximately 0-0.2 m) and then approximately every 0.5 m to 1m. 11 samples analysed for BTEX, TPH, PAH and/or metals. Four samples for asbestos. BH102/MW102 did not make sufficient water for sampling.

Of the data summarised above, one borehole (BH124) was located within the Student Accommodation (W1) site. The location of this boreholes is shown on Attachment 4, Appendix A (W1 is shown as 3B on Attachments 2 to 4). As discussed in Section 5.2 BH124 was installed as a monitoring well. However, it did not make water.

Based on the review documented in the Section B Audit, the Auditor concluded with respect to the Haymarket Precinct:

- The data were adequate for the purpose of developing a conceptual site model that was sufficient for providing the basis for a remedial framework.
- Presence of visual/olfactory indicators of contamination including anthropogenic inclusions may be underestimated on the available borehole logs based on the following:

- Borehole logs between sampling events were not directly comparable due to variations in drilling methods and sampling personnel.
- All investigation locations were boreholes which are less conducive to identifying anthropogenic inclusions (including potential asbestos containing materials) than other methods such as test pitting.
- A high degree of heterogeneity was present in fill materials and uneven distribution of contaminants within the soil matrix (even across a distance of centimetres) as evidenced by field observations and both field and laboratory duplicates.
- The fill and development history is not well known. Former ground surface at the time of operations of the rail yards may be a zone of potential contamination. Buried concrete slabs suggest filling has occurred over former ground surface levels.
- The site history suggests that areas of concern may be present such as associated with the former council depot and metal works. However, the specific locations of these areas have not been identified.
- Typically boreholes are spaced approximately 40-60m apart. The areas of concern suggested by the site history (e.g. USTs associated with the depot, if any) could potentially result in areas of contamination that may not be detected by the achieved sample density.
- The number and position of groundwater wells is appropriate to provide general overview of water quality beneath and leaving the Haymarket Precinct. They may not be adequate to assess specific areas of concern based on past land use.
- The primary laboratories provided sufficient information to conclude that data is of sufficient precision subject to inherent heterogeneity in the soil matrix.
- The field and laboratory quality control samples provided sufficient information to conclude that data is of sufficient accuracy subject to inherent heterogeneity in the soil matrix.

The issues discussed above were considered by the Auditor when drawing conclusions and opinions. Overall, the data were considered sufficiently precise, accurate, reproducible, comparable and complete to provide an adequate basis for developing a conceptual site model to provide the basis for the RAP.

6.2 Student Accommodation (W1) Site

As discussed in Section 1.2, the RAP did not identify any specific remedial requirements within the Student Accommodation (W1) site. Coffey (2015b) identified the following data gaps in relation to the investigation at the Student Accommodation (W1) site:

- The investigation data set was considered insufficient to adequately characterise soils at or below the construction formation level of 3.7 mAHD.
- The sampling density within the site is lower than the minimum sampling density recommended within Sampling Design Guidelines (NSW EPA, 1995).

- Groundwater quality and subsequent risks associated with vapour ingress into the proposed building remains uncertain.

The Auditor is of the opinion these data gaps are consistent with the RAP and the outcomes of the Section B Audit and addresses the uncertainties discussed in Section 6.1. To address the data gaps and to validate the site Coffey (2014c & 2015b) conducted the following additional investigations:

- Soil samples were collected from soils prior to the bulk excavation works described in Section 2.4. Ten test pits were excavated from along an approximate north-south centreline through the W1 and adjoining W2 sites and 5 samples were analysed (one each from 5 of the test pits between 0.1 and 1.5 m) and were reported in a waste classification report provided as an Appendix to Coffey (2015b).
- The following investigations were conducted after bulk excavations works to 3.7 mAHD across the majority of the site (Coffey 2015b) with the crest of spoil stockpiles at 4.4 mAHD in some areas:
 - 6 x test pits (TPW1-1 to TPW1-6) to a depths of 2.8 m (RL 0.9 mAHD) to 4.9 m (RL -1.2 mAHD). TPW1-4 was excavated to a depth of 4 m through the spoil stockpiles from RL 4.4 mAHD
 - 1 x groundwater well (BHW1-1) to a depth of 9.8 m
 - Analyses of 24 primary soil samples for metals, BTEX, TPH, PAHs, VOCs and/or SVOCs. Re analyses of 1 x soil sample for TPH with silica gel clean up. It is noted that eleven samples exhibiting the highest PID readings and/or detectable hydrocarbon/solvent odours were scheduled for VOCs and SVOCs analyses.
 - 1 x groundwater monitoring event
 - Analyses of 1 x primary groundwater sample for metals, TPH, BTEX, PAH, SVOC and VOCs.

The Auditor has assessed the overall quality of the additional data by review of the information presented in the referenced reports, supplemented by field observations. The Auditor's assessment follows in Tables 6.2 and 6.3.

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
<p>Data Quality Objectives (DQO) Coffey defined specific DQOs in accordance with the seven step process outlined in DEC (2006).</p>	<p>These were considered appropriate for the investigations conducted.</p>
<p>Sampling pattern, locations density and depth <i>Soil:</i> Soil samples were collected from 7 new investigation locations across the site. Data from the existing BH124 (Coffey 2012b reviewed for the previous Section B Audit) was</p>	<p>The soil investigation location, pattern, density and depths were adequate to provide coverage across the site and to provide a data set</p>

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	Auditor’s Opinion
<p>also considered.</p> <p>The sample pattern was generally systematic (i.e. not targeted), however, was not a true systematic grid given site restraints but provided general coverage and the boreholes (BH124 and BHW1-1) were located closely to test pit locations reducing the effective sample density to approximately 6. The effective sampling density of 6 locations over approximately 988.5 m² is adequate compared to the minimum recommended by EPA (1995) <i>Sampling Design Guidelines</i> of 6 locations. This data is further supplemented by an additional 5 locations for waste classification from soils that were later bulk excavated but are considered representative of the general fill across the wider site.</p> <p>Samples were analysed from various depths within the fill profile including surface samples and at approximate depths of 0.5 m, 1 m, 1.5 m, 2 m, 3 m and 4 m below ground level (RL 3.7 mAHD) (and up to a depth of 4.8 m from BH124) and from the stockpiled soil stored on the site (consisting of heterogeneous soil excavated from trenches during construction on other parts of the Darling Square site).</p> <p>One test pit (TPW1-4) was excavated through the stockpiled material and one sample collected. Some of the waste classification test pits were also excavated through the stockpiled soil. The stockpiled soil was consistent with the heterogenous fill encountered across the wider site.</p> <p><i>Groundwater Monitoring Bores:</i> One groundwater monitoring bore was located on the north east corner of the site to assess groundwater beneath the site and supplement the groundwater assessment reviewed for the Haymarket Precinct during the previous Section B Audit.</p>	<p>representative of the heterogeneous fill material including stockpiled soil stored on the site). The samples also targeted olfactory indications of contamination and zones with elevated PID readings.</p> <p>The groundwater monitoring bore provided general coverage and assessed a zone of apparent hydrocarbon impact within the alluvium (considered likely to be due to historical smearing from groundwater) that was encountered across most of the W1 site. One bore was considered adequate to provide coverage given the relatively small size and in the context of the groundwater data across the Haymarket Precinct.</p>
<p>Groundwater Well construction</p> <p>Coffey (2015b) reports the bore was drilled with solid flight augers and rock coring and the monitoring well was constructed using 50mm diameter PVC casing with machine slotted screen. The well screen was positioned within the bedrock at depths of 7.5m to 9.5mbgs (-3.9m to -5.9mAHD). Graded filter sand was placed in the borehole around the screened interval and bentonite was used to seal the annulus of the monitoring well. The remainder of the borehole was backfilled with bentonite to a depth of 1.5mbgs (2.1m AHD) to minimise the potential to create a preferential flow path between the bedrock and overlying alluvium which has exhibited some visual/olfactory indications of contamination. The monitoring well was fitted with lockable cover set in concrete grout.</p> <p>Following the completion of the drilling works a disposable bailer was used to develop the well by removing approximately 21 L of water until the well purged dry.</p>	<p>Acceptable.</p> <p>Development consisting of bailing the well dry with a bailer is likely to result in soil particles being present within the water column as a results of drilling activities (the limitations/difficulties associated with developing a well in a low yield aquifer are noted). This has been considered by the Auditor when assessing groundwater data.</p>
<p>Sample collection method</p>	<p>Acceptable.</p>

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	Auditor’s Opinion
<p>Coffey (2015b) reports test pits were progressed using an excavator. Soils were collected from the centre of the excavator bucket by hand to reduce the potential for cross contamination from soil adhered to the walls of the bucket.</p> <p>Prior to collecting a groundwater sample, the well was purged using a low flow peristaltic pump and disposable bladder and tubing. During purging, water quality parameters including pH, Temperature, Dissolved Oxygen, Electrical Conductivity and Redox Potential were monitored.</p> <p>Groundwater samples were also collected with a low flow peristaltic pump and disposable bladder and tubing. Groundwater samples were collected following the stabilisation (i.e. ±10%) of groundwater quality parameters.</p>	
<p>Decontamination procedures</p> <p>Coffey (2015b) states where practical, non-disposable sampling equipment was decontaminated with approximately 5% Decon 90 solution in potable water, and rinsed with potable water prior to use and between each sample location.</p> <p>Clean, disposable nitrile gloves were used during the collection of each soil sample.</p>	Acceptable
<p>Sample handling and containers</p> <p>Soil samples were immediately placed into laboratory supplied glass jars, with Teflon lined seals, and packed to reduce headspace to limit volatile loss and placed into an ice chilled cooler for transport to the laboratories.</p> <p>Groundwater samples were placed in laboratory supplied bottles containing appropriate preservatives and were filled to minimise headspace. Samples collected for heavy metals were filtered in the field using disposable 0.45µm cellulose filter pack. Sample containers were immediately capped and placed in an insulated container filled with ice. Samples were dispatched to laboratories that hold NATA accreditation under chain of custody control.</p>	Acceptable
<p>Chain of Custody (COC)</p> <p>Completed chain of custody forms were provided in the reports.</p>	Acceptable
<p>Detailed description of field screening protocols</p> <p>Soil headspace screening was carried out for the presence of VOCs using a Photoionisation Detector (PID) fitted with a 10.6 eV lamp. Soil headspace screening was undertaken on soils by placing a small quantity of soil sample inside a clean, zip-locked plastic bag and sealed. The sample was agitated and then the plastic bag was pierced using the tip of the PID. The readings on the PID were observed and the maximum reading recorded on the borehole log.</p>	Acceptable
<p>Calibration of field equipment</p>	Acceptable

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	Auditor’s Opinion
<p>The reports indicated that the PID was calibrated routinely to 100 ppm using isobutylene calibration gas.</p> <p>Field and supplier calibration certificates were provided in Coffey (2015b).</p>	
<p>Sampling logs</p> <p>Soil logs are provided within the report, indicating sample depth, PID readings and lithology.</p> <p>A sample register with soil description was provided for the samples collected for waste classification.</p> <p>Well purging and sampling records were provided.</p>	Acceptable

Table 6.3: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	Auditor’s Opinion
<p>Field quality control samples</p> <p>Field quality control samples including 3x field intra-laboratory (rate of 12%) and 1 x inter-laboratory soil duplicates (rate of 4%) and a field intra-laboratory groundwater sample were analysed.</p> <p>As soil sampling works were undertaken using disposable sampling equipment, no rinsate blank samples were collected during the soil sampling fieldworks. No trip spike and trip blank samples were submitted as part of the soil sampling programme.</p> <p>During the groundwater sampling program a rinsate blank was collected following decontamination of the interface probe. A trip spike and trip blank sample prepared by the primary laboratory were also submitted for analysis.</p> <p>No trip blanks or spikes were analysed. This was not considered to affect the usability of the data since no volatile compounds (including BTEX and TPH C₆-C₉) were detected in the soil samples analysed and these have not been detected at significant concentrations across the Haymarket Precinct.</p>	Acceptable.
<p>Field quality control results</p> <p>RPDs for the soil duplicate samples ranged from 0% to 131%. However, they were generally within 30% and exceedances of 30% were correlated with results close to the detection limit where small variations result in larger RPDs. RPDs for the groundwater duplicate samples ranged from 0-25%.</p> <p>Coffey (2015b) stated that In summary, RPD values indicate reasonable correlation between primary/duplicate samples pairs when the LOR is considered. The Auditor agrees with this statement.</p> <p>Results of the laboratory analysis for the trip and rinsate blanks were below the laboratory LOR. Trip spikes ranged</p>	Acceptable

Table 6.3: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	Auditor’s Opinion
from 97-103%.	
<p><i>NATA registered laboratory and NATA endorsed methods</i> Primary laboratory for soil and groundwater was Eurofins, The secondary laboratory was ALS. The laboratories were NATA accredited for the analyses performed and the laboratory certificates were NATA stamped.</p>	Acceptable
<p><i>Analytical methods</i> Analytical methods were included in the laboratory test certificates and the laboratories provided brief method summaries of in-house NATA accredited methods used based on USEPA and/or APHA methods.</p>	Acceptable
<p><i>Holding times</i> Review of the COCs and laboratory certificates indicate that the holding times had been met. Coffey also reported that holding times have been met.</p>	Acceptable
<p><i>Limits or Reporting (LORs)</i> Soil: LORs were less than the threshold criteria for the contaminants of concern. Groundwater: LORs were less than the threshold criteria for the contaminants of concern with the exception of the low reliability trigger values for anthracene of 0.00001 mg/L compared to the LOR of <0.00005.</p>	Acceptable. The LOR for anthracene was not considered to have a material outcome on the quality of the data in the context of the data set reviewed.
<p><i>Laboratory quality control samples</i> Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratories.</p>	Acceptable
<p><i>Laboratory quality control results</i> The results of laboratory quality control samples were within appropriate limits.</p>	Acceptable
<p><i>Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy)</i> Predetermined data quality indicators (DQIs) were set for field duplicate samples and blank samples. Laboratory certificates indicated DQIs for blanks, duplicates, laboratory control samples, matrix spikes, surrogate spikes and internal standards. Coffey (2105b) concluded “Based on an assessment of the field and laboratory QA/QC data, Coffey considers that the data obtained is representative of subsurface conditions at the sampling locations, and the results are acceptable for the purposes of this assessment”.</p>	Acceptable

Overall, the data are considered sufficiently precise, accurate, reproducible, comparable and complete to validate the Student Accommodation (W1) site for the proposed land use.

7 Validation and Screening Criteria

7.1 Soil

Site Specific Target Levels

Site Specific Target Levels (SSTLs) (also referred to as Remediation and Validation Acceptance Criteria) were developed in the RAP for key contaminants identified at the Haymarket Precinct and were reviewed and endorsed in the Section B Audit. The SSTLs were based on the human health and ecological risk assessment (HHERA) (EnRisks 2013).

SSTLs for open space areas with exposed soils or paving and the remainder of the site (e.g. beneath buildings and hard stand) were derived for application during remedial and validation works. In the development of the SSTLs, a number of key assumptions were made relating to the proposed development including:

- No permanent residential occupation at ground floor level. Ground floor uses may include residential lobbies, television studio, retail, commercial, access and egress and community uses
- A small percentage of the site (approximately 5% or less) will be developed as public open space areas
- No basements will be constructed.

Table 7.1 summarises the SSTLs adopted in the RAP.

Key Contaminant of Concern	Open Spaces	Rest of Site (based on protection of residents, commercial workers, construction workers, intrusive works)
Benzo[a]pyrene TEQs	20	50
TPH C10-C14	360 (based on 50/50 split aromatic/ aliphatic)	360 (based on 50/50 split aromatic/ aliphatic)
TPH C15+	2 300 (based on 50/50 split aromatic/ aliphatic)	2 300 (based on 50/50 split aromatic/ aliphatic)
Naphthalene	Not Limiting (or maximum value found at site currently 15 mg/kg)	7
2-Naphthylamine	Maximum value found at the site currently – 0.8	0.8
Bonded ACM	No visible Bonded ACM in surface soils (top 0.1m), and not more than 0.02%w/w Bonded ACM in the upper 1.5m of fill	No visible Bonded ACM in surface soils (top 0.1m), and not more than 0.04%w/w Bonded ACM in fill to a depth of 0.3m below level of construction disturbance
Asbestos Fines / Fibrous Asbestos	No visible fibrous asbestos and asbestos fines in surface soils (top 10cm), and not more than	No visible fibrous asbestos and asbestos fines in surface soils (top 0.1m), and not more than

Table 7.1: Site Specific Target Levels (mg/kg)		
Key Contaminant of Concern	Open Spaces	Rest of Site (based on protection of residents, commercial workers, construction workers, intrusive works)
	0.001%w/w fibrous asbestos and asbestos fines and no respirable asbestos fibres in the upper 1.5m of fill	0.001%w/w fibrous asbestos and asbestos fines and no respirable asbestos fibres in fill to a depth of 0.3m below level of construction disturbance

The SSTLs were used to assess the data used for validation collected by Coffey (2014c and 2015b). Other contaminants were also considered by the HHERA. However, where these were not considered key contaminants (i.e. were not significant in nature or extent) across the Haymarket Precinct, SSTLS were not developed. The HHERA assessed the risk posed by these contaminants considering the highest concentrations detected on site. Therefore, in the absence of a SSTL, the Auditor has considered the previous highest concentration of contaminants as assessed by the HHERA.

Additionally, for analytes where no SSTLs had been derived the Auditor adopted conservative initial screening criteria from the National Environment Protection (assessment of Site Contamination) Measure (NEPM 1999) [2013]. Health investigation levels (HILs) were conservatively considered for low density residential land use settings and where exceeded HILs for residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments were considered. The former being very conservative under the proposed developed and the latter being more consistent with the proposed development.

Health screening levels (HSLs) for vapour intrusion were also considered for low to high density residential land uses. Where exceeded vapour intrusion criteria for recreational opens space and commercial/industrial criteria were considered in accordance with (NEPM 1999) [2013] where no residential land uses are located on the ground floor.

Human health assessment criteria were adopted as follows:

- Health Based Investigation Levels (HIL A¹ and HIL B²)
- Soil Health Screening Levels (HSL A & B; HSL C³, and HSL D⁴) for vapour intrusion. The most conservative criteria were adopted i.e. assumed depth to source < 1 m and sandy soils

¹ HIL A Health investigation level for residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry), also includes children's day care centres, preschools and primary schools

² HIL B Residential with minimal opportunities for soil access includes dwellings with fully and permanently paved yard space such as high-rise buildings and flats

³ HIL C Recreational open space

⁴ HIL D Commercial/industrial

- Management Limits (coarse), residential, parkland and public open space.
- Previous maximum concentrations as considered by the HHERA (e.g. Lindane 1.3 mg/kg).

As asbestos was not identified onsite additional ecological assessment criteria (such as NEPM (1999) [2013] Ecological Screening Levels) were generally not considered relevant given the nature of the proposed development as described in Section 2.5 (i.e. majority of site building or hard paving with no open space or significant landscaping areas).

The aesthetic condition of the soil remaining onsite was also considered. The criteria was no highly malodorous or stained soils.

7.2 Groundwater

No SSTLs were provided for groundwater (as significant contamination was not identified). Therefore, Auditor has assessed the groundwater data in reference to Tier 1 (screening) criteria for commercial/industrial and low to high density residential land uses from the following:

- Human Health Assessment
 - Groundwater Health Screening Levels (HSL A & B residential and D commercial/industrial) for vapour intrusion (sand, 2 to <4 m)
- Ecological Assessment (for data representative of potential offsite impacts only)
 - Groundwater Investigation Levels (GILs) listed in NEPM (1999) [2013] for protection of aquatic ecosystems referenced in ANZECC (2000) 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'. Trigger values (TVs) provided are concentrations that, if exceeded, indicate a potential environmental problem at the point of use and 'trigger' further investigation. The marine water 95% level of protection was adopted. '
 - In the absence of a GIL, a low reliability ANZECC (2000) TV has been adopted for arsenic of 0.0023 mg/L, conservatively assuming that arsenic detected in the groundwater is As(III), rather than As(V) (TV: 0.0045 mg/L)
 - Other low reliability ANZECC (2000) TVs have been adopted for toluene (0.11 mg/L), ethylbenzene (0.05 mg/L) and the xylene isomers (0.05 mg/L). Also, anthracene (0.00001 mg/L), benzo(a)pyrene (0.0001 mg/L), fluoranthene (0.001 mg/L), phenanthrene (0.0006 mg/L) at 99% protection levels.
- The LOR was used as an initial screen for other VOCs and SVOCs

The yield in the wells is low and as there is a reticulated water supply for the area, extraction and use of groundwater as a resource is unlikely. Therefore assessment of direct contact and consumption of groundwater is not required.

The adopted groundwater screening criteria are discussed in Section 9 where relevant.

7.3 Consultant's Validation Criteria

Coffey adopted the SSTLs (and previous maximum concentrations considered by the HHERA) for soil validation and the GILs NEPM (1999) [2013] for groundwater assessment.

Coffey also adopted HIL Ds and HSLDs for sandy soils at depth <1 m as initial assessment criteria for volatile contaminants without SSTLs. The Auditor is of the opinion that HIL B is more relevant based on land use for non-volatile contaminants. However, overall, the differences between the consultant's and the Auditor's validation criteria did not have a material bearing on the final conclusion regarding land use suitability.

8 Evaluation of Soil Analytical Results

8.1 Haymarket Precinct

The Section B Audit for the Haymarket Precinct concluded that the investigations reviewed provided a reasonable characterisation of the fill and natural soils at the site. In summary, the fill was heterogeneous and contained various anthropogenic inclusions. Heavy end petroleum hydrocarbons and PAHs were identified as the main chemicals of concern throughout the fill materials. Volatile compounds (including TPH and naphthalene) were also detected above the screening criteria at some locations in soils and low levels of petroleum hydrocarbons (including the volatile compounds toluene, ethyl benzene, xylenes, TPH C₆-C₉, TPH C₆-C₁₀) were detected in groundwater.

A summary of the soil data was provided in the human health and ecological risk assessment (HHERA) (EnRisks 2013) and is reproduced below in Table 8.1.

Key Contaminant of Concern	Maximum Concentration in Soil (mg/kg)	95% Upper Confidence Limit of Arithmetic Mean (UCL) Concentration in Soil (mg/kg)
TPH C10-14 aliphatic	330	79
TPH C10-14 aromatic	330	79
TPH C15+ aliphatic	2100	601
TPH C15+ aromatic	3100	601
Benzo[a]pyrene	200	8
Benzo[a]anthracene	260	12
Benzo[b&k]fluoranthene	340	15
Benzo[ghi]perylene	62	3.7
Chrysene	300	12
Dibenzo[ah]anthracene	19	2.5
Indeno[123-cd]pyrene	60	3.3
Naphthalene	15	1.1
2-naphthylamine	0.8	0.8
Lead	2700	211
Lindane	1.3	Only detected at one location

Notes: For TPH C10-14 – the maximum concentration of TPH C10-14 measured at the site has been assumed to be present as 50% aliphatic and 50% aromatic For TPH C15+ - the maximum concentration of TPH C15+ measured at the site has been assumed to be present as 50% aliphatic and 50% aromatic with the aromatic fraction corrected for the amount of PAHs found in the sample.

Threshold and non-threshold risks were calculated for ingestion, dermal and inhalation pathways for construction workers, recreational/residential child, retail worker, car park attendant, and intrusive worker post completion. The risks were calculated using both the

maximum concentration detected onsite and the 95% upper confidence limit (UCL) of the arithmetic mean (95% UCL) for all data. When the maximum concentrations were used, unacceptable risks were identified for recreational/residential child and retail worker and car park attendant. The risks were primarily attributed to ingestion and dermal contact for recreational/residential child and vapour inhalation (TPH C₁₀-C₁₄ and naphthalene) and dermal contact for the retail worker/car park attendant.

The calculated risks were at least an order of magnitude lower and acceptable when the 95% UCL was used. The Auditor is of the opinion that it is appropriate to apply the 95% UCLs for soils beneath buildings and hardstand. The Auditor also notes, that the 95% UCLs for the key contaminants of concern are below or comparable to the applicable health screening and investigations levels in NEPC (1999) [2013].

Therefore, the risk posed to human health under the proposed land use is acceptable in areas of buildings and hardstand.

The ingestion and dermal pathways would be attributed to open space areas (and not a complete pathway where buildings and hard stand present). These areas may pose some risk to site users if maximum concentrations were present. Thus, validation of open space areas with exposed soils or paving is proposed to confirm that concentrations are less than the maximum site levels and below the SSTLs derived for open space areas (discussed in Section 7.1).

8.2 Student Accommodation Site (W1)

The fill encountered on Student Accommodation (W1) site was consistent with the wider Haymarket Precinct described in Section 8.1.

Slight to moderate hydrocarbon odour was noted from approximately 3 m to 5 m at the base of fill and in underlying alluvial soils in BH124 and similar conditions were noted in the subsequent investigations by Coffey (2015b) including strong hydrocarbon odour and some black discoloration were observed in BHW1-1 at 2.3 m and resolving by approximately 4 m. Faint to strong “solvent type” odour was noted at TPW1-3, TPW1-4, TPW1-5 and TPW1-6 at approximately 2 m. PID readings up to 117 ppm were recorded in the hydrocarbon impacted zone.

Trace anthropogenic inclusions (brick) were observed at some locations.

No potential asbestos containing materials were observed.

Soil samples were analysed for a variety of contaminants including petroleum hydrocarbons (TPH and BTEX), PAHs, heavy metals, pesticides, VOCs, SVOCs and phenols. The results have been assessed against the SSTLs and initial screening criteria described in Section 7.1.

The Auditor considered the following data when assessing the suitability the site for the proposed land use:

- Validation data (test pits) collected at or below the final site grade and from the spoil stockpiles (Coffey 2015b)

- Analytical data from BH124 (Coffey 2012b) reviewed during the Section B Audit
- Waste classification data from soils later bulk excavated by (Coffey 2015b).

The waste classification data from fill that was bulk excavated was considered relevant to characterising the heterogeneous fill in general and increased the size of the data set. The laboratory results and field observations from the bulk excavated soil were generally consistent with the validation data subsequently collected from at or below the final site grade.

The data is summarised in Table 8.1. Soil validation locations are shown as Attachment 2, Appendix A.

Analyte	n	Detections	Maximum	Auditor Screening Criteria (source ¹)	n > Auditor Screening Criteria
Arsenic	22	22	33	100 (HIL A)	0
Cadmium	22	6	1.9	20 (HIL A)	0
Total Chromium	22	17	27	100 (HIL A)	0
Copper	22	22	140	6000 (HIL A)	0
Lead	22	15	3000 (next highest 370)	300 (HIL A)	2
				1200 (HIL B)	1
				600 (HIL C)	1
				1500 (HIL D)	1
Nickel	22	9	20	400 (HIL A)	0
Zinc	22	14	240	7400 (HIL A)	0
Mercury (inorganic)	22	10	1	10 (HIL A)	0
Benzene	37	0	<0.5	0.5 (HSL A & B, sand 0-1 m)	0
Toluene	37	0	<0.5	390 (HSL A & B, sand 0-1 m)	0
Ethyl Benzene	37	0	<0.5	NL (HSL A & B, sand 0-1 m)	0
Xylenes	37	0	<1.5	95 (HSL A & B, sand 0-1 m)	0
TPH (C6-C10) less BTEX (F1)	34	0	<20	45 (HSL A & B, sand, 0-1 m)	0
TPH >C10-C16 less naphthalene (F2)	34	12	1700	110 (HSL A & B, sand 0-1 m)	12
				360 (SSTL)	9
				1000 (ML, coarse, residential, parkland and public open space & commercial /industrial)	1
				NL (HSL C & D, sand 0-1 m)	0

Analyte	n	Detections	Maximum	Auditor Screening Criteria (source ¹)	n > Auditor Screening Criteria
TPH >C16-C34	34	21	3800	2500 (ML, coarse, residential, parkland and public open space)	5
				3500 (ML, coarse, commercial/ industrial)	1
				2300 (SSTL)	5
TPH >C34-C40	34	7	350	10000 (ML, coarse, residential, parkland and public open space)	0
				2300 (SSTL)	0
Naphthalene	38	0	<0.5	7 (SSTL)	0
2-Naphthylamine	17	2	0.8	0.8 (SSTL)	0
Benzo[a]pyrene TEQs	37	4	2.5	50 (SSTL)	0
				20 (Open Space SSTL)	0
Total PAHs	37	12	28	300 (HIL A)	0
g-BHC (Lindane)	17	2	1.3	1.3	0
VOCs/SVOCs	17	0	<LOR	LOR as screen	0

Notes:

1) refer to Section 7 for source

The Auditor is of the opinion that the soil analytical results were consistent with those expected based on the data for the Haymarket Precinct reviewed for the Section B Audit.

Petroleum Hydrocarbons

A zone of hydrocarbon contamination in the F2 (C>10-C16 less naphthalene) and C>16-C34 fractions was encountered across the site (in seven out of eight borehole and test pit locations) at a depth of approximately 2 m to 4 m in alluvial material. The distribution of impact suggested a smear zone associated with groundwater and the zone of impact was consistent with standing water levels of 3.2 m measured in BHW1-1. BTEX and naphthalene were not detected suggesting the impact was predominantly aliphatic compounds. The source of impact is not clear and may be located downgradient to the south west (potentially an historical offsite source impacting groundwater migrating on to the Haymarket Precinct in the vicinity of the W1 site).

Concentrations in the F2 (C>10-C16 less naphthalene) and C>16-C34 fractions exceeded the SSTLs in up to 9 samples. However, all concentrations were less than the health screening level for vapour intrusion for commercial/industrial land use based on NEPM

(1999) [2013]. Management Limits may be exceeded locally. However, this impact was below a depth of 3 m and significant odour, staining or sheen were not observed. Therefore, local exceedence of Management Limits are unlikely to pose a significant management risk during development of the site under the proposed land use

Lindane

Lindane was detected in two samples from BH124 both from a depth of 4.6-4.8 m with a maximum of 1.3 mg/kg. Lindane was not detected in any other sample collected from the W1 site during the Coffey (2015b) investigations or from the wider Haymarket Precinct during the previous Section B Audit. The detections of concentrations were consistent with those considered in the HHERA (with no unacceptable risk identified).

PAHs

All soil results for PAH were well below the SSTLs for areas of open space and the rest of the site as well as NEPM (1999) [2013] health investigation levels for residential and open space land use. Therefore PAHs are not considered to pose a risk to human health under the proposed land use.

Lead

Elevated lead of 3000 mg/kg, an order of magnitude higher than the next highest concentration measured at the W1 site and exceeding the various screening criteria including the criterion for commercial/industrial land use, was detected at a depth of 1 m in fill at TPW1-3. The concentration at 0-0.2 m at this location was 39 mg/kg. High concentrations of lead have not been detected near the surface of the site based on the available data set.

The maximum concentration of lead detected previously across the wider Haymarket Precinct (and considered in the HHERA) was 2,700 mg/kg (of comparable magnitude and with no unacceptable risk identified) at a depth of 1.5-1.6 m in BH121 approximately 100 m to the east of the site. Coffey calculated the 95% UCL for lead to be approximately 910 mg/kg based on the 17 samples analysed from the test pits and BH124. The 95% UCL across the wider Haymarket Precinct was previously calculated to be approximately 210 mg/kg.

Based on the data set reviewed for both the W1 site and the Haymarket Precinct, elevated lead was consistent with the data assessed for the HHERA; was not widespread; and the 95% UCLs indicate the average concentration is below the health based investigation level for residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments (HIL B). Therefore, lead is not considered to pose a risk to human health under the proposed land use.

Further, it is noted that proposed landscaping areas are expected to comprise a number of trees and shrubs established within engineered tree pits and imported soil, or designated planter boxes, thereby maintaining minimal access to existing fill materials on the site. Therefore, the potential for fill containing locally high concentrations of lead being exposed near the surface in landscaping areas is considered very low.

9 Evaluation of Groundwater

9.1 Haymarket Precinct

Groundwater was assessed for the Haymarket Precinct during the Section B Audit and is summarised as follows:

- Metals in groundwater were detected at low levels, generally of comparable magnitude to the screening levels adopted in the Section B Audit (based on ecological protection)
- PAHs in groundwater were present at low levels in three of the five wells tested in the January 2013 monitoring event. However, the concentrations were comparable to the screening criteria which were also low. The LOR was often higher than the screening level. PAHs were generally not detected in previous sampling rounds, but variations in LORs between rounds and the wells sampled made comparison of limited value.
- PAHs were not detected after filtering the samples.
- Volatile petroleum hydrocarbons (including toluene, ethyl benzene, xylenes, TPH C₆-C₉, TPH C₆-C₁₀) were detected in three locations (BH12, MW6 and MW120). The source of the volatile impact was not identified.

9.2 Student Accommodation Site (W1)

No groundwater data was collected beneath or in the near vicinity the site during the Section B Audit. One groundwater well was subsequently installed and sampled by Coffey (2015b). Results are tabulated in Table 9.1.

	Auditor Screening Criteria¹	BHW1-1	Duplicate Sample (QC5)
Arsenic (filtered)	0.0023 (Low Reliability TV)	0.003	0.003
Cadmium (filtered)	0.0007 (GIL)	<0.0001	<0.0001
Chromium (filtered)	0.027 (GIL)	0.002	0.002
Copper (filtered)	0.013 (GIL)	<0.001	<0.001
Lead (filtered)	0.0044 (GIL)	<0.001	<0.001
Nickel (filtered)	0.007 (GIL)	0.010	0.010
Zinc (filtered)	0.015 (GIL)	0.39	0.37
Mercury (filtered)	0.0001 (GIL)	< 0.0001	< 0.0001
Benzene	0.5 (GIL) 0.8 (HSL A & B)	<0.001	<0.001
Toluene	0.11 (Low Reliability TV)	<0.001	<0.001
Ethyl benzene	0.05 (Low Reliability TV)	<0.001	<0.001
Xylene (m & p)	0.05 (Low Reliability TV)	<0.002	<0.002
Xylene (o)		<0.001	<0.001
Naphthalene	0.05 (GIL)	<0.02	<0.02

Table 9.1: Evaluation of Groundwater Analytical Results – Summary Table (mg/L)			
	Auditor Screening Criteria¹	BHW1-1	Duplicate Sample (QC5)
TPH C6-C9	-	<0.02	<0.02
TPH C6-C10	-	<0.02	<0.02
TPH C6-C10 less BTEX (F1)	1 (HSL A & B)	<0.02	<0.02
TPH >C10-C16 less naphthalene (F2)	1 (HSL A & B)	0.14	0.17
TPH >C10-C16	-	0.14	0.17
TPH >C16-C34	-	0.6	0.7
TPH >C34-C40	-	<0.1	<0.1
TPH C10-C14	-	0.09	0.11
TPH C15-C28	-	0.7	0.9
TPH C29-C36	-	<0.1	<0.1
TPH C10-C36 (sum)	-	0.79	1.0
Anthracene	0.00001 (Low Reliability TV)	< 0.00005	< 0.00005
Acenaphthylene	-	< 0.00005	< 0.00005
Acenaphthene	-	0.00020	0.00020
Benz(a)anthracene	-	0.00010	0.00010
Benzo(a)pyrene	0.0001 (Low Reliability TV)	< 0.00005	< 0.00005
Benzo(b&j)fluoranthene	-	< 0.00005	< 0.00005
Benzo(g,h,i)perylene	-	< 0.00005	< 0.00005
Benzo(k)fluoranthene	-	< 0.00005	< 0.00005
Chrysene	-	0.00010	< 0.00005
Dibenz(a,h)anthracene	-	< 0.00005	< 0.00005
Fluoranthene	0.001 (Low Reliability TV)	0.00010	0.00010
Fluorene	-	0.00030	0.00030
Indeno(1,2,3-cd)pyrene	-	< 0.00005	< 0.00005
Naphthalene	-	0.00010	0.00010
Phenanthrene	0.0006 (Low Reliability TV)	0.00020	0.00020
Pyrene	-	0.00010	0.00010
Total PAH*	-	0.001	0.001
VOCs	LOR	<LOR	<LOR
SVOCs	LOR	<LOR	<LOR

Notes:

1) refer to Section 7 for sources

The Auditor is of the opinion that the groundwater analytical results were consistent with those expected based on the data for the Haymarket Precinct reviewed for the Section B Audit and the field observations on the W1 site.

No olfactory or visual indications of contamination were noted during purging and sampling of the well.

Hydrocarbon impact in the F2 and C10-C34 range consistent with the field observations and soil data was detected. The concentrations were low and less than the screening criteria.

As per the data set reviewed for the Section B Audit the results for metals were generally below the screening criteria and where above (arsenic) were similar in magnitude to the screening criteria, with the exception of zinc which was detected at concentrations an order of magnitude above the screening criteria.

The highest concentration of PAHs detected on the W1 site was 0.0003 mg/L and the highest detected previously across the Haymarket precinct was and 0.00016 mg/L. L. The levels in groundwater were generally relatively low and comparable in magnitude to the conservative screening levels.

The reports reviewed suggest minimal development of groundwater wells was completed by Coffey prior to sampling (bailing the well dry with a bailer). Thus it is likely that soil particles are present within the water column as a results of drilling activities. These particles may be contributing to the PAH results and may not be representative of contamination that is mobile within the aquifer. This was supported by that data set reviewed for the previous Section B Audit where samples filtered before analyses for PAHs returning results below the LOR. However, other factors such as adsorption/entrainment of dissolved PAHs and colloidal materials (that may be mobile in the aquifer) on the filter paper cannot be excluded and may result in false negative results for filtered samples.

During the previous Section B, PAHs were detected in the limited TCLP leachate data suggesting the PAHs in the soil samples were leachable under the acidic TCLP test conditions (which are designed to simulate aggressive landfill conditions and would likely overestimate leachate potential under site conditions). PAHs were not analysed by the less aggressive ASLP testing.

The potential for migration and the risk posed by groundwater is discussed in Sections 10 and 11.

10 Contamination Migration Potential

10.1 Soils

Site soils are to be covered in hardstand or landscaping. Migration of soil offsite is considered unlikely subject to appropriate controls during disturbance such as construction.

10.2 Groundwater

The contamination migration potential was assessed across the Haymarket Precinct for the Section B Audit. It was concluded that metals and PAHs appeared to have some (albeit low) potential to leach from fill soils and concentrations of PAHs, TPH (C₆-C₉, C₁₀-C₃₆), BTEX (rarely) and metals in groundwater have been detected above ecological based screening levels in some wells across the precinct. Groundwater data beneath the Student Accommodation (W1) site was consistent with this (although it is noted no BTEX was detected on the W1 site).

The Haymarket Precinct and the W1 site are approximately 500 m from Cockle Bay. The relatively low levels of metals, PAHs, TPH and BTEX detected in groundwater were considered unlikely to pose a risk to Cockle Bay.

As the soil and groundwater validation results for the Student Accommodation (W1) site were consistent with those for the Haymarket Precinct reviewed for the Section B Audit this conclusion remains unchanged.

11 Assessment of Risk

Risk to human health and the environment was assessed during the Section B Audit as follows:

- Based on the soil data for the Haymarket Precinct it was concluded that the risk posed to human health under the proposed land use is acceptable in areas of buildings and hardstand (Section 8.1).
- The maximum concentrations of contaminants in groundwater detected at the site were compared against health based drinking water criteria and HSLs for vapour intrusion to assess potential risk to human health at the site. Drinking water criteria were considered to be conservative as a pathway to groundwater will not exist at the site under the proposed development and water is not proposed to be abstracted for beneficial reuse. Based on this assessment groundwater across the Haymarket Precinct was considered unlikely to pose a risk to human health under the proposed land use. This was confirmed during groundwater sampling at the site (Section 9).
- Similarly, groundwater was considered unlikely to pose a risk to human health during development/construction (where it may be exposed in excavations).
- Locally elevated concentrations of contaminants in groundwater and/or hydrocarbon sheen may be present locally across the Haymarket Precinct. The potential risks posed by this to construction workers (if any) is to be managed by the construction management plan and unexpected finds protocol of the RAP.

No unexpected finds of volatile or leachable contamination were identified during bulk earthworks at the Student Accommodation (W1) site. Validation sampling (soil and groundwater) did not indicate a significant risk to human health or the environment at the site for the proposed land uses including any landscaping areas. Therefore the conclusions made in the Section B Audit remain unchanged. Further discussion in relation to the data set reviewed for the W1 site is provided in Section 8.

Odourous soils (petroleum hydrocarbon and what was described by Coffey as a “solvent-type” odour) and limited discoloration was observed between approximately 2 to 5 m above sandstone across the W1 site. This is not considered to pose a risk under the proposed land use. However, it is recommended if any odorous or discoloured soils are excavated during development (such as during piling), that they be replaced at depth or disposed offsite.

Overall, based on the validation data reviewed the Auditor is of the opinion that the Student Accommodation (W1) site does not pose a risk to human health of the environment under the proposed land use.

12 Compliance with Regulatory Guidelines and Directions

The Auditor has used guidelines currently approved by the EPA under section 105 of the NSW *Contaminated Land Management Act 1997* when conducting the Audit.

The investigation was generally conducted in accordance with SEPP 55 Planning Guidelines and reported in accordance with the EPA (1997) *Guidelines for Consultants Reporting on Contaminated Sites*.

Coffey (2015b) conducted a waste classification in general accordance with NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* and assessed that the material located onsite classified as General Solid Waste (non-putrescible).

Coffey (2015b) reported 1129.5 tonnes of soil materials were removed from the site by H. Hassarati & Co. Pty Ltd. These materials were transported to Kurnell Landfill operated by Breen Kurnell Landfill Company, located at Captain Cook Drive, Kurnell. Coffey (2015b) stated that these materials were accepted as General Solid Waste.

Coffey (2015b) reported that the surplus fill within the site was removed at the same period as surplus fill was removed from the adjoining W2 site. The materials disposed from Plots W1 and W2 were not tracked on a plot specific basis and the 1129.5 tonnes recorded by Hassarti/Kurnell landfill represents the total amount of surplus fill disposed from W1 and W2. It was noted by Coffey (2015b) that the tonnage disposed from these plots broadly correlates with the estimate adopted within waste classification assessment.

Some further earthworks were subsequently undertaken to bring the final site level to 3.7 mAHD and Coffey (2015c) reported "Based on the recorded provided, 183.78 tonnes of fill was disposed to the Kurnell Landfill on the 1st June 2015, located at Captain Cook Drive, Kurnell. The waste consignment records supplied by the land fill correlate with the waste tracking form provided by Lend Lease. These materials were accepted as General Solid Waste (non-putrescible), which is consistent with the waste classification assessment prepared by Coffey..."

The Auditor searched the public register on 23 March 2015 and license 4608 indicates that Kurnell Landfill is licensed to accept:

- Soil which does not meet the definition of Virgin Excavated Natural Material or the Resource Recovery Exemption definition of Excavated Natural Material, but does not have contaminant levels that exceed General Solid Waste in the current Waste Classification Guidelines for waste disposal to land.
- Soil that meets the General Solid Waste Classification with the exception of the maximum threshold values for arsenic: 40 mg/kg; cadmium: 2 mg/kg; copper: 200 mg/kg; mercury: 1.5 mg/kg; zinc: 600 mg/kg; TPH C6 to C9: 150 mg/kg; TPH C₁₀ to C₃₆: 1600 mg/kg; PAHs: 80 mg/kg; polychlorinated biphenols (individual): 1 mg/kg for "Resource Recovery and Waste Storage".

The fate of the material at the land fill (i.e. disposal to land or Resource Recovery and Waste Storage) was not clear to the Auditor. The delivery dockets refer to the material as "INERT/GENERAL S GS/ Recyclable 85".

13 Conclusions and Recommendations

Coffey (2015b) concluded:

'Based on the records collected during the validation sampling programme, Coffey considers that this data is acceptable for the purposes of the validation assessment. In consideration of the findings of the validation assessment, the site is considered suitable for the proposed land use...'

Based on the information presented in the reports listed in Section 1 and observations made on site, and following the Decision Process for Assessing Urban Redevelopment Sites in DEC (2006) *Guidelines for the NSW Site Auditor Scheme*, the Auditor concludes that the site is suitable for the purposes of the proposed Student Accommodation (W1) development.

Coffey (2015c) conducted a final site inspection following the removal of surplus fill, and placement fill along the eastern site boundary adjoining Darling Drive, and confirmed that conditions were consistent with the findings of the validation assessment.

The key elements of the development (consistent with the assumptions made in the RAP) are:

- No accommodation will be situated on the ground floor
- Ground floor uses are limited to building entry, office and building administration, display apartment/s, communal areas, garbage and bicycle stores and building services
- No basement will be constructed
- The building will be constructed on piles
- Areas surrounding the building footprint will comprise predominantly hard paved walkways
- Minimal landscaping will be established and will comprise a number of trees and shrubs in engineered tree pots and imported soil or planter boxes.

No long-term (i.e post construction during operation phase) Environmental Management Plan to address contamination has been recommended by the consultant. The Auditor agrees that a long-term Environmental Management Plan is not required based on the available data.

It is recommended by the Auditor that an unexpected find protocol be adopted during development such as the construction management plan and unexpected finds protocol provided in the RAP (Coffey 2014a).

Odourous soils (petroleum hydrocarbon and solvent-type odour) and limited discoloration was observed between approximately 2 to 5 m above sandstone across the W1 site. This is not considered to pose a risk under the proposed land use while the material remains insitu. However, it is recommended by the Auditor that if any odorous or discoloured soils are excavated during development (such as during piling), that they be replaced at depth or disposed offsite.

Alluvial deposits at the Haymarket Precinct may contain potential ASS (PASS) and actual ASS (AASS). Alluvium was observed at the W1 site above sandstone bedrock below depths of approximately 2 m. PASS or AASS would need to be managed if disturbed during construction.

14 Other Relevant Information

This Audit was conducted on the behalf of Lend Lease Haymarket to provide an independent review by an EPA Accredited Auditor of whether the land is suitable for any specified use or range of uses.

This summary Site Audit Report may not be suitable for other uses. The consultants (reports listed in Section 1) included limitations in their reports. The Audit must also be subject to those limitations. The Auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which he had some control or is reasonably able to check.

The Auditor has relied on the documents referenced in Section 1 of the Site Audit Report in preparing his opinion. If the Auditor is unable to rely on any of those documents, the conclusions of the Audit could change.

It is not possible in a Site Audit Report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

Appendix A: Attachments

Attachment 1: Site Locality & Haymarket Precinct

Attachment 2: Student Accommodation (W1)

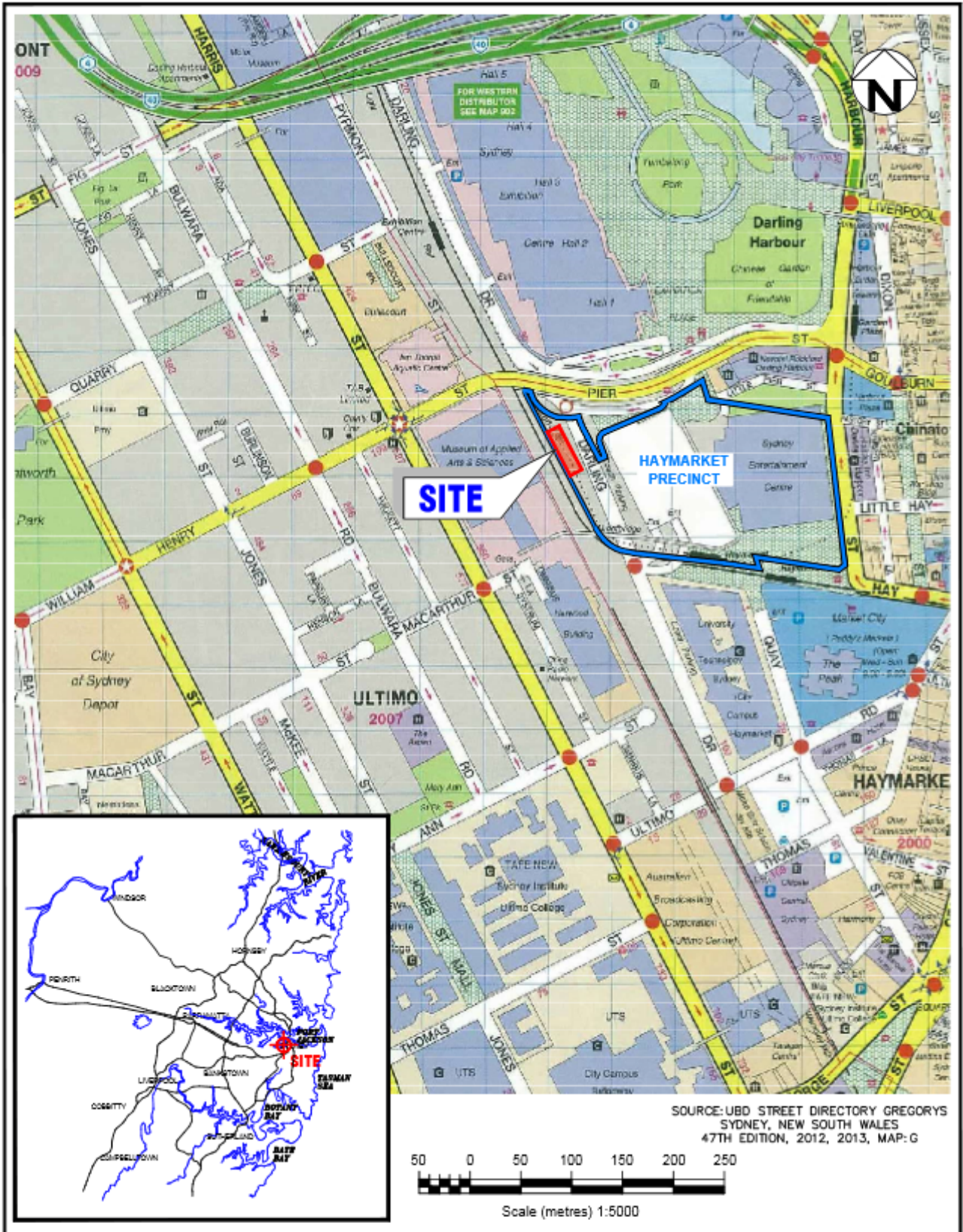
Site Layout & Soil Validation Locations

Attachment 3: Haymarket Precinct

Remediation Areas 1 to 5

Attachment 4: Haymarket Precinct Soil and

Groundwater Investigation Locations



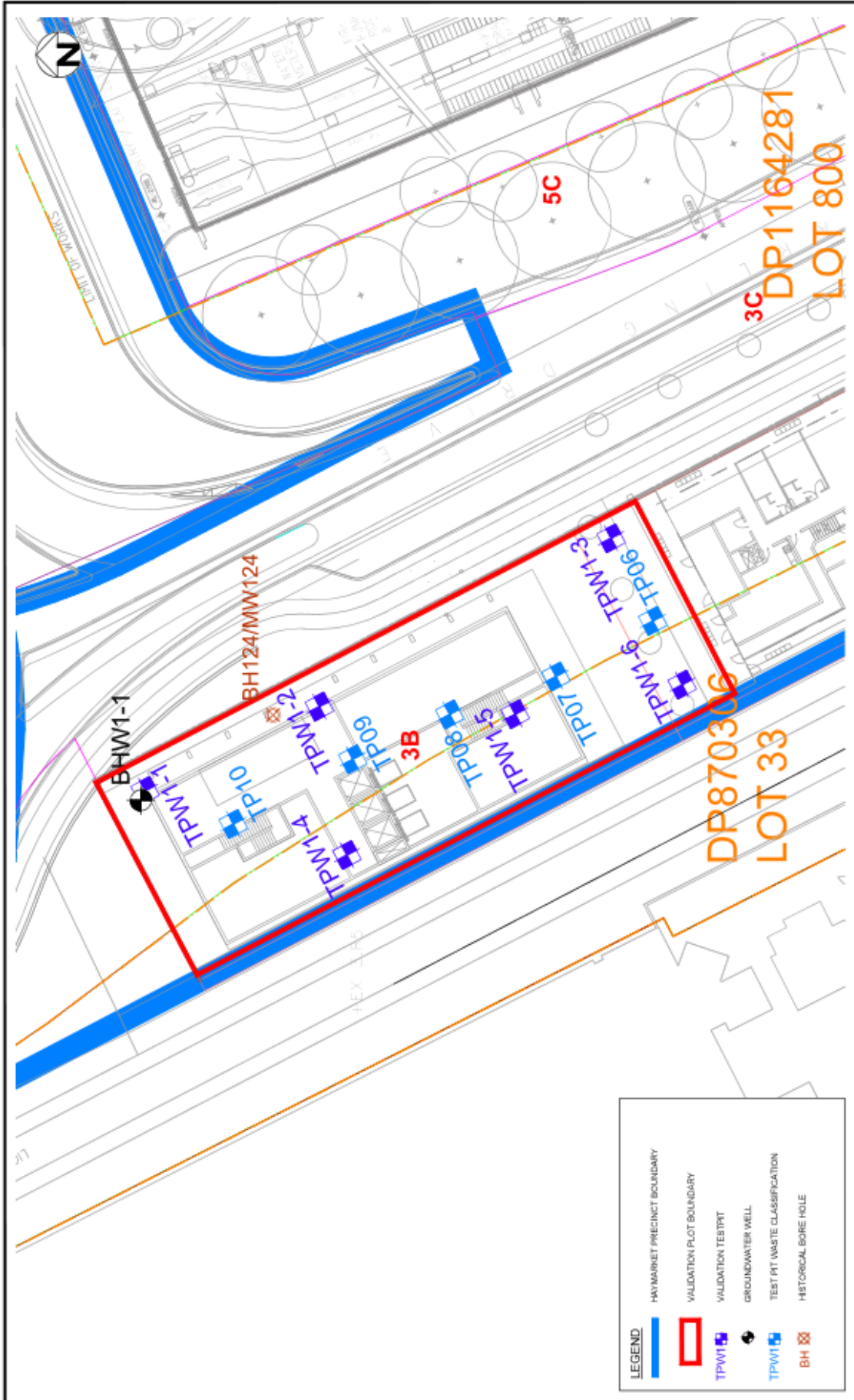
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drawn	MV
approved	ML
date	07/05/15
scale	AS SHOWN
original size	A4



client:	LEND LEASE DEVELOPMENT		
project:	DARLING SQUARE STUDENT ACCOMODATION BLOCK - W1 HAYMARKET, NSW		
title:	SITE LOCATION PLAN		
project no:	ENAU\HOD04498AD-DS-WI-VR1	figure no:	FIGURE 1
		rev:	B

Attachment 2: Student Accommodation (W1) Site Layout & Soil Validation Locations



LEGEND

- HAYMARKET PRECINCT BOUNDARY
- VALIDATION PLOT BOUNDARY
- TPW1
- GROUNDWATER WELL
- TEST PIT WASTE CLASSIFICATION
- ⊗ BH

NO.	DESCRIPTION	DATE	APPROVED	DATE	SCALE	DATE	APPROVED	DATE
A	ORIGINAL ISSUE	15/03/15	ML	15/03/15	AS SHOWN	07/05/15	ML	15/03/15
B	REVISED SAMPLING LOCATIONS	07/05/15	ML	07/05/15	AS SHOWN	07/05/15	ML	07/05/15

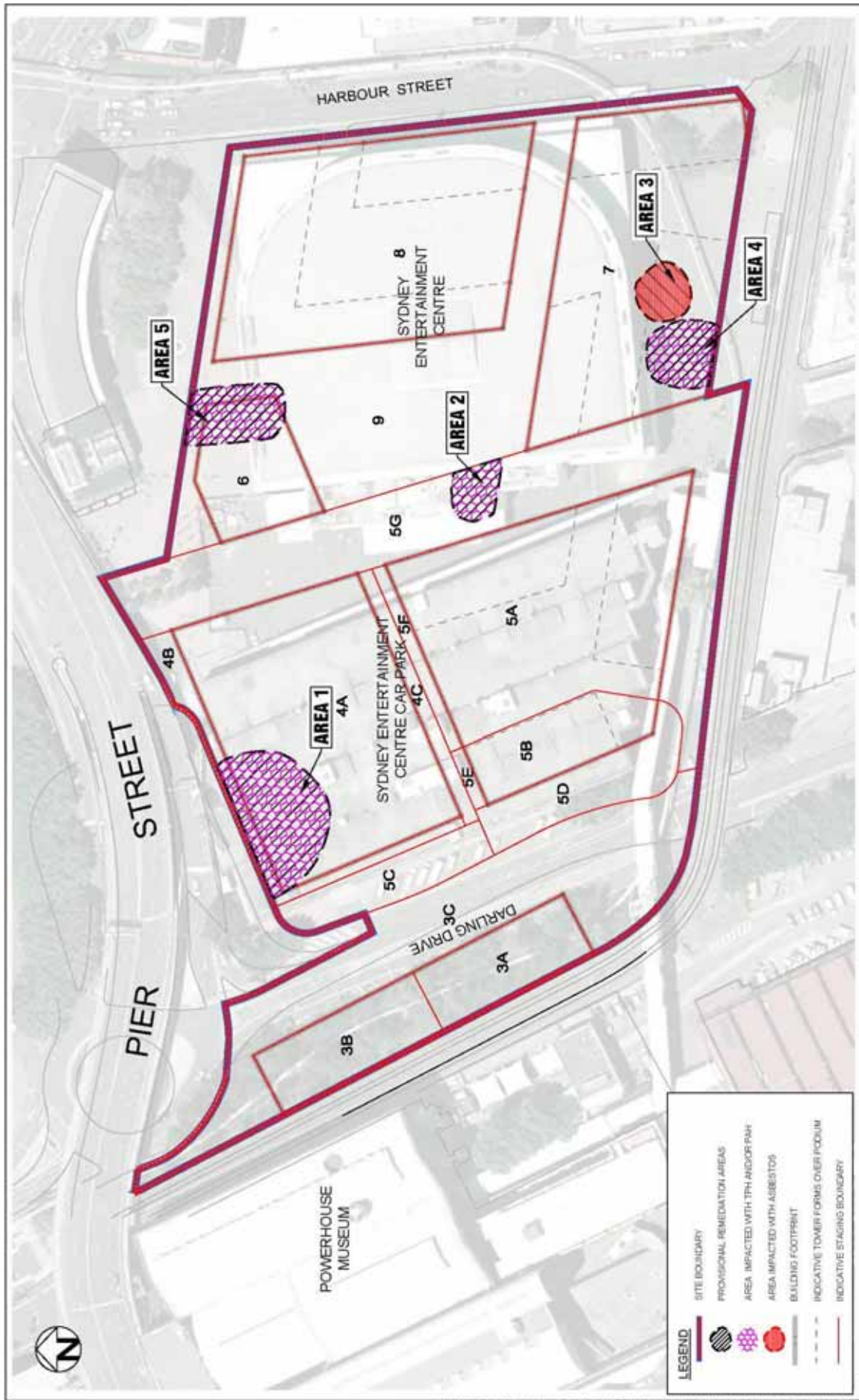
drawn	MV	approved	ML
date	07/05/15	scale	AS SHOWN
original size	A3	scale	1:200

NOTE: LOCATIONS ARE APPROXIMATE DIMENSIONS IN METRES.

Scale (metres) 1:200

Client:	LEND LEASE DEVELOPMENT
Project:	DARLING SQUARE STUDENT ACCOMMODATION BLOCK - W1 HAYMARKET, NSW
Title:	VALIDATION INVESTIGATION LOCATION PLAN
Project no.:	ENVALRHD0446840-05-YA-VR1
Figure no.:	FIGURE 2
Rev.:	B

Attachment 3: Haymarket Precinct Remediation Areas 1 to 5



LEGEND

- SITE BOUNDARY
- PROVISIONAL REMEDIATION AREAS
- AREA IMPACTED WITH TPH AND/OR PAH
- AREA IMPACTED WITH ARSENIC
- BUILDING FOOTPRINT
- INDICATIVE TOWER FORMS OVER POOLUM
- INDICATIVE STAGING BOUNDARY

revision	description	drawn	approved	date	<p>AREAS MADE PUBLIC: GOOGLE EARTH (NO. 4.2.0.11)</p> <p>AREAS MADE CR: 2013 INDIAN RIGHTS REPT: 2013 INDIAN RIGHTS REPT (D)</p> <p>Scale (metres): 1:1000</p>	<p>Drawn: approved</p> <p>Date: 16/12/18</p> <p>Scale: 1:1000</p> <p>Original size: A3</p>		<p>CLIENT: LEND LEASE DEVELOPMENT</p> <p>PROJECT: HAYMARKET PRECINCT, DARLING HARBOUR SYDNEY, NEW SOUTH WALES</p> <p>TITLE: PROVISIONAL SOIL REMEDIATION AREAS</p> <p>PROJECT NO: ENAURH0004198A1.004</p> <p>FIGURE NO: FIGURE 15</p>
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