Prepared for

Mirvac Projects Pty Ltd

Prepared by

Ramboll Environ Australia Pty Ltd

Date

June 2016

Project Number

AS121947

Audit Number

GN 527

SITE AUDIT REPORT

REMEDIAL ACTION PLAN FOR AUSTRALIAN TECHNOLOGY PARK

RAMBOLL ENVIRON

24 June 2016

Mirvac Projects Pty Ltd
Attn.: Barry Steedman
Level 26, 60 Margaret Street
Sydney NSW 2000

Dear Barry

SITE AUDIT REPORT - REMEDIAL ACTION PLAN FOR AUSTRALIAN TECHNOLOGY PARK

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 Mirvac Projects Pty Ltd to assess the suitability of a remedial action plan.

This Site Audit Report is not currently required by regulation or legislation and is therefore a non-statutory audit.

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

Ramboll Environ Australia
Level 3, 100 Pacific Highway
PO Box 560
North Sydney NSW 2060

T +61 2 9954 8100
F +61 2 9954 8150
www.ramboll-environ.com

Ref AS121947

Yours faithfully,
Ramboll Environ Australia Pty Ltd

Graeme Nyland
EPA Accredited Site Auditor 9808

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 527

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: Ramboll 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: Locomotive Street, Eveleigh

Postcode: 2015

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

Lot 8, 9 and 12 of DP1136859, part Lot 10 of DP1136859, Lot 4000 of DP1194309 and part Lot 4007 of DP1194309 (See attachment at end of Part 1)

Local Government Area: City of Sydney

Area of site (e.g. hectares): 11.6 ha Current zoning: Major Development

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: Joseph Scuderi Company: Mirvac Projects Pty Ltd

Address: Level 26, 60 Margaret Street, Sydney

Postcode: 2000

Phone: 9080 8885 Fax: NA

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

Barry Steedman, Mirvac Projects Pty Ltd, 9080 8142

Purpose of site audit

~~☐ A. To determine land use suitability *(please specify intended use[s])*~~

~~**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])*

Commercial, childcare, roads, pedestrian walkways, recreational, open space

Information sources for site audit

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

- Environmental Strategies Pty Ltd (ES)
- JBS&G Australia Pty Ltd (JBS&G)

Title(s) of report(s) reviewed:

- 'Environmental Investigation and Preliminary Insitu Waste Classification Developable Lots 8, 9 and 12, Australian Technology Park, Eveleigh', July 2014 by ES.
- 'Site Wide Groundwater Monitoring Report, Australian Technology Park, Eveleigh NSW', 31 July 2014 by ES.
- 'Limited Environmental Site Assessment, Lot 8 – Australian Technology Park, Eveleigh', August 2014 by ES.
- 'Environmental Status Report Lot 12 Australian Technology Park', dated August 2014 by ES.
- 'Environmental Status Report, Lot 9, The Australian Technology Park', dated September 2014 by ES.
- 'Environmental Status Report, Public Open Space Areas, The Australian Technology Park, Locomotive Street, Eveleigh NSW', dated October 2014 by ES.
- 'Australian Technology Park Detailed Site Assessment, 2 Locomotive Street, Eveleigh NSW', 9 December 2015, JBS&G.

Strike out as appropriate

- ‘Locomotive Workshop Soil Vapour – Factual Data Report’, 27 May 2016, JBS&G.
- ‘Retention of Lot 12 Fill Materials – Factual Data Report’, 27 May 2016, JBS&G.
- ‘Ecological Risk Assessment, 2 Locomotive Street, Eveleigh NSW’, 15 June 2016, JBS&G.
- ‘Human Health Risk Assessment, 2 Locomotive Street, Eveleigh NSW’, 15 June 2016, JBS&G.
- ‘Australian Technology Park Remedial Action Plan, 2 Locomotive Street, Eveleigh, NSW’, 15 June 2016, JBS&G.

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

- ‘Interim Advice Letter No. 1, Australian Technology Park, Groundwater’, dated 15 December 2014.
- ‘Site Audit Report - Lot 8, Australian Technology Park, Eveleigh’, GN 366B, dated 15 December 2014.
- ‘Site Audit Report - Lot 9, Australian Technology Park, Eveleigh’, GN 504, dated 22 December 2014.
- ‘Site Audit Report - Lot 12, Australian Technology Park, Eveleigh’, GN 500, dated 15 December 2014.
- ‘Site Audit Report – Public Open Space Areas, Australian Technology Park, Eveleigh’, GN 522, DRAFT version completed in November 2015 (not finalised).

Site audit report

Title: Site Audit Report – Remedial Action Plan for Australian Technology Park

Report no. GN 527 (Ramboll Environ Ref: AS121947)

Date: June 2016

Strike out as appropriate

Legend:

- Approximate Boundary - ATP
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"
- UST (Inferred Historical Location)

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:3,500

0 40 80
metres

Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SITE LAYOUT

FIGURE 2:

Site Audit Statement GN 527 - Page 4 of 10

File Name: 51142_02
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au

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)* ……

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:

Section B

Purpose of the plan[1] which is the subject of the audit was to present a remediation strategy that could be used during redevelopment of the site for mixed land uses.

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) the proposed development as described in section 2 of the remedial action plan referenced below, including the following:*
    - *Lot 8 will comprise a commercial building with a childcare centre on the first floor.*
    - *Lot 9 will comprise a commercial building with a childcare centre on the ground floor.*
    - *Lot 12 will comprise a commercial building over a two level basement car park.*
    - *Locomotive Workshop will continue to be used for commercial purposes, with no development proposed.*
    - *Surrounding areas will include existing roads, existing paved pedestrian walkways, new and existing gardens and open space areas.*

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

- 'Australian Technology Park Remedial Action Plan, 2 Locomotive Street, Eveleigh, NSW', 15 June 2016, JBS&G.

subject to compliance with the following condition(s):

- Assessment of the extent of volatile organic compounds and the potential to impact the proposed development on Lot 12.

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

**** Strike out as appropriate***

- Groundwater monitoring is undertaken following development of Lot 12 to assess potential impact of fill material placed below groundwater.
- Long term Environmental Management Plans (EMPs) are prepared for the ongoing management of site areas following remediation and development.

These conditions are consistent with the Remedial Action Plan.

- Groundwater is not abstracted from the site for beneficial use.
- A Section A site audit statement is prepared at the end of each stage of development, certifying suitability for the proposed use.

Overall comments

Investigations identified fill material across the site containing elevated concentrations of metals, polycyclic aromatic hydrocarbons and petroleum hydrocarbons. Asbestos as loose fibre bundles was identified in the fill material. Fill material was found to comprise a mix of sand, silt and clay with some gravel, sandstone, concrete, ash, slag, charcoal, glass, ceramic and brick.

Volatile contaminants were typically not detected, however an area of chlorinated hydrocarbon contamination was identified beneath the Locomotive Workshop building located up gradient of the Lot 12 development area. Further investigation to delineate the chlorinated hydrocarbons is required prior to remediation and is proposed in the remedial action plan.

The referenced remedial action plan provides a strategy to retain the majority of the contaminated fill material beneath commercial buildings, hardstand paving (roads and pathways) or a separation layer of clean soil or mulch (landscaping and lawn areas). Some off-site disposal of fill material may also be undertaken depending on final fill volumes and site levels. Long-term environmental management plans will be prepared to maintain site surfaces and limit exposure to underlying fill material.

Remediation will include placement of fill material beneath the groundwater table on Lot 12. Groundwater monitoring will be required following development of Lot 12 to ensure contaminants are not leaching into groundwater. Site wide groundwater conditions have been adequately established and do not indicate the need for groundwater remediation.

The Locomotive Workshop is not currently proposed for redevelopment. The potential for vapour intrusion would need to be considered in the event of any proposed development or reconfiguration.

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... 24/6/2016

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.

CONTENTS

LIST OF TABLES

APPENDICES

LIST OF ABBREVIATIONS

Measures

%	per cent
µg/L	Micrograms per Litre
µg/m^3	Micrograms per Cubic Metre
ha	Hectare
km	Kilometres
m	Metre
mAHD	Metres Australian Height Datum
mbgl	Metres below ground level
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mg/m^3	Milligrams per Cubic Metre
mm	Millimetre
ng/L	Nanograms per Litre
ppm	Parts Per Million

General

ABC	Added Background Concentrations
ACL	Added Contaminant Limit
ACM	Asbestos Containing Material
ADWG	Australian Drinking Water Guidelines
AF	Asbestos Fines
AHD	Australian Height Datum
ANZECC Council	Australian and New Zealand Environment and Conservation
ASLP	Australian Standard Leaching Procedure
ASS	Acid Sulphate Soil
ATP	Australian Technology Park
BaP	Benzo(a)pyrene
BTEX Hydrocarbons)	Benzene, Toluene, Ethylbenzene & Xylenes (Monocyclic Aromatic
CLM Act	NSW Contaminated Land Management Act 1997
COC	Chain of Custody
COPC	Contaminants of Potential Concern
Council	City of Sydney Council
CSM	Conceptual Site Model
Douglas	Douglas Partners Pty Ltd
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EIL	Ecological Investigation Level
EMP	Environmental Management Plan
EPA	Environment Protection Authority (NSW)
ERA	Ecological Risk Assessment
ES	Environmental Strategies Pty Ltd
ESL	Ecological Screening Level
F1	TRH C_6-C_{10} minus BTEX
F2	TRH >C_{10}-C_{16} minus naphthalene
FA	Fibrous Asbestos
GETEX	GETEX Pty Ltd
GIL	Groundwater Investigation Level
GME	Groundwater Monitoring Event
HHRA	Human Health Risk Assessment
HIL	Health Investigation Level
HLA	HLA-Envirosciences Pty Ltd
HSL	Health Screening Level
IPA	Iso-Propyl Alcohol
JBS&G	JBS&G Australia Pty Ltd
JET	Johnstone Environmental Technology Pty Ltd
LCS	Laboratory Control Sample
LEP	Local Environment Plan

MAH	Monocyclic Aromatic Hydrocarbons
mbgl	Metre Below Ground Level
mbTOC	Metres Below Top of Well Casing
Mercury	Inorganic mercury unless noted otherwise
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury
MCS	Material Classification Form
ML	Management Limits
MS	Matrix Spike
MTS	Material Tracking Sheet
NATA	National Association of Testing Authorities
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NL	Non-Limiting
n	Number of Samples
OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OH&S	Occupational Health & Safety
OPPs	Organophosphorus Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
pH	A measure of acidity, hydrogen ion activity
PID	Photoionisation Detector
PQL	Practical Quantitation Limit
PSH	Phase Separated Hydrocarbon
QA/QC	Quality Assurance/Quality Control
RAP	Remediation Action Plan
REMP	Remediation Environmental Management Plan
RfD	Reference Dose
RPD	Relative Percent Difference
RSL	Regional Screening Level
SAR	Site Audit Report
SAS	Site Audit Statement
SCEW	Standing Council on Environment and Water
SILs	Soil Investigation Levels
SMP	Site Management Plan
SVOCs	Semi Volatile Organic Compounds
SWL	Standing Water Level
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TPHs	Total Petroleum Hydrocarbons
TRHs	Total Recoverable Hydrocarbons
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VENM	virgin excavated natural material
VMP	Voluntary Management Proposal
VOCs	Volatile Organic Compounds
-	On tables is "not calculated", "no criteria" or "not applicable"

1. INTRODUCTION

A site contamination audit has been conducted in relation to part of the Australian Technology Park (ATP) located at Locomotive Street, Eveleigh.

The Audit was conducted to provide an independent review by an EPA Accredited Auditor of the suitability and appropriateness of a remedial action plan (RAP) i.e. a "Site Audit" as defined in Section 4 (1) (b) (v) of the NSW *Contaminated Land Management Act 1997* (the CLM Act).

The ATP is a former railway and goods yard that has been progressively redeveloped for a variety of uses. The ATP currently comprises new commercial buildings, a heritage building used for commercial purposes known as the Locomotive Workshop (Lot 4000), bitumen sealed car parks (Lot 8, 9 and 12), internal roads (Locomotive Street, Central Avenue and Davey Road), pedestrian walkways (Mitchell Way), recreational areas (Vice Chancellors Oval, tennis courts, basketball court) and landscaped areas along road verges and around car parks.

The following previous audits were undertaken on different parts of the ATP that are within the current audit area:

- GN 366B for Lot 8 of the ATP, dated 15 December 2014. The site audit statement (SAS) concluded that the site was suitable for commercial/industrial land use.
- GN 504 for Lot 9 of the ATP, dated 22 December 2014. The SAS concluded that the nature and extent of contamination at the site had been appropriately determined.
- GN 500 for Lot 12 of the ATP, dated 15 December 2014. The SAS concluded that the nature and extent of contamination at the site had been appropriately determined.
- GN 522 for public open space areas of the ATP. A draft version of the SAR was completed in November 2015, however was not finalised at the time because the site was sold and responsibility for implementation of the environmental management plan (EMP) was to pass to the new owners.

Relevant information from these audits has been included within this Site Audit Report (SAR).

1.1 Scope of the Audit

Details of the Audit are:

Requested by:	Joseph Scuderi on behalf of Mirvac Projects Pty Ltd
Request/Commencement Date:	20 November 2015
Auditor:	Graeme Nyland
Accreditation No.:	9808

The scope of the Audit included:

- Review of the following reports:
  - 'Environmental Investigation and Preliminary Insitu Waste Classification Developable Lots 8, 9 and 12, Australian Technology Park, Eveleigh', July 2014(a) by Environmental Strategies Pty Ltd (ES).
  - 'Site Wide Groundwater Monitoring Report, Australian Technology Park, Eveleigh NSW', 31 July 2014(b) by ES.
  - 'Limited Environmental Site Assessment, Lot 8 – Australian Technology Park, Eveleigh', August 2014(c) by ES.
  - 'Environmental Status Report Lot 12 Australian Technology Park', dated August 2014(d) by ES.
  - 'Environmental Status Report, Lot 9, The Australian Technology Park', dated September 2014(e) by ES.

- 'Environmental Status Report, Public Open Space Areas, The Australian Technology Park, Locomotive Street, Eveleigh NSW', dated October 2014(f) by ES.
- 'Australian Technology Park Detailed Site Assessment, 2 Locomotive Street, Eveleigh NSW', 9 December 2015 (and drafts dated 5 November 2015 and 23 November 2015), JBS&G Australia Pty Ltd (JBS&G).
- 'Locomotive Workshop Soil Vapour – Factual Data Report', 27 May 2016(a), JBS&G.
- 'Retention of Lot 12 Fill Materials – Factual Data Report', 27 May 2016(b), JBS&G.
- 'Ecological Risk Assessment, 2 Locomotive Street, Eveleigh NSW', 15 June 2016(c) (and draft versions dated 23 November 2015, 8 December 2015, 29 January 2016 and 27 May 2016), JBS&G (the ERA).
- 'Human Health Risk Assessment, 2 Locomotive Street, Eveleigh NSW', 15 June 2016(d) (as well as a previous final version dated 15 June 2015 and draft versions dated 23 November 2015, 8 December 2015 and 27 May 2016), JBS&G (the HHRA).
- 'Australian Technology Park Remedial Action Plan, 2 Locomotive Street, Eveleigh, NSW', 15 June 2016(e) (as well as a previous final version dated 15 June 2015 and draft versions dated 5 November 2015, 24 November 2015, 8 December 2015 and 27 May 2016), JBS&G (the RAP).

- Site visits by the Auditor and/or representative, including 9 October 2014 and 12 February 2015.
- Discussions with Mirvac and with JBS&G who prepared the RAP, HHRA and ERA.

The ES reports contain the results of investigations conducted by ES as well as a compilation of data from previous investigations. Eight investigations have been conducted by six different consultants since 1993, including: Johnstone Environmental Technology Pty Ltd (JET), CMPS&F, HLA-Envirosciences Pty Ltd (HLA), Douglas Partners Pty Ltd (Douglas), GETEX Pty Ltd (GETEX) and ES. The reports referenced by ES and JBS&G include the following documents, however these have not been provided to the Auditor for review:

- 'Groundwater Contamination Investigation and Remedial Works for Eveleigh South Redevelopment', November 1993 by JET.
- 'NSW Public Works- City West, Australian Technology Park, Eveleigh, Site Contamination Assessment Phase 1 (draft)', September 1994 by CMPS&F.
- 'Site Investigation Masterplan Blocks F, K, L and Part G, Australian Technology Park, Redfern NSW', February 2001 by HLA.
- 'Report on Contamination Assessment, Development Parcel C2, Australian Technology Park, Eveleigh', July 2005 by Douglas.
- 'Report on Supplementary Contamination Assessment and Waste Classification, C3 Development Parcel, Australian Technology Park, Eveleigh', January 2008 by Douglas.
- 'Revised Preliminary Soil Contamination report', 2013, GETEX.

2. SITE DETAILS

2.1 Location

The site locality is shown on Attachment 1, Appendix A.

The site details are as follows:

Street address:	Locomotive Street, Eveleigh, NSW 2015
Identifier:	Lot 8, Lot 9 and Lot 12, DP1136859 (developable Lots) part Lot 10, DP1136859 (open space) part Lot 4007, DP1194309 (open space and roads) Lot 4000, DP1194309 (Locomotive Workshop)
Local Government:	City of Sydney Council
Owner:	Mirvac
Site Area:	Approximately 11.6 ha

The boundaries of the site are not well defined. Boundaries include adjacent roads and buildings in some areas. The layout of the Lots comprising the site is shown in Attachment 2 in Appendix A.

2.2 Zoning

The zoning of the site is given by JBS&G as SEPP Major Development 2005 under the City of Sydney Local Environment Plan 2012.

2.3 Adjacent Uses

The ATP is located in an area of mixed commercial and medium density residential use. Surrounding land uses include:

North: Rail corridor.

East: Cornwallis and Garden Streets, then residential and commercial (retail and vehicle repairs).

South: Henderson Road, then residential and commercial (retail, service station and mechanics).

West: Alexander Street, Rowley Lane and a childcare facility, then residential.

There are stormwater detention basins in the south of the ATP. Alexandra Canal, approximately 1 km south of the site, is the nearest groundwater receptor.

2.4 Site Condition

JBS&G (2016e) noted the following regarding the condition of the site:

- The site comprises roads (Locomotive Street, Central Avenue and Davy Road), pedestrian walkways (Mitchell Way), gardens and open space areas (Vice Chancellors Oval, tennis courts, basketball court and other areas), car parks (Lot 8, 9 and 12) and the Locomotive Workshop (Lot 4000). The site layout is shown in Attachment 2 in Appendix A.
- The Locomotive Workshop comprises a large masonry and steel former railway building that has been reused for commercial purposes. Other buildings located on the ATP are excluded from the site area (hatched areas shown on Attachment 2 in Appendix A).
- The topography of the area slopes to the south, with discrete areas of the site (car parks, courts) reshaped into levelled areas. Lot 12 is a two level car park separated by a 3 m high retaining wall.
- No surface water bodies are located on the site. Two stormwater detention basins are located in the south of the ATP.

2.5 Proposed Development

It is understood that the site is to be redeveloped by Mirvac. Developable Lots 8, 9 and 12 are to comprise multi-storey commercial buildings including parking, retail, commercial and childcare (Lot 8 and 9) uses. The surrounding area will include roads and public open space. Development of the Locomotive Workshop is not proposed.

Design plans appended to the RAP indicate the commercial buildings will comprise the following:

- Lot 8 will comprise a four storey multi-purpose building including commercial office, community office, childcare, retail and gym uses. The childcare centre is to be located on the first floor. Basement car parking is not included in the plans.
- Lot 9 will comprise a nine storey commercial building, with the ground floor use including a childcare centre, retail and car parking. Basement car parking is not included in the plans.
- Lot 12 will comprise a seven storey commercial office building with ground level retail including a supermarket. Two levels of car parking will be cut into the existing site, resulting in the base being level with Central Avenue and two levels deep at Locomotive Street.

Areas surround the buildings (Lot 10 and 4007) will include roads, paved pedestrian walkways, gardens and open space areas (Vice Chancellors Oval, tennis courts, basketball court and other areas).

For the purposes of this audit, the following different land use scenarios will therefore be assumed for the different development areas:

- ‘childcare’ for Lot 9.
- ‘commercial/industrial’ for Lot 8, Lot 12, Lot 4000, roads and walkways.
- ‘open space’ for part Lot 10 and part Lot 4007.

3. SITE HISTORY

ES (2014a-2014e) provided site history information based on a previous Phase 1 Contamination Investigation undertaken by Douglas.

Douglas reported that the site was previously part of the Eveleigh Railway Yards, founded in 1880, and Alexandria Goods Yards. The workshops were used for the assembly of components required for locomotives and included a locomotive workshop, a foundry, railway sidings and goods yards (Attachment 3, Appendix A). Activities were reported to have comprised brass, iron and steel founding, heavy engineering machining, blacksmith works, refuelling, cleaning and degreasing.

The foundry contained furnaces, smelting apparatus and furnace pits and appeared to have a dirt floor for the duration of its operation.

Douglas reported that the potash shed in the locomotive workshop was used to wash dirt and grease from the locomotive wheels and axles and to remove rust and scale through acid bath drenching.

Potential contaminating activities included use of the site as a rail yard, fill material placed on the site from unknown sources, and two areas of underground storage tanks (UST). The USTs were thought to be located to the west of the Locomotive Workshop and in the northeast of the ATP.

3.1 Auditor's Opinion

The Auditor considers that the site history is broadly understood. Details regarding specific site usage are lacking. With respect to groundwater conditions, the absence of site specific history has been compensated for by the density of the investigations.

4. CONTAMINANTS OF CONCERN

The RAP (JBS&G, 2016e) identified the following as contaminants of concern based on a review of previous site investigations:

- Total recoverable hydrocarbons (TRH)
- Metals, particularly lead, nickel and zinc
- Polycyclic aromatic hydrocarbons (PAHs)
- Asbestos

Consultants undertaking previous investigations of the site additionally identified benzene, toluene, ethylbenzene and xylene (BTEX), organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), polychlorinated biphenyls (PCB) and volatile organic compounds (VOCs) as contaminants of concern based on the site history. The analytical results of the previous investigation undertaken at the site did not identify these contaminants at concentrations that would indicate they are of concern. They have therefore not been included in the RAP as contaminants of concern.

4.1 Auditor's Opinion

The Auditor considers that the analyte list used by the various consultants during the previous investigations was generally consistent with the site history.

The contaminants of concern identified by the RAP are generally considered to reflect the contaminants identified during the previous investigations. It is noted that VOCs have been identified in soil vapour in two areas beneath the Locomotive Workshop. The impacted areas are located off-site and up gradient of the site. Migration of VOC contamination onto the Lot 12 part of the site has not been assessed. VOCs, particularly tetrachloroethene (PCE) and trichloroethene (TCE), are therefore also considered to be contaminants of concern.

5. STRATIGRAPHY AND HYDROGEOLOGY

Following a review of the reports provided, a summary of the site stratigraphy and hydrogeology was compiled as follows.

5.1 Stratigraphy

ES (2014a) indicated that the site is on the boundary of the Middle Triassic Wianamatta Shale (shale and laminites with weathered clays) and the Quaternary Botany Sand (sand with podsols and peat).

The sub-surface profile of the site based on logs from previous intrusive investigations is summarised in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
0 – 0.2	Asphalt, concrete and brick pavers in roadways, car parks and pathways Leaf litter, wood chip and topsoil in garden areas Turf in oval and other garden areas Synthetic grass for tennis and basketball courts
0 – 7.6 (maximum) Typically 1 – 4 m thick	Fill material comprising a mix of sand, silt and clay with some gravel, crushed sandstone, concrete, ash, slag, charcoal, railway ballast, blue metal, glass, ceramic and brick identified. Fill was identified at all investigation locations, and was generally thicker in the north of the site.
Lot 8 and 9: 4 – 8 (sand) Lot 12: 4 – 8.5 (silty clay)	Natural silty sand or sand was identified in the south of the site. Bedrock was not identified underlying natural sand. Silty clay was identified in the north of the site, which was underlain by weathered shale bedrock at 6-8.5 mbgl.

mbgl – metres below ground level

The boundary between the clay/shale of the Wianamatta Shale and the sands of the Botany Sands is approximately between Lot 12 and Lots 8/9.

5.2 Hydrogeology

Nineteen groundwater monitoring wells remain on the ATP, mainly on Lots 8, 9 and 12 and the roads between them, and two wells to the northeast (Attachment 4, Appendix A).

Groundwater has historically been at depths of between 2.1 m below top of well casing (mbTOC) in the south of the site (DP403) and 9.64 mbTOC to the northeast of the site (ADI_AH1). Review of the borehole logs indicates that groundwater was encountered in sand or fill material in the south of the site and clay in the north of the site.

During the most recent groundwater monitoring round, measured parameters indicated that groundwater was acidic (pH 3.7-6.4), anaerobic in most wells (0.2-2 ppm), aerobic in four wells located across the site (4-5.7 ppm), and with low conductivity (2-900 µS/cm).

Douglas indicate that groundwater flows to the south towards Alexandra Canal, located approximately 1 km south of the site. Surface water would drain in a southerly direction to the stormwater detention basins in the south of the site and nearby road drainage system.

Review of the Department of Water and Energy (former DIPNR) Botany Basin Groundwater Management Map indicates that the site is immediately to the north of the ‘Zone 2- Embargoed’

Groundwater Protection Zone of the Botany Basin. Although no new licences will be issued for this zone, any existing licence holders may continue to extract water. Extraction of groundwater for domestic use is prohibited and bores for industrial use must be tested annually.

5.3 Auditor's Opinion

The subsurface conditions are adequately known, given the variability in fill and site location near the boundary of geological units.

6. EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

The Auditor has assessed the overall quality of the current data by review of the information presented in the referenced report. This excludes reports prepared by HLA, CMPS&F, JET, GETEX and Douglas which were not provided to the Auditor for review, however some information is included below where available, such as sampling locations, density and well construction.

The Auditor's assessment follows in Tables 6.1 and 6.2.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Data Quality Objectives (DQO) ES and JBS&G defined specific DQOs in accordance with the seven step process outlined in DEC (2006) *Guidelines for the NSW Site Auditor Scheme*.	These were considered appropriate for the investigations conducted. ES however did not provide an evaluation of quality, and has not presented an assessment of the quality of the previous consultants' data.
Sampling pattern and locations *Soil:* Investigation locations were spaced to gain coverage of the majority of the site with the combined sampling between the investigations providing a random stratified approach (Attachments 5-7, Appendix A). *Groundwater:* Groundwater monitoring wells have been installed across the ATP, however existing wells are largely located on Lots 8, 9 and 12 (Attachment 4, Appendix A). *Soil vapour:* Sub-slab soil vapour points were located within the Locomotive Workshop. Twenty seven sample points were installed on a 30 m grid across the building, with an additional six targeted in areas where VOCs were detected (Attachment 8, Appendix A). Two soil vapour wells (SVE and SVF) were existing at the time of the JBS&G (2016a) investigation, however were not sampled.	In the Auditor's opinion the soil and soil vapour investigation locations adequately target the main areas of concern. Groundwater wells have not been installed to delineate the two areas of VOC impact identified beneath the Locomotive Workshop.
Sampling density *Soil:* The sampling density included approximately 280 locations over approximately 6.6 ha (i.e. the site area less existing buildings). The density exceeds the minimum recommended by EPA (1995) *Sampling Design Guidelines*. Spacing between locations was up to approximately 100 m, but was generally much closer. Some areas were not investigated or were investigated at a low density, such as the south of Davy Road, Mitchell Way, the southwest of the site, the oval and the part of Lot 10 within the site. It is considered that the vertical sampling density of the various fill and natural layers encountered across the site was adequate. Laboratory analysis of samples is considered sufficient to characterise subsurface conditions.	Not all soil locations were analysed for all contaminants of concern, but the density is sufficient to detect any major contamination hotspots over the majority of the site. No groundwater wells have targeted the VOC source area beneath the Locomotive Workshop. Investigation of this area is required, particularly with respect to migration onto Lot 12, located down gradient across Locomotive Street. The density of soil vapour wells within the Locomotive Workshop is adequate, however areas outside

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
Groundwater: A total of nineteen groundwater wells were sampled. Sufficient wells are located on Lots 8 and 9. Wells on Lot 12 were not located downgradient of the VOC contamination identified beneath the Locomotive Workshop. No groundwater wells were installed within the workshop targeting the VOC contamination. Historical wells covered a wider part of the ATP, but none were located within the major remaining buildings. *Soil vapour*: Thirty five soil vapour sampling points were located within the Locomotive Workshop.	the building footprint has not been investigated.
Sample depths Samples were collected and analysed from a range of depths, with the primary intervals being within the fill material and close to the fill/natural interface.	In the Auditor's opinion, this sampling strategy was appropriate and adequate to characterise the primary material types present on site.
Well construction *Groundwater:* Douglas and ES groundwater wells were drilled using solid flight augers. The Douglas wells (DP103, DP104, DP107, DP328, DP402, DP403, DP405, DP504, DP507, DP508, DP511, DP619 and DP625) were extended to depths of 4.5 to 9 m. Wells were constructed of wells screens placed in gravel pack, sealed with bentonite and backfilled with soil cuttings. Some wells (DP104 and DP107) had cave-in of sand around the well screen. Wells were screened across fill and/or natural material. The ES wells (ES1, ES3, ES14, ES15 and ES16) were extended to depths of 4.35 to 7 m. Well screens were placed in gravel pack, sealed with bentonite and backfilled with soil cuttings. Wells were screened across fill and/or natural material. The screened interval is intersected by the groundwater table. The historical wells had screen lengths varying from 1 m to 19 m, with 3 m most common. *Soil Vapour*: Sample points were constructed of 6 mm Teflon tubing and steel wool filter inserted in a 20 mm diameter core. The hole was sealed with air-drying clay and cementitious grout.	In the Auditor's opinion the well construction was acceptable.
Sample collection method *Soil*: Sample collection was typically by rotary auger, with limited sampling by SPT, hand auger, test pit and pushtube (JET, HLA, ES and JBS&G). *Groundwater*: The method of well development was not	The soil sampling methods (except pushtubes) can result in loss of volatiles and sample cross contamination. Given that some of the contaminants of concern at the site

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
reported. ES report that a low-flow sampling method was used since July 2012. The depth of the sample tube inlet was not specified. Prior to this, re-useable or disposable bailers were used for groundwater purging and sampling. *Soil Vapour:* Samples were collected as a 6 L volume of vapour through a carbon sorbent tubes (TO-17) following purging of sample points with a PID and multi-gas meter. Leak testing was undertaken using iso-propyl alcohol (IPA). JBS&G measured for potential leaks using a PID. Results were typically low (<2 ppm) or <PQL.	are volatile organics, the soil concentrations reported must be considered as indicative only and may underestimate the actual concentrations present. Investigation by augers is also not ideal for identifying asbestos in fill. No test pits are known to have been excavated on Lot 8. The groundwater and soil vapour sample collection methods are considered acceptable.
Decontamination procedures *Soil:* Non-disposable sampling equipment was cleaned with phosphate-free detergent and distilled water between sampling events to prevent cross contamination. Decontamination of truck-mounted augers between locations was not explicitly reported. *Groundwater*: Dedicated tubing was used by ES for each monitoring well. Decontamination of the interface probe was conducted with a Decon 90 solution, followed by a rinse with demineralised water.	Acceptable
Sample handling and containers *Soil*: Soil samples were placed into sampling jars provided by the laboratory and chilled during storage and subsequent transport to the labs. The exception was for samples analysed for asbestos, acid sulphate soil (ASS) properties and leachability, which were sampled in plastic bags. *Groundwater*: Sample containers used by ES were supplied by the laboratory, and were chilled during storage and subsequent transport to the labs. Samples to be analysed for heavy metals were field filtered. *Soil vapour*: Samples were collected on carbon tubes provided by the analytical laboratory.	Acceptable
Chain of Custody (COC) Completed chain of custody forms were provided in the reports for more recent investigations. COCs were often not provided for analysis by HLA, CMPS&F and JET.	Acceptable where provided
Detailed description of field screening protocols *Soil:* Field screening for volatiles was undertaken using a PID. Limited screening procedures were provided, and indicated that plastic bag samples were equilibrated before taking the PID reading.	While no PID screening method was provided, results on logs were consistently low and correlate well with laboratory analytical results and observations.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
PID readings are provided on JBS&G, Douglas, ES, JET and HLA borehole logs. Readings were low or non-detect. Results were typical of background levels. Field screening for pH and peroxide pH was undertaken by Douglas to check for potential ASS. pH was measured by adding distilled water to a soil sample and using a pH meter and temperature probe. Peroxide pH measurement was undertaken by mixing a soil sample with a peroxide solution and noting any resulting effervescence, colour change or odour. The sample was then mixed with water and a pH meter and temperature probe were used to measure pH. The pH meter was reported to be calibrated, but no supporting documentation was provided. *Groundwater:* Groundwater field parameters were measured during monitoring well purging. *Soil vapour:* A PID and MX6 gas analyser were used during collection of soil vapour samples. The MX6 was used to assess concentrations of methane, oxygen and carbon dioxide.	Groundwater and soil vapour field screening was considered acceptable.
Calibration of field equipment *Soil*: Although the PID was reported to have been calibrated, no supporting documentation was provided. *Groundwater:* A calibration certificate from the equipment supplier was provided. Field calibration records were not provided. *Soil vapour:* calibration certificates from the equipment supplier were provided for the PID and MX6. Field PID calibration records were provided for the initial sampling event.	PID readings have a low reliability, however were typically low and correlate well with laboratory analytical results.
Sampling logs *Soil:* Logs are provided within the reports, indicating sample depth, PID readings, lithology, water table and well construction details. A separate sample register was also provided. ES provided logs for their wells and those of Douglas that they sampled, plus some of the historical wells installed by JET and CMPS&F. *Groundwater:* Field sampling records were provided for the January sampling only. Field parameters were also not included in the report. *Soil vapour:* Field sampling records were provided, including, PID readings and methane, oxygen and carbon dioxide readings.	Acceptable, noting that there is likely to be inconsistencies between logs produced in the investigations by different consultants.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Field quality control samples Field quality control samples included inter-laboratory duplicates, intra-laboratory duplicates, rinsate blank, trip blank and trip spike. Laboratory certificates from earlier sampling events indicate that a check laboratory was used, however insufficient information was provided to determine duplicate and triplicate pairs. Field quality control samples included intra-laboratory duplicates and an equipment blank during soil vapour sampling.	Acceptable where provided
Field quality control results The results from field quality control samples were generally within appropriate limits. • Rinsate blank results were <PQL, with the exception of zinc (0.05 mg/L). • Trip blank results were <PQL for volatiles. • The trip spike sample analysed during DP sampling had low recovery (60-79%). Other trip spikes had acceptable recoveries. • Inter- and intra-laboratory duplicate results were generally within appropriate limits; however elevated RPDs were reported for metals and PAHs. These were considered to be for results that were close to PQLs, and were attributed to fill heterogeneity. • Soil vapour duplicates report elevated RPDs for PCE in one duplicate pair. The higher concentration was reported in the primary sample.	Overall, in the context of the dataset reported, the elevated RPD results are not considered significant and the field quality control results are acceptable.
NATA registered laboratory and NATA endorsed methods Laboratories used included: Envirolab (primary/secondary), SGS (primary), Eurofins|MGT (primary), LabMark (secondary), NMI (secondary) and ALS (secondary). Laboratory certificates were NATA stamped.	Acceptable
Analytical methods Analytical methods were included in the laboratory test certificates where they were provided.	Acceptable where provided
Holding times Review of the COCs and laboratory certificates indicate that the holding times were generally met. The exception included selected TCLP's; however given that the test replicates the acidic conditions encountered in landfill cells, it is considered that the exceedance of holding times (two weeks for benzo(a)pyrene) is not significant. ES reported	The reliability of results analysed outside of holding times is low.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
25 samples analysed outside of holding times which they did not consider altered their conclusions.	
Practical Quantitation Limits (PQLs) *Soil:* PQLs were less than the threshold criteria for the contaminants of concern. *Groundwater:* Not all PQLs for the groundwater assessment were sufficiently low, with the PQLs exceeding the ES GILs for some PAHs, OCPs, OPPs and VOCs. Historically the PQLs exceeded current GILs for a number of other analytes. *Soil vapour:* PQLs were less than the threshold criteria.	*Soil:* Acceptable. *Groundwater*: The elevated PQLs were only marginally elevated above the trigger values and, in the context of the results reported, overall these discrepancies do not materially affect the outcome of the audit. *Soil vapour*: Acceptable
Laboratory quality control samples Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratory.	Acceptable
Laboratory quality control results The results of laboratory quality control samples were generally within appropriate limits, with the following exceptions: • Slightly low spike recoveries were recorded for one batch of soil for TPH and BTEX (between 60-86%). Some of the results may therefore underestimate the volatile fraction. • The matrix spike recovery was not determined for TPH, PAH, metals and cyanide in a limited number of instances. This was attributed to the sample matrix by the laboratory. • Laboratory duplicates for metals often had elevated RPDs. This was attributed to the non-homogeneous nature of the sample by the laboratory. • Laboratory duplicates for PAHs had elevated RPDs, however samples typically had low concentrations (<10x PQL). This was attributed to the non-homogeneous nature of the sample by the laboratory. • Surrogate recovery for TPH not determined in number of instances. This was attributed to the elevated analyte concentrations in the sample by the laboratory.	The slightly low spike recoveries are not considered to affect the usability of the data as TRH and BTEX were not detected in the soil samples analysed. In the context of the dataset reported, the elevated RPD is not considered significant and the laboratory quality control results are acceptable. They indicate that the fill material is highly heterogeneous.
Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy) Douglas provided a narrative on QA/QC but did not undertake a formal QA/QC data evaluation of laboratory data. Overall they concluded that *"results indicate an acceptable consistency between the samples and their*	An assessment of the data quality with respect to the five category areas has been undertaken by the auditor and is summarised below.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
replicates and indicate that suitable field sampling methodology was adopted and laboratory precision achieved". ES conducted an evaluation of their data and concluded that data was generally acceptable while commenting on exceedances of holding times and RPDs. They did not undertake a formal QA/QC data evaluation against the five category areas. JBS&G conducted an evaluation of soil vapour and soil QA/QC data against the five category areas. With respect to the soil vapour data, JBS&G concluded that the data *"…are considered reliable and representative of the vapour conditions beneath the Locomotive Workshop during the time of sampling"*. With respect to the soil data, JBS&G concluded *"…the soil data is of an acceptable quality upon which to draw conclusions"*.	

In considering the data as a whole the Auditor concludes that:

- Data from the various investigations was relatively consistent and likely to be representative of the overall conditions on site.
- The data is not complete as per omissions noted above.
- There is a reasonable degree of confidence that data is comparable for each sampling and analytical event.
- Where provided, the primary laboratory provided sufficient information to conclude that data is of sufficient precision.
- Laboratory quality control information was provided to support that analytical data is likely to be accurate.

7. ENVIRONMENTAL QUALITY CRITERIA

The Auditor has assessed **soil** data provided with reference to criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as amended 2013 (NEPM, 2013). Most of the investigations on the ATP were completed prior to the amendment to the NEPM and the various consultants referred to criteria applicable at the time. ES and JBS&G collated all data and listed Site Assessment Criteria mainly sourced from NEPM (2013).

Based on the proposed development (Section 2.5), the following Tier 1 (screening) criteria were referred to depending on the proposed land use.

- Human Health Assessment
  - Health Based Investigation Levels (HIL A, C & D).
  - Soil Health Screening Levels (HSL A, C & D) for Vapour Intrusion. The most conservative criteria were adopted i.e. assumed depth to source < 1 m and sand.
  - CRC CARE (2011) Direct Contact (HSL A, C & D and intrusive maintenance worker).
  - Asbestos Health Screening Levels were not used as there has been no asbestos quantification. ES consider a detection of asbestos to be above the criteria.
- Terrestrial Ecological Assessment
  - Ecological Screening Levels (ESL) assuming coarse soil.
  - Ecological Investigation Levels (EIL urban residential and commercial/industrial). In the absence of site specific soil data on pH, clay content, cation exchange capacity and background concentrations, the published range of the added contaminant values have been applied as an initial screen.
- Management Limits (ML Commercial/Industrial) assuming coarse soil
- Aesthetics
  - The Auditor has considered the need for remediation based on the 'aesthetic' contamination as outlined in the NEPM (2013).

The Auditor assessed the **groundwater** data provided by ES in reference to Tier 1 (screening) criteria for 'commercial/industrial' use from the following:

- Human Health Assessment
  - NEPM (2013) Groundwater Health Screening Levels (HSL D) for vapour intrusion (sand, 2 to <4 m)
- Ecological Assessment
  - Groundwater Investigation Levels (GILs) listed in NEPM (2013) for protection of aquatic ecosystems referenced in ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. GILs 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. Some have been modified based on bioaccumulation or acute-toxicity or potential toxicity to particular species.

The site is located immediately north of 'Zone 2' of the Botany groundwater management zones. Zone 2 prohibits the use of groundwater for domestic use (drinking, watering gardens, washing cars, bathing or filling swimming pools), and bores for industrial use must be tested annually. The Auditor has therefore not considered the NHMRC and NRMMC (2011) *Australian Drinking Water Guidelines* (ADWG) for potable or recreational use.

The Auditor assessed the **soil vapour** data provided by JBS&G against the following criteria for a Tier 1 (screening level) 'commercial/industrial' assessment as follows:

- NEPM (2013) Soil vapour Health Screening Levels (HSL D) for Vapour Intrusion (sand, 0 m to <1 m)
- NEPM (2013) Interim Soil Vapour Health Investigation Levels (HIL D) for Volatile Organic Chlorinated Compounds

8. EVALUATION OF SOIL ANALYTICAL RESULTS

Investigation of the ATP site has been undertaken by JET, CMPS&F, HLA, Douglas Partners, ES, GETEX and JBS&G. The investigations undertaken in each area of the site are discussed below.

8.1 Lot 8

Lot 8 analytical results are summarized in Table 8.1. Figures attached to the RAP indicate that the development will comprise a four storey multi-purpose building, including commercial office, community office, childcare, retail and gym uses. The childcare centre is to be located on the first floor, not ground floor. The results were therefore compared against the criteria for commercial/industrial land use.

Investigation locations undertaken in Lot 8 are shown in Attachment 5 in Appendix A.

Table 8.1: Evaluation of Lot 8 Soil Analytical Results – Summary Table (mg/kg)

Analyte	n	Detections	Maximum	n > Human Health Screening Criteria	n > Terrestrial Ecological Screening Criteria
Asbestos	14	**1**	**detect**	**-**	-
Arsenic	56	10	20	0	0
Cadmium	56	1	0.4	0	-
Total Chromium	56	52	28	-	0
Copper	56	42	**220**	0	**1**
Lead	56	51	130	0	0
Mercury (inorganic)	56	7	0.44	0	-
Nickel	56	39	**190**	0	**1**
Zinc	56	34	**150**	0	**1**
TPH C_6-C_9	53	0	<PQL	0	-
TPH C_{10}-C_{36}	53	2	160	0	-
TRH C_6-C_{40}	20	0	<PQL	0	0
BTEX	53	0	<PQL	0	0
Total PAHs	53	21	221	0	0
Carcinogenic PAHs (BaP TEQ)	53	21	18.8	0	-
Benzo(a)pyrene	53	21	**3.7**	-	**2**
PCBs	47	0	<PQL	0	-
OCPs	47	0	<PQL	0	-
OPPs	20	0	<PQL	-	-
VOCs	27	0	<PQL	-	-
Total phenols	26	0	<PQL	-	0

n *number of samples*

- *No criteria available/used*

There are some elevated concentrations of heavy metals, petroleum hydrocarbons and PAHs from the various fill and natural soils analysed from across the site, however concentrations were generally below the site criteria. In considering the data, the following comments are made:

- Results above typical background concentrations were from samples collected from fill material. No organics or elevated metal concentrations (above background concentrations) were detected in underlying natural soils.
- Previous investigations (pre-ES 2014) included seven samples analysed for asbestos from various fill layers ranging in depth from 0.2 to 1 mbgl. Only two of these were from fill immediately beneath the current asphalt surface. No asbestos was detected and there were no observations of potential asbestos-containing materials recorded in the borelogs. ES analysed a further seven samples from two boreholes, and asbestos was detected in one. The asbestos detection was from a sample of fill described as roadbase/crushed sandstone, without anthropogenic material being recorded. The borehole log for the other ES location noted some anthropogenic material (brick, plastic with rubble) in fill. It is not known whether the asbestos is related to shallow roadbase beneath asphalt or the bulk of the fill material.
- Elevated concentrations of carcinogenic PAHs were detected in samples of fill material, however less than the adopted criteria for commercial use. Should the proposed childcare centre be located on the ground floor (rather than the 1st floor as proposed), two samples would contain concentrations of carcinogenic PAHs exceeding the HIL. Results for other samples collected from Lot 8 were typically less than 1 mg/kg.
- In addition to the above tabulated analysis, field screening and laboratory analysis for potential ASS was carried out by Douglas. Results from laboratory analysis are somewhat inconclusive, with the highest total potential acidity (TPA 65 mol H+/tonne) and total actual acidity (TAA 300 mol H+/tonne) recorded from a natural clay sample (borehole 401 at 6 mbgl). Douglas recommend preparation of an ASS management plan only if necessary for further assessment prior to bulk excavation if excavation is to be extended to levels identified as at risk.
- Douglas undertook selected TCLP tests in order to undertake preliminary waste classification of soils at the site that may be taken offsite during site development. Ideally the TCLP test should be undertaken on samples that have the highest total concentration, which Douglas did in most cases. Douglas has indicated that natural soils are classified as Virgin Excavated Natural Material (VENM). Fill material requires further investigation to determine an accurate waste classification and volume estimates.

8.2 Lot 9

Lot 9 analytical results are summarized in Table 8.2. Figures attached to the RAP indicate that the development will comprise a nine storey commercial building, with the ground floor use including a childcare centre, retail and car parking. The results were therefore compared against the criteria for the most sensitive land use, being a childcare centre.

Investigation locations undertaken in Lot 9 are shown in Attachment 5 in Appendix A.

Table 8.2: Evaluation of Lot 9 Soil Analytical Results – Summary Table (mg/kg)

Analyte	n	Detections	Maximum	n > Human Health Screening Criteria (NEPM, 2013)	n > Terrestrial Ecological Screening Criteria (NEPM, 2013)
Asbestos	33	**1**	**detect**	-	-
Arsenic	122	45	74	0	0
Cadmium	122	13	4	0	-

Table 8.2: Evaluation of Lot 9 Soil Analytical Results – Summary Table (mg/kg)					
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**	**n > Terrestrial Ecological Screening Criteria (NEPM, 2013)**
Total Chromium	122	108	103	-	0
Copper	122	101	**370**	0	**14**
Lead	122	116	**1,180**	**7**	0
Mercury (inorganic)	102	15	2	0	-
Nickel	102	73	25	0	0
Zinc	122	120	**2,040**	0	**25**
TRH C_6-C_{10} – BTEX (F1)	50	0	<PQL	0	0
TRH >C_{10}-C_{16} – naphthalene (F2)	50	3	**1,000**	**3**	**2**
TRH >C_{16}-C_{34}	50	9	**13,000**	**1**	**3**
TRH >C_{34}-C_{40}	50	6	1,700	0	0
TPH C_6-C_9	84	0	<PQL	-	-
TPH C_{10}-C_{36}	83	16	15,000	-	-
BTEX	84	0	<PQL	0	0
Total PAHs	103	56	**2,400**	**4**	-
Carcinogenic PAHs (BaP TEQ)	103	44	**220**	**15**	-
Benzo(a)pyrene	103	56	**160**	-	**21**
Naphthalene	103	20	**12**	**2**	0
Total Phenols	31	1	5	0	-
PCBs	80	0	<PQL	0	-
OCP	86	0	<PQL	0	-
OPP	61	1*	0.5	0	-

n *number of samples*

- *No criteria available/used*

NL *Non-limiting*

* *OPP detection was Chlorpyrifos*

In considering the data, the following comments are made:

- Elevated concentrations of the metals copper, lead and zinc were recorded in samples generally collected from fill material containing ash and slag. Lead concentrations exceeded the human health criteria in six samples of fill material and one sample of natural material. Metals concentrations (copper, zinc) exceeded the EILs in many samples, however as noted in Section 7.2 these were based on the most conservative criteria due to the absence of site specific soil data.

- Volatile hydrocarbons (naphthalene and F2) exceeded the criteria for vapour intrusion at four investigation locations across Lot 9 (ES7, ES8, BH80 and BH510). It is noted that the naphthalene detection in BH80 is at a depth where the HSL is non-limiting (3-3.45 mbgl). A basement is not proposed as part of the redevelopment, therefore the naphthalene detection in BH80 is unlikely to present a risk to future site occupants. Other detections are a depths where the HSL applies, and therefore require remediation or further consideration.
- The sample of ash fill material collected from ES7 (1.5-1.6 mbgl) also contained concentrations of TRH >C_{16}-C_{34} exceeded the ML (3,500 mg/kg) and ESL (1,700 mg/kg). Concentrations in ES8 at 0.06 mbgl (2,000 mg/kg) and 1 mbgl (2,400 mg/kg) exceeded the ESL in samples of roadbase and sand fill material.
- Analyses of samples collected by JET, CMPS&F, HLA and Douglas Partners was undertaken prior to the revision of NEPM. Samples were therefore analysed for TPH (rather than TRH) and had different reporting bands for carbon. Comparison of the analytical results with the adopted criteria is therefore difficult, and some samples may have exceeded the ML and ESL. Thirty four historical samples were analysed and reported under the old TPH bands. It is also noted that TPH results from the JET (1993) investigation have not been included in the summary table or discussion of results.
- Total PAHs and carcinogenic PAHs exceeded the HIL A primarily in samples of fill material containing ash and slag. Not every sample containing ash and slag had elevated PAH concentrations.
- Asbestos as loose fibre bundles was detected in one sample (ES10 at 2 m) of fill material containing rubble and brick. Due to the investigation methods adopted, asbestos is likely to be present at a greater density than indicated by the analytical results. Bulk sampling by test pitting would be required to adequately quantify the amount of asbestos in the fill.
- The OPP detected was Chlorpyrifos (0.5 mg/kg) in a sample collected by HLA from HLA_74 from 0.9-1 mbgl. The sample was collected from natural clay in the north of the site. The detected concentration was less than the HSL A (160 mg/kg).

8.3 Lot 12

Lot 12 analytical results are summarized in Table 8.3. Figures attached to the RAP indicate that the development will comprise a seven storey commercial office building with ground floor level retail including a supermarket. Two levels of car parking will be cut into the existing site, resulting in the base being level with Central Avenue and two levels deep at Locomotive Street. The results were therefore compared against the criteria for commercial/industrial land use.

Investigation locations undertaken in Lot 12 are shown in Attachment 6 in Appendix A.

Table 8.3: Evaluation of Lot 12 Soil Analytical Results – Summary Table (mg/kg)

Analyte	n	Detections	Maximum	n > Human Health Screening Criteria (NEPM, 2013)	n > Terrestrial Ecological Screening Criteria (NEPM, 2013)
Asbestos	97	**2**	**detect**	-	-
Arsenic	340	240	**625**	0	**3**
Cadmium	340	57	8	0	-
Total Chromium	340	328	140	0	0
Copper	340	332	**27,000**	0	**146**
Lead	340	336	**15,000**	**14**	**12**

Table 8.3: Evaluation of Lot 12 Soil Analytical Results – Summary Table (mg/kg)					
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**	**n > Terrestrial Ecological Screening Criteria (NEPM, 2013)**
Mercury (inorganic)	305	117	17	0	-
Nickel	305	246	**1,200**	0	**8**
Zinc	340	328	**4,550**	0	**112**
Cyanide	18	0	<PQL	0	-
TRH C_6-C_{10} – BTEX (F1)	121	0	<PQL	0	0
TRH >C_{10}-C_{16} – naphthalene (F2)	121	3	**400**	NL	**2**
TRH >C_{16}-C_{34}	121	23	**4,800**	**2**	**2**
TRH >C_{34}-C_{40}	121	11	1,400	0	0
TPH C_6-C_9	115	0	<PQL	-	-
TPH C_{10}-C_{36}	115	21	5,030	-	-
BTEX	200	0	<PQL	0	0
Total PAHs	236	116	564	0	-
Carcinogenic PAHs (BaP TEQ)	236	104	**52**	**1**	-
Benzo(a)pyrene	236	102	**36**	-	**20**
Naphthalene	227	33	3.3	NL	0
Total Phenols	47	0	<PQL	0	-
PCBs	125	0	<PQL	0	-
OCP	124	1*	2.3	0	-
OPP	76	0	<PQL	-	-
VOCs	20	0	<PQL	0	-

n *number of samples*

- *No criteria available/used*

NL *Non-limiting*

* *OCP detection was aldrin and dieldrin*

The soil analytical results are summarised as follows:

- Elevated metals concentrations were recorded in samples generally collected from fill material containing ash and slag. Lead concentrations exceeded the human health criteria in fourteen samples of fill material, with no exceedances in natural soils. Metals concentrations exceeded the EILs in many samples, however as noted in Section 7.2 these were based on the most conservative criteria due to the absence of site specific soil data.
- TRH >C_{16}-C_{34} exceeded the ML (3,500 mg/kg) and ESL (1,700 mg/kg) in ES4 at 0.35 mbgl, located in the bottom car park. The sample was collected from fill material comprising black

sand with gravel, building rubble and metal. Other samples collected by ES and GETEX typically had concentrations less than the PQL.

- TRH >C_{10}-C_{16} exceeded the ESL (170 mg/kg) in ES5 at 3 mbgl. The sample was collected from natural clay material, with ES noting a strong hydrocarbon odour. BTEX and PAH concentrations were less than the PQL in the sample. It is noted that ESLs apply to the top 2 m of material.
- Analyses of samples collected by JET, CMPS&F, HLA and Douglas Partners was undertaken prior to the revision of NEPM. Samples were therefore analysed for TPH (rather than TRH) and had different reporting bands for carbon. Comparison of the analytical results with the adopted criteria is therefore difficult, and some samples may have exceeded the ML and ESL. 115 historical samples were analysed and reported under the old TPH bands. It is also noted that TPH results from the JET (1993) investigation have not been included in the summary table or discussion of results.
- The majority of the analyses was undertaken by JET, CMPS&F, HLA and Douglas, prior to the revision of NEPM. Samples were therefore analysed for TPH (rather than TRH) and had different reporting bands for carbon. Comparison of the analytical results with the adopted criteria is therefore difficult, and some samples may have exceeded the ML and ESL
- Carcinogenic PAHs exceeded the HIL D (40 mg/kg) in DP625 at 0.9 to 1 mbgl, located in the bottom car park. The sample also contained the highest benzo(a)pyrene concentration. The borehole log indicates that the sample was collected from fill material comprising silty sand with ash and slag. Elevated carcinogenic PAH concentrations were typically identified in samples of fill material containing ash and slag, however not every sample containing ash and slag had elevated PAH concentrations.
- Benzo(a)pyrene exceeded the ESL (1.4 mg/kg) in twenty samples of fill material, which typically contained ash and slag. It is noted that two of the samples containing exceedances were collected from below 2 mbgl, which is below the depth at which ESLs apply.
- Asbestos was detected in two samples of fill material from ES4A at 0.35 m and ES2 at 3 m. ES identify former structures or fill material as potential sources. Due to the investigation methods adopted, asbestos is likely to be present at a greater density than indicated by the analytical results. Bulk sampling by test pitting would be required to adequately characterise the site for asbestos.
- The OCPs detected were aldrin (0.9 mg/kg) and dieldrin (1.4 mg/kg) in a sample collected by Douglas Partners from DP604 from 0.1-0.2 mbgl. The sample was collected from below asphalt. The detected concentrations were less than the HSL D for aldrin and dieldrin (45 mg/kg).

JBS&G (2016b) undertook leachability analysis of fill material collected from sixteen locations on Lot 12 (Attachment 6, Appendix A). Samples from BH11 and BH14 were not analysed. The sampling density was considered by JBS&G to be approximately 1 sample per 1,000 m^3 of fill material.

Samples of fill material were subject to the Australian Standard Leaching Procedure (ASLP), in accordance with AS 4439, followed by analysis for metals and PAHs, with limited analysis for TRH.

Six composited samples, each comprising material from 4 to 5 sample locations, were subject to leaching in a column apparatus in accordance with ASTM D4874-95. The process was considered to be more representative of the proposed excavation, stockpiling and homogenisation process to be undertaken on Lot 12. Leachate samples representative of 1, 2, 4 and 8 void volumes were collected and analysed for metals, with limited analysis for TRH and PAHs.

The results of the leaching procedures are presented in Table 8.4.

Table 8.4: Evaluation of Lot 12 Leaching Procedure Analytical Results – Summary Table (mg/L)							
Analyte	**GILs**	**ASLP**			**Column Leach**		
		n	**Detections**	**Maximum**	**n**	**Detections**	**Maximum**
Arsenic	0.0023	36	23	**0.098**	30	23	**0.008**
Cadmium	0.0007	36	0	<PQL	30	3	0.0002
Total Chromium	0.27	36	7	0.008	30	9	0.004
Copper	0.0013	36	28	**0.059**	30	30	**0.016**
Lead	0.0044	36	25	**0.05**	30	12	**0.022**
Mercury (inorganic)	0.0001	36	4	0.0001	30	2	0.0001
Nickel	0.007	36	2	0.001	30	7	0.005
Zinc	0.015	36	20	**0.025**	30	21	**0.093**
TRH $>C_{10}$-C_{16}	-	4	0	<PQL	6	0	<PQL
TRH $>C_{16}$-C_{34}	-	4	1	0.9	6	1	0.2
TRH $>C_{34}$-C_{40}	-	4	0	<PQL	6	0	<PQL
Naphthalene	0.05	36	10	0.007	6	0	<PQL
Anthracene	0.00001	36	1	**0.004**	6	0	<PQL
Phenanthrene	0.0006	36	6	**0.004**	6	0	<PQL
Fluoranthene	0.001	36	0	<PQL	6	0	<PQL
Benzo(a)pyrene	0.0001	36	0	<PQL	6	0	<PQL
Total PAHs	-	36	12	0.016	6	0	<PQL

GILs *ANZECC (2000), as referenced in Section 7*

- *No criteria available/used*

n *Number of samples analysed*

Bold *Concentration exceeds the GIL*

In reviewing the results, the Auditor notes that metals and PAHs are leachable from fill material.

Concentrations of arsenic, copper, lead and zinc exceeded the GILs in ASLP and column leach samples. The frequency of GIL exceedances included:

- Arsenic concentrations exceeded the GILs in approximately a third of ASLP and column leach samples.
- Copper concentrations exceeded the GILs in approximately three quarters of ASLP samples and all column leach samples.
- Lead concentrations exceeded the GILs in approximately a third of ASLP and column leach samples.
- Zinc concentrations exceeded the GILs in three ASLP and three column leach samples.

PAHs were detected in ASLP samples from seven of the sixteen boreholes, with naphthalene and phenanthrene the two most common PAHs detected. No PAHs were detected in column leach samples.

Concentrations of PAHs in ASLP samples exceeded the GILs in two samples of fill material: BH18 at 2-3 mbgl and BH12 at 0-1 mbgl. The logs indicate the samples represented fill material

containing slag and charcoal. It is however noted that slag and charcoal were observed in all of the boreholes, including locations where PAHs were less than the PQL.

TRH analysis was undertaken at a low frequency and reported concentrations that were less than the PQL or not significantly elevated.

Redevelopment of the site proposes reusing fill material below the water table on Lot 12. The ecological risk posed by leaching of contaminants from fill material was assessed by JBS&G (2016c) and is reviewed by the Auditor in Section 11.

8.4 Open Space and Roads

Analytical results for areas of open space and roads are summarized in Table 8.5 and 8.6, respectively. It is understood that a change in land use is not proposed for these areas, however some redevelopment may be undertaken. The results were therefore compared against criteria appropriate for the land use, i.e. 'commercial/industrial' for roads and 'recreational' for open space.

Investigation locations undertaken in these areas are shown in Attachment 7 in Appendix A.

Table 8.5: Evaluation of Soil Analytical Results – Open Space Summary Table (mg/kg)

Analyte	n	Detections	Maximum	n > Human Health Screening Criteria (NEPM, 2013)	n > Terrestrial Ecological Screening Criteria (NEPM, 2013)
Asbestos	22	0	<PQL	-	-
Arsenic	126	49	48	0	0
Cadmium	126	9	3.6	0	-
Total Chromium	126	112	**250**	0	**1**
Copper	126	116	**5,210**	0	**21**
Lead	121	111	**5,500**	**8**	**4**
Mercury (inorganic)	37	9	0.6	0	-
Nickel	37	33	**140**	0	**2**
Zinc	126	119	**4,200**	0	**34**
TRH	0	-	<PQL	0	0
TPH C_6-C_9	95	16	4.9	-	-
TPH C_{10}-C_{36}	95	57	9,401	-	-
BTEX	38	0	<PQL	0	0
Total PAHs	39	20	221.3	0	-
Carcinogenic PAHs (BaP TEQ)	39	19	**29.6**	**2**	-
Benzo(a)pyrene	39	19	**18.8**	-	**6**
Naphthalene	31	4	0.5	NL	0
Total Phenols	12	0	<PQL	0	-
PCBs	14	0	<PQL	0	-
OCP	12	0	<PQL	0	-

Table 8.5: Evaluation of Soil Analytical Results – Open Space Summary Table (mg/kg)					
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**	**n > Terrestrial Ecological Screening Criteria (NEPM, 2013)**
OPP	3	0	<PQL	-	-
VOC	0	-	-	-	-

n *number of samples*
- *No criteria available/used*
NL *Non-limiting*

Table 8.6: Evaluation of Soil Analytical Results – Roads Summary Table (mg/kg)					
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**	**n > Terrestrial Ecological Screening Criteria (NEPM, 2013)**
Asbestos	9	0	<PQL	-	-
Arsenic	143	72	64	0	0
Cadmium	143	20	21	0	-
Total Chromium	142	138	57	0	0
Copper	143	142	**8,650**	0	**66**
Lead	138	138	**6,500**	**4**	**7**
Mercury (inorganic)	50	20	0.99	0	-
Nickel	50	43	**140**	0	**13**
Zinc	131	131	**2,950**	0	**57**
TRH C_6-C_{10} – BTEX (F1)	11	0	<PQL	0	0
TRH >C_{10}-C_{16} – naphthalene (F2)	11	0	<PQL	NL	0
TRH >C_{16}-C_{34}	11	0	<PQL	0	0
TRH >C_{34}-C_{40}	11	0	<PQL	0	0
TPH C_6-C_9	113	39	1,506	-	-
TPH C_{10}-C_{36}	106	82	22,980	-	-
Benzene	44	0	<PQL	0	0
Toluene	44	0	<PQL	0	0
Ethylbenzene	44	1	1	0	0
Total Xylenes	44	1	2	0	0
Total PAHs	57	28	259	0	-
Carcinogenic PAHs (BaP TEQ)	52	27	23.2	0	-

Table 8.6: Evaluation of Soil Analytical Results – Roads Summary Table (mg/kg)					
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**	**n > Terrestrial Ecological Screening Criteria (NEPM, 2013)**
Benzo(a)pyrene	54	22	**15.4**	-	**13**
Naphthalene	29	9	20.2	NL	0
Total Phenols	21	0	<PQL	0	-
PCBs	18	0	<PQL	0	-
OCP	15	2*	2.2	0	-
OPP	2	0	<PQL	-	-
VOC	9	0	<PQL	-	-

n *number of samples*

- *No criteria available/used*

NL *Non-limiting*

* *OCP detection was DDT+DDE+DDD*

The soil analytical results are summarised as follows:

- The majority of the analyses was undertaken by JET, CMPS&F, HLA and Douglas, prior to the revision of NEPM. Samples were therefore analysed for TPH (rather than TRH) and had different reporting bands for carbon. Comparison of the analytical results with the adopted criteria is therefore difficult, and some samples may have exceeded the ML and ESL.
- TPH C_6-C_9 detections were in samples collected by JET in 1993, who reported a PQL of 0 mg/kg (versus 25 mg/kg currently). Detections were less than the current PQL, with the exception of ERBH47 at 0.5-1 mbgl which had a concentration of 1,506 mg/kg. The borehole log for ERBH47 noted ash and slag fill material with a slightly oily odour and low PID reading (0 ppm) at approximately 0.5-1 mbgl. The sample was not analysed for BTEX, PAHs or VOCs. A deeper sample was not analysed. The sample was collected from beneath the road pavement of Locomotive Street (near the south eastern corner of the Locomotive Workshop). Adjacent investigation locations (GETEX_S2 and MW3) did not analyse samples from the 0.5-1 m interval, however no odours or staining were reported on the borehole logs.
- Elevated TPH C_{10}-C_{36} concentrations were reported in boreholes excavated in the northeast of the ATP (Area 1) and along Locomotive Street (Area 2). Review of borehole logs indicated that samples collected from early investigations undertaken by JET, CMPS&F and Douglas were from the water table (BH48, BH60 and DP602) or from fill material (BH45, BH69, TP99 and DP319) containing a hydrocarbon odour. TPH C_{10}-C_{36} concentrations from later investigations by ES, BTEX and HLA were generally low or less than the PQL.
- Elevated concentrations of the metals copper, lead and zinc were recorded in samples generally collected from fill material containing ash and slag in Area 1, 2, 5 and 7. Concentrations of lead exceeded the open space (HSL C) and commercial/industrial (HSL D) criteria in eight and four samples, respectively. The exceedances represent approximately 5% of fill samples collected from the site.
- Metals concentrations (copper, zinc) exceeded the EILs in many samples, however as noted in Section 7 these were based on the most conservative criteria due to the absence of site specific soil data.
- Carcinogenic PAHs exceeded HIL C (3 mg/kg) in samples of fill material from one location in Area 1 (ES BHN) and two locations in Area 5 (BH18D and HLA 97). Concentrations did not exceed HIL D (40 mg/kg). Elevated carcinogenic PAH concentrations were typically identified

in samples of fill material containing ash and slag, however not every sample containing ash and slag had elevated PAH concentrations.

- Benzo(a)pyrene exceeded the ESL (1.4 mg/kg) in nineteen samples of fill material, which typically contained ash and slag. It is noted that three of the samples containing exceedances were collected from below 2 mbgl, which is below the depth at which ESLs apply.
- Asbestos was not identified on the site, however has been identified elsewhere on the ATP. The investigation methods adopted (mostly augers) limits the ability to identify asbestos in fill material.
- The OCP detected was DDT+DDD+DDE (0.18 and 2.2 mg/kg) in samples collected by JET in Area 1. The area is currently sealed with concrete and brick paving. The detected concentrations were less than HSL C (400 mg/kg).

8.5 Auditor's Opinion

While there may be inconsistencies between the various investigations, they have identified mixed fill material comprising sand, silt and clay with some gravel, crushed sandstone and concrete. Ash, slag and charcoal were identified in approximately half of the investigation locations. The Auditor also notes that the sampling methods adopted typically do not allow detailed observations of the stratigraphy. Anthropogenic material and asbestos may therefore be more prevalent than indicated by the logs.

Elevated metal, TRH/TPH and PAH concentrations were typically associated with the fill material containing ash and slag. Asbestos has not been identified visually in fill material, however was detected in several samples analysed by the laboratory. Volatile contaminants (naphthalene and F2) were detected in a limited number of samples at the site. Other volatile contaminants (BTEX and VOCs) were not detected. No clear distribution of contaminants within the fill has been identified.

Some data gaps are present, including open space areas of the site where the sampling density is low. No soil investigation has been undertaken in the Locomotive Workshop, however this area is not included in the area to be remediated or redeveloped.

9. EVALUATION OF SOIL VAPOUR RESULTS

JBS&G installed thirty three (SV1-SV27 and SV31-36) soil vapour sample points beneath the slab of the Locomotive Workshop to assess volatile chlorinated compounds (Attachment 8, Appendix A). No soil vapour wells were installed outside of the building footprint.

The soil vapour probes were sampled in May 2016 and results of probes that contained concentrations above the PQL are summarised in Table 9.1.

Table 9.1: Soil Vapour Results (µg/m³)

	TCE	PCE	1,1,1-TCA	Benzene	Toluene	Ethyl benzene	Xylene
HSL D Sand 0-<1 m (NEPM, 2013)	-	-	-	*4*	*4800*	*1300*	*840*
Soil Vapour HIL D (NEPM, 2013)	*0.08*	*8*	*230*	-	-	-	-
Intrusive Worker Sand 0-2m CRC Care (2011)	-	-	-	*760*	*NL*	*NL*	*NL*
SV3	**0.183**	0.33	<PQL	<PQL	<PQL	<PQL	<PQL
SV7	**0.5**	0.77	1.1	<PQL	<PQL	<PQL	<PQL
SV10	<PQL	<PQL	<PQL	<PQL	0.37	0.82	5.67
SV17	**10.67**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SV24	<PQL	<PQL	<PQL	<PQL	0.25	<PQL	0.43
SV26	**0.25**	0.92	<PQL	<PQL	<PQL	<PQL	<PQL
SV32	**0.23**	0.43	<PQL	<PQL	<PQL	<PQL	<PQL
SV34	**6.17**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SV35	**2.33**	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
SV36	**0.57**	3.17	<PQL	<PQL	<PQL	<PQL	<PQL

- No criteria available or adopted
NL Non limiting
Bold Concentration exceeds the adopted criteria
<PQL less than the practical quantitation limit

In assessing the analytical results, the Auditor makes the following observations:

- Concentrations of TCE exceeded the HSL D criteria in sub-slab sample points located in two areas of the Locomotive Workshop, one in the west of the building (SV3 and SV7) and in the east of the building (SV17, SV26, SV32, SV34, SV35 and SV36).
- The USEPA RSL for industrial air are 0.003 mg/m^3 for TCE and 0.047 mg/m^3 for PCE. Assuming an attenuation factor of 0.1 (NEPM, 2013), the reported TCE and PCE soil vapour concentrations present a potential vapour intrusion risk to occupants of the Locomotive Workshop. JBS&G (2016a) report that the results of previous ambient air sampling *"…were all below the adopted assessment criteria"*. The ambient air results were not provided to the Auditor.
- Concentrations of 1,2-dichloroethene and vinyl chloride, breakdown products of TCE and PCE, were not reported at concentrations above the detection limit in soil vapour.

- Elevated petroleum hydrocarbon concentrations were reported in SV10, located in the north western corner of the building, and in SV24, located in east of the building. The reported concentrations were less than the adopted human health criteria for vapour inhalation.
- Other wells sampled (SV1, SV2, SV4, SV5, SV6, SV8, SV9, SV11-SV16, SV18-SV23, SV25, SV27, SV31 and SV33) had no detections.

JBS&G (2016e) concluded that *"…on the basis that ambient air quality sampling results were reported below the adopted assessment criteria, no current risk from sub-slab vapour conditions has been reported"* and *"…ongoing ambient air monitoring is required to demonstrate ongoing commercial land use suitability"*.

9.1 Auditor's Opinion

Ambient air quality sampling results within the Locomotive Workshop were not provided to the Auditor. The current risk to occupants of the Locomotive Workshop therefore cannot be assessed.

Based on the data summarised in the table above, the Auditor agrees with the JBS&G conclusion that ongoing ambient air monitoring within the Locomotive Workshop is required to assess the potential for vapour intrusion.

Developable Lot 12 is located approximately 25 m down gradient of soil vapour detections within the Locomotive Workshop. The Auditor considers that investigation of the potential for vapour intrusion risks to the future occupants of the Lot 12 building is required. Further investigation of chlorinated hydrocarbons on Lot 12 is proposed in the RAP and discussed in Section 12 of the SAR.

The Locomotive Workshop is not currently proposed for redevelopment. The potential for vapour intrusion would need to be considered in the event of any proposed development or reconfiguration.

10. EVALUATION OF GROUNDWATER ANALYTICAL RESULTS

A number of groundwater monitoring events have been undertaken at the site since 1993. ES report that 82 monitoring wells were installed on the site between 1993 and 2014, however only 14 remained during the groundwater monitoring round in January 2014. Five additional wells were installed by ES in March 2014 and sampled in April 2014.

Groundwater samples were collected from the 19 monitoring wells (DP103, DP104, DP107, DP328, DP402, DP403, DP405, DP504, DP507, DP508, DP511, DP619, DP625, ES1, ES3, ES14, ES15, ES16 and AH1) (Attachment 4, Appendix A) by ES in 2014. The analytical results are summarised below in Table 10.1.

Table 10.1: Evaluation of Groundwater Analytical Results – Summary Table (µg/L)

Analyte	n	Detections	Maximum	n > GILs NEPM (2013)	n > HSL D sand, 2-<4 m NEPM (2013)
Arsenic	19	10	4	**3**	-
Cadmium	19	2	0.2	0	-
Total Chromium	19	2	1	0	-
Copper	19	6	10	**3**	-
Lead	19	1	1	0	-
Mercury	19	2	0.05	0	-
Nickel	19	7	11	**1**	-
Zinc	19	18	690	**8**	-
TPH (C_6-C_9)	19	0	<PQL	-	0
TPH (C_{10}-C_{36})	19	0	<PQL	-	NL
BTEX	19	0	<PQL	0	0
Naphthalene	19	1	2	0	NL
PAH	19	1*	2	0	-
OCP	19	0	<PQL	0	-
OPP	19	0	<PQL	0	-
PCB	19	0	<PQL	0	-
VOC	19	0	<PQL	0	-

n Number of samples
PQL Practical quantitation limit
NL Non-limiting
- No criteria available/adopted
* PAH detection was acenaphthalene

The groundwater monitoring results are summarised as follows:

- Concentrations of some metals (copper, nickel and zinc) were above the ecological criteria for marine waters. The concentrations were generally not significantly elevated, with the exception of zinc in DP508 (690 µg/L) located in the middle of Lot 9. Other wells had concentrations between <PQL and 90 µg/L (criteria 15 µg/L). Monitoring well ES15, located

approximately 25 m downgradient of DP508, had a zinc concentration of 25 µg/L. Well DP508 is screened in sand, with fill containing ash, charcoal, concrete and brick overlying.

- No volatile contaminants were detected.
- Concentrations of other contaminants were less than the PQL.

Historical groundwater monitoring results tabulated by ES (2014b) are summarised as follows:

- Elevated zinc concentrations in DP508 were identified at concentrations of up to 1,600 µg/L in seven of eight monitoring rounds. A historical well (DP322), which was located approximately 40 m to the northeast of DP508, also contained elevated zinc concentrations (up to 990 µg/L) in monitoring undertaken in 2005 and 2007. ES report that wells were historically sampled by bailer, which may have contributed to the elevated zinc concentrations. Monitoring rounds undertaken since July 2012 have used low flow sampling techniques.
- Zinc concentrations in other wells on Lot 9, as well as those on Lot 8 and 12, exceeded the ecological criteria for marine waters, however were not significantly elevated.
- Historical results are generally consistent with the recent results, with copper, nickel and zinc exceeding the GIL in a number of wells across the whole site.
- There were occasional low detections of TPH C_{10}-C_{36} (up to 730 µg/L) and PAHs (mostly naphthalene and acenaphthene). While a detailed review has not been conducted, these and notes of odours in borelogs appear to be mainly associated with wells within fill or clay.
- There was one detection of toluene (950 µg/L) and TPH C_6-C_9 (1,100 µg/L) in a historical well (DP149) located near the centre of Lot 12 during monitoring in May 2005. Follow-up groundwater monitoring results for DP149 were not provided. Wells located downgradient of DP149 have not identified elevated concentrations of petroleum hydrocarbons. Volatiles have rarely been detected historically. There have been no recordings of benzene in 122 individual samples analysed between 1993 and 2013.
- ES report that PSH was identified in groundwater monitoring well CMPS&F_MW3 to the north east of Lot 12 in 1994. PSH was also reported in 2008 during piling of the commercial building located to the north of Lot 9. PSH has not been identified on Lots 8, 9 or 12.

10.1 Auditor's Opinion

ES (2014b) investigated the groundwater conditions in 2014 and presented historical groundwater monitoring results from 1993 to 2013. The groundwater monitoring has not identified any current significant groundwater contamination on Lots 8, 9 or 12.

Metals concentrations exceeding the ecological criteria for marine waters are considered to be largely representative of background concentrations based on the results of wells on the up gradient boundary. The closest down gradient surface water receptor is approximately 1 km to the south of the site, and is therefore unlikely to be impacted by the metals identified in onsite wells.

Soil vapour monitoring has identified TCE and PCE contamination beneath the Locomotive Workshop. VOC contamination within groundwater has not been delineated. Investigation of VOCs will be required to assess potential risks to the proposed commercial development of Lot 12.

11. ASSESSMENT OF RISK

The site history indicates that there have been potential polluting industries on the site as detailed in Section 3. Investigation of subsurface conditions at the site identified conditions likely to be a result of the historical site use. Fill material was found to contain ash, slag and asbestos, with elevated concentrations of some metals, TPH and PAHs.

As the site contains a significant thickness of variable fill, there is a risk of encountering areas of soil with different characteristics to those encountered in the investigations. Asbestos could be encountered with anthropogenic material. Asbestos has also been detected by laboratory analysis of a sample of fill described as roadbase/crushed sandstone, without anthropogenic material being recorded. More asbestos may be present.

Development of the site may expose contaminated fill material. The most likely contaminants are asbestos, metals and relatively low toxicity long chain aliphatic hydrocarbons. JBS&G (2016e) prepared a RAP for the site based on the proposed development and have also assessed the human health and ecological risk associated with the contaminants as detailed below.

11.1 Human Health Risk Assessment

JBS&G (2016d) completed a Human Health Risk Assessment (HHRA) in June 2016, with the specific objective to determine:

- *"Whether risks posed by identified contamination are unacceptable with respect to the proposed future use of the site;*
- *What remediation and/or management measures are necessary in order to reduce risks to acceptable levels."*

11.2 Issue Identification and Data Assessment

11.2.1 Soil

Numerous soil investigations have been conducted on the site, with soil concentrations reported in the Detailed Site Assessment report (JBS&G, 2015) screened for identification of the chemicals of concern. The HHRA did not review concentrations presented in the 'Retention of Lot 12 Fill Materials – Factual Data Report' (JBS&G, 2016b). The Auditor has included the data in JBS&G 2016b when reviewing data for Lot 12.

The guidelines used to select COPC were identified based on the land use for each Lot and include:

- Health Based Investigation Levels (HIL). The screening for Lot 9 included HIL A to account for the possible inclusion of a childcare centre, the screening of Lot 8 and 12 included HIL D for commercial use, and the screening for Lots 10 and 4007 included HIL C to account for the recreational use of the area.
- Soil Health Screening Levels (HSL) for Vapour Intrusion. The most conservative criteria were adopted i.e. assumed depth to source <1 m and sand. The screening for Lot 9 included HSL A to account for the possible inclusion of a childcare centre, the screening of Lots 8 and 12 included HSL D for commercial use, and the screening for Lots 10 and 4007 included HSL C to account for the recreational use of the area.
- CRC CARE (2011) Direct Contact (HSL A, C & D and intrusive maintenance worker).
- USEPA regional screening levels (RSL) for commercial use (Lot 8 & 12) and residential use (Lot 9). It is noted that the RSL sourced for the HHRA are referenced 2015. A more recent version of the RSLs has been published (May 2016), however there were no changes to the RSL for the COPC.
- Asbestos Health Screening Levels were not used as there has been no asbestos quantification. A detection of asbestos was considered to be above the criteria.

Chemicals below the laboratory PQL were not included. This approach and screening criteria are considered reasonable, it is noted that JBS&G source the guidelines for naphthalene direct contact from USEPA RSL, the Auditor has used the HSL from CRC CARE (2011).

Screening of the soil analytical results against the adopted guidelines was undertaken in Section 8 of the SAR, including the following:

- Tables 8.1 and 8.3 summarises the maximum concentrations of chemicals of concern detected in soil from Lot 8 and 12 compared to the health based guidelines for commercial use (commercial/industrial criteria).
- Table 8.2 summarises the maximum concentration of chemicals of concern detected in soil from Lot 9 compared to the health based guidelines for childcare use (residential criteria).
- Table 8.5 summarises the maximum concentration of chemicals of concern detected in soil from part Lot 10 and part Lot 4007 compared to the health based guidelines for open space use (recreational criteria).
- Table 8.6 summarises the maximum concentration of chemicals of concern detected in soil from part Lot 4007 compared to the health based guidelines for roads and pedestrian walkways (commercial/industrial criteria).

JBS&G identify the soil COPC as asbestos, lead and B(a)P TEQ, and identify that management measures are warranted to control exposure to site soils.

The exceedance of sensitive residential criteria for TRH >C_{16}–C_{34} in data from Lots 8 & 9 and open space criteria in Lot 13 is not considered significant as TRH >C_{16}–C_{34} is non-volatile and the concentration is below the commercial industrial criteria of 27,000 mg/kg. The Auditor considers this assessment and conclusion reasonable.

The exceedances of vapour intrusion guidelines (HSL A) for naphthalene and TRH >C_{10}-C_{16} in Lot 9 were not considered significant by JBS&G for a variety of reasons. While the auditor does not agree with all the reasoning, preliminary vapour intrusion modelling by the Auditor into a childcare centre scenario on the ground floor of Lot 9 indicated acceptable levels of risk. The exceedance of criteria for naphthalene and TRH are therefore not considered to represent a risk to site users.

The exceedance of the HSL D for vapour intrusion TRH C_6-C_{10} from Lot 4007 is not specifically discussed in the JBS&G report. The Auditor does not consider the concentration significant as the detection was beneath Locomotive Street, and in accordance with NEPM (2013) the HSL D are not necessarily considered relevant for road verges and the HSL C for open space is non-limiting.

While it is not discussed by JBS&G the exceedance of the total PAH criteria is considered adequately addressed through the assessment of the individual PAHs and B(a)P TEQ.

The Auditor considers the selection of soil CoPC reasonable and agrees that management measures are necessary to control exposure to soil contaminants.

11.2.2 Soil Vapour

Soil vapour investigations have been completed for the Locomotive Workshop (Lot 4000), these are discussed in Section 9. The soil vapour sampling indicates that there are exceedances of the HSL D criteria for TCE. Concentrations of trimethylbenzenes in soil vapour are also identified above a modified RSL for industrial air. JBS&G conclude that the risks to site workers are acceptable based on indoor air sampling conducted in the Locomotive Workshop, however, ongoing vapour monitoring is recommended. The indoor air monitoring results were not provided to the Auditor for review. No further evaluation of the soil vapour is conducted in the HHRA.

The Auditor agrees with the JBS&G conclusion that ongoing ambient air monitoring within the Locomotive Workshop is required to assess the potential for vapour intrusion.

In addition, developable Lot 12 is located approximately 25 m down gradient of soil vapour detections within the Locomotive Workshop. The Auditor considers that investigation of the potential for vapour intrusion risks to the future occupants of the Lot 12 building is required.

11.2.3 Groundwater

The groundwater concentrations reported in the Detailed Site Assessment (JBS&G, 2015) were screened for identification of the chemicals of concern against the ADWGs and World Health Organisation (WHO 2005) Petroleum products in drinking water guidelines (PDWG). For chemicals for which there is no Australian or WHO DWG, the USEPA RSLs for tap water were adopted. The NEPM HSL A for vapour intrusion was also used to assess the TPH F1 fraction.

Chemicals below the PQL were not included. This approach and screening criteria are considered reasonable.

Table 11.1 summarises the maximum concentration of chemicals of concern detected in groundwater from all monitoring rounds undertaken at the site.

Table 11.1: Maximum Groundwater Concentrations Compared to Adopted Guidelines (mg/L)

Chemical of Concern in Groundwater	Maximum Concentration	Adopted Guidelines
Arsenic	0.007	0.01[1]
Cadmium	0.001	0.002[1]
Total Chromium	0.001	0.002[1]
Copper	0.01	2[1]
Lead	0.001	0.01[1]
Mercury	0.00005	0.001[1]
Nickel	0.012	0.02[1]
Zinc	**0.69**	0.6[3]
TRH >C_{10}–C_{16}	0.15	1[2]
Acenaphthalene	0.002	0.53[1]

1. ADWG (2011) / NEPM (2013)
2. NEPM (2013)
3. USEPA RSL Tap Water

0.041 – value exceeds drinking water guideline

The Auditor notes that the maximum concentrations of zinc exceeds the screening criteria. JBS&G did not select the chemical as a COPC due to:

- The concentration was just above the drinking water guideline.
- The chemical was not considered volatile and there was no direct contact pathways identified.

JBS&G considered that groundwater use for purposes other than monitoring should be precluded. No groundwater COPC are therefore identified and groundwater is not considered any further in the risk assessment.

The Auditor considers this assessment and conclusion reasonable.

11.3 Exposure Assessment

The exposure assessment involves the determination of the receptor populations who may be exposed to the identified chemicals of concern during normal activities and the pathway by which they are exposed.

Based on the screening level assessment undertaken and the proposed uses of the site, the following receptors and exposure pathways were considered complete and to warrant further assessment in the HHRA.

Exposure Populations and Identified Complete Exposure Pathways

JBS&G identified the following receptor populations and receptor pathways:

- Soil vapour contamination leading to site user or subsurface maintenance worker exposure via vapour inhalation;
- Construction workers being exposed to contaminated soils via direct contact (i.e. incidental ingestion and dermal contact) and particulate inhalation; and
- Subsurface maintenance workers being exposed to contaminated soils via direct contact (i.e. incidental ingestion and dermal contact) and particulate inhalation.

Following screening of the soil, groundwater and soil vapour data, no evaluation of the vapour inhalation pathway was assessed by JBS&G, however the need for ongoing vapour and indoor air monitoring in the Locomotive Workshop was identified. Investigation of the potential for vapour intrusion by chlorinated hydrocarbons on Lot 12 (down gradient of the Locomotive Workshop) is also proposed in the RAP. The Auditor agrees with the need for further monitoring.

Exposure Assumptions

The exposure parameters adopted by JBS&G to evaluate the direct contact pathways for construction workers and maintenance workers, as well as the Auditor's comments, are outlined in Table 11.2.

Table 11.2: Significant Exposure Parameters Used by JBS&G and Auditor's Comments

Parameter	Construction Worker	Maintenance Worker	Auditor Comments
Exposure Duration (yrs)	1	10	Construction worker: Acceptable. Maintenance Worker: Low NEPM (2013) recommends 30
Exposure Frequency (days/yr)	288	15	Construction worker: Acceptable based on 6 days a week for 1 year minus 4 weeks holiday. Maintenance Worker: Low NEPM (2013) recommends 20
Time of outdoor exposure	8	8	Construction worker: Acceptable Consistent with NEPM (2013) Maintenance worker: Acceptable Consistent with NEPM (2013)
Body Weight	70	70	Construction worker: Acceptable Consistent with NEPM (2013) Maintenance worker: Acceptable Consistent with NEPM (2013)
Averaging time - Non threshold	70	70	Construction worker: Acceptable Consistent with NEPM (2013) Maintenance worker: Acceptable Consistent with NEPM (2013)
Averaging time -	1	10	Construction worker: Acceptable Consistent with NEPM (2013)

Table 11.2: Significant Exposure Parameters Used by JBS&G and Auditor's Comments			
Parameter	**Construction Worker**	**Maintenance Worker**	**Auditor Comments**
threshold			Maintenance worker: Low should be consistent with exposure duration of 30
Ingestion Rate (mg/day)	330		Acceptable Consistent with NEPM (2013)
Soil Adherence – Dermal (mg/soil/cm^2 skin)	0.5		Acceptable Consistent with NEPM (2013)
Inhalation rate (m^3/hr)	2.1		Acceptable Consistent with NEPM (2013)
Lung retention factor (-)	0.378		Acceptable Consistent with NEPM (2013)
Particulate emission factor (m^3/kg)	$4.4 \times 10^{+8}$		Acceptable Consistent with NEPM (2013)
Exposed Skin Area (cm^2)	6,300		Acceptable, likely to be higher than actual exposure consistent with head, feet, legs, arm and hand exposure for an adult from enHealth (2012)

Note: assessment limited by the assumptions identified in this table

11.4 Toxicological Information

A detailed toxicity section is provided that discusses the toxicity of lead, B(a)P and asbestos. However, the lead discussion does not discuss or address the NEPC 2015 *Guidance Note – Lead (Supplementary Information to Schedule B7 Section 5.4).* The guidance note identifies that the toxicity reference values for lead have been withdrawn by the WHO and other relevant agencies. As such the adult blood lead model is identified as the relevant model to address commercial industrial exposure to lead. The blood lead model has not been used to evaluate the exposures to lead, as such the evaluation of lead is not consistent with NEPC.

In addition the assessment of asbestos and the derivation of an asbestos criteria is not considered relevant as exposure to asbestos should be controlled through management measures associated with occupational exposure.

A summary of the toxicity values and Auditor comments are presented in Table 11.3.

Table 11.3: Toxicity Criteria Adopted by JBS&G and Auditor comments						
Chemical of concern	**Inhalation Toxicity Criteria for particulate exposure**		**Oral/Dermal Toxicity Criteria**			**Auditor Comment**
	Unit Risk $(mg/m^3)^{-1}$	TC/RfC (ug/m3)	Slope Factor (mg/kg/day)-1	Oral Bioavailability /Dermal absorption	Oral RfD	
B(a)P	$6.7x10^{-2}$	NA	0.035	1 / 0.06	NA	Acceptable
Lead	NA	0.12	NA	0.5/ negligible	0.035	Not acceptable as toxicity value has been withdrawn and Adult blood lead level modelling should be undertaken. It is noted the previous RfD was 0.0035 not 0.035
Asbestos	0.2(f/mL)	NA	NA	NA		Assessment of asbestos not considered relevant as exposure to asbestos should be controlled through management measures.

The overall assessment of asbestos and lead is not considered applicable and the Auditor has not reviewed the assessment of these COPC any further.

11.4.1 Background

The exposure to background is not considered for B(a)P as it is assessed on the basis of non-threshold effects. This is considered acceptable

11.5 Acceptable Levels of Risk

The HHRA states:

- *"An acceptable level of risk is defined as a risk less than 1 x 10^{-5} incremental lifetime risk of cancer."*

The Auditor considers that the acceptable level of risk is reasonable and consistent with NEPM (2013).

11.6 Risk Characterisation

The risk calculations provided by JBS&G indicate the incremental lifetime risk of cancer from B(a)P to site maintenance workers and construction workers were below the adopted risk based levels.

The Auditor considered that although the assumptions and inputs used in the exposure scenario were not necessarily conservative, the risk from B(a)P to site maintenance workers and construction workers were below the adopted risk based levels when conservative parameters were adopted for the exposure assessment.

11.7 Overall Assessment and Conclusions

The Auditor agrees with the following conclusions by JBS&G:

- The risk to site users from contaminates in groundwater is currently acceptable however groundwater use for purposes other than monitoring should be precluded.
- Soil vapour concentrations in the Locomotive Workshop currently exceed screening criteria and the vapour intrusion risk should be continued to be evaluated through sub surface and indoor air vapour monitoring.

In addition, as identified in the RAP the Auditor considers that investigation of the potential for vapour intrusion risks to the future occupants of the Lot 12 building is required.

The Auditor agrees that risks to site users associated with direct contact exposures (i.e. incidental ingestion, dermal contact, dust inhalation) to contaminated soils can be managed through the establishment and maintenance of physical barriers and management controls through an EMP. The Auditor considers that management controls should also be extended to prevent direct contact with site soils for intrusive workers as the risk from lead in soil had not been adequately assessed and characterized. The Auditor notes that the RAP also specifies that backfill around new services will *"…be environmentally suitable material for human and/or ecological exposure"*.

11.8 Ecological Risk Assessment

JBS&G (2016c) completed an Ecological Risk Assessment (ERA) in June 2016, with the specific objective to:

- "*determine the ecological suitability of levels of a range of environmental constituents identified as being present in soils and groundwater across the site consistent with the potential range of ecological exposures potentially on the site; and*
- *To establish a process / remedial framework for the re-use of site soils during site development activities to facilitate meeting the project's ecologically sustainable development objectives.*"

The ERA is comprised of a screening level assessment of soil and groundwater data against ecological criteria, and an assessment of the ecological impact of the reuse of fill on site. In particular the ERA assessed the potential for fill currently located above the water table to be placed in deep excavations below the existing groundwater level.

The screening assessment identified several soil exceedances of ecological screening levels and concluded that:

- *"(Imported) growing media are used in accessible areas of the site where potential plantings are proposed to occur;*
- *"A minimum depth of 0.5 m of growing media should be adopted in areas of grasses / shrubs, or depths of 0.1 m in areas already subject to management by the existing Environmental Management Plan;*
- *"A minimum depth of 1.5 m, not exceeding 2 m, is appropriate for areas of the site where larger trees are proposed to be planted;*
- *"Growing media should have levels of constituents consistent with ecological protection criteria for 'urban residential and public open space' as provided to NEPC (2013), and levels of aldrin, dieldrin and polychlorinated biphenyls (PCBs) below laboratory detection limits;*
- *"Fill materials on site are not suitable to be used as growing media, unless demonstrated to be environmentally suitable by additional targeted sampling and analysis;*
- *"A significant extent of the natural soils on the site, generally at depths in proximity to the extent of the fill based soils, are further not suitable to be used as growing media, unless demonstrated otherwise. Where natural soils are proposed to be used on site as growing media they will require to be validated for heavy metals, TRH and PAHs;*

- *"Natural soils on site (underlying fill materials) may be suitable to be used as growing media subject to validation of hydrocarbons meeting NEPC (2013) criteria*."

The Auditor agrees that management measures (as part of an EMP) are required to address the contamination present in site soils. The Auditor also agrees that soils used in growing areas/root zones should meet 'urban residential and public open space' land use guidelines specified in NEPM (2013) and levels of aldrin, dieldrin and polychlorinated biphenyls (PCBs) are to be below laboratory detection limits. The Auditor also considered that any accessible garden areas meet the human health (HIL/HSL) guidelines for the appropriate land use as specified in NEPM (2013).

The ERA also concludes that:

- *"'There is not considered to be an unacceptable ecological risk, from a protection of groundwater / off site ecological receptor perspective, to the re-use of fill materials within the site subject to the retention of fill materials within clay based soils as present over the northern portion of the site. The levels of potential leachates, where fill materials are retained in this lithology, have been demonstrated to be negligible."*

The Auditor does not currently agree that redistribution of fill, including the placement of fill below the water table, is acceptable without adequate management. The design of the borrow pit must be adequate to ensure leachate from the fill will not increase contaminate concentrations in site groundwater. Monitoring of groundwater is required to demonstrate that there will be no impact on groundwater concentrations at the site following backfill of the borrow pit. This is proposed in the RAP and discussed in Section 12 of this SAR.

11.9 References

ASTM, 2002. Emergency Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites.

ATSDR online toxicity profiles, Agency for Toxic Substances and Diseases Registry US Department of Health and Human Services, Atlanta Georgia

CCM 2008. Canada –Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale, Supporting Technical Document. Canadian Council of Ministers of the Environment (CCME), January 2008

CRC Care (2011), Health Screening Levels for petroleum hydrocarbons in soil and groundwater, E. Friebel and P. Nadebaum, Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC Care) Technical Report Series, no. 10

CalEPA (2005), Guidance for the Evaluation and Mitigation of Subsurface Vapour Intrusion to Indoor Air, Department of Toxic Substances Control California Environmental Protection Agency

enHealth 2002 (reprinted 2004) Environmental Health Risk Assessment Guidelines for assessing human health risks from environmental hazards, Department of Health and Ageing and enHealth Council, June 2002

enHealth (2003), Australian Exposure Factors Handbook – Consultation Draft, Department of Health and Ageing and enHealth Council, December 2003

IARC, 2000. Some industrial chemicals. IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans, Volume 77, 227-266, Lyon, International Agency for Research on Cancer

IARC, 2012. A review of human carcinogens – Part F. IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans, Volume 100F. Lyon, International Agency for Research on Cancer

ITRC (2007) Interstate Technology and Regulatory Council Vapour Intrusion Team. Vapour Intrusion Pathway: A Practical Guideline. Washington DC

Johnson, P.C., & Ettinger, R.A. (1991) Heuristic Model for Predicting the Intrusion Rates of Contaminated Vapours into Buildings. Environ.Sci.Technol., 25, 1445-1452

Johnson, P.C. (2002) Identification of Critical Parameters for the Johnson and Ettinger (1991) Vapor Intrusion Model. American Petroleum Institute, 2002

NEPC (1999), National Environment Protection (Assessment of Site Contamination) Measure, National Environmental Protection Council Canberra

NEPM (2013) National Environment Protection (Assessment of Site Contamination) Measure 1999, National Environmental Protection Council Canberra, Amended 2013

NHMRC and ARMCANZ, 2004 (National Health and Medical Research Council and the Agricultural and Resource Management Council of Australia and New Zealand). Australian Drinking Water Guidelines – 6 National Water Quality Management Strategy

Office of Environmental Health Hazard Assessment (QEHHA), run by the California EPA

Ontario Standards for Air Quality (2006)

RAIS/ORNL The Risk Assessment Information System

RIVM 2001 Re-Evaluation of human-toxicological Maximum Permissible Risk Levels. National Institute of Public Health and the Environment, Bilthoven, The Netherlands

Standards Australia (2002), The use of ventilation and airconditioning in buildings Part 2: Ventilation design for indoor air contaminant control, AS 1668.2-2002

TPHCWG (1997), Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons, Total Petroleum Hydrocarbon Criteria Working Group, Toxicology Technical Action Group

USEPA (1999) United States Environmental Protection Agency (USEPA). *Derivation of a volatilization factor to estimate upper bound exposure point concentration for workers in trenches flooded with groundwater off-gassing volatile organic chemicals.* Region 8. Ref: 8EPR-PS. July 29, 1999

USEPA (2002), Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, US Environmental Protection Agency, Office of Emergency and Remedial Response

USEPA (2002), Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. USEPA Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA (2004) User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings, US

USEPA (2016) Regional Screening Levels, derived from USEPA Region 9 Air and Tap Water Guidelines, Screening Levels for Chemical Contaminants at Superfund Sites (latest version 2016)

USEPA IRIS online database

World Health Organisation (WHO) Air Quality Guidelines for Europe, Second Edition, WHO Regional Publications, European Series No 91 (2000), WHO Guidelines for Air Quality (2000), WHO Indoor Air Quality Guidelines (2010) and associated WHO EHC/CICADs documents/revisions

12. EVALUATION OF REMEDIATION

12.1 Conceptual Site Model

A conceptual site model (CSM) is a representation of the source, pathway and receptor linkages at a site. The RAP includes a CSM, which is summarised in Table 12.1 and provides the Auditor's review.

Table 12.1: Review of the Conceptual Site Model

Element of CSM	Consultant	Auditor Opinion
Contaminant source and mechanism	Fill material identified across the site containing PAHs, TRH, metals and asbestos. Sourced from historical industrial site use and development. VOCs identified beneath the Locomotive Workshop.	The source and mechanism of VOC contamination was not identified.
Affected media	Fill material, underlying natural soil, soil vapour and groundwater have been assessed.	The extent of VOC contamination in groundwater and soil vapour extending down gradient of the Locomotive Workshop has not been assessed. This is addressed in the RAP.
Receptor identification	Future users of unpaved areas Construction and maintenance workers Future site workers within buildings Alexandra Canal located down gradient Vegetation	Adequately identified
Exposure pathways	Dermal and oral contact with soil and shallow groundwater Inhalation of VOC vapours Contamination uptake by vegetation	Exposure pathways have been identified. Remediation of the site will address the exposure pathways by installation of a capping layer.
Presence of preferential pathways for contaminant movement	Fill material with a higher permeability than natural soils Underground services and backfill material	The basement structure proposed for Lot 12 may act as a preferential pathway for VOC vapours identified on the Locomotive Workshop.
Evaluation of data gaps	Not identified	Further investigation is required to delineate the extent of VOC contamination and the potential to impact future occupants of Lot 12.

12.2 Remediation Required

Based on the previous investigations, contamination on the site requiring remediation has been summarised in Table 12.1.

Table 12.2: Remediation Required and Preferred Options

Description	Extent of Remediation Required	Preferred Options
Fill material containing metals, PAHs, TPH/TRH and asbestos	Lateral: Extends across the site. Vertical: Thickness ranges from approximately 0.3 to 7.6 m.	Manage in situ beneath buildings, hardstand and landscape material
VOCs, particularly PCE and TCE	Lateral: Not delineated, however has been identified in soil vapour in two areas beneath the Locomotive Workshop. Vertical: Unknown	Further investigation of the lateral extent, followed by risk assessment (if required)

The Auditor has assessed the RAP by comparison with the checklist included in OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The RAP was found to address the required information, as detailed in Table 12.3, below.

Table 12.3: Evaluation of Remedial Action Plan

Remedial Action Plan	Auditor Comments
Remedial Goal JBS&G (2016e) give the remedial goals as: • *"Remove unacceptable risks to human populations working on/using the site posed by fill/soil contamination within Developable Lots;* • *"Maintain requirements in the EMPs or appropriate revised management requirements to ensure ongoing suitability of public domain areas for recreational and commercial land uses;* • *"Prevent exposure of human populations working on/using the site to potentially impacted soils and soil vapour underlying the Locomotive Workshop, and hazardous materials within the Locomotive Workshop that may cause an unacceptable risk; and* • *"Remove or manage unacceptable ecological risks to flora posed by fill/soil contamination (where applicable)."*	In the Auditor's opinion, this goal is considered appropriate.
Discussion of the extent of remediation required *Developable Lots*: The entirety of Lots 8, 9 and 12 will require remediation during redevelopment to address fill material. Lot 12 will require further investigation for	The Auditor considers the extent of remediation required appropriate.

Table 12.3: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
VOCs, followed by remediation and/or management (if required). *Public Domain*: The entirety of the public domain will require remediation, including roads, pedestrian walkways, landscaped areas, the oval and courts.	
Remedial Options A number of remedial options were assessed, including on-site treatment, off-site treatment, off-site disposal, and in situ management.	The Auditor considers that a range of options were assessed.
Selected Preferred Option and Rationale Preferred option was in situ management beneath buildings on developable lots, beneath hardstand paving on roads and pedestrian walkways, and beneath a minimum of 0.5 m of landscape material in open space areas. This option will require ongoing management. Off-site disposal was also considered feasible, however was not preferred due to the environmental impact of excavating, transporting and disposing of the material. It was considered appropriate where material was not suitable for in situ management. Containment of fill material is proposed beneath Lot 12 in a 'borrow pit'. A secant pile wall is to be constructed along the northern and western boundaries of Lot 12, followed by excavation of fill material and underlying natural material to a depth of 9-11 mAHD. Fill material will then be placed in the excavation to a depth of approximately 15.5-16.5 mAHD, prior to construction of the overlying building. Fill will be placed below groundwater, which was at 17-17.5 mAHD in the north of Lot 12 and 15.5-14 mAHD in the south of Lot 12. The extent of the borrow pit is shown in Attachment 9 in Appendix A. Further investigation of the VOCs on Lot 12 is proposed in the RAP. The scope of the further investigation is not provided. A risk assessment will be undertaken based on the investigation results and proposed development.	Contaminants within the fill material are typically non-volatile, and are therefore considered suitable for management in situ beneath an adequate separation layer. Some volatile PAHs have been identified in fill material on the site, however these have been shown not to present a risk to occupants of proposed buildings (see risk discussion in Section 11). The RAP proposes excavation of natural material on Lot 12 and placement of fill material beneath the water table. Assessment of the leaching potential of metals and PAHs from fill material identified concentrations exceeding the GILs (see results in Section 8.3). JBS&G reviewed the ecological risk posed by the leaching contaminants, and concluded that the material did not present an unacceptable ecological risk. The Auditor notes fill material will be placed in a pit of clay and shale bedrock, with a pile wall along the up gradient boundary. This will limit the potential for leachate to migrate from the material to the down gradient sand aquifer. Post-development groundwater monitoring is proposed over a 12 month period. Investigation of VOCs within Lot 12 should delineate the extent and magnitude of contaminants. A preferred remedial option was not identified. Vapour management measures could be included in the design of the Lot 12 building.
Containment A capping layer will be installed in each area of the site to prevent exposure to in situ fill material.	The Auditor considers that the capping layer on developable portions of the site will be adequate if installed as per the requirements of the RAP, including a survey to demonstrate the thickness achieved and comprehensive

Table 12.3: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
On developable Lot 8, 9 and 12, the building slab will comprise the capping layer, with a marker layer placed beneath. Areas of landscaping are to be capped as per open space areas. Services are to be placed above the marker layer in clean material. In open space areas of the site, a minimum of 0.5 m of suitable material (VENM and validated landscaping material) in new areas of shallow planting (grass and shrubs) and 1.5 m for new tree planting. No marker layer is proposed. Existing landscaped areas are to be managed as per the existing EMPs, with no further capping proposed. New services are to be backfilled with suitable material from an environmental and human health perspective. In all areas of the site, the capping layer is to be surveyed prior to and following installation to ensure that the required lateral extent and thickness is achieved.	photographic evidence. The proposed capping for open space areas of the site should be adequate, however will be dependent on the level of management required.
Proposed Validation Testing Growing media from the site is to be sampled at a rate of 1/70 m^3. Fill will be analysed for TRH, PAH, metals, OCPs, PCBs, asbestos and pH. Natural soils will be analysed for TPH and PAHs. Consideration will also be given to aesthetic issues. Growing media comprising imported material is to be validated in a batch process, with a minimum of 10 samples collected from each supplier/product and analysed for TRH, PAHs, metals, OCP, PCB, asbestos and pH. VENM is to be validated by 5 samples per source site, and 1/1,000 m^3 if more than 10,000 m^3 of material. Survey of site will be undertaken to ensure capping layers are of sufficient thickness and extent, with photographic evidence. The RAP includes material classification forms (MCF) and material tracking sheets (MTS) which are to be completed during the works. These will form part of the validation documentation prepared for the remediation and development.	Growing media comprising natural site soil should additionally be tested for metals and compared to background concentrations. The Auditor notes that imported material must either be VENM, ENM or be classified under a Resource Recovery Exemption. The density of testing would need to be commensurate with the documentation provided, the consistency of the results and the volume imported.
Interim Site Management Plan (before remediation)	Considered appropriate.

Table 12.3: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Not proposed. There are existing EMPs for roads, walkways, landscaped areas, the oval and courts.	
Unexpected Finds An unexpected finds process was included in the RAP. A protocol included in the RAP is to be displayed in the site office and referred to during site inductions.	Fill material of variable composition has been identified across the site. It is therefore important that a process for adequately managing unexpected finds is maintained during remediation and development of the site. In the Auditor's opinion, the procedure for handling unexpected finds, which includes stopping work and identification of materials is appropriate and practical and can be implemented within the proposed remediation strategy.
Site Management Plan (operation phase) including stormwater, soil, noise, dust, odour and OH&S The RAP does not include a detailed site management plan. OH&S, including a Work Health & Safety Management Plan (WHSP) is to be prepared by the remediation contractor. Air monitoring for asbestos on a daily basis. Other site management requirements are to be included in the Remediation EMP (REMP) prepared prior to remediation commencing.	The Auditor notes that a site management plan (SMP) is required to be included in the RAP, as per NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. Inclusion of a SMP in the REMP should address this requirement. The RAP outlines the required content of the REMP.
Contingency Plan if Selected Remedial Strategy Fails Off-site disposal is proposed if material is not suitable to remain on the site.	The remedial strategy has a low risk of failure if implemented competently. Off-site disposal an alternative strategy is considered acceptable.
Contingency Plans to Respond to site Incidents The RAP considers unexpected finds, such as the identification of underground storage tanks, identification of oily/tarry material, breach of material storage containment, and emissions complaints.	The Auditor notes that the RAP provides management and contingency plans that are directly applicable for the proposed works.
Remediation Schedule and Hours of Operation The RAP reports that work hours are to be in accordance with the development consent. The duration of works is to be provided in the REMP.	Considered acceptable.
Licence and Approvals The RAP identifies the site as a State Significant Site within Schedule 3 of the Major Projects	Considered acceptable.

Table 12.3: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
SEPP. Development approval falls under Part 4 of the EP&A Act. Material disposed off-site should be classified and tracked from the site to an appropriately licensed landfill.	
Contacts/Community Relations Contacts and community relations plan not provided in the RAP, however will be included in the REMP.	Considered acceptable as the REMP is to be reviewed by the Auditor.
Staged Progress Reporting The RAP reports that redevelopment of the site is to be undertaken in a staged manner. Figures attached to the RAP show works undertaken over 2 stages. Stage 1 will comprise Lot 8, Lot 9 and some open space areas and roads. Stage 2 will comprise Lot 12 and the remaining open space areas and roads. A third stage is shown within the Locomotive Workshop, however this is not considered as part of the site.	Staged remediation of the site will require consideration of cross contamination of already validated areas.
Long term site management plan Long-term EMPs are to be prepared for areas of the site where residual contamination remains capped on-site. Multiple EMP are anticipated, however the number and contents will depend on the remediation undertaken. It will include measures to maintain capping layers and prevent beneficial use of groundwater. As well as incorporating elements of existing EMPs for open space areas of the site (Lot 10 and Lot 4007). Post remediation monitoring of groundwater will be undertaken down gradient of Lot 12 at three monthly intervals for a period of 12 months (4 events). Further details are to be included in the EMP prepared following remediation and development of the site. Ongoing monitoring of VOCs at the Locomotive Workshop is proposed in the RAP. Further investigation of VOCs will determine the need for ongoing monitoring on Lot 12. These monitoring requirements will also be included in the relevant EMP.	An EMP will be a condition of suitability on Section A SASs certifying the suitability for the proposed site use. An EMP is considered an appropriate means to manage risk provided the document is practical and legally enforceable. Ongoing monitoring can be specified in the EMP if necessary.

12.3 Auditor's Opinion

In the Auditor's opinion, the proposed remediation works should ensure that the site is suitable for the proposed land uses through the appropriate long-term management beneath a capping layer.

Remediation and validation will need to demonstrate that VOCs identified beneath the Locomotive Workshop do not present a risk to future occupants of Lot 12. Groundwater monitoring following construction on Lot 12 will also be required to demonstrate that fill material placed in the borrow pit is not impacting site groundwater.

It is recommended that the potential for vapour intrusion into the Locomotive Workshop is monitored through ongoing soil vapour and indoor air monitoring. Vapour intrusion would need to be considered in the event of any proposed development or reconfiguration.

13. CONTAMINATION MIGRATION POTENTIAL

Fill material containing elevated concentrations of metals, TPH, PAHs and asbestos has been identified across the site.

Redevelopment of Lot 8, 9 and 12 will result in these areas being largely sealed with hardstand paving. Surrounding roads, paved walkways, landscaped areas and open space areas (Lots 10 and 4007) will be capped with hardstand paving or 0.5-1.5 m of clean material in newly established open space areas. Established open space areas will have existing cover layers maintained. Long-term EMPs will be prepared to manage residual contamination remaining on the site. This will limit the potential for off-site migration of contaminants in surface water or dust.

Assessment of groundwater contamination on the ATP did not identify significant groundwater contamination. In the Auditor's opinion, contaminants detected within the soil at the site have not adversely affected the groundwater quality. The RAP proposes placing site fill material below the groundwater table on Lot 12, which has the potential to result in the migration of contamination via groundwater. The RAP considered the potential to be low based on the low permeability of the clay/shale stratigraphy underlying Lot 12.

In the Auditor's opinion, there is no evidence of significant migration of contamination under currently conditions. Remediation of the site as part of the proposed redevelopment should limit the potential for future migration of contamination from the site surface. Groundwater monitoring following redevelopment will be required and is proposed to demonstrate that fill material placed below groundwater on Lot 12 has not resulted in migration of contamination.

14. COMPLIANCE WITH REGULATORY GUIDELINES AND DIRECTIONS

Guidelines currently approved by the EPA under section 105 of the NSW *Contaminated Land Management Act 1997* have been used by the Auditor.

The various investigations were generally conducted in accordance with SEPP 55 Planning Guidelines and reported in accordance with the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The EPA's Checklist for Site Auditors using the EPA Guidelines for the NSW Site Auditor Scheme 1998 (December 1999) has also been referred to.

As of June 2016, the ATP was listed on the NSW EPA 'List of NSW contaminated sites notified to EPA', which notes that *"Regulation under CLM Act not required"*.

15. CONCLUSIONS AND RECOMMENDATIONS

JBS&G (2016e) considered that the proposed remediation was *"…technically feasible; environmentally justifiable; and consistent with relevant laws policies and guidelines endorsed by NSW EPA"*. JBS&G concluded that *"…the site can be made suitable for the intended uses and that the risks posed by contamination can be managed in such a way as to be adequately protective of human health and the environment"*.

Based on the information presented in the reports listed in Section 1.1 of this SAR, and with reference to the NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites*, the Auditor concludes that the site can be made suitable for the purposed uses if remediated in accordance with the following remedial action plan:

> 'Australian Technology Park Remedial Action Plan, 2 Locomotive Street, Eveleigh, NSW', 15 June 2016 (Revision 0), JBS&G.

Subject to compliance with the following conditions:

1. Assessment of extent of volatile organic compounds and the potential to impact the proposed development on Lot 12.
2. Groundwater monitoring is undertaken following development of Lot 12 to assess potential impact of fill material placed below groundwater.
3. Long term EMPs are prepared for the ongoing management of site areas following remediation and development.
4. Groundwater is not abstracted from the site for beneficial use.
5. A Section A site audit statement is prepared at the end of each stage of the development certifying suitability for the proposed use.

16. OTHER RELEVANT INFORMATION

This Audit was conducted on the behalf of Client for the purpose of assessing the suitability and appropriateness of a remedial action plan (RAP), i.e. a “Site Audit” as defined in Section 4 (1) (b) (v) of the CLM Act.

This summary report may not be suitable for other uses. Douglas, ES and JBS&G included limitations in their report. 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 the Auditor 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 the Auditor’s 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 Location

Attachment 2: Site Layout

Attachment 3: Historical Site Layout

Attachment 4: Groundwater Monitoring Well Locations

Attachment 5: Soil Sample Locations Lot 8 and 9

Attachment 6: Soil Sample Locations Lot 12

Attachment 7: Soil Sample Locations Lot 4007

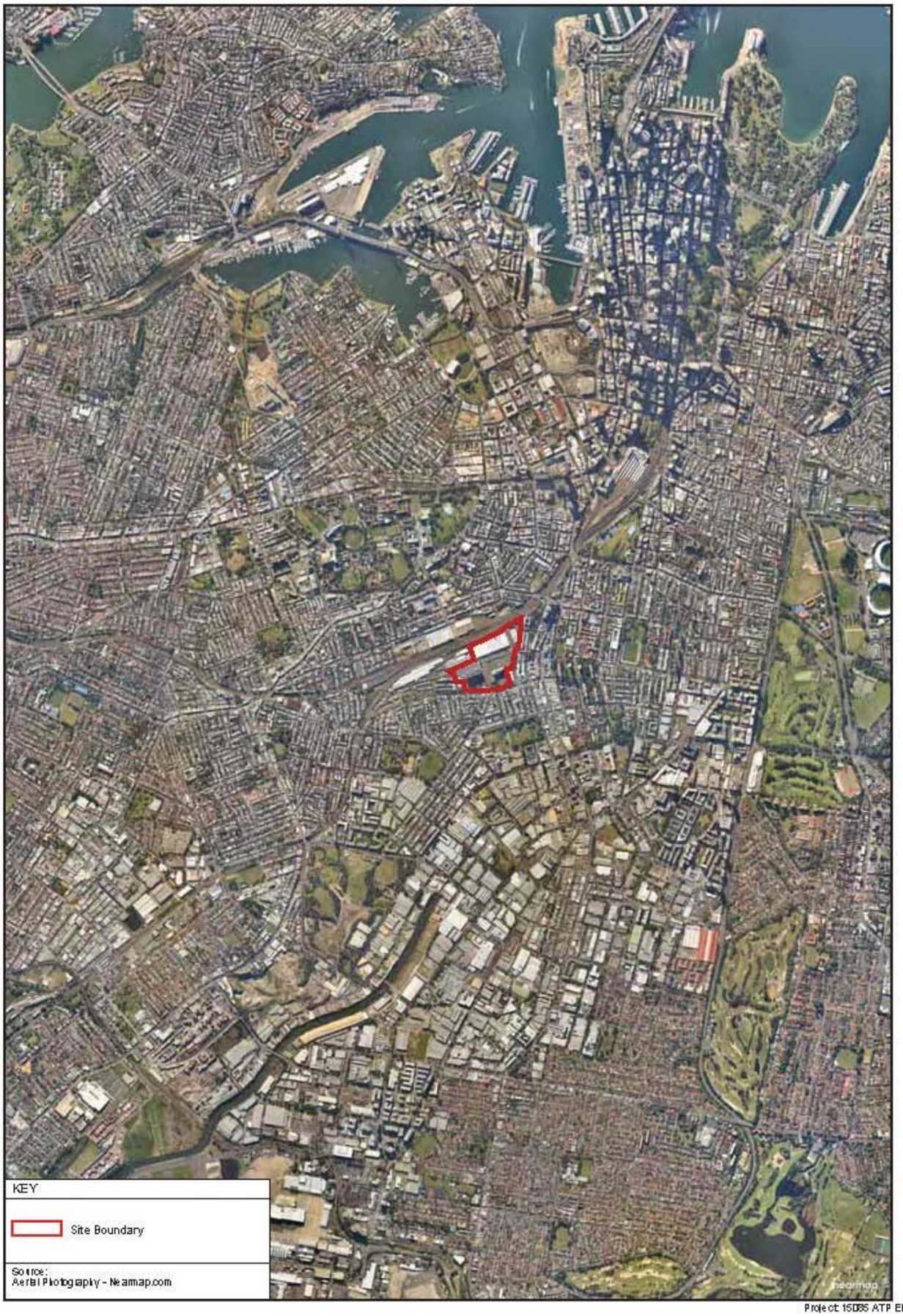
Attachment 8: Soil Vapour Locations

Attachment 9: Borrow Pit Extent and Construction

EnvironmentalStrategies

Site Location Plan | Figure 1

Australian Technology Park, Eveleigh NSW 2015



Project 15086 ATP EMP

0 400 800 1200 1600 2000m

Approximate Scale

N

Legend:

- Approximate Boundary - ATP
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"
- UST (Inferred Historical Location)

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:3,500

0 40 80
metres

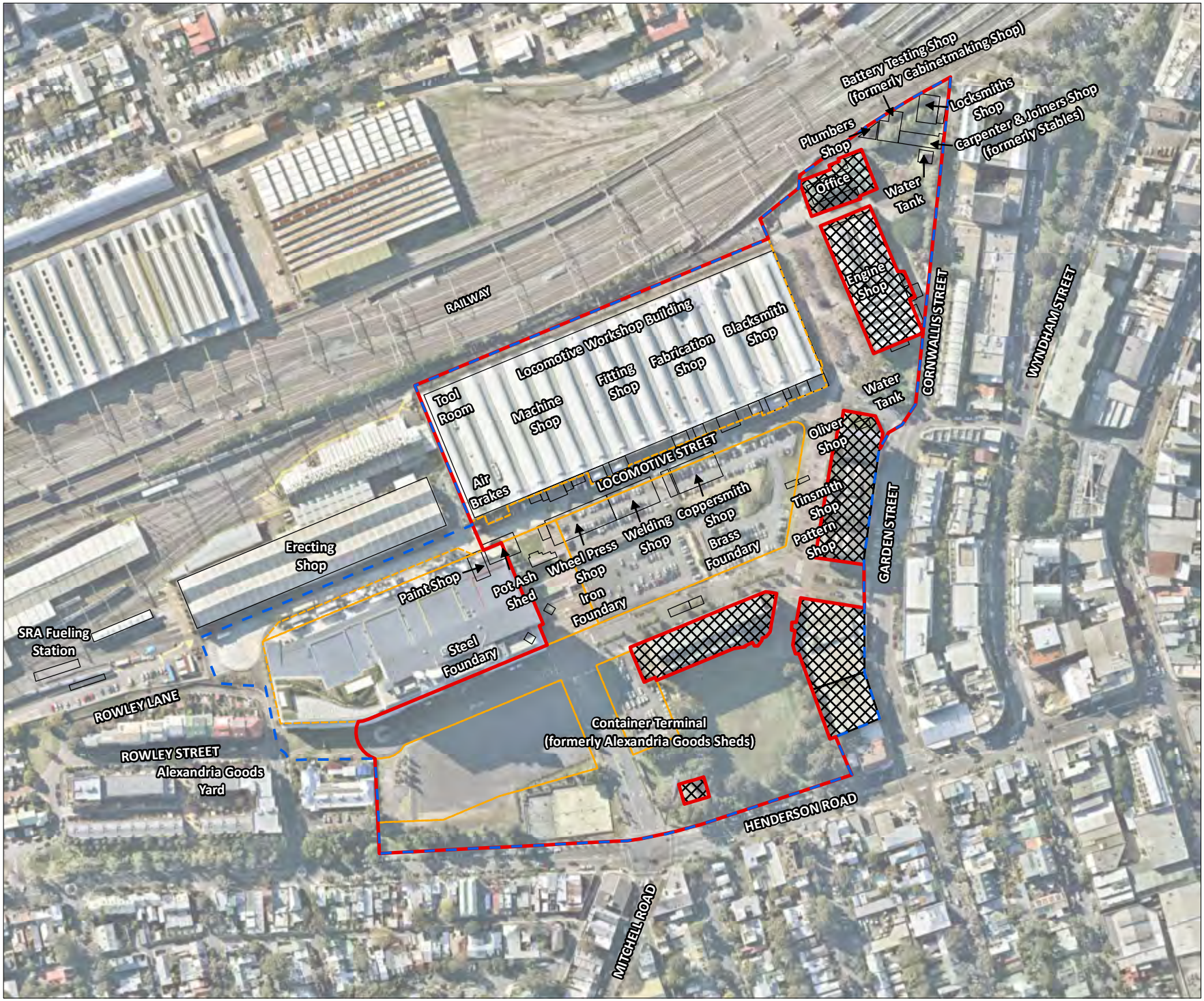
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

SITE LAYOUT

FIGURE 2:

File Name: 51142_02
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"
- Historic Site Layout

JBS&G

Client: Mirvac

Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:3,500

0 40 80
metres

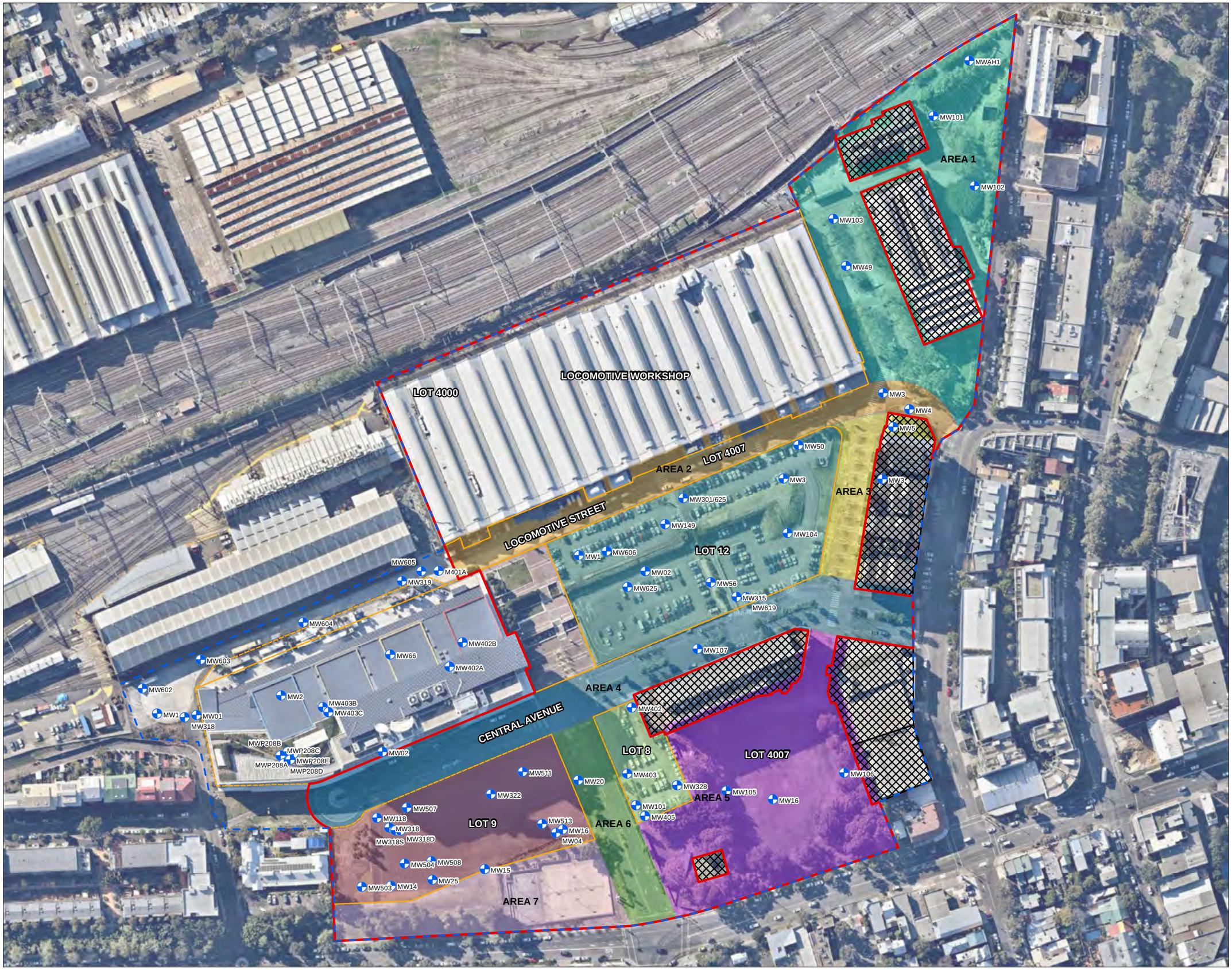
Coor. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

HISTORICAL SITE LAYOUT

FIGURE 6:

File Name: 51142_06
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

- Historical Groundwater Monitoring Location
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Development Area - Lot 4007

- AREA 1
- AREA 2
- AREA 3
- AREA 4
- AREA 5
- AREA 6
- AREA 7

Lot & DP

- Lot 12 DP1136859
- Lot 8 DP1136859
- Lot 9 DP1136859

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:2,000

0 40
metres

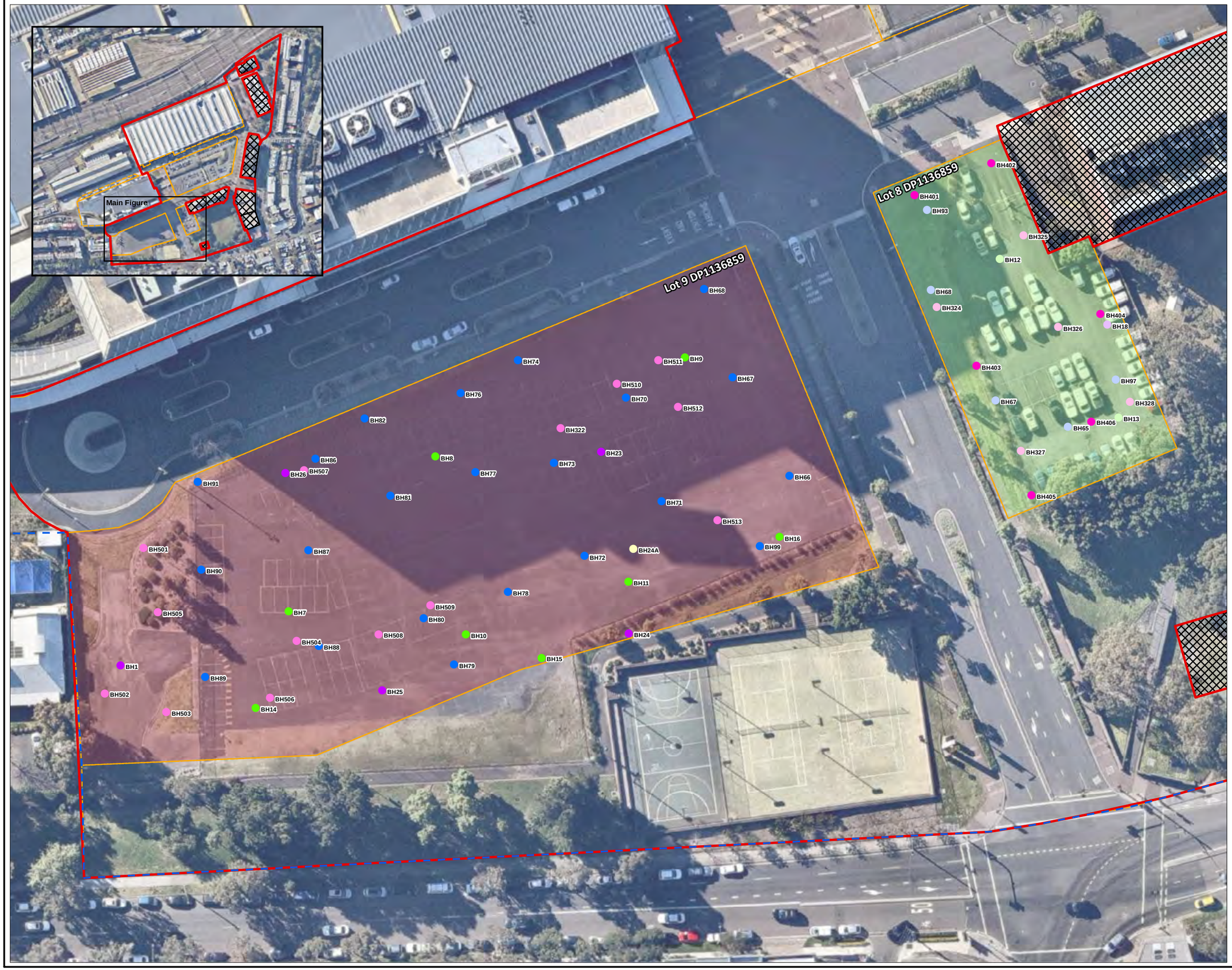
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC GROUNDWATER MONITORING WELL LOCATIONS

FIGURE 7D:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07d.mxd
Reference:



Legend:

Historical Soil Sample Locations

- CMPS&F 1994 (ES 2014b) - Lot 9
- DP 2005a - Lot 8
- DP 2008 (ES 2014b) - Lot 9
- DP 2008a - Lot 8
- ES 2014a - Lot 8
- ES 2014b - Lot 9
- HLA 2001 (DP 2005a) - Lot 8
- HLA 2001 (ES 2014b) - Lot 9
- HLA 2001 (ES 2014e) - Lot 8
- JET 1993 (DP 2005a) - Lot 8
- JET 1993 (ES 2014b) - Lot 9
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Lot & DP

- Lot 8 DP1136859
- Lot 9 DP1136859

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R02 Rev 0	Date: 15-Jun-2016
Drawn By: RF	Checked By: NC

Scale 1:650

0 14
metres

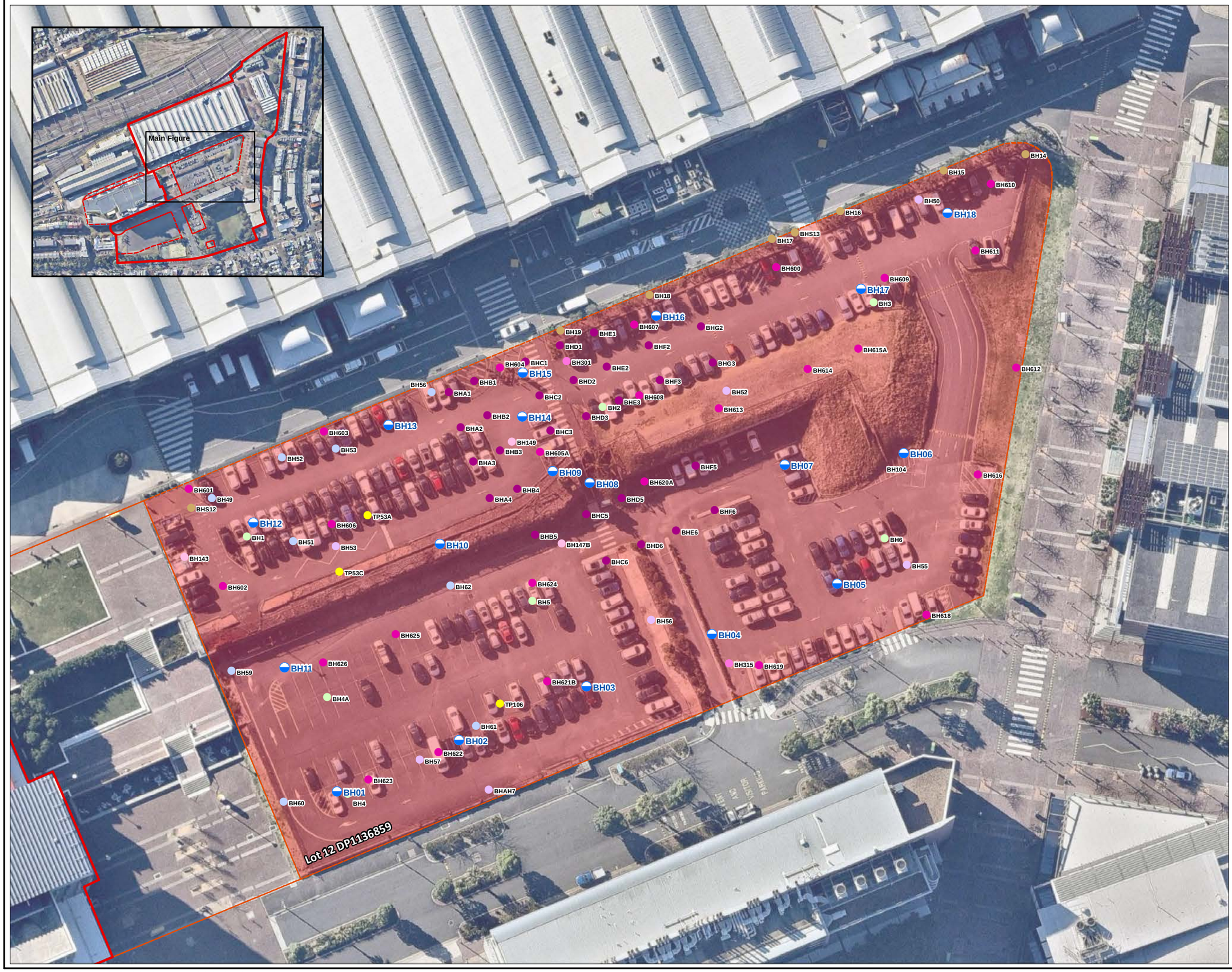
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC SOIL SAMPLE LOCATIONS LOT 8 AND 9

FIGURE 7A:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07a.mxd
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

- Sample Locations JBS&G 2016

Historical Soil Sample Locations

- CMP&F 1993 (ES 2014e) - Lot 12
- CMPS&F 1994 (ES 2014c) - Lot 12
- DP 2003 (ES 2014c) - Lot 12
- DP 2005a - Lot 12
- DP 2008 (ES 2014c) - Lot 12
- DP 2009 (ES 2014c) - Lot 12
- ES 2014 (ES 2014c) - Lot 12
- GETEX 2013 (ES 2014c) - Lot 12
- HLA 2001 (ES 2014c) - Lot 12
- JET 1993 (ES 2014c) - Lot 12
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R05 Rev B	Date: 27-May-2016
Drawn By: RF	Checked By: NC

Scale 1:650

0 14
metres

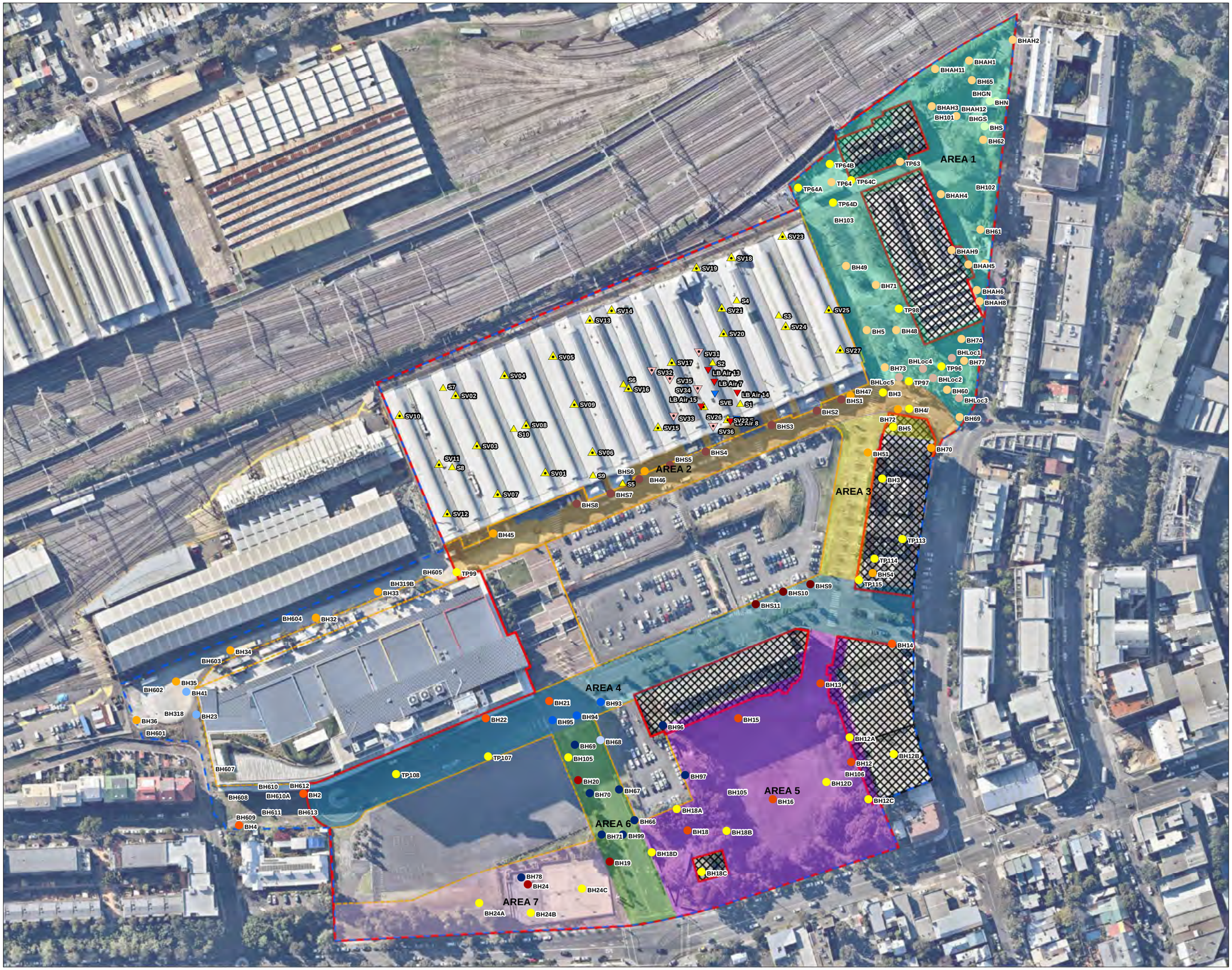
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park
Eveleigh, NSW

HISTORIC AND CURRENT SOIL SAMPLE LOCATIONS LOT 12

FIGURE 5:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R05 Rev B\51142_05.mxd
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au



Legend:

Historical Ambient Air and Soil Vapour Locations

- Ambient Air DP 2010c
- Ambient Air ES 2015a
- Soil Vapour ES 2015a
- Soil Vapour Location - JBS&G May 20 2016
- Soil Vapour Location - JBS&G May 5-6 2016

Historical Soil Sample Locations

- CMPS&F 1993 (ES 2014e) - Lot 13 Area 1
- ES 2010 (ES2014e) - Lot 13 Area 1
- GETEX 2011-2013 (ES 2014e) - Lot 13 Area 1
- GETEX 2011-2013 (ES 2014e) - Lot 13 Area 2
- GETEX 2011-2013 (ES 2014e) - Lot 13 Area 4
- HLA 2001 (DP 2005a) - Lot 13 Area 6
- HLA 2001 (ES 2014e) - Lot 13 Area 2
- HLA 2001 (ES 2014e) - Lot 13 Area 4
- HLA 2001 (ES 2014e) - Lot 13 Area 5
- HLA 2001 (ES 2014e) - Lot 13 Area 6
- HLA 2001 (ES 2014e) - Lot 13 Area 7
- JET 1993 (ES 2014e) - Lot 13 Area 1
- JET 1993 (ES 2014e) - Lot 13 Area 2
- JET 1993 (ES 2014e) - Lot 13 Area 4
- JET 1993 (ES 2014e) - Lot 13 Area 5
- JET 1993 (ES 2014e) - Lot 13 Area 6
- JET 1993 (ES 2014e) - Lot 13 Area 7
- Approximate Boundary - ATP Site
- Approximate Boundary - The Site
- Cadastral Boundaries
- Cadastral Boundaries Excluded from "The Site"

Development Area - Lot 4007

- AREA 1
- AREA 2
- AREA 3
- AREA 4
- AREA 5
- AREA 6
- AREA 7

JBS&G

Job No: 51142

Client: Mirvac

Version: R02 Rev 0 | Date: 15-Jun-2016

Drawn By: RF | Checked By: NC

Scale 1:2,000

0 40
metres

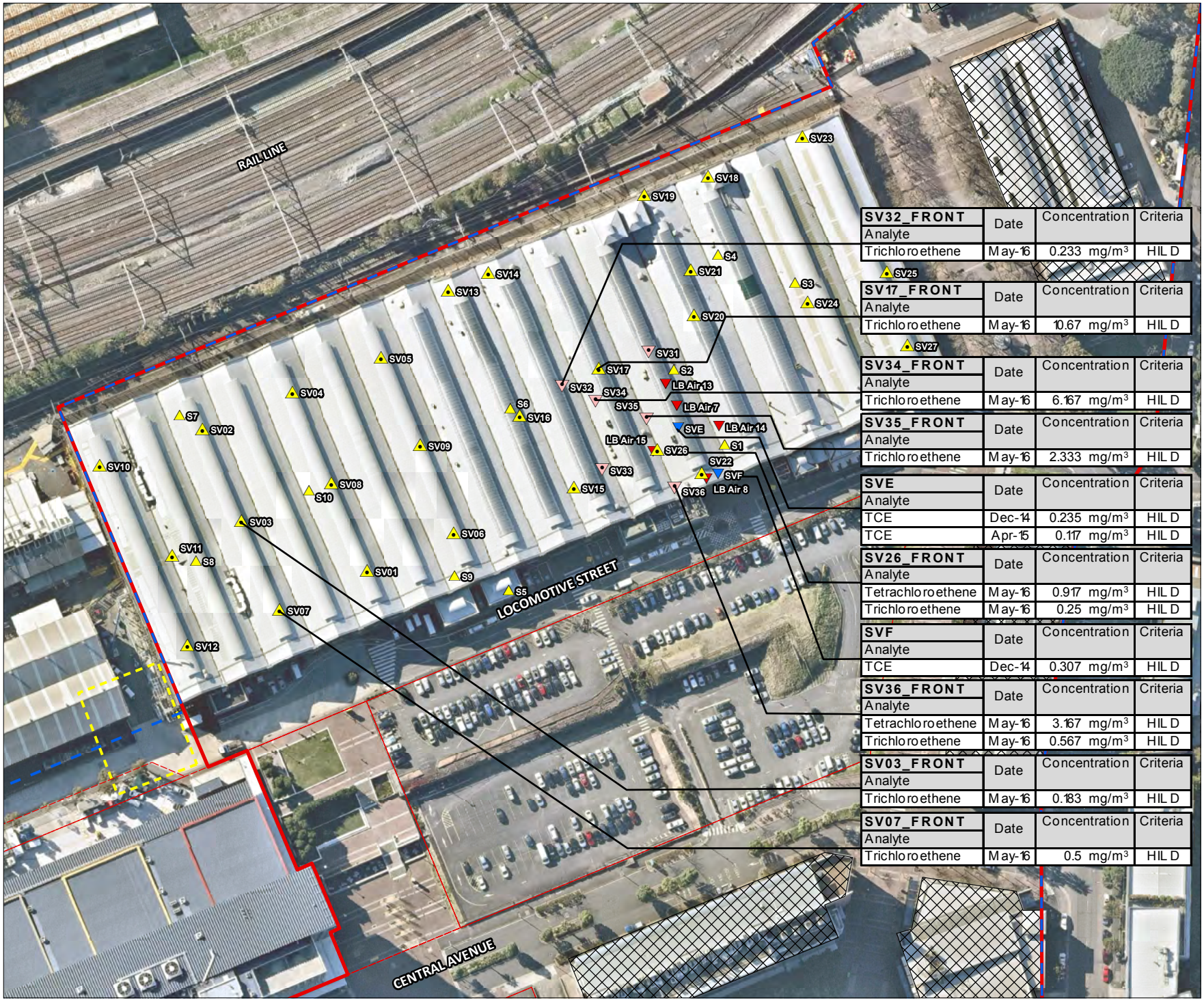
Coord. Sys. GDA 1994 MGA Zone 56

Australia Technology Park Eveleigh, NSW

HISTORIC SOIL/SOIL VAPOUR SAMPLE LOCATIONS LOTS 4000 AND 4007

FIGURE 7C:

Document Path: G:\JBS Environmental\Projects\Mirvac\51142 ATP Validation\GIS\Maps\R02 Rev 0\51142_07c.mxd
Reference:



SV32_FRONT	Date	Concentration	Criteria
Analyte			
Trichloroethene	May-16	0.233 mg/m³	HIL D

SV17_FRONT	Date	Concentration	Criteria
Analyte			
Trichloroethene	May-16	10.67 mg/m³	HIL D

SV34_FRONT	Date	Concentration	Criteria
Analyte			
Trichloroethene	May-16	6.167 mg/m³	HIL D

SV35_FRONT	Date	Concentration	Criteria
Analyte			
Trichloroethene	May-16	2.333 mg/m³	HIL D

SVE	Date	Concentration	Criteria
Analyte			
TCE	Dec-14	0.235 mg/m³	HIL D
TCE	Apr-15	0.117 mg/m³	HIL D

SV26_FRONT	Date	Concentration	Criteria
Analyte			
Tetrachloroethene	May-16	0.917 mg/m³	HIL D
Trichloroethene	May-16	0.25 mg/m³	HIL D

SVF	Date	Concentration	Criteria
Analyte			
TCE	Dec-14	0.307 mg/m³	HIL D

SV36_FRONT	Date	Concentration	Criteria
Analyte			
Tetrachloroethene	May-16	3.167 mg/m³	HIL D
Trichloroethene	May-16	0.567 mg/m³	HIL D

SV03_FRONT	Date	Concentration	Criteria
Analyte			
Trichloroethene	May-16	0.183 mg/m³	HIL D

SV07_FRONT	Date	Concentration	Criteria
Analyte			
Trichloroethene	May-16	0.5 mg/m³	HIL D

Legend:

- Approximate Boundary - ATP Precinct
- Approximate Boundary - The Site
- Cadastral Boundaries
- Existing Building Footprint Excluded from "The Site"
- UST (Inferred Historical Location)
- Soil Vapour Location - May 5-6 2016
- Soil Vapour Location - May 20 2016

Historical Ambient Air and Soil Vapour Locations

- Ambient Air DP 2010c
- Ambient Air ES 2015a
- Soil Vapour ES 2015a

JBS&G

Job No: 51142

Client: Mirvac

Version: L06 Rev 0	Date: 25-May-2016
Drawn By: SE	Checked By: NC

Scale 1:1,600

0 20 40
metres

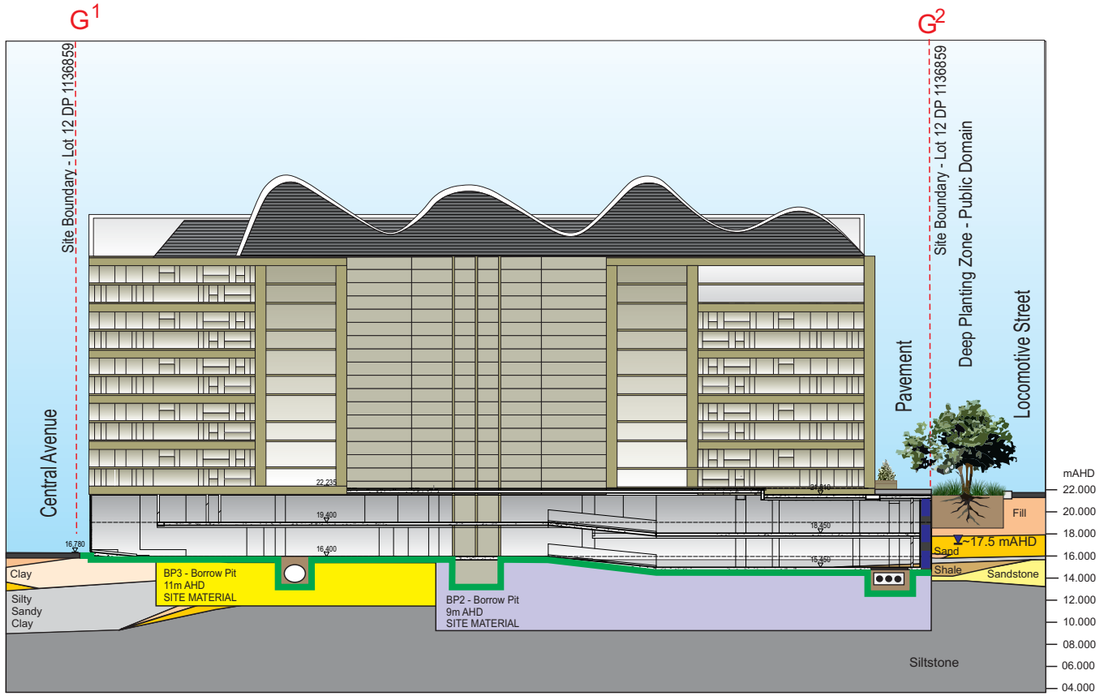
Coor. Sys. GDA 1994 MGA Zone 56

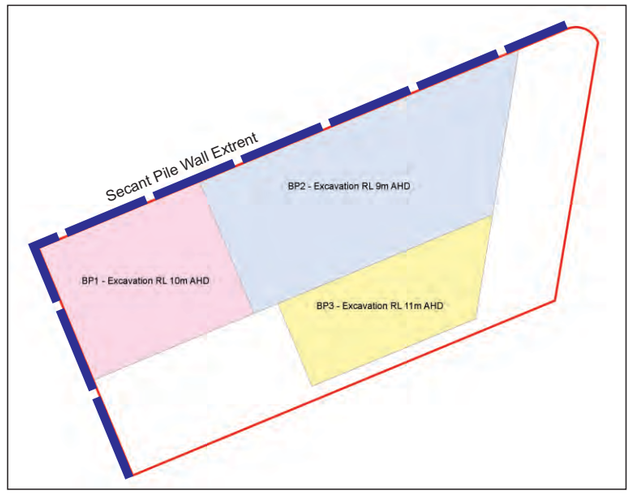
Australia Technology Park Eveleigh, NSW

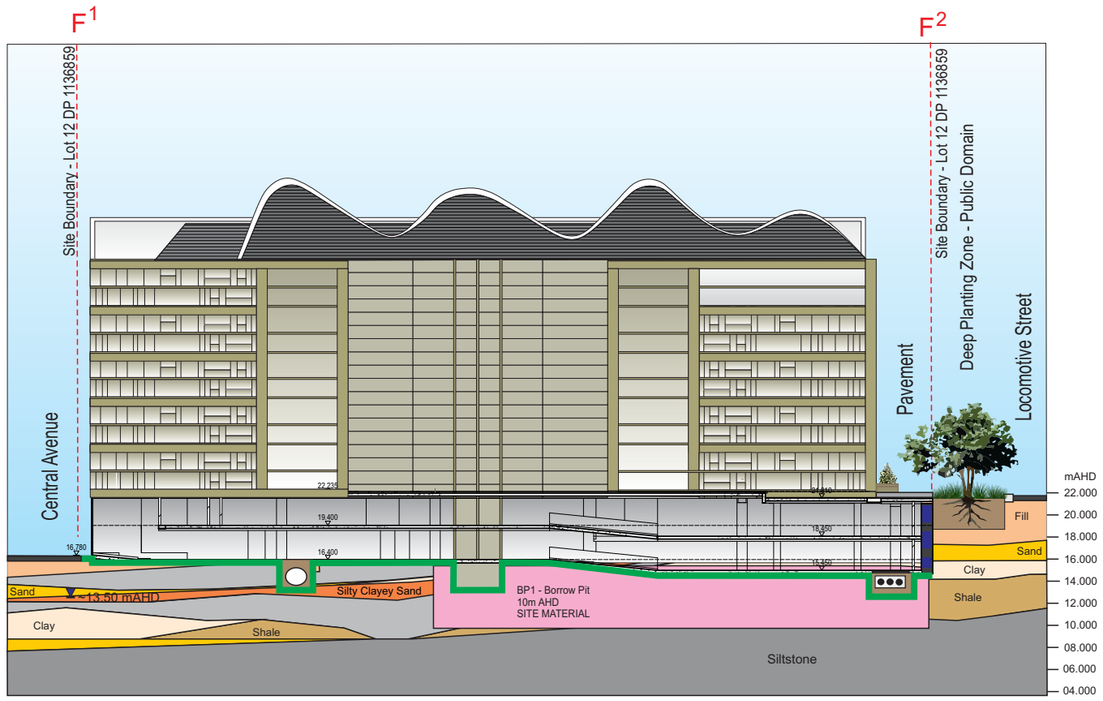
SOIL VAPOUR LOCATIONS AND EXCEEDANCES

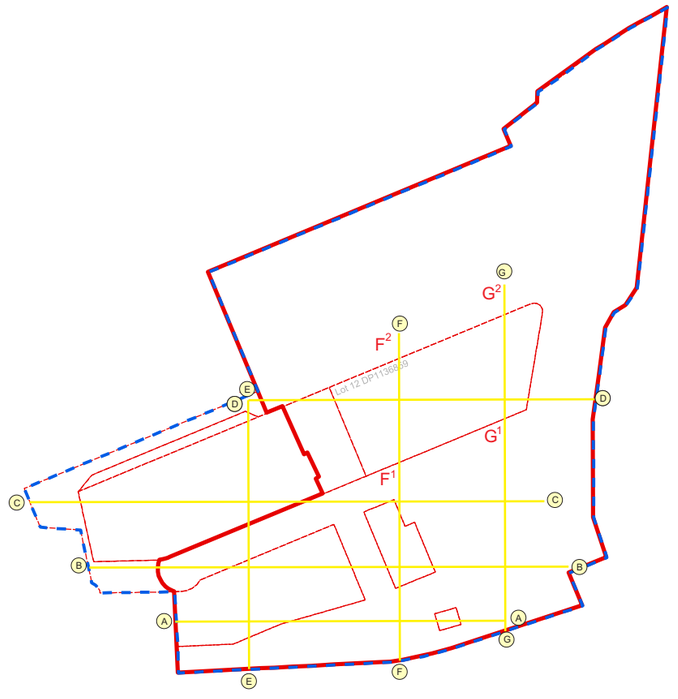
FIGURE 5:

File Name: 51142_05
Reference: Imagery - www.nearmap.com: Cadastre Boundary -maps.six.nsw.gov.au









Legend:

- Approximate Site Boundary

Borrow Pit Locations

- BP1 - Excavation RL 10m AHD
- BP2 - Excavation RL 9m AHD
- BP3 - Excavation RL 11m AHD
- Site Material

Lithology

- Silty Sandy Clay
- Clay
- Sand
- Silty Clayey Sand
- Shale
- Sandstone
- Siltstone
- Secant Pile Wall

JBS&G

Job No: 51142	
Client: Mirvac	
Version: R02 Rev 1	Date: 23-Jun-2016
Drawn By: RF	Checked By: NC
Not to Scale	
Coord. Sys. GDA 1994 MGA Zone 56	

Australia Technology Park
Eveleigh, NSW

BORROW PIT EXTENT AND CONSTRUCTION
- LOT 12 DP1136859

FIGURE 10: