



Site Audit Report

0503-0622-04

Brookfield Multiplex Constructions Pty Ltd

Auburn Hospital - Area 1B
Cnr Hargrave Rd and Norval St Auburn NSW

June 2009
JBS40205-13322
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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 26 March 2009. For more information about completing this form, go to Part IV.

PART I: Site audit identification

Site audit statement no. 0503-0622-04

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 **Andrew Lau** Company **JBS Environmental Pty Ltd**
Address **PO Box 940**
MASCOT NSW Postcode **1460**
Phone **02 8338 1011** Fax **02 8338 1700**

Site Details

Address **(Stage 1B), Auburn Hospital Complex**
Cnr Hargrave Rd and Norval St Auburn NSW Postcode **2144**

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

Lots 8-13 and Part Lots 7 and 14, Section 4, DP873

Local Government Area **Auburn**

Area of Site (eg. hectares) **8,500 m²** Current zoning **Residential 2(b) Medium Density**

To the best of my knowledge, the site ~~is~~**is not*** the subject of a declaration, order, agreement, proposal 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 **Allan Young** Company **Brookfield Multiplex Constructions Pty Ltd**

Address

1 Kent Street SYDNEY NSW

Postcode **2000**

Phone **02 9615 4200**

Fax **02 8915 1485**

Purpose of site audit

☐ ~~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]*)

Continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas

Information sources for site audit

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

Weir and Phillips Pty Ltd

Douglas Partners Pty Ltd

ANSTO Pty Ltd

Airsafe Occupational Health Consultants Pty Ltd

Title(s) of report(s) reviewed

- *Heritage Report, Auburn Hospital, NSW, Weir and Phillips, May 2006 (Weir & Phillips 2006);*
- *Hazardous Building Materials Survey, Auburn Hospital, Auburn, Douglas Partners Pty Ltd, September 2006 (DP 2006a);*
- *Preliminary Contamination Assessment, Auburn Hospital, Norval Street, Auburn, Douglas Partners Pty Ltd, October 2006 (DP 2006b);*
- *Assessment and Recommendations of Asbestos Materials: Auburn Hospital, Hargrave Road, Auburn, Airsafe Occupational Health Consultants, April 2007 (Airsafe 2007);*
- *Site Radiological Survey of Auburn Hospital, Australian Nuclear Science and Technology Organisation, May 2007 (ANSTO 2007);*
- *Detailed Contamination Assessment, Auburn Hospital Stage 1B, Corner of Hargrave and Norval Street, Auburn, Douglas Partners Pty Ltd, April 2009 (DP 2009a); and*
- *Remedial Action Plan – Area 1B, Auburn Hospital, Norval Street, Auburn, Douglas Partners Pty Ltd, May 2009 (DP 2009b).*

*** Strike out as appropriate**

0503-0622-04

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

Detailed Contamination Investigation of Area1A and Water Street Residences, Auburn Hospital, Auburn, NSW, Earth Air Water Consulting and Monitoring Pty Ltd, August 2007 (EAW 2007d)

Site audit report

Title **Site Audit Report 0503-0622-04, Auburn Hospital – Area 1B, Cnr Hargrave Rd and Norval St, Auburn, NSW**

Report no. **JBS40205-13322**

Date **19th June 2009**

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 plan¹ which is the subject of the audit:

"To describe the works which are necessary to remediate the site and to provide a scope of validation works which are sufficient to demonstrate that the site has been made suitable for the intended landuse following remediation" (DP 2009b).

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) - hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas.

if the site is remediated/~~managed~~* in accordance with the following remedial action plan/~~management plan~~*

Remedial Action Plan – Area 1B, Auburn Hospital, Norval Street, Auburn, Douglas Partners Pty Ltd, May 2009 (DP 2009b)

subject to compliance with the following condition(s):

A Site Audit must be conducted following the completion of the remediation and validation works to verify the suitability of the site for the intended use.

Overall comments

NIL

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

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. **0503**).

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: :



Andrew Lau

19th June 2009

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:

Department of Environment and Climate Change (NSW)

Contaminated Sites Section

PO Box A290, SYDNEY SOUTH NSW 1232

Fax: (02) 9995 5930

AND

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

Site Audit Report

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Brookfield Multiplex Constructions Pty Ltd

Auburn Hospital - Area 1B
Cnr Hargrave Rd and Norval St Auburn NSW

June 2009
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List of Abbreviations

A list of the common abbreviations used throughout this report is provided below.

- As Arsenic
- Cd Cadmium
- Cr Chromium
- Cu Copper
- BTEX Benzene, Toluene, Ethylbenzene and Xylenes
- B(a)P Benzo (a) pyrene
- DECC NSW Department of Environment and Climate Change
- DoP NSW Department of Planning
- DQO Data Quality Objectives
- DP Deposited Plan
- EPA New South Wales Environment Protection Authority
- Hg Mercury
- HIL Health Based Investigation Level
- LOR Limit of Reporting
- MAH Monocyclic Aromatic Hydrocarbon
- Ni Nickel
- OCP Organochlorine Pesticide
- SAR Site Audit Report
- SAS Site Audit Statement
- PAH Polycyclic Aromatic Hydrocarbons
- Pb Lead
- PBIL (Provisional) Phytotoxicity Based Investigation Level
- PCB Polychlorinated Biphenyls
- PQL Practical Quantitation Limit
- QA/QC Quality Assurance/Quality Control
- RPD Relative Percentage Difference
- TPH Total Petroleum Hydrocarbons (C₆-C₉ and C₁₀-C₃₆)
- Zn Zinc

Executive Summary

Introduction & Background

Andrew Lau, of JBS Environmental Pty Ltd (DECC Accreditation Number 0503), was engaged by Multiplex Constructions Pty Ltd on 1st March 2007 to conduct a site audit at the property located on the corner of Hargrave Road and Norval Street, Auburn, NSW, 2144. The site is identified as Lots 8-13 and Part Lots 7 and 14, Section 4, DP873, and has an area of approximately 8,500 m².

The site forms "Stage 1B" of the Auburn Hospital complex which has been undergoing a process of redevelopment since 2007. The site audit was conducted as a statutory audit, since the requirement arose as a result of a condition of development approval issued by the Minister for Planning (Major Project # 06_0129) under the *Environmental Planning and Assessment Act 1979* (EPAA 1979).

The primary objective of the site audit was to review the appropriateness of the site investigation process and provide an opinion as to whether the site can be made suitable for the proposed uses, subject to the successful implementation of proposed remediation and validation works.

Summary of Identified Contamination Issues

The following conclusions were made in relation to contamination issues at the site (DP 2009a and ANSTO 2007):

- Fill materials in the western portion of the site were identified as being contaminated with PAHs (including BaP) at concentrations warranting remediation. The fill materials contained building rubble and ash/slag inclusions which were considered to be the source of the identified PAH contamination.
- Asbestos was identified in fill materials in the western portion of the site, with the likely extent of asbestos contamination considered to be more widespread than the single reported exceedance due to the identified presence of building rubble in fill material in this part of the site. The identified asbestos impacted fill was considered to require remediation.
- No elevated levels of radioactivity above natural background were identified, with no radiation from external sources or radioactive contaminants detected during the survey.
- The minor PIL exceedances for metals (nickel and zinc) were considered not to be significant as there was no evidence of stressed vegetation. As such, metals were considered not to pose a contamination issue in soil at the site warranting further investigation, remediation or management.
- The reported concentrations of TPH, BTEX, VOCs, phenols, OCPs, OPPs and PCBs in soil were all below the adopted site criteria and considered not to pose a contamination issue in soil at the site warranting further investigation, remediation or management.
- The reported concentrations of metals (excluding nickel and zinc), TPH, BTEX, VOCs, phenols, OCPs, OPPs and PCBs in groundwater were all below the adopted groundwater trigger levels and therefore groundwater was considered not to have been impacted by either on-site or upgradient activities.

- The reported concentrations of nickel and zinc in groundwater, whilst exceeding the adopted trigger levels, were considered not to pose a contamination issue warranting further investigation, remediation or management since the concentrations were consistent with typical background concentrations in the vicinity of the site.
- A bituminous membrane was identified beneath the slab under the main hospital building which contained elevated levels of TPH and is required to be segregated and disposed of separately as part of the building demolition works.

Proposed Remediation and Validation Works

With consideration to the identified nature and extent of contamination, the proposed remediation approach involves excavation and off-site disposal of the identified contamination. The success of the remediation works are to be confirmed through appropriate validation inspection, sampling and analyses, including in areas inaccessible at the time of the site investigations due to the presence of buildings.

A Remedial Action Plan (DP 2009b) has been prepared documenting the proposed remediation process.

Summary Audit Opinion

The site assessment and proposed remedial activities are considered to have met the requirements of the Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd Edition) (DEC 2006).

The soils in parts of the site have been impacted with PAHs and asbestos at levels which require remediation for the proposed landuse. There was no other soil contamination identified as part of the site assessment works which is considered to require remediation or management.

The site can be made suitable for the proposed landuse (i.e., continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas) based on the successful implementation of the soil remediation and validation works detailed in the Remedial Action Plan prepared for the site (DP 2009b).

1 Introduction

1.1 Site Auditor

Andrew Lau, of JBS Environmental Pty Ltd, was engaged by Multiplex Constructions Pty Ltd on 1st March 2007 to conduct a site audit at the property located on the corner of Hargrave Road and Norval Street, Auburn, NSW, 2144. The site is identified as Lots 8-13 and Part Lots 7 and 14, Section 4, DP873, and has an area of approximately 8,500 m².

The site forms "Stage 1B" of the Auburn Hospital complex which has been undergoing a process of redevelopment since 2007. Stage 1B is the final stage of the redevelopment, with investigations, remediation works, validation works and site audits previously completed on the remaining stages (1A, Water St Residences and Arthur Stone areas) located to the south of Stage 1B.

Andrew Lau is a Site Auditor accredited by the NSW Department of Environment and Climate Change (DECC) under the *Contaminated Land Management Act 1997* (CLMA 1997) (Accreditation Number 0503).

1.2 Objectives of Audit

The objectives of this site audit were to:

- Independently review the environmental status of the site as determined by contamination assessments undertaken at the site;
- Assess the appropriateness of proposed remediation methodologies to rehabilitate the site of contamination identified by assessments;
- Assess the appropriateness of validation methodologies to assess the effectiveness of remediation works; and
- Prepare a Site Audit Report and issue a Site Audit Statement providing an opinion as to whether the site can be made suitable for the proposed uses which include continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas.

In accordance with the requirements of s.51 (CLMA 1997), the site audit was undertaken with consideration to:

- The provisions of the Act, Regulations and subsequent amendments;
- The provisions of any environmental planning instruments applying to the site; and
- The guidelines made or approved by the DECC (**Appendix A**).

1.3 Type of Audit

The site audit was conducted as a statutory audit, since the requirement arose as a result of a condition of development approval issued by the Minister for Planning (Major Project # 06_0129) under the *Environmental Planning and Assessment Act 1979* (EPAA 1979). Notification was made to the DECC on the 15th March 2007 after the auditor became aware of the statutory nature of the engagement on 13th March 2007. The audit reference number is 0503-0622-04.

1.4 Documents Reviewed

The following documents were reviewed as part of this site audit:

- *Heritage Report, Auburn Hospital, NSW, Weir and Phillips, May 2006 (Weir & Phillips 2006);*
- *Hazardous Building Materials Survey, Auburn Hospital, Auburn, Douglas Partners Pty Ltd, September 2006 (DP 2006a);*
- *Preliminary Contamination Assessment, Auburn Hospital, Norval Street, Auburn, Douglas Partners Pty Ltd, October 2006 (DP 2006b);*
- *Assessment and Recommendations of Asbestos Materials: Auburn Hospital, Hargrave Road, Auburn, Airsafe Occupational Health Consultants, April 2007 (Airsafe 2007);*
- *Site Radiological Survey of Auburn Hospital, Australian Nuclear Science and Technology Organisation, May 2007 (ANSTO 2007);*
- *Detailed Contamination Assessment, Auburn Hospital Stage 1B, Corner of Hargrave and Norval Street, Auburn, Douglas Partners Pty Ltd, April 2009 (DP 2009a); and*
- *Remedial Action Plan – Area 1B, Auburn Hospital, Norval Street, Auburn, Douglas Partners Pty Ltd, May 2009 (DP 2009b).*

1.5 Site Inspections

The site was inspected on the date shown in **Table 1.1**.

Table 1.1 Summary of Audit Inspections

Date	Attendance	Purpose
30 th January 2007	Andrew Lau – JBS Environmental Pty Ltd Andrew Debeck – Multiplex Constructions Pty Ltd Allan Young – Multiplex Constructions Pty Ltd	Initial site inspection (pre demolition)
24 th July 2007	Andrew Lau – JBS Environmental Pty Ltd Andrew Debeck – Multiplex Constructions Pty Ltd	Detailed site inspection
10 th March 2008	Andrew Lau – JBS Environmental Pty Ltd	Additional Site inspection

1.6 Chronology of Site Assessment and Audit Works

The process of site assessment, Auditor review and preparation of final audit undertaken at the site has been summarised in **Table 1.2**.

Table 1.2 Summary of Assessment and Audits Works Undertaken at the Site

Date	Action
May 2006	Preparation of a Heritage Report for the Auburn Hospital complex (Weir & Phillips 2006)
September 2006	Completion of Hazardous Materials Building Survey (DP 2006a)
October 2006	Preparation of Preliminary Contamination Assessment (DP 2006b)
March 2007	Commencement of Site Audit
April 2007	Completion of additional asbestos assessment within buildings (AirSafe 2007)
May 2007	Completion of a radiological survey by ANSTO, targeting the interior of the buildings and the outside grounds area, following review of sampling plan by Site Auditor
April 2009	Completion of Detailed Contamination Assessment (DP 2009a) following review of sampling plan by Site Auditor
May 2009	Completion of Remedial Action Plan (DP 2009b) following review and comment by Site Auditor
June 2009	Preparation of Site Audit Statement and Site Audit Report (JBS 2009)
June 2009	Anticipated commencement of remediation and validation works

2 Site Description

2.1 Site Identification

The site details have been summarised in **Table 2.1** and described in further detail in the following sections. Plans identifying the subject site have been presented in **Appendix C**. The site location and layout is shown in **Appendix D**.

Table 2.1 Summary Site Details – Area 1B

Street Address:	'Area 1B' forms part of the Auburn Hospital Complex which is located on the corner of Hargrave Road and Norval Street Auburn NSW 2144
Property Description:	Lots 8-13 and Part Lots 7 and 14, Section 4, DP 873.
Parish:	Liberty Plains
County:	Cumberland
Local Government Area:	Auburn
Property Size:	8,500 m ²
Zoning:	Residential 2(b) Medium Density
Existing Use	Formerly used as a hospital with associated grounds areas. The site is still being used as a hospital facility.
Proposed Use	Continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas

2.2 Site Condition

The site is generally rectangular in shape and the layout of the site (DP 2009a) is provided in **Appendix D**. At the time of the site investigations, the consultant (DP 2009a) reported that the main features of Area 1B included:

- The main hospital building, comprising an "L" shaped 7 – 8 storey building;
- A smaller, 2 storey extension to the north of the main hospital building;
- Demountable sheds in the northwestern corner of the site, following the demolition of other parts of the hospital as part of the site redevelopment;
- A small retaining wall along the Norval Street boundary, which is approximately 0.5 m higher than the adjacent street level;
- Vegetated areas including grass and scattered trees, with a number of park benches and a carparking area; and
- Generators, transformers and oxygen tanks were formerly located within the north-eastern corner of the site.

The consultant did not identify any evidence of underground tanks within Stage 1B. A garbage compactor was observed to be present in the southeastern corner of Stage 1B with some evidence of iron staining on the concrete pavement surface, reportedly due to garbage containers. There was no reported evidence of disturbed or stressed vegetation.

2.3 Topography

The consultant (DP 2009a) reported that the majority of the site was level with a slight downward gradient towards the north east. Evidence of cutting was reported on the eastern site of the site, along with evidence of minor filling along the northern boundary of the site.

2.4 Geology

The consultant (DP 2009a) undertook a review of published geological information. The regional geology was identified as the Wianamatta Group comprising Ashfield Shale and

Bringelly Shale. This formation comprises shale with occasional claystone, laminite and coal laminite with dark grey siltstone.

The soil landscapes encompass *Red and Brown Podzolic* soils that are shallow to moderately deep (<100cm). In areas of lower slopes and in areas of poor drainage *Yellow Podzolic* soils and *Soloths* are dominant within these areas. Based on the site elevation, the soil type identified at the site is residual clay.

The consultant identified that the site lies in an area that has a moderate to high salinity potential, based on published information from the Department of Water and Energy (DWE).

Typical soil conditions encountered on the site during investigation works (DP 2009a) are summarised in **Table 2.2**.

Table 2.2 Summary Site Geology

Depth (m)	Material Type	Material Description
0 - 0.5	Fill	Topsoil underlain by crushed shale and clay fill materials, which included ash/slag and building rubble in parts of the site (particularly western portion)
0.5 - 1.5 m	Clay	Silty clay, red brown to mottled grey brown, with ironstone gravels
1.0 - 6.0 m	Shale	Shale bedrock interbedded with layers of silty clay bands at varying depths
5.0 - 7.0	Siltstone / Laminite	Siltstone/Laminite, low to medium strength, moderately weathered, fractured

2.5 Hydrology

The consultant (DP 2009a) reported that any site surface water would flow to the east following the site topography, upon which it would be diverted to the stormwater drainage systems located on Water Street, Hevington and Hargrave Roads.

It is noted that historical information revealed that localised flooding occurred within the area in 1951.

The consultant (DP 2009a) identified the presence of two surface water bodies in the vicinity of the site. These include Duck Creek located approximately 1.7km west of the site and Haslams Creek located approximately 1km northeast of the site. Haslams Creek discharges into Homebush Bay.

2.6 Hydrogeology

The consultant (DP 2009a) completed a search of the groundwater bore information from the Department of Natural Resources (DNR). The search revealed the presence of 15 groundwater bores within a 3 km radius of the site. Relevant bore data information is summarised as follows:

- The identified groundwater bores (GW102644, GW102646, GW102647, GW102649-GW102660) were all installed for monitoring purposes only.
- The total bore depth ranged from 8.0m to 25.0m
- The standing water level in these bores ranged from 1.0m to 10.0m. The water bearing zone was generally encountered within the underlying siltstone and shale bedrock.
- A review of the bore data reveals that siltstone and shale bedrock was encountered at depths of 5m to 25m.

- The salinity for groundwater bores (GW102644, GW102647, GW102650, GW102654, GW102655, GW102656, GW102659, GW102660) ranged from 1,360 mg/L to 6,430 mg/L. However the salinity in the remaining bores was generally highly saline with levels greater than 10,000 mg/L.
- Information regarding bore yield was not available.

The consultant (DP 2009a) identified that, based on previous groundwater investigations and topography, that groundwater would be expected to flow in a generally northeasterly direction. The consultant (DP 2009a) reported some variability in groundwater flow direction, with a localised groundwater trough thought to be generated through the basement formation.

2.7 Local Meteorology

The consultant (DP 2009a) did not provide any information regarding the local meteorology. However, information obtained from a previous report on an adjoining part of the hospital site (EAW 2007d¹) indicated the climate was temperate, with an annual rainfall of approximately 1,020 mm.

2.8 Surrounding Environment

The consultant (DP 2009a) reported that the surrounding landuses were predominantly residential. However it is noted that Hargrave Road, Hevington Road and Water Street are located to the west, east and south of the site, respectively; Civic Park to the west of the site beyond Hargrave Road; with the main Auburn Hospital building located to the north of the site.

The consultant has identified that the surrounding properties have historically been used for residential purposes.

2.9 Audit Findings

The information provided by the consultant (DP 2009a) in regards to the site condition and surrounding environment has been checked against, and meets the requirements of EPA 1997. The information provided was also consistent with the observations made by the Site Auditor during the site inspection.

Overall, the information provided by the consultant (DP 2009a) in relation to site condition and the surrounding environment is considered adequate for the purposes of assessing the suitability of the site for the intended purposes.

¹ Detailed Contamination Investigation of Area1A and Water Street Residences, Auburn Hospital, Auburn, NSW, Earth Air Water Consulting and Monitoring Pty Ltd, August 2007 (EAW 2007d)

3 Site History

3.1 Site History Information Sources

The consultant (DP 2009a) reviewed historical data published in historical accounts of the area and supplemented with additional information from available sources. Historical information relating to the site has been obtained from the following sources:

- *Heritage Report, Auburn Hospital*, prepared by Weir and Phillips, May 2006;
- Aerial Photographs (1930, 1950, 1961, 1970 and 2005);
- Historical title search;
- Council information (review of s.149 certificates);
- NSW DEC records; and
- WorkCover dangerous goods licensing records.

In relation to potential radiation sources remaining at the site, the consultant (ANSTO 2007) obtained historical information from the following specific sources:

- Sales and dispatch records from ANSTO's Australian Radioisotopes Industries, which was reported as being Australia's major manufacturer and supplier of radioisotopes;
- Interview and documentation of responses from Auburn Hospital's appointed radiation safety officer, Mr Lee Collins;
- Interview and documentation of responses from Auburn Hospital staff on their knowledge of practices undertaken in the past involving radioactive material or procedures; and
- Direct observations of practices during the site survey work (e.g., signage in relation to short lived radioisotope Technetium-99m imaging sign in the Arthur Stone Annex.

3.2 Summary Site History

The consultants (DP 2009a and ANSTO 2007) reported the history of the site as follows:

Table 3.1 Summary of Site History (DP 2009a and ANSTO 2007)

Year	Site Use / Observations
1907	A small cottage building was constructed on the site and the Auburn Hospital commenced operations as a health care facility. The original Hospital building has been demolished and the location of the original building is unknown.
1930s	The Auburn Hospital complex underwent extension and re-development of the grounds area. The 1951 aerial photograph indicates that the Hospital buildings constructed in the 1930s are mainly located within the north-western corner of the site. The remaining Hospital area forms the general grounds area of the Hospital.
1960s	The Auburn Hospital complex was again re-developed to include the site existing site features and infrastructure (i.e., prior to the current demolition and re-development works). The aerial photographs indicate that the Hospital layout remains relatively unchanged until present day. It is noted that some of the original buildings constructed in the 1930s (i.e., located within the north-western corner of the site) were demolished. This area was replaced with garden / grounds area and forms the main entrance to the Hospital.
1978-1982	A review of the aerial photographs indicates the presence of small additions to the site. It is noted that the addition of the annex to the north of the nurses accommodation and construction of the swimming pool was completed during this period.
2007	Commencement of site re-development works.

3.3 Regulatory Searches

The consultant (DP 2009a) undertook a search of Auburn City Council records. No building approval information or specific information on when zoning was approved was available. Information from the s.149 certificate indicates that the site is currently zoned Residential 2(b) Medium Density under the Auburn City Council Local Environment Plan 2000. However it is understood that the boundaries of the Hospital will be redefined to include the Water Street Residences under the 'Special Uses' Zoning of the Auburn Hospital.

A search of the WorkCover Dangerous Goods Licensing Register was undertaken by the consultant (DP 2009a). The search revealed that records for the storage of dangerous goods at Auburn Hospital dates back to 1971, including type, volume and location of chemicals stored at the site. The records also contain site sketches from 1971, 1977, 1996, 1998 and 2003 showing the locations of the chemicals stored onsite and the location of a former UST. A review of the WorkCover records indicates that a license for Class 2.2 liquid oxygen is held for the main grounds of the Auburn Hospital complex.

These Dangerous Goods storages were located outside Stage 1B and have been previously remediated and validated as part of the redevelopment of the Auburn Hospital complex.

A search of the NSW DECC's contaminated land database by the consultant (DP 2009a) did not reveal any records of land contamination issues being regulated by the DECC within the site or the immediate vicinity.

Information obtained as part of a previous investigation (EAW 2007d) identified that the Sydney West Area Health Service at Auburn Hospital holds a 'Waste Generation or Storage of Hazardous, Industrial or Group A' license (# 11683). The wastes prescribed under this license are stored in the loading dock area within the portion of the Auburn Hospital complex identified as Area 1B. The license is in relation to medical wastes removed on a daily basis. The consultants noted that wastes are not stored on site.

Relevant information from the Heritage Report (Weir and Phillips 2006) states that Auburn Hospital has been identified as an item of regional historic and social significance owing to its association with the provision of health care to the community.

The consultant (ANSTO 2007) obtained a written response from DECC which identified that "...the DECC database does not show any premises on which a radioactive substance is kept or any device containing a radioactive substance ever being registered with DECC at this [Auburn Hospital] location."

3.4 Site Interviews

The consultant (ANSTO 2007) interviewed a number of Auburn Hospital staff and the radiation safety officer in relation to the potential for radiation contamination at the site. The interviewer concluded that only short lived radioisotopes Tc-99m, I-131 and Co-57 were used across Auburn Hospital, with the potential for a long-lived (30 yr half life) 40MBq Cs-137 source that may have been used as a check source for calibration purposes.

3.5 Sewer and Service Plans

Information obtained from a previous investigation (EAW 2007d) identified that the majority of major services, including power, water, sewer and some stormwater) were confined to suspended piping within service tunnels under the main Hospital building,

which is located within the Stage 1B portion of the site. The consultant noted that the abovementioned services were suspended from the roof of the service tunnels, negating any potential risk associated with migration pathways for contamination.

3.6 Audit Findings

The site history information provided by the consultants (DP 2009a, EAW 2007d and ANSTO 2007) has been checked against, and meets the requirements of, EPA 1997.

The extent of site history information presented by the consultants (DP 2009a, Weir and Phillips 2006, EAW 2007d and ANSTO 2007) is considered adequately complete for the purposes of identifying potential contamination issues at the site as part of the site investigation process.

4 Potential Contamination Issues

4.1 Potential Contamination Issues

Based on the site history review and site inspection, the consultant (DP 2009a) did not identify specific contamination sources or areas of concern and therefore adopted a broad suite of potential contaminants of concern:

- Heavy metals (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), zinc (Zn));
- Petroleum hydrocarbons (TPH);
- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX);
- Polycyclic Aromatic Hydrocarbons (PAHs) including benzo(a)pyrene;
- Organochlorine Pesticides (OCPs);
- Organophosphate Pesticides (OPPs);
- Phenols;
- Polychlorinated Biphenyls (PCBs); and
- Asbestos.

In relation to potential radiation contamination, the consultant (ANSTO 2007) identified the following potential radionuclides for which specific anecdotal information was obtained:

- Tc-99m (gamma emitter);
- I-131 (beta/gamma emitter);
- Co-57 (gamma emitter); and
- Cs-137 (beta emitter).

In addition, consideration was also given by the consultant (ANSTO 2007) to a number of other potential radionuclides which are typically associated with hospitals:

- H-3 (tritium) (low energy beta emitter);
- C-14 (low energy beta emitter);
- Ba-133 (gamma emitter);
- Co-60 (beta/gamma emitter);
- Ra-226 (alpha/gamma emitter, with decay products including Rn-222, Pb-214, Bi-214, Po-214, Pb-210, Bi-210 and Po-210);
- S-35 (beta emitter);
- I-125 (gamma emitter);
- Fe-59 (beta/gamma emitter);
- Cr-51 (gamma emitter); and
- P-32 (beta emitter).

An Asbestos Building Material Assessment (Airsafe 2007) was undertaken on the a number of buildings located across the Auburn Hospital complex, including the pathology, ward block, nurses quarter, boiler room, service corridor, kitchen, carpenters and maintenance workshops. The survey also included an assessment of the main Hospital Building located within the portion of the site identified as Area 1B.

Findings from this assessment indicated the presence of asbestos containing materials in the building structures and numerous service pipes. It is also noted that soil samples collected from beneath the sub-floor (which contained numerous fibrous insulated service pipes) in the nurses quarter, pathology building, boiler room and service corridor also detected asbestos. The vertical extent of the asbestos contamination beneath the sub-floor in these buildings is unknown.

4.2 Potentially Contaminated Media

The consultants (DP 2009a and ANSTO 2007) have identified that potential contaminants where present would occur mainly in fill materials and in underlying natural soils, as the identified contaminants of concern are most likely present in a solid (i.e., fill and asbestos) rather than a liquid form. However, the consultant also considered that groundwater may also act as a potentially contaminated media, particularly given previous TPH/PAH contamination identified in groundwater in other parts of the Auburn Hospital complex associated with the former UST.

Information provided as part of a previous investigation (EAW 2007d) noted that the majority of major services, including power, water, sewer and some stormwater) were confined to suspended piping within service tunnels under the main Hospital building, which is located within Stage 1B. The consultant concluded that as the services were suspended from the roof of the service tunnels, any potential risk associated with migration pathways for contamination was considered not to be an issue at the site.

4.3 Audit Findings

The consultants (DP 2009a and ANSTO 2007) identified a number of potential contaminants based on the findings of the site history review and the site inspection conducted as part of the initial investigations.

Whilst specific potential sources of contamination were not identified by the consultants (DP 2009a and ANSTO 2007), the list of potential contaminants is considered to have been suitably comprehensive noting the site history.

In relation to the identified potential radionuclide contaminants of concern, advice was sought from the Auditor's nominated support team member for radiation, Mr Roger Alsop, which confirmed that the identified radionuclides were appropriate based on the site history and for hospitals in general.

It is noted that the consultant (DP 2009a) did not take into consideration potential impacts to sediments and surface water bodies in the vicinity of the site. However, based on the absence of creeks or rivers transecting the site or located within the immediate vicinity of the site this is considered not to be an issue. Based on this, the potentially contaminated media (i.e., soil and groundwater) identified and investigated by the consultants are considered appropriate for assessing the suitability of the site for the intended uses.

5 Sampling Analytical and Quality Program

5.1 Sampling / Analytical Regime

The sampling/analytical regimes adopted as part of the site investigation (DP 2009a and ANSTO 2007) are summarised in **Table 5.1** and **Table 5.2**.

The sample locations are shown on the consultants' sample diagram provided in **Appendix D**.

Table 5.1 Summary of Soil Sampling / Analytical Schedule (DP 2009a)

Media	Area	No. Sampling Locations	General Depth Intervals (m)	Sampling Regime	No. Analyses (not incl QA / QC)
Fill / Soil	Area 1B 8,500 m ²	21	0 – 0.1 0.3-0.5 0.5-0.7 1.8 – 2.0	Systematic	Metals – 38 TPH – 38 BTEX – 38 PAHs – 39 OCPs – 23 OPPs – 10 PCBs – 22 Phenols – 22 VOCs – 10 Asbestos – 26
G'Water	-	5	16m (maximum drilling depth)	-	Metals – 5 TPH – 5 PAHs – 5 OCPs – 5 OPPs – 5 Phenols – 5 VOCs – 5 PCBs – 5

Table 5.2 Summary of Soil Sampling / Analytical Schedule (ANSTO 2007)

Media	Area	No. Sampling Locations	General Depth Intervals (m)	Sampling Regime	No. Analyses (not incl QA / QC)
Fill / Soil	Area 1B 8,500 m ²	10 systematic	0.05 – 0.10	Grid based	Bulk Gamma – 17 Low energy Beta – 5 Gross alpha/beta – 5 Gamma radiation – 5

Note: The number of ANSTO 2007 samples collected and analysed for the site include samples taken from Stage 1A of the hospital site as well (i.e., outside the boundaries which form the subject of this audit). However, sample location descriptions provided by ANSTO were insufficient to separate those samples collected from Stage 1A and Stage 1B, hence the need to include both in Table 5.2.

5.2 Sampling Methodology

5.2.1 Soil Investigation

The consultant (DP 2009a) reported that samples were collected according to the following procedures:

- Soil samples from accessible parts of the site were obtained using a bobcat mounted drill rig using solid flight augers. Samples were collected directly from the auger flights.
- Soil samples from parts of the site inaccessible to the drill rig (e.g., around buildings/services) were obtained via handauger. Soil samples were collected using new disposable nitrile gloves for each sample.

- Soil samples were immediately placed in glass sample jars which were sealed tight and placed on ice for transport to the analytical laboratories.
- Soil samples collected during the site assessment program were reportedly screened with a photo-ionisation detector (PID). The method of screening and screening results are detailed in the consultant's report (DP 2009a). Calibration documentation was provided by the consultant for the PID.
- Bore logs from soil sampling works were included in the site investigation reports (DP 2009a), which contained information on the soil type, colour, texture and other relevant observations.

5.2.2 Groundwater Investigation

The consultant (DP 2009a) sampled groundwater at four existing and one newly installed groundwater monitoring wells at the site. All monitoring wells were constructed out of Class 18 PVC screen and casing.

The existing monitoring wells were installed as part of the previous investigations undertaken in the other parts of the hospital complex. Information obtained from the previous investigation report (EAW 2007d) indicates that the groundwater monitoring wells were installed to a maximum depth of 16m below ground surface. The existing monitoring wells were installed using a truck mounted drilling rig with a compressed 'air hammer' to drill through the shale bedrock formation.

Existing monitoring well GW6 was installed to a maximum depth of 16m, targeting the lower strength, fractured shale formation. The previous consultant (EAW 2007d) reported that this bore was screened between 12 m – 15 m below ground level. A bentonite seal was provided at a depth of approximately 8.5 m - 11.5 m, with 2 mm -3 mm graded sand surrounding the well annulus around the slotted screen section.

The remaining existing monitoring wells (GW12, GW13 & GW15) were installed to a maximum depth of 6.5m, targeting the 'fresh', high strength shale bedrock and any groundwater likely to be associated with the upper shale bedrock formation. The previous consultant (EAW 2007d) reported that these bores were screened to depths of approximately 3 m - 6.0 m below ground level. A bentonite seal was provided at a depth of approximately 2.5 m – 3 m, with 2 mm – 3 mm graded sand surrounding the well annulus around the slotted screen section.

The newly installed monitoring well (201-GW) was installed to a reported depth of 15 m, with a screened interval of 9 m – 15 m. A bentonite seal was provided at a depth of approximately 7 m – 9 m, with 2 mm - 3 mm graded sand surrounding the well annulus around the slotted screen section.

The previous consultant (EAW 2007d) noted that groundwater did not accumulate within the monitoring wells immediately following installation. Based on the low yield of the underlying aquifer, well development subsequent to installation did not occur in all wells.

Purging (where completed) and sampling of the monitoring wells was undertaken by the consultant (DP 2009a) using a low flow pump and disposable tubing. The groundwater samples were placed into appropriately preserved containers provided by the laboratory. The groundwater sample bottles were stored in a chilled ice chest prior to and during transport to the testing laboratory. Groundwater samples destined for metal analyses were reportedly field filtered using a sterilized 0.45 µm filter.

5.2.3 Radiation Survey

Prior to the collection of soil samples for radionuclide analyses, a radiological survey was carried out across the site using direct probe monitoring techniques with areas swept in 1 m strips outside the buildings and within each of the site buildings on a room-to-room basis to enable complete site coverage. The instruments used in the survey included:

- Eberline E-600 MTE 2568, a high sensitivity gamma detector;
- Mini Instruments Type 1500 MTE 1963, an alpha and beta detector;
- Target Field MTE 2357, nuclide identification, dose rate, count rate capability; and
- ROTEM RAM R-200 MTE 2591, measures ionising radiation (gamma exposure rates).

The instruments were reported as being calibrated annually at ANSTO to a traceable standard and, in the case of contamination monitors, subject to daily response checks, details of which were provided in the report by the consultant (ANSTO 2007).

Soil samples were collected from grid-based locations at a depth of 0.05 – 0.10 m and included samples taken from drainage locations or low points where radioactive material may have concentrated over time. A minimum volume of 200 g of soil was collected using new disposable gloves at each location, and placed in to uniquely identified sealed plastic bags for field storage and transfer to the testing laboratories under chain of custody conditions.

5.3 Laboratory Methods

The consultant (DP 2009a) used laboratories which were NATA accredited for the chemical analyses undertaken. Envirolab Services at Chatswood NSW was the primary analytical laboratory and Labmark at Asquith NSW was the secondary (check) laboratory.

The consultant (ANSTO 2007) had the soil samples analysed for radionuclide contamination at the ANSTO facilities, with inter-laboratory samples sent to Western Radiation Services.

The methods used by the primary laboratories as part of the site investigation program are shown in **Table 5.3**. Comparable methods were used by the secondary laboratories.

Table 5.3 Laboratory Methods Used in Site Investigation (DP 2009a and ANSTO 2007)

	Limit of Reporting		Laboratory Method
	Soil (mg/kg)	Water (µg/L)	
METALS			
Arsenic	0.5-5	1	ICP-MS
Cadmium	0.5-1	0.1	ICP-MS
Chromium (Total)	0.5-1	1	ICP-MS
Copper	0.5-5	1	ICP-MS
Nickel	0.5-5	1	ICP-MS
Lead	0.5-5	1	ICP-MS
Zinc	0.5-2	5	ICP-MS
Mercury (inorganic)	0.005-0.1	0.1	ICP-FIMS
PETROLEUM HYDROCARBONS			
C ₆ – C ₉ Fraction	10 – 25	20	Purge Trap-GC/MS
C ₁₀ – C ₃₆ Fraction	250	200	Purge Trap-GC/FID
BTEX			
Benzene	0.2-0.5	1	Purge Trap-GC/MS
Toluene	0.5	2	Purge Trap-GC/MS
Ethylbenzene	0.5-1.0	2	Purge Trap-GC/MS
Total Xylenes	1-3	4	Purge Trap-GC/MS
POLYCYCLIC AROMATIC HYDROCARBONS			
Benzo(a)pyrene	0.05-0.5	0.5	GC/MS-SIM
Total PAH's	1.55-8	8	GC/MS-SIM
ORGANOCHLORINE PESTICIDES			
Aldrin + Dieldrin	0.1	1.0	GC/MS
Chlordane	0.05	0.5	GC/MS
DDT + DDD + DDE	0.3	3.0	GC/MS
Heptachlor	0.05	0.5	GC/MS
ORGANOPHOSPHATE PESTICIDES			
(individual OPPs)	0.05-0.2	0.5-2.0	GCMS
PCBs			
PCBs (total)	0.1	1.0	GC/MS
PHENOLS			
Phenolic Compounds	0.5-1.0	0.2-1.0	GC/MS
DIOXINS (units pg/g)			
Dioxins – Individual	0.25-2.5	-	GC/HRMS
Dioxins – Total	0.25-2.5	-	
RADIONUCLIDES			
Gross alpha and beta radiation	-	-	ANSTO Method (ENV-I-044-001 Alpha Spec)
Low energy beta radiation	-	-	ANSTO Method (HOR-I-09.1.18 Liquid Scintillation Counting)
Gamma radiation	-	-	ANSTO Method (ENV-052-005 ²²⁶ Ra Gamma Ray Spectrometry)
OTHER			
Asbestos	Presence	N/A	PLM / Dispersion Staining

5.4 Quality Assurance / Quality Control (QA/QC)

The consultants (DP 2009a and ANSTO 2007) developed pre-determined data quality indicators broadly based on the seven step process referred to in DEC 2006. Both a field and laboratory quality assurance/quality control (QA/QC) program was conducted during the site investigation works. Field QA/QC consisted of the following procedures:

- New (disposable) sampling equipment used where possible for each sampling location;
- Equipment decontamination between sampling locations using phosphate free detergent and water;

- Collection and analysis of 'blind duplicate' samples for a suite of potential chemicals of concern (intra or 'within' laboratory duplicates);
- Collection and analysis of 'split duplicate' soil samples for a suite of potential chemicals of concern (interlaboratory duplicates);
- Inclusion of a rinsate sample to assess decontamination between sampling locations during the soil sampling program;
- Inclusion of trip blank samples collected during the soil sampling program; and
- Transporting samples in ice-cooled chests, under chain of custody conditions, to laboratories that were NATA accredited for the analysis performed.

Laboratory QA/QC consisted of the following procedures:

- Analysis and reporting of laboratory duplicate samples;
- Analysis and reporting of laboratory method blank samples;
- Analysis and reporting of laboratory control samples;
- Analysis and reporting of laboratory control spikes, matrix and surrogate spikes.

The QA/QC undertaken by the consultant(s) has been reviewed and summarised in **Table 5.4** against the PARCC parameters (precision, accuracy, representativeness, comparability and completeness).

Table 5.4 Investigation QA/QC summary (DP 2009a and ANSTO 2007)

Quality Indicator	Reported results	Meets the requirements of Site Audit?
Precision		
Intra-laboratory (blind) duplicates	<u>Soil</u> Frequency = 3/38 primary samples RPDs = 0% - 67%	Yes ¹
	<u>Groundwater</u> Frequency = 1/5 primary samples RPDs = 0% - 37%	
Inter-laboratory (split) duplicates	<u>Soil</u> Frequency = 2/38 primary samples RPDs = 0% - 35%	Yes
	<u>Groundwater</u> Frequency = 1/5 primary samples RPDs = 0% - 13%	
Laboratory Duplicates	Frequency = 1/batch of 20 samples RPDs = 0% - 75%	Yes ¹
Accuracy		
Matrix Spike	65% - 130%	Yes
Surrogate Spikes	62% - 140%	Yes
Representativeness		
Sampling appropriate for media and analytes	Samples were generally collected using appropriate methods	Yes ¹
Rinsate blanks	<LOR	Yes
Trip spike	94% - 107%	Yes
Trip blank	<LOR for volatile substances	Yes
Laboratory blanks	<LOR for all reported sample batches	Yes
Samples extracted and analysed within holding times.	All samples extracted and analysed within holding times	Yes
Comparability		
Standard operating procedures used for sample collection and handling	Suitable description of sampling procedures provided	Yes
Standard analytical methods used for all analyses	Analytical methods were referenced and generally NATA Accredited	Yes ¹
Consistent field conditions, sampling staff and laboratory analysis	Project team were identified and single primary laboratory used	Yes
Limits of reporting appropriate and consistent	Reporting limits were less than the site criteria	Yes
Completeness		

Quality Indicator	Reported results	Meets the requirements of Site Audit?
Soil logs completed and appropriate	Complete & appropriate soil logs in report	Yes
Appropriate & complete COC documentation	Complete & appropriate COCs in report	Yes
Satisfactory frequency and result for QC samples	The frequency and results reported as acceptable	Yes
Data from critical samples valid	Critical sample data is considered valid	Yes

1. See discussion in Section 5.5.

5.5 Audit Findings

The number of soil sampling locations adopted by the consultants (DP 2009a and ANSTO 2007) during the intrusive investigation works generally provided sufficient coverage of the site noting the potential areas of concern and associated COPCs identified as part of the site history review, whilst taking into consideration the gaps in such information. The number of sampling locations met the minimum requirements outlined in EPA 1995. However, some parts of the site (e.g., beneath the demountable buildings) were not accessible for components of the radiation survey and the consultant (ANSTO 2007) made appropriate recommendations that this data gap be addressed as part of the site remediation/validation process.

The sample intervals at each of the sampling locations were appropriate given the identified potential contamination sources at the site and the site geology. The sample depths were also appropriate to assess the vertical extent of contamination at the site.

Whilst samples were generally collected using appropriate methods, the consultant (DP 2009a) reported that soil samples were collected directly from the solid flight augers in the initial sampling round. It is noted that this sampling method is not appropriate when volatile compounds are included in the contaminants of potential concern. However, based on the general absence of volatile contaminants being identified during this and previous works in other parts of the hospital complex, and the relatively low PID readings available for each sampling locations, the potential for any volatile loss due to sampling technique to significantly affect the outcomes of the investigation is considered low.

The analytical schedule is considered appropriately complete given the site history and the identified potential contaminants of concern.

The primary laboratory (Envirolab) and the secondary laboratory (Labmark) employed for the chemical analyses used analytical methods which were considered appropriate for the identified contaminants of concern at the site and were NATA accredited. The laboratory methods employed for the radionuclide analyses by the primary radiation testing laboratory (ANSTO) were not NATA accredited, however, the check radiation laboratory (Western Radiation Services) did use NATA accredited methods. Consultation with the Auditor's nominated support team member for radiation, Mr Roger Alsop, confirmed that the radionuclide analyses were appropriate for the identified radionuclides of concern.

Sufficient intra-laboratory and inter-laboratory duplicates were collected and analysed as part of the site investigation program. The RPDs calculated for the intra-laboratory soil duplicates ranged between 0% - 67%. The RPDs calculated for the intra-laboratory duplicates were generally within the DQI of 50%, with only a single RPD exceeding this DQI associated with low concentrations of mercury (0.1 mg/kg - 0.2 mg/kg).

The consultant (DP 2008a) attributed the elevated RPD to analyte concentrations being low or close to the laboratory detection limits and sample heterogeneity. Given that the reported concentrations of this potential contaminant was below the adopted assessment

levels and the fact that the samples were obtained from fill materials, the auditor accepts the consultants explanation of the higher than expected RPD and is of the opinion that the isolated elevated RPD result does not effect the overall reliability of the analytical data.

The RPDs calculated for the inter-laboratory soil duplicates and both the intra and inter laboratory groundwater duplicates were within the DQI of 50%.

The interlaboratory duplicates for the radionuclide analyses indicated consistent performance of both the primary and secondary radionuclide testing laboratory, noting that the primary laboratory (ANSTO) was not NATA accredited for the methods used. As such, the data obtained from the radiation sample analytical program is considered adequate for the purposes of the site audit, noting the relatively low potential for radionuclide contamination at the site based on the site history.

The internal laboratory duplicates analysed by the primary laboratory were generally within the control limits of 50% with the exception of a single Fluoranthene (55%), a single nickel (75%) and a single chromium (56%) result. In each instance, the concentrations were low and significantly less than the assessment criteria, and like the field duplicate RPD results are most likely due to sample heterogeneity associated with the sample (fill) matrix. Overall, however, the internal laboratory duplicates do not indicate a sustained pattern of reduced precision by the testing laboratory and are considered not to affect the overall reliability of the analytical data.

All matrix spike recoveries and surrogate spike recoveries reported by the primary laboratory were within the control limits indicating that the accuracy of the results are acceptable for assessing the suitability of the environmental condition of the site.

The field rinsate blanks, field trip blank and laboratory blanks were all less than the laboratory LORs, indicating no introduction of contamination or cross contamination during the field and analytical program.

Overall, the quality assurance/quality control measures employed by the consultant (DP 2009a and ANSTO 2007) were checked and found to adequately comply with the requirements outlined in EPA 1997 and NEPC 1999. The laboratory QA/QC results have been reviewed and the results indicate that the analytical laboratories were achieving adequate levels of precision and accuracy during the time when samples from the site were being analysed. As such, the sampling, analytical and quality protocols undertaken by the consultants (DP 2009a and ANSTO 2007) were considered satisfactory and the data are considered to be adequately reliable for the purpose of assessing the contamination status of the site, noting that inaccessible parts of the site which were unable to be included in the radiation survey are required to be addressed as part of the validation program.

6 Assessment Criteria

6.1 Soil Criteria

The proposed use of Area 1B is for continued hospital use, including a community health centre and associated carparking and landscaped areas.

The soil criteria used by the consultant during the investigation (DP 2009a) were a combination of the Health-based Investigation Levels for residential landuse with gardens and accessible soils (Column 1, DEC 2006), the provisional phytotoxicity-based investigation levels (Column 5, DEC 2006) and the Threshold Criteria for sensitive landuse from EPA 1994, as presented in **Table 6.1**.

Table 6.1 Soil Criteria (DP 2009a)

Substance	Health-Based Criteria ¹ (mg / kg)	Provisional Phytotoxicity Based Criteria ³ (mg / kg)
Arsenic	100	20
Cadmium	20	3
Chromium	100	400
Copper	1000	100
Lead	300	600
Mercury (inorganic)	15	1
Nickel	600	60
Zinc	7000	200
TPH C ₆ – C ₉	65 ²	-
TPH C ₁₀ – C ₃₆	1000 ²	-
Benzene	1 ²	1 ²
Toluene	130 ²	1.4
Ethyl benzene	50 ²	3.1 ²
Xylene	25 ²	14 ²
Benzo (a) pyrene	1	-
Total PAHs	20	-
Total PCBs	10	-
Aldrin+Dieldrin	10	-
Chlordane (cis and trans)	50	-
DDT+DDD+DDE	200	-
Total Phenols	8500	-
Asbestos	No asbestos in soil	-
Aesthetics	No odours or discolouration	-

Note 1: Health Based Investigation Levels for 'standard' residential with gardens and accessible soils (Column 1, DEC 2006)

Note 2: Threshold Concentrations for Sensitive Landuse (Table 3, EPA 1994)

Note 3: Provisional Phytotoxicity Based Investigation Levels (Column 5, DEC 2006)

In relation to radiation, the consultant (ANSTO 2007) adopted the following "clearance criteria":

- Where there are no reproducible levels of radiation detected above natural background (identified as a "critical limit" of counts with 95% confidence); or
- Reproducible radiation levels above background does not result in radiological exposure to a person greater than 0.03 mSv/yr above natural background levels.

The "critical limit" was determined based on Guidance Material number 6, p.34, Chapter 6, MARSSIM 2000².

² Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) US Environmental Protection Agency, US Department of Energy, US Department of Defence and US Nuclear Regulatory Commission. Revision 1, August 2000 (MARSSIM 2000)

6.2 Groundwater Criteria

The consultant (DP 2009a) adopted groundwater criteria based on the protection of fresh water aquatic ecosystems from ANZECC/ARMCANZ 2000 in addition to criteria from MHSPE 1994 and USEPA (Region IX) in the absence of trigger values in the primary reference source.

However, the consultant did not consider environmental values of the groundwater beneath the site when nominating the groundwater assessment criteria. For completeness and in accordance with the requirements of the DEC 2007, the Auditor has considered that environmental values of groundwater beneath the site include:

- Aquatic ecosystems of Haslams Creek, located approximately 1km northeast of the site; and
- Recreational use of Haslams Creek. It is noted that Haslams Creek eventually flows into Homebush Bay.

Based on the absence of any irrigation and drinking water groundwater bores within a 1km radius of the site; the low yield of the groundwater; and the high salinity of the groundwater beneath the site, it is considered that irrigation and drinking water are considered not to be significant environmental values for the groundwater beneath the site.

Based on the environmental values identified by the Auditor, the groundwater criteria used during the investigation were based on trigger values relating to the protection of "slightly to moderately disturbed ecosystems" (marine) based on 95% protection levels and recreational purposes (ANZECC/ARMCANZ 2000) as presented in **Table 6.2**.

Table 6.2 Groundwater Criteria

Substance	Trigger Values for protection of 95 % of marine water species ($\mu\text{g/L}$) ¹	Water Quality Guidelines for Recreational Purposes ($\mu\text{g/L}$) ⁵
Inorganics		
Arsenic (III)	2.3 ²	-
Arsenic (V)	4.5 ²	-
Arsenic	-	50
Cadmium	5.5	5
Chromium (III)	10 ³	-
Chromium (VI)	4.4	-
Total Chromium	-	50
Copper	1.8	-
Lead	4.4	50
Mercury	0.4	1
Manganese	80	100
Nickel	70	100
Zinc	15	5000
Total Petroleum Hydrocarbons (TPH)		
TPH (C ₆ -C ₃₆)	325 ⁴	-
BTEX		
Benzene	500	-
Toluene	180	-
Ethylbenzene	5	-
Xylene	625	-
Polycyclic Aromatic Hydrocarbons (PAHs)		
Naphthalene	50	-
Benzo(a)pyrene	0.2	0.01
Phenanthrene	2	-
Anthracene	0.4	-

Substance	Trigger Values for protection of 95 % of marine water species (µg / L) ¹	Water Quality Guidelines for Recreational Purposes (µg / L) ⁵
Fluoranthene	1.4	-
Phenols		
Pentachlorophenol	-	10
2,4,5-Trichlorophenol	-	1
2,4,6-Trichlorophenol	-	10
2,4-Dimethylphenol	2	-
Phenol	400	-
Polychlorinated Biphenyls		
PCBs	0.01	0.1
Organochlorine Pesticides (OCPs)		
Aldrin	0.003 ²	1
Heptachlor	0.0004 ²	3
Endosulfan	0.005 ²	40
Dieldrin	0.01 ²	1
Endrin	0.008 ²	1
DDE	0.0005 ²	
DDT	0.0004 ²	3
Chlordane	0.001 ²	
Organophosphorus Pesticides (OPPs)		
Dichlorvos	-	20
Demeton-S-methyl	4 ²	30
Monocrotophos	-	2
Dimethoate	-	100
Diazinon	0.01 ²	10
Parathion-methyl	0.004 ²	6
Chlorpyrifos	0.009 ²	2
Primphos-ethyl	-	1
Chlorfenvinphos	-	10
Bromophos-ethyl	-	20
Ethion	-	6
Carbophenothion	-	1
Azinphos Methyl	0.01 ²	10

Note: 1. ANZECC/AMRCANZ (2000) 'Australian and New Zealand Guidelines for Fresh and Marine Water' – Protection of Marine Species, 95% Protection Level
 2. ANZECC/AMRCANZ (2000) 'Australian and New Zealand Guidelines for Fresh and Marine Water' – Protection of Marine Species, Low Reliability Trigger Values
 3. ANZECC/AMRCANZ (2000) 'Australian and New Zealand Guidelines for Fresh and Marine Water' – Protection of Marine Species, Moderate Reliability Trigger Values
 4. Dutch Intervention Guidelines – for initial comparison only.
 5. ANZECC/AMRCANZ (2000) – 'Australian and New Zealand Guidelines for Fresh and Marine Water' – Guidelines for Recreational Water Quality and Aesthetics.

6.3 Audit Findings

The chemical soil criteria adopted by the consultant (DP 2009a) are endorsed by the DECC and are considered adequately conservative for investigating the suitability of the site for the proposed use of the site, i.e., continued hospital use and community health centre and associated carparks/landscaped areas. It is noted that the proposed development includes a community hub and there was some uncertainty as to whether this might involve child care facilities, so the consultant appropriately adopted the most sensitive health-based criteria (HIL-A) which includes consideration of children's day care centres.

In the absence of a NSW DECC criterion for asbestos, the consultant adopted a "no asbestos in soil" criterion, which is considered by the auditor to be adequately conservative.

The consultant (DP 2009a) also took into consideration aesthetic issues (i.e., odours and discolouration) as part of the site assessment criteria.

It is the auditor's understanding that there are no currently DECC endorsed criteria for radiation in soils with the exception of a circa 1986 NSW Health Department advice in relation to annual acceptable doses applicable to site involving mineral sands. As such, advice was sought from the Auditor's nominated support team member for radiation, Mr Roger Alsop, who indicated that the consultant's adopted "clearance criteria" for radiation were appropriate for the purposes of the site investigation, and based on internationally endorsed protocols, as articulated in MARSSIM 2000. Hence, the radiation criteria adopted as part of the site investigation process are considered adequately conservative for assessing the suitability of the site for the intended use.

The same soil investigation levels are also proposed to be used as the validation (i.e., clean up) criteria. While the use of the investigation levels for validation purposes may result in an overly conservative remediation outcome, the use of investigation criteria as validation criteria is considered adequately conservative and is considered to result in sufficient confidence that the levels of residual contamination in soil after remediation are unlikely to pose a risk to future site users.

The groundwater investigation criteria adopted by the consultant were based on the assumption that the nearest water body was a freshwater system. However it is noted that both Haslams Creek and Homebush Bay are marine water bodies. Based on this, the Auditor has revised the groundwater assessment criteria taking into account the ANZECC/AMRCANZ 2000 – Protection of Marine Species, 95% Protection Level, as presented in **Table 6.2**.

The consultant (DP 2009a) did not take into account all environmental values in accordance with DEC 2007. As such, the Auditor has included recreational values as part of the groundwater assessment criteria.

The consultant (DP 2009a) has taken into consideration visual amenity (i.e., odours or sheens) when assessing the groundwater data.

7 Site Investigation Results

7.1 Field Observations

Observations made by the consultants (DP 2009a and ANSTO 2007) during the site investigation included:

- A bituminous waterproof membrane was identified between the two concrete slabs (suspended) beneath the hospital building;
- Fill material beneath the hospital building generally comprised crushed shale and clay, however, timber and scrap metal was observed in one borehole;
- A damp area was observed in the sub-slab area beneath the main hospital, reportedly caused by a combination of stormwater accumulation and from a sewer overflow. It was also noted that this area had been sprayed for fleas prior to the site investigation (DP 2009a);
- Some brick pieces were observed in fill materials in the northern part of the site;
- Concrete, bricks, scrap metal and some ash/slag was observed in fill materials at a number of locations in the western portion of the site;
- All Photo Ionisation Detector (PID) results were consistent with background levels and <50 ppm;
- Groundwater was generally neutral and a number of monitoring wells had groundwater which was highly turbid;
- During the construction of monitoring well 201-GW, there was significant loss of drilling fluids reportedly due to joints/fractures in the rock;
- A review of the borelogs shows that no hydrocarbon odours or soil staining were noted during subsurface drilling;
- No hydrocarbon odours, sheens or phase separate hydrocarbons (PSH) were noted during on the groundwater during the sampling works.

7.2 Soil Investigation Results

The consultant provided summary results tables (**Appendix E**) in addition to detailed laboratory reports and chain of custody documentation. In comparison to the adopted soil criteria (**Section 6.1**), the following results were reported:

7.2.1 Metals

The total concentration of arsenic in the soil samples from across the site ranged from <4 mg/kg to 19 mg/kg, with no reported concentrations exceeding the adopted HIL-A or PIL criteria.

The total concentration of cadmium in the soil samples from across the site ranged from <0.5 mg/kg to 1 mg/kg, with no reported concentrations exceeding the adopted HIL-A or PIL criteria.

The total concentration of chromium in the soil samples from across the site ranged from 2 mg/kg to 48 mg/kg, with no reported concentrations exceeding the adopted HIL-A or PIL criteria.

The total concentration of copper in the soil samples from across the site ranged from 17 mg/kg to 49 mg/kg, with no reported concentrations exceeding the adopted HIL-A or PIL criteria.

The total concentration of lead in the soil samples from across the site ranged from 8 mg/kg to 170 mg/kg, with no reported concentrations exceeding the adopted HIL-A or PIL criteria.

The total concentration of mercury in the soil samples from across the site ranged from <0.1 mg/kg to 0.3 mg/kg, with no reported concentrations exceeding the adopted HIL-A or PIL criteria.

The total concentration of nickel in the soil samples from across the site ranged from 3 mg/kg to 110 mg/kg, with no reported concentrations exceeding the adopted HIL-A criterion. Two samples obtained from fill material (110 mg/kg at BH102/0.1 and 64 mg/kg at BH201/0.1) exceeded the PIL of 60 mg/kg.

The total concentration of zinc in the soil samples from across the site ranged from 10 mg/kg to 770 mg/kg, with no reported concentrations exceeding the adopted HIL-A criterion. Two samples obtained from fill material (650 mg/kg at BH203/0.5 and 770 mg/kg at BH220/0.4) exceeded the PIL of 200 mg/kg.

7.2.2 TPH/BTEX

The reported concentrations of BTEX compounds were all below the laboratory limits of reporting, with no reported concentrations exceeding the adopted criteria for sensitive landuse.

The reported concentrations of TPH C₆-C₉ compounds were all below the laboratory limits of reporting (<25 mg/kg), with no reported concentrations exceeding the adopted criterion for sensitive landuse.

The reported concentration of TPH C₁₀-C₃₆ in the soil samples from across the site ranged from <LOR to 740 mg/kg, with no reported concentrations exceeding the adopted criteria for sensitive landuse.

It is noted that a sample of the bituminous material which formed part of the building reported concentration of TPH C₁₀-C₃₆ of 24,000 mg/kg.

7.2.3 PAHs

The reported concentration of benzo(a)pyrene in the soil samples from across the site ranged from <0.05 mg/kg to 15 mg/kg, with the reported concentrations at BH203A (15 mg/kg) exceeding the adopted health based criterion (HIL-A) of 1 mg/kg.

The reported concentration of Total PAHs in the soil samples from across the site ranged from <0.5 mg/kg to 157.8 mg/kg, with the reported concentrations at BH203A (157.8 mg/kg) exceeding the adopted health based criterion (HIL-A) of 20 mg/kg.

7.2.4 Phenols

The total concentration of phenolics in the soil samples from across the site were all below the laboratory limits of reporting (< 5 mg/kg), with no reported concentrations exceeding the adopted HIL-A criterion.

7.2.5 OCPs / OPPs / PCBs

The total concentration of OCPs in the soil samples from across the site ranged from <0.1 mg/kg to 0.5 mg/kg, with no reported concentrations exceeding the adopted HIL-A criterion.

The reported concentrations of OPPs/PCBs were all below the laboratory limits of reporting (<0.1 mg/kg – <2 mg/kg), with no reported concentrations exceeding the adopted HIL-A criteria.

7.2.6 VOCs

The reported concentrations of VOCs were all below the laboratory limits of reporting (<1 mg/kg – <10 mg/kg), with no reported concentrations exceeding the adopted criteria.

7.2.7 Asbestos

Chrysotile and Amosite asbestos was identified in a sample collected from fill materials at location BH202. There was no asbestos identified in any other sample submitted for analyses.

7.2.8 Radiation

Direct Probe Monitoring Results

The direct probe measurements taken across the site indicated that levels were, in all cases, consistent with natural background levels and that no radioactive sources or radioactive contamination was detected at the site at the time of the survey.

The consultant (ANSTO 2007) reported that the background external radiation dose rate was measured between 0.11 to 0.15 $\mu\text{Sv/hr}$, which was reported as equating to a level of exposure between 0.9 and 1.3 mSv/yr of background radiation for permanent 24 hour/day occupancy, consistent with typical natural background exposure levels in Australia.

Soil Sampling Analytical Results

The results of samples analysed for radiological content were compared against the background samples obtained from the municipal parks near the hospital site. The consultant (ANSTO 2007) reported that there were no significant differences between the samples analysed from the site and the background samples.

7.3 Groundwater Investigation Results

The consultant (DP 2009a) provided summary results tables (**Appendix E**) in addition to detailed laboratory reports and chain of custody documentation. In comparison to the adopted groundwater assessment criteria (**Section 6.2**), the following results were reported.

7.3.1 Metals

The reported concentration of dissolved arsenic in the groundwater samples from across the site ranged from <1 $\mu\text{g/L}$ to 2.6 $\mu\text{g/L}$, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved cadmium in the groundwater samples from across the site ranged from <0.1 $\mu\text{g/L}$ to 0.8 $\mu\text{g/L}$, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved chromium in the groundwater samples from across the site ranged from <1 µg/L to 4.8 µg/L, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved copper in the groundwater samples from across the site ranged from <1 µg/L to 2.3 µg/L, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved lead in the groundwater samples from across the site were all <1 µg/L, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved mercury in the groundwater samples from across the site were all <0.1 µg/L, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved nickel in the groundwater samples from across the site ranged from 5.1 µg/L to 22 µg/L, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

The reported concentration of dissolved zinc in the groundwater samples from across the site ranged from 4.3 µg/L to 65 µg/L, with all but one of the reported concentrations exceeding the ANZECC/ARMCANZ 2000 aquatic ecosystem trigger value of 15 µg/L.

7.3.2 TPH/BTEX

The reported dissolved concentrations of TPH (C₆-C₉ and C₁₀-C₃₆) and BTEX compounds were all below the laboratory limits of reporting, with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

7.3.3 PAHs

The reported dissolved concentrations of PAHs were below the laboratory limits of reporting (<1 µg/L), with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

7.3.4 VOCs

The reported dissolved concentrations of VOCs were below the laboratory limits of reporting (<1 µg/L - <10 µg/L), with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values or other adopted screening level criteria.

7.3.5 Phenols

The reported dissolved concentrations of phenols were below the laboratory limits of reporting (<50 µg/L), with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

7.3.6 OCPs/OPPs/PCBs

The reported dissolved concentrations of OCPs/OPPs/PCBs were below the laboratory limits of reporting (<0.001 µg/L - <0.01 µg/L), with no reported concentrations exceeding the ANZECC/ARMCANZ 2000 trigger values.

7.4 Consultants Interpretation and Conclusions

The consultant (ANSTO 2007) concluded the following in relation to radionuclide levels at the site:

- Radiological surveys of outside areas and hospital grounds indicted no elevated readings above natural background levels at the time of the survey;
- The soil analytical results confirmed no radioactivity above natural background levels; and
- Since no radiation from external sources or radioactive contaminants was detected at all during the survey, there is considered not to be any risk to the public through future land use from a radiation point of view and therefore no site remediation is necessary.

The consultant (DP 2009a) concluded the following in relation to contamination at the site:

- Fill materials in the western portion of the site were identified as being contaminated with PAHs (including BaP) at concentrations warranting remediation. The fill materials contained building rubble and ash/slag inclusions which were considered to be the source of the identified PAH contamination.
- Asbestos was identified in fill materials in the western portion of the site, with the likely extent of asbestos contamination considered to be more widespread than the single reported exceedance due to the identified presence of building rubble in fill material in this part of the site. The identified asbestos impacted fill was considered to require remediation.
- The minor PIL exceedances for metals (nickel and zinc) were considered not to be significant as there was no evidence of stressed vegetation. As such, metals were considered not to pose a contamination issue in soil at the site warranting further investigation, remediation or management.
- The reported concentrations of TPH, BTEX, VOCs, phenols, OCPs, OPPs and PCBs in soil were all below the adopted site criteria and considered not to pose a contamination issue in soil at the site warranting further investigation, remediation or management.
- The reported concentrations of metals (excluding nickel and zinc), TPH, BTEX, VOCs, phenols, OCPs, OPPs and PCBs in groundwater were all below the adopted groundwater trigger levels and therefore groundwater was considered not to have been impacted by either on-site or upgradient activities.
- The reported concentrations of nickel and zinc in groundwater, whilst exceeding the adopted trigger levels, were considered not to pose a contamination issue warranting further investigation, remediation or management since the concentrations were consistent with typical background concentrations in the vicinity of the site.
- It was also noted that the bituminous membrane identified beneath the slab under the main hospital building contained elevated levels of TPH and required to be segregated and disposed of separately as part of the building demolition works.

Based on the conclusions presented in the report, the consultant (DP 2009a) recommended that a Remedial Action Plan be prepared to address the identified contamination at the site.

7.5 Audit Findings

The consultants (DP 2009a and ANSTO 2007) provided tables which adequately summarised the laboratory results. The reported concentrations of contaminants by the consultants (DP 2009a and ANSTO 2007) were checked against, and found to be consistent with, those reported by the laboratories. The laboratory procedures were appropriate for the identified potential contaminants of concern and the adopted site assessment criteria against which the results were compared.

The site plans provided by the consultants (DP 2009a and ANSTO 2007) were to scale and adequately identified the sampling locations relevant to the main site features such as buildings, boundaries and street frontages.

The consultants' interpretation of both the soil and groundwater data were considered appropriate. The radiation consultant (ANSTO 2007) correctly acknowledged the data gaps imposed by a number of the site buildings and made appropriate recommendations to address this following demolition as part of the remediation/validation works at the site. The sampling protocols proposed for the residual radiation investigations are consistent with the previous approach and, as discussed in **Section 5**, are considered appropriate.

The consultant's conclusion in relation to the absence of groundwater contamination are consistent with the data obtained from the investigations and are considered appropriate.

The conclusions reached by the consultant (DP 2009a) in relation to the need for remediation and validation of the identified PAH and asbestos impacted fill materials in the western part of the site are considered appropriate in light of the intended proposed landuse.

A Remedial Action Plan to document the necessary remediation and validation works has been prepared by the consultant (DP 2009b) and is discussed in **Section 8**.

8 Remediation Action Plan

8.1 Remediation Objective

The consultant (DP 2009b) identified that the remediation objectives were to:

- Delineate and remove the identified PAH and asbestos impacted fill materials in the western portion of the site and validate the remaining soils as being suitable for the proposed landuse (continued hospital, community health centre, carpark and landscaped gardens); and
- Inspect and validate the building footprints which were unable to be completely investigated as part of the site assessment activities due to the access limitations imposed by the presence of the buildings.

8.2 Remediation Options and Proposed Approach

8.2.1 Selection of Remediation Option

In accordance with ANZECC/NHMRC 1992, soil remediation and management is implemented in the following preferred order:

1. "on site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. off site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
3. removal of contaminated soil to an appropriate site or facility, followed where necessary by replacement with clean fill;
4. consolidation and isolation of the soil on-site by containment within a properly designed barrier."

The consultant (DP 2009b) considered that excavation and offsite disposal was the most appropriate remedial option, given the sensitive nature of the proposed development and with an intention to minimise future management requirements and associated liability.

8.2.2 Remediation Sequence

The consultant has proposed the following remediation sequence (DP 2009b):

- Demolition of buildings, including removal and validation of hazardous building materials off site to an appropriately licensed waste facility.
- Radiological survey of building footprints, comprising direct probe monitoring beneath the footprints of former buildings once demolished and collection/analyses of soil validation samples for radionuclides.
- Delineation testpitting in western portion of site to further delineate anticipated extent of contaminated fill material;
- Excavation and stockpiling for waste classification purposes, with possible segregation where possible of different material/contaminant types;
- Off-site disposal of excavated contaminated materials to a NSW DECC licensed waste facility, consistent with the waste classification determined for the materials;
- Validation inspection and sampling/analyses, data assessment; and

- Backfilling excavations with clean, validated imported materials, followed by reporting of the remediation/validation process.

8.3 Validation Program

The consultant (DP 2009b) has developed a validation sampling and analyses program using the seven-step Data Quality Objectives (DQO) process outlined in DEC 2006. The consultant's systematic validation program is summarised in **Table 8.1**.

Table 8.1 Summary of Soil Validation Sampling / Analytical Schedule

Validation Component	Proposed Validation Frequency	Proposed Analytes
Excavation Floor	1/ 100 m ²	<u>Remediation Areas</u> PAHs, asbestos, metals, TPH, BTEX, OCPs, OPPs, PCBs, phenols <u>Building Footprints</u> PAHs, asbestos, metals, TPH, BTEX, OCPs, OPPs, PCBs, phenols, VOCs, alpha/beta/gamma radiation.
Excavation Walls	1 / 10 lineal metres	
Stockpiled Materials	1 / 25 m ³ (1 st 100m ³)	
	1 / 100 m ³ (200m ³ - 500m ³)	
	1 / 500 m ³ (>500m ³)	
Imported materials	1 / 100 m ³	Metals, TPH, PAHs, BTEX, Phenols, OCPs, PCBs, asbestos

The consultant reported that the analytical data obtained from validation sampling locations shall be statistically analysed and the 95% upper confidence limit of the arithmetic average concentration shall be below the adopted validation criteria.

The consultant nominated the Health Based Investigation Levels for standard residential use (NEHF-A), Threshold Concentrations for Sensitive Landuse and no detectable asbestos as the adopted Soil Remediation Acceptance Criteria, as listed in **Section 6.1**.

Upon successful completion of the remediation and validation activities, the consultant (DP 2009b) stated that a validation report shall be prepared in accordance with the requirements of EPA 1997.

8.4 Unexpected Finds

The consultant (DP 2009b) has developed appropriate protocols for dealing with unexpected finds during the course of the planned remedial works. The unexpected finds protocol includes characterisation, removal and validation actions, based on a number of possible contaminant sources.

8.5 Site Management

The consultant (DP 2009b) included site management provisions to reduce the impact of the remediation works on the remediation workforce and surrounding environment (including neighbours).

8.6 Regulatory Compliance

The consultant (DP 2009b) reported that relevant regulatory requirements relating to the proposed works have been considered, including but not limited to:

- State Environmental Planning Policy No. 55 Remediation of Land;
- Protection of the Environment Operations Act 1997;
- Contaminated Land Management Act 1997;
- Dangerous Goods Act (Road and Rail Transport Act) 2008; and

- Occupational Health and Safety Act 2000.

The consultant also identified that, based on the buried asbestos identified during the detailed site investigation, that Class AS1 licensed asbestos contractor would be required to undertake the asbestos remediation component of the remediation works.

8.7 Long Term Site Management

Based on the proposed remediation methodology, no long term site management provisions are nominated by the consultant (DP 2009b).

8.8 Audit Findings

Based on the information contained in the consultant's Remedial Action Plan (DP 2009b), it is considered that the proposed remediation:

- is technically feasible;
- is environmentally justifiable given the quantity of materials to be removed and the intractable nature of the identified contaminants which make them unsuitable for on or off site treatment; and
- is consistent with relevant laws, policies and guidelines.

9 Evaluation of Landuse Suitability

In assessing the suitability of a site for an existing or proposed landuse in an urban context, the decision process for assessing urban redevelopment sites should be followed (Page 50 and 51, DEC 2006), as discussed in the following sections. For the purposes of this assessment, consideration was given to the requirements relating to residential landuse with gardens and accessible soils, which is considered adequately conservative for the proposed continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas.

9.1 Reporting in accordance with EPA requirements

The documents provided by the consultant have been checked against, and meet the requirements of, EPA 1997. As such, the reporting of the assessment/validation process is considered to have been undertaken in accordance with relevant guidelines.

9.2 Aesthetic issues have been addressed

The consultant gave adequate consideration to odours and soil discolouration during the site assessment process, as evidenced in both the site description information provided in the report and also detailed soil descriptions provided in the borehole logs. In addition, the RAP prepared for the site includes aesthetic considerations as part of the validation program. As such, aesthetic issues are considered to have been adequately addressed.

9.3 Soils have been assessed against the appropriate investigation levels

The criteria adopted by the consultant for the site assessment process have been checked against, and are consistent with, appropriate criteria endorsed by the DECC for the proposed landuse (i.e., continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas). The same criteria are proposed for site validation and are considered adequately conservative.

9.4 Background soil concentrations have been adequately addressed

During the site assessment works, the consultants (DP 2009a and ANSTO 2007) collected samples from natural formations, providing a clear indication and representation of local natural soil profiles. The chemical and radiological concentrations in soil for the natural soil profile were below the appropriate soil criteria and consistent with background levels in Australia. As such, background soil concentrations are considered to have been adequately addressed.

9.5 All impacts of chemical mixtures have been assessed

No issues relating to chemical mixtures in relation to the identified contaminants of concern were identified. Hence, there was no requirement to give any further consideration to the impact of chemical mixtures.

9.6 The site management strategy is appropriate

The site management strategy of excavation and off-site disposal of the identified contamination is found to be appropriate, given the proposed site use. The proposed remediation approach is unlikely to require ongoing site management provisions.

9.7 Contaminant migration (actual or potential) has been addressed

The consultant (DP 2009a) conducted an assessment of groundwater beneath the site (i.e., within the shale bedrock) as part of the site investigation program. The groundwater investigation identified a low potential for any widespread or off-site impact from contamination sourced from the site.

This was supported by data from the underlying natural soils beneath the site which did not identify concentrations of contaminants which would likely pose a migration risk via groundwater. As such, both the potential and actual migration of the identified contaminants of concern at the site have been adequately addressed.

10 Audit Summary Opinion

On the basis of the findings of the site audit, and subject to the limitations in **Section 11**, the following summary opinions are provided:

- The site assessment and proposed remedial activities are considered to have met the requirements of the Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd Edition) (DEC 2006).
- The soils in parts of the site have been impacted with PAHs and asbestos at levels which require remediation for the proposed landuse.
- There were no other levels of the identified chemical contaminants of concern (i.e., TPH, BTEX, VOCs, phenols, OCPs, OPPs or PCBs) in soil which are considered to require remediation.
- No elevated levels of radioactivity above natural background were identified, with no radiation from external sources or radioactive contaminants detected during the survey.
- There is no evidence of migration of contaminants from the site which is likely to result in any unacceptable risks to surrounding human or ecological receptors.
- The site can be made suitable for the proposed landuse (i.e., continued hospital use, community health centre which may include a children's day care centre and associated carparking and landscaped areas) based on the successful implementation of the soil remediation and validation works detailed in the Remedial Action Plan prepared for the site (DP 2009b).

11 Limitations

This audit was conducted with a reasonable level of scrutiny, care and diligence on behalf of the client for the purposes outlined in s.47(1) of the *Contaminated Land Management Act 1997*. The data used to support the conclusions reached in this audit were obtained by other consultants and the limitations which apply to the consultant's report(s) apply equally to this audit report.

Every reasonable effort has been made to identify and obtain all relevant data, reports and other information that provide evidence about the condition of the site, and those that were held by the client and the client's consultants, or that were readily available. No liability can be accepted for unreported omissions, alterations or errors in the data collected and presented by other consultants. Accordingly, the data and information presented by others are taken and interpreted in good faith.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations reviewed, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this audit are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS Environmental Pty Ltd and the Site Auditor reserve the right to review the report in the context of the additional information.

Appendix A

Guidelines made or approved by the DECC

Guidelines made or approved by the DECC (s.105 CLM Act 1997)

Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council, 1992 (ANZECC/NHMRC 1992)

Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Paper No 4, 2000 (ANZECC/ARMCANZ 2000)

Australian Drinking Water Guidelines, National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand, 2004 (NHMRC/NRMMC 2004)

Composite Sampling, Lock, W. H., National Environmental Health Forum Monographs, Soil Series No.3, 1996, SA Health Commission, (NEHF 1996)

Contaminated Sites: Guidelines for Assessing Service Station Sites, NSW EPA, 1994 (EPA 1994)

Contaminated Sites: Sampling Design Guidelines, NSW EPA, 1995 (EPA 1995)

Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Former Broad-Acre Agricultural Land, NSW EPA, 1995 (EPA 1995b)

Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, NSW EPA, 1997 (EPA 1997)

Contaminated Sites: Guidelines for Assessing Banana Plantation Sites, NSW EPA, 1997 (EPA 1997b)

Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd Edition), NSW DEC, 2006 (DEC 2006)

Contaminated Sites: Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report, NSW EPA, 1999 (EPA 1999)

Contaminated Sites: Guidelines for Assessing Former Orchards and Market Gardens, NSW EPA, 2005 (EPA 2005)

Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards, Department of Health and Ageing and EnHealth Council, Commonwealth of Australia, June 2002 (EnHealth 2002)

Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes, NSW Agriculture and CMPS&F Environmental, February 1996 (NSW Agr. 1996)

Guidelines for the Assessment and Management of Groundwater Contamination, NSW DEC, March 2007 (NSW DEC 2007)

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

Appendix B
Audit Correspondence

Our Ref: JBS40205-13129

23 April 2009

Allan Young
Brookfield Multiplex Limited
Via email: Allan.Young@brookfieldmultiplex.com

Cc: Kurt Plambeck
Douglas Partners Pty Ltd
Via email: kurt.plambeck@douglaspartners.com.au

Interim Audit Advice (0503-0622-0012): Comments on Draft DSI Report for Stage 1B Auburn Hospital, Auburn, NSW

Allan / Kurt,

1. Nature of Interim Advice

JBS Environmental Pty Ltd has been engaged to provide the services of a NSW DECC Contaminated Land Accredited Auditor to conduct a Site Audit in relation to the proposed redevelopment of the Auburn Hospital.

This interim advice does not constitute a Site Audit Statement or a Site Audit Report, but is provided to assist in the assessment and management of contamination issues at the site in regard to requirements of the site audit. The information provided herein should not be considered pre-emptive of the final audit conclusions, but rather represent the findings of the audit based on a preliminary review of available site information. Furthermore, the interim advice should not be regarded as "approval" of any proposed investigations or remedial activities, as any such approval is beyond the scope of an independent review.

2. Review of Reports

The following report was reviewed in order to prepare this advice:

- *Report on Phase 2 Contamination Assessment, Stage 1B Auburn Hospital, Corner of Hargrave and Norval Street, Auburn, NSW, Douglas Partners Pty Ltd, April 2009 (DP 2009a).*

3. Draft Phase 2 Contamination Assessment Report (DP 2009a)

The following comments are provided and are required to be addressed to the satisfaction of the Site Auditor in order to progress the Site Audit:

- Section 1 – satisfactory.
- Section 2 – satisfactory.
- Section 3 – satisfactory.
- Section 4.1 – please review / confirm the property identification. The Auditor is under the impression that the property details are Lots 8-13 and Part Lots 7 & 14, Section 4, DP873, whereas the details contained in the draft report indicate DP673 and no section. Given that the identified investigation area includes only part of a number of lots, a survey plan prepared by a registered surveyor identifying the boundary co-ordinates will be required in order to define the site boundary.
- Section 4.2 – satisfactory.
- Section 5 – satisfactory.
- Section 6 - satisfactory.
- Section 7 – satisfactory.

- Section 8 – satisfactory.
- Section 9 – the list of contaminants of potential concern should be expanded to include radiological contaminants, given the earlier recommendation in the report to complete the final stages of the radiological survey previously undertaken by ANSTO.
- Section 10.1 – generally satisfactory. In regards to the acceptable limits on decision error, the consultant is requested to refer to pages 40 & 41 (AS 4482.1-2005) and provide calculations to demonstrate that the adopted limits on decision error have been achieved for each COPC in each identified solid media (e.g., fill, natural soil).
- Section 10.2 – the consultant is required to provide further justification for the adopted sampling program, noting that EPA 1995 requires that, “investigators must be prepared to defend the appropriateness of applying Table A only.”
- Section 10.3 – the limitations of the adopted sampling methodology in relation to identifying asbestos should be acknowledged and appropriately considered in developing remediation plans for the site, particularly noting the site history which indicates previous buildings at the site and the widespread presence of asbestos impacted fill materials across other stages of the Auburn hospital project.
- Section 10.4 – please confirm whether the well elevations were surveyed to enable reliable estimation of groundwater flow direction.
- Section 11.1 – satisfactory.
- Section 11.2 – please confirm units for all groundwater investigation levels included in Table 6.
- Section 11.3 – satisfactory.
- Section 12.1 – satisfactory.
- Section 12.2 – satisfactory.
- Section 13.1.1 – the auditor notes that the provisional phytotoxicity investigation levels have significant limitations (DEC 2006) and the discussion provided by the consultant which suggests that areas of PPIL exceedances require remediation and validation is not supported by the auditor, unless further evidence can be provided that an actual phytotoxicity risk is likely to be posed by the reported concentrations of metals in the fill material. However, it is accepted that a number of the PPIL exceedances are present at or near other contamination (e.g., BH201 and BH203) and removal of these materials is likely to occur to address the other identified contamination, namely, PAHs and asbestos.
- Section 13.1.2 – satisfactory.
- Section 13.1.3 – with reference to primary and secondary laboratory results and the material descriptions provided in the borelogs, the auditor agrees with the consultant’s discussion that the PAH contamination is likely to be more widespread throughout the fill material containing building rubble in the western portion of the site and the auditor requires that the PAH contamination be dealt with on a material-wide basis, rather than an individual point source approach (as is suggested later in the consultant’s conclusions).
- Section 13.2 – the presence of building rubble in fill material in the western portion of the site, combined with the identification of asbestos in one of the samples indicates more widespread potential asbestos impact in the western portion of the site. The auditor considers that it is unlikely that asbestos and non-asbestos fill materials are likely to be able to be reliably segregated during excavation and any proposed remediation plans are requested to take this into account.
- Section 13.3 – satisfactory.
- Section 13.4 – satisfactory.
- Section 14 – please refer to previous comments regarding the auditor’s opinion in regards to the need to remediate isolated PPIL exceedances.
- Section 14 – the auditor does not support the proposed “step out” excavations of PAH contamination at BH203A and separate excavation of PAH contamination at the adjoining sampling

location BH204. The auditor is of the opinion that fill materials (as a whole) in the western portion o the site (i.e., comprising BH201, BH202, BH203, BH203A and BH204) are impacted with a combination of asbestos, PAHs and metals, with the precise nature and extent of each contaminant unknown. Given that the proximity of the sample locations and the presence of heterogeneous fill materials with building rubble, ash, etc inclusions, the auditor requires that these fill materials be remediated as a whole, unless further data can be presented demonstrating that they are unrelated, isolated areas of contamination.

Thank you for your time with regards to this matter. Should you have any queries or require further clarification, please feel free to contact me by phone on (02) 8338 1011 or email alau@jbsgroup.com.au.

Yours sincerely,



Andrew Lau
NSW DECC Accredited Site Auditor (0503)
JBS Environmental Pty Ltd

attachments: (1) Limitations

Attachment 1 - Limitations

Site audits relate only to those matters relevant to the *Contaminated Land Management Act 1997*, which describes that “The general object of this Act is to establish a process for investigating and (where appropriate) remediating land areas where contamination presents a significant risk of harm to human health or some other aspect of the environment”.

The Site Audit Report (SAR) and subsequent Site Audit Statement (SAS) do not seek to provide an opinion regarding other aspects of the environment not related to site contamination, such as the suitability of the site in regard to the occupational health and safety legislation, or in regards to the suitability of the geotechnical or engineering design.

By definition, auditing involves the review and critique of consultants' and contractors' work, including site histories, site surveys, subsurface investigations, chemical and physical analyses, and risk assessments and modelling. Accordingly, the audit relies on the experience, expertise and integrity of the relevant organisations. The information sources referenced have been used to determine site history and local subsurface conditions. While reasonable care has been used to avoid reliance on data and information that is inaccurate or unsuitable, the audit is not able to verify the accuracy or completeness of all information and data made available.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants.

Limited sampling and laboratory analyses were undertaken as part of the investigations reviewed by the Auditor, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which was not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this site audit are based on the information provided at the time of the audit.

Our Ref: JBS40205-13173

7 May 2009

Allan Young
Brookfield Multiplex Limited
Via email: Allan.Young@brookfieldmultiplex.com

Cc: Kurt Plambeck
Douglas Partners Pty Ltd
Via email: kurt.plambeck@douglaspartners.com.au

Interim Audit Advice (0503-0622-0013): Comments on Draft RAP Report for Stage 1B Auburn Hospital, Auburn, NSW

Allan / Kurt,

1. Nature of Interim Advice

JBS Environmental Pty Ltd has been engaged to provide the services of a NSW DECC Contaminated Land Accredited Auditor to conduct a Site Audit in relation to the proposed redevelopment of the Auburn Hospital.

This interim advice does not constitute a Site Audit Statement or a Site Audit Report, but is provided to assist in the assessment and management of contamination issues at the site in regard to requirements of the site audit. The information provided herein should not be considered pre-emptive of the final audit conclusions, but rather represent the findings of the audit based on a preliminary review of available site information. Furthermore, the interim advice should not be regarded as "approval" of any proposed investigations or remedial activities, as any such approval is beyond the scope of an independent review.

2. Review of Reports

The following report was reviewed in order to prepare this advice:

- *Report on Remedial Action Plan, Stage 1B Auburn Hospital, Corner of Hargrave and Norval Street, Auburn, NSW, Douglas Partners Pty Ltd, May 2009 (DP 2009b).*

3. Draft Remedial Action Plan Report (DP 2009b)

The following comments are provided and are required to be addressed to the satisfaction of the Site Auditor in order to progress the Site Audit:

- Executive Summary – it would be useful to include a summary of the contamination issues at the site and an indicative extent of remediation required, in addition to acknowledging the supplementary radiological validation activities required to be undertaken as part of the works.
- Section 1 – satisfactory.
- Section 2 – satisfactory.
- Section 3 – satisfactory.
- Section 4 – satisfactory.
- Section 5.1 – satisfactory.
- Section 5.2 – site description.
- Section 6 – satisfactory.

- Section 7 – satisfactory.
- Section 8.1 – satisfactory.
- Section 8.2 (Table 2) – further discussion is required as to the application of “no asbestos” to the validation program. Does the consultant intend this to mean “no visible asbestos and no asbestos identified via analyses above the laboratory limits of reporting (0.1 g/kg)”?
- Section 8.3 – in the event that the proposed groundwater criteria are required to be utilised, further explanation as to how they will be applied is requested.
- Section 8.4 – please ensure that any waste classification activities include the existing assessment data. That is, the auditor does not endorse an approach which omits existing data on the basis that the materials are more representative in a stockpiled format. It is further noted that the criteria proposed for assessing VENM imported/exported from the site for organic constituents should be reduced to the laboratory limits of reporting. The auditor does not accept that the proposed ANZECC/NHMRC 1992 criteria achieve the definition of VENM as described under the POEO Act.
- Section 9 – The consideration of remediation options needs to be expanded to include all of the potential remediation approaches, as outlined in ANZECC/NHMRC 1992.
- Section 10.1 - the remediation sequencing may need revision to incorporate the final radiological validation prior to waste classification and off-site removal, in the event that radiological contaminants are identified and require remediation.
- Section 10.2 – specific additional procedures should be included to appropriately address any radiological unexpected finds, since protocols for the management of such contaminants may not be compatible with the other general contaminants.
- Section 10.3.1 – please refer to previous comments regarding inclusion of previous data in stockpile classification data in determining waste classification.
- Section 10.3.2 – please refer to previous comments regarding background criteria for organic constituents in assessing VENM.
- Section 10.3.3 – please refer to previous comments regarding contingency measures for any radiological contamination, if identified.
- Section 10.3.4 – satisfactory.
- Section 10.3.5 – satisfactory.
- Section 10.3.6 – satisfactory.
- Section 11 – please ensure that appropriately trained and experienced personnel are used to conduct the visual asbestos inspection component of the proposed validation program.
- Section 11.1 – for the purposes of data clarity, it is requested that consideration be given to reducing the frequency of the wall samples from 15 m to 10 m, consistent with the 10 m grid spacing of the floor samples.
- Section 11.2 – please provide details of the proposed radiological validation program.
- Section 11.3 – satisfactory.
- Section 11.4 – satisfactory.
- Section 11.5 – please identify the sample size for asbestos analyses.
- Section 11.6 – please confirm that duplicates and triplicates will be collected and analysed for asbestos.
- Section 11.7 – satisfactory.
- Section 11.8 – please correct guideline reference date.

- Section 12 – please identify that additional OH&S controls may be required in the event that radiological contamination is identified.
- Section 13 – reference to hours of operation should be made to the Minister's Approval, rather than council. The specific regulatory requirements of SEPP55 (i.e., notification prior to commencement and notification of completion) should be articulated and complied with.
- Section 14 – satisfactory.

Thank you for your time with regards to this matter. Should you have any queries or require further clarification, please feel free to contact me by phone on (02) 8338 1011 or email alau@jbgroup.com.au.

Yours sincerely,



Andrew Lau
NSW DECC Accredited Site Auditor (0503)
JBS Environmental Pty Ltd

attachments: (1) Limitations

Attachment 1 - Limitations

Site audits relate only to those matters relevant to the *Contaminated Land Management Act 1997*, which describes that “The general object of this Act is to establish a process for investigating and (where appropriate) remediating land areas where contamination presents a significant risk of harm to human health or some other aspect of the environment”.

The Site Audit Report (SAR) and subsequent Site Audit Statement (SAS) do not seek to provide an opinion regarding other aspects of the environment not related to site contamination, such as the suitability of the site in regard to the occupational health and safety legislation, or in regards to the suitability of the geotechnical or engineering design.

By definition, auditing involves the review and critique of consultants' and contractors' work, including site histories, site surveys, subsurface investigations, chemical and physical analyses, and risk assessments and modelling. Accordingly, the audit relies on the experience, expertise and integrity of the relevant organisations. The information sources referenced have been used to determine site history and local subsurface conditions. While reasonable care has been used to avoid reliance on data and information that is inaccurate or unsuitable, the audit is not able to verify the accuracy or completeness of all information and data made available.

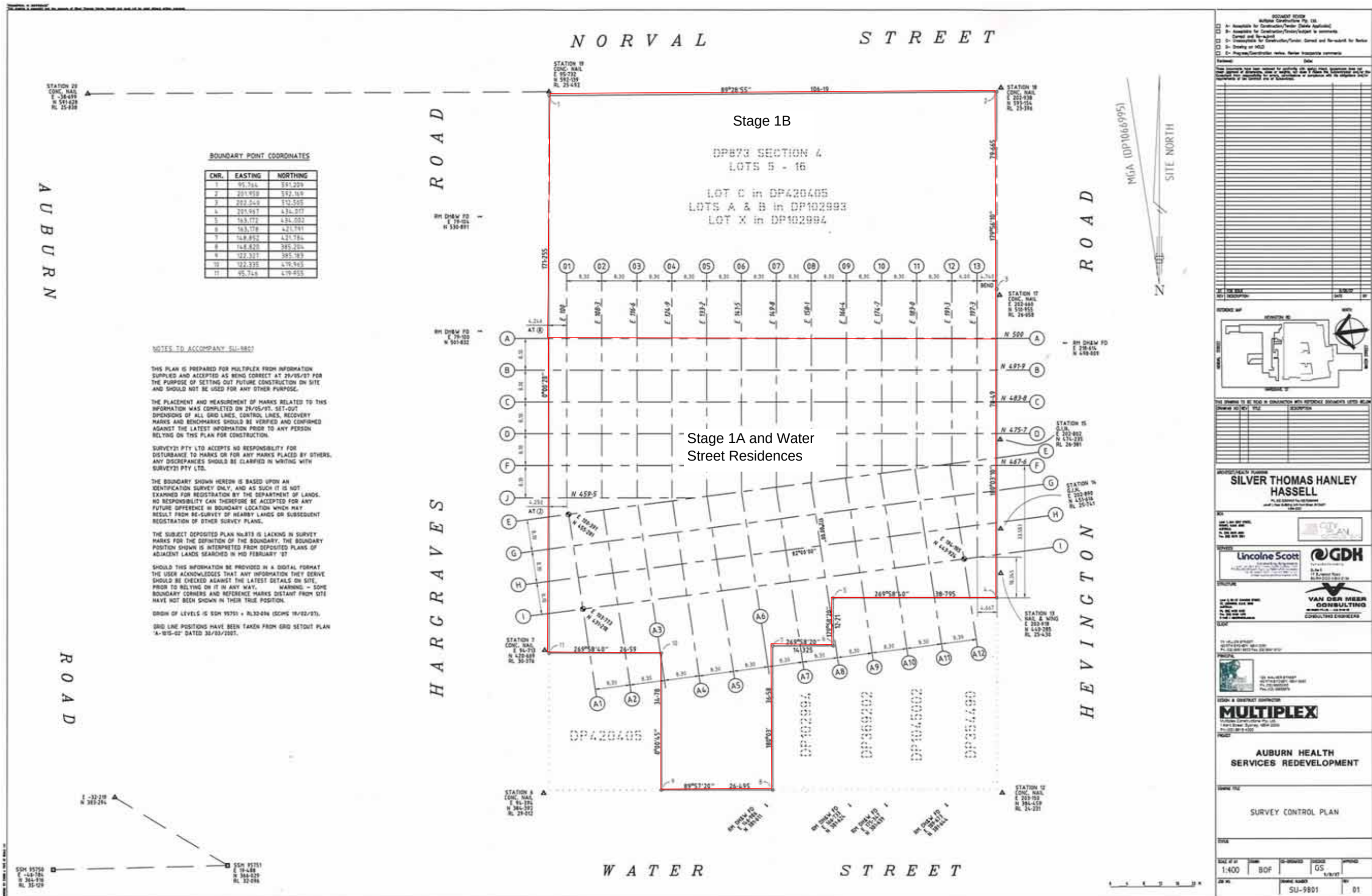
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants.

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Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this site audit are based on the information provided at the time of the audit.

Appendix C

Site Plan



D.P. 873 (E)

GRAMPIAN HILLS ESTATE

AUBURN

Ph. of Liberty Plains Co. of Cumberland

Scale 200 feet to an Inch

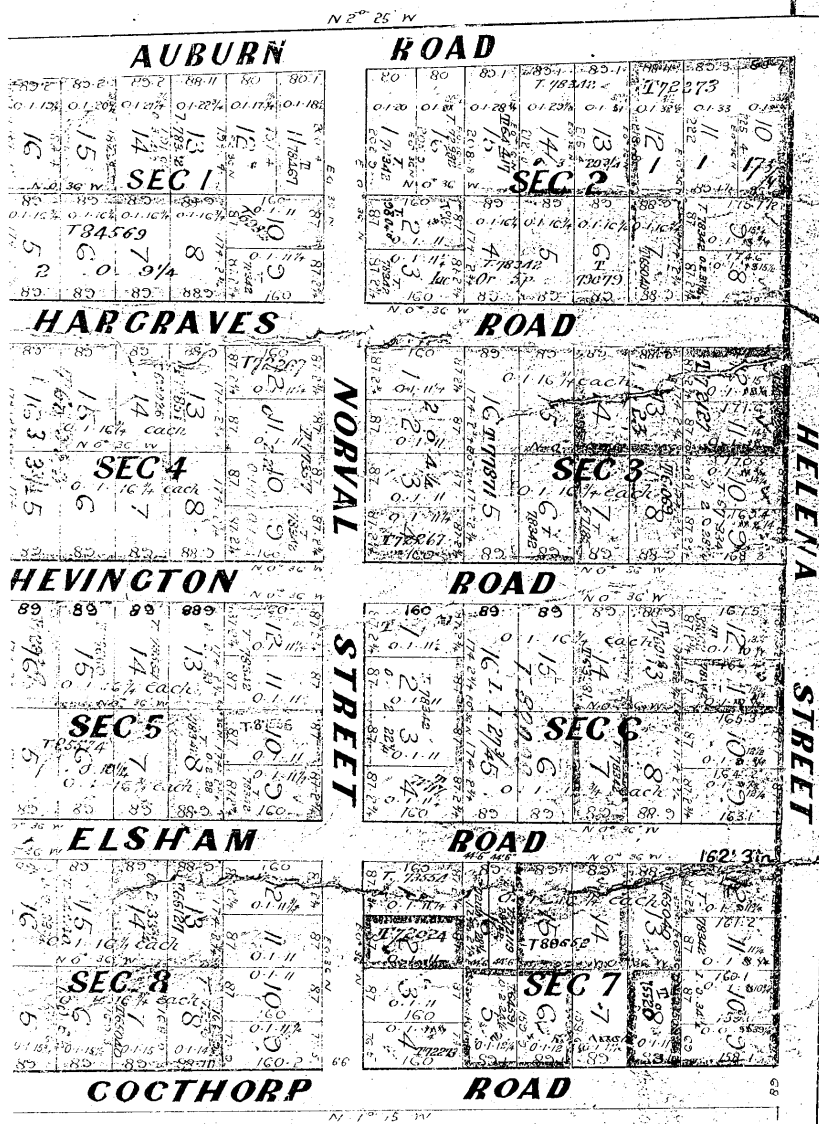


DP873 (E)

B. J. CAMPBELL (L.S.)

Declaration dated 30/3/82

REGISTRAR GENERAL'S DEPARTMENT



AUBURN

Grandview Hills Estate

Part of 80ac Grant to William White 30th June 1873

subdivision here see Deposited Plan 751

COPY MADE 8.2.13
 EXAMINED 9.8.13

87/5

STANDARD PREPARED

DP873

7

for subdivision here see Deposited Plan 235

Scale 200 Feet to 1 inch

Woodburn
Park

for subdivision, here see Deposited Plan 751

DP 873 (E)

"A" This is the Plan referred to in my Declaration of this date, 10-3-34.

COPY MADE 8-29-78 27157
EXAMINED 8-2-82

Appendix D

Consultants Figures

P:\45686 AUBURN, Hospital Stage 1B KDP\Drawings\45686-1.dwg, 3/23/2009 9:21:39 AM

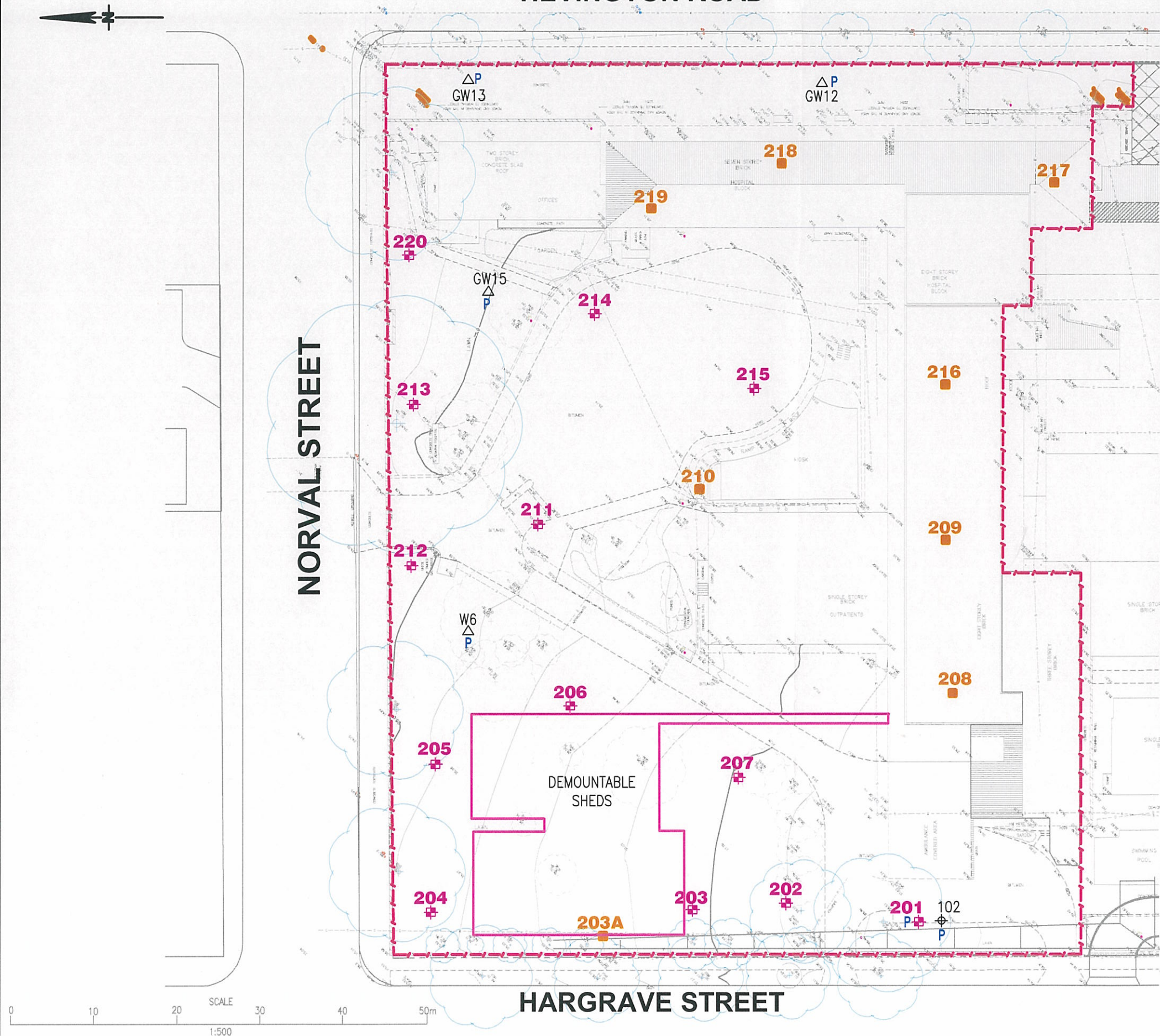
HEVINGTON ROAD

NORVAL STREET

HARGRAVE STREET

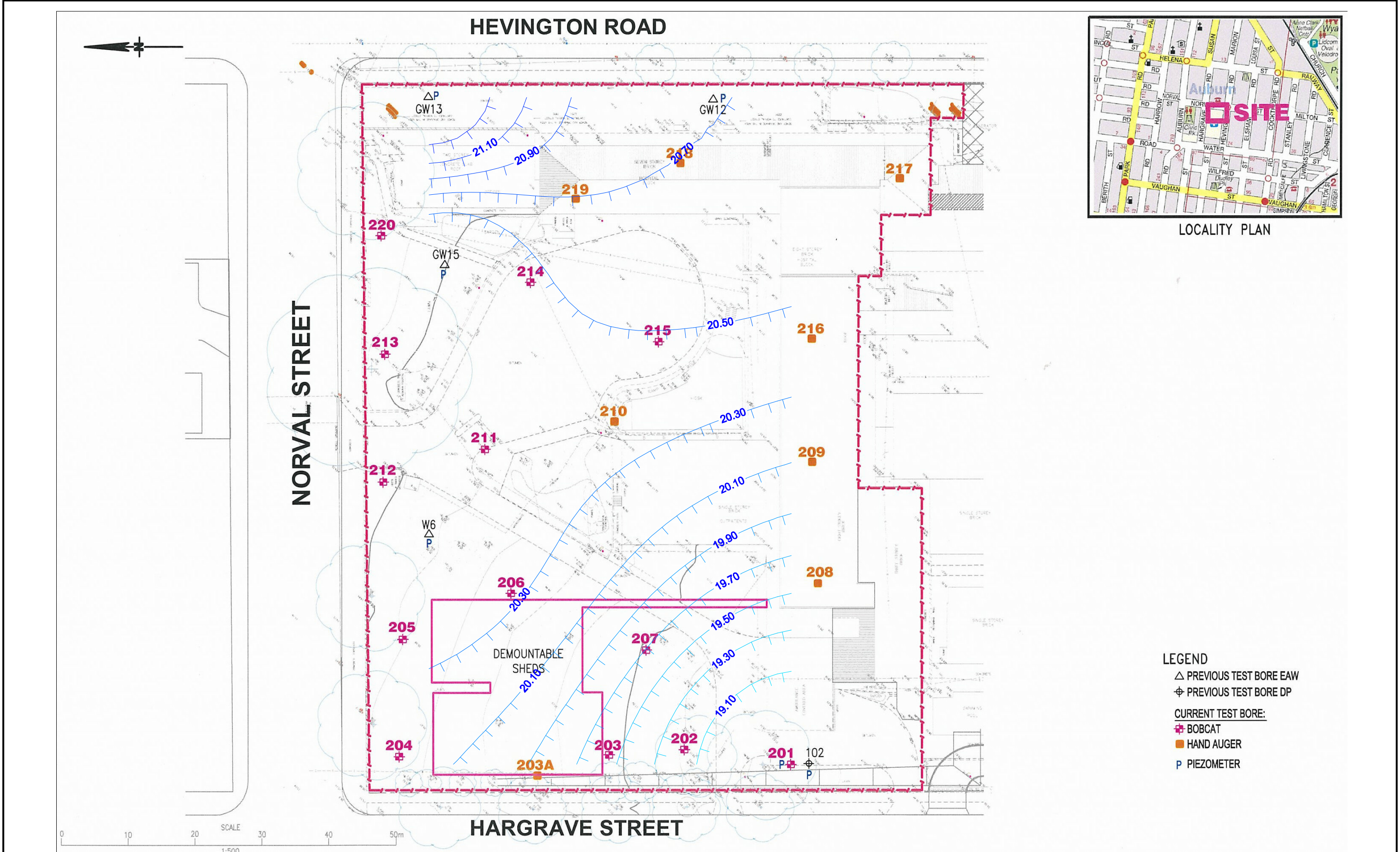


LOCALITY PLAN



LEGEND

- △ PREVIOUS TEST BORE EAW
- ⊕ PREVIOUS TEST BORE DP
- CURRENT TEST BORE:
 - ⊕ BOBCAT
 - HAND AUGER
 - P PIEZOMETER



Douglas Partners
Geotechnics • Environment • Groundwater

CLIENT: Brookfield Multiplex

DRAWN BY: KDP

SCALE: As shown

OFFICE: Sydney

APPROVED BY

DATE: 23.2.2009

TITLE:

Groundwater Levels
Phase 2 Contamination Assessment
Stage 1B, Auburn Hospital

Project No: 45686

Drawing No: 2

Revision: A

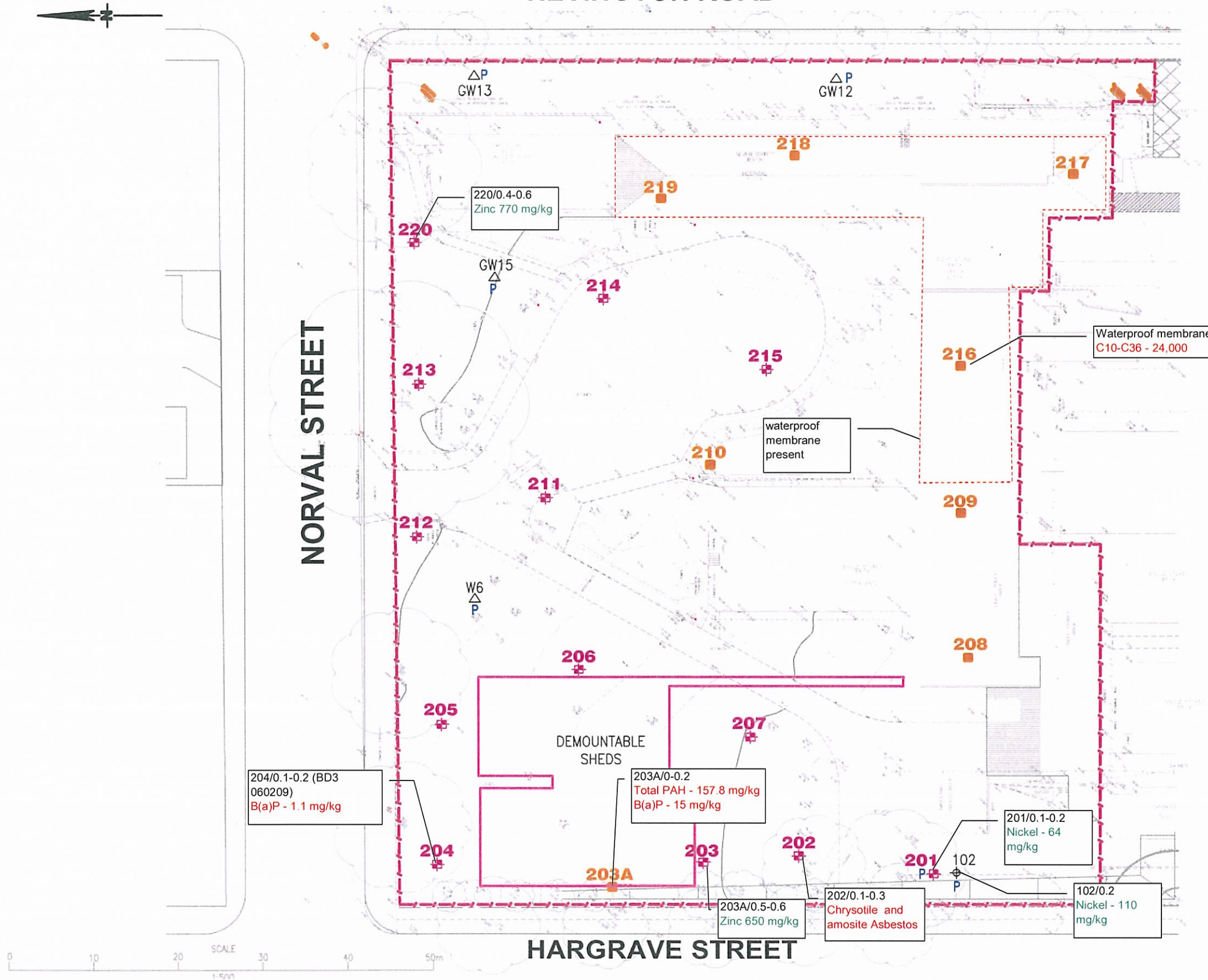
HEVINGTON ROAD

NORVAL STREET

HARGRAVE STREET



LOCALITY PLAN



LEGEND

- △ PREVIOUS TEST BORE EAW
- ⊕ PREVIOUS TEST BORE DP
- CURRENT TEST BORE:
- ⊕ BOBCAT
- ⊕ HAND AUGER
- P PIEZOMETER



Douglas Partners
Geotechnics • Environment • Groundwater

CLIENT: Brookfield Multiplex

DRAWN BY: KDP

SCALE: As shown

OFFICE: Sydney

APPROVED BY

DATE: 23.2.2009

TITLE:

Soil Exceedances

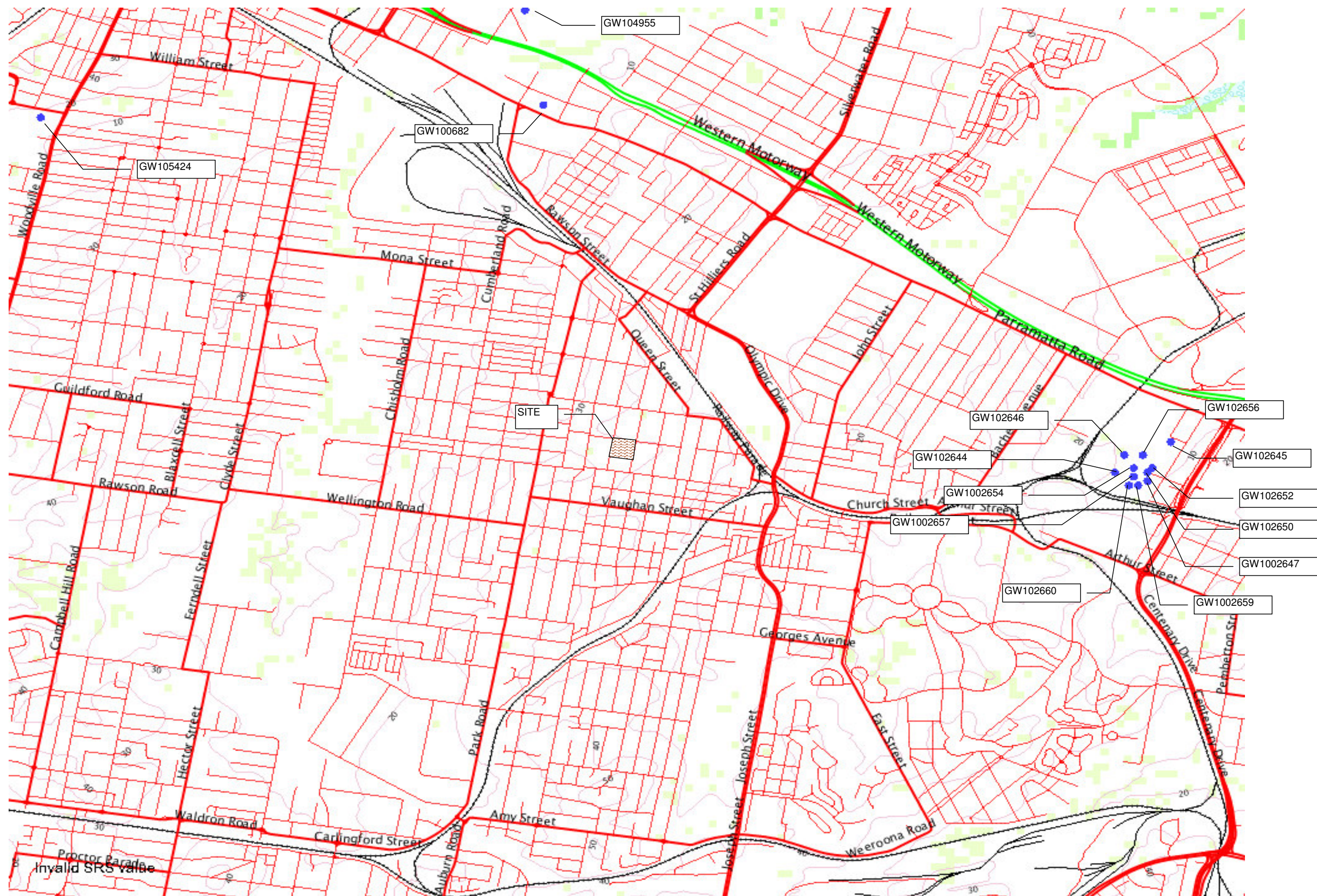
Phase 2 Contamination Assessment

Stage 1B, Auburn Hospital

Project No: 45686

Drawing No: 3

Revision: A

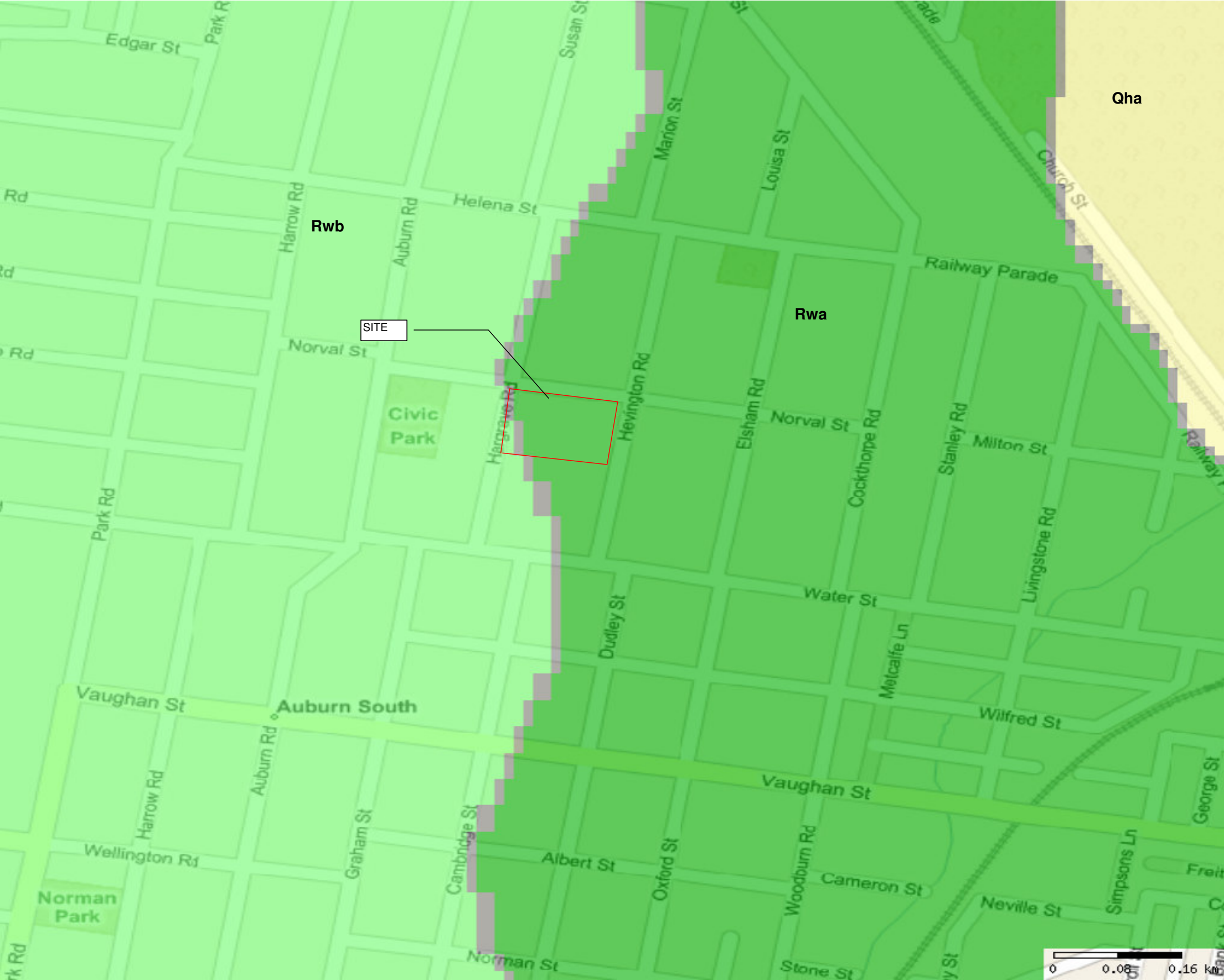


Map created with the NSW Natural Resource Atlas – www.nratlas.nsw.gov.au <23 March 2009>. Copyright © <2009> New South Wales Government. Map has been compiled from various sources and may contain errors or omissions. No representation is made as to its accuracy or suitability.



CLIENT: Brookfield Multiplex		
DRAWN BY: KDP	SCALE: As shown	OFFICE: Sydney
APPROVED BY		DATE: 23.2.2009

TITLE:	Registered Groundwater Bores	Project No:	45686
	Phase 2 Contamination Assessment	Drawing No:	4
	Stage 1B, Auburn Hospital	Revision:	A



- Rwa**
Ashfield Shale
- Rwb**
Bringelly Shale
- Qha**
Quaternary Deposits

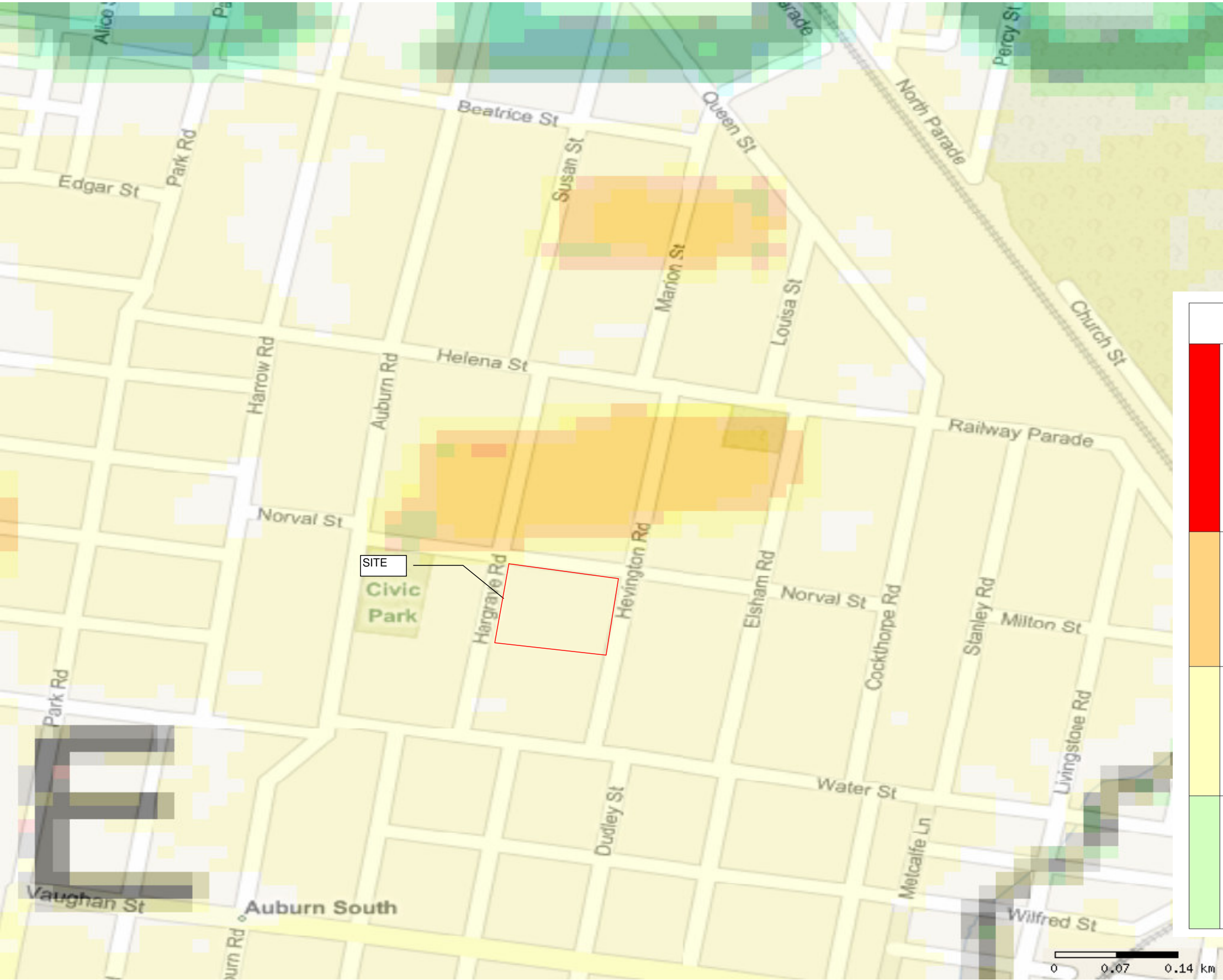
Sydney 1:100,000 Geological Map Sheet



CLIENT: Brookfield Multiplex		
DRAWN BY: KDP	SCALE: As shown	OFFICE: Sydney
APPROVED BY		DATE: 23.2.2009

TITLE:	Geology Map
	Phase 2 Contamination Assessment
	Stage 1B, Auburn Hospital

Project No:	45686
Drawing No:	6
Revision:	A



MAPPING CATEGORY	
	KNOWN SALINITY Areas where there is a known occurrence of saline soil, or where air photo interpretation and field observations have confirmed more than one of these: - a - scalding - b - salt efflorescence - c - vegetation dieback - d - salt tolerant plant species - e - waterlogging A high relative wetness index occurs in these areas.
	HIGH SALINITY POTENTIAL Areas where soil, geology, topography and groundwater conditions predispose a site to salinity. These conditions are similar to areas of known salinity (see above). These areas are most common in lower slopes and drainage systems where water accumulation is high (ie. high relative wetness index).
	MODERATE SALINITY POTENTIAL Areas on Wianamatta Group Shales and Tertiary Alluvial Terraces. Scattered areas of scalding and indicator vegetation have been noted but no concentrations have been mapped. Saline areas may occur in this zone, which have not yet been identified or may occur if risk factors change adversely.
	VERY LOW SALINITY POTENTIAL Areas where salinity processes do not operate or are of minor significance. Soils are rapidly drained and underlying strata (Hawkesbury/Narrabeen Sandstone) are highly permeable, resulting in continual flushing and removal of salts in the landscape. No salinity has been observed in these areas and is not expected to occur.

Salinity Potential In Western Sydney 2002, NSW Department of Infrastructure and Natural Resources



Douglas Partners
Geotechnics • Environment • Groundwater

CLIENT: Brookfield Multiplex

DRAWN BY: KDP

SCALE: As shown

OFFICE: Sydney

APPROVED BY

DATE: 23.2.2009

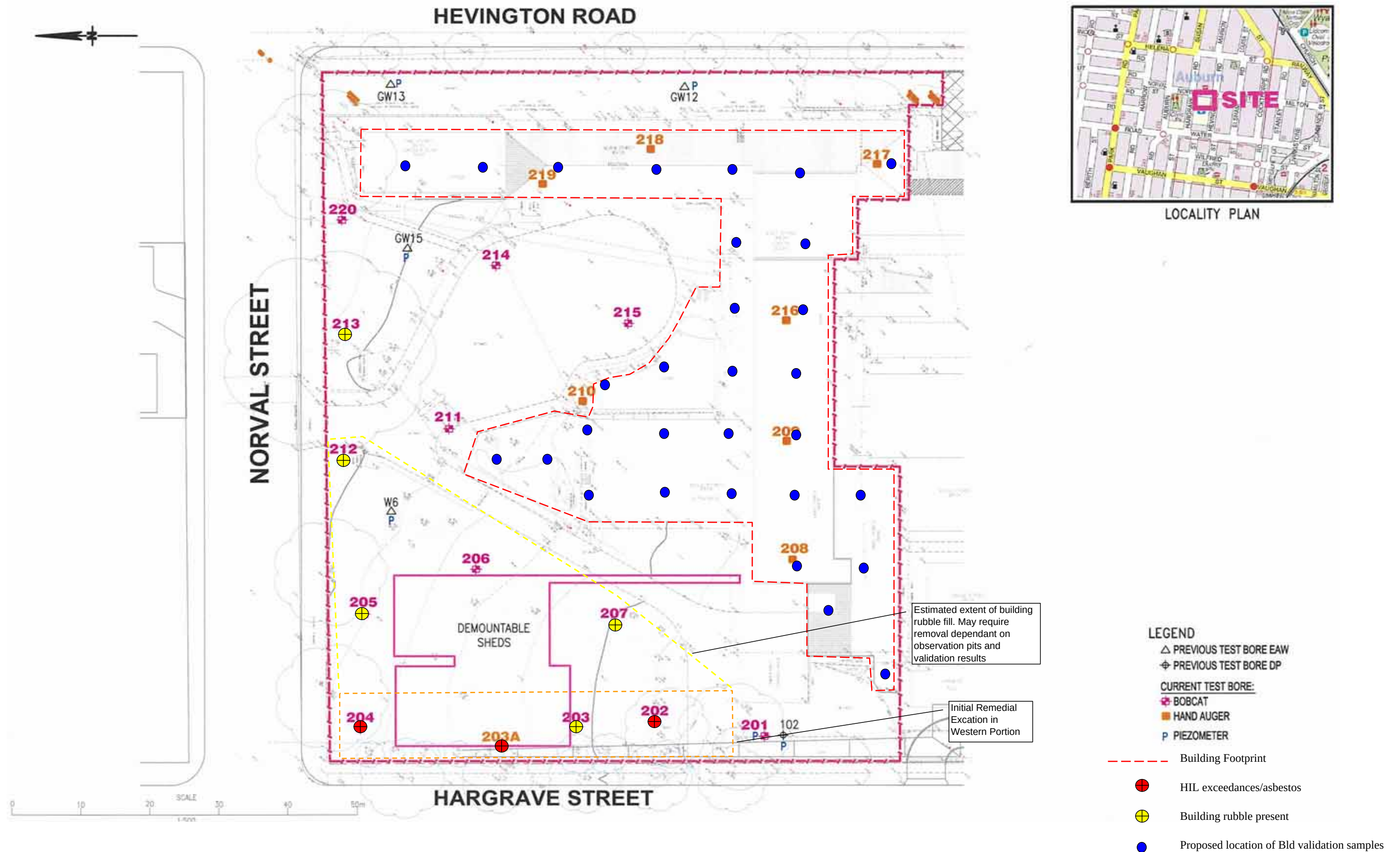
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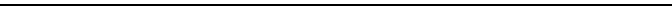
Salinity Potential Map
Phase 2 Contamination Assessment
Stage 1B, Auburn Hospital

Project No: 45686

Drawing No: 7

Revision: A



	CLIENT: Brookfield Multiplex			TITLE: Remedial Excavations and Building Footprint Remediation Action Plan Stage 1B, Auburn Hospital	Project No: 45686
	DRAWN BY: KDP	SCALE: As shown	OFFICE: Sydney		Drawing No: 4
	APPROVED BY		DATE: 23.2.2009		Revision: A

Appendix E
Consultants Summary Tables

The description of soil samples has no bearing on the radiological dose consequence assessment, however the samples collected can be generally described as being fine sandy type soil. The area of the incinerator did not contain any visible ash deposits, and was consistent with the other site samples collected.

A summary of the soil sample analysis results can be found in table 3. The detailed individual results from each analysis type are in appendix 5 at the end of this report.

Sample ID	Area collected	GPS location UTM WGS84 E	GPS location UTM WGS84 N	Results of Bulk γ screening	Results of low energy β screening (Bq/ml)	Results of gross α/β analysis	Results of γ radionuclide analysis (Bq/g)
1R	Arthur stone annex	0317899	6251535	—	Background	Background	0.038 ^{226}Ra
2G	Arthur stone annex	0317924	6251513	—	Background	Background	0.021 ^{226}Ra
3G	Arthur stone annex	0317905	6251793	Nil detected	Background	—	—
4G	Arthur stone annex	0317861	6251500	Nil detected	Background	—	—
5G	Arthur stone annex	0317966	6251487	Nil detected	Background	—	—
6G	Arthur stone annex	0317972	6251537	Nil detected	Background	—	—
7R	Arthur stone annex	0317914	6251541	Nil detected	Background	—	—
8G	Arthur stone annex	0317870	6251549	Nil detected	Background	—	—
11G	Hospital entrance	0317966	6251587	Nil detected	-	—	—
12R	Under road (footprint)	0318044	6251518	Nil detected	-	—	—
13R	Under concrete (footprint)	0318023	6251546	Nil detected	-	—	—
14G	Old house grounds	0318039	6251519	Nil detected	—	—	—
15G	Old house (footprint)	0318037	6251476	Nil detected	-	—	—
16G	Hospital ground near drain	0318100	6251521	Nil detected	-	—	—
17G	Hospital grounds	0318104	6251584	Nil detected	-	—	—
18G	Hospital ground in drain	0318112	6251634	—	Background	Background	0.012 ^{226}Ra 0.0044 ^{137}Cs
19G	Hospital grounds	0318116	6251672	Nil detected	-	—	—
20G	Hospital grounds	0318093	6251653	Nil detected	-	—	—
21G	Hospital ground edge of garden	0318075	6251679	Nil detected	-	—	—
22G	Hospital ground at demountable	0318041	6251667	—	Background	Background	0.017 ^{226}Ra 0.0038 ^{137}Cs
23G	Hospital grounds	0318030	6251685	Nil detected	-	—	—
24G	Main hospital entrance	0318011	6251639	Nil detected	-	—	—
25G	Hospital grounds	0317987	6251609	Nil detected	-	—	—
26P	Old incinerator footprint area	0318091	6251529	—	Background	Background	0.0056 ^{226}Ra
27P	Old incinerator footprint area	0318063	6251537	—	Background	Background	0.041 ^{226}Ra
28R	Building footprint	0318040	6251573	Nil detected	-	—	—
29R	Building footprint	0318045	6251637	Nil detected	-	—	—
30R	Main entrance footprint	0318027	6251603	Nil detected	Background	—	—
31R	Building footprint	0318078	6251551	—	-	Background	0.031 ^{226}Ra
32R	Building footprint	0318077	6251597	Nil detected	-	—	—
Baseline Samples							
9BG	Dudley Reserve	0318059	6251216	Nil detected	—	N/a	0.020 ^{226}Ra
10BG	Civic Park	0317915	6251702	Nil detected	—	N/a	0.032 ^{226}Ra

Appendix 1 – Direct probe monitoring survey results

(See following sheets)

KEY: \$\$\$Radiologically Cleared **Attention !Requires Action									
Survey point (if applicable)	Date	Time	Building	level	Room	Background cps		Background DoseRate (uSv/h)	Notes (all measurements include background)
Arthur Stone Annex	23.3.07		Arthur stone annex	2	whole floor	DP2	SPA 3	<0.02	outside area shows switchboard with labels n/m (i.e nuc med)
	23.3.07		Arthur stone annex	1	bathroom	5	200	<0.02	poster for cardio we refer to Pic 2 in report
	23.3.07		Arthur stone annex	ground		4	230	<0.02	railings infloor possible a bed & gantry
	23.3.07		Arthur stone annex	ground		4	296	<0.02	
	23.3.08		Arthur stone annex	ground	stair area	-	-	<0.02	found 2 smoke detectors with 100 uCi Am-241 sources - removed by MULTIPLEX
	26.3.07		Arthur Stone grounds		outside arthur stone-aged care facility ground	2	150	<0.02	
	26.3.07		Arthur Stone grounds		concrete	4	240	<0.02	
	26.3.07		Arthur Stone grounds		outside storey big	3	140	<0.02	
	26.3.07		Arthur Stone grounds		concrete carparks & grass area	5	286	<0.02	
	26.3.07		Arthur Stone grounds		bricks	5	330	<0.02	
	30.3.07	14.30	Building D	G	Staff gym/ old incinerator area	4.5	160	<0.02	
	30.3.07	14.35	Building D	G	contaminated waste store	4	181	<0.02	
	30.3.07		Building M	G	Electrical workshop	4	218	<0.02	2 areas (separate rooms)
	30.3.07		Building C	I	tea room	4	225	<0.02	
	30.3.07		Building H	I	Change room	3	217	<0.02	
	30.3.07		Building C	G	Catering room	3.5	243	<0.02	
	30.3.07		Building C	G	Kitchen	3	213	<0.02	
	30.3.07		Building M	G	Maintenance offices	3.5	200	<0.02	
	30.3.07		Building M	G	Paint store	4	211	<0.02	
	30.3.07		Building M	G	Welding Workshop	3.5	196	<0.02	

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	30.3.07	Building M	G	metal store	3	170	<0.02	
	30.3.07	Building M	G	Carpentary Store	2.5	110	<0.02	
	30.3.07	Building M	G	Plumbers store	3	160	<0.02	
	30.3.07	Building M	G	Seamstress Room	3	172	<0.02	
Bid foot print	30.3.07	09.15 site 1		old house	3.5	155	<0.02	20m-10m area all readings = b/g
Bid foot print	30.3.07	09.35 site 2		old house	3.5	145	<0.02	15m-25m area all readings = b/g
	30.3.07	10.45 accom block	G	entrance foyer	4	200	<0.02	B/g
	30.3.07	Building V	G	nurse quarters South of fire door 56	4	255	<0.02	B/g
	30.3.07	Building V	G	corridor as above all rooms	4	260	<0.02	B/g
	30.3.07	Building V	G	lift well, area/foyer	3	241	<0.02	B/g
	30.3.07	Building V	G	room g-5	3	240	<0.02	
	30.3.07	Building V	G	reception	3.1	250	<0.02	
	30.3.07	Building V	G	Room G-2 (multiplex)	3	250	<0.02	
	30.3.07	1330 Building V	G	nurse common room next to pool	3.5	215	<0.02	
	30.3.07	1350 Building V	G	kitchen	4.5	245	<0.02	
	30.3.07	1355 Building V	G	transport bid	5	300	<0.02	
	30.3.07	Building V	G	central sterilizing dept	4	205	<0.02	
	30.3.07	1420 Building V	G	clean linen room	3.5	220	<0.02	
	30.3.07	1420 Building V	G	boiler room	4	203	<0.02	
	3.4.07	0930 Physio Morgue	1	Morgue entrance foyer	4	230	<0.02	background levels
	3.4.07	0940 Electro therapy	1	electro therapy room	3.5	190	<0.02	
	3.4.07	0945 Physio rooms	1	physio room	4	275	<0.02	1 large room with several smaller off shoot rooms
	3.4.07	0950 Physio office	1	physio office	3	260	<0.02	
	3.4.07	0955 Physio morgue	1	paramedical staff toilet	3	235	<0.02	
	3.4.07	1000 Physio morgue	2	store room 11	3.5	220	<0.02	pathology lab old artefacts. b/g levels only
	3.4.07	1010 Physio morgue	2	store 12	4	260	<0.02	
	3.4.07	1012 Physio morgue	2	tea room	4	220	<0.02	

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3.4.07	1015	Physio morgue	2	pathology qc	3	220	<0.02	
3.4.07	1015	Physio morgue	2	pathology labs	3.5	220	<0.02	
3.4.07	1020	Physio morgue	2	specimen collecting room	4	230	<0.02	7cps / 400cps in sink due to ceramic material
3.4.07	1020	Physio morgue	2	toilets	4	240	<0.02	
3.4.07	1020	Physio morgue	2	specimen collecting room	4	220	<0.02	
3.4.07	1020	Physio morgue	2	enviro services room	3.5	220	<0.02	
3.4.07	1025	Physio morgue	2	speech therapy	3	230	<0.02	
3.4.07	1100	below kitchen	Lower Grnd	stn end corridors under bid in basement area	4	230	<0.02	below bid C & D
3.4.07	1110	Below bid V	Lower Grnd	plant room and lift foyer	3	210	<0.02	below bid V
3.4.07	1115	main hospital	Lower Grnd	main store	3	160	<0.02	hospital records
3.4.07	1115	block	Lower Grnd	purchasing officer	3	210	<0.02	hospital records
3.4.07	1120	east hos. Block	Lower Grnd	hazardous waste store	3	210	<0.02	
3.4.07	1120	east hos. Block	Lower Grnd	mechanical & plumbers workshop	3.5	190	<0.02	
3.4.07		east hos. Block	Lower Grnd	carpenters shop	3	190	<0.02	full of junk
3.4.07		east hos. Block	Lower Grnd	toilets	4	230	<0.02	
3.4.07		east hos. Block	Lower Grnd	boiler room	3.5	240	<0.02	below bid V
3.4.07	1125	east block	Lower Grnd	new washing machine room	4	200	<0.02	new room (old resident medical officers)
3.4.07		east block	Lower Grnd	linen room	3.5	210	<0.02	new room (old resident medical officers)
3.4.07	1130	RMO quarters	Lower Grnd	tea room	3	230	<0.02	
3.4.07		RMO quarters	Lower Grnd	LG-6	3	220	<0.02	

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3.4.07		RMO quarters	Lower Grnd	LG-2	3	240	<0.02	
3.4.07		RMO quarters	Lower Grnd	LG-6	3.5	185	<0.02	
3.4.07	1150	RMO quarters	Lower Grnd	LG-1	3.5	197	<0.02	
3.4.07	1150	RMO quarters	Lower Grnd	transport office	3.5	200	<0.02	
3.4.07	1200	Main hospital bid block F	Ground	main entrance lift foyer	3.5	190	<0.02	1100CPS from "hot" patient from Westmead hospital!
3.4.07	1215	Main hospital bid block F	Ground	x-ray rooms	3.5	220	<0.02	no sources (2 rooms)
3.4.07	1220	Main hospital bid block F	Ground	ct rooms	3.5	220	<0.02	no sources
3.4.07		Main hospital bid block F	Ground	examination room	3.5	220	<0.02	
3.4.07		Main hospital bid block F	Ground	x-ray rooms	3	150	<0.02	no sources (2 rooms)
3.4.07		Main hospital bid block F	Ground	file store	3.5	180	<0.02	
3.4.07		Main hospital bid block F	Ground	radiologist	3	220	<0.02	Co-joined wards
3.4.07		Main hospital bid block F	Ground	receiving room	3	220	<0.02	Co-joined wards
3.4.07		Main hospital bid block F	Ground	observation ward	3	220	<0.02	Co-joined wards
3.4.07		Main hospital bid block F	Ground	out patient reception	3	200	<0.02	
3.4.07		Building S	Ground	pathology lab	2	120	<0.02	demountable (temp)
3.4.07		Building S	Ground	physio	2	100	<0.02	demountable (temp)
3.4.07	1230	Building S	Ground	occupational therapy	2	100	<0.02	demountable (temp)
3.4.07	1235	Building K	Ground	calentria	2	160	<0.02	
3.4.07		Building B	Ground	health info services	2.5	180	<0.02	
3.4.07		Building B	Ground	clerical service managers	3	259	<0.02	office
3.4.07		Building A	Ground	store room no2	3	230	<0.02	
3.4.07	1310	Building A	Ground	conference room	3	250	<0.02	
3.4.07	1400	Building F	1	foyer (lift)	4	220	<0.02	
3.4.07	1410	Building F	1	2nd stage recovery	3	150	<0.02	western end

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	3.4.07	1420	Building F	1	theatre reception corridor & holding bay	2.5	170	<0.02	
	3.4.07	1430	Building F	1	store room	3	220	<0.02	
	3.4.07	1435	Building F	1	anaesthetic room 1	2	167	<0.02	
	3.4.07	1435	Building F	1	tea room	2	120	<0.02	
	3.4.07	1445	Building F	1	anaesthetic room 2	2	170	<0.02	
	3.4.07	1445	Building F	1	Corridors to operating theatres	2	130	<0.02	
	3.4.07	1445	Building F	1	waiting room reception	3	210	<0.02	
	3.4.07	1500	Building F	1	pre admission clinic	2	200	<0.02	
	3.4.07	1505	Building F	1	servery / washing	3	200	<0.02	
	3.4.07	1505	Building F	1	staff canteen	3	200	<0.02	
	3.4.07	1506	Building F	2	foyer / lift	2	201	<0.02	Level 2 Nth (cardiac step down)
	3.4.07	1508	Building F	2	kitchen	3	201	<0.02	
	3.4.07	1510	Building F	2	sterilizing room	3	220	<0.02	
	3.4.07	1515	Building F	2	high dependency coronary care	2.5	180	<0.02	
	3.4.07	1515	Building F	2	corridors	4	260	<0.02	level 2 east
	3.4.07	1516	Building F	2	library	3	200	<0.02	
	3.4.07	1518	Building F	2	post acute coronary care	4	200	<0.02	
	3.4.07	1520	Building F	2	nurse educator	4	250	<0.02	
Francois McKay wing	4.4.07	0845	Building F	3 Nth	foyer / lifts	3	230	<0.02	
Francois McKay wing	4.4.07	0850	Building B	3 east	Corridor	4	250	<0.02	
Francois McKay wing	4.4.07		Building B	3 east	reception	3.5	230	<0.02	
Francois McKay wing	4.4.07		Building B	3 east	sterile and medical store	3.5	240	<0.02	
Francois McKay wing	4.4.07		Building B	3 east	utility room	4	230	<0.02	
Francois McKay wing	4.4.07		Building B	3 east	tea room	4	230	<0.02	
Francois McKay wing	4.4.07		Building B	3 east	room 306/307	3	250	<0.02	
Francois McKay wing	4.4.07		Building B	3 east	room 308	4	240	<0.02	

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Francois McKay wing	4.4.07		Building B	3 east	tea room	2.5	190	<0.02	
Francois McKay wing	4.4.07	0900	Building F	3 nth	staff resource room	4	220	<0.02	
Francois McKay wing	4.4.07		Building F	3 nth	corridor	4	240	<0.02	
Francois McKay wing	4.4.07		Building F	4 nth	nurse unit manager	4.5	260	<0.02	
Francois McKay wing	4.4.07		Building F	5 nth	cleaner room	4	260	<0.02	
Francois McKay wing	4.4.07		Building F	6 nth	room 310	3.5	210	<0.02	
Mark Stanton wing	4.4.07	0900	Building F	3 nth	servery room	3.5	240	<0.02	
Mark Stanton wing	4.4.07		Building F	3 nth	utility room	3.5	240	<0.02	
Mark Stanton wing	4.4.07		Building F	3 nth	store room	4	250	<0.02	
Mark Stanton wing	4.4.07		Building F	3 nth	wards 311-318	3.5	230	<0.02	all wards consistent with background levels
	4.4.07	0910	Building F	4	foyer / lift	4	230	<0.02	
	4.4.07		Building F	4 nth	corridors	3	210	<0.02	
	4.4.07		Building F	4 nth	equip. room 2	4	230	<0.02	
	4.4.07		Building F	4 nth	servery	3.5	230	<0.02	
	4.4.07		Building F	4 nth	room 416	4	210	<0.02	
	4.4.07		Building F	4 nth	room 419	4	220	<0.02	
	4.4.07		Building F	4 nth	room 417	3	200	<0.02	
	4.4.07		Building F	4 nth	salarium	3	190	<0.02	
	4.4.07		Building F	4 nth	wards 411-415	3	200	<0.02	all wards consistent with background levels
	4.4.07		Building B	4 east	corridors	4	250	<0.02	n.b. All wards 401-408 at background levels
	4.4.07	0930	Building B	4 sth	store room	4	220	<0.02	
	4.4.07	1025	Building F	5	foyer / lift	4	230	<0.02	
	4.4.07		Building F	5 nth	staff station	3.5	230	<0.02	
	4.4.07		Building F	5nth	servery	4	240	<0.02	
	4.4.07		Building F	5nth	education room	3.5	200	<0.02	
	4.4.07		Building F	5nth	corridor area	3.5	220	<0.02	
	4.4.07		Building F	5nth	all wards	3.5	220	<0.02	all wards consistent with background levels

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4.4.07	1035	Building B	5east	special care & paediatrics	4	250	<0.02	
4.4.07		Building B	5east	corridors	4	240	<0.02	
4.4.07		Building B	5sth	nurse unit manager	4	210	<0.02	
4.4.07		Building B	5sth	stores & medical	4	230	<0.02	
4.4.07	1040	Building B	5east	all wards	4	240	<0.02	all wards consistent with background levels
4.4.07	1041	Building F	6 Nth	foyer	3	180	<0.02	
4.4.07	1042	Building F	6 Nth	parent mid wife office	3	200	<0.02	
4.4.07		Building F	6 Nth	pharmacy	3	190	<0.02	
4.4.07	1046	Building F	6 Nth	common room	3.5	210	<0.02	
4.4.07	1050	Building F	6 Nth	Dialysis office	4	220	<0.02	
4.4.07	1055	Building F	6 Nth	nth corridors beside office	4	220	<0.02	b/g levels
4.4.07	1055	Building B	6east	lounge room	3.5	190	<0.02	
4.4.07		Building B	6east	corridors	4	210	<0.02	
4.4.07		Building B	6east	admission room	4	230	<0.02	
4.4.07		Building B	6east	staff tea room	4.5	220	<0.02	
4.4.07		Building B	6east	medical & store room	4	200	<0.02	
4.4.07	1105	Building B	6east	all delivery rooms	4	230	<0.02	b/g levels
4.4.07		Building F		ventilation p/r	2	160	<0.02	roof top
4.4.07		Building F		battery room	2.5	170	<0.02	roof top
4.4.07		Building F		balcony	2	120	<0.02	roof top
4.4.07	1130	Building F		top roof	3	100	<0.02	roof top

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Table 11 - Soil Results

Bore ID	Sample Depth (m)	Material Type	Heavy Metals								PAH		TPH		Benzene	Toluene	Ethyl- benzene	Total Xylene	OCP ³	OPP	PCB	Total Phenols	VOCs	pH	Asbestos	
			As	Cd	Cr ¹	Cu	Pb	Hg	Ni	Zn	B(a)P ²	Total +ve PAH ³	C6- C9	C10-C36												
DP Preliminary Contamination Assessment 2006																										
102	0.1	Filling	<4	<1	18	57	20	<0.1	<u>110</u>	54	<0.05	<0.1	<25	<250	<1	<1	<1	<3	<2	-	<1.5	<5	-	-	-	
Current DP Investigation 2009																										
201	0.1-0.2	Filling	<4	<0.5	19	43	26	<0.1	<u>64</u>	45	0.2	2.4	<25	<250	<0.5	<0.5	<1	<3	-	<0.1	-	-	-	-	No asbestos/fibre detected	
201	0.3-0.5	Filling	11	<0.5	22	28	52	<0.1	18	58	0.3	3.7	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	<10/<1	8.4	No asbestos/fibre detected	
201	0.8-1.0	Shale	10	<0.5	10	29	24	<0.1	10	23	0.08	0.58	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
BD1 050209 ⁵		Shale	8	<0.1	9	22	29	<0.05	10	19	<0.5	<0.5	<10	<250	<0.2	<0.5	<0.5	<1.5	-	-	-	-	-	-	-	
202	0.1-0.3	Filling	9	<0.5	17	29	<u>170</u>	0.2	12	100	0.1	0.7	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	chrysotile asbestos detected Amosite asbestos detected respirable fibres not detected	
202	0.8-1.0	Filling	7	<0.5	14	96	<u>110</u>	0.2	8	93	0.1	0.5	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	No asbestos/fibre detected	
203	0.1-0.3	Filling	7	<0.5	15	32	<u>130</u>	0.2	10	160	0.2	1.7	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	<10/<1	7.1	-	
203	0.5-0.6	Filling	9	1	17	32	<u>150</u>	0.2	11	650	0.8	8.4	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	No asbestos/fibre detected	
203A	0-0.2	Filling	8	<0.5	15	36	<u>170</u>	0.2	7	120	15	157.8	<25	740	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
204	0.1-0.2	Filling	7	<0.5	21	37	<u>170</u>	0.1	10	160	0.8	10.4	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	No asbestos/fibre detected	
BD3 060209 ⁴		Filling	8	<0.5	23	34	<u>140</u>	0.1	9	110	1.1	12	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
204	0.3-0.5	Filling	7	<0.5	20	25	55	<0.1	10	58	0.06	0.26	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
205	0.1-0.3	Filling	8	<0.5	20	29	<u>130</u>	0.2	8	140	0.1	0.9	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	<10/<1	8.3	No asbestos/fibre detected	
205	0.7-0.9	Shale	7	<0.5	15	23	61	0.1	4	61	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
206	0.1-0.3	Filling	7	<0.5	13	28	94	0.2	5	130	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
206	0.5-0.7	Shale	6	<0.5	10	34	51	0.1	5	67	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
207	0.1-0.3	Filling	9	<0.5	15	39	<u>140</u>	0.1	8	100	0.09	0.59	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	-	-	No asbestos/fibre detected	
207	0.7-1.0	Silty Clay	4	<0.5	9	37	25	<0.1	4	37	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
208	0-0.1	Filling	8	<0.5	7	45	20	0.1	17	71	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	<10/<1	8.2	No asbestos/fibre detected	
209	0-0.2	Filling	5	<0.5	7	42	22	<0.1	10	52	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	0.5	-	-	-	-	-	No asbestos/fibre detected	
209	0.5-0.6	Filling	5	<0.5	9	38	22	<0.1	6	49	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	0.2	<0.1	<0.1	<5	-	-	-	
210	0.1-0.2	Filling	7	<0.5	15	24	60	0.3	4	26	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	-	7.9	No asbestos/fibre detected	
211	0.1-0.3	Filling	5	<0.5	17	18	14	<0.1	10	10	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	<10/<1	5.3	No asbestos/fibre detected	
211	0.4-0.45	Shale	<4	<0.5	43	28	31	<0.1	29	23	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
212	0.1-0.3	Filling	9	<0.5	19	22	43	0.1	5	30	0.1	1	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	-	-	No asbestos/fibre detected	
213	0.1-0.3	Filling	7	<0.5	19	49	100	0.3	8	120	0.2	1.2	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
213	0.3-0.6	Filling	8	<0.5	19	33	55	0.1	5	61	0.2	1.8	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	No asbestos/fibre detected	
214	0.25-.04	Filling	7	<0.5	48	27	50	0.2	42	66	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	<10/<1	8.5	No asbestos/fibre detected	
214	0.8-1	Silty Clay	8	<0.5	18	17	21	<0.1	7	22	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
215	0.3-0.5	Filling	7	<0.5	25	25	72	0.3	18	100	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	<10/<1	7.6	No asbestos/fibre detected	
215	1.8-2	Shale	<4	<0.5	5	49	12	<0.1	12	91	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
216	0.3-0.4	Filling	5	<0.5	7	36	16	<0.1	29	130	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	<10/<1	11.1	No asbestos/fibre detected	
217	0.25-0.35	Filling	10	<0.5	8	40	27	0.1	26	82	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
BD1 030209 ⁵		Filling	10	0.1	7	42	21	0.07	22	81	<0.5	<0.5	<10	<250	<0.2	<0.5	<0.5	<1.5	<0.05	-	<0.5	<0.5	-	-	-	
218	0.4-0.6	Filling	14	<0.5	6	49	17	0.2	58	160	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	<0.1	<0.1	<5	<10/<1	-	No asbestos/fibre detected	
BD2 030209 ⁴		Filling	19	<0.5	6	47	18	0.1	65	190	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	-	
219	0.4-0.5	Filling	<4	<0.5	3	33	9	<0.1	4	23	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
219	0.9-1.0	Shale	<4	<0.5	2	31	8	<0.1	3	17	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3		-	-	-	-	-	-	

Bore ID	Sample Depth (m)		Heavy Metals								PAH		TPH		Benzene	Toluene	Ethyl- benzene	Total Xylene	OCP ³	OPP	PCB	Total Phenols	VOCs	pH	Asbestos	
		Material Type	As	Cd	Cr ¹	Cu	Pb	Hg	Ni	Zn	B(a)P ²	Total +ve PAH ³	C6- C9	C10-C36												
220	0-0.2	Filling	6	<0.5	14	31	51	0.1	10	67	0.1	0.5	<25	<250	<0.5	<0.5	<1	<3	-	<0.1	-	-	<10/<1	7.6	-	
220	0.4-0.6	Filling	11	<0.5	17	21	53	0.2	6	770	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	<0.1	-	<0.1	<5	-	-	No asbestos/fibre detected	
220	1.3-1.5	Shale	11	<0.5	11	30	22	0.1	5	100	<0.05	<0.1	<25	<250	<0.5	<0.5	<1	<3	-	-	-	-	-	-	-	
Waterproof Membrane		material	-	-	-	-	-	-	-	-	0.8	11.3	<25	24000 ¹¹	<0.5	<0.5	<1	<3	-	-	-	-	-	-	no asbestos detected	
SAC																										
HIL ⁷			100	20	12%	1000	300	15	600	7000	1	20	65	1000	1 ⁸	1.4/130 ⁸	3.1/50 ⁸	14/25 ⁸	10/50/200/10 ⁶	ND	10	8500	ND	-	None detected in surface soils	
PPIL ⁹			20	3	400	100	600	1	60	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Waste Classification Criteria ¹⁰																										
General Solid Waste Without TCLP			100	20	100	-	100	4	40	-	0.8	-	-	-	10	288	600	1000	-	-	-	288	-	-	Nil Detected	
General Solid Waste With TCLP			500	100	1900	-	1500	50	1050	-	10	200	650	10000	18	518	1080	1800	<50	<50	<50	518	-	-	Nil Detected	

Notes

- 1
- All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) is too reactive and unstable under the normal environment
- 2
- benzo(a)pyrene
- 3
- where results less than practical quantitative limit (PQL), quoted as less than PQL for most individual compounds
- 4
- Intralaboratory Duplicate of sample listed above
- 5
- Interlaboratory duplicate of sample listed above
- 6
- OCP SACs given in order Aldrin+Dieldrin/Chlordane/ DDD+DDE+DDT/Heptachlor
- 7
- NSW DECC Contaminated Sites *Guidelines for the NSW Site Auditor Scheme* 2nd edition (2006) Soil Investigation Levels for Urban Redevelopment Sites in NSW Heath-based investigation levels for Commercial and Industrial sites (HIL Column 4).
- 8
- NSW EPA Contaminated Sites *Guidelines for Assessing Service Station Sites* (1994)
- 9
- NSW DECC Contaminated Sites *Guidelines for the NSW Site Auditor Scheme* 2nd edition (2006) Provisional Phytotoxicity Based Investigation Levels (PPIL)
- 10
- Waste Classification Guidelines 2008
- 11
- Material pre-classified as per Waste Classification Guidelines as asphalt waste

Notes

-
- not analysed
- ND
- Not defined
- BOLD
- Exceeds SAC
- Red
- Hotspot Concentration
- green
- exceeds PPIL
- Exceeds General Solid
- Waste without TCLP
- Italics
-

Table 12 - Waste Classification Results

Bore ID	Sample Depth (m)	Heavy Metals				PAH ²			
		Pb	Pb TCLP	Ni	Ni TCLP	B(a)P ¹	B(a)P TCLP	Total +ve PAH	PAH TCLP
201	0.1-0.2	26	-	64	0.04	0.2	-	2.4	-
202	0.1-0.3	170	2	12	-	0.1	-	0.7	-
203	0.5-0.6	150	0.25	11	-	0.8	-	8.4	-
203A	0-0.2	170	0.07	7	-	15 ⁴	<0.001	157.8	<0.016
204	0.1-0.2	170	0.24	10	-	0.8	-	10.4	-
BD3 060209		140	-	9	-	1.1	<0.001	12	<0.016
207	0.1-0.3	140	0.25	8	-	0.09	-	0.59	-
214	0.25-.04	50	-	42	<0.02	<0.05	-	<0.1	-
218	0.4-0.6	17	-	58	<0.02	<0.05	-	<0.1	-
BD2 030209		18	-	65	0.04	<0.05	-	<0.1	-
Waste Classification Guidelines									
General Solid Waste Without TCLP		100	-	40	-	0.8	-	-	-
General Solid Waste With TCLP		1500	5	1050	2	10	0.04	200	-

Notes:

- 1
- benzo(a)pyrene
- 2
- where results less than practical quantitative limit (PQL), quoted as less than PQL for most individual compounds
- 3
- Waste Classification Guidelines 2008
- 4
- Sample contains ash and slag so therefore classified by leachable concentration only i.e. general solid waste
-
- not analysed
- ND
- Not defined
- Italics*
- Exceeds General Solid Waste without TCLP
- shading
- Exceeds general solid waste with TCLP

Table 13 – Groundwater Results – Heavy metals and PCBs

Sample ID	Heavy Metals								Hardness (mgCaCO ₃ /L)	pH	PCBs						
	As	Cd	Ch	Cu	Pb	Hg	Ni	Zn			Total ³	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254
EAW Investigation Results 2007																	
GW6	70	0.3	21	8	36	<0.1	71	134	-	-	<1	-	-	-	-	-	-
GW12	4	0.5	12	31	40	<0.1	16	164	-	-	-	-	-	-	-	-	-
GW13	8	0.8	13	26	18	<0.1	34	124	-	-	-	-	-	-	-	-	-
GW15	2	1.1	20	33	37	<0.1	30	164	-	-	-	-	-	-	-	-	-
DP Results 2009 (current)																	
GW6	2.6	<0.1	<1	<1	<1	<0.5	8.6	4.3	2700	6.6	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GW12	1	<0.1	4.8	2.3	<0.5	<0.5	5.1	35	53	8	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GW13	<1	0.1	<1	<1	<1	<0.5	4.4	56	560	6.6	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GW15	<1	0.8	<1	<1	<1	<0.5	22	61	1700	6.6	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
201-GW	1.1	0.1	<1	1.8	<1	<0.5	6.8	25	2900	6.7	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BD1 160209 ¹	1.6	0.1	<1	1.4	<1	<0.5	5.8	28	-	-	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BD2 160209 ²	<10	0.1	<5	<4	<1	<0.1	7	22	-	-	<0.07	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Guidelines																	
ANZECC	13	0.2	1	1.4	3.4	0.06	11	8	Not Specified	-	Not Specified	0.001	1	0.3	0.3	0.3	0.01
HMTV ⁴	-	2	8.4	12.6	90.8	-	99	72	-	-	-	-	-	-	-	-	-

Notes:

- 1 Intra-laboratory Duplicate of 201-GW
- 2 Inter-laboratory duplicate of 201-GW
- 3 Given as sum of PQL of all analytes in list where all analytes below PQL
- 4 Hardness modified trigger value for extremely hard waters (hardness 400)

Shading Exceeds GIL

Table 14 - Groundwater Results – TPH, BTEX, PAH and Phenols

Sample ID	TPH		BTEX				PAH						Phenols
	C6-C9	C10-C36	Benzene	Toluene	Ethyl benzene	Xylenes	Total ³	Benzo(a)Pyrene	Naphthalene	Anthracene	Phenanthrene	Fluoranthene	Total
EAW Investigation Results 2007													
GW6	<20	<250	<1	<2	<2	<2	<7	<1	<1	<1	<1	<1	
GW12	<20	<250	<1	<2	<2	<2	-	-	-	-	-	-	
GW13	<20	<250	<1	<2	<2	<2	-	-	-	-	-	-	
GW15	<20	<250	<1	<2	<2	<2	-	-	-	-	-	-	
DP Results 2009 (current)													
GW6	<10	<250	<1	<1	<1	<3	<1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<50
GW12	<10	<250	<1	<1	<1	<3	<1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<50
GW13	<10	<250	<1	<1	<1	<3	<1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<50
GW15	<10	<250	<1	<1	<1	<3	<1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<50
201-GW	<10	<250	<1	<1	<1	<3	<1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<50
BD1 160209 ¹	<10	<250	<1	<1	<1	<3	<1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<50
BD2 160209 ²	<50	<300	<5	<5	<5	<15	0.7	<0.05	<0.1	<0.1	0.2	0.2	<34
Guidelines													
	150	600	950	180	80	550	Not Specified	0.2	16	0.4	2	1.4	320

Notes:

- 1 Intra-laboratory Duplicate of 201-GW
- 2 Inter-laboratory duplicate of 201-GW
- 3 Given as sum of PQL of all analytes in list where all analytes below PQL

Table 15 - Groundwater Results – OCP and OPP

Sample ID	OCPs						OPP								
	Total ³	Chlordane	DDT	Endosulfan	Endrin	Heptachlor	Total ³	Demonton-S-methyl	Diazinon	Dimethoate	Chloropyrifos	Malathion	Azinophos Methyl	Fenitrothion	Parathion (ethyl)
EAW Investigation Results 2007															
GW6	<0.5	-	-	-	-	-	<0.5	-	-	-	-	-	-	-	-
GW12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GW15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DP Results 2009 (current)															
GW6	<0.022	<0.001	<0.001	<0.001	<0.001	<0.001	<0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GW12	<0.022	<0.001	<0.001	<0.001	<0.001	<0.001	<0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GW13	<0.022	<0.001	<0.001	<0.001	<0.001	<0.001	<0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GW15	<0.022	<0.001	<0.001	<0.001	<0.001	<0.001	<0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
201-GW	<0.022	<0.001	<0.001	<0.001	<0.001	<0.001	<0.18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BD1 160209 ¹	<0.022	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-
BD2 160209 ²	<0.19	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-
Guidelines															
	Not Specified	0.08	0.01	0.2	0.02	0.09	Not Specified	0.4	0.01	0.15	0.01	0.05	0.02	0.2	0.004

Notes:

- 1 Intra-laboratory Duplicate of 201-GW
- 2 Inter-laboratory duplicate of 201-GW
- 3 Given as sum of PQL of all analytes in list where all analytes below PQL

Table 16 - Groundwater Results – VOCs

Analyte	Sample ID							Guidelines	ANZECC	Dutch	Region 9
	GW6	GW12	GW13	GW15	201-GW	BD1 160209 ¹	BD2 160209 ²				
Dichlorodifluoromethane	<10	<10	<10	<10	<10	<10	<50	-	-	-	-
Chloromethane	<10	<10	<10	<10	<10	<10	<50	-	-	-	160
Vinyl Chloride	<10	<10	<10	<10	<10	<10	<50	100	-	-	0.02
Bromomethane	<10	<10	<10	<10	<10	<10	<50	-	-	-	8.7
Chloroethane	<10	<10	<10	<10	<10	<10	<50	-	-	-	4.6
Trichlorodifluoromethane	<1	<1	<1	<1	<1	<1	<5	-	-	-	1300
1,1-Dichloroethene	<1	<1	<1	<1	<1	<1	<5	700	-	-	340
Trans-1,2-dichloroethene	<1	<1	<1	<1	<1	<1	<5	-	-	-	120
1,1-dichloroethane	<1	<1	<1	<1	<1	<1	<5	90	900	-	810
Cis-1,2-dichloroethene	<1	<1	<1	<1	<1	<1	<5	-	-	-	61
Bromochloromethane	<1	<1	<1	<1	<1	<1	<5	-	-	-	-
Chloroform	<1	<1	<1	<1	<1	<1	<5	370	400	-	0.17
2,2-dichloropropane	<1	<1	<1	<1	<1	<1	<5	-	-	-	-
1,2-dichloroethane	<1	<1	<1	<1	<1	<1	<5	1900	400	-	0.12
1,1,1-trichloroethane	<1	<1	<1	<1	<1	<1	<5	270	300	-	3200
1,1-dichloropropene	<1	<1	<1	<1	<1	<1	<5	500	-	-	-
Carbon tetrachloride	<1	<1	<1	<1	<1	<1	<5	240	-	-	0.17
Benzene	<1	<1	<1	<1	<1	<1	<5	950	30	-	-
Dibromomethane	<1	<1	<1	<1	<1	<1	<5	-	-	-	-
Trichloroethene	<1	<1	<1	<1	<1	<1	<5	330	-	-	0.028
Bromodichloromethane	<1	<1	<1	<1	<1	<1	<5	-	-	-	1.15
trans-1,3-dichloropropene	<1	<1	<1	<1	<1	<1	<5	-	-	-	-
cis-1,3-dichloropropene	<1	<1	<1	<1	<1	<1	<5	-	-	-	-
1,1,2-trichloroethane	<1	<1	<1	<1	<1	<1	<5	1900	130	-	0.25
Toluene	<1	<1	<1	<1	<1	<1	<5	180	1000	-	720
1,3-dichloropropane	<1	<1	<1	<1	<1	<1	<5	1100	-	-	120
Dibromochloromethane	<1	<1	<1	<1	<1	<1	<5	-	-	-	0.13
1,2-dibromoethane	<1	<1	<1	<1	<1	<1	<5	-	-	-	0.0056
Tetrachloroethene	<1	<1	<1	<1	<1	<1	<5	70	40	-	0.1
1,1,1,2-tetrachloroethane	<1	<1	<1	<1	<1	<1	<5				0.43
Chlorobenzene	<1	<1	<1	<1	<1	<1	<5	55	-	-	110
Ethylbenzene	<1	<1	<1	<1	<1	<1	<5	80	150	-	1300
Bromoform	<1	<1	<1	<1	<1	<1	<5	-	-	-	8.55
m+p-xylene	<2	<2	<2	<2	<2	<2	<10	200+75	-	-	-
Styrene	<1	<1	<1	<1	<1	<1	<5	-	300	-	2100
1,1,2,2-tetrachloroethane	<1	<1	<1	<1	<1	<1	<5	400		-	0.055
o-xylene	<1	<1	<1	<1	<1	<1	<5	350	-	-	210
1,2,3-trichloropropane	<1	<1	<1	<1	<1	<1	<5	-	-	-	0.0056
Isopropylbenzene	<1	<1	<1	<1	<1	<1	<5	30	-	-	6.2
Bromobenzene	<1	<1	<1	<1	<1	<1	<5	-	-	-	20
n-propyl benzene	<1	<1	<1	<1	<1	<1	<5	-	-	-	240

Analyte	Sample ID							ANZECC	Dutch	Region 9
	GW6	GW12	GW13	GW15	201-GW	BD1 160209 ¹	BD2 160209 ²			
2-chlorotoluene	<1	<1	<1	<1	<1	<1	<5	-	-	-
4-chlorotoluene	<1	<1	<1	<1	<1	<1	<5	-	-	-
1,3,5-trimethyl benzene	<1	<1	<1	<1	<1	<1	<5	-	-	12
Tert-butyl benzene	<1	<1	<1	<1	<1	<1	<5	-	-	240
1,2,4-trimethyl benzene	<1	<1	<1	<1	<1	<1	<5	-	-	12
1,3-dichlorobenzene	<1	<1	<1	<1	<1	<1	<5	260	-	180
Sec-butyl benzene	<1	<1	<1	<1	<1	<1	<5	-	-	240
1,4-dichlorobenzene	<1	<1	<1	<1	<1	<1	<5	60	-	0.5
4-isopropyl toluene	<1	<1	<1	<1	<1	<1	<5	-	-	-
1,2-dichlorobenzene	<1	<1	<1	<1	<1	<1	<5	160	-	370
n-butyl benzene	<1	<1	<1	<1	<1	<1	<5	-	-	-
1,2-dibromo-3-chloropropane	<1	<1	<1	<1	<1	<1	<5	-	-	0.048
1,2,4-trichlorobenzene	<1	<1	<1	<1	<1	<1	<5	80	-	-
Hexachlorobutadiene	<1	<1	<1	<1	<1	<1	<5	-	-	0.86
1,2,3-trichlorobenzene	<1	<1	<1	<1	<1	<1	<5	3	-	-
Notes:										

- 1
- Intra-laboratory duplicate of 201-GW
- 2
- Inter-laboratory duplicate of 201-GW

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