

Remedial Action Plan

Crown Hotel Development (Part of ORWN Area), Barangaroo South



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Crown Hotel Development (Part of ORWN Area), Barangaroo South

Client: Crown Sydney Property Pty Ltd

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Glossary of Terms and Acronyms

Term	Description
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARC	Asbestos Removal Contractor
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASLP	Australian Standard Leaching Procedure
ASSMAC	New South Wales Acid Sulfate Soils Management Advisory Committee
As	Arsenic
Ba	Barium
BACM	bonded asbestos containing material
BaP/ B(a)P	Benzo-a-pyrene
BDA	Barangaroo Delivery Authority
BH	Borehole location
BTEX	Benzene, Toluene, Ethyl benzene and Xylene
CBD	Central Business District
Cd	Cadmium
CIM	Confirmed Impacted Material
CLM	Contaminated Land Management
Co	Cobalt
CoC	Chain of Custody
CO ₂	Carbon Dioxide
Cr	Chromium
CoPC	Chemicals of Potential Concern
Cu	Copper
CUTEP	Clean Up to the Extent Practicable
DEC	Department of Environment and Conservation NSW (superseded)
DECC	Department of Environment and Climate Change NSW (superseded)
DECCW	Department of Environment, Climate Change and Water NSW (now the NSW OEH)
DGI	Data Gap Investigation
DO	dissolved oxygen
DoP	NSW Department of Planning
DP	Deposited Plan
DQO	Data Quality Objectives
Declaration Site	Declaration Site (Development Works) Remediation Works Area
DSI	Detailed Site Investigation
EC	electrical conductivity

Term	Description
ECS	Emission Control Systems
EE	Excavation Enclosure
EMP	Environment Management Plan
ESCO	Ex-Situ Chemical Oxidation
EPA	Environmental Protection Authority
EPL	Environment Protection License
ESA	Environmental Site Assessment
ESD	Ecologically Sustainable Development
GAC	Generic Assessment Criteria
Hg	Mercury
HHR	Harbour Heat Rejection
HHERA	Human Health and Ecological Risk Assessment
HI	Hazard Index
m bgl	metres below ground level
Mn	Manganese
MW	Monitoring Well Location
MWQC	Marine Water Quality Criteria
LOR	Limit of Reporting
LLMP	Lend Lease (Millers Point) Pty Limited
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	(National Environmental Protection (Assessment of Site Contamination) Measure
Ni	Nickel
NHMRC	National Health and Medical Research Council
NSW	New South Wales
NSW OEH	New South Wales Office of Environment and Heritage
OHS/OH&S	Occupational Health and Safety
OHSP	Occupational Health and Safety Plan
OPT	Overseas Passenger Terminal
ORWN	Other Remediation Works (North) Area (Stage 1C)
ORWS	Other Remediation Works (South) Area (Stage 1A)
PAH	Polycyclic Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
PDA	Project Delivery Agreement
PID	Photoionisation Detector
PIM	Potential Impacted Material
Pb	Lead

Term	Description
POEO	Protection of the Environment Operations Act 1997 (NSW)
PPE	Personal Protective Equipment
PSI	Preliminary Site Assessment
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RBCL	Risk Based Clean Up Levels
RL	Relative Level
RE	Remediation Enclosure
RWP	Remediation Work Plan
SDS	Safety Data Sheets
SHFA	Sydney Harbour Foreshore Authority
SIL	Soil Investigation Level
S-ESCO	Surfactant Enhanced Ex-Situ Chemical Oxidation
SPA	Sydney Ports Authority
SPGWT	Separate Phase Gasworks Waste and Tar
SPOCAS	Suspension Peroxide Oxidation Combined Acidity & Sulfate
SSESC	Site-specific Ecological Screening Criteria
SSTC	Site Specific Target Criteria
SWL	Standing Water Level
SVM	Site Validation Manager
SVOC	Semi Volatile Organic Compound
TBT	Tributyltin
TCM	Tar Containing Material
TOC	Top of Casing
TPH	Total Petroleum Hydrocarbons
TSC	Terrestrial Soil Criteria
TTM	Total Toxicity of Mixtures
VMP	Voluntary Management Proposal
VOC	Volatile Organic Compound
VP	Validation Plan
VPD	Validation Project Director
UCL	Upper Confidence Level
UCS	Unconfined Compressive Strength
USCS	Unified Soil Classification System
US EPA	United States Environment Protection Agency
VENM	Virgin Excavated Natural Material
Zn	Zinc

Term	Description		
Units of Measurement			
°C	degrees Celsius	mg	milligrams
cm	centimetre	mS	milli-Siemens
ha	hectare	mV	millivolts
kg	kilogram	ppm	parts per million
km	Kilometre	µg	microgram
m	Metres	%	percent

Executive Summary

Introduction

AECOM Australia Pty Limited (AECOM) was commissioned by Crown Resorts Limited (Crown) to prepare this Remedial Action Plan (RAP) for the intended Crown Hotel Development to be constructed within part of the Other Remediation Works (North) Area (the ORWN Area) of Barangaroo South.

The specific area covered by this RAP, hereafter referred to as “the Site” is presented in **Figure F1, Figure F2, Figure F3** and **Figure F4** in **Appendix B** and comprises the following site areas:

- The proposed Crown Site which generally corresponds with the footprint of the future intended Crown Hotel Development;
- The area located to the south and west of the proposed Crown Site that it is intended will be licenced for use by Crown in conjunction with the future intended Crown Hotel Development; and
- That part of the future intended Crown Basement which is located within the ORWN Area (here-in referred to as the Stage 1C Works Area). The future intended Stage 1C Basement will extend beyond the Crown Site to the east below the future road to the boundary of Stage 1B (that is the western boundary of Block 4).

It is noted that the subterranean footprint of the future intended Crown Basement extends outside (to the east) the Site and into the proposed Stage 1B basement. Remediation of that portion of the future intended Crown Basement that is within the Stage 1B basement area will be undertaken in accordance with the ‘Block 4 Development Remediation Works’ described by the *Remedial Action Plan, NSW EPA Declared Remediation Site 21122 and Block 4 (Stage 1B) Development Works, Barangaroo, Millers Point, NSW* (hereafter referred to as the ‘VMP/Block 4 RAP’) (AECOM, 2013c).

This RAP considers the outcomes of the *ORWN Human Health and Ecological Risk Assessment* (HHERA) (AECOM, 2014) and implements the soil and groundwater Site-Specific Target Criteria (SSTC) which were developed therein.

This RAP has generally been prepared to meet the requirements of:

- *Contaminated Land Management Amendment (CLM) Act* (NSW Govt, 1997a);
- Department of Environment and Conservation (DEC, 2006b) *Guidelines for the NSW Site Auditor Scheme* (2nd edition) (DEC, 2006b);
- Department of Urban Affairs and Planning (DUAP) and NSW EPA. *Managing Land Contamination - Planning Guidelines State Environmental Planning Policy (SEPP) 55 - Remediation of Land* (DUAP and NSW EPA, 1998);
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC, 1999);
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPAM, [No. 1])* (NEPC, 2013); and
- New South Wales Environmental Protection Authority (NSW EPA). *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 1997).

Overview of Proposed Development Approval Application Process

A staged planning approval process is proposed in relation to the intended Crown Hotel Development.

The first stage will be a State Significant Development Application (SSDA) seeking approval for remediation and earthworks at Barangaroo South. The works the subject of the first SSDA are termed the “Stage 1C Remediation and Earthworks” and include the following:

- Carrying out of remediation and validation within the Stage 1C Works Area (also referred to as the “Stage 1C Remediation and Earthworks Area”) to ensure it is suitable for the intended future landuses;
- Construction of a perimeter retention wall system and internal stabilising structures (referred to as the “Stage 1C groundwater retention wall system”) to the west of Stage 1B. The Stage 1C groundwater retention wall system would be fully integrated with the Stage 1B groundwater retention wall system (as specified by Lend

Lease in the Environmental Impact Statement for SSD 5897-2013), with direct connections to create a unified groundwater retention wall system across Stage 1B and Stage 1C; and

- Bulk excavation within the perimeter of the Stage 1C groundwater retention wall system, the installation of lateral restraining structures to support the perimeter retention wall system, and off-site disposal of excavated materials.

These works, which are collectively referred to as the Stage 1C Remediation and Earthworks, are consistent with the approved Concept Plan (as modified) because they will enable development of the Site for uses which are currently permissible under the approved Concept Plan (as modified) (here-in referred to as currently permissible land uses).

The Stage 1C Remediation and Earthworks would also facilitate the future development of an underground basement car park and hotel building, which are proposed as part of Modification 8 to the Concept Plan.

The construction, operation and use of any future development within the Site (here-in referred to as future intended land uses) will not be included as part of Stage 1C Remediation and Earthworks SSDA and will be the subject of separate development applications.

Remediation Objectives

The key remediation objective for the Site is to facilitate the currently permissible and future intended land-uses proposed as part of the future intended Crown hotel development. Specific objectives of the remediation works (which will be undertaken as part of the Stage 1C Remediation and Earthworks) are:

- To ensure the remediated site is protective of human health in the context of the:
 - Currently permissible land uses - including a groundwater retention wall and bulk earthworks; and
 - Intended future land uses proposed as part of the Crown hotel development - including the future intended basement car park and Hotel;
- To ensure the remediated site is protective of the environment (specifically groundwater and the adjacent Darling Harbour), to the extent practicable, by minimising the risk of ongoing contamination; and
- Comply with applicable legislative and policy requirements including the appropriate requirements of the NSW EPA and NSW Department of Planning and Environment (DoPE).

It is noted that material which may require off-site disposal to landfill will require classification in accordance with the NSW EPA (2014) *Waste Classification Guidelines*. Further, some material excavated from the Site and designated for off-site disposal may also require treatment prior to off-site disposal.

Scope

The scope of work associated with the preparation of this RAP included:

- Review of available data from previous environmental investigations undertaken at the Site to assess the potential for contamination at the Site;
- Confirm the extent of any required remediation works based on consideration of the outcomes of the *Human Health and Ecological Risk Assessment, Stage 1C Development (ORWN), Barangaroo South* (here-in referred to as the *ORWN HHERA*) (AECOM, 2014);
- Undertake an assessment of the potential remediation approaches and technologies;
- Selection of preferred remediation methodology(s) to remediate the Site;
- Outline how the remediation works will be undertaken to meet the remediation objectives, taking into consideration the information review and technical assessment; and
- Develop procedures to demonstrate that the remediation works have been undertaken to satisfy the remediation objectives.

Preferred Remediation Strategy

Confirmed Impacted Material (soil or groundwater) has not been identified within the Site based on the previous intrusive investigations. However:

- Only limited soil analytical results are available for unsaturated soils that are proposed to remain *in situ* outside the Stage 1C Works Area. Therefore, additional validation testing is required to confirm whether unsaturated soils that are proposed to remain *in situ* outside the Stage 1C Works Area require remediation; and
- Concentrations of contaminants (that do not require remediation) have been identified within the Site which may require specific management practices to mitigate potential risks to construction workers, the public and environment.

Based on the available information, the preferred strategy for management of soil encountered as part of the future intended Crown Hotel Development Works should be focussed on:

- Confirmation, through additional validation sampling, that unsaturated soils that are proposed to remain *in situ* outside the Stage 1C Works Area do not require remediation;
- Excavation within the perimeter of the Stage 1C groundwater retention wall system as required by the proposed Stage 1C Remediation and Earthworks;;
- Offsite disposal of excavated material to a NSW EPA licensed landfill (including treatment if required); and
- Physical containment of material remaining *in situ* below the completed excavation within the Stage 1C groundwater retention wall system.

Conclusions

The soil and groundwater CoPC concentrations reported from previous intrusive investigations did not exceed the relevant soil and groundwater SSTCs derived in the *ORWN HHERA* (AECOM, 2014). Based on these intrusive investigations, remediation of the Site to facilitate the currently permissible and intended future land uses may not be required. However, it should be noted, additional validation sampling is required to confirm whether remediation of unsaturated soils that are proposed to remain *in situ* outside the Stage 1C Works Area is warranted. As an outcome of the additional validation sampling, it is possible that remediation of the unsaturated soils will be required.

Further, the previous soil and groundwater investigation results indicate that the excavation process proposed as part of the Stage 1C Remediation and Earthworks will require management of contaminated soils that have the potential to cause risk to human health and the environment during the excavation process.

The preferred remediation strategy recommended for the Site is:

- Additional validation sampling to confirm whether remediation of unsaturated soils proposed to remain *in situ* outside the Stage 1C Works Area is warranted;
- Construction of the Stage 1C groundwater retention wall system; and
- Excavation within the perimeter of the Stage 1C groundwater retention wall system as required by the proposed Stage 1C Remediation and Earthworks and disposal of excavated material to landfill as required.

It is concluded that the preferred management strategy described by this RAP will, upon successful implementation as evidenced by the prescribed validation program, ensure that the Site is suitable for both the:

- currently permissible; and
- future intended land uses, specifically mixed uses including hotel (incorporating high density residential with minimal access to soil), commercial / retail (with minimal access to soil), public open space and underground parking or any combination of the above.

1.0 Introduction

AECOM Australia Pty Limited (AECOM) was commissioned by Crown Resorts Limited (Crown) to prepare this Remedial Action Plan (RAP) for the intended Crown Hotel Development to be constructed within part of the Other Remediation Works (North) Area (the ORWN Area) of Barangaroo South.

Barangaroo is located on the north western edge of the Sydney Central Business District (CBD), bounded by Sydney Harbour to the west and north; the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and a range of new developments dominated by large CBD commercial tenants and the King Street Wharf/Cockle Bay precinct to the south.

The 22ha Barangaroo site is generally rectangular in shape and has a 1.4 kilometre harbour foreshore frontage, with an eastern street frontage to Hickson Road. Barangaroo has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Barangaroo Central and Barangaroo South, and has been subject to multiple investigations that detail the physical and natural characteristics of the Barangaroo site.

The specific area covered by this RAP, hereafter referred to as “the Site” is presented in **Figure F1** and **Figure F2**, **Figure F3** and **Figure F4** in **Appendix B**) and comprises the following site areas:

- The proposed Crown Site which generally corresponds with the footprint of the future intended Crown Hotel Development;
- The area located to the south and west of the proposed Crown Site that it is intended will be licenced for use by Crown in conjunction with the Crown Hotel Development; and
- That part of the intended Crown Basement which is located within the ORWN Area (here-in referred to as the Stage 1C Works Area). The intended Stage 1C Basement will extend beyond the Crown Site to the east below the future road to the boundary of Stage 1B (that is the western boundary of Block 4).

It is noted that the subterranean footprint of the future intended Crown Basement extends outside (to the east) the Site and into the proposed Stage 1B basement. Remediation of that portion of the future intended Crown Basement that is within the Stage 1B basement area will be undertaken in accordance with the ‘Block 4 Development Remediation Works’ described by the *Remedial Action Plan, NSW EPA Declared Remediation Site 21122 and Block 4 (Stage 1B) Development Works, Barangaroo, Millers Point, NSW* (hereafter referred to as the ‘VMP/Block 4 RAP’) (AECOM, 2013c).

It is noted that the term ‘Block’ in this RAP relates to nominated remediation areas, and is not related to State Environmental Planning Policy (SEPP) block boundaries.

This RAP considers the outcomes of the ORWN Human Health and Ecological Risk Assessment (HHERA) (AECOM, 2014) and implements the soil and groundwater Site-Specific Target Criteria (SSTC) which were developed therein.

AECOM has also prepared RAPs for the following areas which are located adjacent to the Site (refer to **Figure F2**, **Appendix B**):

- AECOM. *Amended Remedial Action Plan, Barangaroo - Other Remediation Works (South) Area*. 7 July (AECOM, 2011a); The *Amended ORWS RAP* relates to Blocks 1 to 3 of the Stage 1 Development area, outside the NSW EPA Declaration Area;
- AECOM. *Addendum to ORWS Amended Remedial Action Plan, Harbour Heat Rejection (HHR) System Inlet Area, Barangaroo South*. 10 October (AECOM, 2012a). This *Addendum* was prepared to facilitate the development and construction of the HHR System Inlet Area in the south western portion of the potential Southern Cove. For clarity, the HHR System Inlet Area is not considered to be part of the Site for the purpose of this *ORWN RAP*; and
- AECOM. *Remedial Action Plan, NSW EPA Declared Remediation Site 21122 and Block 4 (Stage 1B) Development Works, Barangaroo, Millers Point, NSW* (hereafter referred to as the ‘VMP/Block 4 RAP’). 24 July (AECOM, 2013c). The objectives of the *VMP/Block 4 RAP* was as follows:
 - To enable the NSW EPA’s declaration of the Declaration Area as a Remediation Site (Declaration Number 21122; Area Number 3221) to be revoked; and
 - To ensure that Block 4 (Stage 1B basement) is remediated to a standard suitable for the proposed development in Block 4.

A separate RAP (prepared for the Barangaroo Delivery Authority (BDA) by JBS Environmental) has been prepared for Barangaroo Central (located directly north of the Site) to identify remediation works required to facilitate the Barangaroo Central development works.

This RAP has generally been prepared to meet the requirements of:

- *Contaminated Land Management Amendment (CLM) Act* (NSW Govt, 1997a);
- Department of Environment and Conservation (DEC, 2006b) *Guidelines for the NSW Site Auditor Scheme* (2nd edition) (DEC, 2006b);
- Department of Urban Affairs and Planning (DUAP) and NSW EPA. *Managing Land Contamination - Planning Guidelines State Environmental Planning Policy (SEPP) 55 - Remediation of Land* (DUAP and NSW EPA, 1998);
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC, 1999);
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Amendment Measure (NEPAM, [No. 1])* (NEPC, 2013); and
- New South Wales Environmental Protection Authority (NSW EPA). *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 1997).

1.1 Overview of Proposed Development Approval Application Process

A staged planning approval process is proposed in relation to the intended Crown Hotel Development.

The first stage will be a State Significant Development Application (SSDA) seeking approval for remediation and earthworks at Barangaroo South. The works the subject of the first SSDA are termed the "Stage 1C Remediation and Earthworks" and include the following:

- Carrying out of remediation and validation within the Stage 1C Works Area (also referred to as the "Stage 1C Remediation and Earthworks Area") to ensure it is suitable for the intended future landuses;
- Construction of a perimeter retention wall system and internal stabilising structures (referred to as the "Stage 1C groundwater retention wall system") to the west of Stage 1B. The Stage 1C groundwater retention wall system would be fully integrated with the Stage 1B retention wall system (as specified by Lend Lease in the Environmental Impact Statement for SSD 5897-2013), with direct connections to create a unified groundwater retention wall system across Stage 1B and Stage 1C; and
- Bulk excavation within the perimeter of the Stage 1C groundwater retention wall system, the installation of lateral restraining structures to support the perimeter retention wall system, and off-site disposal of excavated materials.

These works, which are collectively referred to as the Stage 1C Remediation and Earthworks, are consistent with the approved Concept Plan (as modified) because they will enable development of the Site for uses which are currently permissible under the approved Concept Plan (as modified) (here-in referred to as currently permissible land uses).

The Stage 1C Remediation and Earthworks would also facilitate the future development of an underground basement car park and hotel building, which are proposed as part of Modification 8 to the Concept Plan.

The construction, operation and use of any future development within the Site (here-in referred to as future intended land uses) will not be included as part of Stage 1C Remediation and Earthworks SSDA and will be the subject of separate development applications.

1.2 Objectives

The key remediation objective for the Site is to facilitate the currently permissible and future intended land-uses proposed as part of the future intended Crown hotel development. Specific objectives of the remediation works (which will be undertaken as part of the Stage 1C Remediation and Earthworks - refer to **Section 1.4**) are:

- To ensure the remediated site is protective of human health in the context of the:
 - Currently permissible land uses - including a groundwater retention wall and bulk earthworks (refer to **Section 1.1**); and
 - Intended future land uses proposed as part of the Crown hotel development - including the future intended basement car park and Hotel (refer to **Section 1.1**);
- To ensure the remediated site is protective of the environment (specifically groundwater and the adjacent Darling Harbour), to the extent practicable, by minimising the risk of ongoing contamination; and
- Comply with applicable legislative and policy requirements including the appropriate requirements of the NSW EPA and NSW Department of Planning and Environment (DoPE).

It is noted that material which may require off-site disposal to landfill will require classification in accordance with the NSW EPA (2014) *Waste Classification Guidelines*. Further, some material excavated from the Site and designated for off-site disposal may also require treatment prior to off-site disposal.

1.3 Scope

The scope of work associated with the preparation of this RAP included:

- Review of available data from previous environmental investigations undertaken at the Site to assess the potential for contamination at the Site;
- Confirm the extent of any required remediation works based on consideration of the outcomes of the *Human Health and Ecological Risk Assessment, Stage 1C Development (ORWN), Barangaroo South* (here-in referred to as the *ORWN HHERA*) (AECOM, 2014);
- Undertake an assessment of the potential remediation approaches and technologies;
- Selection of preferred remediation methodology(s) to remediate the Site;
- Outline how the remediation works will be undertaken to meet the remediation objectives, taking into consideration the information review and technical assessment; and
- Develop procedures to demonstrate that the remediation works have been undertaken to satisfy the remediation objectives.

1.4 Future Development and Land Use

It is understood that future development of the Site will include a combination of land uses, some of which are currently permissible. In particular, the future development of the Site will include:

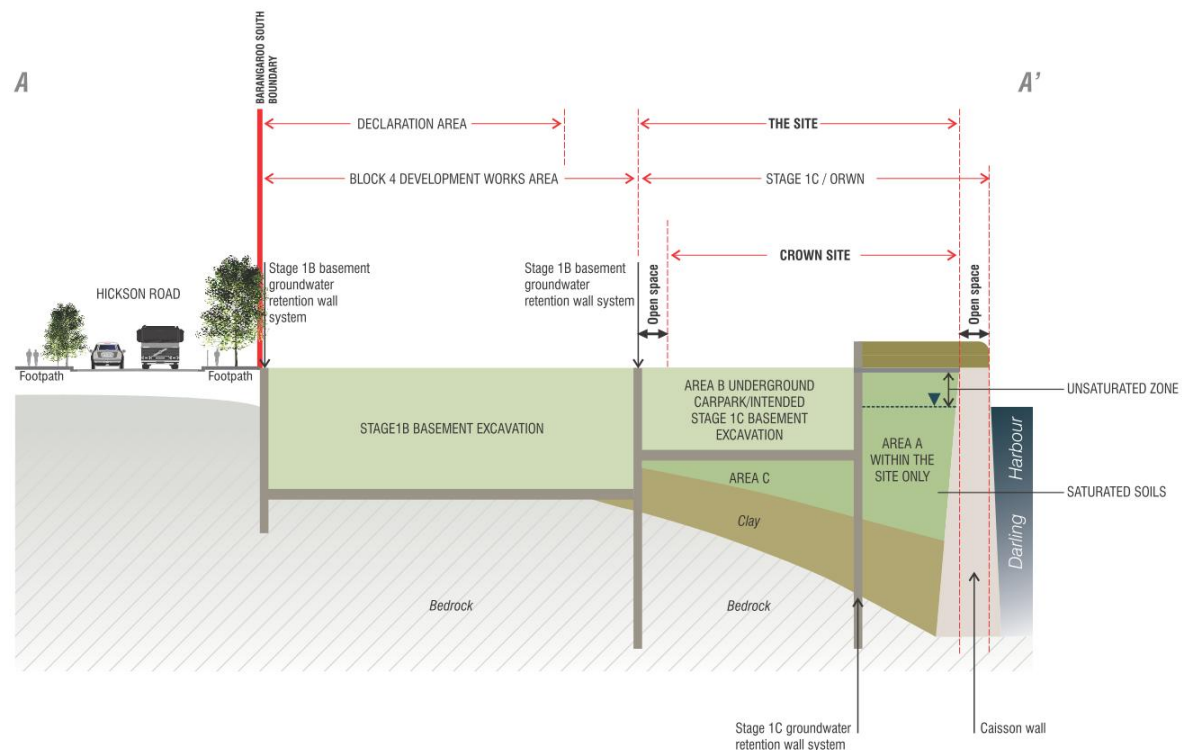
- Currently permissible land uses (refer to **Section 1.1**) including:
 - Groundwater retention walls, internal stabilising structures and bulk earthworks; and
 - Public open space, landscaping, roads pedestrian ways and cycle paths, largely built at grade.
- Intended future land uses (refer to **Section 1.1**) comprising mixed use including hotel (incorporating high density residential with minimal access to soil), commercial / retail (with minimal access to soil) and public open space. In particular, the future intended land uses within the Site will include:
 - A tower containing hotel rooms, suites and residential apartments. The entire footprint of the tower will be above an underground basement;
 - A podium containing hotel reception, retail and gaming facilities. The podium will be largely above a basement but with some limited areas constructed as slab on grade;

- An underground basement intended to provide car parking and loading facilities associated with the future intended Crown hotel development;
- Terrace areas containing restaurant and bar facilities. The elevated Terrace areas will be largely constructed as elevated slab on grade; and
- Public open space, landscaping, roads, pedestrian ways and cycle paths, largely built on grade.

Further detail is provided in **Section 4.0**.

The permissible and future intended land uses associated with the Site and assessed in this RAP are illustrated in **Figure 1** below (the alignment of this cross-section is shown on **Figure F4, Appendix B**):

Figure 1 Schematic Cross Section A-A' (not to scale)



The various land uses / material types associated with both the currently permissible and future intended Crown Hotel Development (as shown in **Figure 1**) are:

- **Area A** – material to remain *in situ* outside the future intended underground car park / Stage 1C groundwater retention wall system and potentially in hydraulic connection with Darling Harbour, where limited or no excavation will be required;
- **Area B** – materials to be removed as part of the future intended underground car park excavations / Stage 1C Remediation and Earthworks that will be removed from Site to landfill; and
- **Area C** – materials to remain *in situ* below the future intended underground car park / within the Stage 1C groundwater retention wall system and with no hydraulic connection with Darling Harbour.

It is understood that materials excavated for the Stage 1C Remediation and Earthworks and/or construction of the future intended underground car park will not be reused onsite. If reuse of materials is required, an Addendum to this RAP will be prepared and submitted to the NSW EPA Accredited Site Auditor for approval.

It is possible that the final details and configuration of currently permissible and future intended land uses within the Site will be revised by Crown as part of the continued development design. However, the proposed land uses will remain generally consistent with those described within this RAP.

As described above, the future intended land uses proposed as part of the Crown Hotel Development include some land uses which are not currently permissible. Therefore, for the purpose of this RAP, reference will primarily be made to future intended land uses.

If the final development design is changed in a way which affects the assumptions of the *ORWN HHERA* (AECOM, 2014) and this RAP, an Addendum will be prepared, as required, and submitted to the NSW EPA Accredited Site Auditor for approval.

1.5 Remediation Documentation

Supporting Management Plans and Work Procedures that will be prepared prior to commencement of the remediation works include:

- Occupational Health and Safety Plan (OH&S);
- Community Consultation Plan;
- Environmental Management Plan;
- Project Management Plan;
- Quality Management Plan;
- Asbestos Management Plan;
- Emergency Response and Contingency Plan (refer to **Section 20.11.6**);
- Remedial Work Plan (RWP, including Excavation Plans) to be prepared in support of the Stage 1C Remediation and Earthworks (which will include remediation [if required]); and
- Validation SAQP (refer to **Section 16.2.1**).

Further detail regarding the above Project Documentation is provided in **Section 12.1.2**.

Notwithstanding the above plans, an appropriate level of information is detailed in this RAP regarding whether the Site can be made suitable for the permissible and future intended land uses (i.e. including hotel, commercial, high density residential, public open space and underground parking).

1.6 Remediation of Adjacent Areas

Separate RAPs have been or are being prepared to describe the remediation required in relation to those areas of Barangaroo South that are adjacent to the Site. These documents are (refer to **Figure F2, Appendix B**):

- *Amended Remedial Action Plan, Barangaroo - Other Remediation Works (South) Area* (AECOM, 2011a) (here in referred to as the *Amended ORWS RAP*) - relates to Blocks 1 to 3 of Barangaroo South (located south of the Site) and is designed to identify remediation required to facilitate the Stage 1A development;
- *Addendum to ORWS Amended Remedial Action Plan, Harbour Heat Rejection (HHR) System Inlet Area, Barangaroo South* (AECOM, 2012a) (here in referred to as the *HHR Addendum RAP*) - prepared to facilitate construction of the HHR System Inlet Area in the south western portion of the potential Southern Cove (located south of the Site);
- *Remedial Action Plan, Other Remediation Works North (ORWN) Public Domain Area* (to be prepared for Lend Lease by AECOM) – relates to those parts of the ORWN Area that are not considered by this RAP. In particular, the public domain areas to the west and south of the Site, including the potential Southern Cove;
- *Remedial Action Plan, NSW EPA Declared Remediation Site 21122 and Block 4 (Stage 1B) Development Works, Barangaroo, Millers Point, NSW* (AECOM, 2013c) (here in referred to as the *VMP/Block 4 RAP*) – relates to the NSW EPA Declaration Area and Block 4. The objectives of the *VMP/Block 4 RAP* are:
 - To enable the NSW EPA's declaration of the Declaration Area as a Remediation Site (Declaration Number 21122; Area Number 3221) to be revoked; and
 - To ensure that Block 4 (Stage 1B basement) is remediated to a standard suitable for the proposed development in Block 4.

A separate RAP (prepared for the BDA by JBS Environmental) has been prepared for Barangaroo Central (located directly north of the Site) to identify remediation works required to facilitate the Barangaroo Central development works.

2.0 Assessment and Approval Process

The planning regime to guide the future redevelopment of the overall Barangaroo site is established by the:

- Planning provisions of Schedule 3 Part 12 of the *State Environmental Planning Policy (Major Development)*, 2005; and
- *Barangaroo Concept Plan (Concept Plan 06_0162)* as approved on 9 February 2007 and modified on 25 September 2007, 16 February 2009 and 16 December 2010.

A “site-wide” *Overarching RAP* has been prepared by ERM (Final, June 2010) for the BDA, and provides an overarching conceptual remediation framework for the whole of Barangaroo. The *Overarching RAP* allows for the provision of separate, detailed RAPs for site portions, of which this RAP is one.

2.1 Project Applications

Remediation works as described by this RAP will be subject to assessment and determination by the Minister for Planning as State Significant Development under Part 4 of the *EP&A Act*. As such, an application(s) will be made to the NSW Department of Planning and Environment (DP&E) for, potentially among other things, remediation works within the Site. An Environmental Impact Statement(s) (EIS) will be prepared to address these assessment requirements, in support of the application and to seek planning approval. AECOM has prepared this RAP for Crown as part of the future EIS(s).

It is understood that Crown is currently planning to seek approval from the Minister for Planning in two parts:

- 1) The Stage 1C Remediation and Earthworks – which will include:
 - Carrying out of remediation and validation within the Stage 1C Works Area;
 - Construction of the Stage 1C groundwater retention wall system (which will include a perimeter retention wall system and internal stabilising structures); and
 - bulk excavation within the perimeter of the Stage 1C groundwater retention wall system; and
- 2) The intended future Crown Hotel Development – which will include development works to provide for future intended land uses such as construction of an integrated resort (incorporating high density residential with minimal access to soil, commercial / retail with minimal access to soil and public open space land uses) and carrying out remediation outside the footprint of the groundwater retention wall system.

This RAP describes remediation works required to facilitate the currently permissible and future intended land uses and is not dependant on whether the proposed Crown hotel development is the subject of a single application for planning approval or two separate applications.

2.2 Legislation Relevant to Remediation Works

The NSW EPA administers a number of Acts and legislative instruments relevant to the remediation works. These include:

- *Contaminated Land Management (CLM) Act* (NSW Govt, 1997a);
- *CLM Amendment Act* (NSW Govt, 2008);
- Department of Environment and Conservation (DEC, 2006b) *Guidelines for the NSW Site Auditor Scheme* (2nd edition) (DEC, 2006b);
- *The Protection of the Environment Operations (POEO) Act*, (NSW Govt, 1997b), in particular, licensing obligations under that Act; and
- DUAP and NSW EPA. *Managing Land Contamination: Planning Guidelines, State Environmental Planning Policy (SEPP) 55 - Remediation of Land*. (DUAP and NSW EPA, 1998).

2.2.1 CLM Act (1997, as amended)

The *CLM Act* (NSW Govt, 1997a) is the primary Act under which contaminated land is regulated by the NSW EPA. Relevant legislation relating to the *CLM Act* (NSW Govt, 1997a) includes the *Contaminated Land Management Regulation* (2008), which commenced on 1 September 2008.

This section addresses the following aspects of the Act:

- Determination and suitability of a contaminated site for a proposed use including the generation of remediation criteria;
- Existing orders and regulatory instruments applicable to the Site; and
- Voluntary remediation proposals and agreements.

The *Guidelines for the NSW Site Auditor's Scheme (The Auditor Guidelines)* (DEC, 2006b) were prepared by the Department of Environment and Conservation (DEC, now known as the NSW EPA) under the *CLM Act* (NSW Govt, 1997a). The *Auditor Guidelines* (DEC, 2006b) describe a decision process for assessing urban redevelopment sites that should be followed by contaminated land consultants. The *Auditor Guidelines* (DEC, 2006b) prescribe soil investigation levels (SILs), which are the concentrations of particular contaminants above which further investigation and evaluation (such as through completion of a quantitative risk assessment) are required.

The substances for which SILs have been prescribed do not include all of the Contaminants of Potential Concern (CoPC) identified at the Site. The *Auditor Guidelines* (DEC, 2006b) make the following provision for such circumstances:

"...where SILs are not available for particular contaminants, or assessment of contaminants against SILs at a particular site is inconclusive... The auditor must check whether the risk assessment is in accordance with the NEPM [National Environmental Protection (Assessment of Site Contamination) Measures] and any relevant guidelines made or approved by DEC. The auditor must also check that any human health risk assessment satisfies all the requirements in the checklist in Appendix VII. The auditor must check that all site-specific risk assessments are scientifically valid and that the site-specific criteria recommended by the consultant are appropriate to protect public health and the environment."

Adoption of the SILs is generally considered inappropriate for remediation works as this may result in unnecessary increased remediation effort and cost. As such, where site investigations indicate that the SILs are exceeded, it is considered appropriate to adopt a health-based and ecological risk assessment approach in determining suitable criteria for the identified CoPC.

In accordance with the *ERM RAP* (ERM, 2010), a Tier 2 and Tier 3 Human Risk assessment and a qualitative ecological risk assessment was prepared to set Site-specific clean up criteria. The *ORWN HHERA* (AECOM, 2014) was prepared to derive site-specific clean up criteria for the future intended ORWN development works (including the Crown Hotel Development Works), which will include a mixture of hotel, commercial and high density residential, public open space and underground parking. The risk assessment process, by which the site-specific criteria were derived for the Site, is summarised in **Section 7.2**.

The *CLM Act* (NSW Govt, 1997a) also sets out requirements for site audits. The *CLM Act* (NSW Govt, 1997a) requires a site audit to be undertaken under certain circumstances, such as if the land use is proposed to be changed, as is the case with the Site. In consideration of this requirement, it is understood that a Site Audit Statement will be prepared by a NSW EPA Accredited Site Auditor for the Site. The SAS will confirm whether the Site has been remediated to a standard suitable for the proposed land uses (refer to **Section 1.4**).

It is noted that the majority of the provisions in the *CLM Amendment Act* (NSW Govt, 2008) received assent on 10 December 2008. The purpose of the amendments was to allow contaminated sites to be cleaned up more efficiently while reinforcing the 'polluter pays' principle. The key amendments to the *CLM Act* (NSW Govt, 1997a) included:

- introducing new powers to enable the NSW EPA (then a part of DECCW) to require certain persons to carry out a preliminary investigation of site contamination;
- amalgamation of the investigation and remediation stages into a single 'management' stage that can cover investigation, remediation or both;
- removing the concept of 'significant risk of harm';
- enabling the NSW EPA to declare land to be 'significantly contaminated land' if it has reason to believe that land is contaminated and the contamination is significant enough to warrant regulation;
- enabling management orders to be issued to any one or more persons who are responsible for the contamination of land;
- enabling the NSW EPA to issue a management order or to withdraw its approval of a voluntary management proposal that has not delivered a satisfactory outcome in managing contamination;

- provision of a more objective basis for the duty to notify the NSW EPA of contaminated land based on criteria to be listed in new guidelines; and
- requiring land owners and persons carrying out certain activities to notify the NSW EPA of contamination when it becomes aware of that contamination.

2.2.2 POEO Act (1997)

Section 48 of the *POEO Act* (NSW Govt, 1997b) requires a person to obtain a licence from the NSW EPA before carrying out any of the premises-based activities described in Schedule 1 of that *Act*.

Clause 15 of Schedule 1 includes the following activity:

"contaminated soil treatment", meaning the on site or off site treatment of contaminated soil (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site).

(2) The activity to which this clause applies is declared to be a scheduled activity if:

(a) in any case, it has the capacity to treat more than 1,000 cubic metres per year of contaminated soil received from off site, or

(b) where it treats contaminated soil originating exclusively on site, it has a capacity:

(i) to incinerate more than 1,000 cubic metres per year of contaminated soil, or

(ii) to treat (otherwise than by incineration) and store more than 30,000 cubic metres of contaminated soil, or

(iii) to disturb more than an aggregate area of 3 hectares of contaminated soil.

The remediation works for the Site will involve management of contaminated¹ soil originating from the Site, is unlikely to require the treatment of more than 30,000 m³ of contaminated soil and is unlikely to disturb more than 3 hectares of contaminated soil. Notwithstanding, a Variation of the existing Environment Protection License (EPL) for the Barangaroo site may be required under the *POEO Act* (NSW Govt, 1997b) depending on the quantity of treatment and disturbance of contaminated soil required in association with other parts of the Barangaroo site.

2.2.3 State Environmental Planning Policy 55 (1998)

SEPP 55 – Remediation of Land (1998) specifies when remediation work will require Development Consent (i.e. Category 1 remediation work).

Clause 9 of SEPP 55 defines Category 1 remediation works as:

- Designated development; or
- Being carried out or to be carried out on land declared to be critical habitat; or
- Likely to have significant effect on a critical habitat or a threatened species, population or ecological community; or
- Development for which another State environmental policy or regional environmental plan requires development consent; or
- Carried out or to be carried out in an area or zone to which any classifications to the following effect apply under an environmental planning instrument.
 - coastal protection;
 - conservation or heritage conservation;
 - habitat area, habitat protection area, habitat or wildlife corridor;
 - environment protection;
 - escarpment, escarpment protection or escarpment preservation;

¹ Contamination is defined in accordance with the CLM Act (1997 as amended) as *the presence in, on or under the land of a substance at a concentration above the concentration at which the substance is normally present in, on or under (respectively) land in the same locality, being a presence that presents a risk of harm to human health or any other aspect of the environment*. As described by Section 8.0, the concentrations of substances in soil and groundwater at the Site are not considered to represent a risk of harm to human health or the environment such that remediation is not required.

- floodway;
 - littoral rainforest;
 - nature reserve;
 - scenic area or scenic protection; and
 - wetland.
- is “carried out or to be carried out on any land in a manner that does not comply with a policy made under the contaminated land planning guidelines by the council for any local government area in which the land is situated”.

All other remediation work may be carried out without development consent and is known as Category 2 remediation work.

It is noted that the *Barangaroo Independent Remediation Review Panel Report* (8 December 2011) prepared by the Barangaroo Independent Remediation Review Panel concluded the approach to remediation for the project was being undertaken with ‘*consideration of contamination and the objective of SEPP 55 (1998) has been appropriately provided for in the determination of approvals*’.

As required by the *Barangaroo Independent Remediation Review Panel Report* (2011), the City of Sydney Council will be notified of the proposed remediation works.

Based on previous intrusive investigations undertaken at the Site, this RAP concludes that remediation is not required to make the site suitable for the proposed development (refer **Section 8.0**). As such, categorisation of the proposed works in accordance with Clause 7(1) of SEPP55 is not required. However, in the event that contamination requiring remediation is identified during the proposed development, it would be remediated in accordance with the contingency measures described by this RAP (refer **Section 20.6**) and would be categorised as Category 1 Remediation Works in accordance with SEPP55.

2.2.4 National Environment Protection (Assessment of Site Contamination) Measure (1999, as amended)

The *National Environment Protection (Assessment of Site Contamination) Measure (NEPM)* (NEPC, 1999) has previously been endorsed by the NSW EPA under Section 105 of the *CLM Act* (1997) as amended. The purpose of the NEPM is to ‘*establish a nationally-consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, contaminated land auditors, land owners, developers and industry*’.

The *NEPM* (1999) has recently been amended by the *National Environment (Assessment of Site Contamination) Amendment Measure (NEPAM)*, (NEPC, 2013) which was made by the Council of Australian Governments Standing Council on Environment and Waste on 11 April 2013. The *NEPM* (NEPC, 1999) as amended by the *NEPM* (NEPC, 2013) (here-in referred to as ‘the *NEPM* [1999] as amended’) has subsequently also been approved by the NSW EPA under Section 105 of the *CLM Act* (NSW Govt, 1997a) as amended on 11 June 2013.

3.0 Site Identification and History

3.1 Site Identification

The Site identification details are provided in **Table 1** below.

Table 1 Site Identification Details

Item	Description
Site Owner	The Barangaroo Delivery Authority
Client	Crown Resorts Limited (Crown)
Site Address	Hickson Road (Sussex Street), Barangaroo, NSW 2000
Legal Description (Lot and DP)	Part Lot 5 and Part Lot 6 in Deposited Plan 876514
County and Parish	County of Cumberland, Parish of Saint Phillip
Local Government Authority	City of Sydney
Current Zoning	Eastern part of Site: Zone B4 Mixed Use ^b Western part of Site: Zone RE1 Public Recreation
Current Land Use	Unused (note that some parts of the Site are temporarily being used as a staging area for construction works in the ORWS Area). Partial access for public recreation (walking and bike riding) (specifically the harbour walk).
Intended Future Land Use	Mixed use including hotel (incorporating high density residential with minimal access to soil), commercial / retail (with minimal access to soil), public open space and underground parking.
Site Area**	10,242 m ²
Approximate Average Current Elevation	2 - 3 m AHD
Site Location	Figure F1 of Appendix B.
Site Layout	Figure F2 of Appendix B.

Notes: ** Derived from CAD plans provided by Crown.

AHD – Australian Height Datum

^a City of Sydney 2005. *Sydney Local Environmental Plan 2005*, Gazetted 9 December 2005, as amended.

^b – NSW Department of Planning 2007. Appendix 4. In: *State Environmental Planning Policy (Major Projects) Amendment (Barangaroo)*, 16 December 2010.

3.2 Site History

The history of the Millers Point area in which the Site is located, has been detailed in the publication *Land at Millers Point Ownership and Usage* (Broomham, 2007). It is understood that the study was commissioned by the former Gasworks owners (Jemena) and focuses on that portion of the Barangaroo Stage 1 Development area. The historic layout of the gasworks infrastructure (previously located off-site to the east on the Declaration Area) is detailed in **Figure F2** and **Figure F5**. AECOM considers the information associated with the former gasworks is relevant to understanding the development history of the broader Stage 1 Development area and potential for Site contamination.

The following summarises historic information presented in Broomham (2007) and ERM (2007, 2008). Those historic activities which relate directly to the Site and/or other parts of Barangaroo are specifically noted.

- **1788-1839:** During early colonial times the shoreline was extended and a wharf and a cottage were constructed near the southern boundary of the original subdivision.

- **1839:** The Declaration Area (offsite to the east) was occupied by the Australian Gas Light Company (AGL) in 1839. The gasworks were extended in 1869 to include a retort house and gasholder 100 feet (approximately 30 metres) in diameter. The gasworks were located at the eastern boundary of Barangaroo and extended across Hickson Road. The remainder of Barangaroo was used for shipping and manufacturing activities.
- **1882:** AGL acquired an additional land on the north side of the gasworks (offsite to the east) and constructed an additional retort house, demolished the first two gas holders and replaced them with a larger 152 feet (approximately 46 metres) diameter gas holder. A tramway system and hydraulic lift was also constructed to transport coke to a depot in Kent Street.
- **1897:** AGL purchased a small piece of land on the northern boundary of the former gasworks site (offsite to the east) to extend the site 40 feet to the north (Broomham, 2007).
- **1899:** A building that housed a carburetted water gas plant was constructed.
- **1908:** Wharf frontages to the north of the gasworks were dredged to make way for the rat-proof sea wall.
- **1912:** The Minister for Public Works of the State of NSW and Sydney Harbour Trust Commissioners (SHTC) owned part of the Declaration Area (part of Lot 3 in DP 876514) between 1912 and 1930. However, it is understood that AGL continued to occupy the gasworks site until 1921 (ERM, 2007 and URS (2001).
- **1918:** Production at the gasworks was terminated at the Declaration Area.
- **1921:** SHTC gained possession of the gasworks site.
- **Mid 1920s:** The following activities occurred at the Declaration Area, in the mid-1920s:
 - Portions of the gasworks (gasholder and purifier beds) were demolished between 1922 and 1925. The former gasholder tanks were backfilled (ERM, 2007 and URS (2001).
 - Hickson Road was constructed through the former gasworks site. At those locations where no rock foundation was identified, a 4-inch (approximately 10 cm) thick foundation of blue metal followed by an 8 inch (approximately 20 cm) thick foundation of concrete was present. A 6-inch (approximately 15 cm) thick foundation of concrete was placed in those locations where a rock foundation was identified;
 - New jetties and cross-wharf sections of new berths required the complete dismantling of the AGL wharf and excavation into a significant part of the former gasworks;
 - The former gasworks was covered with workshops, including blacksmiths, plumbers, carpenters and a motor garage at the northern end; and
 - There was a SHTC depot located on the western side of Hickson Road.
- **Late 1930s:** MSB painted creosote on the wharf piles (located across Barangaroo Stage 1) to protect them against insects. Part of the Declaration Area was transferred to MSB after the SHTC was dissolved in 1936;
- **1951:** Five finger wharfs with approximately a dozen east-west oriented narrow warehouse buildings were present on the western edge of Barangaroo Stage 1.
- **1960s:** The wharfs were reconstructed across the Site. This included the construction of parallel berths with large cargo-moving areas, demolition and removal of some old wharf structures and formation of new sea walls by sinking caissons filled with concrete.
- **1968:** By 1968 the area behind (east of) the sea wall was in-filled (with unclassified fill) and the area was now a continuous wharf. These works occurred across the western portion of Block 4 and 5.
- **1970s and 1980s:** The wharves across the Barangaroo Stage 1 site, including the Site, remained utilised for port activities. The 1972 aerial photograph indicated the finger wharfs had been filled in and the Declaration Area comprised a sealed area with two large warehouses, on the northern and western boundary. Southern Cove is still operative.
- **1988:** Southern Cove was filled south of the Site.
- **1995:** The longshore wharves at the Barangaroo Stage 1 site were leased to Patrick Stevedores No 2 until 2006. The Sydney Ports Corporation (SPC) was also established in 1995.

- **1999:** The SHFA was formed under the Sydney Harbour Foreshore Authority Act 1998 to consolidate the work and functions of City West Development Corporation, Darling Harbour Authority and Sydney Cove Authority. Lots 3 and 5 of DP 876514 were transferred to SHFA in 2007. Wharf 8 Overseas Passenger Terminal constructed within the Site.
- **2007:** The Declaration Area (offsite to the east) is declared an Investigation Area by the NSW EPA.
- **2008:** The wharf west at the Site vacated and warehouses demolished in preparation for development.
- **2009:** The Declaration Area (offsite to the east) is declared a Remediation Site by the NSW EPA.
- **2011:** The Declaration Area (offsite to the east) (excluding Hickson Road) is used as part of the construction site supporting the Barangaroo South Stage 1A basement construction (within the ORWS Area).

3.2.1 Filling History

Based on a review of historic aerial photographs and maps of Barangaroo, the history of filling may be summarised as follows.

- **1836 to 1888:** there appeared to be some limited filling around Millers Point towards Darling and Sydney Harbours (north of the Site);
- **1888 to 1897:** filling occurred into Darling Harbour in the area in the vicinity of the gas works site and there were several finger wharves constructed at the southern end of Barangaroo (offsite to the south);
- **1897 to 1951:** further filling around Millers Point (to the west and north) and four finger wharfs were constructed in the central portion of Barangaroo (between Millers Point and the gas works site) (north of the Site);
- **1951 to 1968:** the southern-most portion of Barangaroo (the current Stage 1A construction site) was filled in to the current eastern extent of the Darling Harbour shoreline;
- **1968 to 1986:** the area between the historic Southern Cove and Millers Point, including the Site, was filled in after the finger wharves were demolished;
- **1986 to 1988:** the historic Southern Cove was filled in; and
- **1988 to present:** no more significant filling occurred.

It should be noted that, notwithstanding the filling history that can be inferred from the above site history, it is difficult to identify, based on observations from the site investigations, distinct differences in fill type relative to the historical filling sequence at the Site. A review of the 1970 aerial photograph (ERM, 2007) shows that the Site was in the process of being filled and the fill was visible above the water in the eastern portion of the Site. The next available aerial photograph was 1988 is the most recent part of the Barangaroo South Development Area to have been in-filled.

3.2.2 Historic Gasworks Features (located Off-Site to the East)

As detailed in the *VMP/Block 4 RAP* (AECOM, 2013c), the former AGL (now Jemena) gasworks was located east of the Site (within the Declaration Area occupying most of Block 4 and 5) and extended to the area now occupied by Hickson Road (refer to **Figure F5**). It is noted that no historic gasworks infrastructure has been identified beneath the Site.

It is understood that URS (2001) estimated that the footprint occupied by the former gasworks² in the discussed offsite areas was approximately 5,420 m². The following infrastructure is understood to have been present within this footprint:

- Retort House;
- Meter House;
- Tar tank;
- Engine House;
- Gasholders; and
- Purifier Beds.

² AECOM did not have access to the URS (2001) report and is unable to confirm whether this area refers to the entire gasworks site or only the gasworks infrastructure.

Previous investigations and remediation works (undertaken at The Bond site on Hickson Road) have identified that existing gasworks infrastructure extend across Hickson Road, including part of the annulus of the former main gasholder, a smaller secondary gasholder and a tar tank (Coffey, 2008).

4.0 Future Development Works

4.1 Future Intended Land Uses – Crown Development Area

The future intended land uses associated with the proposed Crown hotel development incorporate mixed use including hotel (incorporating high density residential with minimal access to soil), commercial / retail (with minimal access to soil) and public open space. In particular, the future intended land uses within the Site will include:

- A tower containing hotel rooms, suites and residential apartments. The entire footprint of the tower will be above an underground basement;
- A podium containing hotel reception, retail and gaming facilities. The podium will be largely above a basement but with some limited areas constructed as slab on grade;
- An underground basement intended to provide car parking and loading facilities associated with the future intended land uses;
- Terrace areas containing restaurant and bar facilities. The elevated Terrace areas will be largely constructed as elevated slab on grade; and
- Public open space, landscaping, roads, pedestrian ways and cycle paths, largely built on grade.

The proposed land uses associated with the future intended Crown hotel development are illustrated in **Figure 1** (refer to **Section 1.4**) and **Figure F3** in **Appendix B**. The future intended draft Crown Hotel Development plans are provided as **Appendix C**.

The various structures intended to be constructed as part of the future intended Crown hotel development will be generally positioned above basement car parks which will extend to approximately Relative Level (RL) -9.45 m AHD (approximately 11.65 m bgl)³ across the majority of the Site footprint (also referred to as the Stage 1C Works Area). Construction of the proposed basement will necessitate removal of a significant portion of fill material from the Site (Area B material). As a consequence, contamination contained within the materials excavated for construction of the basement will also be removed and will require management as part of the remediation works. The excavations within the Stage 1C Works Area will be supported using the basement groundwater retention wall system (refer to **Section 4.3**).

The future intended Crown Hotel Development includes construction of a multistorey Podium, a series of Terraces and Public Open Space areas that will extend outside the footprint of the Stage 1C Works Area. The future intended Crown Hotel Development will include the following features:

- The Podium will largely be constructed within the footprint of the Crown Site (refer to **Figure F3**).
- Much of the Podium will be constructed over the proposed Stage 1C Works Area.
- Those parts of the Podium that will not be constructed over the proposed Stage 1C Works Area and the elevated terrace areas will largely be constructed over either the existing caisson wall or the historic Southern Cove. Of relevance to this RAP:
 - The existing caisson wall, which (with the exception of the historic Southern Cove) forms the western edge of Barangaroo South comprises a large reinforced concrete box filled with dredged sediments / sand from Darling Harbour; and
 - The historic Southern Cove was reclaimed by:
 - Construction an earthen embankment at the western extent of the historic Southern Cove at the boundary with Darling Harbour. The slope of the embankment is approximately 1(V) to 2(H) on the Harbour side and is protected from wave action with a 1,200 mm thick armour layer 600 mm thick filler layer;
 - Construction of concrete piles to support an approximately 25 metre wide suspended concrete slab extending across the western portion of the historic Southern Cove, above the western slope of the embankment (refer to Cross Section 1-1 on Drawing 00915-11SK-0971A in **Appendix C**); and

³ Based on an approximate existing ground surface (top of concrete slab) level of RL 2.2 m AHD.

- Placement of uncontrolled fill material behind the embankment on the eastern side to reclaim the historic southern cove and support the existing concrete surface slab.
- The Barangaroo site history indicates that the historic Southern Cove was the most recent part of Barangaroo South to have been infilled. Therefore, it is considered unlikely that the materials placed in this area (in particular the materials used to form the earthen embankment or backfill to the west of the embankment) would have originated from the former gasworks.
- The elevated Terrace areas will largely be constructed outside the footprint of the Crown Site (and Stage 1C Works Area), within an area licenced to Crown for use in conjunction with the hotel development (refer to **Figure F4**) (it is understood that the licence is subject to approval by the BDA).
- The Public Open Space areas will largely be constructed outside the footprint of the Stage 1C Works Area and Crown Site, predominately within an area licenced to Crown for use in conjunction with the hotel development (refer to **Figure F3**).
- The Stage 1C Works Area will occupy approximately 57% (or 5,790 m²) of the Site considered by this RAP (refer to **Figure F4**). The areas of the Podium, Terraces and Public Open Space that will be constructed outside the footprint of the Stage 1c Works Area will occupy approximately 43% (or 4,420 m²) of the Site considered by this RAP.
- The finished surface level of the elevated Terrace areas, Public Open Space areas and Podium will be at between RL 3.3 m AHD and 3.8 m AHD. Construction of these areas (i.e. within Area A) will therefore require placement of up to 1.6 m of imported fill and only limited excavation as required for localised service construction. Further, very few of these limited excavations are expected to be required to extend to a depth of greater than 1.8m, such that they penetrate through the existing concrete surface slab into the underlying fill materials.
- Minor below ground services constructed in the footprint of the elevated terrace areas, public domain and podium (outside the future intended basement) areas will be constructed to a maximum depth of approximately 1.5 m bgl (or approximate RL 2.3 m AHD) and not below the existing ground level (which is at an approximate RL of 2.2 m AHD). This specification is based on facilitating future maintenance of the services (by keeping them relatively close to the ground surface) and ensuring that the services do not contact saline water as a result of king tides or the effects of sea level rise (noting the design life of the intended future Hotel development).
- Major services to the future intended Crown Hotel Development will be routed from Stage 1A via the Stage 1B Basement.

4.2 Stage 1C Works Area

The Stage 1C Works Area will comprise of an excavation supported by the Stage 1C Groundwater retention Wall System (refer to **Figure F3** in **Appendix B**).

Based on the current design of the Stage 1C Remediation and Earthworks and the future intended Crown Basement (refer to **Figure F4**) it is understood that the excavation within the Stage 1C Works Area will be constructed to a formation depth of approximately RL -9.45 m AHD (approximately 11.65 m bgl)⁴. As such, the underlying natural marine sediments and bedrock will not require excavation due to their presence at depths greater than the proposed depth of excavation (i.e. the shallowest marine sediments are present at approximately RL -10.4 m AHD [BH73], approximately 1.0 metre below the base of the proposed excavation).

The proposed Stage 1C Works (as shown in **Figure 1** above) will result in existing Site materials (refer to **Section 1.4**):

- remaining *in situ* within the Site but outside the Stage 1C Works Area and with hydraulic connection with Darling Harbour (**Area A material**);
- being removed as part of the Stage 1C Works and subject to off-site disposal to an appropriately licensed landfill or other Site in accordance with an EPA approved Resource Recovery Exemption (**Area B material**);
- remaining *in situ* below the Stage 1C Works and within the perimeter retention wall system and without hydraulic connection with Darling Harbour (**Area C material**).

⁴ Based on an approximate existing ground surface (top of concrete slab) level of RL 2.2 m AHD.

Further details regarding the assumptions relating to the development works at the Site and included in the *ORWN HHERA* (AECOM, 2014) are provided in **Section 7.2.2**.

4.3 Stage 1C Groundwater Retention Wall System

As described above, the excavations within the Stage 1C Works Area will be supported by the Stage 1C Groundwater Retention Wall System. It is anticipated that the Stage 1C Groundwater Retention Wall System will consist of a series of perimeter groundwater retention walls, specifically diaphragm walls (or equivalent), with a minimum thickness of 800mm, extending to and keyed into bedrock and a series of internal stabilising structures (refer to **Figure F3**).

It is anticipated that the groundwater retention walls, together with other controls which are standard practice for basement construction, will effectively isolate the basement from surrounding ground conditions.

Further details regarding the assumptions included in the *ORWN HHERA* (AECOM, 2014) are provided in **Section 7.2.2**.

4.4 Development Design Finalisation

It is possible that the final details and the proposed configuration of the future intended land use and Crown Hotel development design within the Site will be revised as part of the continued development design. However, the proposed land uses for the Site - that is a mixture of hotel (incorporating high density residential with minimal access to soil), commercial / retail (with minimal access to soil) and public open space - will remain generally consistent with that described within this RAP.

If the design is changed in a way that affects the assumptions detailed herein (refer to **Section 7.2.2**):

- Contingency measures may be considered. **Section 20.0** presents contingency measures designed to address modification of the development design (for example, minor changes in the depth of the excavation or alignment of the retention wall system); and/or
- an Addendum to this RAP will be prepared and submitted to the NSW EPA Accredited Site Auditor for approval.

5.0 Previous Investigations

A number of previous investigations have been completed in respect of the Site. It is noted that these investigations also included parts of the Barangaroo Stage 1 Development not included in the Site that is considered by this RAP. The reports considered relevant to this RAP include the following:

- NA&A 1996. *Initial Environmental Assessment, Sydney Ports Corporation, Darling Harbour Berths 3-8 Hickson Road, Darling Harbour. June;*
- URS (2001). *Contamination Review for Darling Harbour;*
- Jeffery and Katauskas (J&K). 2006. *Geotechnical Report development of Wharves 3-8 at East Darling Harbour. August;*
- ERM. *Environmental Site Assessment, East Darling Harbour, Sydney, NSW, Final Report. 21 June. (ERM, 2007);*
- ERM. *Additional Investigation Works at Barangaroo, Hickson Road, Millers Point, NSW. July. (ERM, 2008);*
- ERM. *Overarching Remedial Action Plan for the Barangaroo Project Site, Sydney. June. (ERM, 2010);*
- AECOM. *Amended Remedial Action Plan, Barangaroo - ORWS Area. 7 July. (AECOM, 2011a)*
- AECOM. *Data Gap Investigation, EPA Declaration Area (Parts of Barangaroo and Hickson Road). (AECOM, 2010a);*
- AECOM. *Data Gap Investigation, Other Remediation Works North, Hickson Road, Barangaroo, NSW. 20 October. (AECOM, 2010b);*
- AECOM. *Groundwater Discharge Study, Stage 1 Barangaroo Development. 3 November. (AECOM, 2010c);*
- AECOM. *Data Gap Investigation, EPA Declaration Area (Parts of Barangaroo and Hickson Road) Millers Point NSW. 30 July. (AECOM, 2010a);*
- AECOM. *Addendum to ORWS Amended Remedial Action Plan, Harbour Heat Rejection System Inlet Area, Barangaroo South. 10 October. (AECOM, 2012a);*
- AECOM, 2012. *Supplementary Data Gap Investigation, VMP Area, Hickson Road, Millers Point, NSW. 9 March. (AECOM, 2012c);*
- AECOM. *Remedial Action Plan NSW EPA Declared Remediation Site 21122 and Block 4 (Stage 1B) Development Works, Barangaroo, Millers Point, NSW. 24 July. (AECOM, 2013c);*
- AECOM. *HHERA, Stage 1C Development (ORWN Area), Barangaroo South. 3 July. (AECOM, 2014)*

These reports are summarised in **Sections 5.1 to 5.12** below.

Borehole and monitoring well locations from the previous investigations are presented in **Figure F5**.

5.1 NA&A (1996) Initial Environmental Assessment

Noel Arnold and Associates (NA&A) was commissioned by the Sydney Ports Corporation to undertake an Initial Environmental Assessment at Berths 3-8 Hickson Road, Darling Harbour, NSW.

The report details results of an initial contamination assessment and provides options for remedial management of the area investigated. Known and potential contamination was not determined to be a risk to the ongoing use by the then occupant providing subsurface materials were not disturbed. Impact was identified in the area of the former AGL gasworks (located to the east of the Site).

5.2 URS (2001) Contamination Review

URS was commissioned by SHFA to conduct a Contamination Review for Darling Harbour – Berths 3/8, which comprised a review of the contamination issues collated from 11 reports produced between 1993 and 2001. The review identified soil and groundwater contamination associated with the former gasworks to the east of the Site, including off-site migration, and soil contamination associated with the vehicle maintenance operations.

5.3 Jeffery and Katauskas (2006) Geotechnical Investigation

Jeffery and Katauskas Pty Ltd (J&K) undertook a Geotechnical Investigation for the East Darling Harbour property (Barangaroo). The investigation was undertaken concurrently with the ERM (2007) Environmental Site Assessment (ESA) which is summarised in **Section 5.4** below.

Key geotechnical findings from the J&K investigation were:

- Fill was sandy and increased in clay content with depth and refusal occurred within fill at several locations across the Site;
- The fill contained large pieces of rubble and was poorly compacted;
- The alluvial sediments consisted predominantly of sandy clays which extended to sandstone bedrock; and
- Sandstone bedrock was generally shallower at the eastern portions of the Site and deepest over the western portion towards Darling Harbour.

5.4 ERM (2007) Environmental Site Assessment

ERM was commissioned by SHFA to undertake an Environmental Site Assessment (ESA) (ERM, 2007) which consisted of a *Stage 1 Preliminary Site Investigation (PSI)* and *Stage 2 Detailed Site Investigation (DSI)* for the East Darling Harbour property (Barangaroo). The investigation was undertaken concurrently with the J&K (2006) investigation (summarised in **Section 5.3** above). The following provides information related to the Site.

The PSI component of the investigation reported that the Site was historically used for port/wharf activities and workshops. The AGL gasworks site was also located to the east of the Site (off-site) and reclamation activities had historically occurred at the Site for the construction of the wharfs.

Based on the historical information ERM concurred with URS (2001) investigation that the contaminants of potential concern (COPC) for the Site were TPH, BTEX, Heavy Metals, PAHs, PCBs, Cyanide, Sulfates, OCPs and OPPS.

The investigation included the sampling of 161 boreholes (BH001 to BH161) and installation and sampling of 25 monitoring wells (MW01 to MW25) across Barangaroo. Nine of the boreholes and three of the groundwater monitoring wells were located within the Site (BH053/MW11, BH076/MW14 and BH1116/MW22). One borehole and groundwater monitoring well was located just outside the northwest boundary of the Site (BH129/MW24).

The ESA (ERM, 2007) made the following conclusions:

- Impacts to soil and groundwater were identified predominantly within the area of the former gasworks infrastructure (east of the Site) with the primary contaminants of concern confirmed as lead, TPH/BTEX and PAH;
- No non aqueous phase liquids (NAPLs) were observed during the investigation, however concentrations of organic contaminants such as TPH indicated that NAPL was likely present in the vicinity of the former gasworks area located east of the Site;
- The groundwater regime within the Site was likely strongly influenced by tidal fluctuation; and
- There appeared to be potential for both migration of contamination onto the Site from the east and migration of contamination from the Site into adjacent properties and into Darling Harbour.

The ESA (ERM, 2007) included the following key recommendations:

- The extent of the risks to human health and the environment should be assessed through further investigations and a site specific quantitative risk assessment; and
- Additional delineation investigations and assessment of vapour flux from impacted areas and further assessment of hydrogeological conditions should be undertaken before developing a RAP.

A summary of soil and groundwater results from the ESA is included in **Table 2** in **Section 5.5** along with the additional soil data from the 2008 ERM additional investigation.

5.5 ERM (2008) Additional Site Investigation Works

ERM was commissioned by SHFA to undertake additional soil and groundwater investigation works at Barangaroo (ERM, 2008) following on from the 2007 ESA. The objectives of the works were to fill in data gaps in soil and groundwater data to enable an Overarching RAP to be developed for Barangaroo.

The scope of work included drilling and soil sampling of 55 boreholes (BH162 to BH215) and installation of 13 groundwater monitoring wells (MW179 to MW215) across Barangaroo. One borehole (BH191) and one borehole/groundwater monitoring well (BH212/MW212) was located within the Site to which this RAP is the subject of.

A summary of the results from within the Site are provided in **Table 2** below, which also includes the ERM (2007) ESA results.

Table 2 Summary of soil analytical results from ERM 2007 and 2008 Investigations in the Area Immediately Surrounding the Site

Analyte	Number of Soil Samples Analysed	Soil Results (ERM)	Groundwater Results (ERM monitoring rounds)
Heavy Metals	30	All concentrations less than (DEC, 2006b) SIL ₁ , SIL ₂ , SIL ₃ and SIL ₄	The following wells reported concentrations exceeding the ANZECC (2000) 95% Marine Trigger Values: MW14: Cu, Hg, Ni and Zn; MW212: Zinc MW24: Pb, Cu and Zn.
TPH C ₆ -C ₉	18	All concentrations were less than the NSW (1994) EPA criteria of 65 mg/kg. There were two detections of 14 mg/kg (BH191/16.5) and 32 mg/kg (BH021 16.0-16.5).	Concentrations were detected at greater than the LOR in MW22 (30 µg/L)
TPH C ₁₀ -C ₃₆	18	Concentrations were less than the NSW (1994) EPA criteria of 1000 mg/kg, with the exception of: BH021 16.0-16.5 (2100 mg/kg); BH191/16.5 (1160 mg/kg); and BH191/3.7 (1200 mg/kg).	Concentrations were detected at greater than the LOR in, MW22 and MW24, with the following ranges: MW22: 325 to 515 µg/L; and MW24: <200 to 765 µg/L.
BTEX	17	Concentrations were less than the NSW (1994) EPA criteria, with the exception of the following sample: BH191/16.5 – Benzene 2.2 mg/kg (criteria 1 mg/kg).	Concentrations were detected at greater than the LOR in MW22, with the following ranges: MW22: Benzene (<1 to 5 µg/L), Toluene (<5 to 4 µg/L) and Total Xylene (<4 to 3 µg/L). All concentrations of benzene in the samples were less than the ANZECC (2000) 95% Marine Trigger Value (700 µg/L)

Analyte	Number of Soil Samples Analysed	Soil Results (ERM)	Groundwater Results (ERM monitoring rounds)
PAHs	17	Concentrations of Total PAHs ranged between <0.5 to 298 mg/kg. The following six samples exceeded the NSW DECC (2006) SIL ₄ criteria: BH021_16.0-16.5 (151.05 mg/kg); BH063-1.5-1.65 (104.9 mg/kg); BH191/16.5 (298 mg/kg); and BH191/3.7 (228.5 mg/kg). Benzo(a)pyrene was detected in samples with the highest concentration of 12.7 mg/kg (BH191at 3.7 m bgl) Four samples exceeded the NSW DECC (2006) SIL ₃ open space land criteria (2 mg/kg).	Total PAHs have been detected at concentrations greater than the LOR in MW11, MW22 and MW24. Concentrations of Total PAHs in these wells ranged between <1 and 446.6 µg/L, with the highest concentration in MW08. Benzo(a)pyrene was detected in MW24 at concentrations of <0.5 to 2.4 µg/L.
Phenols	13	Concentrations of phenols were less than the laboratory LOR in all samples analysed, with the exception of 1.1 mg/kg of 2,4-dimethylphenol in BH191/16.5.	Phenols were less than the LOR in all samples with the exception of the following phenolic compounds detected in MW08: 2,4-dimethylphenol 20.3 to 28.3 µg/L 2-methylphenol 13.1 to 14.3 µg/L 3-&4-methylphenol 7.6 to 9.1 µg/L
PCBs	7	Concentrations of PCBs were less than the laboratory LOR in all samples analysed.	Concentrations of PCBs were less than the laboratory LOR in all samples analysed.
OCPs/OPPs	1	Concentrations of OCPs and OPPs in the sample analysed were less than the LOR.	Not analysed.
Cyanide	11	Concentrations of total cyanide were less than the laboratory LOR and or less than the adopted criteria	Concentrations of free cyanide were less than the laboratory LOR
Asbestos	2	Not detected	Not applicable

The ERM Additional Investigation (ERM, 2008) made the following recommendations:

- A quantitative human health and ecological risk assessment (HHERA) should be undertaken once further details of future redevelopment are known;
- Results of the investigation should be assessed with reference to previous investigations undertaken for Barangaroo;
- Routine groundwater monitoring should be considered to assess temporal variations in CoPC concentrations;
- Considering asbestos was identified in only one sample, it was unlikely that asbestos contamination was wide spread, however it was recommended that further work is required to determine the extent and nature of asbestos in fill; and
- A RAP should be developed and following completion of a RAP, a RWP should be developed.

5.6 ERM (2010) Overarching RAP

ERM was commissioned by SHFA to complete a conceptual Overarching RAP for Barangaroo. The conceptual RAP envisaged the following scope of works for the site remediation and management of the Barangaroo development site:

- Completion of a Quantitative HHERA to develop Risk Based Clean-up Levels (RBCLs) for each area of the development;
- Preparation of a RWP, Remediation EMP, OH&S Plan, Community Consultation Plan and a Long Term EMP;
- Planning and approvals;
- Site establishment for remediation; and
- Demolition of and appropriate disposal of remaining structures.

The Barangaroo development was divided into four areas (Area 1 to Area 4) for the purposes of the RAP. The Site is located within Area 4. At the time of the Overarching RAP Area 4 was envisioned to be developed as open space and it was stated that:

- Remediation or management of observed impacts would be required when Area 4 was redeveloped;
- Given the extent and nature of soil and groundwater impacts, it was considered that the majority of materials not requiring excavation for development purposes in Area 4 could be managed *in situ*; and
- Spoil generated from excavations in Area 4 would need to be either beneficially reused on-site if possible or classified in accordance with NSW EPA (2014) *Waste Classification Guidelines* and disposed off-site.

The preferred remedial option for Area 4 was on-site management as it minimises financial, environmental and social costs. It was noted that hotspots of heavily impacted material may be present in Area 4 that may require excavation and off-site disposal if it was assessed that they couldn't be effectively managed on-site in accordance with the requirements set by the relevant HHERA.

5.7 AECOM (2010a) Data Gap Investigation, EPA Declaration Area (Parts of Barangaroo and Hickson Road)

AECOM was engaged by Lend Lease to undertake a DGI (AECOM, 2010a) for the Declaration Area (including groundwater monitoring in down hydraulic gradient areas).

A summary of all analytical data available from all previous investigations, including this DGI, for the Declaration Area is provided in Section 4 of the *VMP Remediation Extent* report (AECOM, 2013d).

Fill Materials and Natural Soils

The results of the DGI (which included consideration of investigations conducted by others) are briefly summarised following:

- Observed fill materials generally comprised unconsolidated gravels, sand, bricks, sandstone, timber, slag and steel in a variable gravelly sand to clayey sand matrix. Fill materials were present above natural silty sands, gravelly sands, clays, weathered sandstone and sand with components of clay overlying sandstone bedrock. These results were generally similar to the previous investigations and confirm the presence highly variable fill material underlying the Declaration Area, thickening to the west towards Darling Harbour; and
- Field observations indicated that free tar was observed as a DNAPL in wells MW204D, MW205, MW206, MW53, MW15, BH7 and BH10 (MW10), as well as testpits TP05 and TP07. It was noted that groundwater samples were not collected from the wells, however NAPL samples were collected from monitoring wells MW205 and MW206. All wells with free tar were located within the location of the former gasworks. BH1 (located on Hickson Road to the north of the Declaration Area) was unable to be sampled as the well was dry. Down-gradient well MW212 was filled with sand and unable to be sampled.

Based on the reported results, the following conclusions were made regarding the lateral and vertical extent of contamination in fill and natural material:

- The maximum concentrations of CoPC were generally located in proximity to and down gradient from the former gasworks infrastructure in the Declaration Area. Free tar was identified in a number of additional locations in Hickson Road and Block 4 within and in the vicinity of the tar tank, purifying beds and 1870 gasholder, indicating these locations are source areas of contamination;
- Reported concentrations of TPH, BTEX and PAHs generally decreased with distance from the inferred source areas. The results indicate that lateral migration of contamination has and continues to occur; and
- Asbestos was identified in a single sample during a previous investigation. A second sample reported the presence of unidentified mineral fibres. The reported results and visual observations during sampling indicated that asbestos is not widespread within fill materials within the Declaration Area.

Hydrogeological Conditions

The results of the DGI indicated that groundwater beneath the Declaration Area is present as an unconfined, shallow aquifer within the fill materials and the underlying natural sediments. Groundwater is also likely to occur as a deeper bedrock aquifer within the underlying sandstone bedrock. Groundwater within the bedrock would occur as a fractured bedrock aquifer, potentially confined by an overlying clay unit in some areas of the Declaration Area.

Due to the proximity of the Declaration Area to Darling Harbour, the depth to groundwater is shallow and the overall direction of groundwater flow is expected to be towards Darling Harbour. Groundwater within the Declaration Area is tidally influenced, resulting in the fluctuation of groundwater levels within the fill materials and natural sediments. Groundwater chemistry within the Declaration Area is dominated by sodium and chloride ions, indicative of a saline environment. Variability in the groundwater chemistry and hardness was present in some areas of Declaration Area, which was attributed to the presence of the fill materials.

The hydraulic conductivities reported within the Declaration Area were variable due to the inconsistent nature and distribution of fill materials. This variability in conductivity results in inconsistent lag times for tidal influence across the Declaration Area and creates a tortuous flow path for groundwater and associated contamination.

Groundwater

Contaminants associated with the former gasworks operation were present in groundwater within and down-gradient of the Declaration Area. The distribution of groundwater contamination across the Declaration Area appears to be influenced by tidal fluctuations and the variable nature and distribution of fill materials used to backfill the Declaration Area.

Significant concentrations of TPH, BTEX, PAH were reported in groundwater across the former footprint of the gasworks infrastructure. Cyanide concentrations (free and weak acid dissociable) were reported in various wells in the Declaration Area but showed no correlation with naphthalene (considered a gasworks indicator CoPC) indicating that if the reported cyanide is related to the gasworks it does not appear to be as persistent as the organic contaminants.

Free phase tar was reported in several wells located within the footprint of the former gasworks site. Tar was observed within wells installed at varied depths throughout the profile, indicating dense non aqueous phase liquid (DNAPL) is present within the Declaration Area within fill materials, natural sediments and bedrock. Given the varied depth of DNAPL occurrence within the Declaration Area, it is likely that the associated dissolved phase contamination also exhibits significant spatial variability in terms of depth of occurrence and concentration.

Contaminant concentrations reported in down hydraulic gradient well AECOM MW60 (located down gradient of the Declaration Area in the ORWN Area), screened between 14 and 22 m bgl (-11.31 to 19.31 m AHD) across the base of the fill and natural sediments immediately overlying bedrock, was an order of magnitude higher than concentrations reported for more shallow down-gradient wells. This suggests the most significant dissolved phase concentrations are at depth down-gradient of the Declaration Area and based on the depths to the Harbour floor reported in ERM (2008b), which ranged between 10 m to 13.2 m below the water surface, are present at an elevation below the sea floor of Darling Harbour.

Heavy metals concentrations exceeding the guidelines were widespread across the Declaration Area. Compounds exceeding the criteria in numerous monitoring wells included cobalt, copper, lead, nickel and zinc. The slightly acidic nature of groundwater within the Declaration Area may also be contributing to the mobilisation of heavy metals from within the fill materials. Metals concentrations were generally consistent with previous investigations.

Recommendations

The DGI included the following recommendations:

- A Site-specific HHERA or HHERAs should be prepared providing remediation goals suitable for : (a) removal of the NSW EPA Declaration; and, (b) remediation of the Declaration Area for the proposed future land use; and
- A RAP or RAPs should be prepared detailing options for remediation and/or management that will:
 - Facilitate removal of the NSW EPA Declaration;
 - Render the Declaration Area suitable for its future intended land use; and
 - Detail validation requirements to be implemented to demonstrate successful completion of the remedial.

5.8 AECOM (2010b) ORWN Area Data Gap Investigation

The following scope of work was undertaken to achieve the *ORWN DGI* (AECOM, 2010b) objectives:

- A total of 18 boreholes were advanced as part of the investigation and soil samples were collected from each borehole location. Five of these boreholes (BH46, BH47, BH56, BH60, and BH72) were located within the Site, refer to **Figure F5**.
- Four boreholes were converted into groundwater monitoring wells of which two were located within the Site (BH60/MW60 and BH56/MW56).
- One soil vapour well (SV08) was installed adjacent to BH60/MW60.
- Preparation of a DGI report, discussing the methodologies, the investigation results and conclusions regarding the requirements for management and/or remediation of the Site during the re-development works.

The results of the *ORWN DGI* (AECOM, 2010b) are briefly summarised below:

- Fill was encountered overlying natural sands, gravelly sands, clays and weathered sandstone bedrock at the Site. The fill was generally shallower (12.6 m bgl) in the northern portion of the Site and deeper in the southern portion of the Site (19 m bgl);
- Soil impacts appeared to be associated with the historical presence of the former gasworks located east of the Site and the fill materials used for land reclamation activities;
- The soil vapour results indicated the potential presence of gasworks-derived impacts (as indicated by the presence of naphthalene and toluene vapour) at location SV08.
- Groundwater was present beneath the Site within fill materials at approximately 2.0 m bgl and was subject to tidal fluctuation; and
- Groundwater impacts in the form of dissolved phase TPH and PAH contamination was identified at depth in the deeper fill (>7 m bgl) and marine sediments (>14 m bgl).

The *ORWN DGI* (AECOM, 2010b) identified that elevated concentrations of contamination exceeding the adopted Site investigation criteria. The reported results were considered to be primarily associated with contamination that migrated from the former gasworks located to the east the Site and to a lesser extent with the historic importation of fill materials during reclamation work.

The *ORWN DGI* (AECOM, 2010b) provided the following recommendations:

- Completion of a site-specific HHERA addressing the remediation of the Site for the proposed future land use;
- Development of a RAP detailing options for remediation and/or management and a recommended preferred strategy that would:
 - Render the site suitable for the intended land use;
 - Detail validation requirements to be implemented to demonstrate successful completion of the remedial works; and
 - Detail the requirement for potential future monitoring or management.

- Development of a RWP providing a technical specification that is suitable for issue by Lend Lease to its contractors, and that provides specific details of the work that must be completed to facilitate delivery of the remediation works prescribed by the RAP for the Site.
- Completion of an Acid Sulfate Soil Management Plan may be required for the management of potential acid sulfate soil (PASS) during future excavation works

5.9 AECOM (2010c) Groundwater Discharge Study

The *Groundwater Discharge Study* (GDS) (AECOM, 2010c) was prepared in order to support the *Declaration Site HHERA* (AECOM, 2011b) for the NSW EPA Declaration Site located to the east of the Site. A key pathway and receptor that needed to be considered was the interaction of contaminated groundwater with Darling Harbour. A primary objective of the *Groundwater Discharge Study* (AECOM, 2010c) was to inform the *Declaration Site HHERA* (AECOM, 2011b) with respect to likely attenuation factors for contaminant mass flux due to mixing of seawater prior to discharge.

AECOM installed a transect of multilevel piezometers, comprising two arrays of three piezometers each within the Site (IT01 and IT02, refer to **Figure F5**). Instantaneous hydraulic head measurements, groundwater and surface samples and hydraulic head time series data (hydrographs) were collected from these installations during the investigation.

Groundwater discharge volumes and therefore contaminant mass flux from the marine sediments was considered to be negligible from a hydrogeological perspective, compared to the fill sequence. Groundwater discharge occurring via the basal Hawkesbury Sandstone was not considered significant in the context of contaminant flux due to very low values of permeability reported for this formation in the literature.

The tidal exchange prism is defined as the area immediately behind the caisson wall where full inundation of sea water occurs during the incoming and outgoing tide. The dimensions of the tidal exchange prism have been defined as being a rectangular volume extending 10 metres, on average, landward of the existing caisson wall. Where leachable source material is present within the tidal exchange prism, any resultant groundwater contamination is expected to discharge largely without further attenuation.

The Study indicated that of the total flux towards the Harbour in any given ebb tide, approximately 10% represents water from up gradient, which equates to a groundwater (including connate seawater) to seawater mixing ratio of approximately 1:10. However, given potential uncertainty regarding the original shoreline location and dates for the commencement of reclamation activities, attenuation factors for groundwater up gradient of the tidal exchange prism were conservatively estimated as a factor of 5. It was concluded that contamination which has migrated into, or is otherwise present within the tidal exchange prism, was not expected to undergo further attenuation prior to discharging to the Harbour.

5.10 AECOM (2012b) Supplementary Data Gap Investigation

AECOM was engaged by Lend Lease to undertake a *Supplementary DGI* (AECOM, 2012c). The purpose of the investigation was to refine the extent of remediation required outside the perimeter of the Declaration Area. The investigation included drilling and sampling 14 boreholes (BH400 to BH413) to the depth of bedrock, converting one borehole to a monitoring well (BH401/MW401) and five multilevel piezometers (BH405/IT03, BH410/IT04, BH411/IT05, BH412/IT06 and BH413/IT07). All the boreholes and monitoring wells were located to the east of the Site, with the exception of BH410/IT04 and BH411/IT05 which were located in the western portion of the Site. , refer to **Figure F5**.

The objectives of the investigation were to:

- Refine the extent of remediation works required within the Declaration Area.
- Refine the extent of remediation works required outside the Declaration Area.
- Further assess groundwater quality immediately down hydraulic gradient of the Declaration Area.
- Assess the opportunity for reuse of materials that might be removed from the Declaration Area.

The results of the *Supplementary DGI* (AECOM, 2012a) are summarised following:

- Tar impacted soil was identified at and below the fill and natural soil interface in boreholes BH400 to BH406, located within 20 m of the Site boundary;
- Concentrations of CoPC including lead, TPH, BTEX, and PAHs exceeded the adopted site investigation criteria at all investigation locations (BH400 to BH413), with the exception of BH412;
- Observations of contamination and PID readings were consistent with analytical results;
- Asbestos fibre bundles were identified in fill materials at on-site location BH405 (Block 4, east of the Site) at a depth of 12-12.2 m bgl. Potential asbestos containing material such as fibre cement fragments were not observed in the samples collected; and
- Concentrations of CoPC variably exceeded the adopted groundwater assessment criteria (ANZECC, 2000) in the monitoring wells sampled.

5.11 JBS Barangaroo Central DGI (JBS, 2012a)

JBS Environmental Pty Limited (JBS) was commissioned by the BDA to undertake the *Barangaroo Central DGI* (JBS Environmental Pty Ltd, 2012) within the Barangaroo Central site area located offsite directly to the north of the Site (comprising parts of Lots 5 and 6 of Deposited Plan 876514). It is understood that the Barangaroo Central area is initially proposed to be developed as the Barangaroo Stage 1 Public Domain (comprising a range of open space land uses and car parking) and, in the future, will be developed for a mixture of high density residential and open space land uses.

The *Barangaroo Central DGI* (JBS Environmental Pty Ltd, 2012) involved drilling and soil sampling at 52 boreholes across the Barangaroo Central site. Of these boreholes, 24 were converted to either shallow or deep groundwater monitoring wells. None of the JBS groundwater monitoring wells installed north of the Site were screened within the natural marine sediments.

The following soil and groundwater sampling locations were located in proximity to the Site (i.e. within 20 metres of the northern Site boundary, refer to **Figure F5 in Appendix B**):

- Soil sampling locations:
 - BH543, BH544, BH546, BH547 and BH550;
- Groundwater sampling locations
 - MW543 - screened between 3 and 6 m bgl. Natural clay was reported at 16 m bgl;
 - MW544 (shallow) - screened between 2.5 and 5.5 m bgl; and
 - MW544 (deep) - screened between 10 and 13 m bgl. Natural clay was reported at 15.5 m bgl.

No soil CoPC concentrations were reported at concentrations exceeding the Site Specific Target Criteria (SSTC) (refer to **Section 7.3**) in the sampling locations detailed above (refer to **Figure F5 in Appendix B**).

The JBS groundwater monitoring results reported adjacent to the Site boundary (i.e. monitoring wells MW544S and MW544D) indicated that copper and zinc concentrations variably exceeded the MWQC. BTEX and PAH concentrations were reported to be non-detect.

5.12 AECOM (2014) Human Health and Ecological Risk Assessment, Stage 1C Development (ORWN Area), Barangaroo South

AECOM was engaged by Lend Lease to prepare the *Human Health and Ecological Risk Assessment, Stage 1C Development (ORWN Area), Barangaroo South* (AECOM, 2014) (here-in referred to as the *ORWN HHERA*). The objectives of the HHERA were to:

- Develop human health site-specific target criteria (SSTC) for soil and groundwater for use in defining the remediation end-point for the Site, where the remediation end-point is defined as that required to render the Site suitable for use following redevelopment; and
- Assess the risk to ecological receptors that the Site will represent based on the assumption that the remediation works described by the *VMP/Block 4 RAP* (AECOM, 2013c) are undertaken.

5.12.1 Conceptual Site Models

Description of Assumed Generic Development

Based on the building specific plans supplied by LL in relation to the ORWS basement design with the exception of the Crown Site specific information, it is understood that the potential generic land use across the Site would include mixed land use comprising residential (with minimal access to soil), commercial / retail (with minimal access to soil), public open space and potential open water (associated with a proposed Southern Cove located offsite to the south) connected to Darling Harbour.

Key components of the generic land uses are expected to include:

- A basement car park with perimeter soil and groundwater retention systems generally constructed around a future basement and extending to bedrock;
- Mixed use hotel (including high density residential), commercial and hotel multistorey buildings (greater than two storeys) constructed over the basement;
- Mixed use commercial and retail buildings (greater than two storeys) built on grade;
- Public open space, landscaping, roads, pedestrian ways and cycle paths, built on grade.
- Mixed use commercial and community buildings built on grade (maximum height two storeys).
- Creation of a waterway (the potential Southern Cove) connecting with and extending eastward from Darling Harbour, in the southern portion of the Site. Incidental access to the open water from the Site may be accommodated by the final development (for example through the provision of step seats leading to the edge of the water). However, the potential for recreational access to sediment by the general public is considered very unlikely given the depth of water that will be present within the potential Southern Cove (located offsite to the south).
- Potential areas of open water in water features constructed over basement car parks (if constructed).
- Reuse of material from the Site or other areas of Barangaroo South to build up the elevation of the ORWN public domain.

It should be noted that the location and extent of each of the potential generic land uses within the Site has not yet been finalised. Notwithstanding, the proposed land uses will likely remain consistent with those described by this RAP.

Description of Proposed Crown Hotel Development

Based on the current development concept for the Site, it is understood that Crown intends to construct a Hotel Development on the Site (refer to **Section 4.1**). The proposed land use associated with the Crown Hotel Development will include mixed land use comprising hotel (including high density residential with minimal access to soil), commercial / retail (with minimal access to soil) and public open space.

Key components of the proposed Crown Hotel Development are expected to include:

- An underground basement intended to provide car parking and loading facilities associated with the Crown Hotel Development;
- A tower containing hotel rooms, suites and residential apartments. The entire footprint of the tower will be above a basement;
- A multistorey podium containing hotel reception, retail and gaming facilities. The podium will be largely above a basement but with some limited areas constructed as elevated slab on grade;
- Terrace areas containing restaurant and bar facilities largely constructed as elevated slab on grade;
- Public open space, landscaping, roads, pedestrian ways and cycle paths, largely built on grade (more than 1m above existing surface level); and
- Raising of the finished surface level in areas of the Crown Site that are outside the proposed basement by the import of Suitable Fill by a minimum of 1m above the current ground level.

While the proposed Crown Hotel Development is largely consistent with the generic proposed development design described above, a number of key elements do differ. Specifically:

- All areas outside the proposed basement will be built up, using imported soil, by at least 1m above the existing ground surface;
- The air exchange rate within the buildings will be at least 5 air changes per hour, which is greater than that typically assumed for a generic commercial building (2 air changes per hour); and
- The configuration of the upper most basement level (level B1) will be different such that: the internal height will be greater (5 m verses the generic assumption of 4.5m); and the finished floor level will be higher (-2 m AHD verses the generic assumption of -2.5 m AHD).

The Crown Hotel Development plans are subject to final detailed design and development, however will remain generally consistent with that described by this RAP.

Adopted Land Use Scenarios

Based on the above proposed development plans, the broad land use scenarios for which Site Specific Target Criteria (SSTC) have been derived are as follows. It is noted that Crown specific land use scenarios have been adopted where the differences between the generic proposed development design and the proposed Crown Hotel Development directly impact the assumptions used to derive the relevant SSTC.

- Lower-most basement car park level below the water table (Scenario 1);
- Upper-most basement car park level, partially above the water table (Scenario 2);
- Crown specific upper-most basement car park level, partially above the water table (Scenario 9);
- Public Domain/recreational area with no concrete/hardstand paving (Scenario 3);
- Crown specific Public Domain/recreational area with no concrete/hardstand paving (Scenario 10);
- Public Domain/recreational area with concrete/hardstand paving (Scenario 4);
- Crown specific Public Domain/recreational area with concrete/hardstand paving (Scenario 11);
- Typical commercial slab on ground construction (maximum height two storeys) (Scenario 5);
- Short term ground-intrusive maintenance (Scenario 6);
- Crown specific short term ground-intrusive maintenance (Scenario 12);
- Hotel or High Density Residential development (over a basement car park) (Scenario 7)
- Crown specific Hotel or High Density Residential development (over a basement car park) (Scenario 13);
- Commercial multistorey development with slab on ground construction (Scenario 8);
- Crown specific commercial multistorey development with elevated slab on ground construction (Scenario 14).

Human Health Risk Assessment (HHRA)

- Identification of CoPC for human health, based on comparison of Site data to relevant 'Tier 1' screening criteria derived for protection of human health.
- Review of toxicological data for CoPC and identification of appropriate toxicity values to use in the HHRA;
- Review of chemical and physical properties of each CoPC for risk assessment purposes;
- Development of CSMs for the post-development status of the Site, including:
 - summarising the sources, nature and extent of contamination at the Site;
 - description of Site physical conditions (including Site geology and hydrogeology, existing physical structures and proposed structures to be constructed as part of the development) to be used in assessment of contaminant fate and transport modelling; and
 - identification of human receptors that may be exposed to Site contaminants following redevelopment and the pathways by which exposure may occur.

- Quantitative exposure assessment, including:
 - establishment of relevant exposure parameters for identified receptors and exposure pathways; and
 - application of vapour and dust transport modelling to predict chemical concentrations in air which may result from identified soil and groundwater contamination.
- Characterisation of the nature and potential incidence of adverse health effects to receptors based on comparison of estimated contaminant intake or exposures to relevant toxicity (dose-response) criteria.
- Adoption of acceptable risk levels for SSTC derivation.
- Estimation of SSTC based on consideration of toxicity, exposure, contaminant migration modelling and acceptable risk levels.
- Comparison of SSTC for potential future development scenarios to chemical concentrations reported at the Site.
- Discussion of SSTC exceedances and their significance and relevance to future development plans for the Site.

Consideration of aesthetic risks or issues including odour.

Ecological Risk Assessment:

- Identification of appropriate ecological receptors, including both terrestrial and aquatic ecosystems.
- Identification of relevant MWQC from a nationally adopted hierarchy of acceptable guidance documents plus consideration of additional international sources, based on the protection of the nearest surface water receptor, Darling Harbour.
- Identification of non-gasworks CoPC noting that the *VMP Remediation Extent* report (AECOM, 2013d) considered that if the *VMP/Block 4 RAP* (AECOM, 2013c) is implemented, residual gasworks related contamination remaining *in situ* down hydraulic gradient of the Declaration Area will not represent an unacceptable risk to the environment.
- Identification of potential risk associated with the non-gasworks related CoPC based on the comparison of the concentration of CoPC (reported both within the Site and at the Site boundary) with the adopted MWQC.
- Assessment of whether (or not) the concentrations of CoPC within the Site and at the down hydraulic gradient Site boundary represent a risk to Darling Harbour.

Consideration was also given to protection of future terrestrial plants in open space areas of the Site through adoption of Terrestrial Soil Criteria (TSC) to define material that is appropriate for use as "Suitable Foil" in areas that will be subject to open space use.

5.12.2 Conclusions

Based on the human health and ecological risk assessment and with consideration of the uncertainties and limitations of available data and information, the following conclusions were provided with respect to potential for human health, odour, aesthetic or ecological risks following redevelopment of the ORWN Area under the proposed land use scenarios.

Human Health Risks

- **Scenario 6 (Intrusive Maintenance) – potential contact with groundwater:** The highest reported concentrations of naphthalene and TPH C₁₀-C₁₄ fraction in groundwater within the ORWN Area have the potential to result in unacceptable health risks to intrusive maintenance workers.

The predominant risk driving pathway was identified as dermal contact of intrusive maintenance workers with groundwater. Locations where reported concentrations may result in a potential risk are near the northern edge of the Site, and based on the proposed Crown Hotel Development, the location of these exceedances would be within the proposed Stage 1C Basement. It is considered unlikely that services installed in this area would be constructed at a depth where groundwater contact was probable (that is, the depth to groundwater is approximately 2.5 m (outside of the Crown Hotel Development) and the groundwater is saline which would be corrosive to below ground services). In addition, it is likely that the reported elevated groundwater concentrations are representative of groundwater quality within marine

sediments which are present at depths significantly greater than 2.5 m and from which contaminant flux has been shown to be minimal.

Consequently, under the assumed exposure scenarios presented in the HHERA it is considered unlikely that the reported groundwater concentrations in the ORWN would result in an unacceptable health risk for the intrusive maintenance worker. It is also considered that all intrusive maintenance works will be undertaken in accordance with state occupational health and safety requirements and personal protective equipment will be worn.

- **Scenario 8 (Multistorey Commercial Slab on Ground, with Advection):** The highest reported concentrations of naphthalene in soil and benzene, TPH C₆-C₁₀ and TPH >C₁₀-C₁₆ in groundwater within the ORWN Area have the potential to result in unacceptable health risks to commercial employees working in a building where advection vapour intrusion processes occur. Locations where reported concentrations may result in a potential risk are near the eastern and northern edges of the Site, and the potential health risk assumes that the future multi-storey commercial slab-on-ground building is on top of these impacted areas. Based on the proposed Crown Hotel Development, the location of these exceedances would be within the proposed Stage 1C Basement and therefore this exposure scenario would not be relevant.

Based on proposed future land use at the Site, there is also potential for intrusive maintenance workers (only) to encounter asbestos in soils during intrusive works. There is currently insufficient data to determine the potential for risks associated with asbestos in soil within the Site. However, available data collected during excavation of the ORWS Area indicates that there is a significant potential for asbestos containing material to be present. In order to address the potential for future exposures to asbestos at the Site, the current HHERA presents risk based SSTC for asbestos in soils. The future ORWN RAP [this report] will be required to consider these SSTCs to minimise the potential for unacceptable risks to intrusive maintenance workers.

Human health risks are not expected to be associated with Scenarios other than 6 and 8. This is because SSTC for these scenarios were not exceeded by reported Site contaminant concentrations, or reported exceedances are not considered to pose a health risk based on consideration of their location, nature and/or extent.

Furthermore it is considered that remediation works undertaken in the NSW EPA Declaration Area (including the Block 4 Development Works Area) will result in an overall reduction in groundwater contaminant concentrations within the ORWN Area.

A separate assessment of potential risks to human health from exposure to sediments and surface water within the potential Southern Cove (which, if constructed, will be outside of the Site considered by this RAP) has not been undertaken. This is because, in the event that construction of the potential Southern Cove requires excavation of existing fill, the material at the new surface of the potential Southern Cove will be required to meet the ANZECC (2000) ISQG, which are considered to be suitably protective for recreational exposures for humans and the surface water will be of the same composition and makeup of Darling Harbour.

With respect to potential human health risks associated with material which may be reused within the Site, it is expected that material which meets criteria for Scenarios 3 through 6 and Scenario 8 would be suitable for reuse from a human health perspective in areas/locations where respective land use and human exposure assumptions are met. It is understood that the proposed Crown Hotel Development specifically excludes the reuse material.

Odour Risks

Comparison of Site data to derived odour SSTC indicates one exceedance for 2-methylnaphthalene within the Site, at BH40 at 16.5 m bgl. It is considered that remedial activities at the Site are not likely to extend to this depth. It should be noted, however, observations during intrusive Site investigations have indicated that relatively small scale excavations or intrusive works have potential to result in localised odour issues.

Locations where odour issues may occur are likely to be a result of one or more of the following:

- Compounds not specifically identified in analytical suites may contribute to odour (i.e. there are many hydrocarbon compounds within mixtures of gasworks waste that cannot be specifically identified and which may contribute to odour); and
- Cumulative effects from chemical mixtures may result in odours even where concentrations of individual compounds are below relevant odour thresholds.

It is expected that remediation to mitigate risks to human health and excavation of the proposed basement will remove contamination with the potential to generate odour and therefore result in a reduction in the potential for odour generation. It should also be noted that areas of the Site that will not be the subject of remediation or

basement excavation and in which potentially odorous material may remain *in situ* will be covered by clean fill (referred to as 'Suitable Fill') and/or concrete paving / hardstand which will further reduce the potential for odour generation.

Visual Amenity Risks

Limited visual amenity impacts as a result of sheen or tar (particularly within the potential Southern Cove) are expected to occur at the Site. Furthermore, the remediation work described by the future ORWN RAP (this report) will make consideration of the potential negative impacts from fill, tar or sheen on visual amenity.

As required by the *NEPM* (NEPC, 2013), all surface soils, including Suitable Fill in areas subject to paved and unpaved recreational land uses, must contain 'no visible asbestos'.

Ecological Risks

The *VMP Remediation Extent* report (AECOM, 2013d) considers that if the *VMP/Block 4 RAP* (AECOM, 2013c) is implemented, residual gasworks related contamination remaining *in situ* down hydraulic gradient of the Declaration Area will not represent an unacceptable risk to the environment.

With respect to non-gasworks related contamination, ecological screening criteria were exceeded within the Site for copper, zinc, cobalt and nickel within the groundwater wells screened within both the fill and marine sediment.

The concentrations reported for copper, zinc, cobalt and nickel are higher in groundwater wells screened within the marine clays. Notwithstanding, given that there will be negligible contaminant flux from within the marine sediments to Darling Harbour, these concentrations are not considered representative of those that may discharge to the environment.

Copper, zinc, cobalt and nickel concentrations reported within groundwater screened within the fill materials are also not considered to present a risk to the environment due to:

- The proposed remedial strategy presented within the *VMP Remediation Extent* report (AECOM, 2013d) and *VMP/Block 4 RAP* (AECOM, 2013c) which includes: (a) historical infrastructure source removal; and, (b) removal of secondary sources of contamination such as SPGWT which are both up-gradient sources of contamination on the Site.
- The groundwater retention wall system to be constructed as part of the proposed Block 4 Development Works will limit groundwater movement from up-gradient sources to the Site. It is considered that the up-gradient sources are a significant contributor to the groundwater quality within those wells screened within the fill materials.
- The proposed Stage 1C development is likely to incorporate a basement, similar to that proposed as part of the Block 4 Development Works, contained within a groundwater retention wall which will be keyed into bedrock. While the extent of the basement has not yet been confirmed, it will reduce groundwater migration and potential contaminant flux from that area of the Site that in which the basement is constructed.
- Results of the *GDS* (AECOM 2010c), which concludes that there is a five-fold mixing and dilution of groundwater within the unconfined aquifer prior to discharge through the tidal prism to Darling Harbour. The current ERA has not adjusted the groundwater concentrations to reflect dilution, and therefore it is considered that concentrations reported within groundwater at the Site will undergo additional dilution prior to discharge to the nearest environmental receptor, Darling Harbour.
- Additional remediation works (as might be required to achieve a greater degree of environment protection), would be impracticable, cost prohibitive and inconsistent with the principles of Ecologically Sustainable Development (ESD). That is, the net cost to the environment of undertaking the additional works would be greater than the environment benefit realised from the additional work at the Site (AECOM, 2013b).

Soil material which may be re-used within the unsaturated zone (to a depth of 2m) must demonstrate neutral leachate concentrations which are below the adopted MWQC. This requirement is in addition to the requirement that soil concentrations also comply with the relevant human health SSTC (which have not been derived to be protective of the closest down gradient ecological receptor, Darling Harbour, based on the potential for soil leachate to discharge to groundwater). It is noted that the application of the Terrestrial Soil Criteria (TSC) criteria for Suitable Fill is considered to be suitably protective of the closest down gradient ecological receptor.

Multiple lines of evidence have been provided to demonstrate that residual metals contamination reported within groundwater wells screened with the fill materials will not pose a risk to the environment and that the quality of groundwater in fill within the Site will improve over time following the proposed remedial works in the Declaration Area and Block 4. It is therefore considered that the risks to identified environmental receptors at the Site are low and acceptable.

5.12.3 Recommendations

Based on the above conclusions, and with consideration of the uncertainties and limitations of available data and information, the following recommendations were provided by the *ORWN HHERA* (AECOM, 2014)⁵:

- 1) A RAP [this report] should be prepared to determine the extent and need for remediation at the Site.
- 2) Soil and groundwater remaining within the Site should be remediated and/or validated to meet relevant health/odour criteria (SSTC), as follows:
 - a) The specific health/odour SSTC to be met in different Site locations will depend on the land use(s) relevant to the area.
- 3) Material reused within the Site should meet relevant health/odour criteria (SSTC) and TSC, as follows:
 - a) The specific health/odour SSTC to be met will depend on the exact location of material relative to the proposed land use(s).
 - b) Soil re-used in locations above the current ground level should also demonstrate neutral leachate concentrations which are below the adopted MWQC.
- 4) Basement design plans must include engineering controls to ensure that contaminated groundwater does not accumulate in compartments which are ventilated to basement airspaces. The following is also recommended:
 - a) Basement levels should be maintained at a lower pressure than occupied areas above in accordance with AS 1668.2 (Standards Australia, 2002).
 - b) Sump rooms should be placed as far as possible from lift wells.
 - c) Engineering controls must be in place restricting dermal contact by general public and commercial workers (i.e. car park attendants and loading dock workers) to groundwater which may ingress through basement walls.
- 5) SPGWT should not be present in the immediate vicinity of outer basement walls (to the extent practicable), and basement design and engineering controls should ensure that SPGWT seepage into basements does not occur.
- 6) Soil to be placed in Headland Park will be required to meet the criteria defined in the separate Headland Park RAP prepared by the BDA.
- 7) The ORWN RAP(s) (this report) should include consideration of mitigation measures for the appropriate management of asbestos that may be potentially encountered during the remediation works.
- 8) The ORWN RAP(s) (this report) will describe the validation of groundwater following remediation which will be undertaken by comparison of:
 - a) individual groundwater monitoring results with the lowest of the derived SSTC; and
 - b) groundwater monitoring results at the down-hydraulic gradient Site boundary with the MWQC, to the extent practicable.
- 9) The ORWN RAP(s) [this report] will describe the validation of soil following remediation (as applicable) which will be undertaken in accordance with the following:
 - a) use of systematic sampling patterns;
 - b) collection of an appropriate number of samples for estimation of the arithmetic average concentration of contaminant(s) within relevant environmental media and exposure areas; and
 - c) estimation of the 95% UCL of the arithmetic average concentration.

⁵ Only those recommendations which relate to the Site have been provided.

6.0 Site Condition and Surrounding Environment

6.1 Current Land Use

The Site covers an irregularly shaped area of approximately 10.242 ha (based on existing Crown supplied Site plans). The location of the Site is presented on **Figure F1** and the Site layout is illustrated in **Figure F2**.

At the time of this report the Site was occupied by Lend Lease as a support for the construction of the adjacent Stage 1A development, located to the south of the Site. The Site contained a concrete batching plant, site offices and plant and equipment storage areas.

6.2 Surrounding Land Use

The Site is surrounded by the following land use:

- North: Barangaroo Central (part), currently being used by Lead Lease for the staging of Barangaroo South Stage 1A and then Barangaroo Central Temporary Public Domain and Headland Park (which is being developed for open space land use);
- South: Part of the ORWN Area that is outside the Site and which includes the footprint of the potential Southern Cove and the HHR Inlet Area, followed by the Barangaroo South Stage 1A development (under construction for commercial, residential and open space land use), followed by Shelley Street and then commercial buildings;
- East: Barangaroo South Stage 1B (Block 4) area, followed by Hickson Road and then residential and commercial multistorey buildings; and
- West: Part of the ORWN Area that is outside the Site and to be developed as a public foreshore walkway, followed by Darling Harbour.

6.3 Topography and Drainage

The topography of the Site is relatively flat having been the subject of significant reclamation works for its previous use as a stevedoring facility. The closest surface water body to the Site is Darling Harbour, located less than 30 m west of the Site. The Site is surfaced with hardstand (concrete and bitumen).

The stormwater runoff from the Site is currently captured on-site and treated by Lend Lease's on-site water treatment plant and then discharged to Sydney Harbour under an environmental protection licence (EPL).

6.4 Geology

6.4.1 Regional Geology

Reference to the *1:100,000 Geological Survey of NSW (Sydney) Sheet 9130 (Ed 1), 1983* indicates that the stratigraphy of the Site comprises man-made fill material, marine clays and Hawkesbury Sandstone.

As described by **Section 3.2**, historical information indicates that the former 1880s shoreline ran approximately along the western edge of Hickson Road (i.e. along the eastern edge of the proposed Stage 1 Development). The area to the west of Hickson Road is understood to have been progressively reclaimed. Aerial photographs from the 1950s indicate that the area between Hickson Road and the current shoreline was occupied by a number of finger wharves, extending from Hickson Road. It is understood that the space between the historical finger wharfs and seawalls were infilled in several stages between the 1960's and 1980's with various types of material. The former Southern Cove was located on the south side of the current Site and is understood to have been filled in 1988.

Various intrusive and geotechnical investigations have been undertaken within Barangaroo South and surrounding area. The *Barangaroo Stage 1 Development Geotechnical Report (Coffey, 2010)* described the following sub surface units present across Barangaroo:

- Fill: heterogeneous fill consisting of mainly of crushed sandstone with inclusions of brick, concrete, timber, glass and slag. The fill becomes progressively deeper from east to west and the base of the fill has been interpreted as highly irregular.

- Estuarine sediments: Dark grey to black silty and sandy clays containing shells and organic material were typically observed across the southern and eastern portion of the Barangaroo South. Organic peaty clay layers were also present in areas. The estuarine sediments were identified at two distinct horizons at 4 to 6 m bgl and 11 to 14 m bgl with thicknesses of 1 to 2 m.
- Alluvial sediments: firm silty sands, clayey sands and stiff sandy clay sourced from weathered sandstone were identified at depths of 5 m bgl in the east and greater than 16 m bgl in the west with thickness ranging from 3 to 10 m.
- Residual soil: hard silty clay and sandy clay encountered at depths greater than 13 m bgs in some locations with thicknesses of up to 1.5 m.
- Sandstone: extremely low strength and extremely highly weathered sandstone grading to high strength sandstone generally encountered shallow in the east and slopes down to the west.
- Dolerite Dyke (The Pittman Dyke): a near vertical extremely weathered dyke consisting of very stiff to hard pale grey/white kaolinitic clay runs east-west through the northern portion of the Barangaroo South development at depths from 5 to 14 m bgl.

6.4.2 Site Geology

Based on the boreholes completed during previous environmental investigations, the following is known about the subsurface:

- Fill: A layer of heterogeneous fill consisting of predominantly crushed sandstone and clay containing demolition rubble (mainly bricks, timber and concrete) was encountered across the Site. The fill layer was generally shallowest in the north east portion of the Site (12-13 m bgl) and deepest in the western portion of the Site (20 to 25 m bgl).
- Natural soil/sediments: estuarine sediments including sand with shells, soft sandy clay and organic dark grey silty clay were encountered below the fill in many of the boreholes completed. Residual weathered sandstone soil consisting of stiff sandy clay and dense clayey sand underlay the estuarine sediments in some locations. It is noted in some locations fill directly overlies sandstone bedrock and no natural soil or sediment was present.
- Bedrock: sandstone bedrock was encountered at depths ranging from 19 to 25 m bgl. The depth to sandstone bedrock was highly variable across the Site, with apparent deeper troughs running east to west. It is noted that the dolerite dyke is located in the southern to central portion of the Site.

Observations of tar contamination in the investigations were mainly identified at the interface of fill and natural soil/sediment and directly above bedrock.

6.5 Hydrogeology

The *ORWN DGI* (AECOM, 2010b) reported the following findings:

- Groundwater was present as an unconfined, shallow aquifer within the fill materials and the underlying natural sediments. Groundwater was also likely to occur as a deeper bedrock aquifer within the underlying sandstone bedrock. Groundwater within the bedrock would occur as a fractured bedrock aquifer, potentially confined by an overlying clay unit in some areas of the ORWN Area.
- The highest reported groundwater contaminant concentrations were generally encountered within wells screened deeper within the aquifer, across the base of the fill and natural sediments and immediately overlying bedrock.
- Due to the proximity of the Site to Darling Harbour, the depth to groundwater was shallow (between 1.8 to 2.9 m bgl) and the overall direction of groundwater flow was expected to be towards Darling Harbour. Groundwater at the Site was tidally influenced, resulting in the fluctuation of groundwater levels within the fill materials and natural sediments.
- Although the results of the tidal assessment indicated the Site was tidally influenced, the low dissolved oxygen concentrations reported across the Site suggested there was limited flushing of groundwater and associated contamination occurring.

- Based on the results reported in *ORWN DGI* (AECOM, 2010b) there appeared to be an efficient hydraulic connection between the saturated fill material and Darling Harbour indicating a significant exchange of water during tidal cycles. However groundwater flux in the underlying natural material was determined to be negligible.
- The hydraulic conductivities and laboratory permeability's reported for the Site were considered to be variable due to the heterogeneous nature and distribution of fill materials. This variability in conductivity results in inconsistent lag times for tidal influence across the Site and creates a tortuous flow path for groundwater and associated contamination.

A search of the NSW Department of Natural Resources (DNR) groundwater bore data base was reported in ERM (ERM, 2007) and indicated that there were 32 registered groundwater bores within a 4 km radius of the Site. Groundwater bore information indicated that the bores were registered for either recreation, irrigation or monitoring purposes.

6.6 Site Contamination

6.6.1 Separate Phase Gasworks Waste and Tar (SPGWT)

For the purposes of this report, SPGWT refers to:

- Tar Containing Materials (TCM), as per the definition described below:
 - Greater than 10% visible coal tar (where coal tar is a phase separated hydrocarbon by-product from coal gasification); and/or
 - Contaminant concentrations exceeding the following limits:
 - Polycyclic Aromatic Hydrocarbons (PAHs) - 2,000 mg/kg; or
 - Benzo(a)Pyrene (B(a)P) - 150 mg/kg.
- Dense Non Aqueous Phase Liquids (DNAPLs).

The above TCM definition was originally proposed by AECOM and adopted by Lend Lease/the BDA to define TCM at the Site, particularly in the context of material that is unsuitable for reuse (in conjunction with the site-specific risk based criteria which were derived in the *ORWN HHERA* (AECOM, 2014).

It is noted that the term SPGWT has not been used in the previous site investigation reports where such materials were variably referred to as tar, coal tar, etc.

The *ORWN HHERA* (AECOM, 2014) notes that the *Guidelines for the Assessment and Management of Groundwater Contamination* (DEC, 2007) requires that:

- "Where light NAPLs (LNAPLs) or dense NAPLs (DNAPLs) are present in the subsurface they must be removed or treated as much as practicable".

Consequently, in accordance with NSW EPA policy and guidelines, and the remediation goals recommended by the *ORWN HHERA* (AECOM, 2014), all SPGWT identified on the Site and in adjacent off Site areas is required to be remediated to the extent practicable.

6.6.2 Soil

Field Observations

Table T10, Appendix A summarises field observations of potential gasworks related impacts in the ORWN soils. Some hydrocarbon odours and staining were noted in the soils predominantly at depth within the marine sediments.

A review of the borehole logs and analytical data from the Site indicates that impacted materials, likely to be attributable to the former gas works site (located to the east), are predominantly located within the marine sediments where there is negligible contaminant flux (refer to **Section 6.6.5**). Due to the depth of the marine sediments, these impacts are present at depths generally ranging between approximately 16.5 m bgl (BH40) and 22 m bgl (BH60).

Total Concentrations

The results of the soil total concentration analysis are presented in **Table T5** and **T6, Appendix A**.

PAHs (including B(a)P and naphthalene) and heavy metals (arsenic, chromium, cobalt and lead) in soil were reported at concentrations above the adopted site investigation criteria across the Site. In particular, elevated concentrations have been reported within the marine sediments in the vicinity of BH60, BH72 and BH191.

TPH C₆-C₉ was reported in soil at concentrations that exceeded the adopted site investigation criteria at one sample location (BH60), within the marine sediments. Heavy end TPH fractions (TPH C₁₅-C₂₈ and TPH C₂₉-C₃₆) were reported in soil at concentrations that exceeded the adopted site investigation criteria more broadly across the northern portion of the Site in both the fill and marine sediments.

BTEX were typically reported in soil at concentrations below the laboratory LOR and/or the adopted site investigation criteria. The only exceptions were BH40, BH60, and BH191, where benzene concentrations were reported in marine sediments above the site investigation criteria at depths greater than 16m bgl.

Concentrations of phenols and SVOC were typically reported below the laboratory LOR.

Asbestos

A total of five samples (collected from locations where buried fill and rubble were identified) were analysed for asbestos during the *ORWN DGI* (AECOM, 2010b). No asbestos was detected in the samples analysed. A single result (AECOM BH48_11.5-11.7) (located east of the Site) reported the presence of unidentified mineral fibres. The corresponding bore log notes for this sample recorded the presence of plastic, minor silt, crushed brick and road base gravels.

No visual evidence of bonded fibre cement or possible asbestos fibres was observed by AECOM during the *ORWN DGI* (AECOM, 2010b).

ERM (ERM, 2008) previously analysed a total of 39 samples across Barangaroo (including 1 location (BH191) within the Site) and detected chrysotile and amosite asbestos in a single location (BH203_1.5) (which was not located within the Site).

Greater than 1000 samples were analysed and/or visually inspected for the presence of ACM as part of Stage 1A basement excavations works in the adjacent ORWS Area (AECOM, 2013a). ACM was identified to be widespread within excavated material within the ORWS Area (AECOM, 2013d) therefore it is assumed that there is significant potential for bonded ACM to be present within fill materials within the Site.

6.6.3 Groundwater

Groundwater is present beneath the Site within the fill materials and underlying natural material. Groundwater was encountered at the Site at depths ranging from 1.823 to 2.975 m bgl (AECOM, 2010b).

The groundwater level gauging within the Site produced variable results (as expected based on tidal fluctuation), with no distinct flow direction ascertained. The reported variability is related to tidal fluctuations, the nature and distribution of fill materials and the presence of subsurface structures (including the caisson wall associated with the historic southern cove).

Dissolved phase concentrations of PAH (including naphthalene), heavy metals (in particular, arsenic, cobalt, manganese and nickel), benzene and ethylbenzene in groundwater were reported above the adopted site investigation criteria across the Site.

Concentrations of toluene, xylene, VOC (1,2,4-trimethylbenzene and styrene) and SVOC (bis(2-ethylhexyl)phthalate and dibenzofuran), exceeding the adopted site investigation criteria have also been observed at limited locations and largely within the northern portion of the Site.

Phenols were typically reported below the laboratory LOR and/or adopted site investigation criteria, with the exception of one groundwater sample (MW60) which reported a concentration of 2,4-dimethylphenol above the adopted site investigation criteria.

It should be noted that the most significant groundwater contamination was reported from wells screened deeper within the aquifer, specifically across the base of the fill and within the marine sediments immediately overlying bedrock.

Groundwater results are presented in **Table T8** and **T9, Appendix A**.

6.6.4 Soil Vapour

AECOM (AECOM, 2010b) soil vapour analysis reported some gasworks-derived impacts which exceeded the adopted ambient air guidelines (adjusted using an attenuation factor of 0.01) for naphthalene (converted ATSDR, 2005 MRL) at two locations within the NSW EPA Declaration Area, one location within the Site and two locations within the ORWS area.

Oxygen measurements taken from 11 locations within Barangaroo South, from depths of 0.6 to 1.7 m bgl, ranged from 4.2% to 17.6%. This suggests that there is sufficient oxygen movement through the upper soils present across the Site beneath the current slab on grade (which was observed to be of varying quality) to support biodegradation processes.

6.6.5 Consideration of Contamination at Depth within Natural Marine Clays and Sediments

Groundwater Discharge Study (AECOM, 2010c)

The *GDS* (AECOM, 2010c) was prepared to inform the *VMP HHERA* (AECOM, 2012c) with respect to the interaction of groundwater from Barangaroo South (including the Site) with Darling Harbour and the potential for contaminant mass flux due to mixing of seawater prior to discharge.

Relative to that occurring from the fill sequence, groundwater discharge volumes and therefore contaminant mass flux from the marine sediments was considered to be negligible from a hydrogeological perspective. Groundwater discharge occurring via the basal Hawkesbury Sandstone was not considered significant in the context of contaminant flux due to very low values of permeability reported for this formation in the literature.

A summary of the *GDS* (AECOM, 2010c) is presented in **Section 5.9**.

Contaminant Mass Flux Study (AECOM, 2012b)

AECOM undertook a *Contaminant Mass Flux Study* (AECOM, 2012b) to assess the significance of contaminant mass flux and discharge in the natural soil, marine sediments and groundwater underlying the Site.

The study is presented as part of the *VMP Remediation Extent* report (AECOM, 2013d) and concluded that:

- Lithology and hydraulic conductivity data indicate that groundwater flow in the underlying natural soil and marine sediments is very low and in the order 0.4 metre per year, with contaminant velocities likely to be at least an order of magnitude lower due to attenuation (sorption, biological degradation, etc.);
- The effect of the twice daily tide provides changes in hydraulic head that further reduce the migration of groundwater and hence the contaminants;
- Mass discharge modelling indicates that both the mass and impact from the natural soil and marine sediments underlying the Site to the receiving water are insignificant and could not be measured due to the low expected concentrations; and
- The lines of evidence assessed indicate that there is not a significant flux and discharge of contamination from the natural soil and marine sediments underlying the Site into Darling Harbour.

Additional Groundwater Modelling study (AECOM, 2013b)

AECOM also undertook an *Additional Groundwater Modelling* study (AECOM, 2013b) which is similarly presented as part of the *VMP Remediation Extent* report (AECOM, 2013d). The objective of the supplementary study was to assess: (a) the decrease in contaminant flux that could be expected to result from the proposed remediation extent; and (b) potential impacts to water quality in Darling Harbour from the contamination that will remain *in situ* in fill material and marine sediment as an outcome of the proposed remediation extent.

The study concluded:

- A significant (between 250% and 380%) improvement in contaminant mass flux would be expected to be realised by the remediation proposed by the *VMP Remediation Extent* report (AECOM, 2013d);
- Less than 1% of the calculated contaminant mass flux to Darling Harbour from residual contamination remaining after the proposed remediation extent would be expected to be associated with contamination within the marine sediment; and
- Groundwater quality in fill discharging to Darling Harbour would be expected to improve over time. Contaminant mass flux from contamination that will remain *in situ* (both on Site and off Site) following the proposed remediation for the protection of human health.

6.7 Potentially Sensitive Receptors

6.7.1 Ecological

The nearest receptor for groundwater and surface water coming from the Site is considered to be:

- potential ecosystems present within the thin strip of land down hydraulic gradient of the Site (i.e. less than 20m wide and which is predominantly the Caisson Wall structure); and ultimately
- Darling Harbour, which forms part of the larger Sydney Harbour.

No other environmentally sensitive receptors have been identified.

6.7.2 Human Health

Potential human exposure to CoPC in impacted soil/fill materials and/or groundwater may occur via the following potential exposure pathways:

- Direct dermal contact with impacted materials;
- Incidental ingestion of impacted materials;
- Inhalation of volatile CoPC; and
- Inhalation of potential contaminants of concern sorbed to air-borne particulates.

The following potential human receptors have been identified:

- Workers engaged in future remediation / redevelopment of the Site;
- Workers on the Site entering confined spaces or exposed to subsurface materials during maintenance work;
- Future residents, workers and public inhabiting or visiting the Site; and
- Off-site workers conducting construction, road or other sub-surface works in the vicinity of the Site.

For further detail regarding the exposure pathways and potential human receptors for each of the considered land use scenarios refer to the *ORWN HHERA* (AECOM, 2014).

7.0 Remediation Criteria

7.1 Soil and Groundwater Generic Assessment Criteria

The current Generic Assessment Criteria used in NSW to evaluate possible human health risk from soil analytical results are based on the:

- *Guidelines for the NSW Site Auditor Scheme* (DEC, 2006b);
- *Guidelines for Assessing Service Station Sites* (NSW EPA, 1994); and
- *National Environment Protection (Assessment of Site Contamination) Measure* (National Environment Protection Council [NEPC]) as amended (NEPC, 2013).

These guidelines present a range of Health-Based Soil Investigation Levels (SILs), sensitive land use thresholds and expected background concentration ranges for urban redevelopment sites in NSW.

SILs are not available for all CoPCs identified at the Site and are generally considered inappropriate and potentially unnecessarily conservative for remediation works. Therefore, as described by the *ORWN HHERA* (AECOM, 2014) it is necessary and appropriate to adopt a site-specific health-based approach to determining:

- Whether CoPC concentrations identified at the Site represent a risk to human health; and
- SSTC for soil and groundwater to define the remediation required for the Site to be protective of human health.

7.2 Development of Site-Specific Target Criteria (SSTC)

The following sections summarise development of the soil and groundwater SSTC for the protection of human health at the Site as detailed in the *ORWN HHERA* (AECOM, 2014). The objective of the *ORWN HHERA* (AECOM, 2014) was to:

- develop human health SSTC for soil and groundwater for use in defining the remediation end-point for the Site, where the remediation end-point is defined as that required to render the Site suitable for use following the future intended redevelopment; and
- assess the risk to ecological receptors that the Site will represent based on the assumption that the remediation works described by the *VMP/Block 4 RAP* (AECOM, 2013c) are undertaken.

The remediation end-point is defined as that required to render the Site suitable for use following redevelopment. For the purposes of this RAP, a 'suitable for use' remediation endpoint is considered to be that required to ensure that unacceptable risks to human health or the environment will not occur.

As described by **Section 5.12**, 14 potential exposure scenarios were considered within the *ORWN HHERA* (AECOM, 2014) based on the proposed development concepts. In particular:

- Scenarios 1 to 8 were based on generic land uses and were generally based on plans supplied by Lend Lease in relation to the ORWS basement design; and
- Scenarios 9 to 14 were based on information that is specific to the proposed Crown Hotel Development provided by Crown (as described in **Section 5.12**).

Based on the assumption that the proposed Crown Hotel Development works will be approved and proceed, only those SSTCs that are applicable to the proposed Crown Hotel Development have been adopted for assessment in this RAP (refer to **Section 7.2.1**). It should be noted that, of the generic land use scenarios considered by the *ORWN HHERA*:

- Scenario 1 (lower-most basement car park level below the water table) is considered to be applicable to the proposed Crown Hotel Development because the differences between the future intended Crown Basement design and the assumed generic basement design are not material in the context of risk to human health; and
- Scenario 6 (intrusive maintenance worker with potential contact with groundwater) has been conservatively included in consideration of the unlikely event that services are constructed at a depth where intrusive maintenance worker contact with groundwater is possible (refer to **Section 8.1.6**).

7.2.1 SSTC Exposure Scenarios

The exposure scenarios that are relevant to the proposed Crown Hotel Development as described by **Section 4.2** and illustrated in **Appendix C** are:

- **Scenario 1:** Lower Basement car park level (below the water table) with some groundwater seepage through the basement walls and floor;
- **Scenario 6:** Short term ground-intrusive maintenance (with potential to contact groundwater);
- **Scenario 9** – Crown specific Upper Basement (which includes consideration of a commercial worker undertaking works within loading dock areas potentially within the upper basement areas of the Site and residential receptors utilising car parking);
- **Scenario 10** – Crown specific Unpaved Recreation, with no concrete / hardstand paving;
- **Scenario 11** – Crown specific Paved Recreation, with concrete/hardstand paving;
- **Scenario 12** – Crown Intrusive Maintenance Work (without potential to contact groundwater);
- **Scenario 13** – Crown specific High Density Residential (overlying a basement); and
- **Scenario 14** – Crown specific Multistorey Commercial elevated Slab on Grade (with advection): which is applicable to those parts of the proposed Crown podium that will not be constructed over the proposed Stage 1C Basement.

Table 3 below summarises the land use scenarios and assumptions as discussed in the *ORWN HHERA* (AECOM, 2014).

Table 3 Summary of Land Use Scenarios Considered in the *ORWN HHERA* (AECOM, 2014)

Scenario Number	Name and Description	Most Sensitive Human Receptor	General Assumptions
1	Lower Basement Generic lower-most basement car park level (below water table), with groundwater seepage through walls and floor (i.e. groundwater may be present at inner surface of outer wall and on floor surface).	Adult Worker. Exposed up to 8 hr/day, 240 days/year, for 30 years. Child Resident. Exposure is considered to occur up to 1 hour per day (while en route to and from car), 365 days/year, for 70 years.	Conservative scenario to assess risk if water seeps all the way through walls and floor of lower most basement level. Small layer of groundwater is assumed to be permanently present on some sections of the walls and floor. Specifically up to 50% of the total of 2,950m ² area of two walls and the floor (equalling 1,475m ²) is assumed to be wet and to act as continuous vapour source. This is considered to be a conservative assumption. Advective flow of vapours is assumed to be negligible (airflow through saturated zone cannot occur due to zero air filled porosity). The air exchange rate within the basement car park has been assumed to be an average of 3.5 air exchanges per hour. This air exchange rate is based on the proposed approach to the basement car park ventilation for the Stage 1C Basement. It is understood that it is consistent with the Australian Standard AS 1668.2 and accounts for periods of decreased ventilation when vehicle movement in the basement is minimal.

Scenario Number	Name and Description	Most Sensitive Human Receptor	General Assumptions
6	Intrusive Maintenance – potential contact with groundwater Generic short term intrusive maintenance scenario, e.g. for maintenance of utility services.	Adult worker. 8 hrs/day, 15 days/year for 1 year. Direct contact with groundwater contact may occur due to shallow water – no more than 1 hour per day. Vapour may be derived from pooled groundwater or from exposed soils in trench.	Post development, short term maintenance work may be required. Assumed not to exceed 3 working weeks per year by same worker.
9	Crown specific Upper Basement Upper-most Crown basement car park level, partially above water table. May be used for loading/unloading, or have full time car park attendant present.	Adult Worker. Exposed up to 8 hr/day, 240 days/year, for 30 years.	Upper 3m of walls may have soil directly adjacent to 2 of the 4 walls as a source of vapour. Lower 2 m of 2 of the 4 walls may have water seepage. It has been conservatively assumed that 100m ² of the two walls will be covered in water seepage (50% of the total wall area). Advective vapour flow considered possible through unsaturated soils (upper 3 m). The air exchange rate within the basement car park has been assumed to be an average of 3.5 air exchanges per hour. This air exchange rate is based on the proposed approach to the basement car park ventilation for the Stage 1C Basement. It is understood that it is consistent with the Australian Standard AS 1668.2 and accounts for periods of decreased ventilation when vehicle movement in the basement is minimal (AECOM, 2012h).
10	Crown specific Unpaved Recreation Public open area with no concrete/hardstand paving, but 100 cm of clean fill at surface.	Adult and Child Recreational Users. Assumed to be exposed 2 hr/day, 365 days/year, for 70 years.	Open Space with no Concrete Surface Covering. Assume that areas are landscaped with at least 1.0 m of Suitable Fill overlying contaminated soil. Assume that there is significant oxygen movement through the top 1 m of soil based on the oxygen measurements collected during the soil gas sampling. Groundwater depth assumed to be 3 m bgl (where the ground level refers to the finished ground level that will be 1 m above the existing ground level).

Scenario Number	Name and Description	Most Sensitive Human Receptor	General Assumptions
11	Crown specific Paved Recreation Public open area with concrete/hardstand paving. It has been assumed that paved recreation areas will also be covered in a 1.0 m thick layer of clean fill to accommodate changes in paved and unpaved recreation areas that might occur in the future.	Adult and Child Recreational Users. Assumed to be exposed 2 hr/day, 365 days/year, for 70 years.	Open Space with Concrete surface covering. Assume that areas have at least 1.0 m of Suitable Fill immediately below the concrete surface covering and overlying contaminated soil. Assume that there is significant oxygen movement through the top 1 m of the soil based on the oxygen measurements collected during the soil gas sampling. Concrete assumed to be minimum 10 cm thick and to have a crack fraction of 0.001 (to account for higher cracking possible in surface covering). Groundwater depth assumed to be 3 m bgl (where the ground level refers to the finished ground level that will be 1 m above the existing ground level).
12	Crown Intrusive Maintenance – no potential contact with groundwater Short term intrusive maintenance scenario, e.g. for maintenance of utility services.	Adult worker. 8 hrs/day, 15 days/year for 1 year.	Post development, short term maintenance work may be required. Assumed not to exceed 3 working weeks per year by same worker. Assume that at least 1.0 m of Suitable Fill overlying contaminated soil. Assume the depth of trench is limited to 2 m bgl and therefore will not intersect groundwater based on the finished ground level being 1 m above the existing ground level.
13	Crown specific High Density Residential High density residential overlying a basement carpark. It is possible that the hotel development may include high density residential.	Adult or Child Resident. Assumed to be exposed 24 hrs/day, 365 days/year, for 70 years. Scenario is also considered to be protective of hotel residents and workers in the hotel.	The air exchange rate within the basement car park has been assumed to be an average of 3.5 air exchanges per hour. This air exchange rate is based on the proposed approach to the basement car park ventilation for the Stage 1C Basement. It is understood that it is consistent with the Australian Standard AS 1668.2 and accounts for periods of decreased ventilation when vehicle movement in the basement is minimal. Assumes that vapours which enter the upper level basement are uniformly mixed and 1/10 of the concentration migrates to the overlying residential property on the ground floor. The assumptions adopted for Scenario 9 are applicable for this scenario. This scenario would be protective of residential receptors in higher than ground floor premises, where vapour concentrations would be expected to be further diluted than if only mixed within one overlying residential level.

Scenario Number	Name and Description	Most Sensitive Human Receptor	General Assumptions
14	Crown specific Commercial Multistorey Slab on Ground (with Advection) Multi-storey commercial / hotel development with slab on grade construction.	Adult commercial worker. Exposed up to 8 hr/day, 240 days/year, for 30 years. Scenario also protective of child who may visit premises on a less frequent basis.	Assumes typical multi-storey commercial premises with elevated slab on grade construction. Assumes 5 Air exchanges per hour. This air exchange rate is based on the proposed approach to the ventilation for the Crown Hotel Development podium. Advection driven vapour exposure is considered to be the dominant exposure pathway. Assume that at least 1.0 m of Suitable Fill overlying contaminated soil.

7.2.2 Derivation of SSTCs and Key Assumptions

The SSTC for soil and groundwater derived in the *ORWN HHERA* (AECOM, 2014) were developed to provide human health risk-based concentrations that can be used as remediation criteria applicable to areas of the Site based on the proposed land uses. That is, if all CoPC concentrations in samples are below the applicable SSTC, then further assessment of the health risks would not be warranted.

Further details of how the SSTC have been derived are provided in the *ORWN HHERA* (AECOM, 2014).

The assumptions used in the derivation of the soil and groundwater SSTCs are detailed in Section 1.3 and Section 5.3.4 of the *ORWN HHERA* (AECOM, 2014). The key assumptions are summarised following.

Soil and Groundwater:

- The SSTC were developed based on the Site conditions and chemicals of potential concern (CoPC) detected during the Site investigations detailed within this report;
- The SSTC were based on the proposed development concepts and design assumptions provided by Crown (and Lend Lease) at the time of completion of the *ORWN HHERA* (AECOM, 2014);
- Future car-parking basements, if present, will include engineering controls to ensure that contaminated groundwater does not accumulate in the publically accessible car park areas. Further information relating to the potential development design is contained within **Section 4.2**;
- The development of SSTCs did not consider the presence of tar, which is required by policy of the EPA (NSW DEC, 2007) to be removed from the Site to the extent practicable. As such, the *ORWN HHERA* (AECOM, 2014) assumed that tar will not be present in the immediate vicinity of outer basement walls to the extent practicable, and that basement design and engineering controls as described within this document will ensure that tar seepage into basements does not occur;
- There are significant biodegradation processes occurring within sub-surface soils based on measured oxygen concentrations beneath the sub-surface. To account for these biodegradation processes, a 10-fold factor (Davis, 2009) has been adopted in the derivation of SSTC for soils in paved and unpaved areas of the Site, where biodegradation processes are considered to be significant;
- The development of SSTCs has accounted for the presence of mixtures of chemicals at the Site within the same media. In particular, risks associated with mixtures of chemicals have been modelled by applying proportional risks as follows: BTEX (HI 0.25 each), PAH (HI 0.2), TPH (HI 0.25 total for aliphatic and aromatic per fraction), all other chemicals HI = 1;
- The lower and upper basements have been modelled using a water seepage model adopted from Water 9 (USEPA, 1994).
- Chemicals are assumed to be volatile if Henry's Law constant is greater than 1×10^{-5} atm-m³/mole (USEPA, 2004) and vapour pressure greater than 1mmHg at room temperature (NEPC 2013).

- The development of SSTCs for Crown unpaved areas has assumed that Suitable Fill will be present at the surface at these locations. In particular, a 1.0 m thick layer of Suitable Fill has been assumed for Scenario 10. For the purpose of this definition 'Suitable Fill' is defined as:
 - Virgin excavated natural material (VENM);
 - Soil which contains contaminant concentrations below the TSC (developed for the maintenance of plant health and human health); and
 - Soil which is visually free of bonded ACM (refer to **Section 7.2.3**).
- For Crown paved open space (Scenario 11) it has been assumed that at least 1.0 m of Suitable Fill will be placed directly underneath paved areas. For the purpose of this definition, 'Suitable Fill' is defined as for unpaved areas (see above).
- For Crown specific Commercial Multistorey Slab on Ground (with Advection) (Scenario 14) it has been assumed that at least 1.0 m of Suitable Fill will be placed directly underneath the floor slab. For the purpose of this definition, 'Suitable Fill' is defined as for unpaved areas (see above).
- The current theoretical estimation of vapour concentrations within indoor and outdoor air is based on partitioning modelling which has been demonstrated to overestimate concentrations between 10-1,000 fold. To account for this conservatism, an adjustment factor of 10 has been applied to all modelled soil results for benzene, toluene, ethylbenzene and xylenes (BTEX), Total Petroleum Hydrocarbons (TPH) C₆-C₉ and C₁₀-C₁₆; and
- The remedial works described by the *VMP/Block 4 RAP* (AECOM, 2013c) are completed. Based on the *VMP Remediation Extent* report (AECOM, 2013d), if the remediation works described by the *VMP/Block 4 RAP* (AECOM, 2013c) are completed, it is considered that any residual gasworks contamination that might remain *in situ* within the Site will not represent an unacceptable risk to the environment. Further discussion on addressing the risk to the environment is provided in **Section 7.4**.

Future Intended Basement Construction:

Based on proposed design plans provided by Crown (refer to **Appendix C**) the basement to be constructed as part of the proposed Crown Hotel Development is assumed to:

- Extend over a footprint equal to or greater than the footprint of the proposed hotel tower;
- Extend to a depth below the groundwater table (that is will be constructed within both the saturated and unsaturated soil); and
- Be constructed with a basement groundwater retention wall system that will extend around the perimeter of that part of the Site that will be occupied by the basement and will be designed to prevent groundwater from migrating from within the basement footprint.

Based on the proposed Crown design plans, the following assumed performance specification for the proposed Stage 1c Basement has been adopted (for Scenarios 9 and 13):

- Outer basement walls are anticipated to comprise 800 mm to 1200 mm thick reinforced concrete diaphragm walls. It should be noted that the risk assessment has conservatively assumed basement walls and floor construction to be approximately 150 mm thick.
- The concrete walls are of sufficient strength/density to prevent tar seepage into the concrete.
- A physical barrier will be constructed inside the basement to prevent dermal contact with any groundwater seepage water within the basement in the unlikely event that groundwater seepage occurs.
- A drainage system will be provided that prevents the accumulation of groundwater seepage that may occur through the basement wall by draining water away from the wall.
- The lowermost basement floor will be in contact with groundwater, but the basement will have water collection devices and engineering controls, such as damp proof barriers to minimise the potential of groundwater wetting the lower basement floor or walls.
- The smallest occupiable basement dimension that will be independently ventilated and accessible to general building users is an area of 2,500 m² based on a dimension of (50 m x 50 m).

- Where basement walls are exposed to groundwater, it is assumed that groundwater will seep through an area equivalent to half of 2 (out of the total 4) basement walls. In the lower basement, it is assumed that in addition to the walls, groundwater will also seep through half of the basement floor footprint.
- The basement will be mechanically vented in accordance with *Australian Standard AS 1668.2* (Standards Australia, 2002).
- In accordance with *Australian Standard AS1668.2* (Standards Australia, 2002), the basement levels will be maintained at a lower pressure than the overlying occupied areas.
- The air exchange rate within the basement car park has been assumed to be an average of 3.5 air exchanges per hour. This air exchange rate is based on the proposed approach to the basement car park ventilation for the future intended Crown Basement. It is understood that it is consistent with the Australian Standard AS 1668.2 and accounts for periods of decreased ventilation when vehicle movement in the basement is minimal.
- The hydraulic conductivity of the basement walls has been calculated based on the proposed Crown performance specification for the Stage 1C Basement which requires that groundwater ingress not exceed 0.75 L/min across the entire basement wall area. The hydraulic conductivity of the concrete is required to determine the potential volume of water which can physically move through the basement walls into the basement for use in the USEPA Water Model. The hydraulic conductivity was calculated, based on Darcy's Law which considers flow through porous media, to be 2.04×10^{-5} m/day.
- For Scenario 14 (Crown Commercial with advection), the air exchange rate will be at least 5 air changes per hour, which is greater than that typically assumed for a generic commercial building (2 air changes per hour). Refer to Appendix JJ of the *ORWN HHERA* (AECOM, 2014).

SSTC for soils remaining below the Stage 1C Works Area (Area C) are not applicable because the basement will extend below the groundwater table and there is no complete exposure pathway for humans with saturated soils. Therefore potential risk to human health has been assessed based on the derivation of groundwater SSTC only. Similarly, in the area outside the Stage 1C Works Area (Area A), the potential risk to human health from saturated soils has been assessed based on derivation of groundwater SSTCs only.

7.2.3 Asbestos SSTCs

As described by the *ORWS Asbestos HHERA* (AECOM, 2013a), asbestos reported to be present in soils within the ORWS Area is predominately bonded ACM and the potential for asbestos fibre (AF) generation is considered to be minimal.

It has been assumed that asbestos which may be present within the ORWN Area is likely to be similar – that is predominantly bonded ACM.

The asbestos SSTCs adopted by the *ORWN HHERA* (AECOM, 2014) are summarised by **Table 4** below. The asbestos SSTCs are to be applied in addition to other applicable SSTCs and Terrestrial Soil Criteria (TSC), in the case of Suitable Fill, that have also been developed in the *ORWN HHERA* (AECOM, 2014).

Table 4 Summary of Asbestos SSTC

Exposure Scenario	Asbestos Site Specific Target Criteria
Intrusive Maintenance Worker ²	0.05 % w/w ¹
Suitable Fill ³	No Visible Asbestos

Notes:

- 1) To be measured in accordance with the methodology described by Schedule B2 of the *NEPM* (NEPC, 2013);
- 2) The intrusive maintenance worker exposure scenario is applicable to soil in areas used for Crown paved recreation, Crown unpaved recreation and Crown commercial slab on grade construction (i.e. the terrace and podium areas) either with or without contact with groundwater (i.e. Scenario 6 or 12) at depths:
 - a) below the 1.0 m thick Suitable Fill;
 - b) up to approximately 3.0 m below the final development level (which is understood will be at least 1 m above the current ground surface, refer to **Figure F2** below); and
 - c) above the groundwater table.
- 3) **Section 7.5** of this RAP requires 'Suitable Fill' of 1.0 metres to be placed in open space areas. As described by **Section 7.2.2** of this RAP, all Suitable Fill will be imported to the Site. Therefore, the same SSTC has been applied to the entire thickness of Suitable Fill.

The asbestos SSTCs detailed above will be applicable to those parts of the Site outside the Stage 1C Works Area where either:

- an intrusive maintenance worker may be exposed to bonded ACM in soil as part of future maintenance works associated with the completed development (i.e. the Area A unsaturated soil); or
- a recreational user of the completed Crown development may be exposed to bonded ACM in surface soils (specifically Suitable Fill placed in the top 1.0 m bgs) in areas used for Crown unpaved recreation.

7.3 Remediation Criteria for the Protection of Human Health

7.3.1 Derivation of Remediation Criteria

The SSTCs that are applicable to the proposed landuse scenarios are presented in **Table 5** below. The SSTCs have been selected in terms of two Areas, which share common proposed land uses (as illustrated in **Figure 1, Section 1.4**):

- **Area A** – material to remain *in situ* outside the Stage 1C Works Area and potentially in hydraulic connection with Darling Harbour, where limited or no excavation will be required; and
- **Area C** – materials to remain *in situ* below the Stage 1C Works Area and within the basement groundwater retention wall system and without hydraulic connection with Darling Harbour.

For land use scenarios where more than one SSTC is applicable, the lowest (i.e. most conservative) SSTC has been adopted to appropriately assess soil and groundwater quality in the applicable Site areas (refer to **Table 5** below). The SSTCs applied to the two Site areas (i.e. Area A or Area C) (as illustrated in **Figure 1, Section 1.0**) are described in **Table 5** below and the hybrid Remediation Criteria are detailed in **Table T1** and **T2** (that is where more than one SSTC is applicable, the lowest SSTC has been adopted for each CoPC).

As described by **Section 1.4**, material from Area B is unlikely to be reused at the Site. Notwithstanding, soil SSTC-B are presented in **Table T1** to provide acceptance criteria that are applicable to:

- the (unlikely) event that some of the excavated material is considered suitable for reuse on Site; and
- the import of fill to the Site (refer to **Section 15.0**).

As described by **Table 5**, the soil SSTC-B are based on the lowest (i.e. most conservative) SSTC derived for the applicable exposure scenarios. If the reuse of Area B material is required, it will be described in an Addendum to this RAP and submitted to the NSW EPA Accredited Site Auditor for approval.

Table 5 Landuse and Applicable SSTCs

Area	Proposed Land Use	Applicable SSTCs
Area A (outside Stage 1C Works Area)	Podium and Terrace Area, Limited or No Excavation Area outside the basement groundwater retention wall system and in hydraulic connection with the Harbour	Soil SSTC-A: SSTC for Scenario 6 –Intrusive Maintenance Worker³ SSTC for Scenario 9 – Crown Upper Basement SSTC for Scenario 10 - Crown Paved Recreation^{1, 2} SSTC for Scenario 11 - Crown Unpaved Recreation^{1, 2} SSTC for Scenario 12 – Crown Intrusive Maintenance Worker³ SSTC for Scenario 13 – Crown High Density Residential (overlying a basement) SSTC for Scenario 14 – Crown Multistorey Commercial elevated slab on grade (with advection) Groundwater SSTC-A: - SSTC for Scenario 1 - Lower Basement - SSTC for Scenario 6 –Intrusive Maintenance Worker - SSTC for Scenario 9 – Crown Upper Basement - SSTC for Scenario 10 - Crown Unpaved Recreation - SSTC for Scenario 11 - Crown Paved Recreation - SSTC for Scenario 12 - Crown Intrusive Maintenance Worker - SSTC for Scenario 13 - Crown High Density Residential (overlying a basement) - SSTC for Scenario 14 - Crown Multistorey Commercial elevated slab on grade (with advection)
Area B (excavated soils from Stage 1C Works Area potentially reused as unsaturated soil in Area A) – if required NB - Material from Area B is unlikely to be reused at the Site.	Unsaturated soil reused below 1.0m of Suitable Fill in the Podium and Terrace Area outside the basement groundwater retention wall system	Soil SSTC-B: - SSTC for Scenario 6 –Intrusive Maintenance Worker³ - SSTC for Scenario 9 – Crown Upper Basement - SSTC for Scenario 10 - Crown Paved Recreation^{1, 2} - SSTC for Scenario 11 - Crown Unpaved Recreation^{1, 2} - SSTC for Scenario 12 – Crown Intrusive Maintenance Worker³ - SSTC for Scenario 13 – Crown High Density Residential (overlying a basement) - SSTC for Scenario 14 – Crown Multistorey Commercial elevated slab on grade (with advection)
Area C (beneath Stage 1C Works Area)	Development Area - <i>in situ</i> material below the Stage 1C Basement – hotel, commercial and high density residential with basements	Groundwater SSTC-C: - SSTC for Scenario 1 - Lower Basement - SSTC for Scenario 9 – Crown Upper Basement - SSTC for Scenario 13 – Crown High Density Residential (overlying a basement)

Notes: ¹ asbestos SSTC will also apply for unpaved and paved recreation scenarios in Area A (refer to **Section 7.2.3**).

² the Terrestrial Soil Criteria will also apply to landscaped areas in Area A (refer to **Section 7.5**)

³ asbestos SSTC will also apply for intrusive maintenance workers in Area A (refer to **Section 7.2.3**).

7.3.2 Summary of Remediation Criteria

The soil and groundwater SSTCs derived from the *ORWN HHERA* (AECOM, 2014) are detailed in **Table T1** and **T2, Appendix A**.

To assess whether soil or groundwater CoPC concentrations at the Site are representative of CIM and would warrant remediation, the soil and groundwater analytical data from the Site is compared to the relevant SSTCs in **Appendix A** as follows:

- **Table T3:** Area A – Soil Analytical Results – Unsaturated;
- **Table T4:** Area A – Soil Analytical Results – Saturated;
- **Table T6:** Area C - Soil Analytical Results (below 12 m bgl);
- **Table T7:** Site wide Asbestos Analytical Results;
- **Table T8:** Groundwater Analytical Results (2010-11); and
- **Table T9:** Historic Groundwater Analytical Results (pre 2010).

The soil and groundwater analytical data from Area A and Area C and an assessment of whether or not they are representative of CIM is provided in **Section 8.1** to **Section 8.3**.

7.3.3 Remediation Goals

The remediation goals for the protection of human health, as recommended by the *ORWN HHERA* (AECOM, 2014) are:

- As a primary goal, removal / remediation of SPGWT (as defined in **Section 6.6.1**) to the extent practicable; and
- As a secondary goal, removal / remediation, to the extent practicable, of Confirmed Impacted Material (CIM), which is defined as:
 - Unsaturated soil concentrations exceeding the soil SSTCs; and
 - Unsaturated and saturated soil concentrations that are considered to be the source of groundwater concentrations exceeding the groundwater SSTCs.

The process for assessing the extent of remediation (if required) based on the identification of SPGWT and CIM is summarised in the following sections.

The outcomes of this process are documented in **Section 8.1** and **8.3**.

7.4 Remediation Criteria for Protection of the Environment

As detailed in Section 7.11 of the *ORWN HHERA* (AECOM, 2014), the *VMP Remediation Extent* report (AECOM, 2013d) considers that if the *VMP/Block 4 RAP* (AECOM, 2013c) is implemented, residual gasworks related contamination remaining *in situ* down hydraulic gradient of the Declaration Area (including the Site) will not represent an unacceptable risk to the environment.

The *ORWN HHERA* (AECOM, 2014) also considered that non-gasworks related CoPC (namely copper, zinc, cobalt and cadmium) would not present an unacceptable risk to the environment. This conclusion was based on the following considerations:

- The concentrations of the non-gasworks related CoPC relative to the adopted marine water quality criteria (MWQC) and the number, frequency, variability and location of those results which were reported to be greater than the MWQC (refer to **Table T12**). In particular, consideration was given to whether the reported result was representative of groundwater quality within marine sediments (from which it has been demonstrated there is negligible contaminant flux).
- The proposed remedial strategy presented within the *VMP Remediation Extent* report (AECOM, 2013d) and *VMP/Block 4 RAP* (AECOM, 2013c) includes: (a) historical infrastructure source removal; and, (b) removal of secondary sources of contamination, such as Separated Phase Gasworks Waste and Tar (SPGWT), which are both up-gradient sources of contamination on the Site.

- The groundwater retention wall system to be constructed as part of the proposed Block 4 Development Works will effectively cut off groundwater movement from up-gradient sources to the Site. It is considered that the up-gradient sources are a significant contributor to the groundwater quality within those wells screened within the fill materials.
- The proposed Stage 1C Works (on the Site) will incorporate a Stage 1 C perimeter groundwater retention wall system, similar to that proposed as part of the Block 4 Development Works. The groundwater retention wall system will reduce groundwater migration and potential contaminant flux from that area of the Site in which the basement is constructed.
- Results of the *Groundwater Discharge Study* (GDS) (AECOM, 2010c), which concludes that there is a five-fold mixing and dilution of groundwater within the unconfined aquifer prior to discharge through the tidal prism to Darling Harbour. The current Ecological Risk Assessment (refer to Section 7.0 of the *ORWN HHERA* (AECOM, 2014)) has not adjusted the groundwater concentrations to reflect dilution, and therefore it is considered that concentrations reported within groundwater at the Site will undergo additional dilution prior to discharge to the nearest environmental receptor, Darling Harbour.
- Additional remediation works (as might be required to achieve a greater degree of environment protection), would be impracticable, cost prohibitive and inconsistent with the principles of Ecologically Sustainable Development (ESD). That is, the net cost to the environment of undertaking the additional works would be greater than the environment benefit realised from the additional work at the Site (AECOM, 2013d).

Based on the above multiple lines of evidence, the *ORWN HHERA* (AECOM, 2014) concluded that residual metals contamination reported within groundwater wells screened with the fill materials will not pose a risk to the environment and that the quality of groundwater in fill within the Site will improve over time following the proposed remedial works in the Declaration Area and Block 4. It is therefore considered that the risks to identified environmental receptors at the Site are low and acceptable. Based on these conclusions, risk to the environment is not considered any further in this RAP while the focus of any required remediation works is focussed on the appropriate protection of human health.

7.5 Terrestrial Soil Criteria (Protection of Future Plantings)

The *ORWN HHERA* (AECOM, 2014) assumes that areas of the Site to be used for Crown unpaved recreation land uses will be covered in a minimum of 1.0 m of Suitable Fill. The potential for phytotoxicity to trees and other vegetation planted within the suitable soil cover as part of the future development was addressed by:

- derivation of Terrestrial Soil Criteria (TSC) that will both maintain soil and plant health and be protective of human health under the proposed land use; and
- increasing the depth of suitable soil in specific areas as required to accommodate the current and future potential planting of different species and sizes at the Site.

TSC were developed in the *Declaration Site HHERA* (AECOM, 2011b) and adopted by the *ORWN HHERA* (AECOM, 2014) to define material that is appropriate for use as Suitable Fill placed in the upper 1.0 m of areas of the Site to be used for Crown unpaved recreation land use.

The TSC are detailed in **Table T12, Appendix A**.

7.6 Potential Reuse of Excavated Material

As discussed in **Section 1.4**, it is understood that it is unlikely that Crown will reuse material excavated for construction of the Stage 1C Basement as part of the hotel development (i.e. to raise site levels beneath the Podium and Terrace Area).

The potential for Resource Recovery Exemptions may be considered in accordance with *Guidelines on Resource Recovery Exemptions (Land Application)* (DECC, 2008).

8.0 Extent of Remediation

The results of soil and groundwater samples analysed as part of previous intrusive investigations within the Site are presented in **Tables T3 to T9** in **Appendix A** and compared against the applicable SSTCs (refer to **Section 7.0**). A summary of this comparison is provided in the following sections in the context of the following areas:

- **Area A** - material to remain *in situ* outside the Stage 1C groundwater retention wall system and potentially in hydraulic connection with the Harbour;
- **Area B** – materials to be excavated from the Stage 1C Works Area; and
- **Area C** - material to remain *in situ* below the Stage 1C Works Area without hydraulic connection with the Harbour.

As described by **Section 1.4**, material from Area B is unlikely to be reused at the Site. If this alternative is required, it will be described in an Addendum to this RAP and submitted to the NSW EPA Accredited Site Auditor for approval.

The borehole and groundwater monitoring well locations are presented on **Figure F5**. The localised area where SPGWT has been identified at the Site (at MW60, refer to **Section 8.3.1**) is presented in **Figure F6**.

The summary tables presented in **Appendix A** are as follows:

- **Table T1:** Soil Remediation Criteria
- **Table T2:** Groundwater Remediation Criteria
- **Table T3:** Area A - Soil Analytical Results - Unsaturated
- **Table T4:** Area A - Soil Analytical Results – Saturated
- **Table T5:** Area B - Soil Analytical Results (above 12 m bgl)
- **Table T6:** Area C - Soil Analytical Results (below 12 m bgl)
- **Table T7:** Site wide Asbestos Analytical Results
- **Table T8:** Groundwater Analytical Results (2010-11)
- **Table T9:** Historic Groundwater Analytical Results (pre 2010)
- **Table T10:** Summary of Field Observations of Gasworks Related Impacts
- **Table T11:** Terrestrial Soil Criteria
- **Table T12:** Marine Water Quality Criteria

It is noted that due to the size of the Site and the fact that a number of the existing monitoring wells are located close to both Area A and C (i.e. in proximity to the Stage 1C Works Area), all groundwater monitoring results from the Site have been compared to both the groundwater SSTC-A and SSTC-C. Consequently, the lowest of the groundwater SSTC-A and SSTC-C have been conservatively adopted for the purpose of assessing CoPC concentrations in **Table T8** and **T9**.

8.1 Area A - Materials to Remain *In Situ*

8.1.1 Separate Phase Gasworks Waste and Tar

SPGWT was not identified in Area A by the previous investigations (refer to **Figure F6**).

8.1.2 Unsaturated Soil Analytical Results

The presence of CIM in the Area A unsaturated soils was assessed using soil analytical data from boreholes drilled as part of the previous investigations (refer to **Table T3**) and including some boreholes located near the Area A boundary which are likely to be representative of CoPC concentrations on the Area A boundary (i.e. BH39, BH17, BH116 and BH143, refer to **Figure F5**).

All CoPC concentrations were reported to be less than the relevant soil SSTC-A. In addition, key CoPC (including BTEX, TPH, PAHs and phenols) were generally reported at concentrations below the laboratory limit of reporting (LOR).

Asbestos was not analysed in samples from the Area A unsaturated soils (refer to **Table T7**). As described by **Section 6.6.1**, ACM was identified to be widespread within excavated material within the ORWS Area (AECOM, 2013d) therefore it is assumed that there is significant potential for bonded ACM to be present within fill materials within Area A.

8.1.3 Saturated Soil Analytical Results

The analytical data from soil samples considered to be representative of Area A saturated soils are detailed in **Table T4**. As discussed in **Section 7.2.2**, soil SSTCs have not been derived for saturated soils. Therefore, the assessment of whether CIM is present within saturated soils in Area A is based on comparison of groundwater CoPC concentrations to the relevant groundwater SSTC-A (refer to **Section 8.1.4**).

Asbestos was not analysed in samples from the Area A saturated soils (refer to **Table T7**).

8.1.4 Groundwater Analytical Results

The results for groundwater monitoring events within Area A between 2006 and 2013 are presented in **Table T8** and **Table T9**. The groundwater monitoring wells considered representative of Area A are IT01, MW24, MW40, MW212, MW410/IT04, MW411/IT05 and MW544. All CoPC concentrations were reported to be less than the groundwater SSTC-A in these wells.

8.1.5 Area A – Identification of CIM

The results of the soil and groundwater analytical results within Area A, as discussed in **Section 8.1.1** to **8.1.4**, were all less than the soil and groundwater SSTC-A. As such, no CIM warranting remediation was identified within Area A.

8.1.6 Area A – Extent of Remediation

Based on the available data within Area A, CIM has not been identified in Area A. However, only limited soil analytical results are available for soil in the unsaturated zone. Therefore, additional validation sampling of the soils in the unsaturated zone of Area A should be conducted to ensure the sampling density is sufficient to appropriately characterise this material (refer to **Section 16.4.1**).

Based on the findings of this additional validation sampling, an assessment of whether CIM is present within Area A unsaturated soils will be undertaken in consultation with the NSW EPA Accredited Site Auditor. If required, remediation and subsequent validation works will be undertaken in the Area A unsaturated soil to make it suitable for the currently permissible and/or future intended landuses.

8.2 Area B – Materials to be Excavated During Stage 1C Basement Excavation Works

As described by **Section 1.4**, material from Area B is unlikely to be reused at the Site. Therefore, comparison of soil analytical data has been made to the NSW EPA (2014) *Waste Classification Guidelines* to provide an indication of the potential classification of materials to be disposed of to landfill.

8.2.1 Tar Containing Material

SPGWT was not identified within Area B by the previous investigations (refer to **Figure F6**).

8.2.2 Soil Analytical Results

Soil analytical data from samples collected to a depth of up to 12 m bgl from boreholes drilled as part of the previous investigations (refer to **Table T5**) was compared to the NSW EPA (2014) *Waste Classification Guidelines* to provide an indication of the potential classification of materials to be disposed of to landfill. The depth of 12 m bgl is slightly greater than the proposed approximate depth of the excavation proposed in the Stage 1C Works Area (refer to **Section 4.2**) but is considered appropriate to assess those materials which are likely to be in proximity to the base of the excavation.

The Area B results indicate that the material is variably impacted with low level TPH and PAH concentrations and BTEX concentrations are generally non-detect.

Asbestos (amosite) was detected in one soil sample collected from sampling location BH47_10.0-10.2 (refer to **Table T7**). Based on the proposed Stage 1C Works excavation depth of approximately 11.45 m bgl, this material will be removed during the Area B bulk excavation works and subsequently will require management.

It is noted that asbestos analysis conducted in Area B did not include the gravimetric assessment of bonded ACM (per Schedule B2 of the *NEPM* [NEPC, 2013]) as required for comparison against the SSTC-A for asbestos.

8.2.3 Area B – Preliminary Waste Classification

Based on the Area B soil results discussed above, asbestos was detected in the soils at sampling location BH47. Data collected during excavation of the Stage 1A (located offsite to the south) basement indicates that there is a significant potential for asbestos to be present in the Area B materials. Consequently, it is considered probable that asbestos will also be encountered during the Stage 1C Works and the majority of the Area B will be classified as Special Waste (containing asbestos).

Based on total CoPC concentrations (only) and excluding the potential presence of asbestos, it is likely that the majority of the Area B material would be classified as General Solid Waste in accordance with the NSW EPA (2014) *Waste Classification Guidelines*. Based on the available analytical data, the only exceptions to this are likely to be:

- The material in the vicinity of BH191 which is likely to be classified as Restricted Solid Waste based on a benzo(a)pyrene concentration of 12.6 mg/kg (3.7 m depth); and
- SPGWT that may be recovered during construction of the basement groundwater retention wall system, particularly where the wall extends into marine sediments where SPGWT has been inferred to be present (for example in the vicinity of BH48, BH60 and BH406, refer to **Figure F6**).

Additional sample analysis will be required to fully characterise the Area B material to be excavated as part of the Stage 1C Works for landfill disposal. Due to the likely space restrictions on the Site during the proposed Stage 1C Works and to avoid the requirement for stockpiling, it is considered likely that the additional waste classification required to confirm these preliminary waste classifications in accordance with the NSW EPA (2014) *Waste Classification Guidelines* would be undertaken *in situ*.

Given that these waste classification works relate to the Area B material being removed from the Site for landfill disposal and do not affect the future proposed land uses, these additional works are not discussed further herein.

8.3 Area C - Materials to Remain *In Situ* below the Stage 1C Basement

8.3.1 Separate Phase Gasworks Waste and Tar

SPGWT was observed, based on visual observations (including 'black lumps of tar with a strong tar odour'), during the previous investigations to be present at MW60 (refer to **Figure F6**). These impacts were observed at depths ranging between 16 and 17.5 m bgl within the natural marine sediments. It is noted that soil samples collected from the discussed depths reported benzo(a)pyrene and PAH concentrations which are less than the TCM criteria detailed in **Section 6.6.1**. The field observations and soil analytical results for nearby sampling locations (BH72 and BH191) indicate that the SPGWT observed at MW60 is relatively localised.

8.3.2 Saturated Soil Analytical Results

The analytical results from soil samples considered to be representative of Area C are presented in **Table T6**. Only soil samples collected from a depth of greater than 12 m bgl (which corresponds with the approximate depth of the excavation in the Stage 1C Works Area) are presented. As described by **Section 7.2.2**, soil SSTC have not been derived for saturated soils. Therefore, the assessment of whether CIM is present within saturated soils in Area C is based on comparison of groundwater CoPC concentrations to the relevant groundwater SSTC-C (refer to **Section 8.3.3**).

Asbestos was not detected in the Area C saturated soils (specifically soil sample BH48 11.5-11.7, refer to **Table T7**).

8.3.3 Groundwater Analytical Results

The results for groundwater monitoring events within Area C between 2006 and 2013 are presented in **Table T8** and **Table T9**. The groundwater monitoring wells considered representative of Area C are IT01, IT02, MW11, MW14, MW22, MW56 and MW60. All CoPC concentrations were reported to be less than the groundwater SSTC-C in these wells.

8.3.4 Area C - Identification of CIM

The result of the soil and groundwater analytical results within Area C, as discussed in **Section 8.3.2** to **8.3.3**, were all less than the soil and groundwater SSTC-C. The SPGWT reported at MW60 (as discussed in **Section 8.3.1**) is not considered to be representative of CIM that warrants remediation because:

- MW60 was screened across the base of the fill and marine sediment interface. As described by **Section 6.6.5**, there is considered to be negligible contaminant flux from the natural marine sediments into the overlying fill;
- field observations from other investigation locations within Area C indicate that the presence of SPGWT is localised to the MW60 area indicating that the reported impact is relatively localised. SPGWT was not observed in the boreholes adjacent to MW60, indicating that the reported impact is relatively localised;
- the observed SPGWT at MW60 is located approximately 4.5 m below the depth of the proposed Stage 1C Basement (refer to **Section 4.2**) and, as such, will not be in direct contact with the lower basement; and
- as discussed in **Section 4.3**, the Stage 1C Basement retention wall system will effectively isolate soil (including SPGWT) and groundwater within Area C from surrounding ground conditions and mitigate significant groundwater flows to Darling Harbour.

8.3.5 Area C – Extent of Remediation

Based on the available data, CIM has not been identified in Area C and no remediation work is likely to be required.

9.0 Remedial Technology Assessment

9.1 Introduction

As described by **Section 8.0**, CIM has not been identified within the Site based on the previous intrusive investigations undertaken within the Site and it is considered unlikely that remediation will be required. As such, a specific remedial technology assessment has not been undertaken for this RAP.

9.2 Contingency Assessment

It is possible that unexpected CIM may be identified in unsaturated soils within Area A as an outcome of the additional Area A unsaturated soils validation works recommended in **Section 16.4.1** and/or during construction works.

It is also noted that material from Area B (materials to be excavated from the Stage 1C Works Area) may require treatment prior to disposal to landfill.

Section 20.6 presents contingency actions that will be implemented in the event that:

- CIM requiring remediation is unexpectedly identified during construction works in Area A; and/or
- treatment of Area B material removed as part of the Stage 1C Basement excavation as necessary to facilitate disposal to landfill.

The selection of remedial technologies that might be implemented as part of the contingency actions described by **Section 20.6** would be based on the Remedial Technology Assessment previously presented in Section 10 of the *VMP/Block 4 RAP* (AECOM, 2013c). This approach is considered valid because the key parameters adopted for assessment of the remediation technology options are largely consistent between the *VMP/Block 4 RAP* (AECOM, 2013c) and this RAP.

10.0 Preferred Management Strategy

As described by **Section 8.0**, the soil and groundwater CoPC concentrations reported from previous intrusive investigations did not exceed the relevant soil and groundwater SSTCs derived in the *ORWN HHERA* (AECOM, 2014). Based on these intrusive investigations, remediation of the Site to facilitate the currently permissible and intended future land uses may not be required. However, it should be noted, additional validation sampling is required to confirm whether remediation of unsaturated soils that are proposed to remain *in situ* outside the Stage 1C Works Area is warranted. As an outcome of the additional validation sampling, it is possible that remediation of the unsaturated soils will be required.

Concentrations of contaminants (that do not require remediation) are present within the Site which may require specific management practices to mitigate potential risks to construction workers, the public and environment.

Based on the available information, the preferred strategy for management of soil encountered as part of the intended Crown Hotel Development Works should be focussed on:

- Excavation within the perimeter of the Stage 1C groundwater retention wall system as required by the proposed Stage 1C Remediation and Earthworks (refer to **Section 11.1**);
- Offsite disposal of excavated material to a NSW EPA licensed landfill (including treatment if required); and
- Physical containment of material remaining *in situ* below the completed excavation within the Stage 1C groundwater retention wall system.

10.1 Area A - Preferred Management Strategy

10.1.1 Strategy Summary

As discussed in **Section 8.1**, no CIM warranting remediation or management has been identified in Area A (materials to remain *in situ* outside the intended Stage 1C Works Area). However, additional Area A validation sampling is required from unsaturated soil to demonstrate whether remediation is required (refer to **Section 16.4.1**).

The intended future Crown Hotel Development design requires that the future intended finished surface level in Area A will be up to 1.6 m above the current ground level. This increase in surface level will be accomplished by placement of imported Suitable Fill. As a consequence, the potential for future intrusive maintenance workers coming into contact with Area A unsaturated fill materials will be minimised. In particular (as described by **Section 4.1**):

- Minor below ground services will be constructed within Area A typically in the imported Suitable Fill to be placed above the existing ground surface level; and
- Major services between Stage 1A and Stage 1C will be routed via the Stage 1B basement;

Therefore, what limited excavation may be required within Area A as part of the future land use is likely to require be predominantly completed within the imported suitable fill and is unlikely to require penetration into the underlying fill materials.

Based on the assumption that only minor excavation works will be required within Area A and noting that reuse of material from Area A will not be required as part of the intended Crown Hotel Development Works, the preferred management strategy for Area A is:

- Collection of additional soil samples to adequately characterise unsaturated soil quality (refer to **Section 16.4.1**);
- If the results of the additional soil validation program confirm that the concentrations of CoPCs in the Area A unsaturated soil are:
 - less than the soil SSTC-A, no further remedial works will be required; or
 - greater than the soil SSTC-A, implementation of the contingency measures described by **Section 20.6**;
- Site establishment and preparatory works (refer to **Section 12.0**);
- Construction of the Stage 1C groundwater retention wall system (refer to **Section 4.3**);

- Excavation as required by the future intended development (likely to be small volumes only related to the installation of services in the south east corner, refer to **Section 4.1**);
- Physical separation of recyclable and oversize material, including timber, rock, concrete, steel and brick, from other material (as required to optimise landfill disposal);
- Treatment of excavated Area A material (if required) to facilitate off-site disposal to licensed landfill (refer to **Section 20.7**);
- Off-site disposal of excavated Area A material to licensed landfill, subject to classification in accordance with the NSW EPA (2014) *Waste Classification Guidelines*;
- Retention of all remaining Area A material *in situ* (i.e. predominately within the existing caisson wall and between the existing caisson wall and the Stage 1C groundwater retention wall system);
- Validation in accordance with **Section 16.4.1**;

10.1.2 Reasons for Strategy Selection

Feasibility

- Based on the available data, remediation of Area A may not be required. Notwithstanding, additional validation sampling is required to demonstrate that CIM is not present in unsaturated soils in Area A and that remediation is not required (refer to **Section 16.4.1**);
- The future intended Crown Hotel Development does not require significant excavation within Area A;
- If (limited) materials are excavated from Area A, it is considered unlikely that they will be reused as part of the proposed Crown Hotel Development;
- If required for landfill disposal, ex-situ stabilisation/solidification is likely to be the most practical, cost effective, and established remediation technology for management of the excavated material based on the type of contaminants identified in the previous investigations (refer to contingency **Section 20.6**);
- The Area A footprint will be developed for retail purposes and public open space. Excavation of this area is not necessarily required to facilitate this end land use;
- Retention of Area A material in-situ is considered the most practical and cost effective remediation technology for materials not otherwise requiring excavation as part of the development based on the type of contaminants anticipated and the risk they represent to human health and the environment; and
- Retention of material *in situ* has been successfully implemented on a number of previously remediated foreshore sites around Sydney Harbour.

Sustainability

The nominated strategy is considered a sustainable solution to management of the Area A material because:

- CIM has not been identified in this area based on the available data;
- The retention of material in-situ in conjunction with limited excavation as required by the future intended development works will:
 - minimise earthworks, materials handling, separation, dewatering and drying requirements, therefore minimising emissions from diesel operated equipment and machinery and the overall carbon footprint for the development;
 - minimise fugitive emissions and odours from handling of contaminated material, therefore minimising the risk of adverse stakeholder concerns. It will minimise the quantities of material that requires off-site disposal to landfill; and
 - appropriately manage the risks the Area A material without unnecessary and resource intensive excavation works.

10.2 Area B – Preferred Management Strategy

10.2.1 Strategy Summary

Crown has instructed that material excavated as part of the Stage 1C Works (Area B) will not be reused onsite. If reuse of Area B materials is required, an Addendum to this RAP will be prepared and submitted to the NSW EPA Accredited Site Auditor for approval.

Accordingly, the preferred remediation strategy for the Stage 1C Works Area involves ex-situ remediation works as follows:

- Site establishment and preparatory works (refer to **Section 12.0**);
- Construction of the Stage 1C groundwater retention wall system (refer to **Section 4.3**);
- Excavation of all Area B material within the perimeter of the Stage 1C groundwater retention wall system;
 - If asbestos containing material is encountered during the excavation of Area B material it will be managed in accordance with **Section 13.9**;
- Physical separation of recyclable and oversize material, including timber, rock, concrete, steel and brick, from other material (as required to optimise landfill disposal);
- Treatment of excavated Area B material (if required) to facilitate off-site disposal to licensed landfill;
- Off-site disposal of excavated Area B material to licensed landfill, subject to classification in accordance with the NSW EPA (2014) *Waste Classification Guidelines*;
- Visual inspection of the excavation base and validation (if required) as per **Section 16.4.2.1** (i.e. validation of materials to remain *in situ* below the proposed Stage 1C Works); and
- Completion of relevant basement construction elements per the *ORWN HHERA* (AECOM, 2014) as per **Section 16.3**.

10.2.2 Reasons for Strategy Selection

Feasibility

- Removal of material as part of the proposed Stage 1C Works is consistent with the proposal to excavate a basement at the Site as part of the future intended Crown Hotel Development Works or to facilitate other permissible uses;
- If required for landfill disposal, ex-situ stabilisation/solidification is likely to be the most practical, cost effective, and established remediation technology for management of the excavated material based on the type of contaminants identified in the previous investigations (refer to **Section 20.6**);
- Removal of material as part of the proposed bulk excavation works will remove significant contaminant mass from the Site and minimise future risks to human health and the environment from residual CoPC concentrations remaining within the Site.

Sustainability

The nominated option of ex-situ remediation in parallel with the intended Stage 1C Works is considered a sustainable solution due to the following considerations:

- It will utilise equipment and infrastructure already required for excavation of the Stage 1C Works, therefore minimising duplication and maximising utilisation of the required equipment;
- It maximises the opportunity for recycling and reuse of material through segregation of oversize materials, timber and steel, etc; and
- It will minimise the carbon footprint of the remediation project.

10.3 Area C – Preferred Management Strategy

10.3.1 Strategy Summary

As discussed in **Section 8.3.5**, no CIM warranting remediation or management has been identified in Area C (materials to remain *in situ* below the Stage 1C Works).

Therefore, the preferred management strategy for Area C is:

- Site establishment and preparatory works (refer to **Section 12.0**);
- Construction of the Stage 1C groundwater retention wall system (refer to **Section 4.3**);
- Excavation of Area B, overlying Area C material, and management of the excavated material as described in **Section 10.2.1**;
- Retention of all Area C material that does not require excavation as part of the Stage 1C Works *in situ* (i.e. within the Stage 1C groundwater retention wall system); and
- Validation in accordance with **Section 16.4.2**.

10.3.2 Reasons for Strategy Selection

Feasibility

- The Stage 1C Works require excavation of Area B material overlying Area C. Consequently, as discussed in **Section 10.2**, a large volume of Area B material is being removed as part of the bulk excavation works.
- The Stage 1C groundwater retention wall system will effectively contain material within it from the surrounding environment. Retention of material *in situ* within a containment structure has been successfully implemented on a number of previous remediation projects.

Sustainability

The nominated management strategy is considered a sustainable solution for management of the Area C materials because:

- CIM has not been identified in Area C which would warrant remediation;
- It will utilise equipment and infrastructure also required for the Stage 1C Works, therefore minimising duplication and maximise utilisation of the required equipment;
- It will minimise earthworks and materials handling requirements, therefore minimising emissions from diesel operated equipment and machinery; and
- It will minimise the carbon footprint of the remediation project.

10.4 Benefits of the Preferred Management Strategy

Specific benefits that will be realised by the preferred management strategy for Area A, Area B and Area C include the following.

- 1) **Removal of significant contaminant mass.** The proposed Stage 1C Works will result in removal of a significant mass of soil contamination (primarily heavy metals and PAHs) from the environment. This will include contaminated soil present below the groundwater table that has the potential to negatively impact groundwater quality leaving the site and entering Darling Harbour. Contaminated soil removed as part of the basement excavation will be managed by disposal to appropriately licenced waste facilities.
- 2) **Isolation of soil and groundwater contamination from the surrounding environment.** The proposed design includes a groundwater retention wall system that will extend to and be keyed into underlying bedrock. The Stage 1C groundwater retention wall system is expected to:
 - effectively isolate soil and groundwater contamination (heavy metals and PAHs) in material that will remain in place below the proposed car park / basement from the surrounding environment, including Darling Harbour;
 - remove the hydraulic connection between the majority of the Site (approximately 75%) and the nearest sensitive environmental receptor (Darling Harbour); and
 - Have a beneficial effect on the groundwater quality at Barangaroo South and ultimately result in an improvement in groundwater quality migrating to Darling Harbour.
- 3) **Minimise potential emissions to the environment.** The excavation methodology, as described by **Section 13.2** is based on a top down partial methodology that will realise the following benefits.

- The risk of fugitive emissions from contamination from excavation within the groundwater retention walls (potentially including asbestos, hydrocarbons and vehicle exhaust emissions) will be minimised by excavation below the future ground floor slab;
- The risk of odours from contamination within the excavation will be minimised by reducing the excavation surface area that is directly exposed to the atmosphere and, if required, use of an ECS to manage air quality released from the basement excavation;
- The excavation will not be visible to interested stakeholders (including the local community and regulatory authorities) increasing confidence that fugitive emissions and odours are being appropriately controlled; and
- Surface water runoff and rainfall will be prevented from accumulating within the excavation, minimising the requirement for dewatering and treatment prior to discharge to Darling Harbour.

11.0 Remediation Works Overview

11.1 General Works Program Overview

The following sections do not include consideration of planning requirements which are described in **Section 2.2.2**. The planning process will necessarily be concluded prior to execution of the full scale remediation works.

As described by **Section 1.4**, the proposed Crown development plans are still to be finalised and may be subject further development. Consequently, this may affect the nature of the proposed excavation works described herein and how these works are staged across the Site. Notwithstanding, the proposed land uses (that is a combination of hotel, commercial and high density residential, public open space and underground parking) will remain generally consistent with that described in this RAP.

11.2 Project Schedule

The proposed excavation works at the Site will be scheduled under the following tasks:

- Approvals process, including concept, project and development approval and Immobilisation Approval (obtained from the NSW EPA for soil stabilisation works), if required for off-site disposal of excavated to landfill (refer to **Section 13.8.9**);
- Preparation of management plans (refer to **Section 1.5**);
- Site establishment and preparatory works (refer to **Section 12.0**);
- Installation of the groundwater retention wall system (refer to **Section 4.3**);
- If required, construction of odour control structures (refer to **Appendix D**) and associated structures (if required) for the intended Stage 1C Basement excavation;
- Validation sampling to characterise Area A unsaturated soils and remediation of any CIM identified in the Area A unsaturated soils (as required, refer to **Section 16.4.1**);
- Tracking of all excavated materials in accordance with the Materials Tracking Procedure (refer to **Section 13.8.2**);
- Validation to demonstrate compliance with the requirements of this RAP;
- Reporting; and
- Decommissioning and demobilisation.

11.3 Management Works

Summary detail of the proposed remediation works to be completed is provided following:

- Validation sampling to characterise Area A unsaturated soils and remediation of any CIM (if any) identified in the Area A unsaturated soils (refer to **Section 16.4.1**);
- Installation of the Stage 1C groundwater retention wall system (refer to **Section 4.3**);
- Assessment of Area B soil to be excavated from within the Stage 1C Works Area against the NSW EPA (2014) *Waste Classification Guidelines* to facilitate *in situ* waste classification prior to commencement of excavation works. The strategy to be adopted for the *in situ* waste classification of Area B soil to be excavated will be developed in consultation with and subject to endorsement by the NSW EPA;
- Installation of the internal stabilising structures to be constructed as part of the Stage 1C groundwater retention wall system (refer to **Section 4.2**);
- If required, construction of odour control structures (refer to **Appendix D**) and associated structures (if required) for the excavation;
- Selective excavation of material as required for the Stage 1C Works in accordance with the aforementioned *in situ* waste classification. The excavation process should include, as appropriate to optimise waste

classification, physical separation of recyclable and oversize material, including timber, rock, concrete, steel and brick from contaminated material;

- Ex-situ stabilisation/solidification of excavated material, as required, to facilitate off-site disposal to landfill (subject to an Immobilisation Approval from NSW EPA);
- Off-site disposal of excavated Area B (and limited Area A) material to licensed landfill, subject to classification in accordance with the NSW EPA (2014) *Waste Classification Guidelines*;
- Tracking of all excavated materials in accordance with the Materials Tracking Procedure (refer to **Section 13.8.2**); and
- Placement of Suitable Fill to increase elevation of Area A by approximately up to 1.6 m (to an approximate RL of 3.8 m AHD) as described by **Section 10.1.1**; and
- Validation (progressive and concurrent with remediation excavation and treatment) to demonstrate compliance with the requirements of this RAP.

12.0 Site Establishment

12.1 Work to be Completed Prior to Site Establishment

12.1.1 Planning Approvals

The assessment and approvals process for the proposed management works are described by **Section 2.0**.

Approvals and licences required to facilitate the required excavation works will include:

- If required, an Immobilisation Approval from the NSW EPA, if the ex-situ treatment of soil is required prior to off-site disposal to landfill;
- A variation to the existing Environment Protection License (EPL, as required) to facilitate the proposed management works. For example:
 - Discharge of treated groundwater from the wastewater treatment system to Darling Harbour (refer to **Section 14.3**);
 - Emissions from odour control structures (if required) as part of the excavation works; and
 - If treatment of material is required - refer to **Section 20.7**.
- A Trade Waste Licence from Sydney Water for disposal to sewer (if required); and
- Consent from an appropriately licenced landfill(s) to receive waste generated by the remediation works.

12.1.2 Project Documentation

Prior to site establishment, all plans, programs, certificates and other documents necessary for the commencement of work will be completed. These documents will include, but not be limited to the following:

Table 6 Project Documentation

Report Title	Approval Party	Approval Prerequisite	Relevant Section of this Report
Occupational Health and Safety (OH&S) Plan	Crown	Site Establishment	Section 18.0
Community Consultation Plan	Crown	Site Establishment	Section 19.0
Environmental Management Plan	Crown and NSW DoPI	Site Establishment	Section 17.0
Project Management Plan	Crown	Site Establishment	-
Quality Management Plan	Crown	Site Establishment	-
Asbestos Management Plan	Crown	Site Establishment	Section 7.2.3 and Section 13.9
Emergency Response and Contingency Plan	Crown	Site Establishment	Section 20.11.6)
Remedial Work Plan (including Excavation Plans)	Crown	Site Establishment	Section 13.4
Validation SAQP	Site Auditor	Site Establishment	Section 16.2.1

In addition, the following will be undertaken:

- Preparation of a detailed work program and logic diagram;
- Submission of all WorkCover Authority notifications;
- Commissioning and Mobilisation of Plant; and
- Preparatory works required for utilities connections and supply agreements.

12.2 Site Preparation

If required, works to be undertaken prior to the excavation works include:

- Establishment of site offices;
- Demolition of existing infrastructure and removal of concrete pavements, where required;
- Installation of the Stage 1C groundwater retention wall system;
- Establishment of exclusion zones;
- Establishment of environment control measures (potentially including an Emissions Control System (ECS) if required) for management of odorous materials and/or materials from which volatile emissions are possible;
- If required, establishment of ex-situ treatment facilities for the stabilisation / solidification (potentially including a Remediation Enclosure [RE] and associated ECS if required) (refer to **Section 12.3**); and
- Establishment of the plant and supporting infrastructure as required for the proposed partial top down excavation methodology (refer to **Section 13.2**).

12.3 Site Facilities and Procedures

Site facilities required for the excavation works will be established in compliance with the relevant regulations. These facilities will be connected to appropriate utilities as required. All connections and reticulations will be carried out by licensed and qualified personnel in accordance with statutory requirements and standards.

It is proposed that ex-situ treatment of material excavated for the Stage 1C Works prior to disposal to landfill (if required) will be undertaken in an appropriately licenced off-site facility. In the unlikely event that on-site treatment is preferred, an on-site treatment facility (potentially including an RE and associated ECS, if required) will be established at a central location (approved by the BDA) and coordinated with the remediation works to be undertaken within the adjacent Block 4 (as described by the *VMP/Block 4 RAP* (AECOM, 2013c)).

Supporting infrastructure required for the proposed partial top down excavation methodology (refer to **Section 13.2**) will be established for the excavation works at the Site. This will potentially include an air circulation system to appropriately manage air quality within the basement excavation and/or an ECS.

Material excavated from the Site which requires treatment will be treated at an off-site treatment facility prior to disposal at a NSW EPA licensed landfill facility.

Other activities will involve the set-up of site offices, fencing, decontamination stations, environmental control measures and other associated facilities including:

- Wheel wash zones at the entrance and exit points;
- Stores, work sheds, lunchrooms and changing areas for the use of subcontractors and consultants;
- Temporary site sheds, first aid and emergency facilities, bathroom facilities and decontamination units; and
- Any additional site facilities to facilitate work in other areas of the Site, or in areas requiring additional safety measures.

Where possible, and dependent on staging and sequencing of the remediation works to be undertaken within the adjacent Block 4 (as described by the *VMP/Block 4 RAP* (AECOM, 2013c)), the facilities provided as part of the Block 4 Development Remediation Works / VMP Remediation Works will be used to avoid duplication of remedial facilities.

12.3.1 Exclusion Zones

Exclusion Zones are areas of the Site that will be outlined in the occupational health and safety plan (OHSP) that either require additional protective measures or may require the adoption of additional OH&S requirements and work practices. Exclusion Zones may also include other areas affected by emissions from the works being undertaken at any point in time. All Exclusion Zones will incorporate a buffer area along the boundary of the zone.

The boundaries of the Exclusion Zones will be defined by fencing and safety signs erected at regular intervals around each exclusion zone warning of the boundary of the exclusion zone, the nature of the hazard associated with it and access restrictions that apply for entry into the zone. Access of personnel into and out of the Exclusion Zones, will be controlled at a Decontamination Station, and will depend on the personnel classification. The location and extent of Exclusion Zones will be detailed in the OHSP and outlined in the Site-Specific Safety Induction.

12.4 Site Access and Security

12.4.1 General

Only authorised personnel and equipment will be allowed into the exclusion zones and other areas associated with the excavation works. Access will be strictly controlled throughout the course of the excavation works using the following procedures.

12.4.2 Working Hours

It is anticipated that construction and demobilisation hours would be between the hours of 7am and 6pm Monday to Friday, and 7am to 5pm Saturdays. No construction work would occur on Sundays and Public Holidays.

Operation hours for the excavation activities would be between 7am to 5pm, six days per week. Operation hours for the RE / ECS (if required) would be 24 hours per day, seven days a week.

12.4.3 Site Haul Roads & Parking Areas

Existing concreted areas will be utilised as haul roads to the extent practicable. Traffic movements on Site and within the broader Barangaroo South site will be directed around areas that are the subject of excavation and/or remediation works to the extent practicable.

12.4.4 Site Access

The primary access route to the Site will be via Hickson Road (to be confirmed as part of the application process and determined as part of the site staging). The entry point will control access to and around the Site during the excavation works.

All site personnel entering and leaving the excavation works will be required to pass through the clean/dirty zone and the decontamination station.

12.4.5 OHS Signage

Signage will be installed at the Site entrance detailing the location of the site offices, excavation works, decontamination units, first aid facilities and parking. Traffic restrictions will be installed to limit access to the safety of site visitors.

Signage at the main gate will include after-hours contact details.

As detailed in **Section 12.3.1**, additional signage will be erected along Exclusion Zone boundaries to restrict access to these areas to authorised personnel only.

12.4.6 Fencing

Security fencing, constructed as part of the Stage 1A development works is already in position around the perimeter of Barangaroo South (refer to **Section 6.1**).

Additional fencing will be erected where necessary to secure other portions of the Site.

12.4.7 Control of Site Entry and Exit

Entry to excavation and related work areas (such as the ex-site treatment facility / RE, if required) will be controlled through the use of a sign-on/sign-off log system at the main gate. Only authorised personnel will be allowed into the excavation works area.

Personnel will gain access to the excavation works area only after they have:

- Attended and completed a site safety induction briefing (applicable to all site workers and visitors);
- Are wearing all applicable PPE as detailed in the OHSP; and
- Been inducted into the OHSP.

All construction vehicles and delivery vehicles will enter the Site through the nominated main gate.

In the event of an emergency and the need for emergency services personnel to access the Site, the Site access process may be expedited. In these situations, which require the need to minimise delays in accessing injured site personnel, prior arrangement will be made for special Site access procedures. However, given the nature of the excavation works, all PPE and decontamination protocols will remain in effect at all times.

An Emergency Response Plan will be developed prior to site establishment detailing the specific procedures relating to site emergencies (refer to **Section 20.11.6**).

13.0 General Excavation and Materials Management

13.1 Background

This section describes management works associated with the proposed excavation works. As discussed in **Section 8.0**, CIM warranting remediation or management has not been identified at the Site.

However, additional validation sampling is required from unsaturated soils within Area A (materials to remain *in situ* outside the Stage 1C Works Area) to demonstrate this (refer to **Section 8.1.6**). Therefore, it is possible that CIM (that is soil containing contaminant concentrations exceeding the SSTC-A) may be identified as an outcome of this additional validation sampling and that remediation of unsaturated soils in Area A may be required. It is also noted that material from Area B (materials to be excavated from the Stage 1C Works Area) may require treatment prior to disposal to landfill.

Further, concentrations of contaminants (that do not require remediation) are known to be present within the Site which may require specific management practices to mitigate potential risks to construction workers, the public and environment.

The following general excavation and material management activities are described as part of the following sections:

- Control and minimisation of emissions from the excavation area (refer also to **Section 17.3**);
- Control and treatment of water from the Area B excavations (**Section 13.6** and **Section 14.0**);
- If required, excavation of the SPGWT and CIM (**Section 13.4** and **Section 13.7**); and
- Loading of excavated materials for transport (**Section 13.8**).

It is noted that any potentially contaminated spoil removed as part of construction of the basement groundwater retention walls or foundation piling works associated with the proposed land uses will also be managed in accordance with this RAP.

13.2 Construction Methodology

It is proposed that the excavation within the Stage 1C groundwater retention wall system will be constructed using a partial top down construction methodology. The key stages of the proposed construction methodology are described following. It is noted that the construction methodology is subject to further refinement and confirmation; however, the broad principles as described below are expected to remain consistent:

- 1) Construction of the Stage 1C perimeter groundwater retention wall system, including internal stabilising structures (including barrettes⁶ and other piles) (refer to **Section 4.3**) from the existing surface level;
- 2) Excavate within the Stage 1C perimeter groundwater retention wall system (and around the internal stabilising structures) to approximately RL - 0.25 m AHD (refer to **Section 4.2**);
- 3) Extend internal stabilising structures and construct the ground floor slab structure across the footprint of the Stage 1C Works Area (at an approximate RL 3.9 m AHD) as a suspended slab;
- 4) Establishment of an appropriate access point to facilitate access below the ground floor slab and movement of excavation plant and excavated materials;
- 5) Construction of above ground structures using the ground floor slab as a working platform;
- 6) Excavate within the Stage 1C perimeter groundwater retention wall system, and below the ground floor slab to the foundation level for car park level 1 (approximate RL -2.4 m AHD). Excavation spoil to be removed via the access point using long reach excavators, crane operated grabs or similar;
- 7) Construct car park level 1 (below the ground floor slab) as a slab on grade;

⁶ Barrettes (often required for high rise construction) are rectangular piles typically installed using bentonite or polymer fluid to assist in maintaining the stability of the bore during installation.

- 8) Excavate within the Stage 1C perimeter groundwater retention wall system, and below the car park level 1 floor slab to the foundation level for car park level 3 (approximate RL -9.45 m AHD). Excavation spoil to be removed via the access point using long reach excavators, crane operated grabs or similar;
- 9) Construct car park level 3 (below the car park level 1 floor slab) as a slab on grade; and
- 10) Construct car park level 2 (below the car park level 1 floor slab and above the car park level 3 floor slab) as a suspended slab.

13.3 Pre Treatment of Materials

Prior to excavation of materials, some preparation and pre-treatment of material may be necessary as summarised in **Section 13.8.3**.

13.4 Excavation Planning

The materials to be excavated comprise heterogeneous fill materials, soil, demolition rubble and other potentially gas works related waste (for example ash). Therefore, prior to commencement of excavations, detailed excavation plans will be prepared and documented in a RWP (refer to **Section 12.1.2**). The RWP will provide specific details of the work that must be completed to facilitate delivery of the remediation works prescribed by this RAP. The excavation plans (to be provided as part of the RWP) will outline the anticipated classification of materials based on all available data. Correlations between field observations (both visual and olfactory) and analytical data will also be used to guide the visual characterisation of fill materials during excavation.

All excavation works will be undertaken in accordance with the following procedures, in sequence:

- Prior to commencement of excavations on each work shift, all necessary environmental, OH&S measures and related equipment will be established and all worker PPE and respiratory controls will be checked to ensure they are in full working order in accordance with the OH&S Management Plans;
- All excavation plant operators, haulage operators and supervisors will be made familiar with the excavation strategy, and all workers will be made aware of their responsibilities prior to the commencement of each shift;
- Stockpile areas (if required) will be prepared with adequate capacity to receive the contaminated materials after excavation prior to the commencement of excavation;
- Exclusion zones will be set up around the active remediation works areas and as required;
- All truck haulage roads will be made suitable for transportation and haulage of the excavated materials;
- All haulage trucks will be covered prior to exiting the exclusion zone/excavation area and will be decontaminated at the end of each shift of haulage operations in accordance with the environmental management plan (EMP). All haulage trucks will be fitted with liquid seals which will be inspected daily to ensure their integrity; and
- All personnel, vehicles and equipment leaving the excavation will be properly decontaminated in accordance with the EMP.

13.5 Excavation Operations

Excavations will be regularly inspected by a suitably experienced environmental engineer or scientist to confirm that the visual and olfactory characteristics of the excavated materials are consistent with expectations. These regular inspections will also serve to identify hotspots of SPGWT and/or CIM that may not otherwise have been identified by the previous site investigations / additional validation sampling (refer to **Section 16.4**).

Odorous materials will be managed as per the requirements of **Section 17.3**.

Asbestos containing materials will be managed in accordance with the requirements of **Section 13.9**.

If CIM is identified by the Area A validation works (refer to **Section 16.4.1**) or Area C validation works (refer to **Section 16.4.2**) the CIM will be selectively excavated (if required) as described by **Section 20.6**. All excavated CIM will be kept separate from other materials. Depending on the level of contamination in the excavated CIM, it will be either:

- transferred to the ex-situ treatment facility (as described by **Section 12.3**), the ex-site treatment facility is likely to be located off-site) for treatment; or
- transferred directly offsite to a NSW EPA licensed landfill facility, in accordance with the appropriate waste tracking requirements (refer to **Section 13.8.2**).

If encountered as an unexpected find, SPGWT will be similarly selectively excavated and kept separate from other materials. All SPGWT will be transferred to the offsite ex-situ treatment facility (as described by **Section 12.3**) for treatment prior to disposal offsite to a NSW EPA licensed landfill facility in accordance with the appropriate waste tracking requirements (refer to **Section 13.8.2**).

13.6 Dewatering of Excavations

De-watering will be undertaken as part of and in parallel with the Stage 1C excavation program.

Management of water and groundwater within excavations will be undertaken in accordance with the procedures outlined in **Section 14.0**.

13.7 Excavation Support

As detailed in **Section 4.3**, a groundwater retention wall system will be constructed. Dependent on the staging and sequencing of the Stage 1B basement works, the Stage 1C retention wall system will connect with the Stage 1B retention wall system (on the Block 4 boundary) and will be designed to facilitate excavation within it.

Final structure details for the retention wall system and the basement layout will be finalised during the detailed design phase of the project so may be subject to further refinement and development. However, the key elements of the basement groundwater retention wall system design are not expected to change.

13.8 Materials Handling

13.8.1 Background

This section outlines the procedures for materials handling following excavation, specific procedures relating to materials tracking and the required environmental controls.

13.8.2 Materials Tracking

All materials handled during the excavation works will be tracked in order to allow verification of the correct movement and handling. The system will track materials from cradle-to-grave, and will provide detailed information on the location and quantity of all material movements both on and off-site, so that the material being handled can be identified and accounted for. The tracking system shall include accurate tracking of stockpiles throughout the entire material handling stage and will include confirmation of stockpile locations via registered survey. This is to reduce the risk of cross-contamination between stockpiles.

As part of this process, accurate records shall be kept to ensure that backfilling of excavations (where required) only occurs following the successful validation of the subject materials. Plans will be made with respect to the extent of each excavation. A register of all analytical results for stockpiles and excavations will be maintained throughout the validation works.

Standard forms shall be prepared as part of the Materials Tracking Procedure. The forms and their function shall include, but not be limited to:

- **Off-site Transport/Disposal Form** - Providing a record of materials removed from the Site and including the material type, quantity, origin, shipping destination and an approval by the nominated environmental consultant that the material meets the disposal requirements;
- **Imported Fill Form** - Providing a record of materials imported to the Site including the date, material type, quantity, point of origin, intended use, visual observations and the suitability of the material for use as backfill at the Site;
- **Material Excavation Form** - Providing a record of excavated materials for each excavation on the Site including the date, material type, excavated quantity, origin and intended destination;
- **Material Treatment Form** – Providing a record of material treatment including the date, material type, treatment regime, stockpile of origin and destination stockpile;
- **Material Stockpiling Form** - Provides a record of all materials placed in stockpiles. The form will include the date, material type, stockpiled quantity, origin and intended end use; and

- **Material Placement Form** - This form provides a record of all materials backfilled on the Site and includes the date, material type, quantity backfilled and origin.

Each form shall be completed on a daily basis (as applicable based on that days activities) and collated into a cumulative log for each process on a weekly basis.

13.8.3 Material Preparation

Excavated materials may require preparation prior to transport to stockpiles, the offsite ex-situ treatment facility and/or off-site licenced landfill.

Material preparation may include, but not be limited to:

- Mixing of wet material *in-situ* (i.e. within the excavation area) to make the material spadeable. This may be achieved by either mixing with other soils or by addition of fly ash, lime or cement (with appropriate volatile emission and odour controls as described below);
- Drainage and drying of saturated excavated materials. This will require installation of appropriate measures to control run off; and
- Screening of material to separate oversize and/or materials suitable for recycling (e.g. steel, concrete footings/historic sea walls, brick and rock fill, timber piles, construction and demolition waste). Physical separation will be achieved by a combination of:
 - Manual separation using excavators fitted with grabs or skeleton buckets; and
 - Screens.

Odorous materials will be managed as per the requirements of **Section 17.3**.

It is recognised that the proposed approach to material preparation (in particular the addition of lime and or cement) may result in increased volatile emissions and/or odour generation. In consideration of this, where preparation of materials with potential for volatile or odorous emissions is required, the management and mitigation measures described in **Section 17.3** will be implemented.

As described by **Section 13.2**, the Stage 1C Works will be undertaken using a partial top down methodology. As a consequence, the majority of the excavation will be undertaken within the Stage 1C groundwater retention walls and below a concrete slab; effectively containing the excavation from the surrounding environment. Notwithstanding, the challenges this approach will generate with respect to protection of the health and safety of workers engaged in the basement excavation, it will mitigate risks associated with the potential for volatile or odorous emissions to impact on the surrounding community or workers in adjacent construction sites (as discussed in **Section 10.4**).

Specific management and mitigation measures that may be adopted in relation to both excavation of the Stage 1C Works Area and minor excavation works required outside the Stage 1C Works Area include:

- Use of an ECS (for example an ECS may be installed at the access point to the excavation) (refer to **Appendix D**);
- minimisation of the quantity or surface area of materials;
- conduct of activities during favourable weather conditions;
- use of surface covers (soil and / or tarps); and/or
- use of odour suppressant sprays or foams (for example an odour suppressant spray curtain may be installed at the access point to the basement excavation) (refer **Section 17.3**).

13.8.4 Crushing/Shredding of Materials

The crushing of oversize excavated materials may be necessary to ensure that the excavated materials can be: recycled (in the case of concrete and brick demolition rubble); reused (if required); or treated in the ex-situ treatment facility.

13.8.5 On-site Transportation of Materials

Materials at the Site will be excavated, handled, moved, treated and stockpiled in a manner designed to minimise exposure to the environment. The following materials handling requirements will be developed for trucks transporting materials within the Site:

- Trucks carrying excavated materials will be covered and decontaminated in a wheel wash facility before exiting the excavation area;
- Trucks will proceed directly to the stockpile area, ex-situ treatment facility, as appropriate, along the predetermined haul roads;
- Trucks carrying contaminated materials will not be permitted to drive over areas of the Site which have previously been excavated, validated or reinstated;
- Trucks carrying contaminated materials will remain covered until authorised to unload. The trucks will be decontaminated and the truck body covered before returning to the excavation area;
- Empty trucks will return directly to the excavation area along predetermined haul roads; and
- The validated excavation will be effectively isolated from contaminated areas of the Site by the use of physical means such as the placement of clean material bunds, temporary fences and by use of signage.

13.8.6 Off-site Transportation of Materials

The following materials handling requirements will be developed for trucks transporting materials off the Site:

- Trucks carrying excavated materials will be covered and decontaminated in the wheel wash facility before exiting the Site;
- Trucks carrying contaminated materials will be covered prior to exiting the Site and will remain covered until authorised to unload at the destination;
- Trucks will be fitted with seals to ensure that the movement of potentially saturated materials is undertaken appropriately. The integrity of the seals will be inspected and tested prior to commencement of each day's haulage works; and
- Trucks will not wait in the streets surrounding the Site or within the CBD; and
- Trucks will exit the Site through predetermined exit points on Hickson Road and will follow a predetermined transport route to the destination (landfill or other) via Sussex Street, Anzac Bridge and the City West Link or across the Harbour Bridge.

13.8.7 Stockpiling of Materials

13.8.7.1 Stockpile Locations

Materials requiring stockpiling will be placed within a designated stockpile area. The location of stockpiles will be confirmed via registered survey as part of the Materials Tracking System.

Where possible and if required, further *in situ* testing of material may be undertaken prior to excavation, to pre-classify materials and minimise interim stockpiling requirements.

13.8.7.2 Stockpile Area Preparation

During site establishment, stockpile areas will be prepared using the following methods:

- Noting that the majority of the Barangaroo Stage 1C Development site is covered by an existing hardstand surface, works will be undertaken initially to clear the area of rubbish, rubble, structures and vegetation;
- Diversion drains and bunds will be constructed around the perimeter of the stockpile areas. Additional sediment and erosion control measures including silt fencing and hay bales will be installed where necessary (refer to **Section 14.1**);
- Signs will be erected at the entrance to the stockpile area and at locations around the stockpile specifying individual stockpile numbers and the type of materials stored; and
- Buffer zones will be established around each stockpile area to enable access to the stockpiles and minimise impacts of the stockpile area on the surrounding facilities.

13.8.7.3 Stockpile Construction and Maintenance

The drainage, sediment and erosion control measures installed within stockpiling areas at the commencement of the project will be maintained, repaired and replaced where necessary for the duration of the stockpiling activities.

Where necessary, long term soil stockpiles on-site will be covered or stabilised with spray grass seeding or other suitable measures to reduce dust generation and erosion.

Measures will be taken to reduce the generation of dust from stockpiles through the use of wetting and covers (refer to **Section 17.3**). Run-off will be managed by the use of surface bunding, silt fences and drainage diversions (refer to **Section 14.1**).

If stockpiling of SPGWT or odorous material is required, the stockpiles will be managed as follows:

- The SPGWT will be stockpiled separately to all other materials and clearly identified with signage;
- If required, odour suppressant sprays or foams will be sprayed onto stockpile surfaces to mitigate odours during construction of the stockpile;
- The SPGWT will be securely covered with a high density polyethylene (HDPE) liner and surface water controls will be constructed around the perimeter (as required for all stockpiled materials); and
- Daily monitoring of the SPGWT stockpile will be undertaken and will include qualitative assessment of odour around the perimeter of the stockpile.

All stockpiles will be maintained in a tidy and safe condition with stable batter slopes.

13.8.8 Classification of Treated Materials

Following treatment of materials within the ex-situ treatment facility, materials will be classified for off-site disposal in accordance with the NSW EPA (2014) *Waste Classification Guidelines* and the requirements of the Immobilisation Approval (if any) (refer to **Section 13.8.9**).

13.8.9 Waste Classification for Off-site Disposal

All material requiring off-site disposal will be assessed for off-site disposal to landfill in accordance with the NSW EPA (2014) *Waste Classification Guidelines* or Part 4 of those guidelines in the case of potential acid sulphate soils (PASS) and acid sulphate soils (ASS).

If required, *in situ* testing of Area B material will be undertaken prior to excavation, to pre-classify materials directly for off-site disposal and minimise stockpiling requirements. Assessment of Area B soil to be excavated from within the Stage 1C Works Area against the NSW EPA (2014) *Waste Classification Guidelines* to facilitate *in situ* waste classification prior to commencement of excavation works. The strategy to be adopted for the *in situ* waste classification works of Area B soil to be excavated will be developed in consultation with and subject to endorsement by the NSW EPA.

If treatment of excavated material is required to facilitate offsite disposal, an Immobilisation Approval will be sought from the NSW EPA prior to offsite disposal.

13.9 Management of Asbestos Containing Materials

Based on information obtained during the Stage 1A basement bulk excavation works (located south of the Site) the identification of bonded ACM during the Stage 1C Works is considered probable. Further, as described by the *ORWS Asbestos HHERA* (AECOM, 2013a), asbestos reported to be present in soils within the Stage 1A basement excavation was predominately bonded ACM and the potential for AF generation was minimal. Therefore, it has been assumed that asbestos which may be present within the ORWN Area is likely to be similar – that is predominantly bonded ACM.

All bonded ACM impacted material will be managed in accordance with an Asbestos Management Plan (refer to **Section 1.5** and **Section 12.1.2**).

Identified bonded ACM which requires removal from the Site will be collected and disposed of by a licensed Asbestos Removal Contractor (ARC) in accordance with the requirements of the following:

- *NSW Work Health and Safety Act* (2011);
- *NSW Work Health and Safety Regulation* (2011);

- *Code of Practice: How to Safely Remove Asbestos*, Safe Work Australia (2011); and
- *Code of Practice: How to manage and control asbestos in the workplace*, Safe Work Australia (2011).

If required, the bonded ACM removal works would be undertaken as follows:

- The excavation contractor would establish appropriate barriers and signage around the area where bonded ACM has been identified;
- The bonded ACM will be suitably removed from the Site by an ARC;
- Airborne asbestos fibre monitoring will be undertaken around the working area during the works to confirm that the bonded ACM is being removed in an appropriately controlled manner;
- An ARC will conduct a visual inspection of the affected area to confirm that it is free of visible ACM fragments; and
- A clearance certificate will be prepared to document these works.

The requirements for validation of materials to remain *in situ* in Area A (outside the Stage 1C groundwater retention wall system) are described by **Section 16.4.1**. Any works required to remove unexpected CIM based on the presence of asbestos concentrations exceeding the SSTC-A for asbestos, as identified by the Area A additional validation works (refer to **Section 20.6.1**) will be managed in accordance with the Asbestos Management Plan.

The requirements for validation of materials to remain *in situ* below the proposed Stage 1C Works are described by **Section 16.4.2**. Additional works (if any) required for management of bonded ACM identified in residual soils for the protection of construction workers will be determined by the Asbestos Management Plan.

The Asbestos Management Plan and all works associated with or potentially associated with disturbance of asbestos will include consideration of construction worker protection and the following independent report commissioned and endorsed by the NSW EPA:

- Associate Professor Tim Driscoll, Sydney School of Public Health, Sydney Medical School, University of Sydney (March 2013). *The Use of Asbestos-Contaminated Soils on Barangaroo, Report to the Environment Protection Authority*.

13.10 Material Fate

13.10.1 Recycling

The recycling of excavated materials will be maximised to the extent practicable. Where possible, materials won from the screening of excavated materials will be assessed for their recycling suitability as follows:

- Steel materials will be transported to appropriate off-site steel recyclers;
- Concrete, brick and rock may be crushed to create fill for use in other areas of the development (as required) and for construction of haul roads or recycled off-site; and
- Timber will be recycled off-site, where possible.

13.10.2 Imported Materials

Where imported material is used for reinstatement purposes, the material will be placed in accordance with specific geotechnical requirements which will be dependent on the area of reinstatement. The geotechnical requirements will be determined as part of the Technical Specifications for the development.

13.10.3 General Solid Waste

Materials requiring off-site disposal and classified as General Solid Waste in accordance with the NSW EPA (2014) *Waste Classification Guidelines* will be transported off-site and disposed of at a landfill licensed to accept General Solid Waste.

13.10.4 Restricted Solid Waste

Materials requiring off-site disposal and classified as Restricted Solid Waste in accordance with the NSW EPA (2014) *Waste Classification Guidelines* will be transported off-site and disposed of at a landfill licensed to accept Restricted Solid Waste.

If treatment of excavated material is required to facilitate offsite disposal, an Immobilisation Approval will be sought from the NSW EPA prior to off-site disposal.

14.0 Management of Water

14.1 Surface Water Management Methods

14.1.1 Surface Water Management from Undisturbed Areas

Clean water will be generated from surface water collected from remediated and undisturbed areas of the Site. Undisturbed surface water runoff will continue to follow existing drainage patterns, unless diversion from active site areas is warranted. Surface water drainage will also be arranged so that surface water run-off from disturbed or contaminated areas does not enter remediated or undisturbed areas.

Clean water collected from undisturbed areas will be retained on-site and used to the maximum extent possible for dust suppression. Excess clean water will be stored, treated (if required, using a temporary Water Treatment Plant [WTP]) and discharged to stormwater or sewer in accordance with the discharge conditions established for the Barangaroo South site. It is understood that formal discharge criteria for surface waters from Barangaroo South have been negotiated with the NSW EPA and included as a condition of the POEO license for the Barangaroo South project. It is anticipated that the discharge of surface waters from the Site will be managed as part of the existing process established for Barangaroo South.

To assist in the collection of surface waters from undisturbed areas of the Site, a sediment basin may be constructed in a suitable location to be determined during site establishment. It is understood that the location of the basin will be coordinated with the remediation works to be undertaken within the adjacent Block 4 (as described by the *VMP/Block 4 RAP* (AECOM, 2013c).

14.1.2 Surface Water Management from Disturbed Areas

Surface water management from disturbed site areas is critical to successful management of the Site and reduction of cross contamination issues and to prevent impact to the Harbour. Successful management of Site water is also essential for materials handling and management.

Surface water flows and stormwater will be managed by segregating clean water from impacted water and preventing the inflow of surface water to excavation areas using surface bunds, silt fences and drainage diversions. The preferred hierarchy for management of water on-site is as follows:

- Minimise volume of contaminated water during the works wherever possible by directing surface water away from excavations, depressions, pits and stockpiles by the construction of drainage works such as bunds and diversion drains. These measures will minimise the flow of clean water into other areas of the Site that contain contaminated materials;
- Recycling water where possible by using on-site as dust suppression for other site operations including wheel washing and truck washing. To ensure that the use of recycled water does not impact on surrounding areas, the following data will be obtained prior to undertaking these activities:
 - Chemical data which demonstrates that the water to be recycled complies with the reuse criteria, including consideration of potential for odour generation;
 - Definition of the area where the water is to be discharged;
 - Details of environmental protection measures installed to ensure that the use of recycled water will have no adverse environmental impact;
 - Appropriate tracking of recycled water reused at the Site; and
 - Discharge to stormwater or sewer, with or without treatment (if required, using a temporary WTP or some other water treatment facility), in accordance with the discharge conditions established for the Barangaroo South site.

14.2 Groundwater Water Management Methods

Groundwater encountered during excavation will require management. The groundwater retention wall system will be installed prior to the excavation works to minimise groundwater infiltration into the excavation. Dewatering and control of groundwater infiltration will also be required.

Groundwater collected from the excavations will be transferred to a temporary WTP, prior to discharge to Darling Harbour in accordance with the discharge conditions established for the Barangaroo South site. .

If required, limited contaminated water may be disposed off-Site with use of truck tankers and/or disposed to sewer (with or without treatment) in accordance with a Sydney Water trade waste licence.

14.3 Wastewater Treatment System

As described above, a temporary WTP may be utilised for the excavation works to the extent practicable in accordance with the existing conditions established for the Barangaroo South site. It is understood that a temporary WTP may also be used for the Block 4 Development Remediation Works and VMP Remediation Works within the NSW EPA Declaration Area (as described by the *VMP / Block 4 RAP* [AECOM, 2103]). This approach will avoid unnecessary duplication of infrastructure.

To the extent that this is not practicable, a Site specific wastewater treatment system will be established for the excavation works and is likely to consist of at least the following process units:

- Pumps and a buffer storage for transferring flows to the plant;
- Dissolved Air Flotation unit for the removal of fats, oils, greases and hydrocarbons which might also include a coagulant and surfactant dosing to assist with solids removal;
- A chemical dosing step to adjust the pH and promote chelation and precipitation of heavy metal complexes;
- Reaction & mixing vessels to facilitate the metals removal process providing flow buffering and adequate reaction times;
- Activated carbon filtration, as required to polish specific residual or trace contaminants from the groundwater and ensure compliance with specific trade waste requirements;
- Sludge handling and/or sludge thickening equipment (or at least a tank, sludge separator) to minimise the residuals that require disposal off-site; and
- Effluent balancing storage (in holding tank) prior to pumping to the transfer sump.

Duty / standby pumps (variable speed drives) will control the pumped outflow to Darling Harbour, following approval of a variation to the existing EPL to the Sydney Water sewerage system or stormwater if appropriate testing is conducted and approvals obtained (refer to **Section 12.1.2**).

14.4 Groundwater Monitoring

As described by **Section 8.0**, CIM has not been identified within the Site based on the previous intrusive investigations undertaken within the Site. In particular, the assessment of whether or not remediation was required included consideration of groundwater quality within the Site. As an outcome it has been determined that existing groundwater quality at the Site does not represent an unacceptable risk to human health or the environment.

With respect to groundwater quality within the Stage 1C Works Area, the Stage 1C groundwater retention wall (refer to **Section 4.3**) will effectively isolate groundwater conditions within the future intended basement footprint from the surrounding environment. Therefore, any residual contamination impacts that may remain within the groundwater retention wall system (and below the future intended basement) are unlikely to impact on the surrounding environment.

With respect to groundwater quality outside the Stage 1C Works Area and adjacent to Darling Harbour (Area A) groundwater monitoring is not considered warranted for the following reasons:

- the groundwater concentrations reported in Area A (IT01, MW24, MW40, MW410/IT04, MW411/IT05, MW212) and MW544, are all less than the groundwater SSTC-A (refer to **Table T8** and **T9**);
- the groundwater concentrations reported for key CoPCs in Area A (IT01, MW410/IT04, MW411/IT05 and MW212) are generally less than the laboratory LOR and MWQC (refer to **Table T8** and **T9**);

- as detailed in Section 7.11 of the *ORWN HHERA* (AECOM, 2014), the *VMP Remediation Extent* report (AECOM, 2013d) considers that if the VMP Remediation Works described by the *VMP/Block 4 RAP* (AECOM, 2013c) are implemented, residual gasworks related contamination remaining *in situ* down hydraulic gradient of the Declaration Area (including within the Site) will not represent an unacceptable risk to the environment;
- as detailed in **Section 7.4**, the *ORWN HHERA* (AECOM, 2014) also considers that residual concentrations of non-gasworks related contamination remaining within the Site do not represent an unacceptable risk to the environment; and
- the groundwater retention wall systems to be constructed as part of the Stage 1C Works and the adjacent Block 4 Development Works will effectively isolate soil and groundwater impacts within them from groundwater within Area A and the adjacent Darling Harbour.

15.0 Imported Materials

The Crown development plans for the future intended land uses (refer to **Appendix C**) includes raising the surface level of the area outside the Stage 1C Basement (containing the Podium and Terrace Areas) by approximately 1.6 m to an approximate RL of 3.8 m AHD. As described by **Section 1.4**, it is understood that it will not be practicable to reuse materials excavated for construction of the Stage 1C basement (Area B materials) for this. Therefore, it is expected that importation of backfill material to the Site will be required.

Materials imported to the Site will be required to meet the environmental and geotechnical requirements specified for the particular end use.

It is expected that materials imported to the Site as part of the development (including material to be used for landscaping and surface material) will generally meet the requirements of:

- Virgin Excavated Natural Material (VENM) in accordance with the NSW EPA (2014) *Waste Classification Guidelines*;
- Excavated Natural Material (ENM) in accordance with the *Protection of the Environment Operations (Waste Regulation 2005 – General Exemption under part 6, Clause 51 and 51A (2012)*;
- the TSC (refer to **Section 7.5**); and
- the soil SSTC-B (refer to **Section 7.3.1** and **Table T1**).

The frequency of validation sampling will be dependent on the source of the fill material. If the material is brought onto the Site from a quarry, and the material is homogeneous, validation will consist of:

- a certificate warranting that the material is VENM or demonstrating the physical and chemical quality of the fill, including supporting test data; and
- visual confirmation that the material is free from contamination as it is imported to the Site.

If the imported material cannot be certified as VENM or clean quarry material, the following works will occur:

- Site inspection of the source site and the reporting of these findings in the relevant validation reports;
- Visual inspection of the imported material upon arrival/stockpiling at the Site to confirm it is consistent with the material observed at the source site and is free from contamination (including visual evidence of asbestos impacts);
- Collection and analysis of one sample per 100m³ or a minimum of 3 samples per source. This sampling density may be decreased depending on the quantity of material to be imported from a given source and the initial laboratory analytical results. Any change in sampling density will be determined in consultation with the NSW EPA Accredited Site Auditor;
- Visual confirmation that the material is free from contamination as it is imported to the Site.

Whenever possible, samples will be collected from the source location, prior to import of the material to the Site.

All soil samples will be analysed for the following suite of potential contaminants:

- Metals (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg);
- PAHs and phenols;
- TPH/BTEX;
- OPPs and OCPs;
- PCBs; and
- Asbestos - measured in accordance with Australian Standard 4964 (2004): *Method for the Qualitative Identification of Asbestos in Bulk Samples*.

16.0 Validation Strategy

This section outlines the proposed validation strategy and protocols required to demonstrate that the management strategies detailed herein have achieved the remediation objectives.

16.1 Remediation Goals

As detailed in **Section 7.3**, the Remediation Goals for the protection of human health, as recommended by the *ORWN HHERA* (AECOM, 2014) are:

- As a primary goal, removal / remediation of SPGWT (as defined in **Section 6.6**) to the extent practicable; and
- As a secondary goal, removal / remediation, to the extent practicable, of Confirmed Impacted Material (CIM), which is defined as:
 - Unsaturated soil concentrations exceeding the soil SSTCs; and
 - Unsaturated and saturated soil concentrations that are considered to be the source of groundwater concentrations exceeding the groundwater SSTCs.

16.2 Validation Principles

The *ORWN HHERA* (AECOM, 2014) recommends that soil validation data be assessed in accordance with the *NEPM* (NEPC, 2013). This will involve demonstrating that relevant SSTCs for the future intended land uses that will form part of the Crown Hotel Development Works have been achieved through the:

- use of systematic sampling patterns;
- collection of an appropriate number of samples for estimation of the arithmetic average concentration of contaminant(s) within relevant environmental media and exposure areas; and
- estimation of the 95% upper confidence limit (UCL) of the arithmetic average concentration for soils.

Where applicable, the above statistical analysis will be applied to separate areas of the Site if staged bulk excavation and validation works are to be conducted.

All soil materials to be retained on-site must comply with the soil SSTCs, as discussed in **Section 7.3** and presented in **Table T1**.

16.2.1 Validation Planning

As discussed in **Section 1.5**, a Validation SAQP will be prepared by a suitably qualified environmental consultant for the bulk excavation works (as required) and will be implemented for the duration of the soil validation testing program. The Validation SAQP will include a description of how the statistical analysis recommended by the *ORWN HHERA* (AECOM, 2014) will be adopted by the soil validation testing program.

The Validation SAQP will be endorsed by NSW EPA Accredited Site Auditor.

If new guidelines/legislation are introduced or endorsed by NSW EPA during the course of the excavation and validation works, consideration will be given to modifying the validation program in consultation with the NSW EPA Accredited Site Auditor.

The NSW EPA Accredited Site Auditor will be invited to undertake regular site inspections during the Stage 1C Works.

16.2.2 Groundwater

The *ORWN HHERA* (AECOM, 2014) recommends that groundwater validation data from: (a) individual groundwater monitoring wells be compared against the relevant SSTCs; and (b) individual groundwater monitoring wells on the down-hydraulic gradient Site boundary be compared against the MWQC (refer to **Table T12**).

As described by **Section 14.4**, groundwater monitoring during or after the work is not considered to be warranted because the previous groundwater concentrations reported within the Site are not considered to represent an unacceptable risk to human health or the environment. Validation of groundwater at the Site is therefore not considered further by this RAP.

16.3 Validation of HHERA Assumptions

An important element of the validation process will be confirmation that the key assumptions regarding the proposed development and on which the *ORWN HHERA* (AECOM, 2014) was based (as described in **Section 7.2.2**) have been or will be implemented.

To this end, validation will include review of appropriate documents confirming that the key assumptions either have been or will be constructed. Appropriate documentation may include:

- “Issue for Construction” Drawings that verify that the key elements of the Stage 1C Works relied on by the *ORWN HHERA* (AECOM, 2014) will be constructed; and/or
- “As Constructed” Drawings that document that the key elements of the Stage 1C Works relied on by the *ORWN HHERA* (AECOM, 2014) have been constructed.

16.3.1 As Constructed Survey and Inspection

Validation will include an as constructed survey of the final extent of Area A and Area C, including the alignment of the Stage 1C basement groundwater retention wall system.

Where applicable (for example, in cases where as constructed features can be confirmed through inspection), validation will include an inspection of specific key as constructed elements of the development.

16.3.2 Potential Design Changes

This review will also assess any potential implications of changes to the design of the Stage 1C Works and/or the final design and alignment of the Stage 1C groundwater retention wall system. Any significant changes to the final development plans will be assessed via the contingency measures detailed in **Section 20.10**. The details of the above review will be included in the Site Validation Report (refer to **Section 16.8**).

As discussed previously, the Stage 1C groundwater retention wall system and future intended Crown Hotel Development are subject to ongoing refinement and development as part of the Crown design process. Consequently, minor changes to the depth of excavation within the Stage 1C Works Area and/or the final alignment of the Stage 1C basement groundwater retention wall system may be required. If the final development design is changed in a way that affects the assumptions of the *ORWN HHERA* (AECOM, 2014) and this RAP, the contingency measures detailed in **Section 20.10** will be adopted. In the event that either report requires revision, they would be issued to the NSW EPA Accredited Site Auditor for approval.

16.3.3 Block 4 and Stage 1C Common Groundwater Retention Wall

The *ORWN HHERA* (AECOM, 2014) assumes that the remedial works described by the *VMP/Block 4 RAP* (AECOM, 2013c) have been completed (or will be completed) prior to remediation of Stage 1C. The *VMP/Block 4 RAP* (AECOM, 2013c) describes:

- The VMP Remediation Works – being those remediation works required to allow the NSW EPA to revoke its Declaration; and
- The Block 4 Development Remediation Works – being those remediation works required to facilitate the proposed Stage 1B development.

The VMP Remediation Works do not require construction of any basement groundwater retention walls.

In contrast, the Block 4 Development Remediation Works assume that a basement groundwater retention wall will be constructed around the entire perimeter of the proposed Stage 1B basement (ie. Block 4).

The future intended Stage 1C Basement includes a portion of the footprint of the proposed Stage 1B basement. As such, part of the Stage 1B basement groundwater retention wall (that is the northern half of the western wall of the Stage 1B basement – refer to **Figure F4**) is not required as it will effectively split the proposed Stage 1C Basement in two. This represents a potential change to the basement design assumed by the *VMP / Block 4 RAP* (AECOM, 2013).

It is considered that validation of the Stage 1C Remediation Works (as described by this RAP) and Block 4 Development Remediation Works (as described by the *VMP / Block 4 RAP* [AECOM, 2013]) would be unaffected by this change provided that either:

- The entire Stage 1B basement groundwater retention wall is constructed generally as currently proposed. This may include construction of a temporary wall, with a performance specification that is consistent with

the assumptions of the *PDA HHERA* (AECOM, 2010), in that section of the Stage 1B groundwater retention wall that will cut across the proposed Stage 1C Basement; or

- The entire Stage 1C groundwater retention wall is constructed as proposed (in addition to the Stage 1B groundwater retention wall excepting that portion that will cut across the proposed Stage 1C Basement). That is the Stage 1C groundwater retention wall would effectively replace that section of the Stage 1B groundwater retention wall that will intersect with the proposed Stage 1C Basement. It is noted that validation of the VMP Remediation Works (as described by the *VMP / Block 4 RAP* [AECOM, 2013]) will be independent of construction of either the Stage 1B or Stage 1C groundwater retention walls.

16.4 Soil Validation

Soil validation works will require validation of:

- Area A:
 - Additional validation sampling of unsaturated soils to more fully characterise this material for comparison with the soil SSTC-A (including the asbestos SSTCs).
- Area C:
 - Validation of the base of the excavation within the Stage 1C Works Area; and/or
 - Validation of the walls of the Stage 1C groundwater retention wall system.
- If required by the contingency measures described by **Section 20.0**:
 - Validation of materials requiring treatment as suitable for disposal to landfill; and/or
 - Validation of areas used for treatment and/or stockpiling at completion of the works.

All validation sampling works will be conducted by a qualified environmental engineer/scientist with experience working on contaminated sites.

All validation soil samples detailed in the following Sections will be discrete soil samples only. That is, composited soil samples will not be used for validation purposes.

16.4.1 Area A - Validation of Limited Excavation Areas

As described by **Section 8.1.6**, only limited soil analytical results are available for the Area A unsaturated soils. Therefore, additional validation testing of unsaturated soils is required to ensure that the unsaturated soils are appropriately characterised and do not contain CIM or SPGWT.

The additional validation testing will be undertaken in accordance with the NSW EPA Accredited Site Auditor endorsed Validation SAQP. In preparing the Validation SAQP, consideration will be given to the range of historic land uses to which Area A was subjected – many of which have a relatively low risk of having resulted in contamination. In particular, much of Area A is located over the existing caisson wall and/or the reclaimed historic Southern Cove. Of particular relevance to development of the Validation SAQP within Area A unsaturated soils (refer also to **Section 4.1**):

- The existing caisson wall, which (with the exception of the historic Southern Cove) forms the western edge of Barangaroo South is reported to be filled with dredged sediments from Darling Harbour;
- The western extent (approximately 25m) of the reclaimed historic Southern Cove comprises of a suspended reinforced slab supported on concrete columns. As such, there is a void below the concrete slab and above Darling Harbour (which extends under the slab to a rock armoured embankment constructed to facilitate reclamation of the historic Southern Cove); and
- The eastern portion of the reclaimed historic Southern Cove has been reported (based on the limited available data) to have been reclaimed with a large proportion of large sandstone cobbles and boulders. In addition, due to the timing of the backfilling in this area it is considered unlikely that the area was backfilled with gasworks related wastes.

The additional validation sampling to be described by the Validation SAQP is expected to involve:

- Collection of additional soil samples such that the net sampling frequency across Area A (including both the previous investigation locations and additional validation locations) is at least one sample location per 20 m grid interval. This sampling grid may be varied, in consultation with the Auditor, based on the historic land uses of particular parts of Area A as described above;
- Where possible, soil samples will be collected from test pits to allow the collection of bulk samples as required for analysis of the gravimetric content of bonded ACM;
- Soil samples will be collected from within the unsaturated zone at depths of approximately 0.5 and 1.5 m bgl;
- Soil samples will be biased toward those zones considered most likely to be impacted based on field observations (including visual/olfactory observations and PID readings); and
- All soil samples will be analysed for the CoPC detailed in per **Section 16.5** and adopting the analytical methods detailed in **Section 16.5.2**.

Based on the result of the additional validation sampling, an assessment of whether CIM and/or SPGWT are present within Area A will be undertaken and conclusions made regarding remediation requirements (if any) (refer to **Section 20.6.1**). These works will be undertaken in consultation with the NSW EPA Accredited Site Auditor.

If CIM and/or SPGWT is identified by the additional Area A validation sampling, additional delineation works may be required to appropriately characterise the vertical and horizontal extent of the impacts. If required, these delineation works would also be conducted in consultation with the NSW EPA Accredited Site Auditor.

16.4.2 Area C Validation Works

16.4.2.1 Validation of Materials to Remain In-situ Below the Stage 1C Works Area

The fill material to remain *in situ* below the Stage 1C Works Area is considered to have been adequately characterised and validated by the previous investigations. Further:

- As described by **Section 7.2.2**, the standard of remediation within the Stage 1C basement retention wall system is based on achieving the groundwater SSTC only - therefore, the collection of soil validation samples within the saturated zone is not required; and
- As described by **Section 8.3.3**, the groundwater quality reported within Area C by previous investigations is less than the groundwater SSTC – therefore, the collection of groundwater validation samples within the basement footprint is not required.

The *ORWN HHERA* (AECOM, 2014) assumes that SPGWT will not be present in the immediate vicinity of the outer basement floor to the extent practicable.

In consideration of this, the Area C excavation base will be visually inspected by a qualified environmental engineer/scientist to confirm that the excavated surface is visually free from:

- SPGWT; and
- ACM to ensure residual soils are suitably validated for the protection of construction workers.

If there is visual evidence of potential SPGWT being present at the base of the bulk excavation, additional validation samples will be collected. If required, excavation base samples (discrete only) will be collected and analysed at a frequency of one sample per 20 m grid intervals across the base of the excavation, within footprint of the potential SPGWT. Excavation base validation samples will be collected using a trowel to a depth of 100 mm (to minimise the potential loss of volatiles). All soil samples will be analysed for PAHs to allow comparison to the TCM criteria (as defined in **Section 6.6.1**). The analytical results from excavation base validation samples will be used to confirm the absence (or otherwise) of SPGWT at the base of the excavation.

If SPGWT is confirmed in the base of the completed excavation, the vertical extent of excavations will be increased in the vicinity of the impact to the following depths:

- 2 m from the finished excavation if permeable fill will be used to backfill the over excavation area; or
- 1 m from the finished excavation if clay will be used to backfill the over excavation area.

The increase to the vertical extent of the required excavations is based on consideration of:

- the practicabilities of increasing the depth of excavation including:
 - the depth that can be reasonably achieved by a single excavation lift; and
 - minimising the requirement for increased excavation shoring, dewatering and associated water management; and
- provision of adequate separation between the underside of the future intended basement slab and any SPGWT remaining *in situ* beneath it such that there is no unacceptable risk to occupants of the future intended basement.

Removal of the additional material shall be validated through visual observations and documented via field notes and photographs.

If ACM is observed in the base of the completed excavation, it will be managed by the Asbestos Management Plan to ensure that construction work health and safety is appropriately protected (refer to **Section 13.9**).

All soil analytical data relevant to characterising materials to remain below the completed excavation will be included in the Validation report (refer to **Section 16.8**).

16.4.2.2 Validation of Stage 1C Excavation Walls

As described by **Section 4.2**, the Stage 1C excavation walls will be supported (and effectively retained) by the groundwater retention wall system. As a consequence, it will not be possible to directly sample materials remaining in excavation walls due to the presence of the groundwater retention wall system.

The *ORWN HHERA* (AECOM, 2014) assumes that SPGWT will not be present in the immediate vicinity of the outer future intended basement walls to the extent practicable.

Figure F6 indicates that there is a potential for SPGWT to be present in the vicinity of the currently proposed Stage 1C groundwater retention wall. In particular, SPGWT has been identified in the vicinity (i.e. within 20 m) of the wall at the following locations:

- BH60/MW60 – located within the proposed Stage 1C Works Area (SPGWT present in marine sediment approximately 4.3 m below the proposed depth of excavation);
- BH48 - located east of the proposed Stage 1C Works Area (SPGWT present in marine sediment approximately 2.8 m below the proposed depth of excavation); and
- BH406 - located east of the proposed Stage 1C Works Area (SPGWT present in fill material and marine sediment approximately 2.6 m below the proposed depth of excavation).

It is noted that the SPGWT impacts identified at BH48 and BH406 (located offsite to the east) are likely to be removed during the proposed Stage 1B basement excavation works which are likely to extend to a depth of 16.5 m bgl. Validation of remediation works associated with the Stage 1B basement will be undertaken in accordance with the '*VMP/Block 4 RAP*' (AECOM, 2013c).

As described by **Section 8.3** SPGWT reported in marine sediments and bedrock below the Stage 1C Works Area is not considered to require remediation. Therefore, while there is a potential that the groundwater retention wall may be installed in some areas where SPGWT may be present in the marine clays, this is not considered to represent an unacceptable risk to site users of the future intended basement because the SPGWT would be several metres below the basement and not be in direct contact with the outer basement walls or floor.

The low potential for SPGWT to be present in proximity to the future intended basement walls and floor will be further verified by consideration of:

- Soil analytical data and visual observations from the proposed Area B *in situ* waste classification works (refer to **Section 13.8.9**); and
- Assessment of the spoil generated from construction of the Stage 1C groundwater retention wall (noting the limited ability to distinguish the depth from which spoil originates).

These observations will be reported in the Validation Report to be prepared as described by **Section 16.8**.

16.4.3 Contingency Validation Measures

16.4.3.1 Validation of Treated Materials for Disposal to Landfill

Materials requiring stabilisation will be tested and validated in accordance with NSW EPA General Immobilisation Approval (approval number 2005/14 or a specific approval for the Site, where required). This will involve the collection and analysis of validation samples from treated and untreated materials at a rate of 1 sample per 500 m³. The validation samples will be analysed for the following:

- Untreated materials:
 - Heavy metals;
 - PAH and phenols;
 - TPH/BTEX;
 - Cyanide; and
 - Asbestos.
- Treated materials:
 - TCLP (Heavy metals)
 - TCLP (PAH and phenols);
 - TCLP (Cyanide); and
 - Unconfined Compressive Strength.

In addition to the above laboratory analysis:

- the composition of the reagent and ratio of reagent to untreated waste (mass/mass) used during the treatment works will be monitored and reported appropriately; and
- material requiring stabilisation will be inspected by a qualified environmental engineer/scientist to confirm whether it contains SPGWT and/or ACM and the results of this inspection documented.

If ACM is identified, it will be managed in accordance with **Section 13.9**.

Further detailing regarding the treatment of materials to facilitate disposal to landfill is provided in **Section 20.7**.

16.4.3.2 Stockpiling Areas

If stockpiling works (or on-site ex-situ treatment works, if required) are undertaken onsite, these works will be undertaken on appropriately sealed hardstand areas in a designated area, with diversion drains and bunding constructed around the perimeter of the area. Consequently, the soil beneath the hardstand is unlikely to be impacted by the stockpiling activities and subsequently, validation testing of these areas, once the hardstand is removed, is not proposed.

As a precautionary measure, before removal of hardstand is commenced, a careful inspection of these areas will be undertaken to identify the presence of contamination. If this inspection indicates the visual presence of any contamination relating to treatment operations, validation of the soil beneath the hardstand will be undertaken. These works will comprise the collection and analysis of validation samples on a 20 m sampling grid. Validation samples will be collected from the soil surface (0.0 to 0.15m depth) underlying the hardstand and analysed as per **Section 16.5**.

16.5 Validation Sample Analysis

16.5.1 Analysis Suite

All soil validation samples will be analysed by National Association of Testing Authorities (NATA) accredited laboratories.

The suite of analysis required for Area A will be as determined by the relevant soil SSTCs detailed in **Table T1**. Note that the analysis of asbestos in soils will be based on measurement of the gravimetric content of bonded ACM in soil as described by Schedule B1 of the NEPM (NEPC, 2013), to allow appropriate comparison to the asbestos SSTCs (refer to **Section 7.2.3**).

16.5.2 Analytical Methods

Two laboratories will analyse original, duplicate and triplicate soil samples using NATA registered methods. Both laboratories must undertake the required analytical testing in accordance with the requirements of Schedule B3 of the *NEPM* (NEPC, 2013) (and Schedule B2 of the *NEPM* [NEPC, 2013] in the case of asbestos).

Details regarding the analytical methods to be used will be discussed with the NSW EPA Accredited Site Auditor and the appropriate analytical laboratory engaged to undertake the works.

16.6 Soil Sampling Methodology

Fieldwork will be conducted in accordance with written standard operating procedures, copies of which will be maintained in a register on-site during the remedial works. This will ensure that representative samples of materials are collected and the sampling methodology remains consistent throughout the duration of the remedial works.

16.6.1 Sampling Methodology

Sample collection will be by:

- sampling trowel from excavation walls and bases (only if it is safe to do so) (refer to **Section 16.4.1 to 16.4.3**);
- grab samples directly from the centre of an excavator bucket from the centre of stockpiles for validation of stockpiled or treated material; and
- grab samples directly from the centre of an excavator bucket from test pits excavated within limited excavation areas (if required, refer to **Section 16.4.1**).

All validation sample points will be surveyed.

Materials will be described in accordance with the Unified Soil Classification System (USCS), with soil type, descriptive properties (colour, particle size, moisture content, sorting), as well as discolouration, staining, odours and other indications (if any) being noted. The information will be recorded on field logs completed for each location.

On-site screening of samples for volatile organic compounds (VOCs) in the field will be undertaken using a portable photoionisation detector (PID). The PID will be calibrated at least once daily (at the start of each sampling day) with a known concentration of isobutylene.

Soil samples will be placed into laboratory supplied glass jars as soon as practicable after collection. The jar size will be sufficient to meet the laboratory requirements for the requested analysis. All sample containers will be filled completely using a method such that the loss of volatile components is minimised. All sample containers will be clearly labelled with information such as sample number, sample location, depth, date collected and sampler's identification. After filling, sample containers will then be transferred to a chilled esky for sample preservation prior to and during shipment to the testing laboratory. The sample preservation requirements are listed in **Table 7** below.

Table 7 Soil Sample Preservations and Storage

Analyte	Preservation	Storage
Inorganics		
Metals (General)	Unpreserved, glass jar with Teflon lined lid.	Store at <4 °C, analysis within 6 months.
Metals (Chromium VI by alkali digestion)	Unpreserved, glass jar with Teflon lined lid.	Store at <4 °C, extract within 28 days, analyse within 7 days.
Metals (inorganic Mercury)	Unpreserved, glass jar with Teflon lined lid.	Store at <4 °C, analysis within 28 days.
Cyanide	Unpreserved, glass jar with Teflon lined lid.	Store at <4 °C, extraction within seven days, analyse within 14 days.
Asbestos	NA	NA

Analyte	Preservation	Storage
Organics		
TPH C ₆ -C ₉	Unpreserved, glass jar with Teflon lined lid.	Store at <4°C, nil headspace, analysis within 14 days.
TPH C ₁₀ -C ₃₆	Unpreserved, glass jar with Teflon lined lid.	Store at <4°C, extraction within 14 days, analysis within 40 days.
BTEX	Unpreserved, glass jar with Teflon lined lid.	Store at <4°C, nil headspace, analysis within 14 days.
PAHs	Unpreserved, glass jar with Teflon lined lid.	Store at <4°C, extraction within 14 days, analysis within 40 days

A sample register will be updated daily to manage and track the validation process.

16.6.2 Sampling Equipment Decontamination

Equipment decontamination will be undertaken as described below. The following equipment will be needed for the detergent wash and water rinse decontamination process:

- laboratory (phosphate-free) detergent or Decon 90;
- tap water and deionised water;
- buckets or tubs (sufficient for size of equipment to be cleaned); and
- stiff brushes for cleaning.

Equipment that cannot be thoroughly decontaminated using the detergent wash and water rinse should be steam cleaned, or if a steam cleaner is not available, not used for further sampling (and marked clearly "not decontaminated") or discarded. Equipment decontaminated using the high pressure steam cleaner will be further decontaminated as described above.

16.6.3 Quality Control samples

The following quality control (QC) samples will be collected as part of the field quality control procedures:

- Intra-Laboratory Duplicates – are identical to field samples, but both samples are sent anonymously to the primary laboratory. Blind duplicates provide an indication of the analytical precision of the main testing laboratory, but may also be affected by sampling techniques and inherent heterogeneity in the sample medium;
- Inter-Laboratory Duplicates – are identical to blind duplicates, but the duplicate sample is sent to the second (check) laboratory. Split duplicates provide an indication of the accuracy of the main testing laboratory;
- Trip Blanks/Spikes – are samples of soil or water prepared by the laboratory with either zero or known analyte concentration. Trip blanks/spikes are a check on the sample contamination originating or lost from sample transport and handling, and shipping. One Trip Blank/Spike will be analysed per sample batch;
- Field Blanks – are similar to trip blanks except the water is transferred to sample containers on-site. Field blanks are a check on sample contamination originating from sample transport, handling, shipping, site conditions or sample containers. One Field Blank will be analysed per water sample batch; and
- Rinsate blanks - one rinsate blank sample (from an item of sampling equipment) will be collected per day of sampling by running distilled water over the selected item and decanting directly into the sample bottle. The rinsate will be taken from the final rinse of the equipment after decontamination.

Procedures for duplicate sampling will be identical to those used for routine sampling and duplicate samples will be despatched for analysis for the same parameters using the same methods as the routine sample. Duplicate soil samples will be collected from directly adjacent to original samples (i.e., from the adjacent area of the excavation base or wall). No homogenisation of samples will occur to reduce the loss of volatile compounds.

Duplicates and equipment blank samples will be collected as follows:

- Intra-Laboratory duplicate samples will be collected at a rate of approximately 1 in 20 soil samples and analysed for the full analyte suite. At least one blind duplicate sample will be included in each batch of samples;

- Inter-Laboratory duplicate samples will be collected at a rate of approximately 1 in 20 soil samples and analysed for the full analyte suite. At least one split duplicate sample will be included in each batch of samples; and
- One equipment blank of soil sampling equipment will be collected for every day of sampling and analysed for the full analyte suite. At least one equipment blank will be included in each batch of samples.

16.6.4 Laboratory QA/QC

The laboratories will undertake the analyses utilising their internal procedures and their test methods (for which they are NATA, or equivalent, registered) and in accordance with their quality assurance (QA) system which forms part of their registration.

Laboratory quality control procedures, which will be used during the project, will comprise the following:

- Laboratory Duplicate Samples – these are sub-samples taken from one sample submitted for analytical testing in a batch. A laboratory duplicate provides data on analytical precision. The rate of duplicate analysis will be according to the requirements of the laboratory's accreditation but will be at least one per batch;
- Matrix Spiked Samples – the purpose of the matrix spike is to monitor the performance of the analytical methods used, and to determine whether matrix interferences exist. A sample is spiked by adding an aliquot of known concentration of the target analyte(s) to the sample matrix prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques. These will be analysed at a rate of approximately 5% of all analyses. At least one per batch will be reported;
- Laboratory Blank – this is usually an organic or aqueous solution that is as free of analyte as possible and contains all the reagents in the same volume as used in the processing of the samples. The reagent blank must be carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample. Blanks will be analysed at a rate of once per process batch, and typically at a rate of 5% of all analyses;
- Laboratory Control Samples – these comprise either a standard reference material or a control matrix fortified with analytes representative of the analyte class. Recovery check portions should be fortified at concentrations that are easily quantified but within the range of concentrations expected for real samples. These will be analysed at a rate of one per process batch, and typically at a rate of 5% of analyses; and
- Surrogates – surrogate spikes are known additions to each sample, blank and matrix spike or reference sample analysis, of compounds which are similar to the analytes of interest in terms of:
 - extraction;
 - recovery through clean-up procedures; and
 - response to chromatography or other determination;but which:
 - are not expected to be found in real samples;
 - will not interfere with quantification of any analyte of interest; and
 - may be separately and independently quantified by virtue of, for example, chromatographic separation or production of ions of different mass in a GC/MS analyser.

Surrogate spikes are added to the analysis before extraction. The purpose of surrogates is to provide a means of checking, for every analysis, that no gross errors have occurred at any stage of the procedure leading to significant analyte losses. Other internal laboratory quality control procedures, as required for NATA, or equivalent, registration, will also be performed.

Results of the QC analyses for both laboratories will be reported with each batch.

16.7 Validation Data Quality Objectives

The Data Quality Objectives (DQO) process is a systematic, seven-step process that defines the criteria that an investigation should satisfy. DQOs for the validation works have been developed based on the iterative DQO process developed by the USEPA (2000) Guidance for the Data Quality Objectives Process – EPA QA/G-4 and

adopted by NSW DEC (2006). The guidelines incorporate field quality control and laboratory analysis, methods and information on laboratory quality control data and have been used to validate the field and analytical data for the validation works.

The DQO approach follows the general guidance provided in Appendix IV of NSW DEC (2006) with respect to setting the DQOs and assessing their achievement by reference to the Data Quality Indicators (DQIs) set out in Appendix V of NSW DEC (2006). The approach has been modified to focus on setting appropriate objectives and ensuring the reliability of data from both field and laboratory procedures. The approach puts more emphasis on Step 5 (Developing the analytical approach to assessing data), which assesses the reliability of both the field and laboratory data and on demonstrating achievement of the objectives of the validation works. The approach assesses achievement of Step 6 (performance or acceptance criteria that data need to achieve) by reference to DQIs for both field and laboratory procedures.

The DQOs are detailed in the following Sections.

16.7.1 Step 1 – State the problem

The historic reclamation of the Site with fill materials (refer to **Section 3.2.1**) has caused metals, BTEX, PAH and TPH contamination in the soils in some areas of the Site. The *ORWN HHERA* (AECOM, 2014) has concluded that some chemicals are present in the Site soils at concentrations which may pose a risk to human health or the environment in the context of the proposed land uses. Consequently, management of soils in some areas of the Site is required.

A validation program is required to demonstrate that the remediation objectives of this RAP, specifically with respect to the mitigation of the risks to human health and the environment, have achieved.

16.7.2 Step 2 – Identify the decisions

The decisions to be made relate to whether the validation program has demonstrated that the works have achieved the objectives of the RAP:

- Is the developed Site protective of human health in the context of the proposed Crown Hotel Development Works?
- Do the completed works comply with applicable legislative requirements including the appropriate requirements of the NSW DP&E and NSW EPA?

16.7.3 Step 3 - Identify the decision inputs

Inputs to the decision that need to be made with respect to whether the proposed excavation works at the Site have achieved the stated objectives are:

- The results of previous investigations (refer to **Section 8.0**);
- The use of appropriate remediation criteria (the SSTCs, refer to **Section 7.0**) as described in the *ORWN HHERA* (AECOM, 2014);
- The development and implementation of remedial options;
- The data to be obtained during soil sampling during the validation testing discussed in **Section 16.4**;
- The use of appropriate validation field methods, including sampling and preservation of soil and groundwater samples;
- The use of NATA registered methods for all analysis; and
- Confirmation that the DQIs have been achieved.

16.7.4 Step 4 – Definition of the boundaries of the remedial works

This is clearly defined by reference to the Site address and surveyed site areas (refer to **Section 3.1** and in **Figure F7** [Rygate site services plan]).

16.7.5 Step 5 – Develop decision rules

The quality of data from field and laboratory procedures will be achieved by assessing data with reference to DQIs. The criteria will be as follows:

Table 8 Field and Laboratory Data Quality Indicators

Data	Data Quality Indicators
Field	
Field Personnel	Use appropriately trained field personnel.
Field data collection	Site conditions and sample locations properly described. All soil sample and groundwater monitoring well locations will be surveyed. Information to be recorded in field notes. Field notes are appropriately completed.
Sample handling (storage and transport)	Soil samples will be collected will be collected in accordance with Section 16.6 .
Field duplicates	As per the requirements of Section 16.6.3 .
Field blanks	As per the requirements of Section 16.6.3 .
Calibration of Field Equipment	On-site screening of samples for volatile organic compounds (VOCs) in the field will be undertaken using a portable photoionisation detector (PID). The PID will be calibrated at least once daily (at the start of each sampling day) with a known concentration of isobutylene. Water quality meters will be calibrated prior to the commencement of field activities with relevant solutions. The calibration will be in accordance with manufacturer's instructions or NATA publications <i>General Requirements for Registration: Supplementary Requirement: Chemical Testing (NATA 1993) and Technical Note NO. 19 (NATA 1994)</i> . Where satisfactory calibration cannot be achieved, the equipment will not be used. Calibration details will be recorded on field sheets, which will be included in the final report.
Laboratory	
Sample Analysis	All sample analyses to be conducted using National Association of Testing Authorities (NATA) certified laboratory using <i>NEPM</i> (1999) procedures. Use NATA certified check laboratory.
Holding times	Maximum acceptable sample holding time will be as follows: - BTEX - 14 days; - TPH C₆-C₉ - 14 days; - TPH C₁₀-C₃₆ - extract within 7 days, analyse within 40 days; - PAHs - extract within 7 days, analyse within 40 days; - Phenols - extract within 7 days, analyse within 40 days; - Ammonia - 28 days; and - Asbestos – NA.
QA/QC samples	As per the requirements of Section 16.6.4 .
Practical Quantitation Limits (PQLs)	All PQLs to be less than the remediation criteria.
Laboratory Relative Percentage Difference (RPD)	The RPDs of replicates will be determined and compared to the following criteria (from tender brief) for acceptability: - Less than 20 percent for laboratory duplicates where the detection is greater than 20 times the PQL; - Less than 50 percent for laboratory duplicates where the detection is greater than 10 times the PQL and less than 20 times the PQL; and - No limit where concentration less than 10 times PQL
Control Spike Duplicate RPDs	RPDs for Control Spike Duplicates will be compared to an acceptable limit of 20% and undertaken at 1 in 20 samples or a minimum of 1 per batch.
Matrix Spike Duplicates RPD	RPDs for Matrix Spike Duplicates will be compared to an acceptable limit of 20% and undertaken at a minimum of 1 in 20 samples.
Control Spike and Matrix Spike Recoveries	Percent recoveries of control spikes and matrix spikes will be compared to an acceptable range of 75–130 % and/or the laboratories internal DQI limits.

Corrective Actions

Analytical data that fails to meet the predetermined DQIs listed in

Table 8 will be managed using the following corrective actions on a case-by-case basis:

- Inspect samples to determine heterogeneity;
- Reanalyse suspect samples;
- Evaluate and amend sampling and/or analytical procedures;
- Re-sampling and re-analysis;
- Accept the data with an acknowledged level of bias and imprecision; and
- Discard the data.

In the event that data of questionable reliability are used, then it is essential that any restrictions and limitations associated with the use of such data are clearly identified. Failure to meet the DQIs will be reported and the implications to data quality will be assessed.

If the DQIs are considered to have been achieved satisfactorily then it will be concluded that the data is suitable for use for validation purposes. If the DQIs are not achieved, the significance of possible errors will be assessed to decide whether the data is useable.

16.7.6 Step 6 – Specification of the acceptable limits on decision errors

Specification of the acceptable limits on decision errors will be achieved by reference to the DQIs outlined below:

Precision

Precision measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques will be assessed by calculating the Relative Percent Difference (RPD) of duplicate (laboratory and field) samples. The criteria to be used for the assessment of RPD will be based on guidelines given in AS4482.1 1997. These criteria listed in **Table 9** below.

Table 9 RPD Assessment Criteria

Sample Type	Typical Acceptable RPD ^(a)
Intra-Laboratory Duplicate	30-50% ^(b)
Inter-Laboratory Duplicate	30-50% ^(b)

Notes: a) The significance of RPDs of results should be evaluated on the basis of sampling technique, sample variability, absolute concentration relative to criteria and laboratory performance.

b) This variation can be expected to be higher for organic analysis than for inorganics and for low concentrations of analytes which are close to the laboratory LOR.

If duplicate results are not within the acceptable RPD range, investigation into the cause will be initiated. The results of the investigations will be written up and filed, and followed up with the laboratories to achieve resolution. Thus the precision of the laboratory will be assessed by the acceptability of the RPD of laboratory duplicate samples, which should be within the acceptable RPD limits as established for intra-laboratory and inter-laboratory duplicates.

Accuracy

Accuracy measures the bias in measurement. Accuracy can be impacted by factors such as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analysis techniques by the analysing laboratory and improper analyses.

The accuracy of the laboratory data that will be generated during the project is a measure of the closeness of the analytical results obtained by a method to the 'true' value. For reference laboratory methods (e.g. USEPA methods), the following levels of accuracy should generally be achievable within $\pm 15\%$ of:

- the expected value of a certified reference material of similar matrix; or
- the value obtained by a separately validated and recognised quantitative method for the sample matrix.

Accuracy will be assessed by:

- reference to the analytical results of laboratory control samples;
- use of trip, equipment and field blanks to check the accuracy of sampling techniques; and
- evaluating the results of laboratory spikes and analyses against reference standards.

Analytical results of these should be sufficient to establish that accuracy has been achieved in the work of the sampling team.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness will be achieved by collecting samples on a grid basis from an adequate number of sample locations, to validate the subject area to the required accuracy and ensuring that an appropriate number of reliable analyses have been reported for each population or environmental condition, and that the concentrations of CoPC have been maintained in the samples during and after their collection. Consistent techniques and methods using written procedures will be utilised throughout the sampling program.

Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being a sufficient amount of valid data generated during the validation works. If there are insufficient valid data, as determined by the other DQIs, then additional data will be required to be collected.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. This will be achieved through maintaining a level of consistency in techniques used to collect samples, and ensuring the selected laboratories use consistent analytical techniques and reporting methods. Reporting of results will be done in consistent units and nomenclatures, and comparability will be achieved by ensuring that precision and accuracy objectives are met.

16.7.7 Step 7 – Optimisation of the design of the collection of data

This will be achieved by meeting the DQOs detailed in Steps 1 to 6 to confirm that the data generated from the remedial works is from appropriate locations, that analytical testing is undertaken for the identified CoPC, in appropriate quantities and of acceptable quality to confirm that the objectives of the remedial works have been achieved.

16.8 Validation Reporting

Following completion of the excavation and validation works, a consolidated Validation Report will be prepared.

The reporting requirements for the Site will be confirmed with the various stakeholders including, but not limited to the Crown, Lend Lease, the NSW EPA Accredited Site Auditor, NSW EPA and the BDA.

It is anticipated that the validation reporting will be undertaken in a manner which enables the NSW EPA Accredited Site Auditor to prepare Site Audit Statements confirming whether the Site has been remediated to a standard suitable for the proposed Crown Hotel Development Works.

The Validation Report will be prepared in accordance with the requirements of the *Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA, 2011) and will include the following information:

- An overview of the excavation works carried out at the Site;
- A summary of the site history and basis for the management approach for the Site;
- Surveyed figures outlining the extent of the excavation works;
- The location of validation and characterisation samples;
- Descriptions of sampled materials (including visual and olfactory observations);

- Additional information collected to characterise the potential presence of SPGWT in proximity to the Stage 1B basement walls and floor (refer to **Section 16.4.2.2**).
- Field Equipment calibration certificates/records;
- Photographic documentation of the bedrock validation works (if required);
- Details of imported material used at the Site;
- Waste classification certificates and landfill waste disposal information;
- Summary tables for soil and groundwater analytical results;
- Confirmation that the project DQO's and DQIs have been appropriately met;
- NATA registered laboratory analytical certificates;
- Summary of the tracking and fate of materials including materials excavated for on-site treatment, reuse on-site or off-site disposal;
- Landfill weighbridge dockets (if required);
- Conclusions as to the suitability of the Site, specifically for the proposed Crown Hotel Development Works; and
- Recommendations (if required) for further works.

17.0 Environment Management Plan – During Excavation

17.1 General

This section of the RAP describes the minimum standards to be adopted to protect the environment during the bulk excavation works. The Contractor will develop and implement a suitable Environmental Management System in compliance with legislative and regulatory requirements. A site-specific Environmental Management Plan (EMP) will be developed prior to commencement of the excavation works. The EMP will detail the appropriate information and mitigation measures necessary to conduct the excavation works in a manner that will minimise the risk to the environment.

17.2 Water Management

The Environment Management Plan for the works will include procedures for the management of surface and groundwater during the works as outlined in **Section 14.0**.

17.3 Air Quality Management

An Air Quality Impact Assessment will be prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005) to assess potential air and odour issues generated during the excavation works. This assessment will make reference to the following guidance documents:

- *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework* (DEC, 2006a); and
- *Management of Odour from Stationary Sources in NSW: Technical Notes* (DEC, 2006c).

17.3.1 Odour

Odour management is recognised as a critical aspect of site environmental management and will need to be given high priority in the planning of all excavation and stockpiling of contaminated soil at the Site. Odours are expected during the soil excavation, and consequently, management procedures will need to be developed within the EMP to address odour issues during all excavation works.

Primarily, odours at the Site will be associated with the excavation of hydrocarbon impacted materials. Odour generation at the Site will be influenced by weather conditions, the extent of open excavations and stockpiles, and the quality of material exposed.

A detailed odour management system will be developed as part of the EMP incorporate the use of various management options as deemed appropriate for particular areas. The odour management system will include the following options:

- investigation as to the source of odours including odour monitoring;
- minimisation of the quantity or surface area of exposed odorous materials;
- implementation of odour management response procedures (as specified in the EMP);
- implementation of progressive contingency measures (as specified in the EMP);
- covering of exposed odorous materials progressively or at the completion of each work period;
- minimising exposed/excavation areas;
- apply odour suppressant sprays or foams to excavation surfaces;
- use an odour suppressant spray curtain at the access point to the excavation area (refer to **Section 13.2**); and
- undertake activities during favourable weather conditions.

The management of odour is recognised as a critical aspect of the environmental management of the proposed excavation works. Selection of the appropriate management and mitigation measures, including those summarised above, will be based on consideration of:

- the quantity of odorous materials that require remediation;
- the duration of the required excavation works and associated management of odorous materials;
- the proximity of the proposed excavation works to sensitive receptors;
- the prevailing and forecast weather conditions; and/or
- other activities being undertaken at the Site in parallel with the excavation work.

17.3.2 Dust

Care should be taken to manage wind-blown dust at the Site during excavation and earthworks activities. Dust can be generated through a range of means and activities:

- Wind action:
 - Exposed soil surfaces will generate dust during winds;
- Agitation and movement:
 - Excavation, mixing and placement of soil will generate dust;
 - Transfer of soil in uncovered trucks may result in dust generation;
- Vehicle Movements:
 - Vehicles' wheels on exposed soil surfaces (such as unsealed roadways) will generate dust.

Appropriate management of dust is required to ensure that it is minimised and/or prevented. Dust management will include the following:

- Excavation in the excavation enclosure for the contaminated areas (refer to **Section 13.2**);
- Covering surfaces;
- Minimising exposed/excavation areas;
- Wetting down; and
- Dust monitoring.

17.4 Noise and Vibration Management

Potential for noise and vibration impacts associated with the excavation works may result from:

- Works associated with preparation of the Site (including construction of the basement groundwater retention wall system);
- Movement of construction vehicles around the Site; and
- Operation of plant and activities on the Site (including excavators and piling rigs).

An assessment of noise and vibration impacts potentially generated during the excavation works was made in the *Barangaroo South Crown Sydney Hotel, Early Works Stage 1C Construction Noise Report* (Wilkinson Murray, April 2014). The report concluded that:

- *no exceedance of noise management levels is expected at surrounding receivers;*
- *the increase in noise has been determined to be marginal; and*
- *the Site 'is remote from any sensitive receivers and resultant vibration levels will be negligible.*

Notwithstanding, the excavation and construction works will be undertaken in accordance with a *Noise and Vibration Management Plan* (to be included as part of the Lend Lease *Construction Framework Environmental Management Plan*).

17.5 Long Term Environmental Management Plan

On the basis that both the key assumptions and requirements of this RAP and the *ORWN HHERA* (AECOM, 2014) are successfully delivered and implemented during the execution of the works, and validated accordingly upon completion, no Long Term Management Plan is envisaged as a requirement of this RAP.

Should future land owners propose to re-develop the Site for a land use that is different to those included as part of the proposed Crown Hotel Development Works (refer to **Section 4.0**), the associated development application would be required to consider the requirement (or otherwise) for a Long Term Environmental Management Plan or further remediation to facilitate the proposed re-developed land use. Such considerations are beyond the scope of this RAP.

18.0 Occupational Health and Safety – During Excavation

18.1 General

This section of the RAP describes the minimum standards to be adopted to protect the health and safety of all persons involved in the excavation works. The Contractor will develop and implement a suitable Health and Safety Management System in compliance with legislative and regulatory requirements. A site-specific Occupational Health and Safety Plan (OHSP) will be developed prior to commencement of the works. The OHSP will detail the appropriate health and safety information necessary to conduct the excavation works in a safe manner. The OHSP will be endorsed by a suitably qualified occupational hygienist.

18.2 Occupational Health & Safety Plan

The purpose of the site-specific OHSP is to present all relevant health and safety information for the works. The information presented in the OHSP will include:

- Assignment of responsibilities for management personnel and workers;
- An outline of the existing Site conditions;
- Details of all work to be conducted;
- An evaluation of hazards and risks;
- Details of the proposed measures to be implemented to manage the identified hazards and risks;
- Establishment of personnel protection standards and mandatory safe work procedures;
- Establishment of OHS monitoring protocols;
- Training requirements for emergency team members;
- Communication protocols and training procedures;
- Evacuation procedures, emergency contacts and emergency drills to be implemented; and
- Provision for contingencies and changes in work practices.

18.2.1 Responsibilities

The responsibilities and duties of the Contractor in relation to OHS will include:

- Ensuring all work undertaken is performed in accordance with relevant legislation and regulations, and directions issued by regulatory authorities;
- Developing and documenting safe working practices for all employees and subcontractors;
- Ensuring workers are adequately trained to undertake their work tasks using the adopted work practices;
- Ensuring that work is performed in strict adherence to the adopted work practices;
- Appointing a suitably qualified and experienced Site Safety Officer (SSO) to supervise and control safety matters;
- Supplying and maintaining first aid kits, first aid facilities and ensuring first aid attendants are present in accordance with statutory requirements;
- Ensuring that all workers are inducted prior to their commencement of work. This will include site-specific training in regard to the site conditions, works procedures, emergency and evacuation procedures, first aid procedures, decontamination procedures and other relevant matters detailed in the OHSP;
- Ensuring that copies of the OHSP are readily available;
- Establishment and maintenance of a record of all hazardous substances on the Site including provision of Safety Data Sheets (SDSs);
- Ensuring that all personnel who work with contaminated materials undergo a medical examination prior to and at the completion of their work on-site;

- Reporting all site incidents and accidents to WorkCover NSW;
- Ensuring that the SSO is on-site during all site works to monitor compliance with the OHSP;
- Ensuring that regular documented OHS inspections are conducted, including the use of a documented follow-up system to monitor improvements and measures introduced to rectify any observations made;
- Supplying and maintaining the required personal protective equipment (PPE);
- Ensuring all workers are trained in the use of the PPE and correctly use PPE; and
- Ensuring that all electrical equipment, plant and tools comply with appropriate statutory requirements and are maintained in a good, serviceable and safe condition.

18.2.2 OH&S Legislation, Regulations and Standards

The excavation works will be conducted in compliance with applicable OH&S legislation, regulations and standards. In addition, the excavation works will comply with relevant industry codes of practice, guidelines and other publications that have been developed by WorkCover NSW. These may include:

- *The Work Health and Safety Act 2011 and Regulation (2011);*
- *The Dangerous Goods Act 1975 and General Regulation (1999);*
- *Guide for Riggers (November 1995);*
- *Electrical Practices for Construction Work (February 1992); and*
- *Exposure Standards for Atmospheric Contaminants in the Occupational Environment (May 1995);*

A number of Australian Standards have been identified relating to OH&S issues for the works proposed at the Site. These standards include:

- AS 1319 -1994 Safety Signs for the Occupational Environment;
- AS 1336 -1997 Recommended Practices for Occupational Eye Protection;
- AS 1470 -1986 Health and Safety at Work - Principles and Practices;
- AS 1715 -1994 Selection, Use and Maintenance of Respiratory Protective Devices;
- AS 1716 -2003 Respiratory Protective Devices;
- AS 1801 -1997 Occupational Protective Helmets;
- AS 1885.1 -1990 Measurements of Occupational Health and Safety Performance - Describing and Reporting Occupational Injuries and Disease (known as the National Standard for Workplace Injury and Disease Recording);
- AS 2161 - 2000 Occupational Protective Gloves;
- AS 2210 - 2000 Occupational Protective Footwear;
- AS 2436 -1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- AS 2601 -2001 The Demolition of Structures;
- AS/NZS 2865-2001 Safe Working in a Confined Space;
- AS 2986 -1987 Workplace Atmospheres - Organic vapours - Sampling by Solid Adsorption Techniques;
- AS/NZS 3012 -1995 Electrical Installations – Construction and Demolition Sites;
- AS 3640 -1989 Workplace Atmospheres - Method for Sampling and Gravimetric Determination of Inspirable Dust; and
- AS/NZS 4576 -1995 Guidelines for Scaffolding.

18.3 Risk Assessment

A hazard analysis should be conducted prior to site establishment to identify the OHS hazards expected during the course of the excavation works. A Risk Management Plan will be developed to identify hazards associated with the proposed excavation works, evaluate the associated risks and determine the necessary measures to reduce or mitigate those risks. This section of the RAP outlines some of the hazards expected over the course of the project. Hazard identification and risk assessment will be conducted and documented on an ongoing basis as the project works proceed.

18.3.1 Chemical Hazards

Based on the information provided in previous investigations at the Site, the presence of asbestos, metals, BTEX, TPH and PAHs has been confirmed within the Sites soils and groundwater in some areas. The hazard posed by these materials will be evaluated and the associated risks assessed in the Risk Management Plan.

18.3.2 Atmospheric Exposure Limits and Recognition Qualities

The exposure limits and recognition qualities of the chemicals likely to be encountered in the excavation works will be taken from the following guidelines (listed in order of precedence) and detailed in the OHSP:

- NOHSC, Exposure Standards for Atmospheric Contaminants in the Occupational Environment, 1995. The most up-to-date Australian exposure standards are located on the Safe Work Australia Hazardous Substances Information System (<http://hsis.ascc.gov.au/SearchHS.aspx>); and
- National Institute for Occupational Safety and Health (NIOSH) 2007, Pocket Guide to Chemical Hazards. Also refer to <http://www.cdc.gov/niosh/npg/>.

18.3.3 Additional Hazards and Risks

The OHSP will identify and describe a range of other hazards anticipated during the excavation works. These hazards will include:

- Heat stress;
- Explosive atmospheres in areas dealing with contaminated materials;
- Oxygen deficient atmospheres and confined spaces (as defined under AS/NZS 2865 - 2001 Safe Working in a Confined Space);
- Underground utilities;
- Underground pipelines, pits, and other obstructions;
- Above ground electrical and utility hazards;
- Traffic hazards (particularly noting that Hickson Road will remain operational during the excavation works);
- Instability of excavation batters and stockpiled material;
- Hazards associated with operation of the treatment works (if required);
- If on-site ex-situ treatment is required (refer to **Section 12.3**):
 - Hazards associated with the construction and decontamination of the RE and ECS;
 - Hazards associated with the airlock and decontamination operations in the RE; and
- Hazards associated with the proposed top down construction methodology (refer to **Section 13.2**); and
- Physical hazards such as trip hazards and mobile plant.

Specific minimum standards for these hazards will be outlined within the Risk Management Plan.

18.4 Work Zones

The Site will be divided into a number of work zones, as follows:

- Exclusion Zones – for example the excavation area;
- Decontamination Zones – decontamination stations located adjacent to the exclusion zones; and
- Support Zones – the site office and site facilities areas adjacent to the decontamination zones.

Movement of personnel and equipment between these zones will be minimised and restricted to specific access control points and decontamination stations to prevent cross contamination to clean areas.

18.4.1 Decontamination Stations

The decontamination stations will be the only entry and exit points to Exclusion Zones. The stations will be located to minimise the transportation of contaminants between the various areas of the Site, and to ensure that the Support Zone does not become contaminated or affected by other site hazards.

As discussed in **Section 12.3.1**, clean and dirty zones will be established at all decontamination stations. All workers will be required to pass through the Decontamination Stations when entering and exiting the Exclusion Zones.

These stations will also house the PPE stock rooms and change rooms, so that when entering the Exclusion Zones workers are able to apply the necessary PPE.

18.4.2 Support Zone

The Support Zone refers to the site office and other support facilities involved in administering the excavation works. Site personnel may wear normal work clothes within this zone, leaving any potentially contaminated clothing, equipment and materials in the decontamination station until decontaminated or appropriately disposed of.

In the event of an emergency, support zone personnel are responsible for alerting the correct authorities. All emergency telephone numbers, evacuation route maps, vehicle keys and site safety information would be held within the Support Zone.

19.0 Community Engagement

Community engagement is critical to the success of development works at Barangaroo. Over the past two years, Lend Lease, in conjunction with the BDA, has undertaken an extensive program of community engagement on the excavation and remediation activities associated with Barangaroo South and the NSW EPA Declaration Area. This engagement has been aimed at educating the community and key stakeholders about the historic nature of the contamination at the Site and the importance of remediation works, the type of works proposed and to provide a forum for community feedback.

A number of consultation avenues have been utilised during this engagement program including:

- presentations to interested stakeholders;
- face to face meetings with key community groups and stakeholders to provide one-on-one briefings about the remediation;
- holding large scale community information sessions jointly between Lend Lease and the BDA;
- issue of Fact Sheets on remediation to relevant stakeholders and included on the BDA website - www.barangaroo.com; and
- newsletter updates and letterbox notifications.

All of these communications tools provided an opportunity to present factual information about the nature of the contamination and remediation works, along with ensuring the community could raise any issues of concern.

Lend Lease's community engagement program for the project has also included establishing a Business Construction Liaison Group (BCLG) and a Community Construction Liaison Group (CCLG), in conjunction with the BDA. The purpose of these groups is to brief key representatives from both the local commercial and residential communities on key aspects of the project, relating to construction, as early as possible in the planning process. To date, both of these forums have received extensive briefings on the proposed remediation and excavation activities at Barangaroo and remain keenly interested in further progress updates in the future. Representatives of these groups then assist in actively disseminating information back to their respective networks on the status of the project. It is intended that further presentations will be given to these two groups as the plans for remediation and excavation activities progress.

All consultation has been carried out in line with the principals and methodologies outlined in the Lend Lease Community & Stakeholder Engagement Strategy (May 2012).

Prior to undertaking excavation works associated with the Stage 1C development, Lend Lease will develop a Remediation Community Engagement Sub Plan, which will summarise ongoing engagement to be undertaken with the community. Engagement will continue, both prior to and during excavation activities, to ensure the community are fully informed of the remediation activities at the Site, and have an opportunity to provide feedback.

Table 10 Summary of Lend Lease Communication Strategy

Communication Channel	Purpose
1300 Community Enquiry Line	A key channel for the community to raise issues, ask questions and speak directly to a member of the Community Relations team. A 24 hour after hours service will be provided to ensure any issues occurring outside of business hours are addressed in a timely manner.
Barangaroo South Website (www.barangaroo.com)	This is the central portal for all information about the project. It is the one-stop-shop for everything the community and stakeholders will need to know about the remediation works including electronic copies of all newsletters, notifications, press releases and links to the NSW DP&E website and submissions.
Barangaroo South Blog (link on website)	An opportunity for open communication between the community, stakeholders and general public about the project.

Communication Channel	Purpose
Newsletters	To provide ongoing updates about the planning process and progress of works on site. This will be a key means of ensuring information transparently flows to the community and stakeholders about the remediation and excavation work.
Community Information Sessions	Used to convey key messages to the local stakeholders and proactively work to address specific concerns.
Stakeholder one-on-one briefings	To discuss concerns raised by key stakeholders face-to face and provide more detailed information and assurances about the project.
Public displays	To effectively raise greater awareness of the project and the progress, particularly during the design phase.
Notifications	To ensure all residents and businesses potentially impacted by Site works are informed in advance of key work commencing. Notifications will be used to inform the community of key issues such as the timing of noisy work, out of hours construction and traffic impacts.
Door knocking	To personally discuss concerns raised by the local business community (particularly the businesses along King Street Wharf and local cafes in the high rise commercial buildings) face-to-face on a one-on-one basis, proactively address any issues and provide assurances about the work.
Signage	To inform the community about who is responsible for the Site activities and the contact details for further information about the work.
Advertising	To provide regular updates to a large audience and direct them to the website for further information. To raise greater awareness about the project in the wider community.
Commercial Property Notice Boards	When appropriate, general information about the overall project will be included on the notice boards in commercial properties. This will also contain the contact details of the Lend Lease Barangaroo South Community Relations team should they require any further information about the work.
Hoardings	Hoardings will be used as a strategic communication tool to ensure the community and public are up to date with information regarding the construction and key marketing elements of the project (such as leasing enquiries). The relevant contact numbers (including the 24 hours Community Information Line) will be displayed on the hoarding at all times.

20.0 Contingency Planning

20.1 Approach

The purpose of the contingency plan is to outline procedures for the identification and management of unexpected issues or events that may occur during the works. The contingency plan will detail the following information:

- The assignment of responsibilities to nominated key personnel;
- The assessment of hazards associated with such situations, and the potential off-site impacts;
- Contingency responses; and
- Procedures for reporting relevant issues to regulatory authorities.

20.2 Potential Unexpected Events

Table 11 summarises the unexpected events which have the potential to occur during the excavation works, the likelihood of such an event occurring and the associated control measure which will mitigate such an event.

Table 11 Potential Unexpected Events and Related Control Measure

Potential Unexpected Event	Likelihood	Contingency Measure
Potential change in the future intended development strategy	Medium	Section 20.3
Variation of contaminant characteristics or identification of unanticipated contaminants and materials	Low	Section 20.4
Validation of excavations founded in bedrock	Low	Section 20.5
CIM/SPGWT is identified during the validation and/or excavation works	Medium	Section 20.6
Treatment is required to facilitate offsite disposal	Medium	Section 20.7
Failure of the preferred treatment approach to achieve a treatment standard required for off-site disposal of excavated material	Low	Section 20.8
Insufficient storage capacity to stockpile all required materials (<i>ex-situ</i> treatment works)	Low	Section 20.9
Further development of the future intended basement and Stage 1C groundwater retention wall system and services designs	Medium	Section 20.10
Operational issues during the remediation works including but not limited to: - Flooding of the Site; - Generation of unacceptable levels of dust during excavation and reinstatement works; - Release of unacceptable levels of fugitive emissions during the excavation works; - Generation of unacceptable odours from the excavation works; - Generation of unacceptable noise levels during site works; - Generation of unacceptable vibration levels during excavation and reinstatement works; and - Spills and leaks of hazardous materials.	Low Medium Medium Medium Low Low Low	Section 20.11

Contingency mitigations for the above events are described in the following sections.

20.3 Changes to the Future Intended Development Strategy

The future intended development strategy for Barangaroo may develop during the course of the planning approval process associated with Barangaroo South and Barangaroo Central. If changes resulting from this process affect the preferred remediation option identified by the RAP, the remediation strategy may require amendment.

Any change to the remediation strategy required may be based on consideration of:

- The requirement for, or changes to, development plans;
- Practical and commercial considerations; and
- Staging and sequencing of the remediation and development works in other Barangaroo site areas as part of the broader development works.

If required, an Addendum to this RAP would be issued to reflect any change to the remediation strategy. The Addendum would be issued to the NSW EPA Accredited Site Auditor for approval.

20.4 Variation of Contaminant Characteristics

The range of contaminants analysed in the previous investigations is considered to be appropriate for development of the soil SSTCs and assessment of whether CIM is present at the Site. However, there is the potential for occurrence of as-yet unidentified contaminants, and for variation in the concentrations or distribution of known contaminants.

Should any significant changes to the nature or types of contaminants be identified during the works a variation to this RAP, the *ORWN HHERA* (AECOM, 2014) and the soil SSTCs may be required. Variations will be issued to the NSW EPA Accredited Site Auditor for review and approval.

It is noted that the project team is familiar with potential site conditions based on its experience on areas adjacent to the Site, which at the time of this RAP included:

- Excavation and remediation of the adjacent Bond site;
- Construction of the basement groundwater perimeter retention wall and a number of piled foundations within the adjacent ORWS Area (Stage 1A Basement);
- Bulk excavation of the Stage 1A Basement (which is substantially complete); and
- Various preparatory and enabling works associated with the Stage 1A development. These have included intrusive works within the Site such as construction of stormwater diversions, establishment of a concrete batching plant and construction of a water treatment plant.

It is considered that any different materials encountered can be adequately addressed by AECOM and Crown following assessment and refinement of any required remediation design.

20.5 Validation of Excavations Founded in Bedrock

Whilst unlikely based on the current proposed excavation depth, it is possible that the excavation may encounter and be based in rock.

In the event that the Stage 1C excavation is founded in rock, the base of the excavation will be validated visually based on observations that:

- The final surface is generally free from SPGWT, specifically:
 - Any SPGWT present is contained within rock defects;
 - Any SPGWT present is not mobile (that is it does not migrate out of the defects under normal weather conditions); and
 - The area of SPGWT impacted defects is less than 5% of the exposed rock surface; and/or
- Surface waters are free of a sheen associated with contamination.

These observations will be documented via photographs (as described by **Section 16.4.2.1**).

If SPGWT is encountered in rock exposed as part of the Stage 1C excavation, the following potential engineering mitigation measures, to prevent the ingress of SPGWT to the excavation, will be considered:

- Local over-excavation of bedrock to remove SPGWT;
- Grouting of the rock defect to seal the SPGWT within the rock matrix; or
- Shotcreting (200 mm thick) of the rock surface to seal the SPGWT within the rock matrix.

Where the excavation is founded in rock, the excavation base will be validated by visual observation and photographic documentation.

20.6 Identification of SPGWT/CIM Requiring Remediation

As discussed in **Section 8.0**, SPGWT/CIM has not been identified at the Site which would warrant remediation. However, there is a potential that SPGWT/CIM could be identified during:

- Area A – additional validation sampling of unsaturated soils as recommended by **Section 16.4.1**; and
- the excavation proposed as part of the Stage 1C Works.

SPGWT/CIM identified during the above works would be appropriately managed in accordance with **Section 13.0** and **Section 17.0**.

20.6.1 Area A Additional Validation Sampling

If SPGWT/CIM is identified during the Area A additional validation sampling and is considered to warrant remediation, the material would be selectively excavated and disposed off-site to landfill. If required to facilitate offsite disposal to landfill, the excavated material would be treated in accordance with **Section 20.7**. If CIM is identified as a result of the presence of asbestos containing material, the required excavation works would be managed in accordance with **Section 13.9**.

Selection of the preferred remediation approach for this material (i.e. offsite disposal to landfill) was based on the Remedial Technology Assessment presented in Section 10 of the *VMP/Block 4 RAP* (AECOM, 2013c). This is assessment is considered appropriate given the similar material, contaminant types and logistical constraints between the Site and the adjacent Block 4 Development Remediation Works. In particular, excavation and off-site disposal to a NSW EPA licensed landfill facility has been selected in consideration of: the limited opportunities for reuse of material within the development; the maximum potential depth of excavations required (which will be limited to unsaturated soils only); and to be consistent with the works otherwise required as part of the future intended Crown Hotel Development.

Remedial excavations that may be required to mitigate risks associated with SPGWT / CIM identified within the Area A unsaturated soils would be validated through the collection of soil samples to confirm that residual CoPC concentrations are less than the soil SSTC-A (including the asbestos SSTCs). In particular:

- Wall validation samples will be collected at 10 m lineal metre intervals along the extent of excavation wall in material identified to be the most impacted (either by visual observations of field screening of samples using a PID); and
- Base validation samples will be collected on a 10 m sampling grid across the excavation base.

20.6.2 Stage 1C Excavations

Construction of the Stage 1C groundwater retention wall system and associated stabilising structures will extend through the marine sediments and into rock underlying the Site. As such, these activities have the potential to generate materials that would otherwise be classified as SPGWT / CIM.

It is also possible that SPGWT or CIM will be encountered during excavation within the Stage 1C groundwater retention walls.

SPGWT/CIM encountered during excavation within the groundwater retention walls will be disposed off-site to a NSW EPA licensed landfill. Validation of these works will not be required unless the CIM / SPGWT is encountered in the base of the excavation, in which case the validation approach described by **Section 16.4.2.1** will be implemented. If required to facilitate offsite disposal to landfill, the excavated material would be treated in accordance with **Section 20.7**. If CIM is identified as a result of the presence of asbestos containing material, the excavation works would be managed in accordance with **Section 13.9**.

As above, selection of the preferred remediation approach for this material was based on the Remedial Technology Assessment presented in Section 10 of the *VMP/Block 4 RAP* (AECOM, 2013c). In particular, off-site disposal to a NSW EPA licensed landfill facility has been selected in consideration of the approach that has been adopted for management of all excavation spoil that will be produced by the Stage 1C Works.

20.7 Treatment is Required to Facilitate Disposal to Landfill

Based on the current analytical data set, treatment of materials will not be required for the offsite disposal of material to a NSW EPA licensed landfill facility. However, it is possible that material (for example SPGWT/CIM as described by **Section 20.6**) will be encountered that requires treatment to facilitate offsite disposal to landfill.

If treatment works are required, Section 10 of the *VMP/Block 4 RAP* (AECOM, 2013c) ('Remediation Technology Assessment') will be referred to assist in the selection of the most appropriate remedial technology. This is considered appropriate given the similar material, contaminant types and logistical constraints anticipated at the Site and those identified in the Declaration Area.

The preferred approach for treatment of material to facilitate off-site disposal to landfill is ex situ stabilisation. If required, ex situ stabilisation will be undertaken as described by **Appendix D**.

Selection of the preferred remediation approach for treatment of material to facilitate landfill disposal is based on the Remedial Technology Assessment presented in Section 10 of the *VMP/Block 4 RAP* (AECOM, 2013c). This is assessment is considered appropriate given the similar material, contaminant types and logistical constraints between the Site and the adjacent Block 4 Development Remediation Works. In particular, Section 10.3.9 of the *VMP/Block 4 RAP* (AECOM, 2013c) concluded that the most appropriate remediation technology was excavation and ex situ stabilisation and offsite disposal to a NSW EPA licensed landfill facility. Depending on staging/sequencing, stabilisation works required at the Site may be undertaken utilising the infrastructure established for the Block 4 Development Remediation Works.

It is noted that stabilisation works will not address asbestos contamination. If asbestos is present, then the waste will be classified as Special Waste (asbestos containing) irrespective of the stabilisation process.

As discussed in **Section 16.4.3.1**, the NSW EPA General Immobilisation Approval # 2005/14 provides specific requirements for the stabilisation of coal tar contaminated soil for the purpose of disposal to an off-site NSW EPA licensed landfill facility. These requirements will include testing of the treated validation samples as per **Section 16.4.3.1**.

20.8 Failure of the preferred treatment approach(es)

As discussed in **Section 20.7**, the preferred approach to treatment of material as required to facilitate disposal to landfill is ex-situ stabilisation. The preferred approach has been selected based on consideration of:

- the ability to obtain an Immobilisation Approval for the stabilisation of material requiring disposal to an off-site licensed landfill;
- consideration of treatment rates, stockpile and curing requirements, programing of the remediation works and commercial efficacy; and
- consistency with the treatment approach proposed in relation to the Block 4 Development Remediation Works (as described by the *VMP / Block 4 RAP* (AECOM, 2013c)).

Depending on timing, the validity of the preferred treatment approach as described by **Section 20.7** will be reviewed based on the outcomes of the Block 4 Development Remediation Works.

Should this treatment approach prove to be unsuccessful in stabilising materials in accordance with the NSW EPA (2014) *Waste Classification Guidelines*, consideration will be given to:

- refinement of the treatment approach including use of different quantities of additives or different additives; or
- Implementation of an alternative ex situ treatment approach.

20.9 Insufficient Storage Capacity for Stockpiles

The proposed management strategy is to minimise the requirement for on-site stockpiling by direct transfer of material for off-site disposal. As described by **Section 11.3** it is anticipated that a program of *in situ* waste classification sampling will be undertaken to facilitate this process. Notwithstanding, variations in quantities or contaminant characteristics or the requirement for ex-situ treatment of material prior to landfill disposal (refer to **Section 20.7**) and associated delays in establishment of treatment infrastructure may result in the requirement for additional stockpiling.

If there is insufficient storage capacity for the stockpiling of material in designated areas within Barangaroo, the following options will be assessed:

- Consider collection of additional *in situ* samples to facilitate characterisation of material (where contaminant quantities or contaminant characteristics may be different from those expected) for off-site disposal before it is excavated;

- Explore options for temporary stockpiling of material outside of Barangaroo South; and
- Consider options for reuse of excavated materials at other sites outside of Barangaroo based on a NSW EPA approved Resource Recovery Exemption (refer to **Section 4.2**).

20.10 Further Development of the future intended Basement and Stage 1C Groundwater Retention Wall System Designs

As discussed previously, the future intended basement and Stage 1C groundwater retention wall system are subject to ongoing refinement and development as part of the Crown design process. Consequently, changes to the depth of the future intended basement and/or the final alignment of the Stage 1C groundwater retention wall system may be required. If the design is changed such that it affects the assumptions in the *ORWN HHERA* (AECOM, 2014) or this RAP, an Addendum to this RAP will be issued, as required, and submitted to the NSW EPA Accredited Site Auditor for approval.

For each of the contingency measures described following, the Auditor would be consulted to confirm agreement with the strategy to be adopted prior to implementation of the proposed measures.

20.10.1 Increase in the future intended basement depth

The future intended basement may be subject to further design development which may increase the basement depths below those detailed in **Section 4.2**.

The additional bulk excavation works that would be required to facilitate construction of the future intended basement to greater depths (i.e. in the order of 1 to 2 m) is not considered to affect the Preferred Management Strategy detailed in **Section 10.3.1**. This is because the depth of identified SPGWT in the MW60 area is currently approximately 4.5 m below the depth of the future intended Stage 1C Basement (as discussed in **Section 8.3.5**). If the depth is to be extended by greater than 2 m, additional assessment of the potential risk to occupants of the basement will be required in consultation with the Auditor.

If the increase in future intended basement depth involves excavation of the underlying bedrock, the contingencies described in **Section 20.5** will be considered.

It should be noted that bulk excavation works associated with a basement with an increased depth may generate contaminated material that, while not considered by this RAP to require remediation, may still require additional management to mitigate risks to human health or the environment. Such materials will require management in accordance with the environmental control measures detailed in **Section 13.0** and **Section 17.3**.

20.10.2 Reduction in future intended basement depth

As above, the future intended basement may be subject to further design development which may reduce the basement depths to less than those detailed in **Section 4.2**.

As discussed in **Section 8.3.5**, the depth of the future intended basement is less than the identified SPGWT identified in the MW60 area. Consequently, if the depth of the future intended basement is reduced further, the extent of the excavation works will increase the distance from the SPGWT present in the marine sediments in the MW60 area. As such, provided that the depth of the future intended basement remains deeper than the depth to groundwater, a reduction in the future intended basement depth would not affect the Preferred Management Strategy detailed in **Section 10.3.1**.

20.10.3 Changes to the Lateral Alignment of the Stage 1C Groundwater Retention Wall System

As for the future intended basement depth, the alignment of the Stage 1C groundwater retention wall system may be subject to further design development (refer to **Section 4.3**).

Realignment of the North Western Groundwater Retention Wall

As discussed in **Section 8.3.1**, SPGWT was identified in the MW60 area which is located adjacent to the northwest corner of the Stage 1C Works Area.

If the alignment of the north western groundwater retention wall system (i.e. in the vicinity of MW60) moves to the north west, there would be no impact to the preferred management strategy as a greater volume of fill material (and in particular, SPGWT identified in marine sediments in the vicinity of MW60) would be encapsulated behind the groundwater retention wall system. As such, potential impacts to the Area A groundwater (outside the Stage 1C Works Area) and ultimately Darling Harbour would be further mitigated.

It should be noted that bulk excavation works within the expanded Stage 1C Works Area may generate contaminated material that, while not considered by this RAP to require remediation, may still require additional management to mitigate risks to human health or the environment. Such materials will require management in accordance with the environmental control measures detailed in **Section 13.0** and **Section 17.3**.

If the alignment of the north western groundwater retention wall system (i.e. in the MW60 area) moves to the south west, whereby a greater volume of fill material (and in particular, SPGWT identified in the MW60 area) is located outside the groundwater retention wall system, there would be no impact to the preferred management strategy for the following reasons:

- MW60 was screened across the base of the fill and marine sediment interface. As described by **Section 6.6.5**, there is considered to be negligible contaminant flux from the natural marine sediments into the overlying fill;
- groundwater analytical results and field observations from other investigation locations within Area C (within the Stage 1C Works Area) indicate that the presence of SPGWT and TPH C₁₀-C₁₆ and naphthalene impacted groundwater is localised to the MW60 area;
- As detailed in Section 7.11 of the *ORWN HHERA* (AECOM, 2014), the *VMP Remediation Extent* report (AECOM, 2013d) considers that if the VMP Remediation Works described by the *VMP/Block 4 RAP* (AECOM, 2013c) are implemented, residual gasworks related contamination remaining *in situ* down hydraulic gradient of the Declaration Area (including within the Site) will not represent an unacceptable risk to the environment; and
- As detailed in **Section 7.4**, the *ORWN HHERA* (AECOM, 2014) also considers that residual concentrations of non-gasworks related contamination remaining within the Site do not represent an unacceptable risk to the environment.

Realignment of the Western Groundwater Retention Wall System to the East

If the alignment of the western groundwater retention wall system moves to the east, the footprint of Area A (that is materials remaining outside the Stage 1C Works Area) would increase. If the change in alignment is minor (i.e. less than 10m) there would be no impact to the preferred management strategy as the additional validation sampling currently proposed for Area A would remain valid. However, if the alignment of the western groundwater retention wall system moves to the east by greater than 10m, the unsaturated soils within the expanded Area A would require validation against the relevant soil SSTC-A in accordance with **Section 16.4.1** and in consultation with the Auditor to determine whether it represents CIM that requires remediation.

Realignment of the Groundwater Retention Wall System to the West

If the alignment of the western groundwater retention wall system moves to the west, there would be no impact to the preferred management strategy as a greater volume of fill material would be encapsulated behind the groundwater retention wall system. As such, potential impacts to the Area A groundwater (outside the Stage 1C Basement) and ultimately Darling Harbour would be further mitigated.

Realignment of the Southern Groundwater Retention Wall System to the South

If the alignment of the southern groundwater retention wall system moves to the south, there would be no impact to the preferred management strategy as a greater volume of fill material would be encapsulated behind the groundwater retention wall system. As such, potential impacts to the Area A groundwater (outside the Stage 1C Works Area) and ultimately Darling Harbour would be further mitigated.

Realignment of the Southern Groundwater Retention Wall System to the North

If the alignment of the southern groundwater retention wall system moves to the north, the footprint of Area A (that is materials remaining outside the groundwater retention wall system) would increase. If the change in alignment is minor (i.e. less than 10m) there would be no impact to the preferred management strategy as the additional validation sampling currently proposed for Area A would remain valid. However, if the alignment of the southern groundwater retention wall system moves to the north by greater than 10m, the unsaturated soils within the expanded Area A would require validation against the relevant soil SSTC-A in accordance with **Section 16.4.1** and in consultation with the Auditor to determine whether it represents CIM that requires remediation.

20.11 Operational Contingencies

20.11.1 Flooding of the Site

The EMP for the excavation works will be developed to control the impact of site works in order to minimise and mitigate against any impacts to off-site waters (Darling Harbour). As outlined in **Section 14.0**, the implementation and maintenance of a variety of environmental control measures will be undertaken during the project to manage water encountered during the works. Measures such as the installation of drains to divert clean water from up gradient areas to on-site stormwater drains, recycling of water and off-site water treatment will be conducted to manage and control water. Surface berms will also be constructed around the sub-surface top down excavation area to mitigate inflows into this area.

In extreme situations such as flooding or heavy rainfall, the discharge of treated water may be permitted to the sewer system in accordance with the conditions of a Sydney Water licence. All water intended for discharge will be stored on-site and tested prior to discharge to confirm compliance.

Records of all discharges will be kept describing the estimated volume of water discharged, the time period over which the discharge occurred, and the water quality results of water samples collected prior to discharge.

These control measures will be monitored during significant rainfall events to confirm their integrity and suitability.

20.11.2 Control of Dust

Should unacceptable levels of dust be detected during the excavation works, an investigation will be conducted to determine the source of the dust, and evaluate the appropriate measures to be implemented.

These measures may include the following:

- Increased use of a water cart or water sprays to suppress dust in open areas;
- Installation of temporary sheeting to cover localised exposed areas and stockpiles;
- Installation of dust screens around the sub-surface top down excavation area;
- Covering stockpiles of contaminated soil which will remain on the Site for more than 24 hours (where practical);
- Alteration of the works program to minimise the extent of disturbed open areas;
- Consolidation of material stockpiles;
- Use of chemical dust-suppressants provided the chemicals do not pose a contamination or OHS hazard;
- Use of alternative coverings such as hydro-mulch to stabilise the surface of open disturbed areas;
- Use of additional dust suppression features on items of dust generating plant and equipment;
- Securely covering all loads entering or exiting the Site; and
- Use of alternate work practices such as modified equipment to minimise dust generation.

20.11.3 Fugitive Emissions and Odours

Should unacceptable levels of fugitive emissions be detected at the Site boundaries or in the surrounding area during the project, an investigation will be conducted to determine the source of the emissions, and to evaluate the appropriate measures to be implemented.

These measures may include the following:

- Alteration in the works program to minimise in the extent of disturbed open areas;
- Prompt removal and treatment of heavily contaminated materials that have been exposed and are identified to have caused the emissions;
- Use of fine mist sprays around the excavation area;
- Conducting the work in more favourable weather conditions;
- Use of alternate work practices to minimise the period of impact of the emissions;
- Use of additional features to control emissions from plant and equipment;

- Use of alternate work practices such as using modified equipment;
- Relocation of offending plant and equipment to less sensitive on-site areas;
- Reducing the number of plant and equipment items on-site; and
- Use of a deodorant within water sprays at locations on-site and at Site boundaries provided the chemicals do not pose a contamination or OHS hazard.

20.11.4 Noise and Vibration

Should unacceptable noise and/or vibration levels be detected during the excavation works the following measures may be implemented:

- Modify the works program to minimise the impact of noisy or vibratory operations, including:
 - Modify the timing of the works to appropriate times of the day; and
 - Accelerate the works program to complete the works quickly and minimise the period of disturbance;
- Install additional noise suppression features on plant and equipment;
- Construct additional noise attenuation measures such as stockpile barriers, works area enclosures; and
- Use of different items of plant and equipment that generate less noise or vibration.

20.11.5 Spills and Leaks

A spill response plan will be developed and implemented as part of the Emergency Response Plan (ERP) detailing the procedures for responding to spills and leaks (refer to **Section 20.11.6**). The procedures outlined in the plan will be aimed at minimising the impact of any contaminant releases that may occur during the works.

The following actions will be taken in preparation for spills or leaks:

- Training of site personnel in appropriate spill response techniques;
- Allocation of spill response materials and equipment on-site (such as oil absorbent pads, booms and bio-dispersants);
- Containment of all storage tanks and drums inside bunded areas with a capacity of 110% of the largest container, or 25% of the total volume of all containers, whichever is greater;
- Initial assessment of the spill;
- Notification of the appropriate authorities if necessary;
- Following a spill or leak, an investigation to determine the root cause of the incident will be undertaken; and
- Corrective and preventative actions implemented to prevent future incidents.

20.11.6 Emergency Response Plan

An ERP will be prepared prior to the commencement of the excavation works. The plan will outline the process for identifying possible emergency situations and detailing the procedures necessary to ensure the safety of both on-site and off-site personnel in the event of an emergency.

The plan should include the following general information:

- Assignment of responsibilities to nominated key personnel;
- Assessment of the potential on and off-site impacts of hazards;
- Emergency reporting procedures including on-site reporting and reporting to the appropriate authorities;
- Emergency response procedures including, but not limited to, the following:
 - On-site fires or explosions;
 - Chemical spills;
 - Rupture of buried services;
 - Hazardous gas releases and emissions;

- Confined spaces situations;
- Traffic accidents both involving the transportation of "Dangerous Goods";
- First aid for injured personnel;
- Evacuation of on-site personnel; and
- Managing unknown/uncertain situations.

Incident investigation procedures to determine the root cause of the incident, and to identify the appropriate corrective and preventative actions to prevent future incidents.

21.0 Key Personnel

The contractual framework of delivery of the excavation works has not yet been determined by Crown. Potential contractual structures include:

- Turn key deliver of the excavation works by a civil contractor;
- Supervision of the excavation works by a superintendant and validation team engaged separately for the civil contractor; and
- A variation on the above.

Notwithstanding the contractual framework adopted by Crown, the key roles and responsibilities associated with the excavation works are as discussed following. Depending on the contract structure the various roles and responsibilities may be discharged by one or more entities.

21.1 Project Director

The Project Director is responsible for ensuring that the excavation works undertaken on-site are in accordance with this RAP, RWP, EMP, the OHSP and other relevant documentation, and that the objectives stated within the RAP are ultimately met. The Project Director will generally also be responsible for ensuring that the project occurs within the timeframe nominated and within the financial budget allocated, and is completed safely. The Project Director assumes ultimate responsibility for the project.

21.2 Project Manager

The Project Manager is responsible for daily operations and directs the site operations to ensure effective planning, verification, documentation and management of operational and environmental and safety issues in accordance with this RAP. This includes maintaining a liaison with regulatory authorities to ensure that the necessary work is undertaken to satisfy the NSW EPA and NSW EPA Accredited Site Auditor that the excavation works achieves the objectives of this RAP.

The Project Manager is responsible for the implementation of all Project Plans including the RAP, RWP, EMP, OHSP Plan, Quality Plan and other relevant contractual documents associated with the excavation works. This includes responsibility for:

- any design that may be required during the work;
- implementation and scheduling of the excavation works in accordance with the abovementioned documents; and
- ensuring compliance with relevant legislation and regulations.

The Project Manager is also responsible for ensuring that human health and the environment are protected at all times, including the provision of training and site inductions to all appropriate subcontractors and workers.

The Project Manager will be a primary community contact and the first point of contact for sub-contractor issues.

21.3 Validation Team

A suitably qualified consultant will undertake the supervision and validation of the excavation works under the direction of a Validation Project Director (VPD). The VPD is responsible for ensuring that all required validation systems are fully functional, and that staff are trained in the requirements of the validation requirements as detailed in **Section 16.0** of this RAP.

Daily validation management will be from an on-site project office. A site-based administrative system will be established to ensure that the project is fully documented. A daily fieldwork summary will be prepared and filed. All job-related incoming and outgoing communications will be logged in a register.

Decisions related to validation will be made in accordance with relevant guidelines endorsed by the NSW EPA and NSW EPA Accredited Site Auditor. Copies of relevant guidelines will be kept in the Site office. All fieldwork will be undertaken by qualified environmental engineer(s)/scientist(s) with experience working on contaminated sites.

A member of the Consultant's field team will be the Site Validation Manager (SVM) responsible for making all validation decisions and directing all routine site fieldwork. Prior to commencement of the project, the SVM will prepare a project manual containing all required procedures and forms. The manual will be updated, in conformance with the VP, on an as needed basis. It is the responsibility of the SVM to ensure that the validation requirements detailed in **Section 16.0** are followed.

Site meetings will be convened, as required, to discuss fieldwork procedures. At least one meeting per week will be held with the SVM and the Project Manager to plan work for the following week and to resolve outstanding issues.

Where, because of an unforeseen circumstance, the SVM considers that a departure from the validation requirements is required, this must be discussed with the VPD and NSW EPA Accredited Site Auditor before any other related action is taken. If the departure is approved it will be documented in site files. If urgent action is required, the VPD will be responsible for deciding the particular issue. The NSW EPA Accredited Site Auditor will be sent written confirmation as soon as practicable, but in any case within 5 working days of the reasons for making the changes to the validation procedures detailed in **Section 16.0** and feedback and endorsement of the changes will be requested in writing from the NSW EPA Accredited Site Auditor.

21.4 Site Foreman

The Site Foreman implements day-to-day operations as directed by the Project Manager.

21.5 Safety/Quality Officer and Environment

The Safety / Quality Officer is responsible for implementation of the quality and safety management systems. This person assists the Project Manager with day-to-day tasks that arise, reports activities undertaken, directs the subcontractors, maintains accurate records of works such as safety checklists, and maintains a photographic record of works undertaken. This will include review and update of the OH&S Plan and EMP plus health and safety manuals, rules and procedures.

The Safety / Quality Officer ensures personnel and visitors to the site are inducted and has responsibility for emergency response and training in accordance with the Emergency Plan. The Safety / Quality Officer has the authority and independence to require reasonable steps to be taken to avoid or minimise unintended or adverse work safety impacts, and can direct relevant actions to be ceased should any adverse impact on worker safety be likely to occur.

The Safety / Quality Officer ensures all H&S monitoring devices are operating in accordance with the RAP, EMP and OHSP and also keeps the incident and accident register up to date with notification given to Work Cover NSW as necessary.

The Safety / Quality Officer will provide advice and recommendations, when appropriate, with regards to:

- legal requirements;
- changes in legislation;
- dealings with Work Cover New South Wales;
- prevention of injury or damage;
- accident and injury investigations and reports;
- work methods, equipment, or materials which could reduce risk; and
- selection, suitability and application of safety equipment.

The Safety/Quality Officer will be responsible for holding regular 'toolbox' safety meetings with all site personnel and will ensure meeting minutes are appropriately documented.

21.6 Subcontractors

All work, irrespective of whom it is completed by will be undertaken, as specified by the Project Manager, and per the requirements stated within this RAP and the RWP, EMP, OHSP and relevant management plans.

Subcontractors will be advised of required work procedures through induction, training, and meetings provided by the Contractor. Maintenance of subcontractor equipment will be the responsibility of the subcontractors.

The Subcontractor is responsible for ensuring that all works executed by the subcontractor complies with relevant WorkCover NSW as necessary.

22.0 Conclusion

The key remediation objective for the Site is to facilitate the currently permissible and future intended land-uses proposed as part of the future intended Crown hotel development. Specific objectives of the remediation works (which will be undertaken as part of the Stage 1C Remediation and Earthworks) are:

- To ensure the remediated site is protective of human health in the context of the:
 - Currently permissible land uses – including a groundwater retention wall and bulk earthworks; and
 - Intended future land uses proposed as part of the Crown hotel development - including the future intended basement car park and Hotel;
- To ensure the remediated site is protective of the environment (specifically groundwater and the adjacent Darling Harbour), to the extent practicable, by minimising the risk of ongoing contamination; and
- Comply with applicable legislative and policy requirements including the appropriate requirements of the NSW EPA and NSW Department of Planning and Environment (DoPE).

The soil and groundwater CoPC concentrations reported from previous intrusive investigations did not exceed the relevant soil and groundwater SSTCs derived in the *ORWN HHERA* (AECOM, 2014). Based on these intrusive investigations, remediation of the Site to facilitate the currently permissible and intended future land uses may not be required. However, it should be noted, additional validation sampling is required to confirm whether remediation of unsaturated soils that are proposed to remain in situ outside the Stage 1C Works Area is warranted. As an outcome of the additional validation sampling, it is possible that remediation of the unsaturated soils will be required.

Further, the previous soil and groundwater investigation results indicate that the excavation process proposed as part of the Stage 1C Remediation and Earthworks will require management of contaminated soils that have the potential to cause risk to human health and the environment during the excavation process.

The preferred remediation strategy recommended for the Site is:

- Additional validation sampling to confirm whether remediation of unsaturated soils proposed to remain in situ outside the Stage 1C Works Area is warranted;
- Construction of the Stage 1C groundwater retention wall system; and
- Excavation within the perimeter of the Stage 1C groundwater retention wall system as required by the proposed Stage 1C Remediation and Earthworks and disposal of excavated material to landfill as required.

This RAP has generally been prepared to meet the requirements of the SEPP 55 (Remediation of Land) (DUAP and NSW EPA, 1998) and the *CLM Act* (NSW Govt, 1997a).

It is concluded that the preferred management strategy described by this RAP will, upon successful implementation as evidenced by the prescribed validation program, ensure that the Site is suitable for both the:

- currently permissible; and
- future intended land uses, specifically a mixed use including hotel (incorporating high density residential with minimal access to soil), commercial / retail (with minimal access to soil), public open space and underground parking or any combination of the above.

23.0 References

ANZECC, 1992. Australian Water Quality Guidelines for Fresh and Marine Waters. Australian and New Zealand Environment and Conservation Council.

ANZECC, 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council and Agriculture and Resourced Management Council of Australia and New Zealand.

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

Australian Standard 4964 (2004): *Method for the Qualitative Identification of Asbestos in Bulk Samples*.

AECOM (2010a). *Data Gap Investigation, EPA Declaration Area (Parts of Barangaroo and Hickson Road) Millers Point NSW*. 30 July.

AECOM (2010b). *Data Gap Investigation, Other Remediation Works (North) Area, Hickson Road, Millers Point, NSW*.

AECOM (2010c). *Groundwater Discharge Study*. 3 November.

AECOM (2011a). *Amended Remedial Action Plan, Barangaroo - ORWS Area*. 7 July.

AECOM (2011b). *Human Health and Ecological Risk Assessment, Declaration Site (Development works) Remediation Works*. 9 June.

AECOM (2012a). *Addendum to ORWS Amended Remedial Action Plan, Harbour Heat Rejection System Inlet Area, Barangaroo South*. 10 October.

AECOM (2012b). *Contaminant Flux and Discharge estimations for natural residual soil and marine sediments, EPA Declaration Area 21122 and adjacent areas of Barangaroo South and Barangaroo Central*. 14 March.

AECOM (2012c). *Supplementary Data Gap Investigation, VMP Area, Hickson Road, Millers Point, NSW*. 9 March.

AECOM (2013a). *Addendum to Human Health and Ecological Risk Assessment. Other Remediation Works (South) Area, Barangaroo*. 16 October.

AECOM (2013b). *Additional Groundwater Modelling to Supplement Contaminant Flux and Discharge Estimates for Natural Soils and Marine Sediments for EPA Declaration Area 21122*. 12 March.

AECOM (2013c). *Remedial Action Plan NSW EPA Declared Remediation Site 21122 and Block 4 (Stage 1b) Development Works, Barangaroo, Millers Point, NSW*. 24 July.

AECOM (2013d). *VMP Remediation Extent, VMP Remediation Works Area, (Parts of Barangaroo and Hickson Road), Millers Point, NSW*. 23 July.

AECOM (2014). *Human Health and Ecological Risk Assessment. Stage 1c Development (ORWN Area), Barangaroo South*. 10 December.

Broomham, R. 2007. Land at Millers Point Ownership and History. June 2007

Coffey Environments. 2008. Preliminary Environmental Investigation, 30-38 Hickson Road, Millers Point, NSW 2000. 12 May.

CCME, 2008b. Canadian Soil Quality Guidelines: Carcinogenic, Other Polycyclic Aromatic Hydrocarbons, Scientific Support Document, Environment Canada

CRC, 2010. Draft Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, Summary for NEPC Consultation, E. Friebe and P Nadebaum, CRC for Contamination Assessment and Remediation of the Environment. June

Davis, GB, Patterson, BM and Trefry, M. (2009). *Biodegradation of Petroleum Hydrocarbon Vapours, CRC CARE Technical Report no. 12. CRC for Contamination Assessment and Remediation of the Environment, Adelaide, Australia*.

DEC (2006a). *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework*.

- DEC (2006b). *Guidelines for the NSW Site Auditor Scheme (2nd edition)*.
- DEC (2006c). *Management of Odour from Stationary Sources in NSW: Technical Notes*.
- DEC (2007). *Guidelines for the Assessment and Management of Groundwater Contamination*.
- DECC (2008). *Guidelines on Resource Recovery Exemptions (Land Application)*. April.
- DECCW, 15 March 2010. Request for Provision of Details for Key Issues and Assessment Requirements, Barangaroo, East Darling Harbour, Sydney & Barangaroo Concept Development Plan Modification.
- DUAP and NSW EPA (1998). *Managing Land Contamination - Planning Guidelines State Environmental Planning Policy (SEPP) 55 - Remediation of Land*.
- ERM (2007). *Environmental Site Assessment, East Darling Harbour, Sydney, NSW*. 21 June.
- ERM (2008). *Additional Investigation Works at Barangaroo, Hickson Road, Millers Point, NSW*. July 2008.
- ERM (2010). *Overarching Remedial Action Plan of the Barangaroo Project Site, Sydney*. 1 June.
- Herbert C, 1983. Sydney 1:100 000 Geological Sheet 9130, 1st edition. Geological Survey of New South Wales, Sydney.
- JBS Environmental Pty Ltd (2012). *Barangaroo Central DGI*.
- Jeffery and Katauskas, 2006. Geotechnical Report development of Wharves 3-8 at East Darling Harbour. August 2006.
- NEPC (1999). *National Environment Protection (Assessment of Site Contamination) Measure*.
- NEPC *National Environment Protection (Assessment of Site Contamination) Amendment Measure (No. 1) (2013)*.
- NSW EPA (1994). *Guidelines for Assessing Service Station Sites*.
- NSW EPA (1997). *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*.
- NSW EPA (2011). *Guidelines for Consultants Reporting on Contaminated Sites*.
- NSW EPA (2014). *Waste Classification Guidelines, Part 1: Classifying Waste*.
- NSW Govt. *Contaminated Land Management Act (1997)*.
- NSW Govt. *The Protection of the Environment Operations Act (1997)*.
- NSW Govt. *Contaminated Land Management Amendment Act (2008)*.
- Standards Australia, 2002. Australian Standard AS1668.2-02. The use of ventilation and air conditioning in buildings - Ventilation design for indoor air contaminant control.
- USEPA, 1994. Air Emissions Models for Waste and Wastewater, EPA-453/R-94-080A.
- USEPA, 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. United States Environmental Protection Agency, Office of Emergency and Remedial Response. Revised February 22.
- VeruTek (2010). *Treatability Study Recommendations for the Implementation of an In Situ Remedy*. 21 September.

Appendix A

Summary Analytical Tables

Appendix A Summary Analytical Tables

Table T1: Soil Remediation Criteria

Table T2: Groundwater Remediation Criteria

Table T3: Area A Soil Analytical Results - Unsaturated

Table T4: Area A Soil Analytical Results – Saturated

Table T5: Area B Soil Analytical Results

Table T6: Area C Soil Analytical Results (below 12 m bgl)

Table T7: Site wide Asbestos Analytical Results

Table T8: Groundwater Analytical Results (2010-11)

Table T9: Historic Groundwater Analytical Results (pre 2010)

Table T10: Summary of Field Observations of Gasworks Related Impacts

Table T11: Terrestrial Soil Criteria

Table T12: Marine Water Quality Criteria

	SOIL REMEDIATION CRITERIA			
	Soil SSTC-A		Soil SSTC-B	
Chemicals of Potential Concern		Land Use Scenario		Land Use Scenario
Relevant Land Use Scenarios	mg/kg	Area A - unsaturated soil	mg/kg	Area B (if required)
Benzene	2.0	Scenario 14	2.0	Scenario 14
Cresols (Total)	250	Scenario 14	250	Scenario 14
Dimethylphenol, 2,4-	36,000	Scenario 12	36,000	Scenario 12
Ethylbenzene	50	Scenario 14	50	Scenario 14
Methylnaphthalene, 2	100	Scenario 14	100	Scenario 14
Naphthalene	4.0	Scenario 14	4.0	Scenario 14
Lead	11,000	Scenario 12	11,000	Scenario 12
Toluene	480	Scenario 14	480	Scenario 14
TPH C ₆ -C ₉	260	Scenario 14	260	Scenario 14
TPH C ₁₀ -C ₁₆	1,100	Scenario 14	1,100	Scenario 14
Trimethylbenzene, 1,2,4-	1.0	Scenario 14	1.0	Scenario 14
Xylenes (total)	-	-	-	-
CPAH**	130	Scenario 12	130	Scenario 12
Asbestos ¹	0.05% w/w	Scenario 12	0.05% w/w	Scenario 12

Notes:

All soil criteria in mg/kg

SSTC - Site Specific Target Criteria

TPH - Total Petroleum Hydrocarbons

CPAH= Sum of 8 carcinogenic PAH Compounds (Benz(a)anthracene Benzo(a) pyrene; Benzo(b)fluoranthene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Dibenz(a,h)anthracene; Indeno(1,2,3-c,d)pyrene)

¹ Asbestos analysis to be conducted as per Schedule B2 of the NEPM (NEPC, 1999, as amended 2013)

Land Use Scenarios:

Scenario 12: Crown Intrusive Maintenance Worker

Scenario 14: Crown Commercial with Advection

	GROUNDWATER REMEDIATION CRITERIA			
		Groundwater SSTC-A		Groundwater SSTC-C
Chemicals of Potential Concern		Land Use Scenario		Land Use Scenario
Relevant Land Use Scenarios	mg/L	Area A	mg/L	Area C
Acenaphthylene	33	Scenario 6	-	-
Acenaphthene	35	Scenario 6	-	-
Ammonia	150	Scenario 6	920	Scenario 1
Aniline	680	Scenario 6	67,000	Scenario 1
Arsenic	140	Scenario 6		
Barium	830	Scenario 6		
Benzene	2.0	Scenario 14	49	Scenario 1
Cadmium	110	Scenario 6	-	-
Cobalt	250	Scenario 6	-	-
Cresols (Total)	2.7	Scenario 6	22	Scenario 1
Dimethylphenol, 2,4-	430	Scenario 6	-	-
Ethylbenzene	100	Scenario 6	-	-
Lead and compounds	630	Scenario 6	-	-
Manganese	27,000	Scenario 6	-	-
Methylnaphthalene, 2-	22	Scenario 6	150	Scenario 1
Naphthalene	1.3	Scenario 6	7.8	Scenario 1
Nickel	1,300	Scenario 6	-	-
Phenol	340	Scenario 6 + 12	4,800	Scenario 1
Styrene	47	Scenario 6	-	-
Toluene	370	Scenario 6	-	-
TPH C ₆ -C ₁₀	9	Scenario 14	19,000	Scenario 1
TPH >C ₁₀ -C ₁₆	12	Scenario 6	1,800	Scenario 1
TPH >C ₁₆ -C ₃₄	-	-	-	-
TPH >C ₃₄ -C ₄₀	-	-	-	-
Trimethylbenzene, 1,2,4-	4.0	Scenario 14	91	Scenario 1
Trimethylbenzene, 1,3,5-	15	Scenario 14	460	Scenario 1

Notes:

All groundwater criteria in mg/L
SSTC - Site Specific Target Criteria
TPH - Total Petroleum Hydrocarbons
CPAH= Sum of 8 carcinogenic PAH Compounds
(Benz(a)anthracene Benzo(a) pyrene;
Benzo(b)fluoranthene; Benzo(g,h,i)perylene;
Benzo(k)fluoranthene; Chrysene;
Dibenz(a,h)anthracene; Indeno(1,2,3-c,d)pyrene)

= an SSTC has not been determined for
remediation purposes as the derived level is at least
10 times greater than saturation/ solubility limits

Land Use Scenarios:

Scenario 1: Lower Basement
Scenario 6: Intrusive Maintenance Worker
Scenario 12: Crown Intrusive Maintenance Worker
Scenario 14: Crown Commercial with Advection

Field ID	BH017 0.5-0.6	BH017 1.5-1.95	BH076 0.3-0.5	BH076 1.5-1.95	BH116 1.5 1.95	BH116 1.5 1.95	BH129 0.4-0.6	BH143 1.5 1.95	BH39 0.15-0.25	BH40 1.0-1.2	BH46-1.0-1.2	QC56	BH544D	BH544D	BH544D	BH544D	BH60 0.17-0.27
Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field D	Normal	Normal	Normal	Normal	Normal
Sample Depth Range	0.5-0.6	1.5-1.95	0.3-0.5	1.5-1.95	1.5-1.95	1.5-1.95	0.4-0.6	1.5-1.95	0.15-0.25	1-1.2	1-1.2	1-1.2	0.55-0.65	0.9-1	1.4-1.5	1.9-2	0.17-0.27
Location Code	BH017	BH017	BH076	BH076	BH116	BH116	BH129	BH143	AECOM BH39	AECOM BH40	AECOM BH46	AECOM BH46	JBS BH544D	JBS BH544D	JBS BH544D	JBS BH544D	AECOM BH60
Sampled Date Time	8/05/2006	8/05/2006	6/06/2006	6/06/2006	28/06/2006	27/06/2006	5/07/2006	10/07/2006	18/02/2010	18/02/2010	23/02/2010	23/02/2010	16/05/2012	16/05/2012	16/05/2012	16/05/2012	24/02/2010

Chem Group	ChemName	Units	LOR	Soil SSTC-A																
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	260	-	-	<2	<2	<2	-	<2	-	-	<10	<10	-	-	-	-	-
	TPH C10 - C14	mg/kg	50	1100	-	-	<50	<50	<50	-	<50	-	-	<50	<50	-	-	-	-	-
	TPH C15-C28	mg/kg	100		-	-	<100	<100	350	-	<100	-	-	<100	<100	-	-	-	-	-
	TPH C29-C36	mg/kg	100		-	-	<100	<100	410	-	<100	-	-	<100	<100	-	-	-	-	-
	TPH+C10 - C36 (Sum of total)	mg/kg	50		-	-	<250	<250	760	-	<250	-	-	<50	<50	-	-	-	-	-
PAHs	2-chloronaphthalene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-methylcholanthrene	mg/kg	0.01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acenaphthene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	-
	Acenaphthylene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.1	0.1	<0.1	<0.1	-
	Acetophenone	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Anthracene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	0.1	0.2	0.1	0.1	-
	Benz(a)anthracene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.8	-	-	<0.5	<0.5	0.3	0.8	0.4	0.5	-
	Benzo(a) pyrene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.8	-	-	<0.5	<0.5	0.3	0.99	0.42	0.57	-
	Benzo(b)&(k)fluoranthene	mg/kg	0.2		-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	0.6	0.8	-
	Benzo(b)fluoranthene	mg/kg	0.01		-	-	<0.5	0.6	-	0.7	0.9	-	-	<0.5	<0.5	-	-	-	-	-
	Benzo(g,h,i)perylene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.5	-	-	<0.5	<0.5	0.2	0.6	0.2	0.3	-
	Benzo(k)fluoranthene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	-	-	-	-	-
	Chrysene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.7	-	-	<0.5	<0.5	0.3	0.6	0.4	0.4	-
	Dibenz(a,h)anthracene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.1	0.1	<0.1	<0.1	-
	Fluoranthene	mg/kg	0.01		-	-	<0.5	0.9	-	0.9	1.4	-	-	<0.5	<0.5	0.6	1.6	0.8	1	-
	Fluorene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	-
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	0.2	0.5	0.2	0.3	-
	Naphthalene	mg/kg	0.01	4	-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1	-
	Phenanthrene	mg/kg	0.01		-	-	<0.5	0.5	-	<0.5	0.6	-	-	<0.5	<0.5	0.4	0.8	0.5	0.5	-
	Pyrene	mg/kg	0.01		-	-	<0.5	0.9	-	0.9	1.4	-	-	<0.5	<0.5	0.6	1.7	0.9	1.1	-
	Sum of PAHs	mg/kg	-		-	-	nc	2.9	-	2.5	7.1	-	-	nc	nc	3.4	9.19	4.52	5.57	-
	CPAH (ESDAT)	mg/kg	-	130	-	-	<4	0.6	-	0.7	3.7	-	-	<4	<4	-	-	-	-	-
	CPAH (TEF)	mg/kg	-		-	-	<1.21	0.06	-	0.07	0.982	-	-	<1.21	<1.21	-	-	-	-	-
	PAH (TOTAL)	mg/kg	-		-	-	<8	2.9	-	2.5	7.1	-	-	<8	<8	-	-	-	-	-
Phenols	2,4-dimethylphenol	mg/kg	0.01	36000	-	-	-	-	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	-
	2-nitrophenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	-
	2-methylphenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	-
	3-&4-methylphenol	mg/kg	0.5		-	-	-	-	<1	-	-	-	-	<1	<1	-	-	-	-	-
	Cresols (Total)	mg/kg		250	-	-	-	-	<1	-	-	-	-	<1	<1	-	-	-	-	-
	4-chloro-3-methylphenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	-
	Phenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	-
	Phenolics Total	mg/kg	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAHs	Tetrachloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Trichloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	cis-1,2-dichloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vinyl chloride	mg/kg	5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos	Asbestos fibres	-	0.1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	weight of sample	g	0.01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BTEX	Benzene	mg/kg	0.2	2	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	<0.2	<0.2	-	-	-	-	-
	Ethylbenzene	mg/kg	0.2	50	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	<0.5	<0.5	-	-	-	-	-
	Toluene	mg/kg	0.2	480	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	<0.5	<0.5	-	-	-	-	-
	Xylene (m & p)	mg/kg	0.2		-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	<0.5	<0.5	-	-	-	-	-
	Xylene (o)	mg/kg	0.2		-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	<0.5	<0.5	-	-	-	-	-
	Total Xylene	mg/kg	0.5		-	-	<0.4	<0.4	<0.4	-	<0.4	-	-	<1	<1	-	-	-	-	-
Metals	Arsenic	mg/kg	1	<5	<5	<5	<5	<5	-	<5	<5	<5	<5	<5	<5	<4	<4	<4	-	<5
	Barium	mg/kg	5		-	-	-	-	-	-	20	20	270	300	-	-	-	-	-	30
	Beryllium	mg/kg	1		-	-	-	-	-	-	<1	<1	<1	<1	<1	<1	<1	-	<1	<1
	Cadmium	mg/kg	0.1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	-	<1
	Chromium	mg/kg	1	5	35	15	14	9	-	16	8	2	9	20	11	8	13	9	-	16
	Chromium (hexavalent)	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cobalt	mg/kg	1		-	-	-	-	-	-	-	13	3	5	5	-	-	-	-	39
	Copper	mg/kg	1	150	49	44	10	30	-	41	11	247	<5	7	5	14	18	11	-	106
	Iron	mg/kg	10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	1	11000	30	21	12	57	23	-	153	6	6	10	11	12	36	66	45	<5
	Manganese	mg/kg	5		-	-	-	-	-	-	-	819	181	285	352	-	-	-	-	649
	Mercury	mg/kg	0.05	<0.1	<0.1	<0.1	0.2	<0.1	-	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1
	Nickel	mg/kg	1	6	6	47	16	4	-	13	4	7	4	6	6	10	18	5	-	149
	Vanadium	mg/kg	5		-	-	-	-	-	-	-	139	13	13	14	-	-	-	-	28
	Zinc	mg/kg	1	71	56	45	65	38	-	154	18	52	20	29	34	46	120	62	-	41
VOCs	1,1,1,2-tetrachloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1,1-trichloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1,2,2-tetrachloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1,2-trichloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1-dichloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1-dichloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1-dichloropropene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,2,3-trichlorobenzene	mg/kg	0.5		-	-	-	-	-	-	-	-	-							

Table T3:
Area A - Soil Analytical Results - Unsaturated

Field ID		BH72 0.15-0.25	BH72 1.0-1.2
Sample Type		Normal	Normal
Sample Depth Range		0.15-0.25	1-1.2
Location Code		AECOM BH72	AECOM BH72
Sampled Date Time		25/02/2010	3/03/2010

Chem Group	ChemName	Units	LOR	Soil SSTC-A		
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	260	<10	<10
	TPH C10 - C14	mg/kg	50	1100	<50	<50
	TPH C15-C28	mg/kg	100		<100	<100
	TPH C29-C36	mg/kg	100		<100	<100
	TPH+C10 - C36 (Sum of total)	mg/kg	50		<50	<50
PAHs	2-chloronaphthalene	mg/kg	0.5		-	<0.5
	2-methylnaphthalene	mg/kg	0.01	100	-	<0.5
	3-methylcholanthrene	mg/kg	0.01		-	<0.5
	Acenaphthene	mg/kg	0.01		-	<0.5
	Acenaphthylene	mg/kg	0.01		-	<0.5
	Acetophenone	mg/kg	0.5		-	<0.5
	Anthracene	mg/kg	0.01		-	<0.5
	Benz(a)anthracene	mg/kg	0.01		-	<0.5
	Benzo(a) pyrene	mg/kg	0.01		-	<0.5
	Benzo(b)&(k)fluoranthene	mg/kg	0.2		-	<1
	Benzo(b)fluoranthene	mg/kg	0.01		-	-
	Benzo(g,h,i)perylene	mg/kg	0.01		-	<0.5
	Benzo(k)fluoranthene	mg/kg	0.01		-	-
	Chrysene	mg/kg	0.01		-	<0.5
	Dibenz(a,h)anthracene	mg/kg	0.01		-	<0.5
	Fluoranthene	mg/kg	0.01		-	<0.5
	Fluorene	mg/kg	0.01		-	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01		-	<0.5
	Naphthalene	mg/kg	0.01	4	-	<0.5
	Phenanthrene	mg/kg	0.01		-	<0.5
	Pyrene	mg/kg	0.01		-	<0.5
	Sum of PAHs	mg/kg	-		-	nc
	CPAH (ESDAT)	mg/kg	-	130	-	<3
	CPAH (TEF)	mg/kg	-		-	<1.11
	PAH (TOTAL)	mg/kg	-		-	<7
Phenols	2,4-dimethylphenol	mg/kg	0.01	36000	-	<0.5
	2-nitrophenol	mg/kg	0.01		-	<0.5
	2-methylphenol	mg/kg	0.01		-	<0.5
	3-&4-methylphenol	mg/kg	0.5		-	<0.5
	Cresols (Total)	mg/kg		250	-	<0.5
	4-chloro-3-methylphenol	mg/kg	0.01		-	<0.5
	Phenol	mg/kg	0.01		-	<0.5
	Phenolics Total	mg/kg	-		-	-
CAHs	Tetrachloroethene	mg/kg	0.5		-	<0.5
	Trichloroethene	mg/kg	0.5		-	<0.5
	cis-1,2-dichloroethene	mg/kg	0.5		-	<0.5
	Vinyl chloride	mg/kg	5		-	<5
Asbestos	Asbestos fibres	-	0.1		-	-
	weight of sample	g	0.01		-	-
BTEX	Benzene	mg/kg	0.2	2	-	<0.2
	Ethylbenzene	mg/kg	0.2	50	-	<0.5
	Toluene	mg/kg	0.2	480	-	<0.5
	Xylene (m & p)	mg/kg	0.2		-	<0.5
	Xylene (o)	mg/kg	0.2		-	<0.5
	Total Xylene	mg/kg	0.5		-	<1
Metals	Arsenic	mg/kg	1		<5	<5
	Barium	mg/kg	5		70	160
	Beryllium	mg/kg	1		<1	<1
	Cadmium	mg/kg	0.1		<1	<1
	Chromium	mg/kg	1		19	9
	Chromium (hexavalent)	mg/kg	0.5		-	<0.5
	Cobalt	mg/kg	1		36	4
	Copper	mg/kg	1		77	14
	Iron	mg/kg	10		-	10,600
	Lead	mg/kg	1	11000	<5	446
	Manganese	mg/kg	5		626	214
	Mercury	mg/kg	0.05		<0.1	<0.1
	Nickel	mg/kg	1		117	6
	Vanadium	mg/kg	5		47	18
	Zinc	mg/kg	1		50	165
VOCs	1,1,1,2-tetrachloroethane	mg/kg	0.5		-	<0.5
	1,1,1-trichloroethane	mg/kg	0.5		-	<0.5
	1,1,2,2-tetrachloroethane	mg/kg	0.5		-	<0.5
	1,1,2-trichloroethane	mg/kg	0.5		-	<0.5
	1,1-dichloroethane	mg/kg	0.5		-	<0.5
	1,1-dichloroethene	mg/kg	0.5		-	<0.5
	1,1-dichloropropene	mg/kg	0.5		-	<0.5
	1,2,3-trichlorobenzene	mg/kg	0.5		-	<0.5
	1,2,3-trichloropropane	mg/kg	0.5		-	<0.5
	1,2,4-trichlorobenzene	mg/kg	0.5		-	<0.5
	1,2,4-trimethylbenzene	mg/kg	0.5	1	-	<0.5

Field ID	BH017 0.5-0.6	BH017 1.5-1.95	BH076 0.3-0.5	BH076 1.5-1.95	BH116 1.5 1.95	BH116 1.5 1.95	BH129 0.4-0.6	BH143 1.5 1.95	BH39 0.15-0.25	BH40 1.0-1.2	BH46-1.0-1.2	QC56	BH544D	BH544D	BH544D	BH544D	BH60 0.17-0.27
Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field D	Normal	Normal	Normal	Normal	Normal
Sample Depth Range	0.5-0.6	1.5-1.95	0.3-0.5	1.5-1.95	1.5-1.95	1.5-1.95	0.4-0.6	1.5-1.95	0.15-0.25	1-1.2	1-1.2	1-1.2	0.55-0.65	0.9-1	1.4-1.5	1.9-2	0.17-0.27
Location Code	BH017	BH017	BH076	BH076	BH116	BH116	BH129	BH143	AECOM BH39	AECOM BH40	AECOM BH46	AECOM BH46	JBS BH544D	JBS BH544D	JBS BH544D	JBS BH544D	AECOM BH60
Sampled Date Time	8/05/2006	8/05/2006	6/06/2006	6/06/2006	28/06/2006	27/06/2006	5/07/2006	10/07/2006	18/02/2010	18/02/2010	23/02/2010	23/02/2010	16/05/2012	16/05/2012	16/05/2012	16/05/2012	24/02/2010

Chem Group	ChemName	Units	LOR	Soil SSTC-A																
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	260	-	-	<2	<2	<2	-	<2	-	-	-	<10	<10	-	-	-	-
	TPH C10 - C14	mg/kg	50	1100	-	-	<50	<50	<50	-	<50	-	-	-	<50	<50	-	-	-	-
	TPH C15-C28	mg/kg	100		-	-	<100	<100	350	-	<100	-	-	-	<100	<100	-	-	-	-
	TPH C29-C36	mg/kg	100		-	-	<100	<100	410	-	<100	-	-	-	<100	<100	-	-	-	-
	TPH+C10 - C36 (Sum of total)	mg/kg	50		-	-	<250	<250	760	-	<250	-	-	-	<50	<50	-	-	-	-
PAHs	2-chloronaphthalene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-methylcholanthrene	mg/kg	0.01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acenaphthene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1
	Acenaphthylene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	<0.1	0.1	<0.1	<0.1
	Acetophenone	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Anthracene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	0.1	0.2	0.1	0.1
	Benz(a)anthracene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.8	-	-	-	<0.5	<0.5	0.3	0.8	0.4	0.5
	Benzo(a) pyrene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.8	-	-	-	<0.5	<0.5	0.3	0.99	0.42	0.57
	Benzo(b)&(k)fluoranthene	mg/kg	0.2		-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	0.6	0.8
	Benzo(b)fluoranthene	mg/kg	0.01		-	-	<0.5	0.6	-	0.7	0.9	-	-	-	<0.5	<0.5	-	-	-	-
	Benzo(g,h,i)perylene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.5	-	-	-	<0.5	<0.5	0.2	0.6	0.2	0.3
	Benzo(k)fluoranthene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	-	-	-	-
	Chrysene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	0.7	-	-	-	<0.5	<0.5	0.3	0.6	0.4	0.4
	Dibenz(a,h)anthracene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	<0.1	0.1	<0.1	<0.1
	Fluoranthene	mg/kg	0.01		-	-	<0.5	0.9	-	0.9	1.4	-	-	-	<0.5	<0.5	0.6	1.6	0.8	1
	Fluorene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01		-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	0.2	0.5	0.2	0.3
	Naphthalene	mg/kg	0.01	4	-	-	<0.5	<0.5	-	<0.5	<0.5	-	-	-	<0.5	<0.5	<0.1	<0.1	<0.1	<0.1
	Phenanthrene	mg/kg	0.01		-	-	<0.5	0.5	-	<0.5	0.6	-	-	-	<0.5	<0.5	0.4	0.8	0.5	0.5
	Pyrene	mg/kg	0.01		-	-	<0.5	0.9	-	0.9	1.4	-	-	-	<0.5	<0.5	0.6	1.7	0.9	1.1
	Sum of PAHs	mg/kg	-		-	-	nc	2.9	-	2.5	7.1	-	-	-	nc	nc	3.4	9.19	4.52	5.57
	CPAH (ESDAT)	mg/kg	-	130	-	-	<4	0.6	-	0.7	3.7	-	-	-	<4	<4	-	-	-	-
	CPAH (TEF)	mg/kg	-		-	-	<1.21	0.06	-	0.07	0.982	-	-	-	<1.21	<1.21	-	-	-	-
	PAH (TOTAL)	mg/kg	-		-	-	<8	2.9	-	2.5	7.1	-	-	-	<8	<8	-	-	-	-
Phenols	2,4-dimethylphenol	mg/kg	0.01	36000	-	-	-	-	<0.5	-	-	-	-	-	<0.5	<0.5	-	-	-	-
	2-nitrophenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	-	<0.5	<0.5	-	-	-	-
	2-methylphenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	-	<0.5	<0.5	-	-	-	-
	3-&4-methylphenol	mg/kg	0.5		-	-	-	-	<1	-	-	-	-	-	<1	<1	-	-	-	-
	Cresols (Total)	mg/kg		250	-	-	-	-	<1	-	-	-	-	-	<1	<1	-	-	-	-
	4-chloro-3-methylphenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	-	<0.5	<0.5	-	-	-	-
	Phenol	mg/kg	0.01		-	-	-	-	<0.5	-	-	-	-	-	<0.5	<0.5	-	-	-	-
	Phenolics Total	mg/kg	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAHs	Tetrachloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Trichloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	cis-1,2-dichloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vinyl chloride	mg/kg	5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos	Asbestos fibres	-	0.1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	weight of sample	g	0.01		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BTEX	Benzene	mg/kg	0.2	2	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	-	<0.2	<0.2	-	-	-	-
	Ethylbenzene	mg/kg	0.2	50	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	-	<0.5	<0.5	-	-	-	-
	Toluene	mg/kg	0.2	480	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	-	<0.5	<0.5	-	-	-	-
	Xylene (m & p)	mg/kg	0.2		-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	-	<0.5	<0.5	-	-	-	-
	Xylene (o)	mg/kg	0.2		-	-	<0.2	<0.2	<0.2	-	<0.2	-	-	-	<0.5	<0.5	-	-	-	-
	Total Xylene	mg/kg	0.5		-	-	<0.4	<0.4	<0.4	-	<0.4	-	-	-	<1	<1	-	-	-	-
Metals	Arsenic	mg/kg	1	<5	<5	<5	<5	<5	-	<5	<5	<5	<5	<5	<5	<5	<4	<4	<4	<5
	Barium	mg/kg	5		-	-	-	-	-	-	20	20	270	300	-	-	-	-	-	30
	Beryllium	mg/kg	1		-	-	-	-	-	-	<1	<1	<1	<1	<1	<1	-	-	-	<1
	Cadmium	mg/kg	0.1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<0.5	<0.5	<0.5	<1
	Chromium	mg/kg	1	5	35	15	14	9	-	16	8	2	9	20	11	8	13	9	-	16
	Chromium (hexavalent)	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cobalt	mg/kg	1		-	-	-	-	-	-	-	13	3	5	5	-	-	-	-	39
	Copper	mg/kg	1	150	49	44	10	30	-	41	11	247	<5	7	5	14	18	11	-	106
	Iron	mg/kg	10		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	1	11000	30	21	12	57	23	-	153	6	6	10	11	12	36	66	45	<5
	Manganese	mg/kg	5		-	-	-	-	-	-	-	819	181	285	352	-	-	-	-	649
	Mercury	mg/kg	0.05	<0.1	<0.1	<0.1	0.2	<0.1	-	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nickel	mg/kg	1	6	6	47	16	4	-	13	4	7	4	6	6	10	18	5	-	149
	Vanadium	mg/kg	5		-	-	-	-	-	-	-	139	13	13	14	-	-	-	-	28
	Zinc	mg/kg	1	71	56	45	65	38	-	154	18	52	20	29	34	46	120	62	-	41
VOCs	1,1,1,2-tetrachloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1,1-trichloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1,2,2-tetrachloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1,2-trichloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1-dichloroethane	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1-dichloroethene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,1-dichloropropene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1,2,3-trichlorobenzene	mg/kg	0.5		-	-	-	-	-	-	-	-	-	-						

Table T3:
Area A - Soil Analytical Results - Unsaturated

Field ID		BH72 0.15-0.25	BH72 1.0-1.2
Sample Type		Normal	Normal
Sample Depth Range		0.15-0.25	1-1.2
Location Code		AECOM BH72	AECOM BH72
Sampled Date Time		25/02/2010	3/03/2010

Chem Group	ChemName	Units	LOR	Soil SSTC-A		
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	260	<10	<10
	TPH C10 - C14	mg/kg	50	1100	<50	<50
	TPH C15-C28	mg/kg	100		<100	<100
	TPH C29-C36	mg/kg	100		<100	<100
	TPH+C10 - C36 (Sum of total)	mg/kg	50		<50	<50
PAHs	2-chloronaphthalene	mg/kg	0.5		-	<0.5
	2-methylnaphthalene	mg/kg	0.01	100	-	<0.5
	3-methylcholanthrene	mg/kg	0.01		-	<0.5
	Acenaphthene	mg/kg	0.01		-	<0.5
	Acenaphthylene	mg/kg	0.01		-	<0.5
	Acetophenone	mg/kg	0.5		-	<0.5
	Anthracene	mg/kg	0.01		-	<0.5
	Benz(a)anthracene	mg/kg	0.01		-	<0.5
	Benzo(a) pyrene	mg/kg	0.01		-	<0.5
	Benzo(b)&(k)fluoranthene	mg/kg	0.2		-	<1
	Benzo(b)fluoranthene	mg/kg	0.01		-	-
	Benzo(g,h,i)perylene	mg/kg	0.01		-	<0.5
	Benzo(k)fluoranthene	mg/kg	0.01		-	-
	Chrysene	mg/kg	0.01		-	<0.5
	Dibenz(a,h)anthracene	mg/kg	0.01		-	<0.5
	Fluoranthene	mg/kg	0.01		-	<0.5
	Fluorene	mg/kg	0.01		-	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01		-	<0.5
	Naphthalene	mg/kg	0.01	4	-	<0.5
	Phenanthrene	mg/kg	0.01		-	<0.5
	Pyrene	mg/kg	0.01		-	<0.5
	Sum of PAHs	mg/kg	-		-	nc
	CPAH (ESDAT)	mg/kg	-	130	-	<3
	CPAH (TEF)	mg/kg	-		-	<1.11
	PAH (TOTAL)	mg/kg	-		-	<7
Phenols	2,4-dimethylphenol	mg/kg	0.01	36000	-	<0.5
	2-nitrophenol	mg/kg	0.01		-	<0.5
	2-methylphenol	mg/kg	0.01		-	<0.5
	3-&4-methylphenol	mg/kg	0.5		-	<0.5
	Cresols (Total)	mg/kg		250	-	<0.5
	4-chloro-3-methylphenol	mg/kg	0.01		-	<0.5
	Phenol	mg/kg	0.01		-	<0.5
	Phenolics Total	mg/kg	-		-	-
CAHs	Tetrachloroethene	mg/kg	0.5		-	<0.5
	Trichloroethene	mg/kg	0.5		-	<0.5
	cis-1,2-dichloroethene	mg/kg	0.5		-	<0.5
	Vinyl chloride	mg/kg	5		-	<5
Asbestos	Asbestos fibres	-	0.1		-	-
	weight of sample	g	0.01		-	-
BTEX	Benzene	mg/kg	0.2	2	-	<0.2
	Ethylbenzene	mg/kg	0.2	50	-	<0.5
	Toluene	mg/kg	0.2	480	-	<0.5
	Xylene (m & p)	mg/kg	0.2		-	<0.5
	Xylene (o)	mg/kg	0.2		-	<0.5
	Total Xylene	mg/kg	0.5		-	<1
Metals	Arsenic	mg/kg	1		<5	<5
	Barium	mg/kg	5		70	160
	Beryllium	mg/kg	1		<1	<1
	Cadmium	mg/kg	0.1		<1	<1
	Chromium	mg/kg	1		19	9
	Chromium (hexavalent)	mg/kg	0.5		-	<0.5
	Cobalt	mg/kg	1		36	4
	Copper	mg/kg	1		77	14
	Iron	mg/kg	10		-	10,600
	Lead	mg/kg	1	11000	<5	446
	Manganese	mg/kg	5		626	214
	Mercury	mg/kg	0.05		<0.1	<0.1
	Nickel	mg/kg	1		117	6
	Vanadium	mg/kg	5		47	18
	Zinc	mg/kg	1		50	165
VOCs	1,1,1,2-tetrachloroethane	mg/kg	0.5		-	<0.5
	1,1,1-trichloroethane	mg/kg	0.5		-	<0.5
	1,1,2,2-tetrachloroethane	mg/kg	0.5		-	<0.5
	1,1,2-trichloroethane	mg/kg	0.5		-	<0.5
	1,1-dichloroethane	mg/kg	0.5		-	<0.5
	1,1-dichloroethene	mg/kg	0.5		-	<0.5
	1,1-dichloropropene	mg/kg	0.5		-	<0.5
	1,2,3-trichlorobenzene	mg/kg	0.5		-	<0.5
	1,2,3-trichloropropane	mg/kg	0.5		-	<0.5
	1,2,4-trichlorobenzene	mg/kg	0.5		-	<0.5
	1,2,4-trimethylbenzene	mg/kg	0.5	1	-	<0.5

Table T4:
Area A - Soil Analytical Results - Saturated

Field_ID	BH017 3.0-3.45	BH017 21.5-22	BH116 3.0 3.45	BH129 3.0-3.45	BH129 12.5-13	BH143 3.0 3.45	BH191/3.7	BH191/5.6	BH191/16.5	BH191/18.2	BH212/3.1	D01 180308	BH212/4.8	BH212/12.2	BH212/26.0	BH39-2.5-2.7	BH39-4.0-4.2	BH39-7.0-7.2
Sample_Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal	Normal	Normal	Normal	Normal	Normal
Sample_Depth_Range	3-3.45	21.5-22	3-3.45	3-3.45	12.5-13	3-3.45	3.7	5.6	16.5	18.2	3.1	3.1	4.8	12.2	26	2.5-2.7	4-4.2	7-7.2
Location_Code	BH017	BH017	BH116	BH129	BH129	BH143	BH191	BH191	BH191	BH191	BH212	BH212	BH212	BH212	BH212	AECOM BH39	AECOM BH39	AECOM BH39
Sampled_Date_Time	8/05/2006	8/05/2006	27/06/2006	3/07/2006	3/07/2006	10/07/2006	27/03/2008	11/04/2008	14/04/2008	14/04/2008	18/03/2008	18/03/2008	25/03/2008	28/03/2008	31/03/2008	23/02/2010	24/02/2010	24/02/2010

Chem_Group	ChemName	Units	LOR																		
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	-	-	-	-	<2	<2	<10	<10	14	<10	-	-	<10	<10	<10	-	<10	-
	TPH C10 - C14	mg/kg	50	-	-	-	-	<50	<50	120	<50	170	<50	-	-	<50	<50	<50	-	<50	-
	TPH C15-C28	mg/kg	100	-	-	-	-	<100	<100	700	<100	680	<100	-	-	<100	<100	<100	-	<100	-
	TPH C29-C36	mg/kg	100	-	-	-	-	<100	<100	380	<100	310	<100	-	-	<100	<100	<100	-	<100	-
	TPH+C10 - C36 (Sum of total)	mg/kg	50	-	-	-	-	<250	<250	1200	<250	1160	<250	-	-	<250	<250	<250	-	<50	-
TRH (NEPM 2013)	TRH C6-C10 less BTEX (F1)	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TRH >C10-C16	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C16 - C34 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C34 - C40 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C10 - C40 Fraction (sum)	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	2-chloronaphthalene	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-methylcholanthrene	mg/kg	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Acenaphthene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	4.7	<0.5	3.4	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Acenaphthylene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	4	<0.5	15.8	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Acetophenone	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Anthracene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	10.4	0.8	14.2	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Benz(a)anthracene	mg/kg	0.01	-	-	0.6	-	<0.5	<0.5	15	<0.5	11.7	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Benzo(a) pyrene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	12.6	<0.5	7.7	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Benzo(b)&(k)fluoranthene	mg/kg	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Benzo(b)fluoranthene	mg/kg	0.01	-	-	0.7	-	<0.5	<0.5	13.6	0.7	9.8	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Benzo(g,h,i)perylene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	7.3	<0.5	3.3	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Benzo(k)fluoranthene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	7.6	0.7	2.9	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Chrysene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	12.4	<0.5	8.2	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Dibenz(a,h)anthracene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	1.9	<0.5	0.8	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Fluoranthene	mg/kg	0.01	-	-	1.3	-	<0.5	<0.5	32.2	0.9	28	0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Fluorene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	3.9	<0.5	18.2	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	6.6	<0.5	2.9	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Naphthalene	mg/kg	0.01	-	-	<0.5	-	<0.5	<0.5	28.5	<0.5	104	0.6	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Phenanthrene	mg/kg	0.01	-	-	1	-	<0.5	<0.5	38.4	0.8	44.7	0.9	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Pyrene	mg/kg	0.01	-	-	1.1	-	<0.5	<0.5	29.4	0.9	22.4	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	CPAH (ESDAT)	mg/kg	-	-	-	1.3	-	<4	<4	77	1.4	47.3	<4	-	-	<4	<4	<4	-	<4	-
	CPAH (TEF)	mg/kg	-	-	-	0.13	-	<1.21	<1.21	18.977	0.14	11.345	<1.21	-	-	<1.21	<1.21	<1.21	-	<1.21	-
	PAH (TOTAL)	mg/kg	-	-	-	4.7	-	<8	<8	228.5	4.8	298	2	-	-	<8	<8	<8	-	<8	-
Phenols	2,4-dimethylphenol	mg/kg	0.01	-	-	-	-	-	-	<0.5	<0.5	1.1	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
BTEx	Benzene	mg/kg	0.2	-	-	-	-	<0.2	<0.2	<0.2	<0.2	2.2	0.3	-	-	<0.2	<0.2	<0.2	-	<0.2	-
	Ethylbenzene	mg/kg	0.2	-	-	-	-	<0.2	<0.2	<0.5	<0.5	0.6	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Toluene	mg/kg	0.2	-	-	-	-	<0.2	<0.2	<0.5	<0.5	5.1	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Xylene (m & p)	mg/kg	0.2	-	-	-	-	<0.2	<0.2	<0.5	<0.5	5.7	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Xylene (o)	mg/kg	0.2	-	-	-	-	<0.2	<0.2	<0.5	<0.5	2.1	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	-
	Total Xylene	mg/kg	0.5	-	-	-	-	<0.4	<0.4	<1	<1	7.8	<1	-	-	<1	<1	<1	-	<1	-
Cyanides	Cyanide (WAD)	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field	pH (Field)	pH	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides	Diallate	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals	Arsenic	mg/kg	1	<5	<5	<5	<5	<5	<5	6	<5	8	9	6	6	7	<5	<5	<5	<5	<5
	Barium	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	110	30
	Beryllium	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1
	Cadmium	mg/kg	0.1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Chromium	mg/kg	1	19	41	31	24	7	10	10	7	16	14	11	21	13	3	4	8	10	12
	Chromium (hexavalent)	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cobalt	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	2
	Copper	mg/kg	1	32	8	18	22	<5	6	46	18	12	<5	45	61	19	81	<5	<5	<5	<5
	Iron	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	1	18	22	14	267	8	14	155	135	66	12	324	602	68	72	<5	6	7	6
	Manganese	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	206	200
	Mercury	mg/kg	0.05	<0.1	0.1	<0.1	<0.1	0.2	<0.1	0.2	<0.1	0.4	0.8	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nickel	mg/kg	1	5	4	4	7	<2	8	6	3	2	<2	7	10	6	2	2	3	3	3
	Vanadium	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	11	12
	Zinc	mg/kg	1	40	25	28	192	<5	43	84	52	62	<5	224	260	76	129	<5	18	16	23
VOCs	1,2,4-trimethylbenzene	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Field ID	BH39-11.5-11.7	BH39-16.0-16.2	QC101	QC102	BH39-20.5-20.7	BH40 7.0-7.2	BH40 8.5-8.7	QC54	BH40 13.0-13.2	BH40 16.5-16.7	BH40 17.8-18.0	BH40 19.0-19.4	BH410 2.0-2.2	BH410 7.0-7.2	BH410 17.0-17.5	QC639
Sample Type	Normal	Normal	Field_D	Interlab_D	Normal	Normal	Normal	Field_D	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sample Depth Range	11.5-11.7	16-16.2	16-16.2	16-16.2	20.5-20.7	7-7.2	8.5-8.7	8.5-8.7	13-13.2	16.5-16.7	17.8-18	19-19.4	2-2.2	7-7.2	17-17.5	17-17.5
Location Code	AECOM BH39	AECOM BH39	AECOM BH39	AECOM BH39	AECOM BH39	AECOM BH40	AECOM BH40	AECOM BH40	AECOM BH40	AECOM BH40	AECOM BH40	AECOM BH40	BH410	BH410	BH410	BH410
Sampled Date Time	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	18/02/2010	18/02/2010	18/02/2010	18/02/2010	18/02/2010	18/02/2010	18/02/2010	18/02/2010	10/05/2011	10/05/2011	11/05/2011

Chem Group	ChemName	Units	LOR															
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	<10	<10	<10	<10	<10	<10	-	<10	-	-	-	<10	<10	<10	<10
	TPH C10 - C14	mg/kg	50	<50	<50	<50	<50	<50	<50	-	<50	-	-	-	<50	<50	<50	<50
	TPH C15-C28	mg/kg	100	<100	<100	<100	<100	<100	<100	-	<100	-	-	-	<100	<100	840	1160
	TPH C29-C36	mg/kg	100	<100	<100	<100	<100	<100	<100	-	<100	-	-	-	<100	<100	290	660
	TPH+C10 - C36 (Sum of total)	mg/kg	50	<50	<50	<50	<250	<50	<50	-	<50	-	-	-	<50	<50	1130	1820
TRH (NEPM 2013)	TRH C6-C10 less BTEX (F1)	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TRH >C10-C16	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C16 - C34 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C34 - C40 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C10 - C40 Fraction (sum)	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	2-chloronaphthalene	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	<0.5	<0.5	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01	-	-	-	-	<0.5	-	-	-	28.6	0.5	-	-	-	-	-
	3-methylcholanthrene	mg/kg	0.01	-	-	-	-	<0.5	-	-	-	<0.5	<0.5	-	-	-	-	-
	Acenaphthene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	2.5	<0.5	<0.5	<0.5	<0.5	4.1	4.5
	Acenaphthylene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	13.1	<0.5	2	<0.5	<0.5	5.2	5
	Acetophenone	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	<0.5	<0.5	-	-	-	-	-
	Anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	10	<0.5	2	<0.5	<0.5	9.7	8.5
	Benz(a)anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	8.4	<0.5	1.4	<0.5	<0.5	9.6	9.9
	Benzo(a) pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	6.8	<0.5	0.8	<0.5	<0.5	7.7	8
	Benzo(b)&(k)fluoranthene	mg/kg	0.2	-	-	-	<1	<1	-	-	-	6	<1	-	-	-	-	-
	Benzo(b)fluoranthene	mg/kg	0.01	<0.5	<0.5	<0.5	-	<0.5	-	-	-	-	-	0.9	<0.5	<0.5	8.9	9.1
	Benzo(g,h,i)perylene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	2	<0.5	<0.5	<0.5	<0.5	3.9	4
	Benzo(k)fluoranthene	mg/kg	0.01	<0.5	<0.5	<0.5	-	<0.5	-	-	-	-	-	<0.5	<0.5	<0.5	4.5	4.9
	Chrysene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	6	<0.5	1.2	<0.5	<0.5	7.9	8.2
	Dibenz(a,h)anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	0.6	<0.5	<0.5	<0.5	<0.5	0.8	0.7
	Fluoranthene	mg/kg	0.01	<0.5	<0.5	1	<0.5	<0.5	<0.5	-	<0.5	31.8	<0.5	3.8	<0.5	<0.5	23	23.6
	Fluorene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	12.6	<0.5	2.7	<0.5	<0.5	4.8	4.9
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	2	<0.5	<0.5	<0.5	<0.5	3.3	3.4
	Naphthalene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	137	1.4	10.5	<0.5	<0.5	2.8	2.6
	Phenanthrene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	36.6	0.8	6.6	<0.5	<0.5	24.4	24.5
	Pyrene	mg/kg	0.01	<0.5	<0.5	1	<0.5	<0.5	<0.5	-	<0.5	19.2	<0.5	3.4	<0.5	<0.5	21.3	21
	CPAH (ESDAT)	mg/kg	-	<4	<4	<4	<3	<3	<4	-	<4	25.8	<3	4.3	<4	<4	46.6	48.2
	CPAH (TEF)	mg/kg	-	<1.21	<1.21	<1.21	<1.11	<1.11	<1.21	-	<1.21	8.52	<1.11	1.042	<1.21	<1.21	11.248	11.552
	PAH (TOTAL)	mg/kg	-	<8	<8	2	<7	<7	<8	-	<8	288.6	2.2	35.3	<8	<8	141.9	142.8
Phenols	2,4-dimethylphenol	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	5.9	1	3.1	<0.5	<0.5	<0.5	<0.5
BTEX	Benzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	5.4	0.8	0.6	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	14	1.5	0.6	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.2	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<0.5	17.2	2.4	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (o)	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	5.6	1	<0.5	<0.5	<0.5	<0.5	<0.5
	Total Xylene	mg/kg	0.5	<1	<1	<1	<1.5 - 0	<1	<1	-	<1	22.8	3.4	<1	<0.5	<0.5	<0.5	<0.5
Cyanides	Cyanide (WAD)	mg/kg	1	-	-	-	<1	-	-	-	-	-	-	-	-	-	-	-
Field	pH (Field)	pH	0.1	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-
Herbicides	Diallate	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-
Metals	Arsenic	mg/kg	1	<5	<5	<5	<1	<5	<5	-	<5	<5	20	<5	38	<5	<5	12
	Barium	mg/kg	5	20	20	20	9	10	20	-	20	<10	<10	10	20	-	-	-
	Beryllium	mg/kg	1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	-	-	-
	Cadmium	mg/kg	0.1	<1	<1	<1	<0.1	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	<1
	Chromium	mg/kg	1	7	7	10	7	4	7	-	7	4	22	5	28	10	8	19
	Chromium (hexavalent)	mg/kg	0.5	-	-	-	-	-	-	-	-	<0.5	<0.5	-	<0.5	-	-	-
	Cobalt	mg/kg	1	<2	<2	<2	<1	<2	4	-	2	<2	<2	<2	<2	-	-	-
	Copper	mg/kg	1	<5	<5	6	2	<5	<5	-	<5	<5	<5	<5	80	51	48	64
	Iron	mg/kg	10	-	-	-	-	-	-	-	-	17,800	890	24,500	-	-	-	-
	Lead	mg/kg	1	<5	5	11	10	<5	7	-	7	8	6	6	8	269	308	419
	Manganese	mg/kg	5	134	<5	6	<5	<5	180	-	115	77	<5	<5	9	-	-	-
	Mercury	mg/kg	0.05	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	2	6.2	1.1
	Nickel	mg/kg	1	<2	<2	<2	1	<2	5	-	3	<2	<2	<2	2	13	7	10
	Vanadium	mg/kg	5	7	14	25	9	<5	9	-	10	8	86	6	116	-	-	-
	Zinc	mg/kg	1	8	<5	8	<5	<5	30	-	15	36	<5	<5	8	303	301	362
VOCs	1,2,4-trimethylbenzene	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	7.5	1.3	-	-	-	-	-

Table T4:
Area A - Soil Analytical Results - Saturated

Field ID	BH410 23.0-23.2	BH410 26.0-26.2	BH410 32.0-32.2	BH411 2.0-2.1	BH411 3.1-3.2	BH411 4.0-4.1	BH411 8.0-8.1	BH411 10.0-10.1	BH411 15.0-15.1	BH411 18.0-18.1	QC632	BH411 19.0-19.1	BH411 23.0-23.1	BH411 26.0-26.1	BH46-4.0-4.2
Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field D	Normal	Normal	Normal	Normal
Sample Depth Range	23-23.2	26-26.2	32-32.2	2-2.1	3.1-3.2	4-4.1	8-8.1	10-10.1	15-15.1	18-18.1	18-18.1	19-19.1	23-23.1	26-26.1	4-4.2
Location Code	BH410	BH410	BH410	BH411	BH411	BH411	BH411	BH411	BH411	BH411	BH411	BH411	BH411	BH411	AECOM BH46
Sampled Date Time	11/05/2011	12/05/2011	12/05/2011	12/04/2011	12/04/2011	12/04/2011	12/04/2011	12/04/2011	12/04/2011	12/04/2011	13/04/2011	12/04/2011	12/04/2011	12/04/2011	23/02/2010

Chem Group	ChemName	Units	LOR															
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	<10	<10	22	<10	-	<10	<10	-	<10	<10	<10	-	-	<10	-
	TPH C10 - C14	mg/kg	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	-
	TPH C15-C28	mg/kg	100	<100	<100	<100	<100	<100	<100	<100	<100	930	1130	1130	<100	<100	<100	-
	TPH C29-C36	mg/kg	100	<100	<100	<100	<100	<100	<100	<100	<100	380	820	760	<100	<100	<100	-
	TPH+C10 - C36 (Sum of total)	mg/kg	50	<50	<50	<50	<50	<50	<50	<50	<50	1310	1950	1890	<50	<50	<50	-
TRH (NEPM 2013)	TRH C6-C10 less BTEX (F1)	mg/kg	10	-	-	-	<10	-	<10	<10	-	<10	<10	<10	-	-	<10	-
	TRH >C10-C16	mg/kg	50	-	-	-	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	-
	>C16 - C34 Fraction	mg/kg	100	-	-	-	<100	<100	<100	<100	<100	1210	1610	1580	<100	<100	<100	-
	>C34 - C40 Fraction	mg/kg	100	-	-	-	<100	<100	<100	<100	<100	120	680	580	<100	<100	<100	-
	>C10 - C40 Fraction (sum)	mg/kg	50	-	-	-	<50	<50	<50	<50	<50	1330	2290	2160	<50	<50	<50	-
PAHs	2-chloronaphthalene	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01	-	-	-	-	0.01	-	-	0.08	-	-	-	<0.01	<0.01	-	-
	3-methylcholanthrene	mg/kg	0.01	-	-	-	-	<0.01	-	-	<0.01	-	-	-	<0.01	<0.01	-	-
	Acenaphthene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.01	<0.5	<0.5	0.06	<0.5	0.5	0.5	<0.01	<0.01	<0.5	-
	Acenaphthylene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.09	<0.5	<0.5	0.34	<0.5	3.4	3.3	<0.01	<0.01	<0.5	-
	Acetophenone	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.12	0.6	0.6	0.62	<0.5	3.3	3.2	<0.01	<0.01	<0.5	-
	Benz(a)anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	0.7	0.46	1.1	0.7	0.97	<0.5	7.3	7.5	<0.01	<0.01	<0.5	-
	Benzo(a) pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	0.6	0.48	0.9	0.5	0.7	<0.5	6.8	6.8	<0.01	<0.01	<0.5	-
	Benzo(b)&(k)fluoranthene	mg/kg	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Benzo(b)fluoranthene	mg/kg	0.01	<0.5	<0.5	<0.5	0.6	0.44	1	0.5	0.62	<0.5	5.9	6.5	<0.01	<0.01	<0.5	-
	Benzo(g,h,i)perylene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.14	<0.5	<0.5	0.15	<0.5	2.7	2.7	<0.01	<0.01	<0.5	-
	Benzo(k)fluoranthene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.26	<0.5	<0.5	0.44	<0.5	1.9	3	<0.01	<0.01	<0.5	-
	Chrysene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.42	0.8	<0.5	0.79	<0.5	5.6	5.5	<0.01	<0.01	<0.5	-
	Dibenz(a,h)anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.06	<0.5	<0.5	0.09	<0.5	<0.5	<0.5	<0.01	<0.01	<0.5	-
	Fluoranthene	mg/kg	0.01	<0.5	<0.5	<0.5	1.3	0.75	2.4	1.8	2.11	1	17	17	<0.01	<0.01	<0.5	-
	Fluorene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.02	<0.5	<0.5	0.35	<0.5	1.2	1.2	<0.01	<0.01	<0.5	-
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.13	<0.5	<0.5	0.17	<0.5	2.2	2.2	<0.01	<0.01	<0.5	-
	Naphthalene	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	0.03	<0.5	<0.5	0.06	<0.5	1.2	1.1	<0.01	<0.01	<0.5	-
	Phenanthrene	mg/kg	0.01	<0.5	<0.5	<0.5	0.7	0.42	1.3	2	2.18	<0.5	5.4	5.4	<0.01	<0.01	<0.5	-
	Pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	1.2	0.79	2.3	1.7	1.9	0.9	17.7	17.7	0.01	<0.01	<0.5	-
	CPAH (ESDAT)	mg/kg	-	<4	<4	<4	1.9	2.39	3.8	1.7	3.93	<4	32.4	34.2	<0.08	<0.08	<4	-
	CPAH (TEF)	mg/kg	-	<1.21	<1.21	<1.21	0.73	0.6746	1.118	0.62	1.0194	<1.21	8.613	8.802	<0.0242	<0.0242	<1.21	-
	PAH (TOTAL)	mg/kg	-	<8	<8	<8	5.1	4.62	10.4	7.8	11.55	1.9	82.1	83.6	0.01	<0.16	<8	-
Phenols	2,4-dimethylphenol	mg/kg	0.01	<0.5	<0.5	<0.5	-	<0.01	-	-	0.01	-	-	-	<0.01	<0.01	-	-
BTEX	Benzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	<0.2	-	-	<0.2	-
	Ethylbenzene	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	-	<0.5	-
	Toluene	mg/kg	0.2	<0.5	<0.5	16.4	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	-	<0.5	-
	Xylene (m & p)	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	-	<0.5	-
	Xylene (o)	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	-	<0.5	-
	Total Xylene	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	-	<0.5	-
Cyanides	Cyanide (WAD)	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field	pH (Field)	pH	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides	Diallate	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals	Arsenic	mg/kg	1	<5	<5	<5	<5	-	<5	5	-	7	24	13	-	-	<5	<5
	Barium	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
	Beryllium	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1
	Cadmium	mg/kg	0.1	<1	<1	<1	<1	-	<1	<1	-	<1	<1	<1	-	-	<1	<1
	Chromium	mg/kg	1	4	3	23	11	-	5	23	-	10	40	27	-	-	2	8
	Chromium (hexavalent)	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cobalt	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
	Copper	mg/kg	1	<5	5	<5	14	-	160	32	-	47	118	77	-	-	6	8
	Iron	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lead	mg/kg	1	11	<5	6	135	-	70	150	-	257	366	333	-	-	<5	6
	Manganese	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130
	Mercury	mg/kg	0.05	<0.1	<0.1	<0.1	0.4	-	0.2	0.2	-	0.9	3.4	1.6	-	-	<0.1	<0.1
	Nickel	mg/kg	1	<2	<2	5	24	-	27	18	-	8	12	9	-	-	<2	6
	Vanadium	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	Zinc	mg/kg	1	23	<5	7	83	-	402	222	-	198	446	316	-	-	<5	24
VOCs	1,2,4-trimethylbenzene	mg/kg	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table T4:
Area A - Soil Analytical Results - Saturated

Field_ID	BH46-7.0-7.2	QC57	QC58	BH46-14.5-14.7	BH46-19.0-19.2	BH46-19.0-19.2	BH46-20.5-20.7	BH46-23.5-23.7	BH544D	BH544D	BH544D	BH544D	BH544D	BH544D	BH60_2.5-2.9	BH60_7.0-7.2
Sample_Type	Normal	Field_D	Interlab_D	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sample_Depth_Range	7-7.2	7-7.2	7-7.2	14.5-14.7	19-19.2	19-19.2	20.5-20.7	23.5-23.7	2.9-3	3.9-4	4.9-5	5.9-6	11.9-12	14.9-15	2.5-2.9	7-7.2
Location_Code	AECOM BH46	AECOM BH46	AECOM BH46	AECOM BH46	AECOM BH46	AECOM BH46	AECOM BH46	AECOM BH46	JBS BH544D	JBS BH544D	JBS BH544D	JBS BH544D	JBS BH544D	JBS BH544D	AECOM BH60	AECOM BH60
Sampled_Date_Time	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	16/05/2012	16/05/2012	16/05/2012	16/05/2012	16/05/2012	16/05/2012	1/03/2010	1/03/2010

Chem_Group	ChemName	Units	LOR															
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	<10	<10	<10	<10	<10	-	<10	<10	-	-	-	-	-	<10	<10
	TPH C10 - C14	mg/kg	50	<50	<50	<50	200	<50	-	<50	<50	-	-	-	-	-	<50	<50
	TPH C15-C28	mg/kg	100	<100	<100	<100	560	<100	-	<100	<100	-	-	-	-	-	430	<100
	TPH C29-C36	mg/kg	100	<100	<100	<100	200	<100	-	<100	<100	-	-	-	-	-	680	<100
	TPH+C10 - C36 (Sum of total)	mg/kg	50	<50	<50	<250	960	<50	-	<50	<50	-	-	-	-	-	1110	<50
TRH (NEPM 2013)	TRH C6-C10 less BTEX (F1)	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TRH >C10-C16	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C16 - C34 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C34 - C40 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C10 - C40 Fraction (sum)	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	2-chloronaphthalene	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-
	2-methylnaphthalene	mg/kg	0.01	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	<0.5	-
	3-methylcholanthrene	mg/kg	0.01	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-
	Acenaphthene	mg/kg	0.01	<0.5	<0.5	<0.5	4.5	<0.5	-	<0.5	<0.5	0.3	0.4	0.4	0.3	0.2	0.1	0.5
	Acenaphthylene	mg/kg	0.01	<0.5	<0.5	<0.5	26.8	<0.5	-	<0.5	<0.5	0.3	0.4	0.3	0.4	0.3	0.6	3.5
	Acetophenone	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-
	Anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	20.7	<0.5	-	<0.5	<0.5	0.9	1.4	1.4	0.9	0.6	0.7	4.4
	Benz(a)anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	17.1	<0.5	-	<0.5	<0.5	2.6	3.5	3.4	3	2.2	2	6.9
	Benzo(a) pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	10.1	<0.5	-	<0.5	<0.5	4.3	5.4	5.2	4.9	3.8	2.5	4.3
	Benzo(b)&(k)fluoranthene	mg/kg	0.2	-	-	<1	-	<1	-	-	-	5.6	7.2	6.8	6.6	5	3.3	-
	Benzo(b)fluoranthene	mg/kg	0.01	<0.5	<0.5	-	14.7	-	-	<0.5	<0.5	-	-	-	-	-	-	7.2
	Benzo(g,h,i)perylene	mg/kg	0.01	<0.5	<0.5	<0.5	4.5	<0.5	-	<0.5	<0.5	2	2.4	2.2	2.2	1.7	1.1	2.3
	Benzo(k)fluoranthene	mg/kg	0.01	<0.5	<0.5	-	4.4	-	-	<0.5	<0.5	-	-	-	-	-	-	2.7
	Chrysene	mg/kg	0.01	<0.5	<0.5	<0.5	12	<0.5	-	<0.5	<0.5	2.4	3.8	3.6	3.2	2.4	1.7	5
	Dibenz(a,h)anthracene	mg/kg	0.01	<0.5	<0.5	<0.5	1.2	<0.5	-	<0.5	<0.5	0.4	0.5	0.5	0.6	0.4	0.3	0.6
	Fluoranthene	mg/kg	0.01	<0.5	<0.5	<0.5	38.3	<0.5	-	<0.5	<0.5	5.3	7.5	7.6	6.2	4.1	3.9	13.5
	Fluorene	mg/kg	0.01	<0.5	<0.5	<0.5	25.9	<0.5	-	<0.5	<0.5	0.2	0.3	0.3	0.2	0.1	0.3	2.3
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	3.7	<0.5	-	<0.5	<0.5	2	2.5	2.3	2.2	1.7	1.1	2.1
	Naphthalene	mg/kg	0.01	<0.5	<0.5	<0.5	114	<0.5	-	<0.5	<0.5	0.1	0.2	0.2	0.3	0.1	0.4	1.1
	Phenanthrene	mg/kg	0.01	<0.5	<0.5	<0.5	55.9	<0.5	-	<0.5	<0.5	1.9	3.5	2.9	2.1	1.1	1.8	12.3
	Pyrene	mg/kg	0.01	<0.5	<0.5	<0.5	32.1	<0.5	-	<0.5	<0.5	7.2	9	9.2	8	7.7	4.7	13.7
	CPAH (ESDAT)	mg/kg	-	<4	<4	<3	67.7	<3	-	<4	<4	-	-	-	-	-	-	31.1
	CPAH (TEF)	mg/kg	-	<1.21	<1.21	<1.11	15.455	<1.11	-	<1.21	<1.21	-	-	-	-	-	-	6.863
	PAH (TOTAL)	mg/kg	-	<8	<8	<7	385.9	<7	-	<8	<8	-	-	-	-	-	-	82.4
Phenols	2,4-dimethylphenol	mg/kg	0.01	<0.5	<0.5	<0.5	<0.5	2.2	-	0.7	<0.5	-	-	-	-	-	-	<0.5
BTEX	Benzene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	0.4	<0.2	-	-	-	-	-	-	<0.2
	Ethylbenzene	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	-	-	-	-	-	<0.5
	Toluene	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	-	-	-	-	-	<0.5
	Xylene (m & p)	mg/kg	0.2	<0.5	<0.5	<1	<0.5	<0.5	-	<0.5	<0.5	-	-	-	-	-	-	<0.5
	Xylene (o)	mg/kg	0.2	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	-	-	-	-	-	<0.5
	Total Xylene	mg/kg	0.5	<1	<1	<1.5	<1	<1	-	<1	<1	-	-	-	-	-	-	<1
Cyanides	Cyanide (WAD)	mg/kg	1	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-
Field	pH (Field)	pH	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides	Diallate	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-
Metals	Arsenic	mg/kg	1	<5	<5	2	<5	<5	-	<5	<5	-	<4	-	-	5	-	<5
	Barium	mg/kg	5	50	20	22	<10	10	-	<10	120	-	-	-	-	-	-	70
	Beryllium	mg/kg	1	<1	<1	<1	<1	<1	-	<1	<1	-	-	-	-	-	-	<1
	Cadmium	mg/kg	0.1	<1	<1	<0.1	<1	<1	-	<1	<1	-	<0.5	-	-	<0.5	-	<1
	Chromium	mg/kg	1	7	8	7	8	5	-	7	12	-	16	-	-	14	-	14
	Chromium (hexavalent)	mg/kg	0.5	-	-	-	<0.5	<0.5	-	<0.5	-	-	-	-	-	-	-	-
	Cobalt	mg/kg	1	3	6	4	<2	<2	-	<2	<2	-	-	-	-	-	-	5
	Copper	mg/kg	1	6	6	12	<5	<5	-	<5	<5	-	28	-	-	45	-	50
	Iron	mg/kg	10	-	-	-	5210	480	-	12,800	-	-	-	-	-	-	-	-
	Lead	mg/kg	1	12	10	11	6	6	-	<5	11	-	190	-	-	100	-	55
	Manganese	mg/kg	5	154	144	121	<5	<5	-	5	9	-	-	-	-	-	-	177
	Mercury	mg/kg	0.05	<0.1	<0.1	<0.05	<0.1	<0.1	-	<0.1	<0.1	-	0.1	-	-	0.1	-	<0.1
	Nickel	mg/kg	1	4	6	4	<2	<2	-	<2	<2	-	8	-	-	9	-	9
	Vanadium	mg/kg	5	12	15	10	13	<5	-	18	17	-	-	-	-	-	-	41
	Zinc	mg/kg	1	27	38	36	<5	<5	-	<5	<5	-	96	-	-	77	-	59
VOCs	1,2,4-trimethylbenzene	mg/kg	0.5	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-	-

Field ID	QC110	BH60 8.5-8.9	BH60 13.0-13.4	BH60 16.0-16.4	BH60 16.0-16.4	BH60 17.5-17.7	QC120	QC121	BH60 20.5-20.9	BH72 2.5-2.7	BH72 5.5-5.7	BH72 13.0-13.2	BH72 16.0-16.2	BH72 19.0-19.2	BH72 20.5-20.7
Sample Type	Field D	Normal	Normal	Normal	Normal	Normal	Field D	Interlab D	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sample Depth Range	7-7.2	8.5-8.9	13-13.4	16-16.4	16-16.4	17.5-17.7	17.5-17.7	17.5-17.7	20.5-20.9	2.5-2.7	5.5-5.7	13-13.2	16-16.2	19-19.2	20.5-20.7
Location Code	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH60	AECOM BH72	AECOM BH72	AECOM BH72	AECOM BH72	AECOM BH72	AECOM BH72
Sampled Date Time	1/03/2010	1/03/2010	1/03/2010	1/03/2010	1/03/2010	2/03/2010	2/03/2010	2/03/2010	2/03/2010	3/03/2010	3/03/2010	3/03/2010	4/03/2010	4/03/2010	4/03/2010

Chem Group	ChemName	Units	LOR															
TRH (NEPM 1999)	TPH C6 - C9	mg/kg	2	<10	-	<10	-	84	12	25	<10	<10	<10	<10	<10	<10	<10	<10
	TPH C10 - C14	mg/kg	50	<50	-	<50	-	760	60	80	270	<50	<50	<50	<50	<50	<50	<50
	TPH C15-C28	mg/kg	100	<100	-	230	-	1660	160	200	550	<100	160	<100	1660	520	<100	<100
	TPH C29-C36	mg/kg	100	<100	-	210	-	620	<100	<100	120	<100	130	<100	940	220	<100	<100
	TPH+C10 - C36 (Sum of total)	mg/kg	50	<50	-	440	-	3040	220	280	940	<50	290	<50	2600	740	<50	<50
TRH (NEPM 2013)	TRH C6-C10 less BTEX (F1)	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TRH >C10-C16	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C16 - C34 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C34 - C40 Fraction	mg/kg	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>C10 - C40 Fraction (sum)	mg/kg	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PAHs	2-chloronaphthalene	mg/kg	0.5	-	-	-	-	-	-	-	-	<0.5	-	<0.5	-	-	<0.5	-
	2-methylnaphthalene	mg/kg	0.01	-	-	-	-	0.8	<0.5	<0.5	-	<0.5	<0.5	0.9	<0.5	<0.5	<0.5	<0.5
	3-methylcholanthrene	mg/kg	0.01	-	-	-	-	-	-	-	-	<0.5	-	<0.5	-	-	<0.5	-
	Acenaphthene	mg/kg	0.01	-	-	-	-	6.3	3.7	4.2	3.1	<0.5	<0.5	<0.5	4.9	2.1	<0.5	<0.5
	Acenaphthylene	mg/kg	0.01	-	-	-	-	44.2	19.5	21.5	14.8	<0.5	0.9	<0.5	8.7	7.3	<0.5	<0.5
	Acetophenone	mg/kg	0.5	-	-	-	-	-	-	-	-	<0.5	-	<0.5	-	-	<0.5	-
	Anthracene	mg/kg	0.01	-	-	-	-	32.6	17.9	19.2	14.4	<0.5	2	1.6	11.3	15	<0.5	<0.5
	Benz(a)anthracene	mg/kg	0.01	-	-	-	-	22.2	13.1	14.5	11.3	<0.5	5.4	2.3	22.1	13.1	<0.5	<0.5
	Benzo(a) pyrene	mg/kg	0.01	-	-	-	-	12.3	6.9	7.7	6.6	<0.5	3.8	1.6	12.8	6.7	<0.5	<0.5
	Benzo(b)&(k)fluoranthene	mg/kg	0.2	-	-	-	-	-	-	-	10	<1	-	2	-	-	<1	-
	Benzo(b)fluoranthene	mg/kg	0.01	-	-	-	-	17.4	9.9	10.6	-	-	6.3	-	17.4	9.3	-	<0.5
	Benzo(g,h,i)perylene	mg/kg	0.01	-	-	-	-	4.4	2.4	2.6	2.4	<0.5	2.2	<0.5	5.6	2.7	<0.5	<0.5
	Benzo(k)fluoranthene	mg/kg	0.01	-	-	-	-	6.4	4.1	5.1	-	-	1.8	-	8.4	3.6	-	<0.5
	Chrysene	mg/kg	0.01	-	-	-	-	16.9	9	10.1	7.9	<0.5	4.4	1.7	14.9	8.6	<0.5	<0.5
	Dibenz(a,h)anthracene	mg/kg	0.01	-	-	-	-	1.3	0.7	0.7	1	<0.5	<0.5	<0.5	1.3	0.6	<0.5	<0.5
	Fluoranthene	mg/kg	0.01	-	-	-	-	56.8	33.4	37.5	39.2	<0.5	9.7	4.2	44.9	27	<0.5	<0.5
	Fluorene	mg/kg	0.01	-	-	-	-	38.6	22.3	25.3	25	<0.5	0.5	1	5.1	13	<0.5	<0.5
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	-	-	-	-	4.2	2.3	2.6	2.4	<0.5	1.7	<0.5	4.4	2.1	<0.5	<0.5
	Naphthalene	mg/kg	0.01	-	-	-	-	256	101	113	222	<0.5	1.4	0.6	4.2	16.4	<0.5	<0.5
	Phenanthrene	mg/kg	0.01	-	-	-	-	88.3	50.7	57.8	58.3	<0.5	6.5	5.3	28.7	43.9	<0.5	<0.5
	Pyrene	mg/kg	0.01	-	-	-	-	45.9	25.7	28.6	27.3	<0.5	9.1	4	42.1	24.1	<0.5	<0.5
	CPAH (ESDAT)	mg/kg	-	-	-	-	-	85.1	48.4	53.9	31.6	<3	25.6	5.6	86.9	46.7	<3	<4
	CPAH (TEF)	mg/kg	-	-	-	-	-	18.833	10.654	11.807	9.1	<1.11	5.386	1.847	19.535	10.223	<1.11	<1.21
	PAH (TOTAL)	mg/kg	-	-	-	-	-	653.8	322.6	361	435.7	<7	55.7	22.3	236.8	195.5	<7	<8
Phenols	2,4-dimethylphenol	mg/kg	0.01	-	-	-	-	4.2	0.6	0.7	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BTEX	Benzene	mg/kg	0.2	<0.2	-	<0.2	-	5.8	0.6	1.2	0.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Ethylbenzene	mg/kg	0.2	<0.5	-	<0.5	-	1	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Toluene	mg/kg	0.2	<0.5	-	<0.5	-	15.5	1.9	5	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Xylene (m & p)	mg/kg	0.2	<0.5	-	<0.5	-	13.4	2.4	7	2	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5
	Xylene (o)	mg/kg	0.2	<0.5	-	<0.5	-	4.8	0.9	2.3	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Total Xylene	mg/kg	0.5	<1	-	<1	-	18.2	3.3	9.3	2.8	<1	<1	<1	<1	0.6	<1	<1
Cyanides	Cyanide (WAD)	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Field	pH (Field)	pH	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Herbicides	Diallate	mg/kg	0.5	-	-	-	-	-	-	-	-	-	<0.5	-	-	-	<0.5	-
Metals	Arsenic	mg/kg	1	<5	-	<5	-	<5	36	16	9	<5	<5	<5	14	11	<5	<5
	Barium	mg/kg	5	80	-	80	-	<10	20	10	11	<10	90	<10	240	20	40	<10
	Beryllium	mg/kg	1	<1	-	<1	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cadmium	mg/kg	0.1	<1	-	<1	-	<1	<1	<1	<0.1	<1	<1	<1	<1	<1	<1	<1
	Chromium	mg/kg	1	14	-	10	-	3	25	13	12	3	6	5	31	19	6	3
	Chromium (hexavalent)	mg/kg	0.5	-	-	<0.5	-	1.4	-	-	-	<0.5	-	<0.5	-	-	<0.5	<0.5
	Cobalt	mg/kg	1	3	-	<2	-	<2	<2	<2	<1	<2	5	<2	3	<2	<2	<2
	Copper	mg/kg	1	125	-	11	-	<5	<5	<5	2	<5	52	7	110	<5	<5	<5
	Iron	mg/kg	10	-	-	6240	-	1060	-	-	-	940	-	2050	-	-	790	790
	Lead	mg/kg	1	38	-	110	-	<5	13	10	10	<5	89	10	420	11	6	<5
	Manganese	mg/kg	5	151	-	105	-	<5	<5	<5	<5	<5	190	9	93	<5	<5	<5
	Mercury	mg/kg	0.05	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	2.8	<0.1	<0.1	<0.1
	Nickel	mg/kg	1	8	-	3	-	<2	2	<2	3	<2	8	<2	9	<2	<2	<2
	Vanadium	mg/kg	5	26	-	13	-	<5	72	53	43	<5	22	6	33	31	9	<5
	Zinc	mg/kg	1	100	-	75	-	<5	5	<5	7	<5	61	9	436	<5	<5	<5
VOCs	1,2,4-trimethylbenzene	mg/kg	0.5	-	-	-	-	-	-	-	-	<0.5	-	<0.5	-	-	<0.5	-

[illegible]

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[illegible]

	Phenols					BTEX							Metals																	Organochlorine Pesticides											
	2-nitrophenol	3-&4-methylphenol	4-chloro-3-methylphenol	Phenol	Phenolics Total	Total Xylene (ESDAT)	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Weak Acid Dissociable Cyanide	Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium (hexavalent)	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC									
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg								
EQL	0.5	0.5	0.5	0.5			0.2	0.2	0.2	0.2	0.2	1	1	10	1	0.1	1	0.5	1	1	10	1	5	0.05	1	5	1	0.5	0.5	0.5			0.5								
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Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

	cis-Chlordane	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Organophosphorous Pesticides																							
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
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Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																																			
JBS BH547	BH547	3		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	7		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	8		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	9		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	12		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Data Entry: KM
Data Review: AR
AECOM

Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

	Fenitrothion	Fensulfothion	Fenthion	Malathion	Methyl methanesulfonate	Methyl parathion	Mevinphos (Phosdrin)	Phorate	Pirimphos-ethyl	Prothiofos	Ronnel	Safrole	Stirophos	trans-Isosafrole	Trichloronate	Plasticiser Compounds	Scheduled chemicals (NSW Waste 2008)	Organic Matter	Pesticides					PCBs	Solvents		SVOCs						
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			0.5	0.5						0.1	0.5	0.5						
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Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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[illegible]

Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

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Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																																			
JBS BH547	BH547	3		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	7		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	8		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	9		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	12		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

	Chlorobenzilate	Dibenzofuran	Diethylphthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Diphenylamine	EPN	Hexachlorocyclopentadiene	Hexachloroethane	Hexachloropropene	Isosafrole	Methapyriliene	Nitrobenzene	N-Nitrosodiphenyl & Diphenylamine	N-nitrosodiethylamine	N-nitrosodi-n-butylamine	N-nitrosodi-n-propylamine	N-Nitrosomethylethylamine	N-nitrosomorpholine	N-nitrosopiperidine	N-nitrosopyrrolidine	2-methylaniline	Pentachlorobenzene	Pentachloronitrobenzene	Pentachlorophenol	Phenacetin	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5
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Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									</
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Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

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Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																																
JBS BH547	BH547	3		23/05/2012	Normal	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	-	<1	<1	<1	<1	<1	<1	<1	-	<1
JBS BH547	BH547	7		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	8		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	9		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	12		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

	Dibromomethane	Dichlorodifluoromethane	Hexachlorobutadiene	Iodomethane	Isophorone	Isopropylbenzene	n-butylbenzene	n-propylbenzene	Pentachloroethane	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	trans-1,4-Dichloro-2-butene	Trichlorofluoromethane	Vinyl acetate
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	5
-																		

Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																	
AECOM BH46	BH46-1.0-1.2	1-1.2	1.12	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	QC56	1-1.2	1.12	23/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	BH46-4.0-4.2	4-4.2	-1.88	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	BH46-7.0-7.2	7-7.2	-4.88	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	QC57	7-7.2	-4.88	23/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	QC58	7-7.2	-4.88	23/02/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH47	BH47-1.0-1.2	1-1.2	1.28	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH47	BH47-4.0-4.2	4-4.2	-1.72	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH47	BH47-8.5-8.7	8.5-8.7	-6.22	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH47	BH47-10.0-10.2	10-10.2	-7.72	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH48	BH48 0.15-0.16	0.15-0.16	2.305	19/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH48	BH48-1.0-1.2	1-1.2	1.36	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH48	QC76	1-1.2	1.36	22/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH48	QC77	1-1.2	1.36	22/02/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH48	BH48-8.5-8.7	8.5-8.7	-6.14	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH48	BH48-11.5-11.7	11.5-11.7	-9.14	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH56	BH56 2.5-2.7	2.5-2.7	0.01	4/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH56	BH56 4.25-4.6	4.25-4.6	-1.815	4/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH56	BH56 7.0-7.2	7-7.2	-4.49	4/03/2010	Normal	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5
AECOM BH56	BH56 7.0-7.2	7-7.2	-4.49	4/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH56	BH56 11.5-11.7	11.5-11.7	-8.99	4/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH57	BH57 4.0-4.2	4-4.2	-1.59	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH57	BH57 7.0-7.2	7-7.2	-4.59	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH57	BH57 11.5-11.7	11.5-11.7	-9.09	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH60	BH60 0.17-0.27	0.17-0.27	2.47	24/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH60	BH60 2.5-2.9	2.5-2.9	-0.01	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH60	BH60 7.0-7.2	7-7.2	-4.41	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH60	QC110	7-7.2	-4.41	1/03/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH60	BH60 8.5-8.9	8.5-8.9	-6.01	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH72	BH72 0.15-0.25	0.15-0.25	2.43	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH72	BH72 1.0-1.2	1-1.2	1.53	3/03/2010	Normal	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5
AECOM BH72	BH72 2.5-2.7	2.5-2.7	0.03	3/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH72	BH72 5.5-5.7	5.5-5.7	-2.97	3/03/2010	Normal	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<5	<5
AECOM BH73	BH73 2.5-2.7	2.5-2.7	-0.27	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH73	BH73 7.0-7.2	7-7.2	-4.77	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH73	BH73 8.5-8.7	8.5-8.7	-6.27	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH73	BH73 11.5-11.7	11.5-11.7	-9.27	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH021	BH021 1.5-1.95	1.5-1.95	0.483	9/05/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH053	BH053-0.3-0.5	0.3-0.5	2.259	29/05/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH053	BH053-1.5-1.95	1.5-1.95	0.934	29/05/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH053	BH053-3.0-3.25	3-3.25	-0.466	29/05/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH054	BH054-1.5-1.6	1.5-1.6	0.91	29/05/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH054	BH054-3.0-3.45	3-3.45	-0.765	29/05/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH063	BH063-1.5-1.65	1.5-1.65	0.719	1/06/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH063	BH063-2.8-3.0	2.8-3	-0.606	1/06/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH064	BH064-1.5-1.95	1.5-1.95	0.813	1/06/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH064	BH064-3.0-3.45	3-3.45	-0.687	1/06/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH076	BH076 0.3-0.5	0.3-0.5	2.141	6/06/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH076	BH076 1.5-1.95	1.5-1.95	0.816	6/06/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH143	BH143 1.5 1.95	1.5-1.95	0.408	10/07/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH143	BH143 3.0 3.45	3-3.45	-1.092	10/07/2006	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH191	BH191/3.7	3.7	-1.4	27/03/2008	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH191	BH191/5.6	5.6	-3.3	11/04/2008	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	0.5		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	1		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	1.5		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	2		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table T5:
Area B - Soil Analytical Results (above 12 m bgl)

						Dibromomethane	Dichlorodifluoromethane	Hexachlorobutadiene	Iodomethane	Isophorone	Isopropylbenzene	n-butylbenzene	n-propylbenzene	Pentachloroethane	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	trans-1,4-Dichloro-2-butene	Trichlorofluoromethane	Vinyl acetate
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL						0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	5
						-																	
Location	Field Sample ID	Sample Depth	Sample Elevation	Sample Date	Sample Type																		
JBS BH547	BH547	3		23/05/2012	Normal	<1	<1	<1	-	-	<1	<1	<1	-	<1	<1	<1	<1	<1	<1	-	<1	-
JBS BH547	BH547	7		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	8		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	9		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JBS BH547	BH547	12		23/05/2012	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table T6:
Area C - Soil Analytical Results (below 12 m bgl)

					Metals												TPH								PAH																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
					Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium (hexavalent)	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc	TPH C6 - C9	TPH C10 - C14	TPH C15-C28	TPH C29-C36	TPH C15-C36	TPH+C10 - C36 (Sum of total)	CPAH (TEF)	PAH (TOTAL)	2-chloronaphthalene	2-methylnaphthalene	3-methylcholanthrene	Acenaphthene	Acenaphthylene	Acetophenone	Anthracene	Benz(a)anthracene	Benzo(a) pyrene	Benzo(b)&(k)fluoranthene																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
EQL					1	10	1	0.1	1	0.5	1	2	10	2	5	0.05	1	5	5	10	50	100	100		50				0.5	0.5	0.5	0.1	0.1	0.5	0.1	0.1	0.05	0.2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Location	Field ID	Sample Depth	Sample Date	Sample Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

Table T6:
Area C - Soil Analytical Results (below 12 m bgl)

					Is											Phenols								BTEX						Cyanides	Inorganics						
					Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	PAHs (Sum of total)	Phenanthrene	Pyrene	2,4-dimethylphenol	2-methylphenol	2-nitrophenol	3-&4-methylphenol	4-chloro-3-methylphenol	Phenol	Phenolics Total	Total Xylene (ESDA T)	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Cyanide (WAD)	Cyanide (Free)	Cyanide Total	Sulphate	TOC	Weak Acid Dissociable Cyanide	4,4-DDE	
EQL					0.5	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.5	0.5	0.5	0.5	0.5		0.2	0.5	0.5	0.5	0.5	1	1	1	100	0.1	1	0.5		
Location	Field ID	Sample Depth	Sample Date	Sample Type																																	
AECOM BH46	BH46-14.5-14.7	14.5-14.7	23/02/2010	Normal	14.7	4.5	4.4	12	1.2	38.3	25.9	3.7	114	-	55.9	32.1	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	<1	-	-	-	1.8	<1	-
AECOM BH46	BH46-19.0-19.2	19-19.2	23/02/2010	Normal	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	2.2	0.8	<0.5	1.4	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	<1	-	-	-	<0.5	<1	<0.5
AECOM BH46	BH46-20.5-20.7	20.5-20.7	23/02/2010	Normal	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	0.7	<0.5	<0.5	<1	<0.5	<0.5	-	<1	0.4	<0.5	<0.5	<0.5	<0.5	-	<1	-	-	-	<0.5	<1	-
AECOM BH46	BH46-23.5-23.7	23.5-23.7	23/02/2010	Normal	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	
AECOM BH47	BH47-13.0-13.2	13-13.2	22/02/2010	Normal	-	<0.5	-	1.7	<0.5	4.8	0.6	<0.5	<0.5	-	3.8	5.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	<1	-	-	-	<0.5	<1	<0.5
AECOM BH47	BH47-18.6-18.8	18.6-18.8	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	QC74	18.6-18.8	22/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	QC75	18.6-18.8	22/02/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH48	BH48-14.5-14.7	14.5-14.7	23/02/2010	Normal	-	8.5	-	30.8	2.9	124	94.3	8.9	517	-	215	101	97.6	30.2	<1.2	57.1	<1.2	9.4	-	27.1	8.9	1.6	20.8	20.1	7	-	<1	-	-	-	<0.5	<1	<1.2
AECOM BH48	BH48-17.0-17.2	17-17.2	23/02/2010	Normal	0.8	<0.5	<0.5	0.9	<0.5	3.1	2.3	<0.5	11	-	5.2	2.4	6.4	4.8	<0.5	10.8	<0.5	2.1	-	0.8	0.2	<0.5	0.8	0.8	<0.5	-	-	-	-	-	-	-	
AECOM BH48	QC78	14.5-14.7	23/02/2010	Field D	-	11.8	-	41.7	3.9	157	121	12.5	720	-	267	128	119	39.1	<1.2	98.3	<1.2	11.2	-	132.3	35	7.6	95.5	101	31.3	-	<1	-	-	-	1	<1	<1.2
AECOM BH56	BH56 13.0-13.2	13-13.2	5/03/2010	Normal	0.6	<0.5	<0.5	0.5	<0.5	1.5	<0.5	<0.5	1.3	-	1.8	1.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	
AECOM BH56	BH56 14.5-15.0	14.5-15	5/03/2010	Normal	-	<0.5	-	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	-	0.9	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	<1	-	0.9	<1	<0.5	
AECOM BH56	BH56 17.5-17.8	17.5-17.8	5/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-		
AECOM BH56	BH56 20.5-20.9	20.5-20.9	5/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-		
AECOM BH56	BH56 21.4-21.6	21.4-21.6	5/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	<1	-	-	<1	-		
AECOM BH56	QC125	14.5-15	5/03/2010	Field D	-	<0.5	-	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	-	0.8	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	<1	-	<0.5	<1	<0.5	
AECOM BH56	QC126	14.5-15	5/03/2010	Interlab D	-	<0.5	-	0.6	<0.5	1.3	<0.5	<0.5	<0.5	-	0.8	1.1	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1.5	<0.5	<0.5	<0.5	<1	<0.5	<1	-	<1	-	0.3	-	<0.5	
AECOM BH57	BH57 16.5-16.7	16.5-16.7	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
AECOM BH60	BH60 13.0-13.4	13-13.4	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	
AECOM BH60	BH60 16.0-16.4	16-16.4	1/03/2010	Normal	17.4	4.4	6.4	16.9	1.3	56.8	38.6	4.2	256	654	88.3	45.9	4.2	<0.5	<0.5	<1	<0.5	<0.5	-	18.2	5.8	1	15.5	13.4	4.8	-	-	<1	-	<0.5	<1	-	
AECOM BH60	BH60 17.5-17.7	17.5-17.7	2/03/2010	Normal	9.9	2.4	4.1	9	0.7	33.4	22.3	2.3	101	323	50.7	25.7	0.6	<0.5	<0.5	<1	<0.5	<0.5	-	3.3	0.6	<0.5	1.9	2.4	0.9	-	-	-	-	-	-	-	
AECOM BH60	BH60 20.5-20.9	20.5-20.9	2/03/2010	Normal	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	<1	-	<0.5	<1	<0.5	
AECOM BH60	QC120	17.5-17.7	2/03/2010	Field D	10.6	2.6	5.1	10.1	0.7	37.5	25.3	2.6	113	361	57.8	28.6	0.7	<0.5	<0.5	<1	<0.5	<0.5	-	9.3	1.2	0.5	5	7	2.3	-	-	-	-	-	-	-	
AECOM BH60	QC121	17.5-17.7	2/03/2010	Interlab D	-	2.4	-	7.9	1	39.2	25	2.4	222	445.7	58.3	27.3	0.7	<0.5	<0.5	<1	<0.5	<0.5	0.7	2.8	0.7	<0.5	1.6	2	0.8	-	-	-	-	-	-	-	
AECOM BH72	BH72 13.0-13.2	13-13.2	3/03/2010	Normal	17.4	5.6	8.4	14.9	1.3	44.9	5.1	4.4	4.2	237	28.7	42.1	<0.5	<0.5	<0.5	<1	<0.5	<0.5	-	<1	<0.2	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-	
AECOM BH72	BH72 16.0-16.2	16-16.2	4/03/2010	Normal	9.3	2.7	3.6																														

Data Entry: KM
 Data Review: AR
 AECOM

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Table T6:
Area C - Soil Analytical Results (below 12 m bgl)

					Organophosphorous Pesticides																				Solvents																												
					Ethion	Ethoprop	Ethyl methanesulfonate	Fenitrothion	Fensulfothion	Fenthion	Malathion	Methyl methanesulfonate	Methyl parathion	Mevinphos (Phosdrin)	Phorate	Pirimphos-ethyl	Prothiofos	Ronnel	Safrole	Stirophos	trans-Isosafrole	Trichloronate	Pronamide	Ethyl acetate	Methyltributyl Ether	1,2,4,5-tetrachlorobenzene																1,3,5-Trichlorobenzene	1,3,5-Trinitrobenzene	1,4-dinitrobenzene	1-naphthylamine	2-(acetylamino) fluorene	2,3,4,6-tetrachlorophenol	2,4,5-trichlorophenol	2,4,6-trichlorophenol	2,4-dichlorophenol	2,4-Dinitrotoluene	2,6-dichlorophenol	2,6-dinitrotoluene
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg																mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5																

Location	Field ID	Sample Depth	Sample Date	Sample Type																																		
AECOM BH46	BH46-14.5-14.7	14.5-14.7	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH46	BH46-19.0-19.2	19-19.2	23/02/2010	Normal	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1
AECOM BH46	BH46-20.5-20.7	20.5-20.7	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH46	BH46-23.5-23.7	23.5-23.7	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH47	BH47-13.0-13.2	13-13.2	22/02/2010	Normal	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1
AECOM BH47	BH47-18.6-18.8	18.6-18.8	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	QC74	18.6-18.8	22/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	QC75	18.6-18.8	22/02/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH48	BH48-14.5-14.7	14.5-14.7	23/02/2010	Normal	<1.2	-	<1.2	-	-	<1.2	<1.2	<1.2	-	-	-	<1.2	<1.2	-	<1.2	-	<1.2	-	<1.2	-	-	<2.5	<1.2	<1.2	-	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
AECOM BH48	BH48-17.0-17.2	17-17.2	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH48	QC78	14.5-14.7	23/02/2010	Field D	<1.2	-	<1.2	-	-	<1.2	<1.2	<1.2	-	-	-	<1.2	<1.2	-	<1.2	-	<1.2	-	<1.2	-	-	<2.5	<1.2	<1.2	-	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
AECOM BH56	BH56 13.0-13.2	13-13.2	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH56	BH56 14.5-15.0	14.5-15	5/03/2010	Normal	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1
AECOM BH56	BH56 17.5-17.8	17.5-17.8	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH56	BH56 20.5-20.9	20.5-20.9	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH56	BH56 21.4-21.6	21.4-21.6	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH56	QC125	14.5-15	5/03/2010	Field D	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1
AECOM BH56	QC126	14.5-15	5/03/2010	Interlab D	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1
AECOM BH57	BH57 16.5-16.7	16.5-16.7	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 13.0-13.4	13-13.4	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 16.0-16.4	16-16.4	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH60	BH60 17.5-17.7	17.5-17.7	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH60	BH60 20.5-20.9	20.5-20.9	2/03/2010	Normal	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	<0.5	<0.5	-	-	-	-	<0.5	-	-	-	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
AECOM BH60	QC120	17.5-17.7	2/03/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
AECOM BH60	QC121	17.5-17.7	2/03/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	-	-	
AECOM BH72	BH72 13.0-13.2	13-13.2	3/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH72	BH72 16.0-16.2	16-16.2	4/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH72	BH72 19.0-19.2	19-19.2	4/03/2010	Normal	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5	-	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<1
AECOM BH72	BH72 20.5-20.7	20.5-20.7	4/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH73	BH73 16.0-16.2	16-16.2	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	
AECOM BH73	BH73 17.5-17.7	17.5-17.7	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH73	BH73 19.0-19.2	19-19.2	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		

					SVOCs																																			
					2-chlorophenol	Methyl Ethyl Ketone	2-hexanone (MBK)	2-naphthylamine	2-nitroaniline	2-Picoline	3,3-Dichlorobenzidine	3-nitroaniline	4-(dimethylamino) azobenzene	4-aminobiphenyl	4-bromophenyl phenyl ether	4-chloroaniline	4-chlorophenyl phenyl ether	4-nitroaniline	4-Nitroquinoline-N-oxide	2-methyl-5-nitroaniline	7,12-dimethylbenz(a)anthracene	Aniline	Azobenzene	Benzyl alcohol	Bis(2-chloroethoxy) methane	Bis(2-chloroethyl)ether	Bis(2-chloroisopropyl) ether	Bis(2-ethylhexyl) phthalate	Butyl benzyl phthalate	Carbazole	Chlorobenzilate	Dibenzofuran	Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Diphenylamine	EPN		
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.5	5	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Location	Field ID	Sample Depth	Sample Date	Sample Type																																				
AECOM BH46	BH46-14.5-14.7	14.5-14.7	23/02/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	BH46-19.0-19.2	19-19.2	23/02/2010	Normal	<0.5	<5	<5	-	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	-	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
AECOM BH46	BH46-20.5-20.7	20.5-20.7	23/02/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH46	BH46-23.5-23.7	23.5-23.7	23/02/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH47	BH47-13.0-13.2	13-13.2	22/02/2010	Normal	<0.5	<5	<5	-	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	-	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
AECOM BH47	BH47-18.6-18.8	18.6-18.8	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AECOM BH47	QC74	18.6-18.8	22/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	QC75	18.6-18.8	22/02/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH48	BH48-14.5-14.7	14.5-14.7	23/02/2010	Normal	<1.2	<5	<5	-	<1.2	<1.2	1.6	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1	-	<1.2	-	<1.2	<5	<1.2	32.8	<1.2	49.4	<1.2	<1.2	<1.2	<1.2	-	-		
AECOM BH48	BH48-17.0-17.2	17-17.2	23/02/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH48	QC78	14.5-14.7	23/02/2010	Field D	<1.2	<5	<5	-	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1	-	<1.2	-	<1.2	<5	<1.2	41.2	<1.2	90.5	<1.2	<1.2	<1.2	<1.2	-	-		
AECOM BH56	BH56 13.0-13.2	13-13.2	5/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	BH56 14.5-15.0	14.5-15	5/03/2010	Normal	<0.5	<5	<5	-	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	-	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-		
AECOM BH56	BH56 17.5-17.8	17.5-17.8	5/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	BH56 20.5-20.9	20.5-20.9	5/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	BH56 21.4-21.6	21.4-21.6	5/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	QC125	14.5-15	5/03/2010	Field D	<0.5	<5	<5	-	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	-	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	
AECOM BH56	QC126	14.5-15	5/03/2010	Interlab D	<0.5	-	-	<0.5	<1	-	-	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
AECOM BH57	BH57 16.5-16.7	16.5-16.7	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 13.0-13.4	13-13.4	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 16.0-16.4	16-16.4	1/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 17.5-17.7	17.5-17.7	2/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 20.5-20.9	20.5-20.9	2/03/2010	Normal	<0.5	<5	<5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-		
AECOM BH60	QC120	17.5-17.7	2/03/2010	Field D	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	QC121	17.5-17.7	2/03/2010	Interlab D	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH72	BH72 13.0-13.2	13-13.2	3/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH72	BH72 16.0-16.2	16-16.2	4/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH72	BH72 19.0-19.2	19-19.2	4/03/2010	Normal	<0.5	<5	<5	-	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	-	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	
AECOM BH72	BH72 20.5-20.7	20.5-20.7	4/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH73	BH73 16.0-16.2	16-16.2	2/03/2010	Normal	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH73	BH73 17.5-17.7	17.5-17.7	2/03																																					

					Hexachlorocyclopentadiene	Hexachloroethane	Hexachloropropene	Isosafrole	Methapyriline	Nitrobenzene	N-Nitrosodiphenyl & Diphenylamine	N-nitrosodiethylamine	N-nitrosodi-n-butylamine	N-nitrosodi-n-propylamine	N-Nitrosomethylethylamine	N-nitrosomorpholine	N-nitrosopiperidine	N-nitrosopyrrolidine	2-methylaniline	Pentachlorobenzene	Pentachloronitrobenzene	Pentachlorophenol	Phenacetin	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,1-dichloroethene	1,1-dichloropropene	1,2,3-trichlorobenzene	1,2,3-trichloropropane	1,2,4-trichlorobenzene	1,2,4-trimethylbenzene	1,2-dibromo-3-chloropropane	1,2-dibromoethane	1,2-dichlorobenzene	1,2-dichloroethane			
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Location	Field ID	Sample Depth	Sample Date	Sample Type																																					
AECOM BH46	BH46-14.5-14.7	14.5-14.7	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH46	BH46-19.0-19.2	19-19.2	23/02/2010	Normal	<2.5	<0.5	<0.5	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
AECOM BH46	BH46-20.5-20.7	20.5-20.7	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH46	BH46-23.5-23.7	23.5-23.7	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	BH47-13.0-13.2	13-13.2	22/02/2010	Normal	<2.5	<0.5	<0.5	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
AECOM BH47	BH47-18.6-18.8	18.6-18.8	22/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH47	QC74	18.6-18.8	22/02/2010	Field D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
AECOM BH47	QC75	18.6-18.8	22/02/2010	Interlab D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
AECOM BH48	BH48-14.5-14.7	14.5-14.7	23/02/2010	Normal	<2.5	<1.2	<1.2	-	<1.2	<1.2	<2.5	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	-	<1.2	<1.2	<2	<1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.7	<0.5	<0.5	<0.5	<0.5	
AECOM BH48	BH48-17.0-17.2	17-17.2	23/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH48	QC78	14.5-14.7	23/02/2010	Field D	<2.5	<1.2	<1.2	-	<1.2	<1.2	<2.5	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	-	<1.2	<1.2	<2	<1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	40.9	<0.5	<0.5	<0.5	<0.5	
AECOM BH56	BH56 13.0-13.2	13-13.2	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	BH56 14.5-15.0	14.5-15	5/03/2010	Normal	<2.5	<0.5	<0.5	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
AECOM BH56	BH56 17.5-17.8	17.5-17.8	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
AECOM BH56	BH56 20.5-20.9	20.5-20.9	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	BH56 21.4-21.6	21.4-21.6	5/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH56	QC125	14.5-15	5/03/2010	Field D	<2.5	<0.5	<0.5	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
AECOM BH56	QC126	14.5-15	5/03/2010	Interlab D	<2	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	<0.5	<0.5	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
AECOM BH57	BH57 16.5-16.7	16.5-16.7	25/02/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 13.0-13.4	13-13.4	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
AECOM BH60	BH60 16.0-16.4	16-16.4	1/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
AECOM BH60	BH60 17.5-17.7	17.5-17.7	2/03/2010	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
AECOM BH60	BH60 20.5-20.9	20.5-20.9	2/03/2010	Normal	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									

Table T6:
Area C - Soil Analytical Results (below 12 m bgl)

					tert-butylbenzene	trans-1,2-dichloroethene	trans-1,3-dichloropropene	trans-1,4-Dichloro-2-butene	Trichlorofluoromethane	Vinyl acetate
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL					0.5	0.5	0.5	0.5	5	5
Location	Field ID	Sample Depth	Sample Date	Sample Type						
AECOM BH46	BH46-14.5-14.7	14.5-14.7	23/02/2010	Normal	-	-	-	-	-	-
AECOM BH46	BH46-19.0-19.2	19-19.2	23/02/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH46	BH46-20.5-20.7	20.5-20.7	23/02/2010	Normal	-	-	-	-	-	-
AECOM BH46	BH46-23.5-23.7	23.5-23.7	23/02/2010	Normal	-	-	-	-	-	-
AECOM BH47	BH47-13.0-13.2	13-13.2	22/02/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH47	BH47-18.6-18.8	18.6-18.8	22/02/2010	Normal	-	-	-	-	-	-
AECOM BH47	QC74	18.6-18.8	22/02/2010	Field D	-	-	-	-	-	-
AECOM BH47	QC75	18.6-18.8	22/02/2010	Interlab D	-	-	-	-	-	-
AECOM BH48	BH48-14.5-14.7	14.5-14.7	23/02/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH48	BH48-17.0-17.2	17-17.2	23/02/2010	Normal	-	-	-	-	-	-
AECOM BH48	QC78	14.5-14.7	23/02/2010	Field D	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH56	BH56 13.0-13.2	13-13.2	5/03/2010	Normal	-	-	-	-	-	-
AECOM BH56	BH56 14.5-15.0	14.5-15	5/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH56	BH56 17.5-17.8	17.5-17.8	5/03/2010	Normal	-	-	-	-	-	-
AECOM BH56	BH56 20.5-20.9	20.5-20.9	5/03/2010	Normal	-	-	-	-	-	-
AECOM BH56	BH56 21.4-21.6	21.4-21.6	5/03/2010	Normal	-	-	-	-	-	-
AECOM BH56	QC125	14.5-15	5/03/2010	Field D	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH56	QC126	14.5-15	5/03/2010	Interlab D	<0.5	<0.5	<0.5	-	<5	<5
AECOM BH57	BH57 16.5-16.7	16.5-16.7	25/02/2010	Normal	-	-	-	-	-	-
AECOM BH60	BH60 13.0-13.4	13-13.4	1/03/2010	Normal	-	-	-	-	-	-
AECOM BH60	BH60 16.0-16.4	16-16.4	1/03/2010	Normal	-	-	-	-	-	-
AECOM BH60	BH60 17.5-17.7	17.5-17.7	2/03/2010	Normal	-	-	-	-	-	-
AECOM BH60	BH60 20.5-20.9	20.5-20.9	2/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH60	QC120	17.5-17.7	2/03/2010	Field D	-	-	-	-	-	-
AECOM BH60	QC121	17.5-17.7	2/03/2010	Interlab D	-	-	-	-	-	-
AECOM BH72	BH72 13.0-13.2	13-13.2	3/03/2010	Normal	-	-	-	-	-	-
AECOM BH72	BH72 16.0-16.2	16-16.2	4/03/2010	Normal	-	-	-	-	-	-
AECOM BH72	BH72 19.0-19.2	19-19.2	4/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH72	BH72 20.5-20.7	20.5-20.7	4/03/2010	Normal	-	-	-	-	-	-
AECOM BH73	BH73 16.0-16.2	16-16.2	2/03/2010	Normal	-	-	-	-	-	-
AECOM BH73	BH73 17.5-17.7	17.5-17.7	2/03/2010	Normal	<0.5	<0.5	<0.5	<0.5	<5	<5
AECOM BH73	BH73 19.0-19.2	19-19.2	2/03/2010	Normal	-	-	-	-	-	-
AECOM BH73	BH73 20.5-20.7	20.5-20.7	2/03/2010	Normal	-	-	-	-	-	-
BH021	BH021 16.0-16.5	16-16.5	9/05/2006	Normal	-	-	-	-	-	-
BH191	BH191/16.5	16.5	14/04/2008	Normal	-	-	-	-	-	-
BH191	BH191/18.2	18.2	14/04/2008	Normal	-	-	-	-	-	-
JBS BH547	BH547	13	23/05/2012	Normal	-	-	-	-	-	-

Table T7:
Site wide Asbestos Analytical Results

		Consultant	ERM	AECOM	AECOM	AECOM	AECOM	AECOM	AECOM
		Field_ID	BH191/5.6	BH47-1.0-1.2	BH47-10.0-10.2	BH48-11.5-11.7	BH56 4.25-4.6	BH60 8.5-8.9	BH73 8.5-8.7
		LocCode	BH191	BH47	BH47	BH48	BH56	BH60	BH73
		Sample_Depth_Range	5.6	1-1.2	10-10.2	11.5-11.7	4.25-4.6	8.5-8.9	8.5-8.7
		Site Area	Area B	Area B	Area B	Area B/C*	Area B	Area B	Area B*
		Sampled_Date-Time	04/11/2008	22/02/2010	22/02/2010	23/02/2010	04/03/2010	01/03/2010	02/03/2010
Method_Type	ChemName	Detected							
Asbestos Identification in bulk solids	Asbestos fibres	Yes/No	No	No	Yes	No	No	No	No
Asbestos Type			-	-	Am and UMF	UMF	UMF	-	-

Notes

UMF = Unidentified Mineral Fibres

Am = Amosite (brown asbestos)

Yes = asbestos fibres detected

No = asbestos fibres not detected

* - reported adjacent to the Site and considered indicative of Site materials

Field_ID	IT04S	IT04S	QC644	QC645	IT04M	IT04M	IT04D	IT04D	IT05S	IT05S	IT05M	IT05M	IT05D	QC643	IT05D	IT1_SHALLOW	IT1_MID	QC331	QC332
Sample_Type	Normal	Normal	Field_D	Interlab_D	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal
RAP_Site_Area	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area A/C	Area A/C	Area A/C	Area A/C
Location_Code	BH410	BH410	BH410	BH410	BH410	BH410	BH410	BH410	BH411	BH411	BH411	BH411	BH411	BH411	BH411	AECOM_IT1	AECOM_IT1	AECOM_IT1	AECOM_IT1
Sampled_Date_Time	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	19/05/2011	25/03/2010	24/03/2010	24/03/2010	24/03/2010

Chem_Group	ChemName	Units	EQL	MWQC	Groundwater SSTC-A & SSTC-C																			
TRH (NEPM 1999)	TRH C6-C9	mg/L	0.02		9	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.09	0.09	0.03	<0.02	<0.02	<0.02	<0.05	
	TRH C10-C14	mg/L	0.05		12	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	0.12	<0.05	<0.05	0.1	0.14	0.07	
	TRH C15-C28	mg/L	0.1			<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.9	0.95	<0.2	
	TRH C29-C36	mg/L	0.05			<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.45	0.34	0.05	
	TRH C10-36 (Total)	mg/L	0.05			<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	0.12	<0.05	<0.05	1.45	1.43	0.12
PAHs	1-Methylnaphthalene	mg/L	0.0001			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2-chloronaphthalene	µg/L	0.5			-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.9	<1	<1	<2	
	2-methylnaphthalene	µg/L	0.1	2.1	22,000	<0.1	<0.1	0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.3	1	0.1	<0.9	4	4	2	
	3-methylcholanthrene	µg/L	0.1			<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	<1	<1	<2	
	Acenaphthene	µg/L	0.01	5.8	35,000	<0.1	<0.1	0.3	0.3	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	6	6	6	
	Acenaphthylene	µg/L	0.01	5.8	33,000	<0.1	<0.1	0.1	4.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.2	<0.1	<0.9	10	11	11	
	Acetophenone	µg/L	0.5			-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.9	2	<1	<2	
	Anthracene	µg/L	0.01	0.01		<0.1	<0.1	0.2	1.8	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	6	6	3	
	Benz(a)anthracene	µg/L	0.01	0.01		<0.1	<0.1	<0.1	6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	7	8	<2	
	Benzo(a) pyrene	µg/L	0.01	0.1		<0.05	<0.05	0.07	5.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.9	7	6	<2	
	Benzo(b)&(k)fluoranthene	µg/L	0.05	0.01		-	-	-	9.8	-	-	-	-	-	-	-	-	-	-	<2	12	12	<4	
	Benzo(b)fluoranthene	µg/L	0.1	0.01		<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	
	Benzo(g,h,i)perylene	µg/L	0.01	0.001		<0.1	<0.1	<0.1	2.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	3	3	<2	
	Benzo(k)fluoranthene	µg/L	0.1	0.01		<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	
	Chrysene	µg/L	0.01	0.001		<0.1	<0.1	<0.1	4.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	7	8	<2	
	Dibenz(a,h)anthracene	µg/L	0.01	0.1		<0.1	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	<1	<1	<2	
	Fluoranthene	µg/L	0.01	1		<0.1	<0.1	0.5	9.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	13	15	5	
	Fluorene	µg/L	0.01	3		<0.1	<0.1	0.3	0.5	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	11	12	9	
	Indeno(1,2,3-c,d)pyrene	µg/L	0.01	0.01		<0.1	<0.1	<0.1	2.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	2	2	<2	
	Naphthalene	µg/L	0.01	70	1,300	<0.1	<0.1	0.4	0.8	0.2	<0.1	4.3	0.5	<0.1	<0.1	<0.1	<0.1	80.2	63.7	6	<0.9	16	17	10
	Phenanthrene	µg/L	0.01	0.6		<0.1	<0.1	0.9	4.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.9	20	22	12
	Pyrene	µg/L	0.01	0.025		<0.1	<0.1	0.6	13	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	14	15	4	
	CPAH	µg/L	-			<0.75	<0.75	0.07	22.5	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<0.75	<5.4	26	27	<12	
	CPAH (TEF)	µg/L	-			<0.192	<0.192	0.07	7.443	<0.192	<0.192	<0.192	<0.192	<0.192	<0.192	<0.192	<0.192	<0.192	<0.192	<1.998	8	7.11	<4.44	
	PAH (TOTAL)	µg/L	-			<1.55	<1.55	3.37	56.5	1.8	<1.55	4.3	0.5	<1.55	<1.55	<1.55	<1.55	80.3	63.9	6.2	<12.6	122	131	60
Phenols	2,4-dimethylphenol	µg/L	0.1	2	430,000	<0.1	<0.1	<0.1	<2	<0.1	<0.1	18.8	8.3	<0.1	<0.1	<0.1	<0.1	12.8	10.3	7.3	<0.9	<1	1	<2
	2-methylphenol	µg/L	0.1	13		<0.1	<0.1	<0.1	<2	<0.1	<0.1	5.4	3.5	<0.1	<0.1	<0.1	<0.1	2.1	2	1.9	<0.9	<1	<1	<2
	3-&4-methylphenol	µg/L	0.5	13		-	-	-	<4	-	-	-	-	-	-	-	-	-	-	<2	<2	<2	<4	
	cresols (total)	µg/L	0.5		2,700	-	-	-	<4	-	-	-	-	-	-	-	-	-	-	<2	<2	<2	<4	
	2-nitrophenol	µg/L	0.1			<0.1	<0.1	<0.1	<2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.9	<1	<1	<2	
	3-Methylphenol	µg/L	0.1	13		<0.1	<0.1	<0.1	-	<0.1	<0.1	1.5	1.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	
	4-chloro-3-methylphenol	µg/L	0.05			<0.05	<0.05	<0.05	<2	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.9	<1	<1	<2	
	4-methylphenol	µg/L	0.1	13		<0.1	<0.1	<0.1	-	<0.1	0.1	0.3	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	
	4-nitrophenol	µg/L	0.1			<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	
	Phenol	µg/L	0.1	400	340,000	<0.1	<0.1	0.1	<0.1	<2	<0.1	0.4	0.2	0.6	<0.1	0.3	<0.1	0.2	<0.1	<0.1	0.5	<0.9	<1	<1
CAHs	Tetrachloroethene	ug/L	0.5			-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	<5	<5	
	Trichloroethene	ug/L	0.5			-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	<5	<5	
	cis-1,2-dichloroethene	ug/L	0.5			-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	<5	<5	<5	
	Vinyl chloride	ug/L	0.3			-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<50	<50	
BTEx	Benzene	ug/L	0.5	700	2,000	<1	<1	<1	-	<1	<1	7	3	<1	<1	<1	<1	34	32	18	<1	<1	<1	<5
	Ethylbenzene	ug/L	0.5	80	100,000	<2	2	<2	-	<2	2	<2	4	<2	2	<2	3	<2	<2	3	<2	<2	<2	<5
	Toluene	ug/L	0.5	180	370,000	<5	<5	<5	-	<5	<5	<5	<5	<5	<5	<5	8	8	<5	<5	<5	<5	<5	

Field_ID	IT1 DEEP	IT2 SHALLOW	IT2 MID	IT2 DEEP	MW14	MW22	MW24	MW24	MW40	MW544S	MW544D	QC01	QC01A	MW56	MW60
Sample_Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field D	Interlab D	Normal	Normal
RAP Site Area	Area A/C	Area C	Area C	Area C	Area A/C	Area A/C	Area A	Area A	Area A	Area A	Area A	Area A	Area A	Area C	Area C
Location_Code	AECOM_IT1	AECOM_IT2	AECOM_IT2	AECOM_IT2	BH076	BH116	BH129	BH129	AECOM_BH40	JBS_BH544S	JBS_BH544D	JBS_BH544D	JBS_BH544D	AECOM_BH56	AECOM_BH60
Sampled_Date_Time	24/03/2010	24/03/2010	24/03/2010	24/03/2010	16/03/2010	15/03/2010	25/05/2012	16/03/2010	20/03/2010	25/05/2012	24/05/2012	24/05/2012	24/05/2012	17/03/2010	18/03/2010

Chem_Group	ChemName	Units	EQL	MWQC	Groundwater SSTC-A & SSTC-C														
TRH (NEPM 1999)	TRH C6-C9	mg/L	0.02		9	0.21	0.04	0.03	0.35	<0.02	<0.02	-	<0.02	-	-	-	-	1.46	4.36
	TRH C10-C14	mg/L	0.05		12	1.35	<0.05	0.21	1.86	<0.05	<0.05	-	<0.05	-	-	-	-	0.44	18.5 *
	TRH C15-C28	mg/L	0.1			3.05	0.24	3.58	2.79	<0.1	<0.1	-	<0.1	-	-	-	-	0.92	2.63
	TRH C29-C36	mg/L	0.05			0.95	0.09	0.32	0.2	<0.05	<0.05	-	<0.05	-	-	-	-	<0.05	0.12
	TRH C10-36 (Total)	mg/L	0.05			5.35	0.33	4.11	4.85	<0.05	<0.05	-	<0.05	-	-	-	-	1.36	21.25
PAHs	1-Methylnaphthalene	mg/L	0.0001			-	-	-	-	-	-	-	-	-	-	-	0.0002	-	-
	2-chloronaphthalene	µg/L	0.5			<10	<1	<1	<1	<2	<2	-	<0.5	<0.9	-	-	-	<0.9	<0.9
	2-methylnaphthalene	µg/L	0.1	2.1	22,000	<10	<1	7	4	<2	<2	-	<0.5	36	-	-	-	0.2	<0.9
	3-methylcholanthrene	µg/L	0.1			<10	<1	<1	<1	<2	<2	-	<0.5	<0.9	-	-	-	<0.9	<0.9
	Acenaphthene	µg/L	0.01	5.8	35,000	<10	1	6	1	<2	<2	<0.1	<0.5	4	<0.1	<0.1	<0.1	<0.1	<0.9
	Acenaphthylene	µg/L	0.01	5.8	33,000	12	<1	2	2	<2	<2	<0.1	<0.5	16	<0.1	<0.1	<0.1	<0.1	<0.9
	Acetophenone	µg/L	0.5			<10	<1	<1	<1	<2	<2	-	<0.5	<0.9	-	-	-	<0.9	<0.9
	Anthracene	µg/L	0.01	0.01		10	<1	2	<1	<2	<2	<0.1	<0.5	3	<0.1	0.1	0.2	0.5	<0.9
	Benz(a)anthracene	µg/L	0.01	0.01		21	<1	<1	<1	<2	<2	<0.1	<0.5	<0.9	<0.1	<0.1	<0.1	0.3	<0.9
	Benzo(a) pyrene	µg/L	0.01	0.1		17	<1	<1	<1	<2	<2	<0.1	<0.5	<0.9	<0.1	<0.1	<0.1	0.2	<0.9
	Benzo(b)&(k)fluoranthene	µg/L	0.05	0.01		39	<2	<2	<2	<4	<4	<0.2	<1	<2	<0.2	<0.2	<0.2	-	<2
	Benzo(b)fluoranthene	µg/L	0.1	0.01		-	-	-	-	-	-	-	-	-	-	-	-	0.2	-
	Benzo(g,h,i)perylene	µg/L	0.01	0.001		10	<1	<1	<1	<2	<2	<0.1	<0.5	<0.9	<0.1	<0.1	<0.1	<0.1	<0.9
	Benzo(k)fluoranthene	µg/L	0.1	0.01		-	-	-	-	-	-	-	-	-	-	-	-	<0.1	-
	Chrysene	µg/L	0.01	0.001		21	<1	<1	<1	<2	<2	<0.1	<0.5	<0.9	<0.1	<0.1	0.1	0.2	<0.9
	Dibenz(a,h)anthracene	µg/L	0.01	0.1		<10	<1	<1	<1	<2	<2	<0.1	<0.5	<0.9	<0.1	<0.1	<0.1	<0.1	<0.9
	Fluoranthene	µg/L	0.01	1		33	1	2	<1	<2	<2	<0.1	<0.5	2	<0.1	0.1	0.2	0.6	<0.9
	Fluorene	µg/L	0.01	3		10	<1	5	1	<2	<2	<0.1	<0.5	12	<0.1	<0.1	<0.1	<0.1	<0.9
	Indeno(1,2,3-c,d)pyrene	µg/L	0.01	0.01		<10	<1	<1	<1	<2	<2	<0.1	<0.5	<0.9	<0.1	<0.1	<0.1	<0.1	<0.9
	Naphthalene	µg/L	0.01	70	1,300	153	<1	41	159	<2	<2	<0.1	<0.5	244	<0.1	0.6	0.6	0.4	<0.9
	Phenanthrene	µg/L	0.01	0.6		29	<1	10	2	<2	<2	<0.1	<0.5	14	<0.1	0.2	0.3	0.5	<0.9
	Pyrene	µg/L	0.01	0.025		38	<1	2	<1	<2	<2	<0.1	<0.5	2	<0.1	0.1	0.2	0.6	<0.9
	CPAH	µg/L	-			69	<6	<6	<6	<12	<12	0	<3	<5.4	0	0	0.1	0.9	<5.1
	CPAH (TEF)	µg/L	-			19.41	<2.22	<2.22	<2.22	<4.44	<4.44	0	<1.11	<1.998	0	0	0.001	0.252	<1.698
	PAH (TOTAL)	µg/L	-			354	2	70	165	<28	<28	0	<7	297	0	1.1	1.6	3.5	<12.3
Phenols	2,4-dimethylphenol	µg/L	0.1	2	430,000	177	2	10	195	<2	<2	-	<0.5	69	-	-	-	<0.9	2260
	2-methylphenol	µg/L	0.1	13		17	1	5	31	<2	<2	-	<0.5	15	-	-	-	<0.9	390
	3-&4-methylphenol	µg/L	0.5	13		<20	<2	9	35	<4	<4	-	<1	20	-	-	-	<2	305
	cresols (total)	µg/L	0.5		2,700	17	<2	14	66	<4	<4	-	<1	35	-	-	-	<2	695
	2-nitrophenol	µg/L	0.1			<10	<1	<1	<1	<2	<2	-	<0.5	<0.9	-	-	-	<0.9	<0.9
	3-Methylphenol	µg/L	0.1	13		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-chloro-3-methylphenol	µg/L	0.05			<10	<1	<1	<1	<2	<2	-	<0.5	<0.9	-	-	-	<0.6	<0.9
	4-methylphenol	µg/L	0.1	13		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-nitrophenol	µg/L	0.1			-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Phenol	µg/L	0.1	400	340,000	<10	<1	2	7	<2	<2	-	<0.5	2	-	-	-	<0.9	29
CAHs	Tetrachloroethene	ug/L	0.5			<5	<5	<5	<5	<5	<1	<5	<5	<1	<1	<1	<0.5	<5	<20
	Trichloroethene	ug/L	0.5			<5	<5	<5	<5	<5	<1	<5	<5	<1	<1	<1	<0.5	<5	<20
	cis-1,2-dichloroethene	ug/L	0.5			<5	<5	<5	<5	<5	<1	<5	<5	<1	<1	<1	<0.5	<5	<20
	Vinyl chloride	ug/L	0.3			<50	<50	<50	<50	<50	<10	<50	<50	<10	<10	<10	<0.3	<50	<200
BTEX	Benzene	ug/L	0.5	700	2,000	113	2	3	265	<1	<1	<1	<1	52	<1	<1	<1	<0.5	378
	Ethylbenzene	ug/L	0.5	80	100,000	4	<2	<2	7	<2	<2	<1	<2	2	<1	<1	<1	<0.5	20
	Toluene	ug/L	0.5	180	370,000	22	20	<5	65	<5	<5	<1	<5	46	<1	<1	<1	<0.5	473
	Xylene (m & p)	ug/L	1	75		22	<2	<2	32	<2	<2	<2	<2	26	<2	<2	<2	<1	189
	Xylene (o)	ug/L	0.5	75		10	<2	<2	18	<2	<2	<1	<2	12	<1	<1	<1	<0.5	66
Inorganics	Total Xylene	ug/L	1.5			32	<4	<4	50	<4	<3	<4	38	<3	<3	<3	<1.5	255	461
	Alkalinity as CaCO3	mg/L	1			209	289	57	198	-	191	-	-	556	-	-	-	-	-
	Ammonia	mg/L	0.01	0.91		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ammonia as N	mg/L	0.005	0.91	150	1.38	<0.1	9.26	5.99	-	2.7	<0.005	-	9.7	0.03	0.54	0.52	0.53	-
	Cyanide (Free)	mg/L	0.004	0.004		0.053	<0.004	<0.004	<0.004	<0.004	-	-	<0.004	-	-	-	-	<0.004	<0.004
	Arsenic (Filtered)	µg/L	0.5	2.3	140,000	1.8	2.1	2	0.6	0.5	<0.5	<1	0.9	5.2	1	2	2	<2	2.5
	Barium (Filtered)	mg/L	0.001		830	0.128	0.185	0.767	0.259	0.052	0.061	-	0.05	0.468	-	-	-	0.464	0.094
	Cadmium (Filtered)	µg/L	0.1	0.7	110,000	0.4	<0.2	<0.2	<0.2	0.3	<0.2	0.2	<0.2	0.4	0.5	<0.1	<0.1	<1	1.7
	Chromium (Filtered)	µg/L	0.5	27.4		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<1	<1	<1	<10	<0.5
	Chromium (hexavalent)	mg/L	0.001	0.0044		<0.002	<0.002	0.004	<0.002	<0.002	<0.002	-	<0.002	0.016	-	-	-	<0.002	0.011
	Chromium (hexavalent) (Filtered)	mg/L	0.01	0.0044		-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cobalt (Filtered)	µg/L	0.2	1	250,000	51.9	3.7	0.5	18.6	<0.2	<0.2	-	<0.2	1.9	-	-	-	-	34.2
	Copper (Filtered)	µg/L	1	1.3		<1	<1	<1	<1	<1	<1	<1	2	4	3	<1	2	<1	17
	Lead (Filtered)	µg/L	0.2	4.4	630,000	1.1	1.6	0.3	0.4	<0.2	0.2	<1	1.9	0.2	<1	<1	<1	1	20
	Manganese (Filtered)	mg/L	0.0005		27,000	4.34	1.09	0.154	0.466	0.0434	0.269	-	0.0062	0.437</					

Table T9:
Historic Groundwater Analytical Results (pre 2010)

Field_ID	MW11	MW11	D01-140807	MW14	MW14	MW14	MW22	MW22	MW24	MW24	D01_150807	MW24	MW212	MW212
Sample_Type	Normal	Normal	Field_D	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Field_D	Normal	Normal	Normal
SDG	+ ES0608744 +	ES0711270	ES0711270	08744 + ES060	ES0711270	ES0806416	08744 + ES060	ES0806416	+ ES0609632 +	ES0711324	ES0711324	ES0806308	8/5/2008	ES0806635
RAP Site Area	Area A	Area A	Area A	Area A/C	Area A/C	Area A/C	Area A/C	Area A/C	Area A	Area A	Area A	Area A	Area A	Area A
Location_Code	BH053	BH053	BH053	BH076	BH076	BH076	BH116	BH116	BH129	BH129	BH129	BH129	BH212	BH212
Sampled_Date_Time	14/07/2006	14/08/2007	14/08/2007	17/07/2006	14/08/2007	7/05/2008	17/07/2006	7/05/2008	25/07/2006	15/08/2007	15/08/2007	6/05/2008	8/05/2008	12/05/2008

Chem_Group	ChemName	Units	EQL	MWQC	Groundwater SSTC-A & SSTC-C														
TRH (NEPM 1999)	TRH C6-C9	mg/L	0.02		9	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	-
	TRH C10-C14	mg/L	0.05		12	<0.05	0.05	0.06	<0.05	<0.05	<0.05	0.09	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	-
	TRH C15-C28	mg/L	0.1			0.2	0.7	0.7	<0.1	<0.1	<0.1	0.4	0.2	0.3	<0.1	<0.1	<0.1	<0.1	-
	TRH C29-C36	mg/L	0.05			<0.05	0.14	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	0.44	<0.05	<0.05	<0.05	<0.05	-
	TRH C10-36 (Total)	mg/L	0.05			0.2	0.89	0.88	<0.2	<0.2	<0.2	0.49	0.3	0.74	<0.2	<0.2	<0.2	-	-
PAHs	Acenaphthene	µg/L	0.01	5.8	35,000	<1	<1	<1	<1	<1	<1	1.2	<1	<1	<1	<1	<1	<1	<0.1
	Acenaphthylene	µg/L	0.01	5.8	33,000	1.5	<1	1	<1	<1	<1	1.1	<1	<1	<1	<1	<1	<1	<0.1
	Anthracene	µg/L	0.01	0.01		<1	<1	<1	<1	<1	<1	<1	<1	4.2	<1	<1	<1	<1	<0.1
	Benz(a)anthracene	µg/L	0.01	0.01		<1	<1	<1	<1	<1	<1	<1	<1	2.5	<1	<1	<1	<1	<0.1
	Benzo(a) pyrene	µg/L	0.01	0.1		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.4	<0.5	<0.5	<0.5	<0.5	<0.05
	Benzo(b)fluoranthene	µg/L	0.1	0.01		<1	<1	<1	<1	<1	<1	<1	<1	2.6	<1	<1	<1	<1	<0.1
	Benzo(g,h,i)perylene	µg/L	0.01	0.001		<1	<1	<1	<1	<1	<1	<1	<1	1.4	<1	<1	<1	<1	<0.1
	Benzo(k)fluoranthene	µg/L	0.1	0.01		<1	<1	<1	<1	<1	<1	<1	<1	1.8	<1	<1	<1	<1	<0.1
	Chrysene	µg/L	0.01	0.001		<1	<1	<1	<1	<1	<1	<1	<1	2.7	<1	<1	<1	<1	<0.1
	Dibenz(a,h)anthracene	µg/L	0.01	0.1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<0.1
	Fluoranthene	µg/L	0.01	1		2.2	1.7	2	<1	<1	<1	<1	<1	9	<1	<1	<1	<1	<0.1
	Fluorene	µg/L	0.01	3		1.6	<1	<1	<1	<1	<1	1.4	<1	<1	<1	<1	<1	<1	<0.1
	Indeno(1,2,3-c,d)pyrene	µg/L	0.01	0.01		<1	<1	<1	<1	<1	<1	<1	<1	1.2	<1	<1	<1	<1	<0.1
	Naphthalene	µg/L	0.01	70	1,300	2.8	<1	<1	<1	<1	<1	9.9	<1	3.8	7.6	<1	<1	<1	<0.1
	Phenanthrene	µg/L	0.01	0.6		<1	<1	<1	<1	<1	<1	1.3	<1	6.6	<1	<1	<1	<1	<0.1
	Pyrene	µg/L	0.01	0.025		1.9	2.2	2.5	<1	<1	<1	<1	<1	6.8	<1	<1	<1	<1	<0.1
	CPAH	µg/L				<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	<7.5	14.6	<7.5	<7.5	<7.5	<7.5	<0.75
	CPAH (TEF)	µg/L				<1.92	<1.92	<1.92	<1.92	<1.92	<1.92	<1.92	<1.92	3.251	<1.92	<1.92	<1.92	<1.92	<0.192
	PAH (TOTAL)	µg/L				10	3.9	5.5	<15.5	<15.5	<15.5	14.9	<15.5	45	7.6	<15.5	<15.5	<15.5	<15.5
	Phenols	2,4-dimethylphenol	µg/L	0.1	2	430,000	-	<1	<1	-	<1	<1	-	<1	-	1.2	<1	<1	<1
2-methylphenol		µg/L	0.1	13		-	<1	<1	-	<1	<1	-	<1	-	<1	<1	<1	<1	-
3-&4-methylphenol		µg/L	0.5	13		-	<2	<2	-	<2	<2	-	<2	-	<2	<2	<2	<2	-
cresol (total)		µg/L	0.5		27,000	-	<2	<2	-	<2	<2	-	<2	-	<2	<2	<2	-	-
2-nitrophenol		µg/L	0.1			-	<1	<1	-	<1	<1	-	<1	-	<1	<1	<1	<1	-
4-chloro-3-methylphenol		µg/L	0.05			-	<1	<1	-	<1	<1	-	<1	-	<1	<1	<1	<1	-
Phenol		µg/L	0.1	400	340,000	-	<1	<1	-	<1	<1	-	<1	-	<1	<1	<1	<1	-
BTEX	Benzene	ug/L	0.5	700	2,000	<1	<1	<1	<1	<1	<1	5	2	<1	<1	<1	<1	<1	-
	Ethylbenzene	ug/L	0.5	80	100,000	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
	Toluene	ug/L	0.5	180	370,000	<2	<2	<2	<2	<2	<5	4	<5	<2	<2	<2	<5	<5	-
	Xylene (m & p)	ug/L	1	75		<2	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	<2	<2	-
	Xylene (o)	ug/L	0.5	75		<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	-
	Total Xylene	ug/L	1.5			<4	<4	<4	<4	<4	<4	2	<4	<4	<4	<4	<4	<5	-
Field	Dissolved Oxygen	mg/L				-	-	-	-	-	2.05	-	-0.05	-	-	-	0.9	1.4	0.44
	pH (Field)	pH Units				-	-	-	-	-	7.6	-	6.8	-	-	-	7.86	7.92	7.93
	Electrical conductivity	uS/cm				-	-	-	-	-	47.2	-	42.4	-	-	-	48.5	-	-
	Redox	mV				-	-	-	-	-	-52	-	-140	-	-	-	57	52	-113
	Temperature	°C				-	-	-	-	-	-	22.7	-	22.1	-	-	-	21.8	20.1
Inorganics	Alkalinity as CaCO3	mg/L	1			-	241	227	-	137	167	-	233	-	126	124	134	118	-
	Ammonia as N	mg/L	0.005	0.91	150	-	6.05	8.36	-	1.07	0.144	-	1.24	-	<0.1	<0.1	0.138	<0.015	-
	Anions Total	meq/L	0.01			-	529	510	-	631	591	-	544	-	609	588	617	691	-
	Bicarbonate	mg/L	1			-	241	227	-	137	167	-	233	-	126	124	134	118	-
	Carbonate	mg/L	1			-	<1	<1	-	<1	<1	-	<1	-	<1	<1	<1	<1	-
	Cations Total	meq/L	0.01			-	559	518	-	625	595	-	515	-	625	638	586	644	-
	Chloride	mg/L	0.5			-	17,500	16,700	-	20,200	18,500	-	17,300	-	19,500	18,600	19,100	19,600	-
	Cyanide (Free)	mg/L	0.004	0.004		-	<0.004	<0.004	-	<0.004	-	-	-	<0.004	<0.004	<0.004	-	-	-
	Cyanide Total	mg/L	0.004	0.004		0.04	-	-	<0.005	-	0.0093	0.014	<0.004	0.013	-	-	<0.004	<0.004	-
	Hydroxide Alkalinity as CaCO3	mg/L	1			-	<1	<1	-	<1	<1	-	<1	-	<1	<1	<1	<1	-
	Ionic Balance	%	0.01			-	2.81	0.78	-	0.48	0.36	-	2.8	-	1.33	4.14	2.6	3.58	-
	Sulphate	mg/L	0.5			1270	1440	1640	2380	2770	3170	2140	2480	-	2740	2850	3640	6540	-
	Sulphate (Filtered)	mg/L	1			-	-	-	-	-	-	-	-	2690	-	-	-	-	-
	Metals	Arsenic (Filtered)	µg/L	0.5	2.3	140,000	<10	<10	<10	<10	<10	1.4	<1	0.5	<10	<10	<10	0.8	1.2
Cadmium (Filtered)		µg/L	0.1	0.7	110,000	<1	<1	<1	<1	16	0.3	<0.1	0.6	<1	<1	<1	<0.2	0.2	-
Calcium		mg/L	0.1			-	1110	1210	-	448	453	-	412	-	435	444	426	418	-
Chromium (Filtered)		µg/L	0.5	27.4		<10	<10	<10	<10	<10	<0.5	<1	<0.5	<10	<10	<10	<0.5	<0.5	-
Copper (Filtered)		µg/L	1	1.3		<1	<20	<20	<1	<20	3	<1	<1	2	30	44	<1	<1	-
Lead (Filtered)		µg/L	0.2	4.4	630,000	0.3	<10	<10	0.4	<10	<0.2	<0.2	<0.2	4.7	<10	12	1.2	1.5	-
Magnesium		mg/L	0.1		27,000	-	554	585	-	1250	1230	-	1120	-	1240	1280	1240	1340	-
Mercury (Filtered)		µg/L	0.05	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Nickel (Filtered)		µg/L	0.5	70		<10	26	28	<10	22	78.8	4	47.4	<10	<10	33	5.8	<0.5	-
Potassium		mg/L	0.1			-	412	386	-	430	414	-	274	-					

SITE AREA	MATERIAL TYPE	BASE DEPTH	OBSERVATIONS OF GASWORK RELATED IMPACTS
BARANGAROO ORWN			
BH017	Fill	21.0	1m faint hydrocarbon odour between 1.0m and 2.2m
BH017	Marine sediments	23.6	NOC
BH017	Bedrock	24.6	NOC
BH021	Fill	15.0	6m faint hydrocarbon odour between 6m and 20m
BH021	Marine sediments	20.8	NOC
BH39	Fill	23.5	NOC
BH39	Marine sediments	25.0	NOC
BH40	Fill	14.3	NOC
BH40	Marine sediments	20.1	16.5m black stained veins of tar with sheen, strong chemical odour,
BH40	Bedrock	20.5	NOC
BH46	Fill	19.0	14.5m very strong chemical odour
BH46	Marine sediments	23.7	19m very strong chemical odour, 20.5m chemical odour
BH47	Fill	16.0	4 to 7m slight hydrocarbon odour, 5.5m black staining, 10 to 11m slight hydrocarbon odour, 13m moderate hydrocarbon odour,
BH47	Marine sediments	18.6	16m slight hydrocarbon odour
BH47	Bedrock	19.1	NOC
BH48	Fill	14.5	1m slight hydrocarbon odour, 13m slight hydrocarbon odour
BH48	Bedrock	17.8	14.5m crude tar (shiny, black, vesicular), strong tar odour and black staining noted
BH053/MW11	Fill	15.5	3m to 3.28m faint hydrogen sulphide odour
BH053/MW11	Marine sediments	21.0	NOC
BH053/MW11	Bedrock	22.4	NOC
BH054	Fill	8.5	2.5m slight to moderate hydrocarbon odour
BH56	Fill	17.5	7m tar odour
BH56	Marine sediments	21.4	19m moderate tar odour
BH56	Bedrock	21.4	NOC
BH57	Fill	15.8	NOC
BH57	Marine sediments	18.3	NOC
BH60	Fill	16.0	2.5m very slight tar odour
BH60	Marine sediments	25.0	16m strong tar odour and black staining, 17.5m strong tar odour and tar mottles, 20.5m strong tar odour, 22m slight tar odour
BH063	Fill	10.0	0.2m slight hydrocarbon odour
BH064	Fill	18.0	NOC
BH068	Fill	10.0	3m moderate hydrocarbon odour
BH72	Fill	13.0	NOC
BH72	Marine sediments	20.5	16m slight chemical odour
BH72	Bedrock	20.7	NOC
BH076/MW14	Fill	16.0	NOC
BH076/MW14	Marine sediments	25.2	NOC
BH116	Fill	26.4	NOC
BH142	Fill	10.0	NOC
BH143	Fill	16.5	NOC
BH143	Marine sediments	20.0	16.5m slight hydrocarbon odour
BH143	Bedrock	24.0	NOC
BH191	Fill	11.5	3.6m slight hydrocarbon odour and black staining, 5m strong hydrocarbon/tar odour and black staining, 7m slight hydrocarbon odour and black staining
BH191	Marine sediments	26.5	11.5m sulfurous odour, 17.95m to 18.4m dark brown tarry substance
BH212	Fill	17.5	1.4m black staining, 1.85m to 2.0m slight hydrocarbon odour and black staining, 2.5m trace black staining, 7.2m trace black staining, 12.6m slag/furnace waste, 15.5m black staining
BH212	Marine sediments	33.8	NOC
IT01	Fill	15.5	5m slight tar odour
IT01	Marine sediments	17.6	NOC
IT02	Fill	16.9	NOC
IT02	Marine sediments	17.5	NOC
BH410/IT04	Fill	17.0	NOC
BH410/IT04	Marine sediments	32.2	17m hydrocarbon odour and minor black staining
BH411/IT05	Fill	18.0	NOC
BH411/IT05	Marine sediments	27.0	NOC
SV08	Fill	2.2	0.8m slight naphthalene odour

Key Chemical	Criteria for Protection of Plants and Soil (mg/kg)	Grouped Criteria (mg/kg)	Data Sources/Notes
Metals and inorganics			
Arsenic ¹	20		NEPM (1999) - Interim Urban
Cadmium	3		NEPM (1999) - Interim Urban
Chromium	190		NEPM (draft, 2010) EILs - Public open space - aged
Copper ¹	60		NEPM (draft, 2010) EILs - Public open space - aged
Lead ¹	1100		NEPM (draft, 2010) EILs - Public open space - aged
Mercury	1		NEPM (1999) - Interim Urban
Nickel	30		NEPM (draft, 2010) EILs - Public open space - aged
Zinca	200		NEPM (1999) - Interim Urban
Cyanide (if free)	8		CCME (1999a) coarse soil
Ammonia			Calculate based on irrigation guideline of 5 mg/L as N (based on protection of plants)
Petroleum Hydrocarbons			
TPH C6 - C9a	210		CCME (2008b) coarse soil
TPH C10 - C14a	150		CCME (2008b) coarse soil
TPH C15 - C28	-	300	CCME (2008b) coarse soil
TPH C29 - C36	-		
Benzene	1		NSW EPA (1994)
Toluene	1.4		NSW EPA (1994)
Ethylbenzene	3.1		NSW EPA (1994)
Xylenes	14		NSW EPA (1994)
Low MWT PAHs			
Acenaphthene ¹		sum - 50b	a: CCME (1999b)
Acenaphthylene ¹			b: Total PAHs (excluding carcinogenic PAHs), from USEPA Eco SSLs of 48mg/kg rounded to 50mg/kg
Anthracene			
Fluorene ¹			
Phenanthrene			
Naphthalene ¹	22a		
High MWT PAHs			
Benzo[a]anthracene	40 c		c: Criteria derived from 4 for benzo(a)pyrene and applied using the following TEFs from CCME (2008a):
Benzo[a]pyrene	4 c		- benzo[a]anthracene, 0.1
Benzo[b]fluoranthene	40 c		- benzo[a]pyrene, 1
Benzo[k]fluoranthene	40 c		- benzo[b]fluoranthene, 0.1
Benzo[ghi]perylene	400 c		- benzo[k]fluoranthene, 0.1
Chrysene	400 c		- benzo[ghi]perylene, 0.01
Dibenz[ah]anthracene	4 c		- chrysene, 0.01
Fluoranthene	- c		- dibenz[ah]anthracene, 1
Indeno[123cd]pyrene	40 c		- indeno[123cd]pyrene, 0.1
Pyrene	- c		TEFs for fluoranthene and pyrene not used by CCME (2008b)
Phenols			
Phenol	3.8		CCME (1999c) coarse soil
2,4dimethylphenol	3.8		CCME (1999c) coarse soil
2-methylphenol	3.8		CCME (1999c) coarse soil
3&4-methylphenol	3.8		CCME (1999c) coarse soil

Note:

¹ Where the TSC are greater than the derived leachability based soil SSEC (refer to Section 5.7.3.3, ORWS HHERA Addendum) the relevant soil SSEC will be adopted.

Analyte	Criteria (µg/L)	Source
Metals and Inorganics		
Arsenic	2.3	ANZECC (2000) 95% Marine Water Environmental Concern Level
Cadmium	0.7	ANZECC (2000) 99% Marine Water Trigger Value
Chromium (hexavalent)	4.4	ANZECC (2000) 95% Marine Water Trigger Value
Chromium III	27.4	ANZECC (2000) 95% Marine Water Trigger Value
Cobalt	1	ANZECC (2000) 95% Marine Water Trigger Value
Copper	1.3	ANZECC (2000) 95% Marine Water Trigger Value
Lead	4.4	ANZECC (2000) 95% Marine Water Trigger Value
Mercury	0.1	ANZECC (2000) 99% Marine Water Trigger Value
Nickel	70	ANZECC (2000) 95% Marine Water Trigger Value
Vanadium	100	ANZECC (2000) 95% Marine Water Trigger Value
Zinc	15	ANZECC (2000) 95% Marine Water Trigger Value
Ammonia	910	ANZECC (2000) 95% Marine Water Trigger Value
Cyanide	4	ANZECC (2000) 95% Marine Water Trigger Value
Low MW PAHs		
Acenaphthene	5.8	CCME (1999) Freshwater Guideline
Acenaphthylene	5.8	Adopted criteria for Acenaphthene as surrogate
Anthracene	0.01 ^a	ANZECC (2000) 99% Marine Water Trigger Value
Fluorene	3	CCME (1999) Freshwater Guideline
Naphthalene	70	ANZECC (2000) 95% Marine Water Trigger Value, moderate reliability
Phenanthrene	0.6 ^a	ANZECC (2000) 99% Marine Water Trigger Value
2-methylnaphthalene	2.1	Oakridge Secondary Chronic Value (1996) for 1-methylnaphthalene
High MW PAHs		
Benz(a)anthracene	0.1 ^{a,b}	Value for high molecular weight PAHs is based off the ANZECC (2000) 99% Marine Water Trigger Values for benzo(a)pyrene. A TEF approach is presented below in accordance with NEPC (2013), CCME (2010) and the <i>Declaration Site HHERA</i> (AECOM, 2011a) <i>Appendix K</i> , toxicity profile for PAHs:
		- Benzo(a)anthracene (0.1)
Benzo(a)pyrene		- Benzo(a)pyrene (1)
Benzo(b)fluoranthene		- Benzo(b)fluoranthene (0.1)
Benzo(g,h,i)perylene		- Benzo(g,h,i)perylene (0.01)
Benzo(k)fluoranthene		- Benzo(k)fluoranthene (0.1)
Chrysene		- Chrysene (0.01)
Dibenz(a,h)anthracene		- Dibenz(a,h)anthracene (1)
Indeno(1,2,3-c,d)pyrene		- Indeno(1,2,3-cd)pyrene (0.1)
Fluoranthene	1	ANZECC (2000) 99% Marine Water Trigger Value
Pyrene	0.025 ^a	CCME (1999) Freshwater Guideline
Other Organics		
2,4-dimethylphenol	2	ANZECC (2000) 95% Marine Water Trigger Value, low reliability
2-methylphenol	13	Oakridge Secondary Chronic Value (1996)
3-&4-methylphenol	13	Adopted value for 2-methylphenol as surrogate
Dibenzofuran	3.7	Oakridge Secondary Chronic Value (1996)
Pentachlorophenol	22	ANZECC (2000) 95% Marine Water Trigger Value
Phenol	400	ANZECC (2000) 95% Marine Water Trigger Value
2,4 dinitrophenol	45	ANZECC (2000) 95% Fresh Water Trigger Value
Styrene	72	CCME (1999) Freshwater Guideline

Petroleum Hydrocarbons		
Benzene	700	ANZECC (2000) 95% Marine Water Trigger Value, moderate reliability
Ethylbenzene	80	ANZECC (2000) 95% Fresh Water Trigger Value
Toluene	180	ANZECC (2000) 95% Marine Water Trigger Value, low reliability
Xylene (m & p)	75	ANZECC (2000) 95% Marine Water Trigger Value, low reliability for m-xylene.
Xylene (o)	350	ANZECC (2000) 95% Marine Water Trigger Value, low reliability for o-xylene.
TPH C ₆ - C ₉	110	CCME (2008) Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil – Table B-9 values for TPH C ₆ to C ₈ and >C ₈ to C ₁₀ . Criteria calculated from a weighted average assuming a Coal Tar composition of 25% aliphatic and 75% aromatic components
TPH C ₁₀ - C ₁₄	40	CCME (2008) Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil – Table B-9 values for TPH >C ₁₀ to C ₁₂ and >C ₁₂ to C ₁₆ . Criteria calculated from a weighted average assuming a Coal Tar composition of 25% aliphatic and 75% aromatic components
TPH C ₁₅ - C ₂₈	-	No guidelines values available
TPH C ₂₉ - C ₃₆	-	No guidelines values available

Notes:

Taken from the ORNW HHERA (AECOM, 2013)

All criteria in ug/L

(a) It is noted that these MWQC are less than the laboratory standard LOR. The laboratory standard LOR will be adopted in place of the MWQC where: (i) analysis of these chemicals is required; or, (ii) where the MWQC are considered in derivation of risk based criteria. This approach is consistent with Section 3.4.3.2 and Section 8.3.5.4 of ANZECC (2000) and has been agreed with the Auditor and the NSW EPA. It is noted that it is not practical to use the laboratory ultra-trace LOR because: (i) the high salinity present in the water (particularly in areas close to the harbour) will cause interferences in the reporting of some analytes and therefore an increased LOR; (ii) the presence of other contaminants (matrix interference) will raise the LOR; and (iii) groundwater turbidity can lead to raised LOR.

(b) In the case of high molecular weight PAHs the standard limit of reporting is greater than the adopted MWQC above which is based on B(a)P (99% Marine Water Guideline). Therefore it is considered appropriate to adopt the standard laboratory limit of reporting for these compounds in applying the TEF approach outlined in CCME, 2010 (Appendix I PAH Toxicity Profile).

Appendix B

Figures

Appendix B Figures

Figure F1: Site Location

Figure F2: Site Layout and Surrounding Area

Figure F3: Proposed Future Intended Land Use - Crown Development Area

Figure F4: Proposed Future Intended Crown Basement

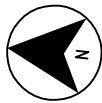
Figure F5: Site Plan and Sampling Locations

Figure F6: Locations of Separated Phase Gasworks Related Wastes and Tar (SPGWT)

Figure F7: Site Services Plan (Rygate survey plan)

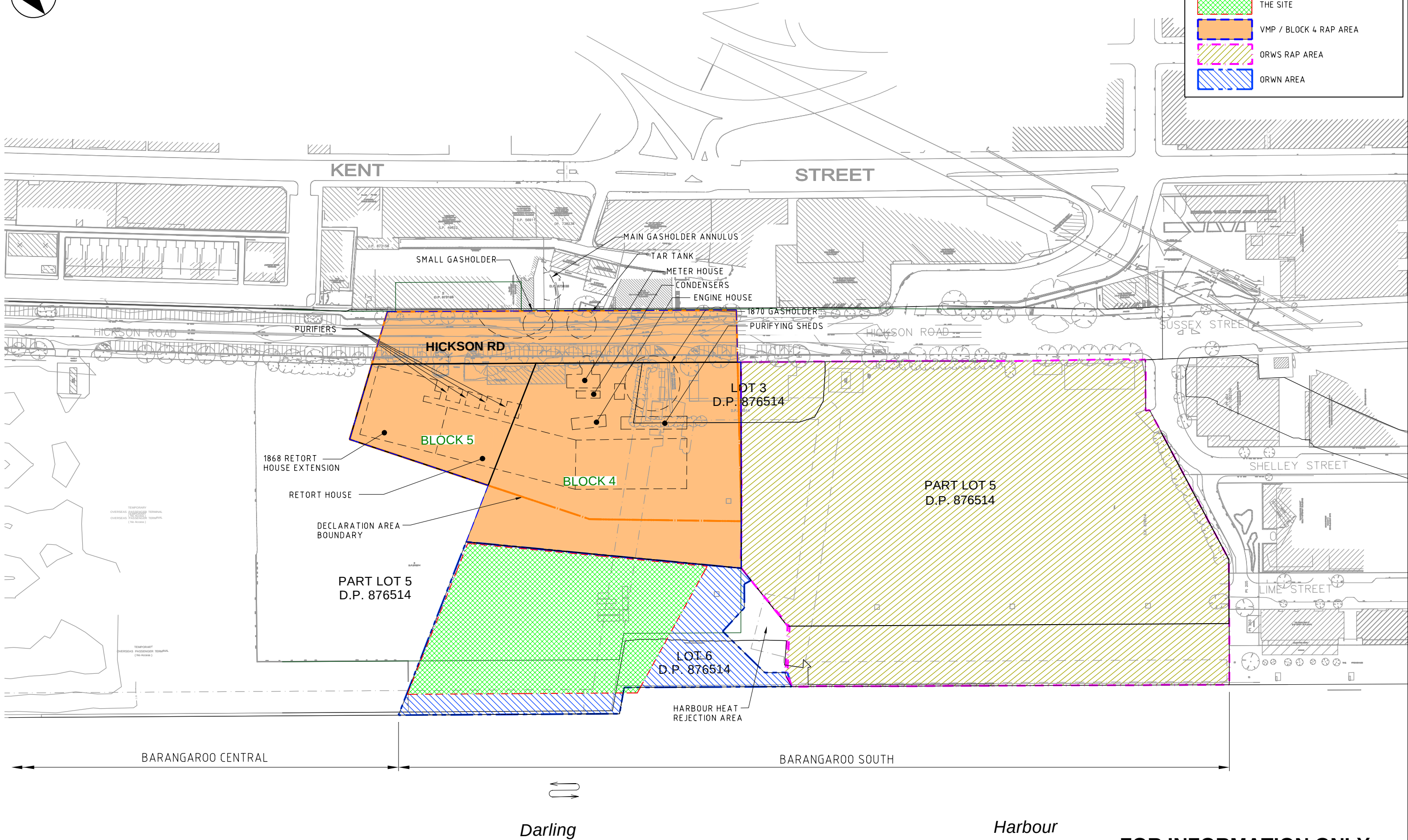


G:\Projects\603 Projects\60310752 Crown Hotel Development RAP\FIGURES\60310752 F1 Site Location 20 11 2013 TO



LEGEND:

DECLARATION AREA

APPROXIMATE EXTENT OF FORMER GASWORKS FEATURES

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	01	PAS	20.11.13	DRAFT ISSUE	

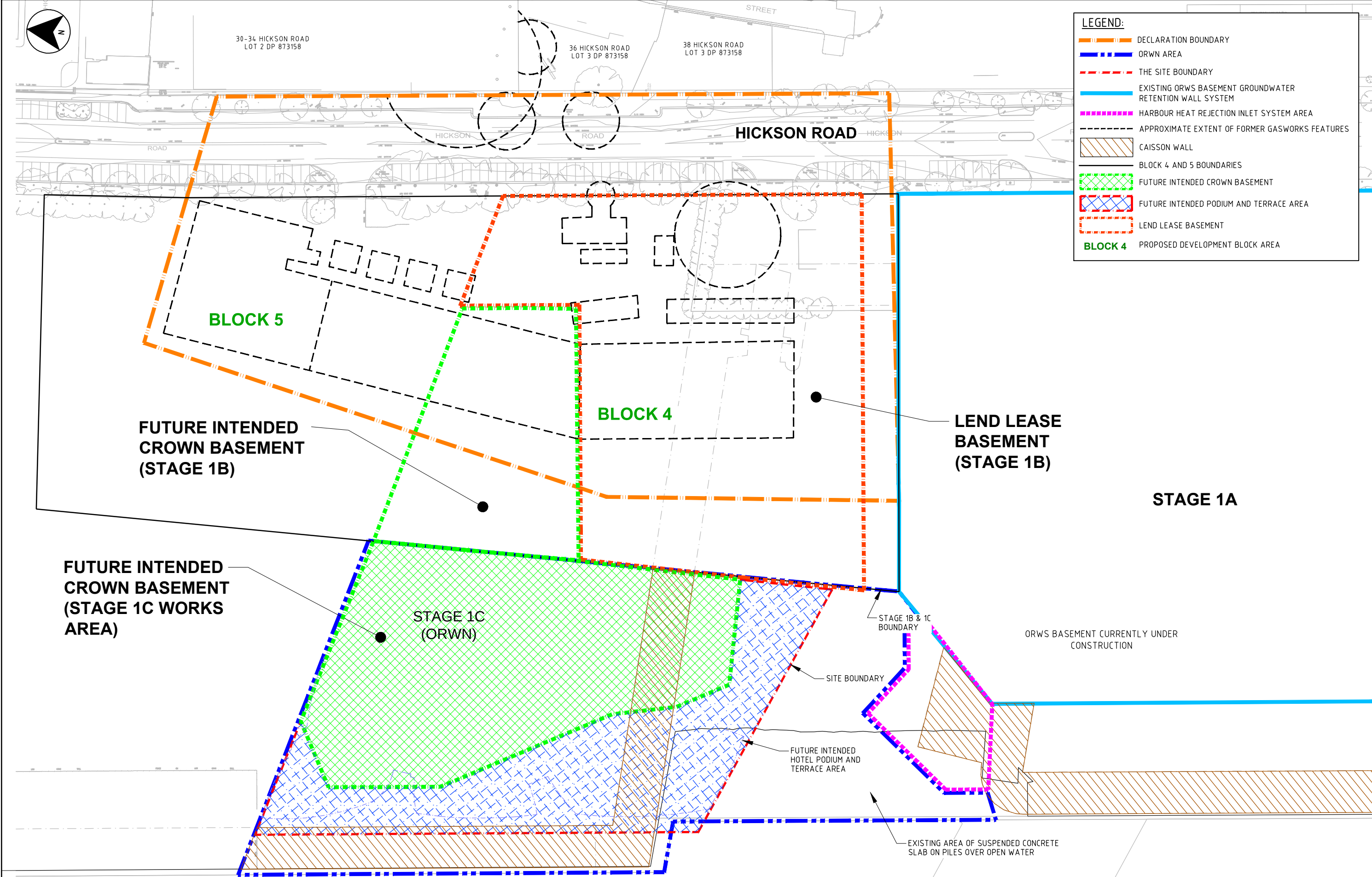
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THE SIGNING OF THIS TITLE BLOCK CONFIRMS THE DESIGN AND DRAFTING OF THIS PROJECT HAVE BEEN PREPARED AND CHECKED IN ACCORDANCE WITH THE AECOM QUALITY ASSURANCE SYSTEM TO ISO 9001:2000			
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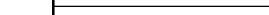
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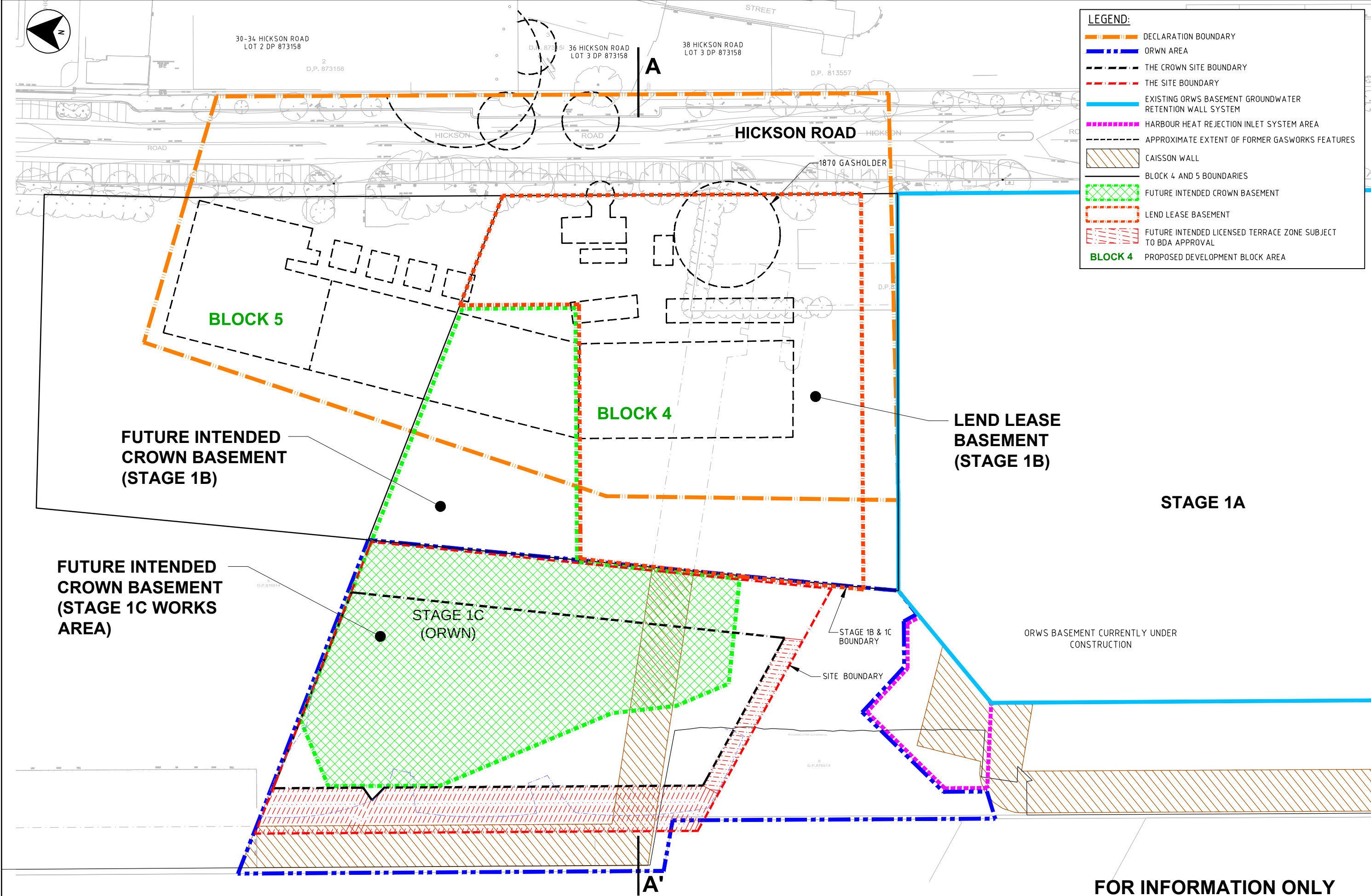
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AECOM	
AECOM Australia Pty Ltd A.B.N. 20 093 846 925	

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CROWN HOTEL DEVELOPMENT RAP, BARANGAROO			
FIGURE F2: SITE LAYOUT AND SURROUNDING AREA			
STATUS: DRAFT		DRAWING NO: 60310752-SKE-EN-FIG-2	REV: 02



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APPROVED		DATE																																				
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REVISIONS					
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03	PAS	09.10.14	DRAFT ISSUE	AR	
02	PAS	06.05.14	DRAFT ISSUE		
01	PAS	20.11.13	DRAFT ISSUE		

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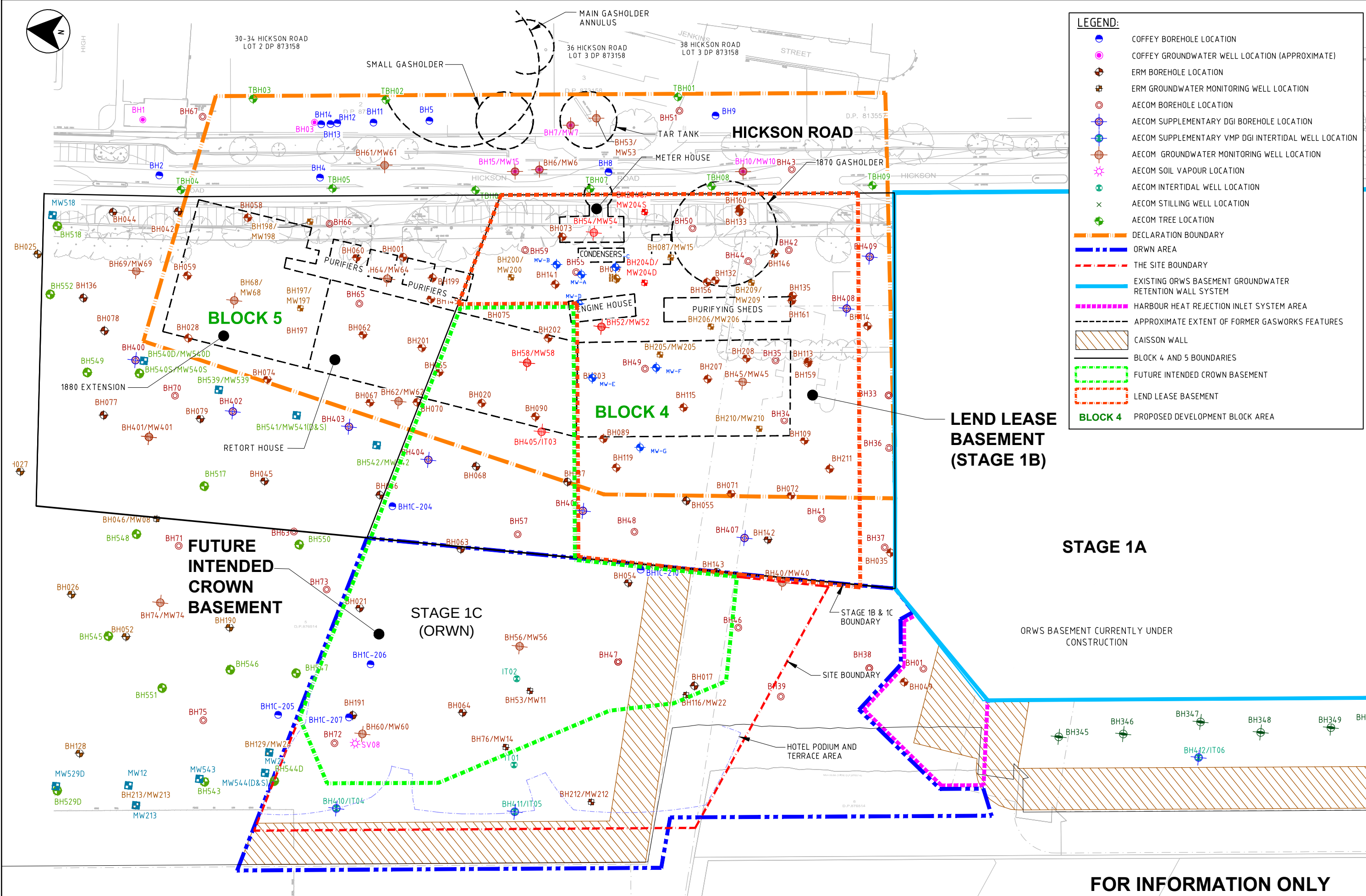
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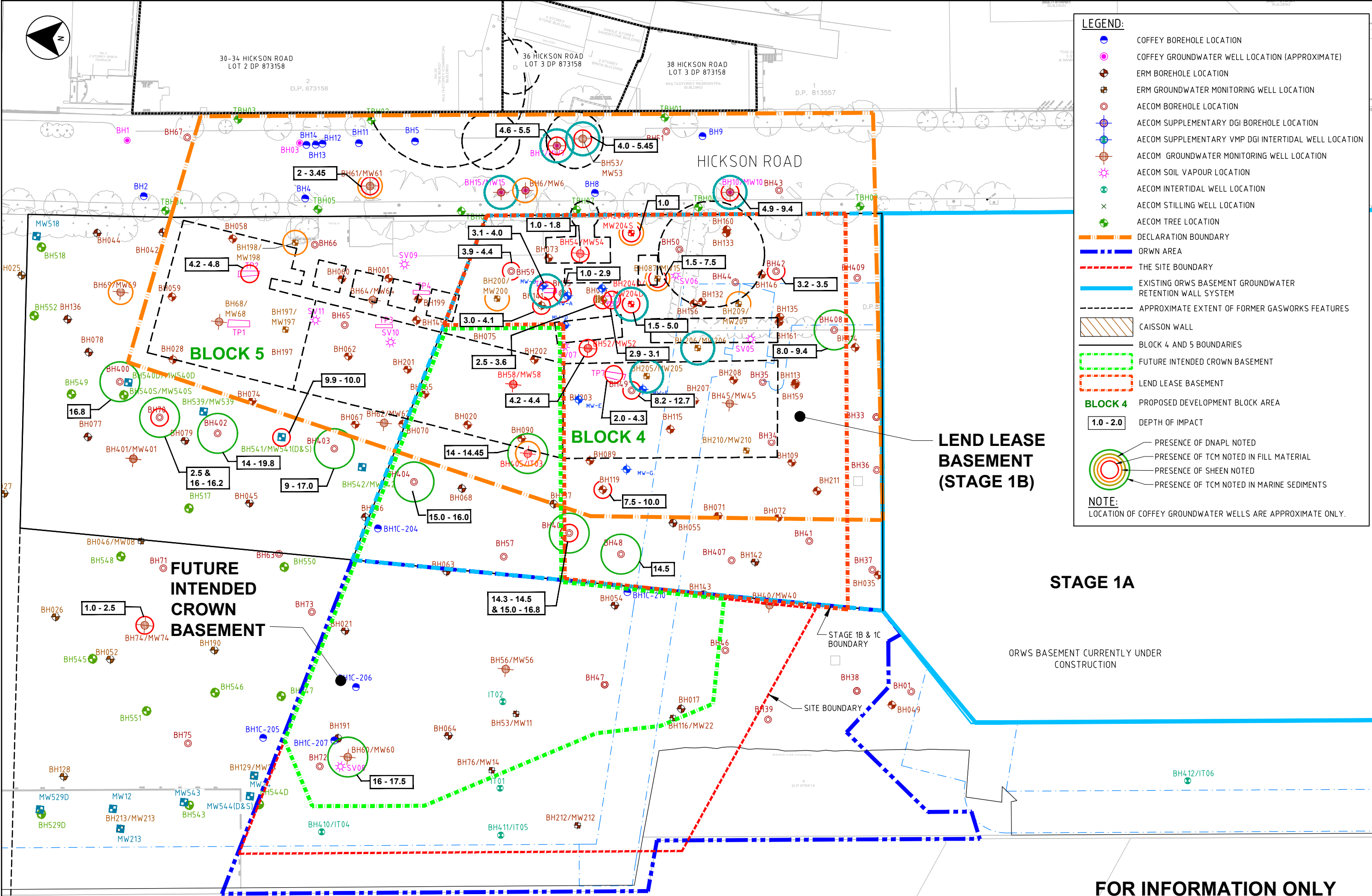
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AECOM Australia Pty Ltd A.B.N. 20 093 846 925	

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60310752-SKE-EN-FIG-4	
REV:	04



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04	SWT	14.04.15	DRAFT ISSUE		5 0 5 10 15m		DRAWN	PAS	CHECKED					FIGURE F5: SITE PLAN AND SAMPLING LOCATIONS CROWN DEVELOPMENT AREA		
03	PAS	09.10.14	DRAFT ISSUE				APPROVED		DATE					STATUS: DRAFT		
02	PAS	06.05.14	DRAFT ISSUE											DRAWING NO: 60310752-SKE-EN-FIG-5		
01	PAS	20.11.13	DRAFT ISSUE											REV: 04		
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02	PAS	06.05.14	DRAFT ISSUE	
01	PAS	20.11.13	DRAFT ISSUE	

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	DATE	

CONTRACTOR	
AECOM	

DESIGNER	
AECOM Australia Pty Ltd A.B.N. 20 093 846 925	

CROWN HOTEL DEVELOPMENT RAP, BARANGAROO	
FIGURE F6: LOCATIONS OF SEPARATED PHASE GASWORKS WASTE AND TAR (SPGWT)	

CROWN HOTEL DEVELOPMENT RAP, BARANGAROO			
FIGURE F6: LOCATIONS OF SEPARATED PHASE GASWORKS WASTE AND TAR (SPGWT)			
STATUS:	DRAFT	DRAWING NO: 60310752-SKE-EN-FIG-6	REV: 04