APPENDIX 15

Draft Remediation Works Plan

Remedial Works Plan

DRAFT

Barangaroo Delivery Authority

Barangaroo Headland Park

February 2011
JBS 41436-16358 Revision C
JBS Environmental Pty Ltd

Remedial Works Plan

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Barangaroo Delivery Authority

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JBS Environmental Pty Ltd

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List of Abbreviations

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

- BDA Barangaroo Development Authority
- BTEX Benzene, Toluene, Ethylbenzene and Xylenes
- B(a)P Benzo (a) pyrene (an individual PAH)
- DECCW NSW Department of Environment Climate Change and Water
- DP Deposited Plan
- EPA NSW Environment Protection Authority
- HHERA Human Health and Ecological Risk Assessment
- HIL Health Based Investigation Level
- LTEMP Long Term Environmental Management Plan
- PAH Polycyclic Aromatic Hydrocarbons
- PIL Phytotoxicity Based Investigation Level
- QA/QC Quality Assurance/Quality Control
- RAP Remedial Action Plan
- REMP Remediation Environmental Management Plan
- ROHSMP Remediation Occupational Health and Safety Management Plan
- RWP Remedial Works Plan
- TPH Total Petroleum Hydrocarbons (C_6-C_9 and C_{10}-C_{36})

Definitions

For the purposes of this document, the following definitions apply:

- "Barangaroo Site" – refers to Lots 1, 3, 5 and 6 of Deposited Plan (DP) 876514.
- "Barangaroo Project Site" – refers to the Barangaroo Site, as defined in the RAP, and adjoining parts of Sussex Street, Hickson Road and Towns Place.
- "Declaration Area" - refers to the part of the Barangaroo Project Site which is the subject of the declaration of Significantly Contaminated Land by the NSW DECCW under the *Contaminated Land Management Act 1997* (Declaration Number 21122, Area Number 3221, dated 6 May 2009.
- "Early Works" – refers to those Early Works described in the Barangaroo Headland Park and Northern Cove Early Works Preferred Project Report prepared by MG Planning Pty Ltd, dated September 2010.
- "Headland Park and Northern Cove RAP" – refers to the Remedial Action Plan (RAP) for the Early Works and Main Works phases of the creation of Headland Park and Northern Cove, prepared by JBS Environmental Pty Ltd.
- "Headland Park Site" – refers to Lot 1 and Part Lot 5 of DP 876514 located at the northern portion of the Barangaroo Site, including land within the Northern Cove area above 1m AHD.
- "Headland Park HHERA" – refers collectively to the Human Health Risk Assessment and Ecological Risk Assessment for the Headland Park Site, prepared by JBS Environmental Pty Ltd, February 2011.
- "Imported Materials" – refers to fill/soil/rock materials imported onto the Headland Park Site as part of the remediation works, sourced from land other than the Barangaroo Project Site, as defined in the RAP.
- "Main Works" – refers to all other works associated with the creation of Headland Park that are not included in the Early Works, as described in the Barangaroo Headland Park and Northern Cove Main Works Environmental Assessment prepared by MG Planning, dated October 2010.
- "Overarching RAP" – refers to the Overarching RAP for the whole Barangaroo Project Site, prepared by ERM Australia Pty Ltd.
- "Risk-based Criteria" – refers to the criteria established in the Headland Park HHERA, which form part of the Site Acceptance Criteria, as defined in the RAP.
- "Site Acceptance Criteria" – refers to the criteria nominated in the RAP which define the suitability, or otherwise, of materials being accepted onto the Headland Park Site.
- "Site Materials" – refers to fill/soil/rock materials sourced from land within the Barangaroo Project Site, as defined in the RAP.
- "Stage 1 Development" – refers to the southern part of the Barangaroo Project Site, which will be developed for commercial/residential/open space uses.

- "Tar Containing Material" – refers to material that contains:
  - more than 10% (volume/volume based on visual assessment) of coal tar (where coal tar is a phase separated hydrocarbon by-product from coal gasification); and
  - Contaminant concentrations exceeding the following limits:
  - Polycyclic Aromatic Hydrocarbons (PAHs) – 2000 mg/kg; or
  - Benzo(a)Pyrene (B(a)P) – 150 mg/kg.
- "Treated Tar Containing Material" – refers to material that was Tar Containing Material, but which has been stabilised using a substance or substances in a manner which does not result in any destruction of PAHs.
- "Former Tar Containing Material" – refers to material that was Tar Containing Material, but which has been treated by one or more chemical and/or physical processes which destroy PAHs so that the materials are no longer Tar Contaminated Materials.

1 Introduction

1.1 Introduction and Background

JBS Environmental Pty Ltd (JBS) was commissioned by the Barangaroo Delivery Authority (BDA) to prepare a Remedial Works Plan (RWP) for the Headland Park portion of Barangaroo located at Hickson Road, Sydney, NSW, 2000 (**Figure 1**).

This RWP applies only to remedial works undertaken on the Headland Park portion of the Barangaroo Site. In this RWP, Headland Park - including areas above 1m AHD in the proposed Northern Cove - is referred to as the "Headland Park Site" and the entire Barangaroo Site is referred to as the "Barangaroo Site", whilst the "Barangaroo Project Site" includes the Barangaroo Site and the adjoining parts of Sussex Street, Hickson Road and Towns Place. The southern part of the Barangaroo Project Site, referred to as the "Stage 1 Development", will be developed for a mixture of commercial, residential and open space uses. The locations of the various parts of the Barangaroo Project Site, including the boundary of the Headland Park Site which is the subject of this RWP, are shown on **Figure 2**.

Previous environmental investigations conducted on the Headland Park Site have identified limited soil contamination, being restricted to total petroleum hydrocarbon (TPH), polycyclic aromatic hydrocarbon (PAH) and metal impacted fill materials, primarily around former Warehouse 3. No significant groundwater contamination has been identified on the Headland Park Site.

Remediation/management of the identified contamination on the Headland Park Site will be undertaken as part of the development of Headland Park and Northern Cove. A Remedial Action Plan (RAP) has been prepared specific to the Headland Park Site (JBS 2011a[1]).

Whilst the RAP and this RWP primarily relate to the remediation of contamination within the Headland Park Site, suitable Site Materials from other parts of the Barangaroo Project Site are proposed to be relocated onto the Headland Park Site, in order to recreate the naturalistic Headland Park landform. The RAP and this RWP therefore give consideration to the broader contamination issues on the Barangaroo Project Site and outlines the requirements for the acceptance of other Site Materials onto the Headland Park Site.

The contamination issues identified across the broader Barangaroo Project Site are principally associated with fill materials, natural soil and groundwater within the footprint of a former gasworks (located on the Stage 1 Development), namely:

- TPH, benzene, toluene, ethylbenzene and xylenes (BTEX), and PAH impacted fill materials, soils and groundwater;
- cyanide impacted fill materials, soil and groundwater;
- phenol and ammonia impacted fill materials, soil and groundwater;
- minor quantities of asbestos impacted fill materials; and
- metal impacted fill materials, soil and groundwater (lead, cadmium, copper & zinc).

[1] *Remedial Action Plan, Barangaroo Headland Park, Hickson Road, Sydney, NSW*, Final Draft, Revision F, JBS Environmental, February 2011 (JBS 2011a)

The footprint of the former gasworks has been declared by the NSW Department of Environment Climate Change and Water (DECCW) as a Remediation Site and is referred to as the "Declaration Area". The Declaration Area is not within the Headland Park Site.

1.2 Objectives

The objectives of this RWP are:

- to document the methodology, procedures and timing required as part of remedial works to aid in successful implementation of remedial works in accordance with the Headland Park RAP (JBS 2011a); and
- to document the plans to be developed and/or implemented during the remedial works to protect the environment and the health, safety and amenity of workers undertaking the works and the general public in proximity to the site.

This RWP has been prepared with consideration to:

- the Headland Park RAP (JBS 2011a);
- the Director General's Requirements relating to Project Application MP10_0047; and
- the requirements of the Overarching RAP prepared for the Barangaroo Project Site (ERM 2010)[2] and the associated Site Audit Statement and Site Audit Report (ENVIRON 2010)[3].

1.3 Overarching Remedial Action Plan

An Overarching RAP (ERM 2010) has been prepared for the Barangaroo Project Site that outlines the remediation approach to address the identified contamination across the Barangaroo Project Site as a whole and makes reference to the preparation of individual RAPs and Remedial Work Plans (RWPs) for various elements of the Barangaroo Project Site.

The RAP for the Headland Park Site, including the Northern Cove, is one of the individual RAPs required to be prepared by the Overarching RAP (ERM 2010). Similarly, this RWP for the Headland Park Site has been prepared by JBS in view of the Overarching RAP and in anticipation of the finalisation of the Headland Park HHERA (**Section 1.4**) and the design of Headland Park.

1.4 Headland Park Human Health and Ecological Risk Assessments

Draft Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) have been undertaken by JBS to define risk-based criteria for fill materials, natural soil and groundwater on the Headland Park Site (JBS 2011b[4] and JBS 2011c[5]). The risk assessments are collectively termed the "Headland Park HHERA". The draft risk-based criteria contained within the Headland Park HHERA apply to the RAP for the Headland Park Site.

[2] *Overarching Remedial Action Plan for The Barangaroo Project Site, Sydney,* ERM, June 2010 (ERM 2010)
[3] *Site Audit Report and Site Audit Statement GN439A, Overarching Remedial Action Plan, Barangaroo,* Graeme Nyland of ENVIRON Australia Pty Ltd, June 2010 (ENVIRON 2010).
[4] *Human Health Risk Assessment, Barangaroo Headland Park,* JBS Environmental Pty Ltd, February 2011 (JBS 2011b)
[5] *Ecological Risk Assessment, Barangaroo Headland Park,* JBS Environmental Pty Ltd, February 2011 (JBS 2011c)

The draft Headland Park HHERA presents soil criteria for the two principal elements of the Headland Park Site, namely:

1. In-situ soils currently present at the Headland Park Site, which are protective of groundwater and the receiving surface water environment of Darling Harbour.
2. Ex-situ (relocated) soils required to create the naturalistic landform of Headland Park, which are protective of future users of the park, vegetation within the park, groundwater and the receiving surface water environment of Darling Harbour.

1.5 Headland Park Remedial Action Plan

The remediation/management goals for the Headland Park Site are:

- To reduce the risks to future site users posed by the identified in-situ contamination within the Headland Park Site to enable the proposed redevelopment of the site to proceed in accordance with the intended parks/open space landuse, including an associated Cultural Facility and carpark;
- To reduce the risks to groundwater and the receiving waters of Darling Harbour posed by the identified in-situ contamination within the Headland Park Site; and
- To reduce the risks to future site users or the surrounding environment posed by Site Materials relocated from other parts of the Barangaroo Project Site onto the Headland Park Site.

The following remediation/management approach has been adopted as part of the Headland Park Site development activities outlined below, as per the Headland Park RAP (JBS 2011a).

Demolition and Earthworks

- On-site reuse/placement of impacted fill materials generated as part of the site excavations, and including any materials from the broader Barangaroo Project Site that meet the Site Acceptance Criteria established in the Headland Park RAP (JBS 2011a). No highly impacted gasworks-related fill materials from within the Stage 1 Development will be accepted on the Headland Park Site.

Sewer Upgrade Work

- On-site reuse/placement of excavation materials generated as part of the sewerage upgrade works, but excluding any highly impacted gasworks-related materials from the Barangaroo Project Site. The risk of encountering highly impacted gasworks-related fill materials is considered to be low.
- Characterisation and off-site treatment and/or disposal at licensed waste facilities, of materials generated as part of the sewerage upgrade works which do not meet the Site Acceptance Criteria.
- Characterisation and release to either stormwater, or sewer or off-site disposal of groundwater collected during the excavation of the sewage overflow storage.

Sandstone Extraction Program

- On-site reuse/placement of impacted fill materials generated as part of the sandstone extraction program.
- On-site testing of collected groundwater during the sandstone extraction program, followed by release to stormwater in accordance with regulatory requirements.

Remediation Works within Headland Park Site

- Excavation of "hotspots" of contaminated soils, followed by on-site management in accordance with the requirements established in the Headland Park HHERA and RAP;
- Excavation of "hotspots" of contaminated soils, followed by classification and off-site disposal of materials which are not able to be managed on-site in accordance with the requirements established in the Headland Park HHERA and RAP; and
- (Likely) ongoing monitoring of groundwater.

Receipt and Placement of Materials from the broader Barangaroo Project Site

- On-site reuse/placement of impacted fill material sourced from the broader Barangaroo Project Site that are demonstrated to meet Site Acceptance Criteria established in the Headland Park RAP to form part of the naturalistic headland.
- On-site management in accordance with the provisions contained in the Headland Park HHERA and RAP and the associated engineering controls required for seepage water prevention, collection and treatment.

Where materials are reused on the Headland Park Site, then this will require ongoing management via the development and implementation of an appropriate LTEMP, which will be prepared upon successful completion of remedial works and subsequent validation reporting.

1.6 Site Auditor Engagement

As part of the assessment and remediation works, a Site Auditor accredited by NSW DECCW has been engaged to provide endorsement of the Headland Park RAP and to provide a Site Audit Statement at the completion of the works on the Headland Park Site certifying that the Headland Park Site is suitable for the proposed uses, subject to implementation of a Long-term Environmental Management Plan (LTEMP).

1.7 The Proposed Development / Current Design

The Headland Park Site is proposed to be developed into a naturalistic headland that will simulate the shoreline as it was in 1836. Establishment of the naturalistic headland will involve shaping of the shoreline through the extraction of approximately 150 000 m^3 of fill materials within or behind the existing caissons and seawall that form the western and northern current boundaries of the Headland Park Site. Additional material, comprising approximately 10 000 m^3 of fill and natural soils and 60 000 m^3 of sandstone will be excavated from within the area of the Headland Park to facilitate construction of a submerged car park and generation of 'yellow rock' sandstone.

The Headland Park Site is proposed to include the following elements:

- A substantial open area of sloped parkland over the majority of the Headland Park Site provided with a network of pathways and plantings formed by a substantial filling program;

- A modified shoreline throughout the perimeter of the Headland Park Site including the fringe of a submerged area at the south known as Northern Cove, resulting in the excavation of approximately 150 000m^3 of fill based soils;
- A void to a depth of -7.6 mAHD as created by a proposed sandstone extraction program located within the central portion of the site, comprise dimensions of 85 m (east-west) and 70 m (north-south) resulting in the excavation of approximately 60 000 m^3 of sandstone and approximately 5 000 m^3 of overlying fill materials;
- A multi-level Car Park as constructed within the void, partially contained within the area of proposed sandstone extraction and extending within an excavation placed to a depth of -2 mAHD within the central to southern portion of the site. The proposed dimensions of the car park are 40 m (east-west) and 165 m (north-south). In addition to the surplus soils as generated by the sandstone excavation, an additional 5 000 m^3 of fill based and natural soils (alluvium and potential sandstone) will be generated by this proposed excavation outside the designated area of sandstone extraction;
- A 'Cultural Facility' as constructed above the Car Park and also substantially contained within a space created within the filling used to form the Headland Park Site; and
- A system to control seepage water movement, collection and re-use, as constructed with the filling and formation of the headland profile of the Park.

The proposed boundaries of the Headland Park Site are shown on **Figure 3**, based on available survey data.

1.8 Site Identification

The Barangaroo Project Site is located at Hickson Road, Sydney, NSW and is legally referred to as Lots 1, 3, 5 and 6 Deposited Plan (DP) 876514 and includes the adjacent parts of Sussex Street, Hickson Road and Towns Place, as shown in **Figure 1**.

It is noted that two small portions have been excluded from the Barangaroo Project Site for the purposes of remediation planning including:

- Moore's Wharf (in the far north eastern section of the Headland Park Site); and
- The area immediately surrounding the Port Control Tower.

The location of these areas relative to the Barangaroo Project Site is shown on **Figure 2**, which also shows the location of former structures that were present during the former commercial/industrial site use.

The Headland Park Site is located at the northern part of the Barangaroo Project Site (refer **Figures 2** and **3**) and the details are summarised in **Table 1.2**.

Table 1.2 Summary Details for the Headland Park Site

Lot/DP	Lot 1 and Part Lot 5 of Deposited Plan 876514, including adjacent parts of Hickson Road and Towns Place
Address	Hickson Rd Millers Point NSW
Local Government Authority	City of Sydney
Site Zoning	Zone B4 Mixed Use and RE1 Pubic Recreation
Current Use	Vacant
Geographical Co-ordinates, Elevation	Easting – 333547m E, Northing – 6252278m, 2-3m AHD
Site Area	Approximately 8 ha

For the purposes of the Headland Park RAP, this RWP, and the ensuing Site Audit, the final site as intended to be described in the Site Auditor sign off consists of the site as defined by the high water mark boundary. A plan view of the proposed site is shown as **Figure 3**.

It is noted that a substantial area of the current Lots 1, 3, 5 and 6 are proposed to be inundated with the proposed site development. These inundated areas are understood to be excluded from the area of the final site audit. Approximate dimensions and locations of the future site boundary can be identified as the 1m AHD contour as shown on **Figure 3**.

Soils as contained within the proposed inundated area will be excavated to a maximum likely depth of approximately -4 m AHD. The majority of these soils are proposed to be used as fill material in the creation of the headland landform on the Headland Park Site.

2 Extent of Contamination Requiring Remediation

2.1 Extent of Remediation / Management Required

2.1.1 In-Situ Soils within the Headland Park Site

All available environmental data for the Headland Park site has been analysed and compared to risk based criteria generated for the proposed site, as part of additional assessment (JBS 2011d[6]). Based on that assessment, it has been found:

- The soils as identified in **Figure 3** by orange shading are considered inappropriate for use within 0.5 m of the final park surface. This is an approximate quantity of 1000 m^3; and
- The soils as identified on **Figure 13** and shown by blue shading, present over an approximate area of 6 000m^2, are considered inappropriate for use as growing medium.

In addition, a minor, isolated and localised area of tar impact was identified during geotechnical investigations at sampling location shown as JBS312A on **Figure 3**. Based on visual observations recorded on the borehole log, it is anticipated that this comprises an approximate quantity of 100 m^3.

Groundwater sampling and analysis has not indicated that significant groundwater impact is present underlying the Headland Park.

The areas shown on Figure 3 represent the current understanding of the anticipated extent of in-situ soils requiring remediation on the Headland Park Site. Prior to commencement of remedial works, any changes in the anticipated extent resulting from Site Auditor advice or design changes will be documented as appropriate and necessary in an addendum to this RWP, following:

1. Review and endorsement of the final Headland Park Cove HHERA (JBS 2011b and 2011c) and RAP (JBS 2011a) by the Site Auditor; and
2. Finalisation of the design of the Headland Park and the Cultural Facility/carpark;

2.1.2 Ex-Situ Soils to be Relocated on the Headland Park Site

The following ex-situ soils relocated on the Headland Park Site require management in accordance with the provisions outlined in the Headland Park RAP:

- All soils excavated on the Headland Park Site which are to be reused to create the naturalistic Headland Park; and
- All Site Materials relocated onto the Headland Park Site which are not Virgin Excavated Natural Materials (VENM), as defined in relevant regulations;
- All Imported Materials brought onto the Headland Park Site which are not VENM or Excavated Natural Materials (ENM), as defined in relevant regulations.

The extent of remediation required in other parts of the Barangaroo Project Site outside the Headland Park Site will be addressed in other RAPs and RWPs and is outside the scope of this RWP.

[6] *Pre Early Works Additional Environmental Assessment, Headland Park, Barangaroo, NSW*, Draft, Revision B, JBS Environmental, February 2011 (JBS 2011d)

3 Remedial Work Plan

An overview of the remedial works as per the RAP (JBS 2011a) is provided in **Section 1.5** of this RWP.

3.1 Methodology and Procedures

This section of the RWP provides the methodology and procedures for measures that are required to be implemented by the Remediation Contractor prior to and during remedial works. This RWP is specific to remedial works on the Headland Park Site, and does not relate to other works being undertaken as part of early works on the Headland Park site. This RWP also takes into consideration materials management required following the early works relating to control of materials imported to the Headland Park Site.

A comprehensive Remediation Works Environmental Management Plan (REMP) has been prepared (JBS 2010a[7]) to manage, monitor, maintain and report environmental control measures, which will be required to be implemented by the Remediation Contractor.

In addition, the Remediation Contractor will be required to develop and implement a comprehensive Remediation Occupational Health and Safety Management Plan (ROHSMP) to manage, monitor, maintain and report health, safety and rehabilitation measures.

3.1.1 Site Establishment

The Headland Park Site boundary and any other relevant boundaries such as the Barangaroo Site boundary or the Barangaroo Project Site boundary will be defined by survey and contained as appropriate to ensure that all safety and environmental controls are implemented, including necessary contractor briefings and inductions for the remediation workforce. The details of the environmental controls are provided in the REMP (JBS 2010a); refer **Section 4** of this RWP.

The Remediation Contractor must establish and disestablish all facilities and compounds, as necessary, required to undertake the works. This must include mobilisation and demobilisation of materials, personnel and plant, securing the works areas and any Contractor compounds, in accordance with the requirements of the BDA.

The Remediation Contractor must provide its own meal room, first aid facilities, site office and any other facilities required to perform the works (including but not limited to toilets and change rooms).

3.1.2 Material Characterisation and Storage

A program of materials characterisation shall be undertaken for the following purposes:

- To verify that the composition of materials excavated from the Headland Park Site and retained on the Headland Park Site meet the Site Acceptance Criteria as per the Headland Park RAP (JBS 2011a);
- To verify that the composition of materials received for placement within the Headland Park Site from the broader Barangaroo Project Site are consistent with that indicated by existing in-situ data and meet the Site Acceptance Criteria as per the Headland Park RAP (JBS 2011a); and

[7] *Remediation Environmental Management Plan, Barangaroo Headland Park and Northern Cove, Hickson Road, Sydney, NSW*, Revision 0, October 2010, JBS Environmental (JBS 2010a).

- To assess the suitability of any materials excavated around any unexpected find of contaminated materials, such as drums or gasworks waste, for placement within the Headland Park Site.

Details of the characterisation program to be undertaken by the Remediation Consultant are provided in the Headland Park RAP (JBS 2011a).

The storage of materials is envisaged, to allow a programming interface between material receipt and placement.

A Materials Compliance Management System (MCMS) shall be developed by the Remediation Contractor prior to receipt of Site Materials for reuse on the Headland Park Site, as described in **Section 3.3**. Any incompatibilities between the placement locations and materials proposed to be placed must be identified, including procedures as to how incompatibility issues are to be addressed, and included in the MCMS.

Separate areas will be required for stockpile storage of the different materials for reuse on the site and/or imported to the site. These areas will need to be defined during preparation of the MCMS.

All stockpiles must be placed in a manner that prevents cross contamination between stockpiled material and the underlying land. Adequate environmental controls must be in place (including but not limited sediment, runoff and dust management) in accordance with the REMP.

The Remediation Contractor must prepare, maintain and update (daily or otherwise as required) an accurate stockpile location plan as part of the MCMS.

3.1.3 Excavation of Contaminated Soil and Reinstatement

In accordance with the principles established for the Headland Park Site, it is proposed that, where possible, materials will be retained on the Headland Park Site.

Contaminated Soils within the Headland Park Site

Contaminated fill materials requiring remediation shall be excavated and stockpiled for characterisation and on-site reuse/placement, subject to compliance with the Site Acceptance Criteria (**Section 3.4**) adopted in the Headland Park RAP.

Site Materials from other Parts of the Barangaroo Project Site

Soils excavated from other parts of the Barangaroo Project Site associated with the creation of Headland Park (e.g., soils associated with the sewer upgrade works) shall be transferred to the Headland Park Site for stockpiling and/or placement.

If any highly contaminated materials are encountered, they may be required to be treated so that the contaminants are stabilised prior to placement on the Headland Park Site (excluding treated tar impacted materials) or disposed off-site to a landfill licensed to receive the appropriate class of waste.

Fill materials from the excavation of basements across the broader Barangaroo Site will be accepted for placement in the naturalistic landform, subject to compliance with the Site Acceptance Criteria (**Section 3.4**) adopted in the Headland Park RAP.

Highly Impacted Soils from within Declaration Area

Any highly impacted materials excavated from within the Declaration Area associated with the construction of the sewer line and sewage overflow storage in Hickson Road shall be characterised to enable an assessment against the Site Acceptance Criteria established in the Headland Park RAP for possible on-site reuse/placement. Any materials which do not

meet the Site Acceptance Criteria established in the Headland Park RAP will be removed offsite for treatment and/or disposal at appropriately licensed waste facilities.

No materials, excavated as part of the relocation of the sewer line, will be permitted on the Headland Park Site unless they meet the Site Acceptance Criteria established in the Headland Park RAP.

Excavation of materials requiring relocation on the Headland Park Site, as depicted in **Figure 3**, will generally follow the procedure outlined below:

- Each excavation area will be marked out as directed by the Remediation Consultant, and the Remediation Contractor will secure the areas and put in place environmental controls as necessary prior to excavation;
- Excavation of the area where tar material was observed, as shown on **Figure 3**, under the guidance of the Remediation Consultant;
- Excavation of areas shown on **Figure 3** as "Material unsuitable to remain in the top 0.5 m of the finished park profile" (orange shading) and "Material unsuitable for use as a growing medium" (blue shading);
- Placement of excavated material in the appropriate established stockpile storage areas under the guidance of the Remediation Consultant (**Section 3.1.2**);
- The Remediation Contractor will assist the Remediation Consultant (through provision of appropriate machinery and suitably qualified operators) to collect any samples necessary to validate the removal of material from each area, and to characterise excavated material placed in stockpile storage (**Section 3.1.2**);
- The Remediation Contractor will secure the excavation areas and maintain appropriate environmental controls to meet ROHSMP and REMP requirements until such time as advised by the Remediation Consultant that the areas can be reinstated with placement of appropriate material (**Section 3.1.4**);
- Once the Remediation Consultant has indicated that the excavation areas can be reinstated, the Remediation Contractor will survey the final outline and depth of each area, prior to reinstatement by placement using appropriate material (as guided by the Remediation Consultant and the material compliance system) and compact as necessary to meet PDA design requirements;
- In addition to surveying the final outline and base of each excavation area, as above, the Remediation Contractor will also survey the final elevation following reinstatement.

3.1.4 Material Placement / Containment of Site Materials

A program of material placement shall be undertaken, following the development and implementation of the following supporting documentation/plans:

- Water Balance Assessment (WBA) to be completed by an appropriately qualified and experienced person;
- Subsurface Drainage Assessment and Design Plan (SDADP), incorporating the required details on the seepage water controls, to be completed by an appropriately qualified and experienced engineer (plans and sections showing the seepage water drainage controls are provided in **Appendix A**); and
- Engineered Materials Placement Plan (EMPP) to be completed by an appropriately qualified and experienced engineer, including demonstrating that the design and

integrity of the placed materials and associated structures are consistent with best practice standards.

Placement of materials in areas where contaminated materials are excavated from the Headland Park Site will be completed in accordance with the procedure outlined in **Section 3.1.3**, as well as the abovementioned documents and the materials compliance system (**Section 3.3**), and the site design requirements of the BDA.

Placement of material from other areas of the Headland Park Site and other parts of the Barangaroo Project Site will need to comply with the abovementioned documents and the materials compliance system (**Section 3.3**) and the site design requirements of the BDA.

3.1.4.1 Validation of Soil Placement Areas

Areas where soils are reused by placement to form Headland Park will be subject to the following data recording process for future reference purposes, and detailed in the REMP:

- A dilapidation survey of the retained pavements prior to material placement;
- A location plan of the placed materials with co-ordinates relative to the lot boundaries;
- The levels in m AHD of the base of the placement location(s) prior to the material placement;
- Confirmation of appropriate modifications to any existing drainage infrastructure beneath the material placement areas so that there are no direct migration pathways for infiltration to enter the receiving waterbody.
- The levels in m AHD of the placement locations once all materials have been placed;
- The levels in m AHD of any defining layers, such as marker layers; and
- Subsequently the total placed volume of materials.

The placed materials and associated structures/controls (e.g., seepage water prevention/collection/treatment) will be retained on the Headland Park Site in a manner which does not impact on the surrounding environment.

At the completion of the Main Works program on the Headland Park Site, a LTEMP will be prepared documenting the presence of the placed materials and the ongoing monitoring/management measures that are expected to be implemented to ensure environmental compliance over the life of the Headland Park Site.

3.2 Timing

The Remediation Contractor is required to prepare a schedule for the remedial works to meet the BDA's project timelines. Current key points/periods in the program as described by BDA are provided below for information:

- Early Works commence — February 2011
- Main Works site preparation, controls — August 2011
- Receipt of material for placement — September 2011 to December 2013
- Validation Report and Site Audit Statement — December 2013.

3.3 Materials Compliance

A Materials Compliance Management System (MCMS) shall be developed by the Remediation Contractor prior to receipt of Site Materials for reuse on the Headland Park Site and include two primary elements:

1. Materials Management Guideline (material qualities); and
2. Materials Tracking Plan (quantity / movement / location).

The MCMS will contain the following specific details:

- Definition of responsibilities, including the Remediation Contractor(s), other contractor(s) e.g., sewerage upgrade works, Lend Lease Remediation Consultant (AECOM), BDA Remediation Consultant (JBS) and the Site Auditor.
- Material Quality, summarising existing analytical (in-situ) data, additional analytical (ex-situ) data, additional observations to satisfy other acceptance criteria (e.g., % tar) and alignment of all data to enable classification as per zones established in the Headland Park HHERA and presented in the Headland Park RAP, and shown in **Figure 4** of this RWP.
- The origin (source details) and classification (as per the Headland Park RAP) of materials to be placed on the Headland Park Site, noting that depths from which materials are sourced are not critical if tied to material type, while placement depths are critical since tied to Headland Park HHERA criteria adopted in the Headland Park RAP (**Section 3.4** and **Appendix B**).
- Where the materials have been placed (lateral & vertical).
- The quantity of placed materials.
- Site grid squares / Site survey data (GPS / GIS), noting size of grid and elevations.
- Frequency of data collection, with consideration to both program (time) and area/material type.
- Material Tracking Records.
- Standard forms / documentation.
- Non-conformances / Unexpected Finds.
- QA/QC.

3.3.1 Imported Soils Compliance with Validation Plan

As stated **Section 3.4**, only materials which meet the definition of VENM or ENM as defined under relevant regulations will be accepted onto the Headland Park Site.

Prior to VENM or ENM materials being accepted onto the site, the following compliance procedure will be implemented:

- The source site(s) and material type(s) shall each be inspected by the Remediation Consultant and confirm that the site history indicates the site is uncontaminated and that the soil proposed to be excavated is visually clean and undisturbed;
- The documentation relating to the materials shall be reviewed by the Remediation Consultant and assessed against the requirements outlined in the Headland Park RAP;

- Regular inspections of imported materials accepted for importation on the Headland Park Site shall be undertaken by the Remediation Consultant. In the event that imported materials are observed by the Remediation Consultant to be inconsistent with that described in the imported material classification documentation and/or that observed by the Remediation Consultant at the source site and/or if suspected signs of contamination are identified, the importation of soils from the specific source site(s) shall be suspended until such time as confirmatory sampling/analyses is undertaken by the Remediation Consultant to confirm the suitability of the materials for acceptance onto the Headland Park Site.

3.4 Site Acceptance Criteria

Draft site-specific risk-based criteria have been developed in the Headland Park HHERA in accordance with relevant guidelines and in consultation with the NSW DECCW. The draft risk-based criteria, which were adopted in the Headland Park RAP (JBS 2011a), are to be reviewed and endorsed for use by the appointed NSW DECCW accredited Site Auditor prior to being applied during the remediation works to be undertaken at the Headland Park Site.

Materials will only be retained or accepted on the Headland Park Site if they meet the Site Acceptance Criteria in the Headland Park RAP, defined below for the following categories of materials:

1. Site Materials – fill/soil/rock materials sourced from land within the Barangaroo Project Site; and
2. Imported Materials – fill/soil/rock materials imported onto the Barangaroo Project Site as part of the creation of Headland Park which have been sourced from land other than the Barangaroo Project Site.

Material tracking details shall be prepared as outlined in (**Section 3.3**) prior to commencement of the remediation works, detailing the material compliance protocols, consistent with the validation sampling program outlined in **Section 3.1.5** and the validation of placement areas outlined in **Section 3.1.4**.

Site Acceptance Criteria for Site Materials

Site Materials will only be retained or accepted on the Headland Park Site if:

1. The concentrations of contaminants within the materials meet the risk-based criteria in the Headland Park HHERA as adopted in the Headland Park RAP (JBS 2011a); and
2. Are not Tar Containing Materials as defined in **Definitions**, or Treated Tar Containing Materials.

The draft risk-based soil criteria for the Headland Park Site for ex-situ soils to be placed within the Headland Park naturalistic landform and in-situ soils beneath the existing site surface have been adopted and presented in the RAP (JBS 2011a). A table summarising the criteria is provided in **Appendix B**, to be reviewed in relation to the zones depicted in **Figure 4**.

Site Acceptance Criteria for Imported Materials

Imported materials will only be accepted on the Headland Park Site if they:

- meet the definition of Virgin Excavated Natural Material (VENM) as defined in relevant legislation, noting that all reported concentrations of organic constituents should be below the laboratory limits of reporting and the reported concentrations of inorganic constituents consistent with published background levels (NEPC 1999); or
- meet the definition of Excavated Natural Material (ENM) as defined in relevant regulations.

Aesthetics

In addition to the quantitative Site Acceptance Criteria adopted in the Headland Park RAP, the following qualitative observations/detections will also supplement the characterisation/validation process:

- Observations made regarding the condition of visible asbestos containing materials in addition to laboratory analyses for the presence of asbestos fibres; and
- The presence of odorous or discoloured soils (caused by contamination).

3.5 Unexpected Finds

The possibility exists for hazards that have not been identified to date to be present at the Headland Park Site. The nature of hazards which may be present and which may be discovered at the Barangaroo Project Site are generally detectable through visual or olfactory means, for example:

- Fragments of asbestos-containing materials (visible) or aggregates of friable asbestos materials (visible);
- Construction/Demolition Waste (visible);
- Hydrocarbon impacted materials (visible/odorous);
- Drums or underground storage tanks (USTs) (visible); and
- Ash and/or slag contaminated soils/fill materials (visible).

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances (or any other unexpected potentially hazardous substance) be identified, the Remediation Contractor should notify the BDA and the Remediation Consultant immediately, and will be addressed as per the RAP (JBS 2011a).

3.6 Remedial Works Validation and Ongoing Monitoring / Management

Validation of the remedial works will be undertaken to demonstrate that the works were undertaken in accordance with the requirements outlined in the Headland Park RAP. Details of the validation program are provided in the Headland Park RAP.

The proposed remediation strategy for the Headland Park Site will require ongoing monitoring and management. A LTEMP will be prepared to detail the ongoing management and monitoring requirements for the Headland Park Site, however, the precise nature and extent of the management/monitoring requirements will not be known until intrusive remediation works are conducted and the validation data obtained. The

LTEMP will be prepared following the completion of the validation report for the Headland Park Site.

An independent Site Audit, completed by a Site Auditor accredited by the NSW DECCW, will be conducted to review:

- The validation report(s) prepared when the validation criteria are achieved; and
- The LTEMP prepared to document the ongoing monitoring/management requirements to ensure the suitability of the Headland Park Site for the intended uses.

4 Protection of the Environment

4.1 Preparation of Remediation Environmental Management Plan

A Remediation Environmental Management Plan (REMP) has been prepared, which documents the environmental monitoring and management measures required to be implemented by the Remediation Contractor during the remediation-related activities associated with the Headland Park Development.

Prior to mobilising on the Headland Park Site, the Remediation Contractor is required to review the REMP and to make any recommendations to BDA as to any amendments that the Remediation Contractor may envisage will enable successful implementation of the REMP by the Remediation Contractor.

Prior to establishment on the Headland Park Site, the REMP requires to be certified as acceptable by an independent person who is experienced with protection of the environment during remediation and management of contaminated sites.

A copy of the REMP and the certification to the satisfaction of BDA are required to be provided to the BDA prior to establishment on the Headland Park Site.

4.2 Other Management Plans

The Remediation Contractor should familiarise themselves with other management plans relating to protection of the environment at and surrounding the Barangaroo site, including:

- Air Quality Management Plan (JBS 2010b[8]);
- Soil and Water Report (WSP 2010[9])

[8] *Air Quality Management Plan, Barangaroo Headland Park and Northern Cove, Hickson Road, Sydney, NSW*, Draft, Revision A, JBS Environmental, November 2010 (JBS 2010b).
[9] *Soil and Water Report to support the Environmental Assessment for Headland Park Barangaroo, Barangaroo Development Authority*, WSP Environment & Energy, August 2010 (WSP 2010).

5 Protection of Health and Safety

5.1 Remediation Occupational Health and Safety Management Plan

A Remediation Occupational Health and Safety Management Plan (ROHSMP) shall be prepared by the Remediation Contractor prior to mobilisation onto the Headland Park Site. The Plan shall contain procedures and requirements that are to be implemented as a minimum during the works to be protective of the health and safety of workers on the site and the general public and to meet relevant regulatory requirements.

Prior to establishment on the Headland Park Site, the Remediation Contractor is required to have the ROHSMP certified as acceptable by a Certified Occupational Hygienist who has experience in the protection of the health and safety of workers, visitors and of neighbours with respect to remediation and management of contaminated sites.

A copy of the ROHSMP and the certification to the satisfaction of the BDA is required to be provided to the BDA prior to establishment on the Headland Park Site.

6 Limitations

This report has been prepared for use by the client who commissioned the works in accordance with the project brief only and has been based in part on information obtained from other parties. The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. Additionally, this report has been based on investigation results documented by others in previous reports. The reader is referred to these reports for the limitations of the investigations.

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

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

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

7 References

Barangaroo Headland Park and Northern Cove, Preliminary Assessment and Request for Director-General's Requirements for Early Works and Main Works Project Applications, MG Planning Pty Ltd, March 2010 (MG 2010)

Code of Practice for the Safe Removal of Asbestos, 2nd Edition, National Occupational Health and Safety Commission, 2005 (NOHSC 2005)

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

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

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

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

Guideline: Your Guide to Working With Asbestos, NSW WorkCover, 2008 (WorkCover 2008)

Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, Western Australia Department of Health, May 2009 (WA DoH 2009)

Managing Land Contamination, Planning Guidelines, NSW Department of Urban Affairs and Planning, August 1998 (DUAP 1998)

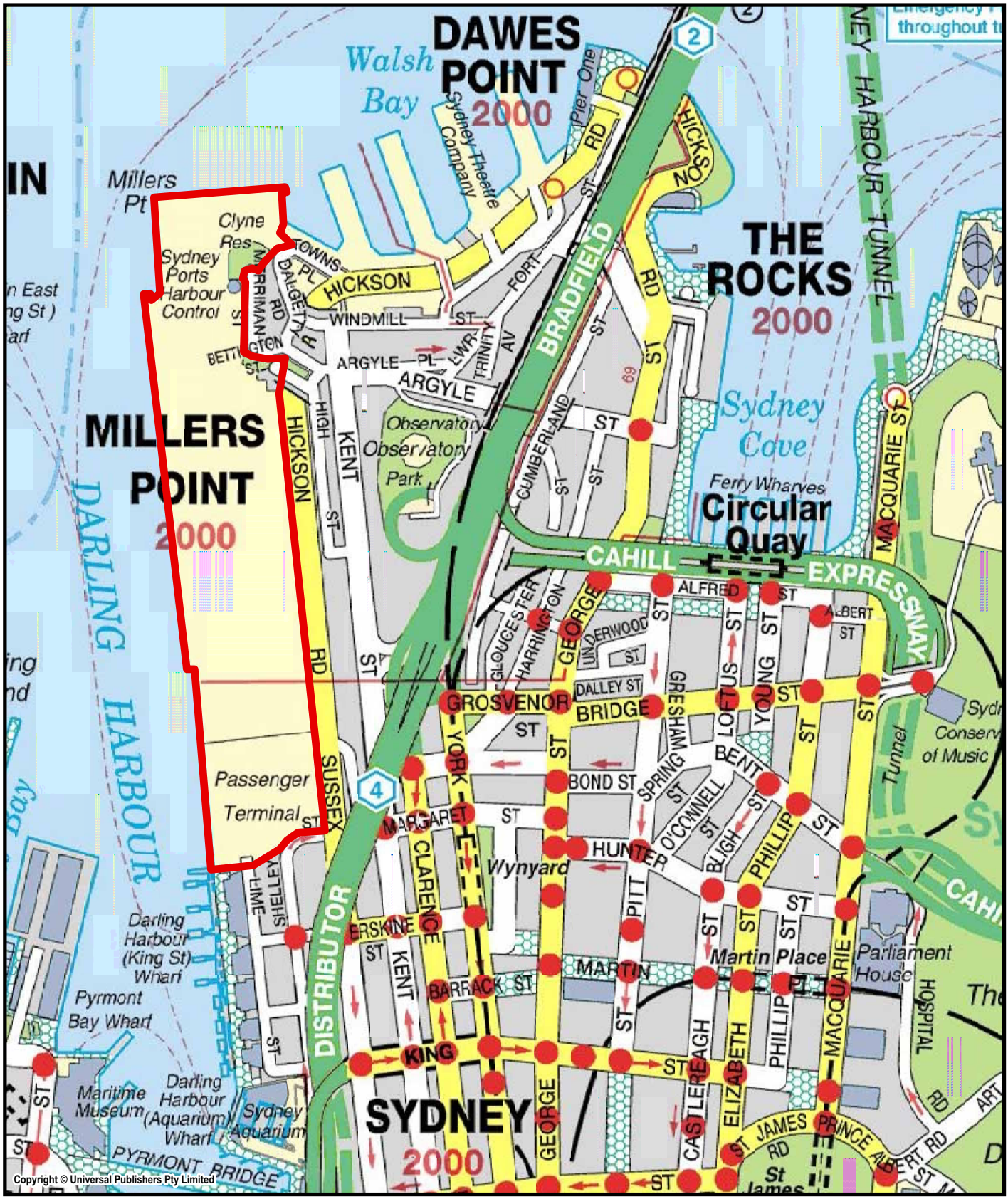
National Environment Protection (Assessment of Site Contamination) Measure, National Environment Protection Council, 1999 (NEPC 1999)

Overarching Remedial Action Plan for The Barangaroo Project Site, Sydney, ERM, June 2010 (ERM 2010)

Site Audit Report and Site Audit Statement, Overarching Remedial Action Plan, Barangaroo, ENVIRON, June 2010 (ENVIRON 2010)

Waste Classification Guidelines: Part 1: Classifying Waste, NSW Department of Environment and Climate Change, July 2008, (DECC 2008)

Figures



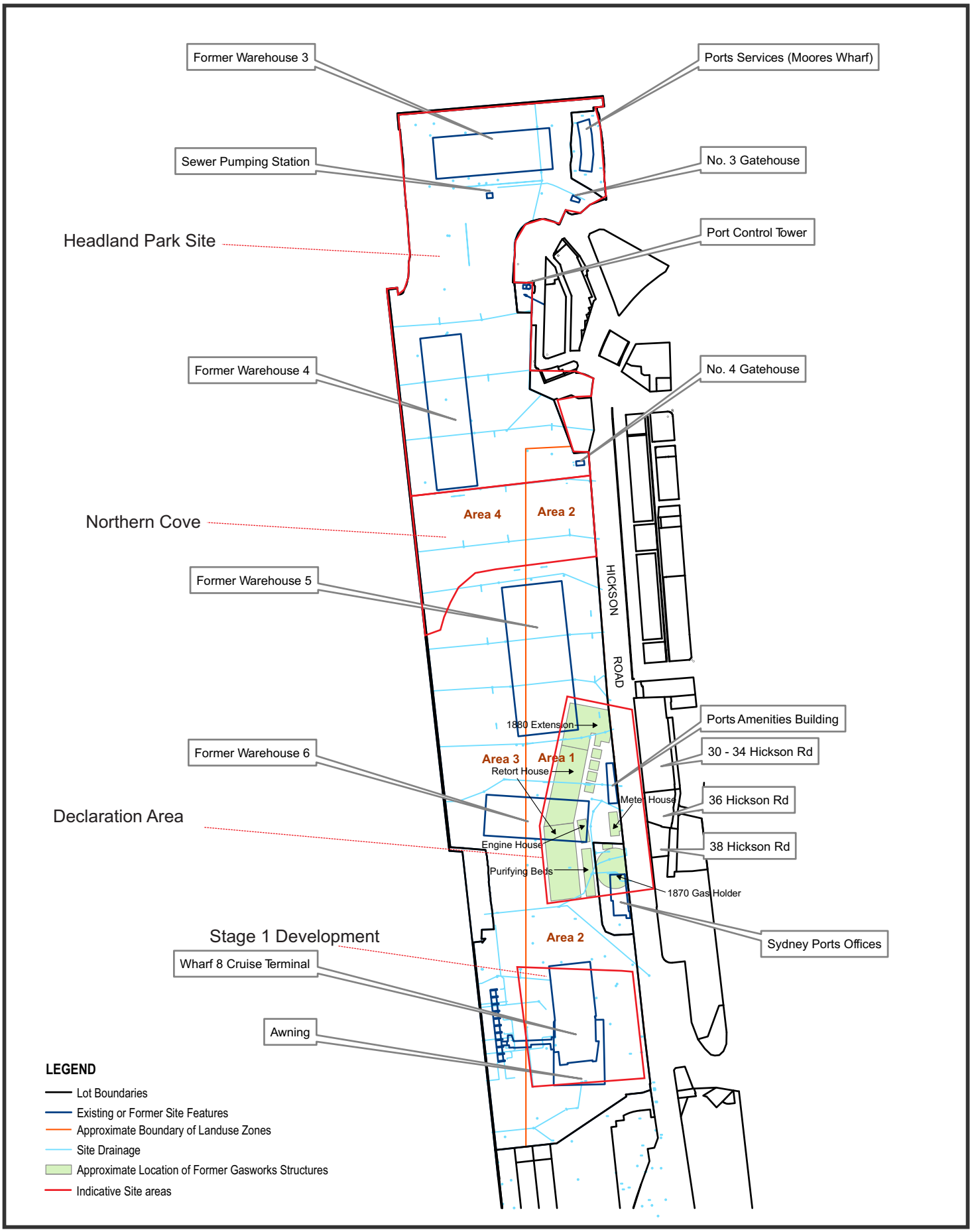
JBS ENVIRONMENTAL

0 250m

Approximate scale

Figure 1 **Location of Barangaroo Site**

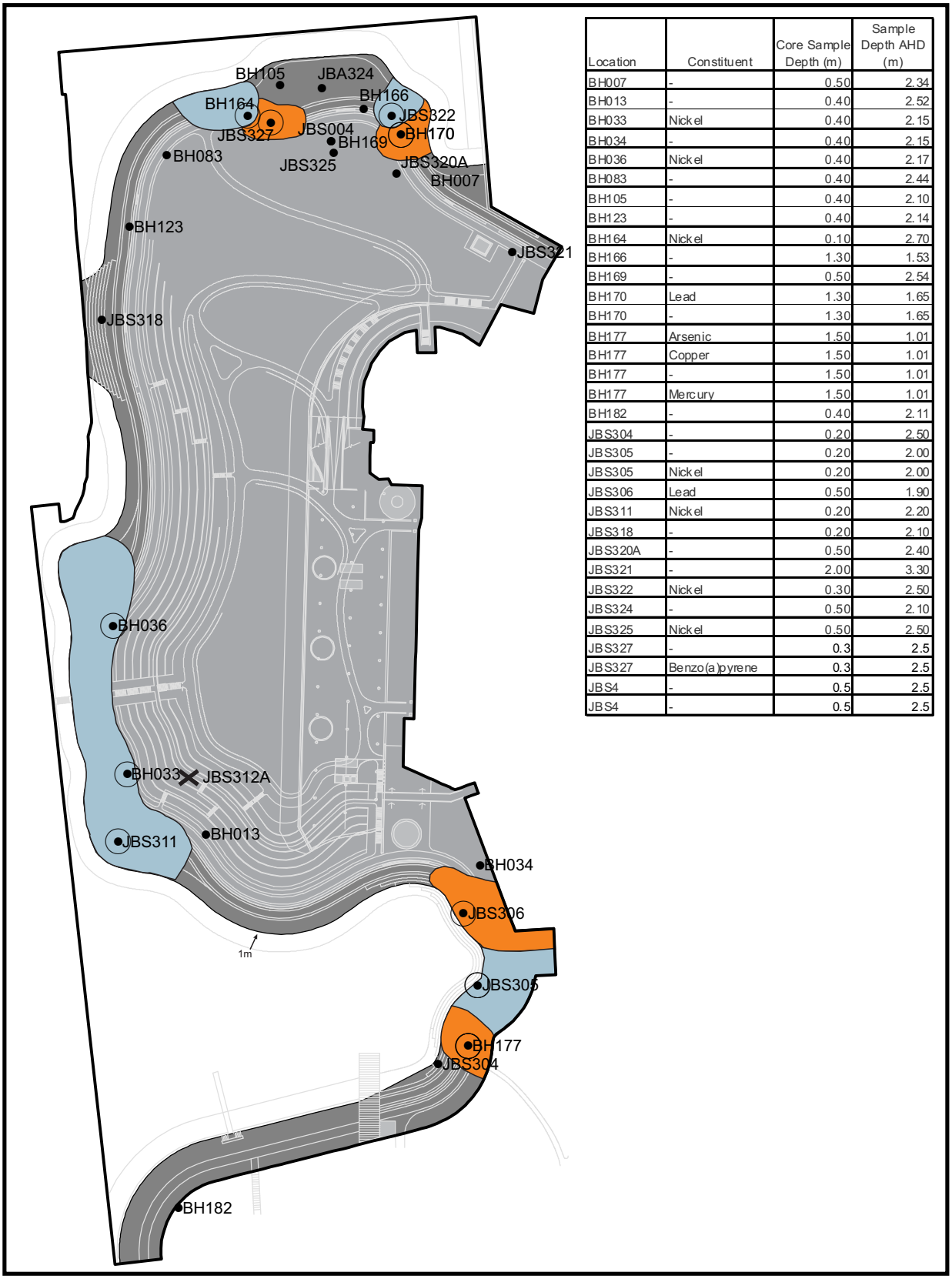
ERM (2008)
Note- All locations shown are approximate only



JBS ENVIRONMENTAL

Figure 2 **Current Site Layout showing Current Site Features**

ERM (2008)
Note- All locations shown are approximate only



Location	Constituent	Core Sample Depth (m)	Sample Depth AHD (m)
BH007	-	0.50	2.34
BH013	-	0.40	2.52
BH033	Nickel	0.40	2.15
BH034	-	0.40	2.15
BH036	Nickel	0.40	2.17
BH083	-	0.40	2.44
BH105	-	0.40	2.10
BH123	-	0.40	2.14
BH164	Nickel	0.10	2.70
BH166	-	1.30	1.53
BH169	-	0.50	2.54
BH170	Lead	1.30	1.65
BH170	-	1.30	1.65
BH177	Arsenic	1.50	1.01
BH177	Copper	1.50	1.01
BH177	-	1.50	1.01
BH177	Mercury	1.50	1.01
BH182	-	0.40	2.11
JBS304	-	0.20	2.50
JBS305	-	0.20	2.00
JBS305	Nickel	0.20	2.00
JBS306	Lead	0.50	1.90
JBS311	Nickel	0.20	2.20
JBS318	-	0.20	2.10
JBS320A	-	0.50	2.40
JBS321	-	2.00	3.30
JBS322	Nickel	0.30	2.50
JBS324	-	0.50	2.10
JBS325	Nickel	0.50	2.50
JBS327	-	0.3	2.5
JBS327	Benzo(a)pyrene	0.3	2.5
JBS4	-	0.5	2.5
JBS4	-	0.5	2.5

0 25 50 100 m
Scale: 1:2,500 (A4)

Datum: MGA94 Zone 56

A4			
D2	Revision	RF	09-2-2011
D1	Original Issue	RF	20-1-2011
Rev	Description	By	Date

Legend:
- Extent of Clay Layer
- Site Boundary
- Material unsuitable to remain in the top 0.5 m of the finished park profile
- Material unsuitable for use as a growing medium
- Tar Impact
- Sample Location
- Exceedance

JBS ENVIRONMENTAL

Figure 3: Areas of Soil Requiring Relocation

Client: Barangaroo Delivery Authority

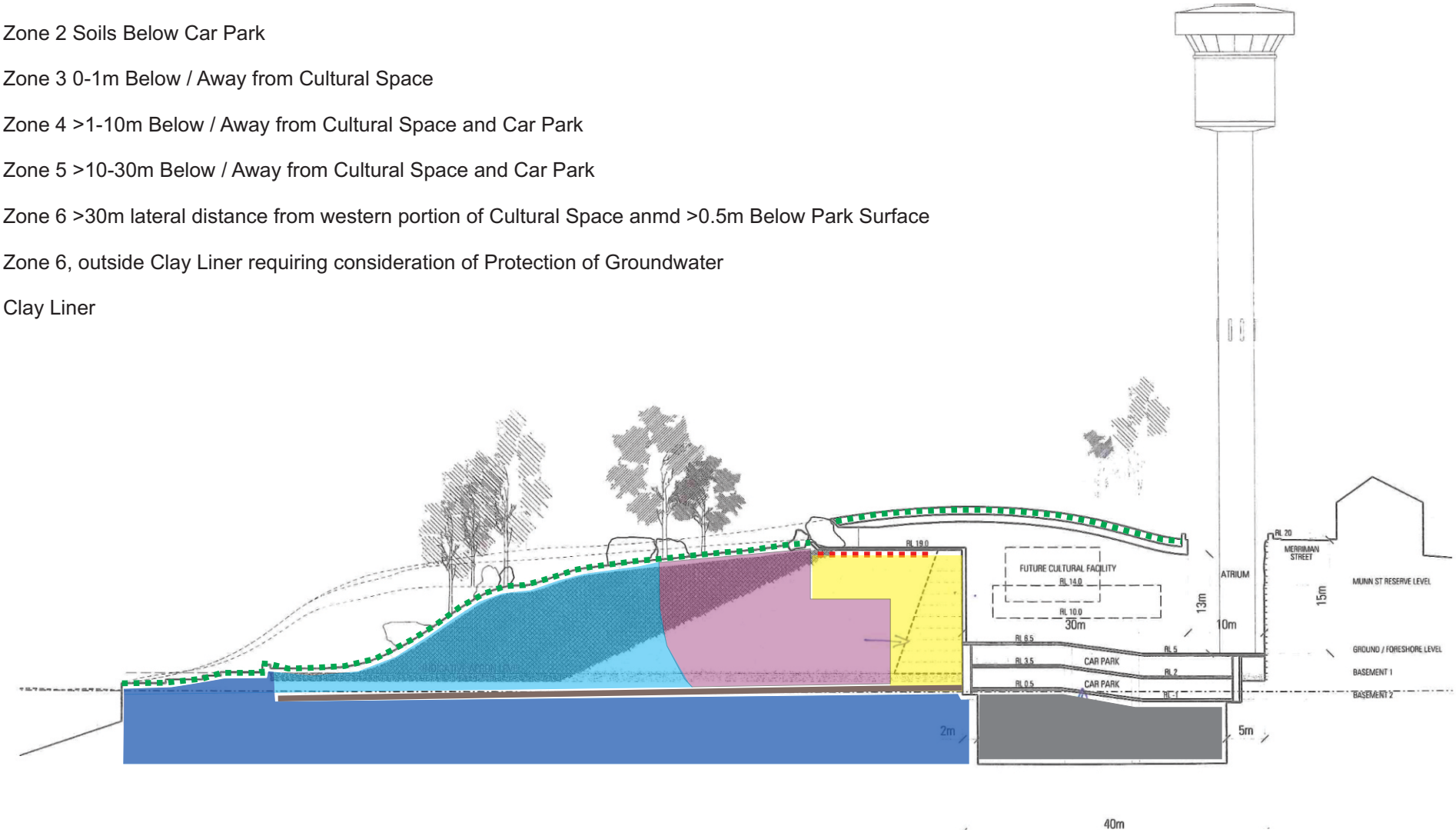
Project: Barangaroo Headland Park

Job No: 41181

File Name: 41181_3 (D2)

LEGEND

- Zone 1 <0.5m below Park Surface (Growing Soils)
- Zone 2 Soils Below Car Park
- Zone 3 0-1m Below / Away from Cultural Space
- Zone 4 >1-10m Below / Away from Cultural Space and Car Park
- Zone 5 >10-30m Below / Away from Cultural Space and Car Park
- Zone 6 >30m lateral distance from western portion of Cultural Space anmd >0.5m Below Park Surface
- Zone 6, outside Clay Liner requiring consideration of Protection of Groundwater
- Clay Liner



JBS ENVIRONMENTAL

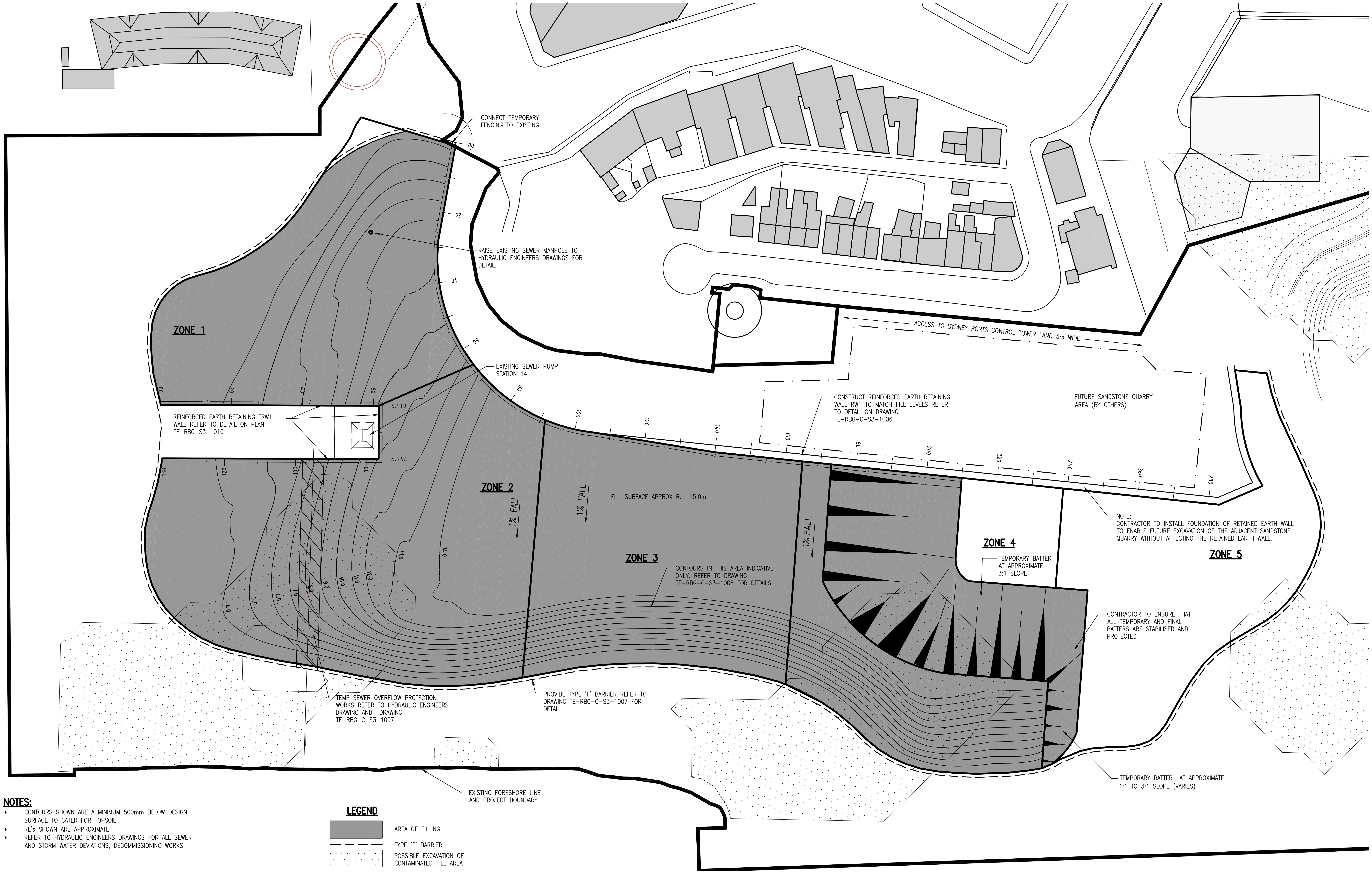
0 50m

Approximate scale

Figure 4 **Proposed Complete Park Section and Soil Zones for Derivation of Human Health Risk Based Soil Criteria**

Johnson Pilton Walker (2010)
Note- All locations shown are approximate only

Appendix A – Seepage Control Plans



NOTES:

- CONTOURS SHOWN ARE A MINIMUM 500mm BELOW DESIGN SURFACE TO CATER FOR TOPSOIL
- RL's SHOWN ARE APPROXIMATE
- REFER TO HYDRAULIC ENGINEERS DRAWINGS FOR ALL SEWER AND STORM WATER DEVIATIONS, DECOMMISSIONING WORKS

LEGEND

- AREA OF FILLING
- TYPE 'F' BARRIER
- POSSIBLE EXCAVATION OF CONTAMINATED FILL AREA
- TEMPORARY FENCING BY CONTRACTOR

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22-Oct-10
2:19 PM

General Notes
Do not scale from drawing. Use marked dimensions.
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Rev	App	Ckd	Revision or reason for issue	Date
A	PD	–	ISSUED FOR TENDER	08.10.10
B	PD	–	REVISED TENDER ISSUE	12.10.10
C	PD	–	REVISED TENDER ISSUE	14.10.10
D	PD	–	REVISED TENDER ISSUE	15.10.10
E	PD	–	REVISED TENDER ISSUE	21.10.10
F	PD	–	REVISED TENDER ISSUE	22.10.10

SCALE 1:500
10 0 10 20m

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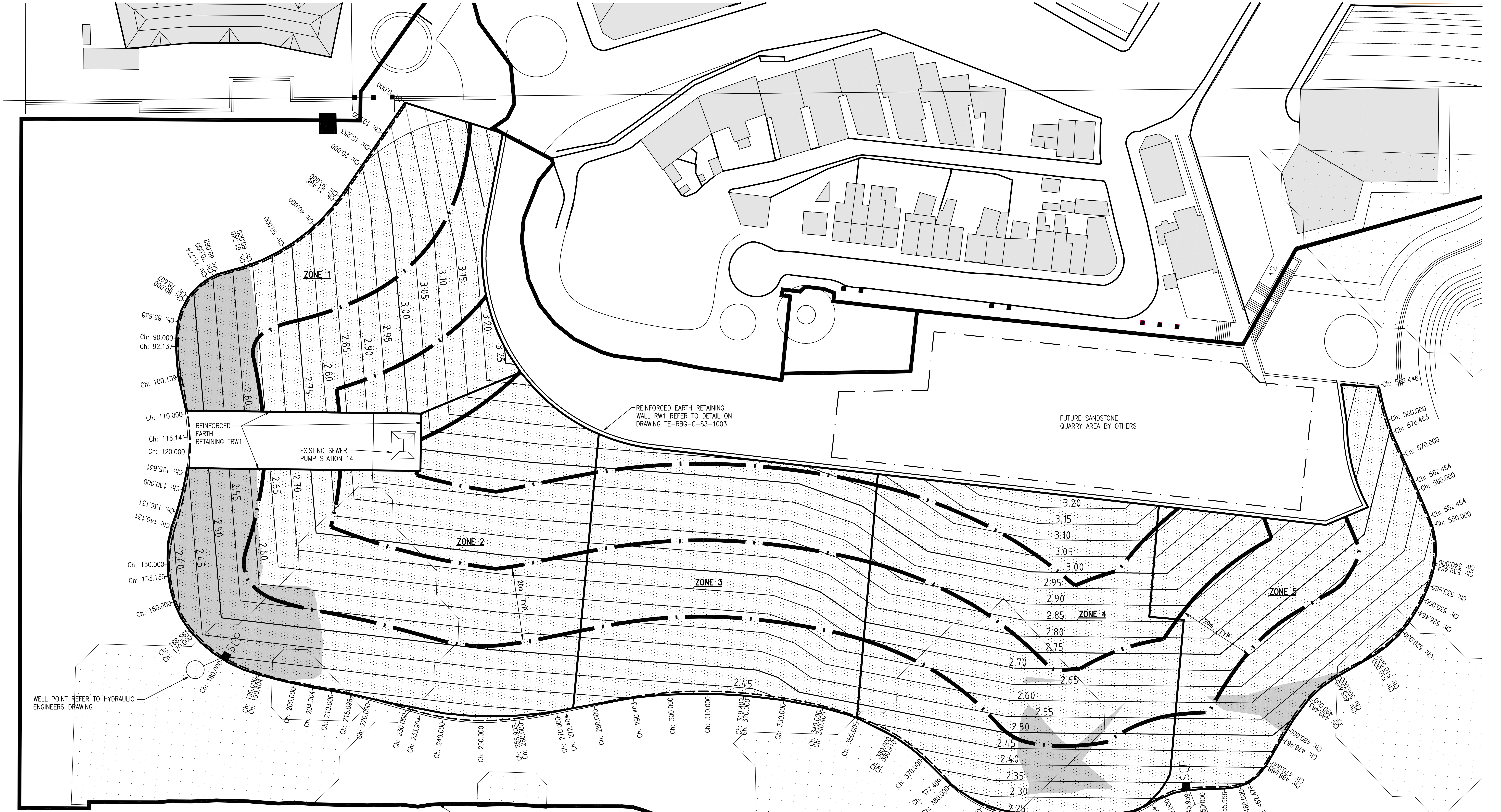
Project Name
BARANGAROO HEADLAND PARK

BARANGAROO SYDNEY AUSTRALIA

HEADLAND PARK WORKS
BULK EARTHWORKS PLAN
PLACEMENT OF FIRST 150 000m^3

Project Number: 10400
Documentation Stage: TENDER
Drawing Number: TE-RBG-C-S3-1001
Revision: F



LEGEND

DRAINAGE LEVELING LAYER SHOWING CONTOUR LEVELS

POSSIBLE EXCAVATION OF CONTAMINATED FILL AREA

■ SCP — SEEPAGE COLLECTION PIT 900x900x2m DEEP FROM INVERT OF SEEPAGE COLLECTION DRAIN. WALL THICKNESS 250mm WITH N16 REINFORCEMENT AT 150 C/C EACH FACE EACH WAY, 40MPa CONCRETE WITH 70 COVER. PROVIDE HEAVY DUTY GATIC COVER TO SUIT.

CONCRETE SHEAR KEY REFER TO DETAIL ON TE-RBG-C-S3-1005

SEEPAGE COLLECTION DRAIN REFER TO DRAWING TE-RBG-C-S3-1005

AREA OF LEVELING LAYER CUT

FOR BULK EARTHWORKS SURFACE LEVELS REFER TO DRAWING TE-RBG-C-S3-1001

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22-Oct-10
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D	PD	–	REVISED TENDER ISSUE	15.10.10
E	PD	–	REVISED TENDER ISSUE	21.10.10
F	PD	–	REVISED TENDER ISSUE	22.10.10

SCALE @ A1

SCALE 1:500
10 0 10 20m

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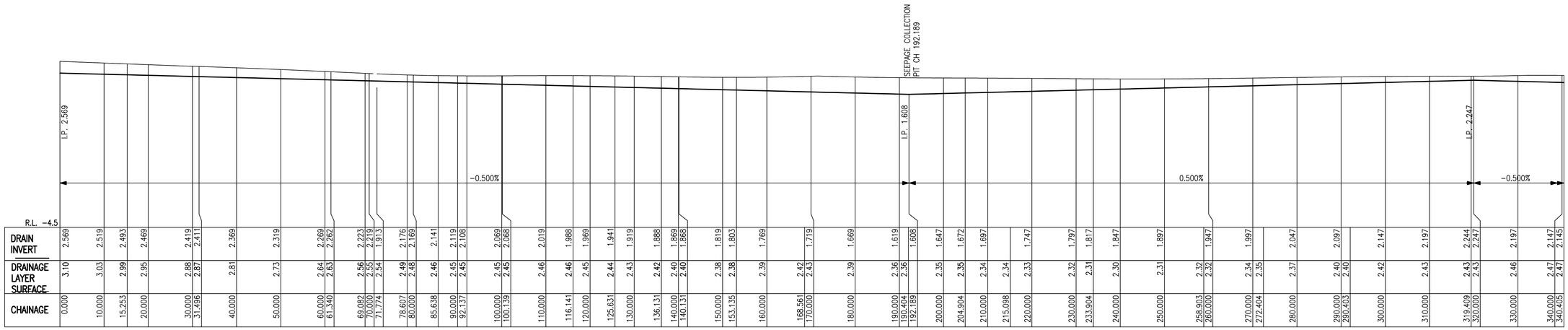
Project Name
BARANGAROO HEADLAND PARK

BARANGAROO SYDNEY AUSTRALIA

HEADLAND PARKS WORKS
DRAINAGE LEVELING LAYER GENERAL ARRANGMENT PLAN

Project Number: 10400
Documentation Stage: TENDER
Drawing Number: TE-RBG-C-S3-1004
Revision: F



DRAIN INVERT	2.569	2.519	2.493	2.469	2.419	2.411	2.369	2.319	2.269	2.262
DRAINAGE LAYER SURFACE	3.10	3.03	2.99	2.95	2.88	2.87	2.81	2.73	2.64	2.63
CHAINAGE	0.000	10.000	15.253	20.000	30.000	31.496	40.000	50.000	60.000	61.340

DRAIN INVERT	2.223	2.219	1.913	2.176	2.169	2.141	2.119	2.108	2.069	2.068
DRAINAGE LAYER SURFACE	2.56	2.55	2.54	2.49	2.48	2.46	2.45	2.45	2.45	2.45
CHAINAGE	69.082	70.000	71.774	78.607	80.000	85.638	90.000	92.137	100.000	100.139

DRAIN INVERT	2.019	1.988	1.969	1.941	1.919	1.888	1.869	1.868	1.819	1.803
DRAINAGE LAYER SURFACE	2.46	2.46	2.45	2.44	2.43	2.42	2.40	2.40	2.38	2.38
CHAINAGE	110.000	116.141	120.000	125.631	130.000	136.131	140.000	140.131	150.000	153.135

DRAIN INVERT	1.769		1.719	1.669	1.619		1.608	1.647	1.672	1.697
DRAINAGE LAYER SURFACE	2.39	2.42	2.43	2.39	2.36	2.36		2.35	2.35	2.34
CHAINAGE	160.000	168.561	170.000	180.000	190.000	190.404	192.189	200.000	204.904	210.000

DRAIN INVERT		1.747	1.797	1.817	1.847	1.897		1.947	1.997	
DRAINAGE LAYER SURFACE	2.34	2.33	2.32	2.31	2.30	2.31	2.32	2.32	2.34	2.35
CHAINAGE	215.098	220.000	230.000	233.904	240.000	250.000	258.903	260.000	270.000	272.404

DRAIN INVERT	2.047	2.097		2.147	2.197	2.244	2.247	2.197	2.147	2.145
DRAINAGE LAYER SURFACE	2.37	2.40	2.40	2.42	2.43	2.43	2.43	2.46	2.47	2.47
CHAINAGE	280.000	290.000	290.403	300.000	310.000	319.409	320.000	330.000	340.000	340.405

SEEPAGE COLLECTION DRAINAGE LONG SECTION (1) Ch 0.000 to Ch 340.405

SCALES: HORIZONTAL 1:500 VERTICAL 1:100

DRAIN INVERT	2.145	2.097	2.047	2.042	1.997	1.960	1.947	1.897		1.847
DRAINAGE LAYER SURFACE	2.47	2.45	2.43	2.42	2.38	2.33	2.31	2.26	2.25	2.23
CHAINAGE	340.405	350.000	360.000	360.910	370.000	377.409	380.000	390.000	395.375	400.000

DRAIN INVERT	1.797	1.763	1.747	1.712	1.697	1.667	1.647	1.617	1.597	1.586
DRAINAGE LAYER SURFACE	2.22	2.22	2.23	2.24	2.25	2.28	2.31	2.33	2.33	
CHAINAGE	410.000	416.846	420.000	426.950	430.000	435.954	440.000	445.959	450.000	452.194

DRAIN INVERT		1.625	1.637	1.670	1.675	1.710	1.725	1.772	1.775	1.817
DRAINAGE LAYER SURFACE	2.33	2.34	2.35	2.41	2.42	2.48	2.49	2.51	2.51	2.51
CHAINAGE	455.956	460.000	462.476	468.968	470.000	476.967	480.000	489.463	490.000	498.465

DRAIN INVERT	1.825	1.875		1.925	1.957	1.975	1.995	2.022	2.025	2.075
DRAINAGE LAYER SURFACE	2.51	2.49	2.49	2.49	2.51	2.52	2.54	2.57	2.57	2.60
CHAINAGE	500.000	510.000	510.960	520.000	526.464	530.000	533.965	539.464	540.000	550.000

DRAIN INVERT	2.087	2.125	2.137	2.175	2.207	2.225	2.272
DRAINAGE LAYER SURFACE	2.61	2.65	2.67	2.71	2.74	2.76	2.80
CHAINAGE	552.464	560.000	562.464	570.000	576.463	580.000	589.446

SEEPAGE COLLECTION DRAINAGE LONG SECTION (1) Ch 340.405 to Ch 589.446

SCALES: HORIZONTAL 1:500 VERTICAL 1:100

CONCRETE SHEAR KEY CONSTRUCTION JOINT DETAIL (C.J.)

N.T.S.

NOTE JOINTS TO BE SPACED AT 15m MAX cts

SEEPAGE COLLECTION DRAIN TYPICAL SECTION

N.T.S

CONCRETE SHEAR KEY DETAIL

N.T.S.

TE-RBG-C-S3-1005.DWG
22-Oct-10
2:26 PM

General Notes

Do not scale from drawing. Use marked dimensions.
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Rev	App	Ckd	Revision or reason for issue	Date
A	PD	–	ISSUED FOR TENDER	08.10.2010
B	PD	–	REVISED TENDER ISSUE	12.10.10
C	PD	–	REVISED TENDER ISSUE	14.10.10
D	PD	–	REVISED TENDER ISSUE	15.10.10
E	PD	–	REVISED TENDER ISSUE	21.10.10
F	PD	–	REVISED TENDER ISSUE	22.10.10

SCALE @ A1

SCALE 1:100
1 0 1 2 3 4m
SCALE 1:500
10 0 10 20m

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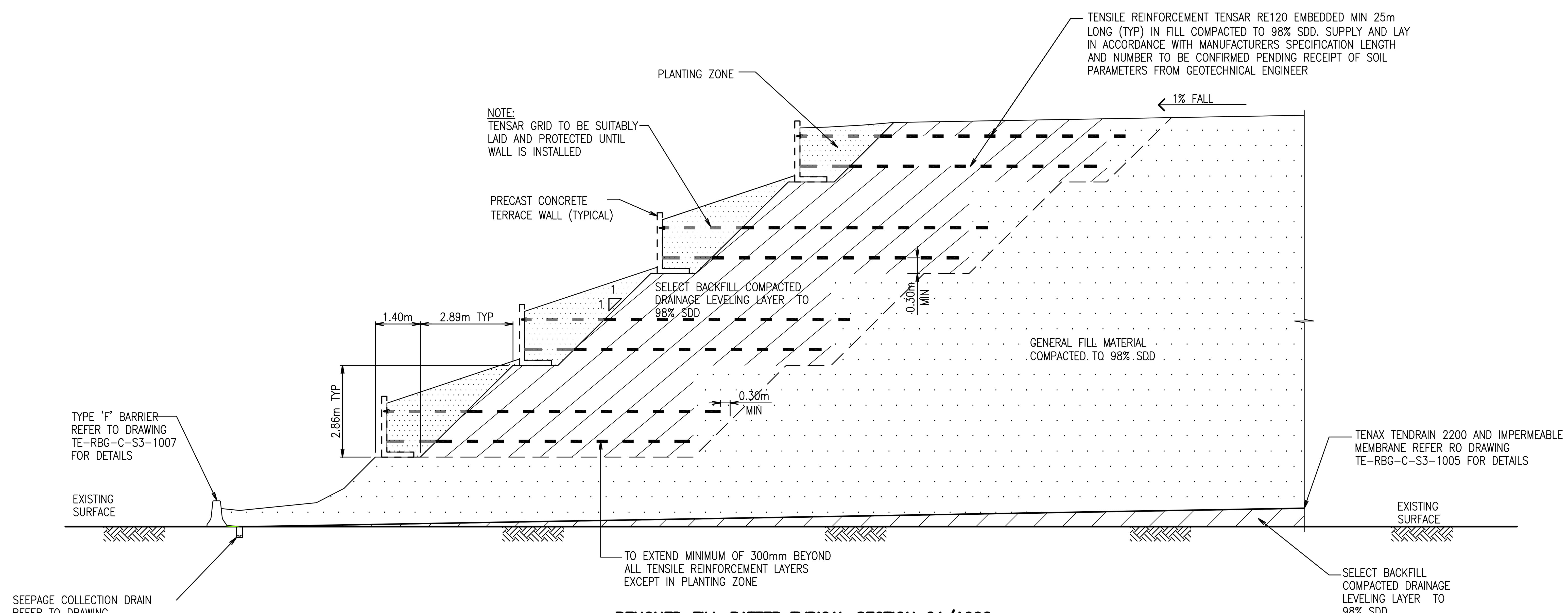
Project Name

BARANGAROO HEADLAND PARK

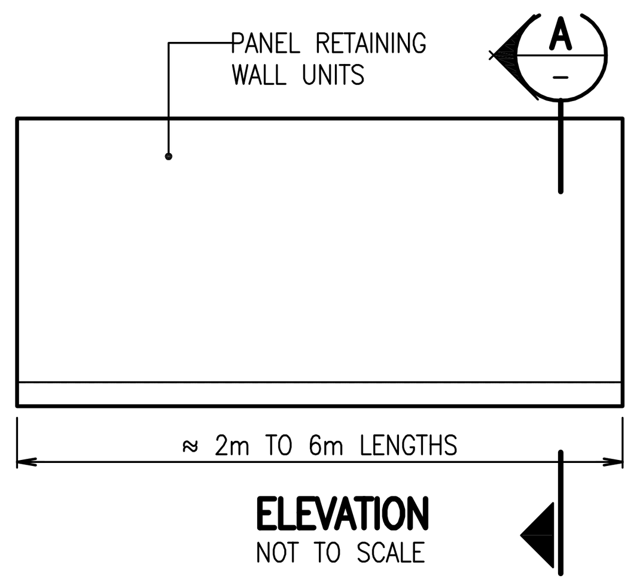
NSW GOVERNMENT
BARANGAROO SYDNEY AUSTRALIA

HEADLAND PARK WORKS
SEEPAGE COLLECTION DRAIN
LONGSECTION & TYPICAL SECTION
PLAN

Project Number	Documentation Stage
10400	TENDER
Drawing Number	**Revision**
TE-RBG-C-S3-1005	F

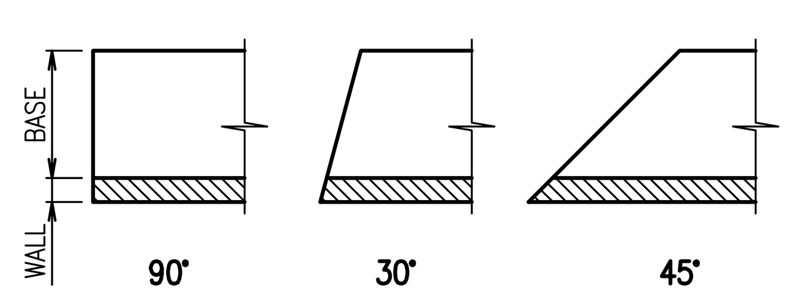


BENCHED FILL BATTER TYPICAL SECTION C1/1002
N.T.S.

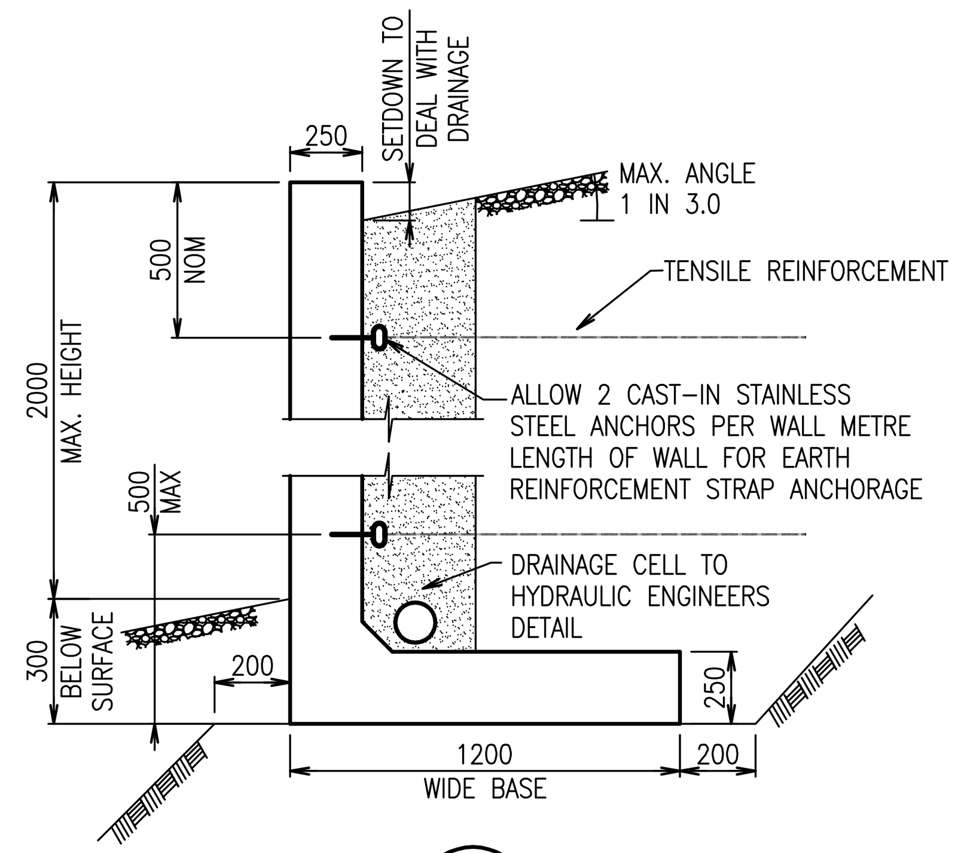


ELEVATION
NOT TO SCALE

PANEL END CONDITIONS



PANEL PART PLANS
NOT TO SCALE

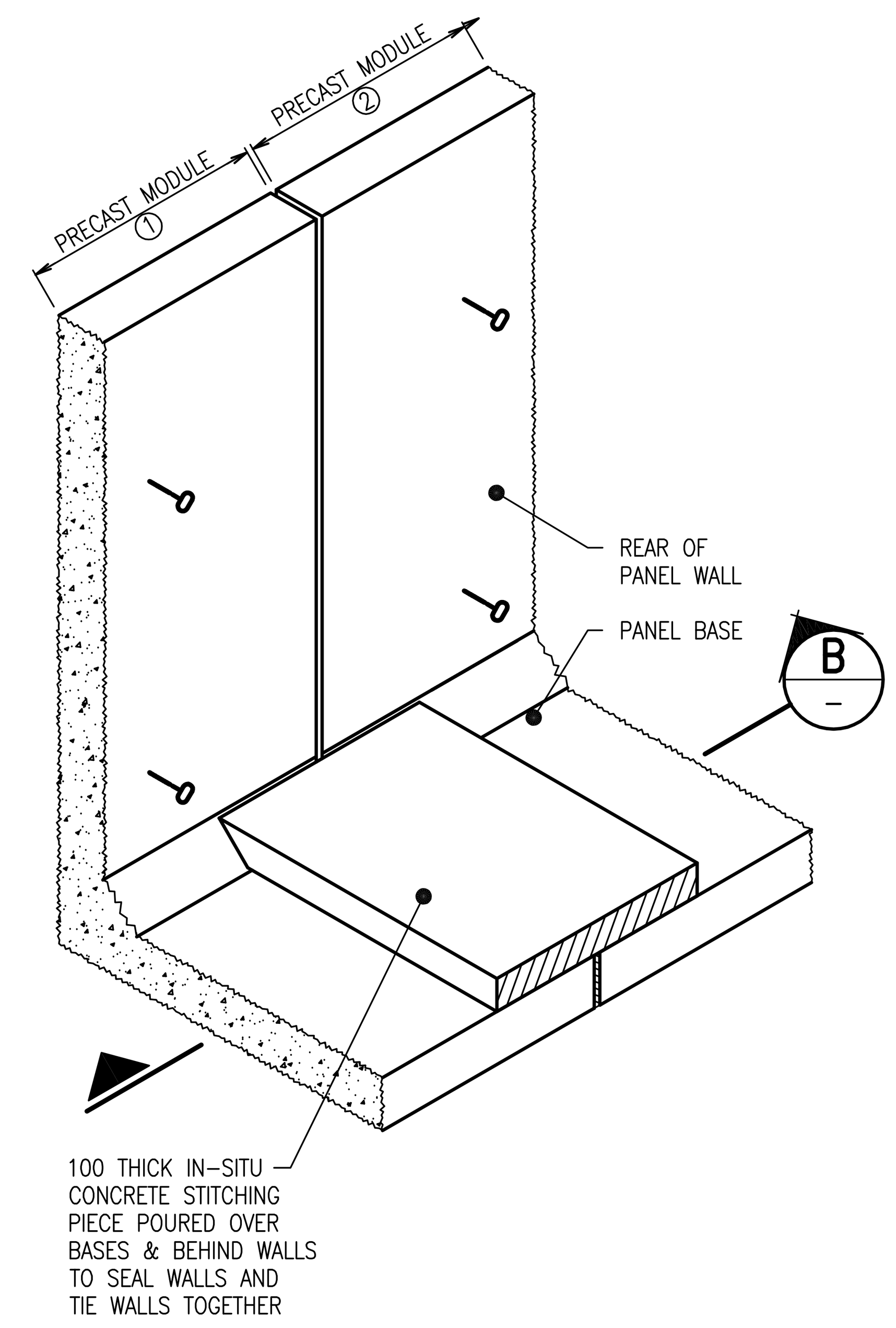


SECTION A
SCALE 1:20

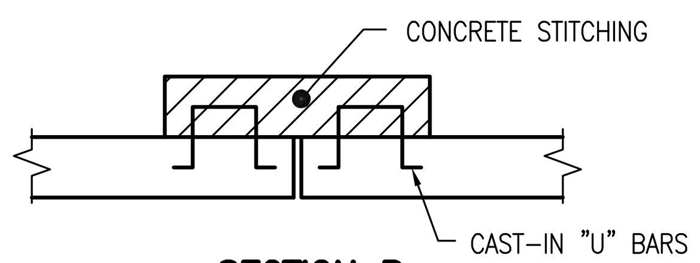
PROPOSED TERRACE WALL DETAIL

NOTES ON WALL DETAILS:

1. REINFORCEMENT – ALLOW 120kg/m³ OF REINFORCEMENT.
2. CONCRETE TO BE 40MPa, COVER TO BE 50mm
3. ALLOW FOR 3% BLACK OXIDE TINT TO CONCRETE.
4. ALLOW FOR EXPOSED AGGREGATE FINISH TO EXPOSED FACE OF PRECAST ONLY.
5. ALLOW FOR 25mm ADDITIONAL CONCRETE THICKNESS TO ALL VERTICAL PANEL FACES (IN ADDITION TO 250mm STRUCTURAL THICKNESS). ALSO ALLOW FOR PATTERN TO BE FORMED IN THIS 25mm ZONE TO FUTURE ARCHITECTURAL DETAIL
6. ALLOW FOR CONNECTION DETAIL BETWEEN ADJACENT PANELS AS SHOWN IN "PANEL CONNECTION DETAIL" SKETCH.
7. ALLOW FOR 3 DIFFERENT MODULE SHAPES IN 30°, 45°, AND 90° TO ACCOMMODATE DIFFERENT GEOMETRIES.
8. WALL DESIGN TO BE CONFIRMED PENDING RECEIPT OF GEOTECHNICAL DESIGN PARAMETERS, PLANTING MASSES AND PLANTING LAYOUTS



PANEL CONNECTION DETAIL
SCALE 1:20



SECTION B
NOT TO SCALE

TE-RBG-C-S3-1008.DWG
22-Oct-10
2:16 PM

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Rev	App	Ckd	Revision or reason for issue	Date
A	PD	–	Preliminary Issue	08.10.10
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C	PD	–	REVISED TENDER ISSUE	14.10.10
D	PD	–	REVISED TENDER ISSUE	15.10.10
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F	PD	–	REVISED TENDER ISSUE	22.10.10

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Project Name
BARANGAROO HEADLAND PARK

BARANGAROO SYDNEY AUSTRALIA

HEADLAND PARK WORKS
BENCHED FILL BATTER
TYPICAL SECTION

Project Number: 10400
Documentation Stage: TENDER
Drawing Number: TE-RBG-C-S3-1008
Revision: F

Appendix B – Site Acceptance Criteria for Validation

Table 6.3: Summary of Risk Based Criteria (Site Specific Human Health Based Risk Criteria Unless Otherwise Specified) – Refer to Figure 14 for location of Zones

Constituent	Zone 1 Risk Based Criteria (mg/kg)			Zone 2 Risk Based Criteria (mg/kg)		Zone 3 Risk Based Criteria (mg/kg)	Zone 4 Risk Based Criteria (mg/kg)	Zone 5 Risk Based Criteria (mg/kg)	Zone 6 Risk Based Criteria (mg/kg)					Irrigation Water Risk Based Criteria (mg/L)
		Outside Drainage Control Area		Saturated Zone Soils					Saturated Zone Soils		Unsaturated Soil Zones			
	Soils within Drainage Control Area	Sourced from Headland Park	Sourced from Barangaroo Central and South	Sourced from Headland Park	Sourced from Barangaroo Central and South				Sourced from Headland Park	Sourced from Barangaroo Central and South	Sourced from Headland Park	Sourced from Barangaroo Central and South	Soil In Clay Liner[6]	
Ammonia	5100			>MAX		580	750	2500	>MAX		>MAX			72
Arsenic	27[4]	92[5]	102[5]	23[5]	26[5]	>MAX	>MAX	>MAX	23[5]	26[5]	92[5]	102[5]	>MAX	0.93[7]
Cadmium	7.7			>MAX		>MAX	>MAX	>MAX	>MAX					0.077
Chromium	450			>MAX		>MAX	>MAX	>MAX	>MAX					0.29
Copper	152[4]	124[5]	87[5]	31[5]	22[5]	-	-	-	31[5]	22[5]	124[5]	87[5]	>MAX	4.3[7]
Lead	130			157[5]	129[5]	>MAX	>MAX	>MAX	157[5]	129[5]	129[5]	629[5]	>MAX	1.1[7]
Mercury	2.9[4]	0.8[5]	2.9[4]	0.2[5]	7[5]	-	-	-	0.2[5]	7[5]	0.8[5]	27[5]	>MAX	0.056[7]
Nickel	67[4]			1061[5]	700[5]	>MAX	>MAX	>MAX	1061[5]	700[5]	4242[5]	2800[5]	>MAX	1.0[7]
Zinc	430[4]	395[5]	180[5]	99[5]	45[5]	-	-	-	99[5]	45[5]	395[5]	180[5]	>MAX	6.9[7]
Cyanide	0.5[4]	<LOR[5]	<LOR[5]	<LOR[5]		950	>MAX	2500	<LOR[5]		<LOR[5]		3400	0.051
Benzene	1.0[4]			1.3		0.1	0.1[1]	0.3[1]	1.3[5]		5.4[5]		2.3	0.023
Toluene	1.4[4]			0.7[5]		180	260[1]	690[8]	0.7[5]		2.9[5]		690	0.02[7]
Ethylbenzene	3.1[4]	<LOR[5]	<LOR[5]	<LOR[5]		25	36[1]	80[8]	<LOR[5]		<LOR[5]		80	0.023[7]
Xylenes	14[4]	1.9[5]	1.9[5]	<LOR[5]		64	86[1]	180[8]	<LOR[5]		1.9[5]		180	0.12[7]
1,2,4-trimethylbenzene	21			44		0.8	1.2[1]	46[8]	46		46		46	0.51
TPH C_6-C_9	65[4]			65[9]		100	130[1]	430[1]	65[5]		261[5]		3500	150[7]
TPH C_{10}-C_{14}	1000[4]			1165.5[9]		107.5	1391	3800[8]	1165.5[10]		4661.5[10]		3800	5.6[11]
TPH C_{15}-C_{28}				714.5[2]		<MAX	<MAX	<MAX	764.5[5]		2857[5]		<MAX	1.15[11]
TPH C_{29}-C_{36}														
Acenapthene	-	279[5]	888[5]	70[5]	222[5]	-	-	-	70[5]	222[5]	279[5]	888[5]	-	0.00066[7]
Acenaphthylene	-	20[5]	12[5]	5[5]	2.9[5]	-	-	-	5[5]	2.9[5]	20[5]	12[5]	-	-
Anthracene	-	167[5]	233[5]	42[5]	58[5]	-	-	-	42[5]	58[5]	167[5]	233[5]	-	-
Benz(a)anthracene	31			95		39	73	>MAX	>MAX					0.0043
Benzo(a)pyrene	3.1			810		810	810	810	>MAX					0.0015
Benzo(b)fluoranthene	31			>MAX		>MAX	>MAX	>MAX	>MAX					0.26[7]
Benzo(k)fluoranthene	31			>MAX		>MAX	>MAX	>MAX	>MAX					0.15[7]
Chrysene	310			>MAX		>MAX	>MAX	>MAX	>MAX					0.18[7]
Dibenz(a,h)anthracene	3.1			>MAX		>MAX	>MAX	>MAX	>MAX					0.0011[7]
Dibenzofuran	>MAX			>MAX		>MAX	>MAX	>MAX	>MAX					21[7]
Fluoranthene	670			35[5]	23[5]	>MAX	>MAX	>MAX	35[5]	23[5]	140[5]	90[5]	>MAX	0.91
Fluorene	30[4]			2.4[5]	3.2[5]	>MAX	>MAX	>MAX	2.4[5]	3.2[5]	10[5]	13[5]	>MAX	8.0[11]
Indeno(1,2,3-c,d)pyrene	31			>MAX		>MAX	>MAX	>MAX	<MAX		>MAX		>MAX	0.0083
2-methylnaphthalene	2600			1100		610	940	2500[8]	2500		2500		2500	9.6
Naphthalene	880	833[5]	104[5]	208[5]	26[5]	12	17[1]	73[1]	208[5]	26[5]	833[5]	104[5]	>MAX	3.3
Phenanthrene	-			17[5]	6[5]	-	-	-	17[5]	6[5]	67[5]	24[5]	-	-
Pyrene	14[4]			12[5]	4.8[5]	>MAX	>MAX	>MAX	12[5]	4.8[5]	48[5]	19[5]	>MAX	3.3[11]
Phenol	>MAX			1.2[5]		>MAX	>MAX	>MAX	1.2[5]		4.9[5]		>MAX	0.25[11]
2,4-dimethylphenol	>MAX	4.9[5]	4.9[5]	<LOR[5]		>MAX	>MAX	>MAX	<LOR[5]		<LOR[5]		>MAX	42
Cresols	3100	3.9[5]	3.9[5]	1.0[5]		>MAX	>MAX	>MAX	1.0[5]		3.9[5]		>MAX	150

Note:
1. Zone 6 criteria may be applied for these constituents where soils are >10m from Cultural Space.
2. Concentration based on risk based criteria from TPH $C_{>16}$ aromatic concentration only, risk based criterion TPH $C_{>16}$ aliphatic concentration >MAX for Ecological Protection of Surface Water
3. Concentration based on risk based criteria from TPH $C_{>16}$ aromatic concentration only, risk based criterion TPH $C_{>16}$ aliphatic concentration >MAX for Ecological Protection of Surface Water
4. Risk based criteria derived for Ecological Protection of Potential Phytotoxicity Effects in 'Growing Zone' soils
5 Risk based criteria derived for Ecological Protection of Surface Water
6 Soil within drainage control area
7 Risk based criteria for Ecological Protection of Potential Phytotoxicity Effects from Irrigation Water
8 Zone 6 criteria applied for constituent
9 Concentration based on risk based criteria from TPH $C_{>6-9}$ aliphatic concentration only, for Ecological Protection of Surface Water
10 Concentration based on risk based criteria from TPH C_{10-14} aromatic and aromatic concentrations
11 Risk based criteria for Human Health Protection from Irrigation Water
Zone 1 – 0-0.5m below open area of Park
Zone 2 – Below Car Park
Zone 3 – 0-1m away from 'Cultural Space'
Zone 4 – >1-10m below / away from 'Cultural Space' and 0-10m away from Car Park
Zone 5 – >10-30m below / away from 'Cultural Space' and away from Car Park
Zone 6 – >30m lateral distance from western portion of 'Cultural Space' and >0.5m below Park surface
<SOL - Above solubility limit
<MAX – risk based criteria exceeds maximum detected concentration on site

Document Status

Rev No.	Author(s)	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Matthew Bennett Andrew Lau	Matthew Bennett	Draft for Client Review	-	04/02/2011
B	Matthew Bennett Andrew Lau	Matthew Bennett	Draft for Client Review		08/02/2011
C	Matthew Bennett Sumi Dorairaj	Sumi Dorairaj	Draft for Client Review		09/02/2011

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