# Construction Soil and Water Management Plan

*(Appendix B6)*

## NorthConnex & M2 Integration Project

**Lend Lease Bouygues Joint Venture**

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<th>Name</th>
<th>Position</th>
<th>Date</th>
<th>Signed/Authorised</th>
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<tr>
<td>Originator(s)</td>
<td>Mark J Turner</td>
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<tr>
<td>Review</td>
<td>Grant Sainsbery</td>
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<tr>
<td>Authorised</td>
<td>Rob Ioffrida</td>
<td>28/5/15</td>
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**Revision:** 06
# Construction Soil and Water Management Plan (Appendix B6)

## Document Control

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<tr>
<td>General</td>
<td>Construction Soil and Water Management Sub Plan (Appendix B6)</td>
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## Revision History

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<td>A (00)</td>
<td>19/11/14</td>
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<td>N/A</td>
</tr>
</tbody>
</table>
# Table of Content:

1. **Introduction** .......................................................................................................................... 1  
   1.1 Context ................................................................................................................................... 1  

2. **Purpose and objectives** ............................................................................................................. 3  
   2.1 Purpose .................................................................................................................................. 3  
   2.2 Objectives .............................................................................................................................. 3  

3. **Environmental requirements** .................................................................................................. 4  
   3.1 Relevant legislation and guidelines ......................................................................................... 4  
   3.1.1 Legislation .......................................................................................................................... 4  
   3.1.2 Guidelines and standards ..................................................................................................... 4  
   3.1.3 ISCA Requirements ............................................................................................................ 5  
   3.2 Minister's Conditions of Approval ......................................................................................... 5  
   3.3 Revised Environmental Management Measures ........................................................................ 9  

4. **Existing environment** ............................................................................................................... 13  
   4.1 Topography and soil characteristics ....................................................................................... 13  
   4.2 Acid Sulphate Soils ................................................................................................................ 13  
   4.3 Surface water .......................................................................................................................... 14  
   4.4 Groundwater .......................................................................................................................... 14  
   4.5 Contamination ....................................................................................................................... 15  
   4.6 Rainfall ................................................................................................................................... 17  
   4.7 Rainfall erosivity factor ......................................................................................................... 17  
   4.8 Flooding .................................................................................................................................. 17  

5. **Environmental aspects and impacts** ...................................................................................... 18  
   5.1 Construction activities ............................................................................................................ 18  

6. **Environmental control measures** ........................................................................................... 23  

7. **Compliance management** ....................................................................................................... 33  
   7.1 Roles and responsibilities ....................................................................................................... 33  
   7.2 Training .................................................................................................................................. 33  
   7.3 Monitoring and inspection ..................................................................................................... 33  
   7.4 Water discharge ..................................................................................................................... 34  
   7.5 Auditing .................................................................................................................................. 34  
   7.6 Reporting ............................................................................................................................... 34  
   7.7 Non-conformances ................................................................................................................ 34  

8. **Review and improvement** ....................................................................................................... 35  
   8.1 Continuous improvement ....................................................................................................... 35  
   8.2 CSWMP update and amendment ............................................................................................ 35
Appendix A Primary Erosion and Sediment Control Plan .................................................................36
Appendix B Unexpected Discovery of Contaminated Land Procedure ............................................37
Appendix C Technical Guideline Environmental Management of Construction Site Dewatering38
Appendix D Water Quality Plan and Monitoring Program ...............................................................39
Appendix E Stockpile Management Protocol .................................................................................40
Appendix F Acid Sulfate Soil Procedure .........................................................................................41
## Glossary / Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ASS</td>
<td>Acid Sulfate Soils</td>
</tr>
<tr>
<td>CEMP</td>
<td>Construction Environmental Management Plan</td>
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<tr>
<td>CoA</td>
<td>Condition of Approval</td>
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<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
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<tr>
<td>EEC</td>
<td>Endangered Ecological Community</td>
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<tr>
<td>EMS</td>
<td>Environmental Management System</td>
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<tr>
<td>EPA</td>
<td>Environment Protection Authority</td>
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<tr>
<td>EP&amp;A Act</td>
<td><em>Environmental Planning and Assessment Act 1979</em></td>
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<tr>
<td>EPL</td>
<td>Environment Protection Licence</td>
</tr>
<tr>
<td>ERSED</td>
<td>Erosion and Sediment</td>
</tr>
<tr>
<td>EWMS</td>
<td>Environmental Work Method Statements</td>
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<td>GMR</td>
<td>Global Minimum Requirements (Lendlease)</td>
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<tr>
<td>NOW</td>
<td>NSW Office of Water</td>
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</table>
| OEH          | Office of Environment and Heritage  
(formally known as DEC and DECCW) |
| PESCP        | Progressive Erosion and Sediment Control Plan |
| POEO Act     | Protection of the Environmental Operations Act |
| SPIR         | Submission and Preferred Infrastructure Report |
| SSI          | State Significant Infrastructure |
| CSWMP        | Construction Soil and Water Management Plan |
| WQP&MP       | Water Quality Plan and Monitoring Program |
1. Introduction

1.1 Context

This Construction Soil and Water Management Sub Plan (CSWMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the construction of the NorthConnex Project. The Project was approved by the Minister for Planning on 13 January 2015.

The NorthConnex project involves the construction of a multi-lane motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills, including integration works with the Hills M2 Motorway (the Project).

The Project will comprise of twin road tunnels generally following the alignment of Pennant Hills Road (the main alignment tunnels), with interchanges at the northern and southern end of the Project and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp. The Project is being constructed by a joint venture partnership comprising Lend Lease and Bouygues (the LLBJV).

The Project will comprise the following key features:

- Twin motorway tunnels around nine kilometres in length with two lanes in each direction and provision for a third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road including sections of on-ramps and off-ramps.
- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect the Project travelling northbound and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway control centre located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.
- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the Project.

This CSWMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), the mitigation measures listed in the NorthConnex Environmental Impact Statement (EIS) and Submissions and Preferred Infrastructure Report (SPIR), and all applicable legislation.
Construction Soil and Water Management Plan
(Appendix B6)

1.2 Background

In October 2013, the NorthConnex Project was declared to be State significant infrastructure and critical State significant infrastructure (SSI 13_6136) under Part 5.1 the Environmental Planning and Assessment Act 1979.

The NorthConnex - Environmental Impact Statement (AECOM, July 2014) assessed the impacts of the construction and operation of the Project on soils and water, within chapter 7.

The EIS also identified the potential for direct and indirect impacts on surface water in regards to water quality and changes to surface water flow regimes. It was concluded that impacts from construction of the Project could be effectively managed to acceptable limits with the implementation of the required mitigation and management measures.

1.3 Environmental management systems overview

The overall Environmental Management System (EMS) for the Project is described in the Construction Environmental Management Plan (CEMP).

The CSWMP is part of the LLBJV environmental management framework for the Project, as described in Section 4.1 of the CEMP. In accordance with CoA D57(f), this Plan has been developed in consultation with the Environmental Protection Authority (EPA), NSW Office of Water, the Hills Shire Council, Hornsby Shire Council and Ku-Ring-Gai Council.

The review and document control processes for this Plan are described in Section 10 of the CEMP.

1.4 Progressive erosion and sediment control plans

Progressive Erosion and Sediment Control Plans (PESCP) are designed for use as a practical guide to manage risks to soil and water associated with construction activities. They may be produced in conjunction with an Environmental Work Method Statement (EWMS) which provide more detailed site-specific environmental mitigation measures.

The PESCPs will be consistent with the Primary Erosion and Sediment Control Plan (Appendix A), which describes the intentions and fundamental principles for erosion and sediment control management for the duration of the entire project. The PESCPs will be developed by the environment team in consultation with construction personnel. They will be developed prior to any construction works commencing in each work zone and will be modified as required when:

- Site conditions evolve.
- Flow paths change.
- Construction activities that affected the characteristics of ground conditions change.

A Project Soil Conservationist will be engaged and consulted throughout construction to provide advice on erosion and sediment control design, installation, maintenance and the development of PESCPs.
2. Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how LLBJV will manage soil and water issues and protect the environment during construction of the Project. This Plan also assists in ensuring that the construction works meets the environmental objectives and targets as defined in Section 3.6 of the CEMP.

2.2 Objectives

The key objective of the CSWMP is to ensure that the potential impacts to soil and water quality are minimised and comply with the conditions set out within the planning approval. To achieve this objective, the LLBJV will undertake the following:

- Ensure appropriate controls and procedures are implemented during construction activities to avoid or minimise erosion and sedimentation impacts and potential impacts to water quality in rivers, creeks and groundwater along the Project corridor.
- Ensure appropriate measures are implemented to address the relevant CoA and SPIR management measures outlined in Table 3.1 and Table 3.2 of this plan.
- Ensure compliance with the Project's Environment Protection Licence (EPL).
- Ensure appropriate measures are implemented to comply with; the client specification G38, G36 and G40; all relevant legislation and other requirements as described in Section 3.1 of this Plan.
3. Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to soil and water management includes:

- *Environmental Planning and Assessment Act 1979.*
- *Water Management Act 2000.*
- *Fisheries Management Act 1994.*
- *Contaminated Land Management Act 1997.*

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the CEMP.

3.1.2 Guidelines and standards

The main guidelines, specifications and policy documents relevant to this Plan include:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000).
- Environment Direction Management of Tannins from Vegetation Mulch (Roads and Maritime 2012).
- RMS General Specification G36 Environmental Protection (Management System) (RMS 2014) (G36)
- RMS General Specification G38 Soil and Water Management (Soil and Water Management Plan) (RMS 2014) (G38)
- RMS General Specification G40 Clearing and Grubbing (RMS 2014) (G40)
- Lend Lease Construction Global Minimum Requirements (Lend Lease 2012) (GMR)
3.1.3 ISCA Requirements

The following categories apply to the CSWMP as identified within the ISCA Technical Manual. It should be noted however, where legislative requirements apply (i.e. Environmental Protection Licence) these legislative requirements override below:

- **DIS 1 (level 1)** Baseline studies of existing receiving water environment have been carried out for the project. AND Predictions for receiving water quality impacts have been developed for construction and operation of the project. AND Measures to minimise adverse impacts to local receiving water quality during construction and operation have been identified and implemented. AND Monitoring of water discharges and receiving waters is undertaken at appropriate intervals and at times of discharge during construction and operation. AND Monitoring and modelling demonstrates no exceedences of water discharge or water quality goals. AND All stormwater leaving the site is treated or filtered in accordance with appropriate urban stormwater guidelines unless it occurs during:
  - DIS 1: (level 2) For construction of less than 1 year, a 6 hour 1 in 2 year storm event; - For construction of greater than 1 year, a 6 hour 1 in 5 year storm event. AND The infrastructure does not increase peak stormwater flows for rainfall events of up to a 1.5 year ARI event discharge.
  - DIS 1: (level 3) Opportunities to improve local receiving water quality and/or provide environmental flows have been identified and implemented. AND Monitoring and modelling demonstrates improvement of local receiving water quality and/or provision of environmental flows.

- **LAN 3 (level 1)** Site assessment follows the recommended approach in Schedule A ‘Recommended general process for assessment of site contamination’ of National Environment Protection (Assessment of Site Contamination) Measure 1999. AND Remediation options are identified and selected using a sustainability hierarchy.
  - LAN 3 (level 2) Site assessment work audited by qualified independent specialist. AND Sustainability appraisal of remediation options is undertaken against the sustainability indicators in Table 1 of ‘A Framework for Assessing the Sustainability of Soil and Groundwater Remediation’ and using multi-criteria analysis or other scored or quantified means.
  - LAN 3 (level 3) The effectiveness and durability of the remedial solution, and maintenance and monitoring, have been considered over the lifetime of the infrastructure and beyond. AND Remediation appraisal and selection audited by qualified independent specialist.

- **WAT 1** Monitoring and modelling of water use, is undertaken. AND Monitoring and modelling demonstrates reduction of total water use by 5-20% below a reference footprint.

- **WAT 2** Opportunities to reduce water use are identified and implemented. AND All feasible opportunities with a financial payback period of four years or less have been implemented. AND Measures to minimise the risk of water losses have been implemented (including e.g. frequency of meter readings, excavation staff awareness of water mains running through site).

- **WAT 3** Identify potential non-potable sources that match demand. AND Monitoring and modelling demonstrates replacement of potable demand 50 to 99% below the reference footprint.

3.2 Minister’s Conditions of Approval

The CoA relevant to this Plan are listed Table 3-1 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other Project management documents.

<table>
<thead>
<tr>
<th>CoA No.</th>
<th>Condition Requirements</th>
<th>Document Reference</th>
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<tbody>
<tr>
<td>B9</td>
<td>Except as may be provided by an EPL, the SSI shall be constructed and operated to comply with section 120 of the Protection of the Environment Operations Act 1997, which prohibits the pollution of waters.</td>
<td>Table 6-1 (SW6)</td>
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### Condition Requirements

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<thead>
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<th>CoA No.</th>
<th>Condition Requirements</th>
<th>Document Reference</th>
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<tr>
<td>B10</td>
<td>All activities taking place in, on or under waterfront land, as defined in the Water Management Act 2000 should be conducted generally in accordance with the NSW Office of Water's Guidelines for Controlled Activities.</td>
<td>Table 6-1(SW5)</td>
</tr>
<tr>
<td>B11</td>
<td>Watercourse crossings, including temporary work platforms, waterway crossings and/or coffer dams, shall be designed and constructed in consultation with the DPI (Fisheries) and NSW Office of Water, and where feasible and reasonable, be consistent with the <em>NSW Guidelines for Controlled Activities Watercourse Crossings</em> (NSW Office of Water 2012), <em>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</em> (Fairfull and Witheridge 2003), <em>Policy and Guidelines for Fish Friendly Waterway Crossings</em> (NSW Fisheries February 2004), and <em>Policy and Guidelines for Fish Habitat Conservation and Management</em> (DPI Fisheries 2013). Where multiple cell culverts are proposed for crossings of fish habitat streams, at least one cell shall be provided for fish passage, with an invert or bed level that mimics watercourse flows.</td>
<td>Table 6-1(SW13)</td>
</tr>
<tr>
<td>B15</td>
<td>A <em>Water Quality Plan and Monitoring Program</em> shall be prepared and implemented to ensure that the project monitor and avoids or mitigates impacts on surface and groundwater quality and resources, during construction and operation. The Plan and Program shall be developed in consultation with the EPA, DPI (Fisheries), NSW Office of Water, and relevant Councils, for the approval of the Secretary, and shall include but not necessarily be limited to:</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(a)</td>
<td>Identification of works and activities during construction and operation of the SSI, including tunnel discharge, runoff, emergencies and spill events, that have the potential to impact on surface water quality of potentially affected watercourses and riparian land;</td>
<td>Appendix D and Section 5.2</td>
</tr>
<tr>
<td>B15(b)</td>
<td>A <em>risk management framework</em> for evaluation of the risks to groundwater and surface water resources and dependent ecosystems as a result of groundwater inflows to the tunnels, including definition of impacts that trigger contingency and ameliorative measures;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(c)</td>
<td>The identification of environmental management measures relating to surface and groundwater during construction and operation, including water treatment, erosion and sediment control plans and stormwater management measures consistent with Water Sensitive Urban Design measures, where relevant, and consistent with the measures detailed in the documents listed in condition A2, including the specifications and design details of the Water Treatment Plants;</td>
<td>Appendix D and Table 6-1</td>
</tr>
<tr>
<td>B15(d)</td>
<td>Commitment to designing discharge points into watercourses affected by the proposal to emulate a natural stream system, where feasible and reasonable;</td>
<td>Appendix D</td>
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<tr>
<td>B15(e)</td>
<td>The presentation of water quality objectives, standards and parameters, having regard to the Australian and New Zealand guidelines for fresh and marine water quality (Agriculture and Resource Management Council of Australia and the Australian and New Zealand Environment and Conservation Council 2000), developed in accordance with condition B16 and endorsed by EPA;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(f)</td>
<td>Representative background monitoring data (including but not necessarily limited to representative data collected by the relevant Council, and considering seasonality) for surface and groundwater quality parameters, to establish baseline water conditions prior to the commencement of construction;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(g)</td>
<td>Identification of construction and operational phase surface and groundwater quality monitoring locations (including watercourses, waterbodies and wetlands) which are representative of the potential extent of impacts from the SSI, including the relevant analytes and frequency of monitoring;</td>
<td>Appendix D</td>
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## Construction Soil and Water Management Plan (Appendix B6)

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<tr>
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<th>Condition Requirements</th>
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<tr>
<td>B15(h)</td>
<td>Commitment to a minimum monitoring period of three years following the completion of construction or until the affected waterways and/or groundwater resources are certified by a suitably qualified and experienced independent expert as being rehabilitated to an acceptable condition. The monitoring shall also confirm the establishment of operational water control measures (such as sedimentation basins and vegetation swales);</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(i)</td>
<td>Contingency and ameliorative measures in the event that adverse impacts to water quality are identified, with reference to the impact triggers defined in accordance with (b);</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(j)</td>
<td>Identification of and commitment to 'make good' provisions for groundwater users to be implemented in the event of a decline in water supply levels from existing bores associated with groundwater changes from either construction and ongoing operational dewatering caused by the SSI; and</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B15(k)</td>
<td>Reporting of the monitoring results to the Secretary, EPA, OEH, NSW Office of Water, DPI (Fisheries) and the relevant Council;</td>
<td>Appendix D and Section 7.6 / Section 8 of the CEMP.</td>
</tr>
<tr>
<td>B15</td>
<td>The construction elements of the Plan and Program shall be submitted to the Secretary for approval prior to the commencement of construction of the SSI, as part of the Construction Soil and Water Management Plan required by condition D57(f). The operational elements of the Plan and Program shall be detailed in principle as part of the Construction Soil and Water Management Plan. The final operational elements of the Plan and Program shall be submitted to the Secretary for approval one year prior to the commencement of operation of the SSI, unless otherwise agreed by the Secretary. A copy of the Plan and Program shall be submitted to the EPA, DPI (Fisheries), NSW Office of Water and relevant Councils prior to its implementation.</td>
<td>This CSWMP and Appendix D</td>
</tr>
<tr>
<td>B16</td>
<td>As part of the Water Quality Plan and Monitoring Program, the Proponent shall provide details of how the potential impact of discharges on receiving waters would be avoided or minimised, which shall include but not necessarily be limited to:</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(a)</td>
<td>Characterisation of current water quality in any receiving waters that could be affected by the proposal;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(b)</td>
<td>A statement of the ambient water quality objectives and the environmental values for the receiving waters relevant to the proposal;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(c)</td>
<td>A statement of the indicators and associated trigger values or criteria for the identified environmental values;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(d)</td>
<td>Details of the significance of any identified impacts on surface waters including consideration of the relevant ambient water quality outcomes;</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(e)</td>
<td>Demonstration of how the proposal will be designed and operated to:</td>
<td>Appendix D and Section 7.3.</td>
</tr>
<tr>
<td>B16(e)(i)</td>
<td>Protect the water quality objectives for receiving waters, where they are currently being achieved, and</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(e)(ii)</td>
<td>Contribute towards achievement of the water quality objectives over time, where they are not currently being achieved; and</td>
<td>Appendix D</td>
</tr>
<tr>
<td>B16(f)</td>
<td>demonstration that any groundwater discharge water quality is consistent with supporting a slightly to moderately disturbed level of aquatic ecosystem protection for receiving waters as defined by the Australian and New Zealand guidelines for fresh and marine water quality (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council 2000).</td>
<td>Appendix D</td>
</tr>
</tbody>
</table>
Prior to the commencement of site preparation and excavation activities, or as otherwise agreed by the Secretary, in areas identified as having a moderate to high risk of contamination, a Soil Contamination Report shall be prepared by a suitably qualified person(s) in accordance with the requirements of the Contaminated Land Management Act 1997 and associated guidelines, detailing the outcomes of Phase 2 contamination investigations within these areas. The Report shall detail, where relevant, whether the soil is suitable (for the intended land use) or can be made suitable through remediation and/or outline the potential contamination risks from the project to human health and receiving waterways.

For land to be disturbed by the SSI, where the investigations identify that the site is suitable for the intended operations and that there is no need for a specific remediation strategy, measures to identify, handle and manage potential contaminated soils, materials and groundwater shall be identified in the Report and incorporated into the Construction Environmental Management Plan and Soil and Water Management Plan. Should a remediation strategy be required, the Report shall include a remediation plan for addressing the disturbed area, and how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater.

If required, the Report shall be accompanied by a Site Audit Statement(s), prepared by an accredited Site Auditor under the Contaminated Land Management Act 1997, verifying that the disturbed area has been or can be remediated to a standard consistent with the intended land use. A final Site Audit Statement(s), if required, shall be prepared by an accredited Site Auditor, certifying that the contaminated disturbed areas have been remediated to a standard consistent with the intended land use and shall be submitted to the Secretary and Relevant councils prior to operation of the site.

### Table 6-1 (SW34, SW35, SW37, SW38, SW39)

- **D3** Soil and water management measures consistent with Managing Urban Stormwater - Soils and Construction Vols 1 and 2, 4th Edition (Landcom, 2004) shall be employed during the construction of the SSI to minimise soil erosion and the discharge of sediment and other pollutants to land and/or waters.

- **D4** Where available and practicable, and of appropriate chemical and biological quality, stormwater, recycled water or other water sources shall be used in preference to potable water for construction activities, including dust control.

- **D56(e)(iii)** measures to monitor and manage waste generated during construction including but not necessarily limited to: general procedures for waste classification, handling, reuse, and disposal; use of secondary waste material in construction wherever feasible and reasonable; procedures or dealing with green waste including timber and mulch from clearing activities; and measures for reducing demand on water resources (including potential for reuse of treated water from sediment control basins);

- **D57(f)** A Construction Soil and Water Management Plan to manage surface and groundwater impacts during construction of the SSI. The plan shall be developed in consultation with, EPA, NSW Office of Water, and relevant Councils, and include, but not necessarily be limited to:

This condition is met within the Waste and Resource Management plan. However mitigation measures relevant to waste handling; procedures for dealing with green waste including timber and mulch and measures for reducing demand on water resources (including potential for reuse of treated water from sediment control basins) have been addressed in Table 6-1 (SW12, SW14, SW17, SW18, SW19, SW21, SW23, SW24, SW43, & SW44)
CoA No. | Condition Requirements | Document Reference
--- | --- | ---
D57(f)(i) | Details of construction activities and their locations, which have the potential to impact on water courses, storage facilities, stormwater flows, and groundwater, including identification of all pollutants that may be introduced into the water cycle; | Section 5.1
D57(f)(ii) | The construction related requirements of condition B15; | Appendix D.
D57(f)(iii) | Potential impacts on watercourse bank stability and the development of appropriate mitigation measures as required; | Flooding Management Study and Table 6-1 (SW15 & SW16)
D57(f)(iv) | An Acid Sulfate Soils Management Plan, if required, including measures for the management, handling, treatment and disposal of acid sulfate soils, including monitoring of water quality at acid sulfate soils treatment areas, should the project impact on acid sulfate soils; | Appendix H
D57(f)(v) | A description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken, the locations where monitoring would take place, how the results of the monitoring would be recorded and reported, and, if any exceedance of the criteria is detected how any non-compliance can be rectified; and | Appendix D
D57(f)(vi) | Mechanisms for the monitoring, review and amendment of this plan. | Section 8

3.3 Revised Environmental Management Measures

The revised environmental management measures (REMM) from the SPIR that are relevant to this Plan are listed in Table 3-2 below. A cross reference is also included to indicate where the REMM is addressed in this Plan. Where conditions are not specifically addressed in this Plan, justification is provided. The timing of when the commitment applies has also been included.

Table 3-2 Revised Environmental Management Measures relevant to this CSWMP

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Ref #</th>
<th>Commitment</th>
<th>Timing</th>
<th>Document Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimise general impacts to soil and water.</td>
<td>HS1</td>
<td>A Construction Soil and Water Quality Management Plan would be prepared to manage surface and groundwater impacts during construction of the project.</td>
<td>Construction</td>
<td>This CSWMP</td>
</tr>
<tr>
<td>Minimise impact of exposing acid sulphate soil.</td>
<td>HS2</td>
<td>If acid sulfate soils are encountered, they would be managed in accordance with the Acid Sulfate Soil Manual (Acid Sulfate Soil Management Advisory Committee, 1998).</td>
<td>Construction</td>
<td>Appendix H</td>
</tr>
<tr>
<td>Minimise impact of exposing contaminated land.</td>
<td>HS3</td>
<td>A Construction Environmental Management Plan prepared for the project would include provisions to manage unexpected finds and hazardous materials identified during site preparation and/or construction works.</td>
<td>Construction</td>
<td>Appendix B</td>
</tr>
<tr>
<td></td>
<td>HS4</td>
<td>Potentially contaminated areas directly affected by the project would be investigated and managed in accordance with the requirements of the Contaminated Land Management Act 1997 and Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites (EPA, 1997).</td>
<td>Construction</td>
<td>Table 6-1 (SW34) and Appendix B</td>
</tr>
<tr>
<td></td>
<td>HS5</td>
<td>Appropriate mitigation measures including stockpiling and management of potentially contaminated material would be undertaken at building demolition sites to prevent movement of</td>
<td>Construction</td>
<td>Table 6-1 (SW37)</td>
</tr>
</tbody>
</table>
## Minimise general impacts to soil and water.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Ref #</th>
<th>Commitment</th>
<th>Timing</th>
<th>Document Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>A Construction Soil and Water Quality Management Plan would be prepared to manage surface and groundwater impacts during construction of the project.</td>
<td>Prior to construction and construction</td>
<td>This CSWMP</td>
<td></td>
</tr>
</tbody>
</table>

## Erosion and sediment controls are effective

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Ref #</th>
<th>Commitment</th>
<th>Timing</th>
<th>Document Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW2</td>
<td>Progressive erosion and sediment control plans (ESCPs) would be prepared and implemented in advance of construction, including earthworks and stockpiling. ESCPs would be updated as required.</td>
<td>Prior to construction and construction</td>
<td>Section 1.4, Appendix A and Table 6-1 (SW3)</td>
<td></td>
</tr>
<tr>
<td>SW3</td>
<td>Erosion and sediment controls, including sedimentation basins, would be designed, installed and managed in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Managing Urban Stormwater: Soils and Construction Volume 2D, Main Road Construction (DECC, 2008).</td>
<td>Prior to construction and construction</td>
<td>Appendix A and Table 6-1 (SW7)</td>
<td></td>
</tr>
<tr>
<td>SW4</td>
<td>A project soil conservationist would be engaged and consulted during construction to provide advice on</td>
<td>Prior to construction</td>
<td>Table 6-1 (SW2)</td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td>Ref #</td>
<td>Commitment</td>
<td>Timing</td>
<td>Document Reference</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>-------------</td>
<td>--------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>erosion and sediment control design, installation and maintenance.</td>
<td>and construction</td>
<td></td>
</tr>
<tr>
<td>SW5</td>
<td></td>
<td>Works would be programmed to minimise the extent and duration of disturbance to vegetation.</td>
<td>Prior to construction and construction</td>
<td>Table 6-1 (SW8)</td>
</tr>
<tr>
<td>SW6</td>
<td></td>
<td>Cleared native vegetation would be mulched for use in erosion and sediment control where feasible and reasonable, in accordance with the Environmental Direction Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012b).</td>
<td>Prior to construction and construction</td>
<td>Table 6-1 (SW12)</td>
</tr>
<tr>
<td>SW7</td>
<td></td>
<td>Site induction and ongoing toolbox talks would be provided to project personnel, including relevant sub-contractors on soil erosion and sediment control requirements and practices and their responsibilities.</td>
<td>Construction</td>
<td>Section 7.2 and Table 6-1 (SW1)</td>
</tr>
<tr>
<td>SW8</td>
<td></td>
<td>Erosion and sediment control structures would remain installed and maintained until sufficient stabilisation is achieved.</td>
<td>Construction</td>
<td>Table 6-1 (SW9)</td>
</tr>
<tr>
<td>SW9</td>
<td></td>
<td>Soil and land rehabilitation would occur as soon as practicable following construction. This would include rehabilitation in stages as the construction process allows.</td>
<td>Prior to construction and construction</td>
<td>Table 6-1 (SW43)</td>
</tr>
<tr>
<td>SW10</td>
<td></td>
<td>Temporary stockpile locations for both site establishment and earthworks would be specified prior to the commencement of construction activities in that area. Diversion drains and erosion and sediment control measures would be in place prior to the commencement of any stockpiling activities. Material would only be stockpiled in designated stockpiling areas.</td>
<td>Prior to construction and construction</td>
<td>Table 6-1 (SW31)</td>
</tr>
<tr>
<td>Minimise impacts on riparian areas</td>
<td>SW11</td>
<td>Scour protection and erosion protection measures would be implemented downstream of the watercourse crossings and surface water discharge points.</td>
<td>Prior to construction</td>
<td>Table 6-1 (SW14)</td>
</tr>
<tr>
<td>SW12</td>
<td></td>
<td>Where water is released into local creeks, outlet scour protection and energy dissipation would be implemented. The discharge point would be at the upstream end of a large pool where feasible and reasonable, to allow for slowing of water.</td>
<td>Prior to construction</td>
<td>Table 6-1 (SW14)</td>
</tr>
<tr>
<td>Water efficiency</td>
<td>SW13</td>
<td>Water efficiency measures would be implemented with a focus on achieving water savings and targeting water recycling and reuse.</td>
<td>Prior to construction and construction</td>
<td>Table 6-1 (SW21)</td>
</tr>
<tr>
<td>Minimise dewatering impacts and risks</td>
<td>SW14</td>
<td>A specific Work Method Statement for dewatering and discharging from open exposed excavations and sediment controls would be prepared, in accordance with the Technical Guideline Environmental Management of Construction Site Dewatering (Roads and Maritime, 2011d).</td>
<td>Construction</td>
<td>Table 6-1 (SW4)</td>
</tr>
<tr>
<td>SW15</td>
<td></td>
<td>Water discharge quality would comply with the requirements of an environmental protection licence issued for the project.</td>
<td>Construction</td>
<td>Section 7.4 and Table 6-1 (SW17 &amp; 20)</td>
</tr>
<tr>
<td>Outcome</td>
<td>Ref #</td>
<td>Commitment</td>
<td>Timing</td>
<td>Document Reference</td>
</tr>
<tr>
<td>---------</td>
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<td>------------</td>
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<td>---------------------</td>
</tr>
</tbody>
</table>
| Minimise risks associated with refuelling and storage of chemicals and fuels on site | SW16 | Where refuelling on-site is required, a Work Method Statement would be prepared and the following management practices would be implemented:  
- Refuelling would be undertaken on level ground and away from drainage lines, waterways and/or environmentally sensitive areas.  
- Refuelling would be undertaken within the designated refuelling areas with appropriate bunding and/or absorbent material.  
- Refuelling activities would be attended at all times.  
- Spill kits would be readily available and personnel trained in their use. A spill kit would be kept on the refuelling truck at all times. | Construction | Table 6-1 (SW4 & SW28) |
| Storage of dangerous goods and hazardous materials would occur in accordance with supplier’s instructions and relevant Australian Standards and may include bulk storage tanks, chemical storage cabinets/containers or impervious bunds. | HR2 | Storage of dangerous goods and hazardous materials would occur in accordance with supplier’s instructions and relevant Australian Standards and may include bulk storage tanks, chemical storage cabinets/containers or impervious bunds. | Construction | Table 6-1 (SW21) |
| Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids. Impervious bunds would be of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container. | HR4 | Secure, bunded areas would be provided around storage areas for oils, fuels and other hazardous liquids. Impervious bunds would be of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container. | Construction | Table 6-1 (SW21) |
| Bunds would be provided around activities such as vehicle refuelling, servicing, maintenance or wash-down, where there is a potential for spills and contamination. | HR5 | Bunds would be provided around activities such as vehicle refuelling, servicing, maintenance or wash-down, where there is a potential for spills and contamination. | Construction | Table 6-1 (SW21) |
| The discharge of treated groundwater would be managed to ensure that discharge does not exceed the capacity of the downstream system. | SW17 | The discharge of treated groundwater would be managed to ensure that discharge does not exceed the capacity of the downstream system. | Construction | Table 6-1 (SW45) |
| Maintain the flow along the current Cockle Creek and Darling Mills Creek alignment through appropriate design. | SW18 | Maintain the flow along the current Cockle Creek and Darling Mills Creek alignment through appropriate design. | Construction | Table 6-1 (SW16) |
| Design waterway crossings, structures, bridges and culverts to maintain fish passage with reference to the guidelines contained in Guidelines and Policies for Aquatic Habitat Management and Fish Conservation’ (Smith and Pollard 1999), Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull and Witheridge, 2003) and Fish and Fauna Friendly Waterway Crossings (Fairfull & Witheridge, 2003). | SW19 | Design waterway crossings, structures, bridges and culverts to maintain fish passage with reference to the guidelines contained in Guidelines and Policies for Aquatic Habitat Management and Fish Conservation’ (Smith and Pollard 1999), Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull and Witheridge, 2003) and Fish and Fauna Friendly Waterway Crossings (Fairfull & Witheridge, 2003). | Prior to construction and construction | Table 6-1 (SW13) |
| A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring program would commence prior to commencement of any construction works and would build on available water quality data. | SW20 | A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring program would commence prior to commencement of any construction works and would build on available water quality data. | Prior to construction and construction | Appendix D and Section 7.3. |
| Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance. | SW21 | Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance. | Construction | Section 7.3 |
4. Existing environment

The following sections summarise what is known about factors influencing soils and water within and adjacent to the Project corridor. The key reference document is chapter 7.8 and 7.9 of the EIS.

4.1 Topography and soil characteristics

The terrain of the Project can be divided into the following sections based on topography:

- Pennant Hills Road from M1 to M2 – generally, the route and adjacent areas are along ridge line(s) and upper slopes within the topographical landscape.
- M2 from Pennant Hills Rd to Windsor Rd – Generally, the route transverses rugged and steep terrain with narrow ridges and incised valleys.

The following Soil Landscape Groups are located along and adjacent to the Project route:

- Hawkesbury (Hawkesbury Sandstone).
- West Pennant Hills (Wianamatta Shales).
- Glenorie (Hawkesbury Sandstone).
- Lucas Heights (Mittagong Formation with alternating bands of shale and sandstone).

All soils are susceptible to water and wind erosion. A high erosion hazard will exist where concentrated flows impact on works, especially in steeper areas (e.g. Hills M2 Motorway).

4.2 Acid Sulphate Soils

The acid sulfate soil analyses in the EIS indicated that both actual and potential acid sulfate soils are unlikely to occur within the Project. This is due to the Project being situated on inland ridgelines and well away from coastal environments. This is illustrated in Figure 1 below which shows a low probability of Acid Sulfate Soils within and surrounding the Project (Australian Soils Resource Information System, 2013).

*Figure 1 Acid Sulfate Soil Probability (Australian Soils Resource Information System, 2013)*
Construction Soil and Water Management Plan (Appendix B6)

4.3 Surface water

The majority of surface works are located within residential areas of West Pennant Hills, Carlingford, Beecroft, Pennant Hills, Thornleigh, Normanhurst and Wahroonga. Run off in these areas is directed into developed stormwater infrastructure that discharge to natural water courses.

Along the Hills M2 Motorway stormwater is managed via detention basins that discharge to Darling Mills Creek and Blue Gum Creek. Darling Mills Creek is crossed by the Project at the Western end of the M2 integration works.

Cockle Creek runs parallel to the M1 Pacific Motorway tie in works. There are no existing detention basins between Cockle Creek and the M1.

These waterways are shown on the sensitive area maps attached at Appendix A5 of the CEMP.

The WQP&MP commenced in 2014 and the information from which is included within Attachment D. This includes a summary of the surface water quality results and laboratory analysis. Comparison of the results against the ANZECC 2000 water quality guidelines is also provided, although it should be noted that these guidelines are not to be used as a mandatory standard, rather they provide a guideline for the environmental values of our water resources.

4.4 Groundwater

The Project is likely to encounter groundwater aquifers during shaft and decline excavation works. There two principal aquifers in the region that are likely to be encountered. These are:

- Ashfield Shale aquifer – A low flowing aquifer that runs along rock fractures and the bedding layer. Ashfield shale aquifers are usually saline.
- Hawkesbury Sandstone aquifer – Variable flow rates via fractures, joints, shears, bedding planes and some intra-granular flow. Hawkesbury Sandstone aquifers often contain naturally elevated concentrations of iron and manganese, and are generally acidic with a pH varying from 4.5 to 6.5. Salinity levels are usually low.

An alluvial aquifer also occurs in the region but is unlikely to be encountered as it occurs locally around watercourses and the Project generally runs along a ridge line.

Groundwater samples were taken along the Project as part of the EIS investigation. The key findings from laboratory testing and analysis were:

- With the exception of heavy metals, all parameters are below laboratory detection limits or below the ANZECC guidelines for freshwater ecosystems at a 95 per cent confidence level.
- The dissolved heavy metal concentrations are typical of background levels present in the geology within the Sydney basin.
- The groundwater sampling indicates that there was no contaminated groundwater encountered.
- Electrical conductivity levels within the Ashfield Shale aquifer range from 1,380 μS/cm to 4,850 μS/cm indicating that the groundwater in this geology is generally brackish.
- Electrical conductivity levels within the Hawkesbury Sandstone aquifer are variable with a range of 1060 μS/cm to 4420 μS/cm. Higher readings correlate with samples taken closer to the sandstone-shale interface.
- pH values in the Ashfield Shale aquifer are generally neutral, ranging from 5.98 to 8.71.
- Standing groundwater levels varied from about 2 meters to 30 meters below ground level.
- pH values in the Hawkesbury Sandstone aquifer are generally neutral, ranging from 6.89 to 8.72.

It is noted that the general pH levels for the Hawkesbury Sandstone aquifer is much lower than those samples taken adjacent to the project during EIS investigations. The level identified during the EIS investigation is potentially due to an error within the sampling methods (e.g. insufficient purging). Furthermore, monitoring
conducted as part of the WQP&MP provided an average pH value within the expected range. The WQP&MP further details other existing groundwater quality data and is included in Appendix D.

Groundwater along the Project is not considered potable but may be used for non-potable domestic purposes.

4.5 Contamination

Contaminated sites identified within the EIS as having a moderate to high risk of contamination are presented in Table 4-1, along with the required mitigation measures. The detail within Table 4-1 is sourced from the EIS and the Contamination Investigation Former Malt Works (GHD 2014).

Section 6 of this plan provides more detail on the suite of mitigation measures listed in Table 4-1 above, that will be implemented to avoid or minimise impacts associated with works within the areas of potential contaminated land.

The contamination risk of all other sites will be managed in accordance with the Unexpected Discovery of Contaminated Land Procedure (Appendix B).
### Table 4-1 Potential contamination and required mitigation at project construction sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Contamination likelihood as per EIS</th>
<th>Mitigation measures as per Table 6.1</th>
<th>Status of contamination report / findings from contamination report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern interchange and Hills M2 Motorway integration works</td>
<td>Moderate risk of soil and groundwater contamination if fuel or agricultural chemicals stored on-site.</td>
<td>Prior to the commencement of site preparation and excavation activities, a Soil Contamination Report will be prepared in accordance with CoA B17.</td>
<td>Contamination report to be compiled and to determine appropriate actions / remediation in accordance with CoA B17.</td>
</tr>
<tr>
<td>Commercial property (landscape supplies)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trelawney Street construction compound</td>
<td>Moderate risk of contaminated soil and groundwater at a motor vehicle workshop site.</td>
<td>Prior to the commencement of site preparation and excavation activities, a Soil Contamination Report will be prepared in accordance with CoA B17.</td>
<td>Contamination report to be compiled and to determine appropriate actions / remediation in accordance with CoA B17.</td>
</tr>
<tr>
<td>Commercial properties</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Pioneer Avenue construction compound                                 | Moderate potential for asbestos containing materials, synthetic mineral fibres, lead-based paint, organochlorine pesticides and polychlorinated biphenyls. | A Soil Contamination Report has been prepared in accordance with CoA B17. Findings as follows. | Proceeding the EIS, a contamination investigation into the Pioneer Avenue construction compound was conducted by GHD in October 2014. The following was determined within the Contamination Investigation Report:  
- Localised occurrences of asbestos were identified on the surface of the site and in shallow soil. The identified asbestos is unlikely to pose a risk to current or future site users if left undisturbed. However, should these areas be disturbed then excavations and associated works should be carried out in a controlled manner, and in accordance with NSW WorkCover guidance Managing Asbestos in Soil (2014).  
- Soils with elevated concentrations of hydrocarbons were identified near the railway lines close to BH25. If excavations are required in these areas, potential exposure risks to construction workers should be managed under OHS with use of PPE.  
- Soils excavated during construction should be carefully stockpiled to prevent mixing of potentially contaminated and uncontaminated soils as the Waste Classification Guidelines states that dilution of contaminants is not an acceptable waste management option. If isolated pieces of fibre cement sheeting are encountered, they may be emu picked out of the excavated soil and classified separately.  
- Investigation of groundwater did not identify widespread contamination at the site and concentrations of contaminants of potential concern did not exceed the adopted human health screening criteria for commercial or industrial land use. Heavy metals (cadmium, copper, nickel, zinc) were detected in groundwater at several locations at concentrations slightly above the screening criteria for a freshwater environment; however the concentrations are unlikely to significantly impact the nearest surface water receptor (Larool Creek approximately 300 m to the north west).  
- Notwithstanding the recommendations above, the site was assessed within the contamination investigation to be suitable for the proposed use. |
4.6 Rainfall

The historical records from the Bureau of Meteorology at Pennant Hills (Station ID 066047) have been selected to reflect the potential rainfall due to its proximity to the overall site, and extent of available data (1941 to present).

A summary of the rainfall records from the Bureau of Meteorology is provided in Table 4-2 below. This data was sourced in November 2014.

<table>
<thead>
<tr>
<th>Summary of Pennant Hills rainfall records from 1941 to present</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer / Autumn</strong></td>
</tr>
<tr>
<td>Dec</td>
</tr>
<tr>
<td>99.7</td>
</tr>
<tr>
<td>7.3</td>
</tr>
</tbody>
</table>

It can be seen from Table 4-2 that rainfall is typically higher during summer and autumn. Winter and spring are typically drier periods during the year. Most of the rain falls during major storms associated with the passage of cold fronts or summer thunderstorms. Prolonged low intensity rainfall is not common.

4.7 Rainfall erosivity factor

The rainfall erosivity factor is a measure of the ability of rainfall to cause erosion (referred as “R” in the Revised Universal Soil Loss Equitation RUSLE). The rainfall erosivity factor is used to determine the soil loss in tonnes per hectare over one year, and is used in calculations when sizing construction sediment basins.

For the purpose of designing sediment basins and managing erosion the Rainfall Erosivity Factor erosion index (EI) of 3000 EI for the Southern end of the Project and 3500 for the Northern end has been used, based on the Rainfall Erosivity maps in the Blue Book. Specific R values for specific sites are listed within Appendix A.

It is also noted that the risk of rainfall erosion is slightly higher during summer months; therefore erosion control will need to be closely planned and managed during the months of December through March, as reflected by the monthly rainfall records in Table 4-2.

4.8 Flooding

Excluding the waterways and catchments in the vicinity of the Hills M2 Motorway, the Project is located on land which is not classified as a flood prone area in the Local Environmental Plans of Hornsby Shire, Ku-ring-gai and the Hills Shire councils, as detailed in the EIS and SPIR. The majority of the Project is positioned on the ridgeline where flooding is not considered a constraint for design parameters. However, there is possibility for localised flooding to occur within the area during high intensity rainfall events. It is noted within the SPIR that waterways and catchments in the vicinity of the Hills M2 Motorway are potentially flood prone, as such modifications to existing drainage infrastructure have been designed to replicate the current design standards and operational functionality of the Hills M2 Motorway.

The flooding design parameters, modelling and mitigation measures will be further detailed in the Flood Management Study, a requirement by CoA B13.
5. Environmental aspects and impacts

5.1 Construction activities

There are a number of key construction activities that could result in adverse impacts to soil and water which were detailed within the EIS. The potential for these activities to cause impacts on soil and water during construction will depend on a number of factors. Primarily impacts will be dependent on the nature, extent and magnitude of construction activities and their interaction with the natural environment. A summary of the key activities and impacts as detailed by the EIS are shown below on Table 5-1:

Table 5-1 – Key Construction Activities with Soil and Water Risks

<table>
<thead>
<tr>
<th>Key activity and location</th>
<th>Potential Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acid Sulfate Soils</td>
</tr>
<tr>
<td>Southern Interchange and M2 Motorway Integration Works</td>
<td>X X</td>
</tr>
<tr>
<td>Clearing and Grubbing</td>
<td>X X</td>
</tr>
<tr>
<td>Construction of Southern Interchange Tunnel Access</td>
<td>X X</td>
</tr>
<tr>
<td>Transvers drainage works (pits and pipes)</td>
<td>X X</td>
</tr>
<tr>
<td>Culvert extensions</td>
<td>X X</td>
</tr>
<tr>
<td>Removal of spoil</td>
<td>X X</td>
</tr>
<tr>
<td>Earthworks (cut and fill)</td>
<td>X X</td>
</tr>
<tr>
<td>Augmentation of existing basins</td>
<td>X X</td>
</tr>
<tr>
<td>Darling Mills Creek crossing</td>
<td>X X</td>
</tr>
<tr>
<td>R.E wall construction</td>
<td>X X</td>
</tr>
<tr>
<td>Paving</td>
<td>X X</td>
</tr>
<tr>
<td>Bridge construction</td>
<td>X X</td>
</tr>
<tr>
<td>Northern Interchange and M1 Pacific Motorway Tie In Works</td>
<td>X X</td>
</tr>
<tr>
<td>Clearing and Grubbing</td>
<td>X X</td>
</tr>
<tr>
<td>Demolish existing buildings</td>
<td>X X</td>
</tr>
<tr>
<td>Construction of Tunnel Access</td>
<td>X X</td>
</tr>
</tbody>
</table>
## Key activity and location

<table>
<thead>
<tr>
<th>Potential Impacts</th>
<th>Acid Sulfate Soils</th>
<th>Contamination</th>
<th>Erosion and Sedimentation</th>
<th>Groundwater Quality Impacts</th>
<th>Groundwater Drainage</th>
<th>Groundwater Treatment</th>
<th>Ground Movement</th>
<th>Impacts to Creeks and waterways</th>
<th>Water Supply and Water Balance</th>
<th>Flooding</th>
<th>Increased BOD in Surface Water</th>
<th>Changes to pH in Surface Water</th>
<th>Increased Turbidity in Surface Water</th>
<th>Increased Runoff</th>
<th>Tannin Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transvers drainage works (pits and pipes)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cockle Creek Tributary culvert extensions</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
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<td>Cockle Creek realignment</td>
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<th>Water Supply and Water Balance</th>
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<td>Tunnelling works across entire project</td>
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<td>Spoil Stockpiling at all surface work sites</td>
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### Key activity and location

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<td>Onsite use of fuels and chemicals</td>
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Some impacts on soil and water attributable to the Project are anticipated. Relevant aspects and the potential for related impacts have been considered in a risk assessment in Section 3.4 and Appendix A2 of the CEMP. Section 6 of this plan provides a suite of mitigation measures that will be implemented to avoid or minimise those impacts.
6. Environmental control measures

A range of environmental requirements and control measures are identified in the various environmental documents, including the SPIR, Conditions of Approval, LLBJV EMS and other Roads and Maritime and NorthConnex Project Co. documents. Specific management measures to address these requirements and impacts on soil and water are outlined in Table 6.1.

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<tr>
<th>ID</th>
<th>Measure / Requirement</th>
<th>When to implement</th>
<th>Responsibility</th>
<th>Reference</th>
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<tbody>
<tr>
<td>SW1</td>
<td>Training will be provided to relevant Project personnel, including relevant sub-contractors on sound erosion and sediment control practices and the requirements from this plan through inductions, toolboxes and targeted training.</td>
<td>Prior to construction</td>
<td>Construction Manager / Environment Manager</td>
<td>G38/G36 SPIR / EIS Section 7.9.4</td>
</tr>
<tr>
<td>SW2</td>
<td>A Project Soil Conservationist will be engaged and consulted throughout construction to provide advice on erosion and sediment control design, installation and maintenance.</td>
<td>Prior to construction / Construction</td>
<td>Environment Manager</td>
<td>G38 SPIR / EIS Section 7.9.4</td>
</tr>
<tr>
<td>SW3</td>
<td>PESCPs will be prepared and implemented in advance of construction, including earthworks and stockpiling. The PESCP will be submitted to the client in order to raise the G38 Hold Point 3.1. PESCPs will be updated as required.</td>
<td>Prior to construction / Construction</td>
<td>Environment Officer / Foreman</td>
<td>G38 SPIR / EIS Section 7.9.4 GMR</td>
</tr>
<tr>
<td>SW4</td>
<td>All activities taking place in, on or under waterfront land, as defined in the Water Management Act 2000 will be conducted generally in accordance with the NSW Office of Water's Guidelines for Controlled Activities.</td>
<td>Prior to construction / Construction</td>
<td>Environment Officer / Foreman</td>
<td>CoA B10</td>
</tr>
<tr>
<td>SW5</td>
<td>Except as may be provided by an EPL, the project shall be constructed and operated to comply with section 120 of the Protection of the Environment Operations Act 1997, which prohibits the pollution of waters.</td>
<td>Construction</td>
<td>Environmental Officer / Foreman</td>
<td>CoA B9</td>
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<tr>
<td>ID</td>
<td>Measure / Requirement</td>
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</table>
| SW6 | EWMS will be prepared and implemented to manage soil and water impacts prior to commencing high risk activities. The EWMS will be developed in accordance with this Plan and requirements included within G38, G36 and G40. This will include an EWMS for the following activities if they are conducted:  
- Working in waterways.  
- Working platforms (e.g. rock platforms) in or adjacent to waterways.  
- Construction of temporary and permanent waterway crossings.  
- Construction of temporary creek diversions.  
- Sediment basin design, construction and management.  
- Dewatering.  
- Operation of water treatment plants.  
- Working in environmentally Sensitive Areas.  
- On-site batching of concrete and asphalt.  
- Bulk fuel or chemical deliveries.  
- Clearing and grubbing.  
- Piling.  
- Blasting.  
- Concrete paving.  
- Refuelling or maintenance and cleaning of plant and equipment including concrete agitators, bitumen spray bars and asphalt pavers.  
- Mixing of bitumen with cutting oil and additives.  
- Application of liquid membranes, including paint and thermoplastic, resin, emulsion, precoat agent and curing compound.  
- Removal and disposal of excess chemicals and water used for washing down of equipment.  
- Pumping out of oil and grease collection pits.  
- Decanting operations such as for fuel, chemicals and bitumen. | Construction | Superintendent / Environment Manager | G38/G36  
EPL  
SPIR / EIS Section 7.9.4  
Appendix C |
| SW7 | Erosion and sediment control structures shall remain installed and maintained until sufficient stabilisation is achieved as per the Blue Book. | Construction | Environmental Manager / Foreman | G38  
SPIR / EIS Section 7.9.4 |
| SW8 | Works will be designed and programmed to minimise the extent and duration of disturbance to vegetation. | Prior to construction / Construction | Superintendent / Foreman | G38  
SPIR / EIS Section 7.9.4  
GMR |
<table>
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<tr>
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<tbody>
<tr>
<td>SW9</td>
<td>Soil and water management measures consistent with Managing Urban Stormwater - Soils and Construction Vols 1 and 2, 4th Edition (Landcom, 2004) shall be designed, installed and managed during the construction of the Project to minimise soil erosion and the discharge of sediment and other pollutants to land and/or waters. This may include: • Separating ‘clean’ run-on water from ‘dirty’ (e.g. turbid) construction area run-off. • Constructing permanent drainage structures early in the project including: • detention/sediment basins and traps; • catch drains with linings (e.g. concrete); • culverts and associated inlet and outlet protection (e.g. dissipators). • Temporary sediment basins. It is noted that some small and/or flat sites might not warrant construction of a sediment basin. This includes sites with &lt;2,500 square metres of disturbed area, or those with an average annual soil loss from the total area of land disturbance that is less than 150 cubic metres per year. If in doubt the total soil loss can be calculation utilizing the data included within Attachment A to determine if the building of a sediment retention basin is considered necessary or unnecessary. • Maximising the diversion of turbid construction runoff into detention/sediment basins. • Controlling run-off during the construction of embankments (e.g. fill shaping and the construction of temporary dykes and batter drains). • Diverting formation run-off through sediment traps and into pits and the stormwater drainage system as soon as practical to reduce surface flow lengths and velocities.</td>
<td>Construction</td>
<td>Superintendent / Foreman / Environmental Officer</td>
<td>CoA D3 G38 SPIR / EIS Section 7.8.4 SPIR / EIS Section 7.9.4 GMR</td>
</tr>
<tr>
<td>SW10</td>
<td>Erosion and sediment control structures shall remain installed and maintained until sufficient stabilisation is achieved.</td>
<td>Construction</td>
<td>Environmental Manager / Foreman</td>
<td>G38 SPIR / EIS Section 7.9.4</td>
</tr>
<tr>
<td>SW11</td>
<td>Measures will be implemented to minimise dust, soil or mud from being deposited by vehicles on public roads. This will be achieved by implementing mitigation measures such as rumble grids; large aggregate at entry/exit points; or wheel wash facilities.</td>
<td>Prior to construction / Construction</td>
<td>Superintendent / Foreman</td>
<td>G38</td>
</tr>
<tr>
<td>SW12</td>
<td>Hardstand areas and surrounding public roads will be cleaned as required, using methods including brooms, bobcat attachments or street sweepers.</td>
<td>Prior to construction / Construction</td>
<td>Superintendent / Foreman</td>
<td>SPIR / EIS Section 7.3.5</td>
</tr>
<tr>
<td>SW13</td>
<td>Cleared native vegetation shall be mulched for use in erosion and sediment control where feasible and reasonable, it will be stored and managed in accordance with the Environmental Direction Management of Tannins from Vegetation Mulch (Roads and Maritime, 2012b).</td>
<td>Construction</td>
<td>Superintendent / Foreman / Environmental Officer</td>
<td>SPIR / EIS Section 7.9.4 CoA D56(e)(iii)</td>
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## DRAINAGE AND WATERWAY

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<tr>
<td>SW14</td>
<td>Where temporary and permanent watercourse crossings (including temporary work platforms and coffer dams) are required they will be designed in consultation with DPI (Fisheries) and NOW and meet the requirements of CoA B11.</td>
<td>Construction</td>
<td>Design Manager / Environment Manager / Superintendent / Engineers</td>
<td>G36 CoA B11 SPIR / EIS Section 7.9.4</td>
</tr>
</tbody>
</table>
| SW15 | Where required scour protection shall be installed within and at the base of permanent or temporary drainage features. Scour protection will be appropriately selected and may include:  
  - Rock lining.  
  - Concrete lining.  
  - Jute-mesh lining.  
  - Jute-matt lining.  
  - Geo-fabric lining  
  - Hydro much.  
  - Revegetation.  
  - Appropriate grade selection.  
  - Appropriately sized drains.  
  Energy dissipaters shall also be installed at the base of permanent and temporary drainage outlets and waterway crossings. Energy dissipaters will be appropriately selected and may include:  
  - Rock riprap.  
  - Detention pools / basins.  
  - Adjusting the discharge locations – such as to the upstream end of a large pool  
  - Appropriately sized drains.  
  - Appropriate grade selection.  
  - Appropriately sized headwalls.  
  - Appropriately sized drainage pipes.  
  - Baffles.  
  Scour protection and energy dissipaters will be integrated where feasible into current banks to minimise impacts. | Construction      | Design Manager | G36, G38 SPIR / EIS Section 7.9.4 CoA D57(e)(iii)                                                    |
| SW16 | Vegetation to be cleared within riparian areas will be cut stump within flood debris level (or within 15m), maximising the retention of ground cover until immediately prior to construction works. | Construction      | Superintendent / Foreman                                                                            | CoA D57(e)(iii) G40 |
| SW17 | The flow along the current Cockle Creek and Darling Mills Creek alignment will be maintained through appropriate design to maintain fish passage (e.g. constructed eddies, appropriately sized drainage and low flow channels). | Prior to construction | Design Manager                                                                                        | SPIR / EIS Section 7.9.4 |
## Groundwater

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<tbody>
<tr>
<td>SW18</td>
<td>Groundwater captured during construction shall be tested, treated (via the groundwater treatment plants at the Southern interchange construction compound, Wilson Road construction compound, Trelawney Street construction compound and the Northern Interchange construction compound) and discharged or reused on site to meet the requirements of the Project EPL.</td>
<td>Construction</td>
<td>Foreman</td>
<td>SPIR / EIS Section 7.8.4 CoA D56(e)(iii)</td>
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## WATER QUALITY AND USE

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<tr>
<td>SW19</td>
<td>In selection of feasible replacement sources to reduce water use, consideration of the financial payback period shall be considered, consistent with the requirements of ISCA Credit Wat-2.</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>CoA D56(e)(iii)</td>
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<tr>
<td>SW20</td>
<td>Proposed water sources intended for use for construction activities will be described within the PESCP. All necessary approvals and licences from the New South Wales Office of Water, the Local Council and/or any other persons or authorities having responsibility for the chosen source(s) will be obtained before commencing extraction.</td>
<td>Construction</td>
<td>Environmental Officer / Environment Manager</td>
<td>G38 CoA D56(e)(iii)</td>
</tr>
<tr>
<td>SW21</td>
<td>Water efficiency measures shall be implemented with a focus on achieving water savings and targeting water recycling and reuse. Such measures may include:   - The installation of water efficient appliances.   - The installation of water efficient taps.   - The installation of water efficient showers.   - The installation of dual flush toilets in new builds and new amenity blocks.   - Where available, practicable, and of appropriate chemical and biological quality: Capture and reuse of construction water (via sediment traps and basins) in preference to potable water for construction activities, such as concrete mixing, dust control and compaction.   - Where available, practicable, and of appropriate chemical and biological quality: Reuse of groundwater water or groundwater inflows in preference to potable water for construction activities, such as concrete mixing, dust control and compaction.   - Where available, practicable, and of appropriate chemical and biological quality: Capture and reuse of stormwater in preference to potable water for construction activities, such as concrete mixing, dust control and compaction.</td>
<td>Construction</td>
<td>Sustainability manager / Superintendent</td>
<td>CoA D4 and D56(e)(iii) SPIR / EIS Section 7.8.4 SPIR / EIS Section 7.9.4 ISCA GMR</td>
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<tr>
<td>SW22</td>
<td>Where flocculation is necessary to settle suspended sediments in sediment basins / traps, calcium sulfate (gypsum) will be utilised unless the use of alternative chemicals is in consultation with both RMS and EPA.</td>
<td>Construction</td>
<td>Superintendent / Foreman</td>
<td>G38</td>
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### CHEMICALS AND MATERIAL MANAGEMENT

**SW26** All chemicals and fuels associated with construction will be stored and handled in accordance with the supplier’s instructions, AS 1940-2004 and / or AS 4452-1997. This is including but not limited to the following requirements:

- The storage of chemicals and fuels in impervious bunds of sufficient capacity to contain at least 110 per cent of the volume of the largest stored container.
- Do not locate fuel and chemical storage areas within 50 m of any aquatic habitat, flood prone areas, or on slopes steeper than 1:10.

*When to implement:* Prior to construction / Construction

*Responsibility:* Superintendent / Foreman

*Reference:* SPIR / EIS Section 8.2.2 SPIR / EIS Section 7.9.4 G36

**SW27** Spill kits will be located at compound sites and key risk locations where they will be readily accessible.

*When to implement:* Construction

*Responsibility:* Environmental Officer / Forman

*Reference:* SPIR / EIS Section 7.9.4

**SW28** Plant maintenance, refuelling, stationary plant (eg pumps and generators), chemical mixing / cutting or other similar activities will not be carried out or positioned in areas where a spill can drain directly to a waterway or environmentally sensitive area, unless temporary bunding is provided.

*When to implement:* Construction

*Responsibility:* Foreman

*Reference:* G36

**SW29** Spills will be managed in accordance with the Environmental Incident / Emergency Response Protocol, Appendix A8 of the CEMP.

*When to implement:* Construction

*Responsibility:* Foreman / Superintendent

*Reference:* G36
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<tr>
<td>SW30</td>
<td>Temporary stockpile locations for both site establishment and earthworks shall be managed in accordance with the Stockpile Management Protocol (Appendix E), and their locations defined within the PESC P.</td>
<td>Construction</td>
<td>Foreman</td>
<td>G38</td>
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<td>SPIR / EIS Section 7.9.4</td>
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<td>SW31</td>
<td>Concrete wash out areas - where necessary, will be adequately sized, regularly maintained and located in a position where wastewater will not enter any drainage lines or waterways.</td>
<td>Construction</td>
<td>Foreman</td>
<td>Good Practice</td>
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<td>SW32</td>
<td>Hazardous Materials Assessments shall be undertaken, and Hazardous Materials Management Plans implemented, prior to and during the demolition of buildings. Demolition works shall be undertaken in accordance with Australian and NSW WorkCover Standards.</td>
<td>Construction</td>
<td>Foreman / Engineer</td>
<td>SPIR / EIS Section 7.8.4</td>
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**CONTAMINATION AND ACID SULFATE SOILS**

| SW33| Unanticipated discovery of contaminated material will be managed in accordance with Appendix B. Works in the vicinity will be stopped or modified and will not recommence until the material has been analysed and management measures developed.                                                                                                                                                                                                                                                                                                                                                             | Construction      | Construction Manager / Environment Manager | CoA B17                   |
|     | SPIR / EIS Section 7.8.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |                          | G36                      |
|     | SPIR / EIS Section 7.8.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |                          | GMR                      |

<p>| SW34| Prior to the commencement of site preparation and excavation activities in areas identified as having a moderate to high risk of contamination, a Soil Contamination Report will be prepared by a suitably qualified person(s) in accordance with the requirements of the Contaminated Land Management Act 1997 and associated guidelines, detailing the outcomes of Phase 2 contamination investigations within these areas. The Report shall detail, where relevant, whether the soil is suitable (for the intended land use) or can be made suitable through remediation and/or outline the potential contamination risks from the project to human health and receiving waterways. | Prior to construction / Construction | Construction Manager / Environment Manager | CoA B17                   |
|     | SPIR / EIS Section 7.8.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |                          | SPIR / EIS Section 7.8.4  |</p>
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</table>
| SW36| If Soil Contamination Report identifies that the site is suitable for the intended operations and that there is no need for a specific remediation strategy, measure to identify, handle and manage potential contaminated soils, materials and groundwater shall be identified and will be incorporated into this CSWMP. This may include, but not limited to the following:  
  - Limit or eliminate excavation requirements.  
  - Separation of known contaminated material (if any) from natural material, to reduce the treatment requirements and disposal volumes.  
  - Delineation of contaminated material.  
  - Spoil re-use within the project where possible.  
  - Odour, dust, air quality and stormwater runoff management, including monitoring.  
  - Development and implementation of occupational hygiene measures to manage ingestion risk.  
  - Identification and implementation of appropriate PPE to manage dermal contact risks if required.  
  - Implement appropriate erosion and sediment controls (e.g. sumps, basins, baffles, bunds or ground cover)                                                                                                                          | Prior to construction / Construction | Construction Manager / Environment Manager | CoA B17 SPIR / EIS Section 7.8.4 |
<p>| SW37| If the Soil Contamination Report identifies that remediation is required, the Report shall include a remediation plan that will be implemented on the Project. The remediation plan will address how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil or groundwater.                                           | Prior to construction / Construction | Construction Manager / Environment Manager | CoA B17 SPIR / EIS Section 7.8.4 GMR |
| SW38| If required, the Soil Contamination Report shall be accompanied by a Site Audit Statement(s), prepared by an accredited Site Auditor under the Contaminated Land Management Act 1997, verifying that the disturbed area has been or can be remediated to a standard consistent with the intended land use. A final Site Audit Statement(s), if required, shall be prepared by an accredited Site Auditor, certifying that the contaminated disturbed areas have been remediated to a standard consistent with the intended land use and shall be submitted to the Secretary and Relevant councils prior to operation of the site. | Prior to construction / Construction | Construction Manager / Environment Manager | CoA B17 SPIR / EIS Section 7.8.4 GMR |
| SW39| It is unlikely that Acid Sulfate Soils will occur within the Project, however in the unlikely event that they are encountered, works will be managed in accordance with Appendix H.                                                                                                                                                             | Construction                           | Superintendent / Foreman / Environmental Manager | CoA D57(f)(iv) SPIR / EIS Section 7.8.4 |</p>
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</thead>
<tbody>
<tr>
<td>SW40</td>
<td>Any known contaminated soils or groundwater on the site likely to cause risk to health, safety or the environment must be identified, signposted and segregated from site activities by the erection of physical barriers to prevent unauthorised entry, exposure and / or cross contamination.</td>
<td>Construction</td>
<td>Foreman / Environmental officer</td>
<td>GMR</td>
</tr>
<tr>
<td>SW41</td>
<td>Disturbed areas will be progressively stabilised and/or rehabilitated as they are completed (e.g. with a cover crop, hydro mulch, hydro seeding, topsoil and/or mulch). Wherever possible, permanent landscaping and revegetation works will take place progressively in accordance with the Urban Design and Landscape Plan.</td>
<td>Construction</td>
<td>Superintendent / Foreman</td>
<td>SPIR / EIS Section 7.9.4 CoA D56(e)(iii)</td>
</tr>
<tr>
<td>SW42</td>
<td>Where feasible and reasonable (and where space permits for stockpiling if required), topsoil and subsoils shall be reused during construction and rehabilitation of the project. The project will ensure all subsoil and topsoil impacted by the construction works is separated and protected from degradation, erosion or mixing with fill or waste and 95% of all topsoil (by volume) retains its productivity and is beneficially re-used.</td>
<td>Construction</td>
<td>Superintendent / Engineer</td>
<td>ISCA CoA D56(e)(iii)</td>
</tr>
</tbody>
</table>

**FLOODING**

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<tr>
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<th>Responsibility</th>
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</thead>
<tbody>
<tr>
<td>SW43</td>
<td>The discharge of treated water shall be managed to ensure that discharge does not exceed the capacity of the downstream system.</td>
<td>Construction / Prior to construction</td>
<td>Design Manager / Environmental Manager / Environment Officer</td>
<td>SPIR / EIS Section 7.9.4</td>
</tr>
<tr>
<td>SW44</td>
<td>The maximum increase in inundation levels upstream of the Project will be 50 mm in a 1 in 100 year Average Recurrence Interval (ARI) rainfall event shall be considered during detailed design of the Project.</td>
<td>Prior to construction</td>
<td>Design Manager</td>
<td>CoA B13(c)(iii)</td>
</tr>
<tr>
<td>SW45</td>
<td>A maximum increase of 10mm in inundation at properties where floor levels are currently exceeded in a 1 in 100 year ARI rainfall event shall be considered during detailed design of the Project.</td>
<td>Prior to construction</td>
<td>Design Manager</td>
<td>CoA B13(c)(ii)</td>
</tr>
<tr>
<td>SW46</td>
<td>A maximum increase in inundation time of one hour in a 1 in 100 year ARI rainfall event shall be considered during detailed design of the Project.</td>
<td>Prior to construction</td>
<td>Design Manager</td>
<td>CoA B13(c)(i)</td>
</tr>
</tbody>
</table>
### MONITORING

<table>
<thead>
<tr>
<th>ID</th>
<th>Measure / Requirement</th>
<th>When to implement</th>
<th>Responsibility</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW47</td>
<td>If the limits set by SW41, SW42 and SW43 cannot be met, alternative flood mitigation solutions consistent with the intent of these shall be provided.</td>
<td>Prior to construction</td>
<td>Design Manager</td>
<td>CoA B13(c)</td>
</tr>
</tbody>
</table>

| SW48 | Rainfall forecasts will be monitored daily and the site managed to avoid erosion and sedimentation, and to minimise the impact of heavy rainfall and flood events. | Construction | Superintendent / Foreman / Environmental Manager / Environment Officer | G38 |

| SW49 | All water quality monitoring will be undertaken in accordance with the WQP&MP, detailed in Section 7.3 and Appendix D of this plan. | Construction | Environment Officer | CoA B15 CoA B16 CoA D57(f)(vi) CoA D57(f)(v) G38 SPIR / EIS Section 7.8.4 |

### RECORDS

| SW50 | Records of monitoring and dewatering activities will be maintained. | Construction | Environmental Manager | G38 GMR |
7. Compliance management

7.1 Roles and responsibilities

The Project organisational structure and roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 6 of this Plan.

7.2 Training

Relevant employees, contractors and utility staff working on site will undergo site induction training relating to soil and water management issues. The induction training will address elements related to soil and water management including:

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Roles and responsibilities for soil and water management.
- The location of ASS or contamination.
- Identification of ASS or contamination.
- Water quality management and protection measures.
- Procedure to be implemented in the event of an unexpected discovery of contaminated land.

Targeted training in the form of toolbox talks or specific training will also be provided to personnel with a key role in soil and water management. Examples of training topics include:

- ERSED (erosion and sediment) control installation methodology and maintenance.
- Sediment basin construction/management.
- Dewatering.
- Emergency response measures in high rainfall events.
- Preparedness for high rainfall events.
- Lessons learnt from incidents and other event (e.g. high rainfall/flooding).

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

7.3 Monitoring and inspection

Regular monitoring and inspections will be undertaken and will include, but not be limited to:

- Weekly inspections at active, exposed work sites to evaluate the effectiveness of erosion and sediment controls measures in accordance with Section 8 of the CEMP.
- Rainfall inspections will be conducted after receiving >20mm over a 24hr period at active, exposed work sites to evaluate the effectiveness of erosion and sediment controls measures in accordance with Section 8 of the CEMP.
- Inspections would also be undertaken of Erosion and Sediment Controls prior to any shut down of greater than 48 hours.
- Pre-work inspection to be conducted prior to ground disturbing activities to ensure appropriate controls are installed or are panned to be installed in accordance with the PESCP.
- Construction sediment basin water will be tested, treated, discharged, recorded and reported to meet the requirements of the Project EPL. This will be required at all licenced sediment basins for every discharge.
Construction Soil and Water Management Plan (Appendix B6)

- Groundwater captured during construction will be tested, treated, discharged, recorded, and reported to meet the requirements of the Project EPL. This will be required for the Southern Interchange, Wilson Road, Trelawney St, and Northern Interchange groundwater treatment plants.

- Surface and groundwater monitoring will be conducted, recorded, and reported in accordance with the project EPL. The location and frequency of monitoring will be in accordance with the WQP&MP.

Additional requirements and responsibilities in relation to inspections are documented in Section 8 of the CEMP.

7.4 Water discharge

An EPL will be obtained for the scheduled activity “road construction”. The EPL typically prescribes water quality parameters to be measured and associated discharge criteria from licensed discharge points. They also detail the monitoring and analytical requirements by reference to authority publications (e.g. Approved Methods for Sampling and Analysis of Water Pollutants in NSW, EPA, 2004). The likely EPL criteria for sediment basin discharge is listed in Table 7-1.

Table 7-1  Discharge water quality criteria

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criteria</th>
<th>Sampling method</th>
<th>Analytical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5 - 8.5</td>
<td>Probe or Grab Sample</td>
<td>Field analysis and confirmed as required with laboratory assessment</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>50 mg/L</td>
<td>Grab Sample</td>
<td>Laboratory analysis</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>None visible</td>
<td>Visual inspection</td>
<td>N.A</td>
</tr>
</tbody>
</table>

Note, that as optional condition of the EPL, a correlation will be established between turbidity and suspended solids, which, once approved by the EPA, will allow turbidity to replace suspended solids as the water clarity criteria. This will allow all required water quality results (pH, turbidity and visible oil and grease) to be measured on site, thus decreasing waiting times for results from laboratories and assisting in basin management.

Water treatment plants will be required for the treatment of water during the excavation of tunnels. The water treatment plants will be located at the Southern Interchange construction compound, Wilson Road construction compound, Trelawney St construction compound, and the Northern Interchange construction compound. The specific locations of water treatment plants and associated water storage tanks/dams at each of these sites will be included on the PESCP. Procedures relating to the management of the water treatment plants will also be prepared and implemented via an EWMS.

Water treatment plants will be of a modular design so that they can be modified if required to ensure discharge can be conducted in accordance with the EPL criteria. The groundwater treatment plant discharge water quality criteria would be determined in consultation with the EPA taking into consideration the current water quality of the receiving watercourses. Further information on groundwater quality and the treatment plants is included within the Water Quality Plan and Monitoring Program (Appendix D).

Any other relevant licences or permits will be obtained in the lead up to and during construction as required.

7.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub plan, CoA and other relevant approvals, licences and guidelines. Audit requirements are detailed in Section 8 of the CEMP.

7.6 Reporting

Reporting requirements and responsibilities are documented in the Water Quality Monitoring Program, and Section 8 of the CEMP.

7.7 Non-conformances

Non-conformances in general will be dealt with and documented in accordance with Section 8.6 of the CEMP.
8. Review and improvement

8.1 Continuous improvement

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement. This will be achieved through the process documented in Section 9 of the CEMP.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance.
- Determine the cause or causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

8.2 CSWMP update and amendment

Revisions to this plan will be in accordance with the process outlined in Section 1.6 and Section 9 of the CEMP. Amendments in response to processes described in Section 8.1 may also occur.

Between the above processes, a register of document issues will be maintained by the project to ensure that any issues with the CSWMP are recorded. This will ensure that the plan can be updated during the following revision and the issues closed out.

Changes to this CSWMP will be approved by the client and stakeholders (if required) and documented in the document control section for each revision.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.
Appendix A
Primary Erosion and Sediment Control Plan
NORTHCONNEX

PROJECT

M1 – M2

PRIMARY / GENERIC
EROSION AND SEDIMENT
CONTROL PLAN / STRATEGY

March 2015 Rev 1

Prepared by T.R.E.E.S. P/L for:
Lend Lease Bouygues Joint Venture (LLBJV)
# NORTHCONNX PROJECT

**TABLE OF CONTENTS**

1.0 **INTRODUCTION** ......................................................................................................................... 2

2.0 **PROJECT DESCRIPTION** ............................................................................................................... 2

3.0 **SCOPE OF THIS PLAN / STRATEGY** ......................................................................................... 3

4.0 **EXISTING ENVIRONMENT** ........................................................................................................... 4
   4.1 Topography.................................................................................................................................. 4
   4.2 Soil Types................................................................................................................................... 4
   4.3 Rainfall......................................................................................................................................... 4
   4.4 Sensitive Areas.............................................................................................................................. 5
   4.5 Erosion & Sedimentation Hazard................................................................................................. 5

5.0 **SUPPORTING DOCUMENTATION** ............................................................................................... 5

6.0 **KEY MANAGEMENT STRATEGIES** ............................................................................................ 6
   6.1 Professional Expertise.................................................................................................................... 6
   6.2 Training....................................................................................................................................... 6
   6.3 Minimising Extent and Duration of Disturbance........................................................................... 6
   6.4 Control of Stormwater Flows onto, through and from the Site..................................................... 7
   6.5 Erosion Control Measures to Prevent On-Site Damage................................................................. 7
   6.6 Sediment Control Measures to Prevent Off-Site Damage............................................................ 7
   6.7 Stabilisation and Revegetation...................................................................................................... 8
   6.8 Inspection and Maintenance.......................................................................................................... 8
   6.9 Documentation and Recording...................................................................................................... 8
   6.10 General....................................................................................................................................... 8

7.0 **CONCLUSION** .............................................................................................................................. 9

8.0 **ACKNOWLEDGEMENTS** ............................................................................................................. 9

9.0 **ATTACHMENTS** .......................................................................................................................... 9
   1 Example Progressive Erosion and Sediment Control Plan
   2 Soil Properties and Design Parameters

T.R.E.E.S. P/L
1.0 INTRODUCTION

The plan focuses on surface works as tunnelling is considered to be a low risk activity in relation to erosion and sediment control. All spoil at the tunnelling support compounds will be primary managed with acoustic sheds which will limit the potential for impact.

The surface construction activities to be undertaken on this project have the potential to impact on soil and water resources. Land to be disturbed and/or cleared of vegetation is potentially subject to erosion by stormwater and wind action.

Generally, soil particles eroded by stormwater runoff are transported downslope, usually settling in rivers, watercourses and wetlands etc (i.e. sedimentation). This may result in many adverse environmental impacts including:

- Reduction in water quality, increased turbidity and nutrient enrichment of water bodies.
- Damage to vegetation communities.
- Disturbance to aquatic flora and fauna.
- Increased potential for flooding.
- Reduction in recreational values.
- Reduction in aesthetic values.
- Increased maintenance costs.
- Promotion of weed growth.

Additionally, erosion may be caused by wind moving unprotected soil particles. This action may result in adverse impacts including:

- Loss of valuable soil (e.g. topsoil).
- Safety on and off site (e.g. traffic hazards).
- Inundation of urban/industrial areas with severe nuisance value.

This Plan/Strategy will form the initial 'part of the chain' to minimise on-site erosion and off-site sedimentation and therefore reduce adverse environmental impact.

2.0 PROJECT DESCRIPTION

The proposed project will link the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney.

Key features of the project include:

- Twin tunnels approximately nine (9) kilometres in length with two (2) lanes in each direction.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road including sections of tunnels for ramps which also facilitate access too and form the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road including sections of tunnels for ramps.
- Integration works with the Hills M2 Motorway including - alterations to the eastbound carriageway to accommodate traffic exiting the Hills M2 Motorway to connect to the project travelling north;
- the provision of a new westbound lane on the Hills M2 Motorway extending through the Windsor Road.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A Motorway operations complex located near the southern interchange on the corner of Eaton road and Pennant Hills Road.
- Two (2) tunnel support facilities incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for Motorway operation including electronic tolling, signage, ventilations systems and fire safety systems, including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two (2) interchanges and operational ancillary facilities.
- Modifications to local roads including –
  - widening of Eaton Road near the southern interchange;
  - repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities including -
  - northern interchange construction compound;
  - southern interchange construction compound;
  - minor construction compounds at Darling Mills Creek viaduct, Barclay Road, Yale Close, Wilson Road, Trewkinney Street, Pioneer Avenue, Bareena Avenue and Junction Road.
- Detention basin works along Hills M2 Motorway.
- Off-site soil disposal sites yet to be fully determined.
- Works to facilitate construction (e.g. geotech, fencing, demolition of properties, clean and grub etc).

3.0 SCOPE OF THIS PLAN / STRATEGY

This Primary/Generic Erosion and Sediment Control Plan (ESCP) / Strategy is a document which describes intentions and fundamental principles for the duration of the entire project.

It is a Plan/Strategy to be complimented by the preparation of more detailed Progressive (Site Specific) Plans prepared for:
- The different stages of construction (e.g. Surface Roadworks - clearing, stripping and stockpiling of topsoil; earthworks; drainage; paving).
- Various work areas (e.g. construction compounds; service installations; detention basins).

The Progressive ESCPs will identify risk and be prepared just prior to construction activity generally on copies of A3 drainage drawings and indicate (were relevant):
- Catchment areas (i.e. within and outside the road reserve).
- Construction boundaries.
- Exclusion zones and sensitive areas.
- Access points and tracks (e.g. haulage).
- Compounds and storage areas.
- Stockpile sites.
- Temporary work areas.
Material processing areas.
Concrete washout pit sites.
Permanent and temporary controls (including order of implementation).

In some instances, more than one (1) Progressive Plan may be required for an activity (e.g. Junction Road construction compound in relation to Cockle Creek management) due to:
- Staging rendering the process complicated.
- Change in the construction process, scope of work or work method.
- Controls are found to be ineffective following rainfall.

Progressive Plans will be prepared by both the Project Soil Conservationist and the Contractor’s environmental and field personnel in consultation with the Soil Conservationist to formulate practical documents for field reference. Additionally, Plans will be developed in consideration of other environmental aspects (e.g. sensitive vegetation).

In some instances these Plans may be developed jointly with Construction Work Method Statements where works are complex.

The Plans will be electronically recorded with hardcopies readily available for agency inspections or similar.

The Progressive ESCPs will be generally prepared according to Roads & Maritime Services QA Specification G38 and the ‘Blue Book’ and are to be read in conjunction with this Plan/Strategy and the Construction Environmental Management Plan.

Refer to Attachment 1 for an example Plan.

4.0 EXISTING ENVIRONMENT

4.1 Topography

The terrain of the project may be divided into the following sections based on location:
- Pennant Hills Road from M1 to M2 – generally the route and adjacent areas are along ridge line(s) and upper slopes within the topographical landscape.
- M2 – generally the route transverses rugged and steep terrain with narrow ridges and incised valleys.

4.2 Soil Types

The following Soil Landscape Groups are located along and adjacent to the project route:
- Hawkesbury (Hawkesbury Sandstone).
- West Pennant Hills (Wianamatta Shales).
- Glenorie (Hawkesbury Sandstone).
- Lucas Heights (Mittagong Formation with alternating bands of shale and sandstone).
All soils are susceptible to water and wind erosion. A high erosion hazard will exist where concentrated flows impact on works, especially in steeper areas (e.g. Hills M2 Motorway). A site specific summary of the different Soil Landscape Groups along with other soil properties is included within the Attachment 2.

4.3 Rainfall

Average annual rainfall of the general vicinity is highest at Turramurra (approximately 1,430mm) which is a nearby suburb to Wahroonga at the northern end of the project. Parramatta has an annual average rainfall of approximately 935mm and is located south of the project. The rainfall erosivity of the region follows the same trend, the northern end of the project has an R-factor of 3500 whereas the southern end of the project has an R-factor of 3000. A summary of specific R-factors across the site is included within attachment 2.

Most of the rain falls during major storms associated with the passage of cold fronts or summer thunderstorms. Prolonged low intensity rainfall is not common. Seasonal rainfall is unpredictable.

4.4 Sensitive Areas

The numerous watercourses transversing/adjacent to the project should be regarded as sensitive with special emphasis on:
- Darling Mills Creek.
- Blue Gum Creek.
- Tedbury Creek.
- Cockle Creek.

Other sensitive areas will include:
- The general urban environment (e.g. dust impacts on houses and factories etc).
- Threatened flora species.

4.5 Erosion and Sedimentation Hazard

It is expected a medium to high erosion and sedimentation hazard will be created during the construction of this project due to a combination of factors including:
- Nature of project with numerous worksites many of which will be quickly stabilised (e.g. compounds).
- Topographical positions as summarised in Section 4.1 with good controls required for Hills M2 Motorway works.
- Soil types as summarised in Section 4.2.
- Rainfall as summarised in Section 4.3 (e.g. high erosion hazard during summer thunderstorm period).
- The majority of works are located away from creeks as listed in Section 4.4.

5.0 SUPPORTING DOCUMENTATION
This Erosion and Sedimentation Control Plan / Strategy is based on the requirements and guidelines contained in the following manuals/documents:

- RTA Road Design Guide, Section 8: Erosion and Sedimentation.

The strategies and techniques detailed in the above documents are appropriate for the protection of the adjacent environment of this project.

### 6.0 KEY MANAGEMENT STRATEGIES

The following list outlines principles and control measures that will be implemented on this project for minimising erosion and sedimentation. They have been identified as key issues and techniques to control erosion and sedimentation on many road construction projects over the last 30 years. These points collectively fulfil the principles of sound soil conservation practice as detailed in the previously mentioned manuals. This will ensure a ‘preventative’ rather than a ‘cosmetic or remedial’ approach to erosion and sediment control.

Major emphasis will be placed on:

#### 6.1 Professional Expertise

- The engagement of a professional Soil Conservationist from T.R.E.E.S. P/L with extensive experience in road construction, who will co-ordinate and oversee all erosion and sediment control aspects during construction.

#### 6.2 Training

- Highlighting the importance of soil conservation issues during site inductions.
- Addressing relevant matters at regular ‘toolbox’ meetings during the course of the project (e.g. construction and maintenance of temporary controls).

#### 6.3 Minimising Extent and Duration of Disturbance

- Marking clearing limits.
- Staging of clearing operations.
- Initially clearing and grubbing to leave the soil surface in a reasonably rough condition with some surface vegetative cover.
Minimising disturbance of vegetation along the road corridor with special emphasis on management of construction activities adjacent to creeks or areas of concentrated flows (e.g. drains).

Minimize disturbance at intermittent water courses where possible by implementing the following methods where possible:
- Minimize disturbance to grasses
- Minimize disturbance to small understorey
- Use the cut-stump method for larger trees instead of stump removal

6.4 Control of Stormwater Flows onto, through and from the Site

- Separating ‘clean’ run-on water from ‘dirty’ (e.g. turbid) construction area run-off.
- Constructing permanent drainage structures early in the project including:
  - detention/sediment basins and traps;
  - catch drains with linings (e.g. concrete, rock, bidum or jute mesh);
  - culverts and associated inlet and outlet protection (e.g. dissipators).
- If reasonable and feasible, temporary sediment basins should be installed in accordance with the ‘Blue Book’. Some small and/or flat sites might not warrant construction of a sediment basin. This includes sites with <2,500 square metres of disturbed area, or those with an average annual soil loss from the total area of land disturbance that is less than 150 cubic metres per year. If in doubt the total soil loss can be calculation utilizing the data included within attachment 2 to determine if the building of a sediment retention basin is considered necessary or unnecessary.
- Maximising the diversion of turbid construction runoff into detention/sediment basins.
- Controlling run-off during the construction of embankments (e.g. fill shaping and the construction of temporary dykes and batter drains).
- Diverting formation run-off through sediment traps and into pits and the stormwater drainage system as soon as practical to reduce surface flow lengths and velocities.

6.5 Erosion Control Measures to Prevent On-Site Damage

- Constructing a range of erosion controls within the various road sub-catchments to reduce flow velocities and to compliment and increase the effectiveness and efficiency of sediment controls in the lower areas (e.g. weir type structures, diversion banks, progressive revegetation).
- Using geotextile linings to provide temporary surface protection in areas of concentrated flows (e.g. batter drains, pipe construction).
- Ensure stockpile sites are adequately established / selected ensuring they are: Located 5 metres away from areas of concentrated water flow.
  - Located at least 10 metres from a waterway.
  - Located so that the appropriate erosion and sediment control measures can be installed and will operate effectively.
  - Located outside of the tree protection zone (in accordance with AS 4970) of trees or native vegetation identified for retention.
- Implementing scour protection measures for haul roads and access tracks when these are an erosion hazard due to either their steepness, soil erodibility or potential for concentrating runoff flow. Such measures may include; ensuring the haul road is stabilized (e.g. selection of stable material such as road base or the use of geo binding
agents); breaking up the slope; catch drains with linings (e.g. bidum, jute mesh, heshen geobinding agents); shaping the haul road appropriately.

6.6 Sediment Control Measures to Prevent Off-Site Damage

- Constructing control measures as close to the potential source of sediment as possible.
- If reasonable and feasible, temporary sediment basins should be installed in accordance with the details provided in Section 6.4.
- Ensuring detention/sediment basin management of turbid water in accordance with the ‘Blue Book’ after cessation of rainfall with one (1) or a combination of:
  - flocculation with gypsum (or approved alternative flocculant);
  - pump-out for construction purposes or dust control.
- Measures such as pit controls and sand bag checks within median areas.
- Water not to be released from detention/sediment basins prior to achieving acceptable water quality standards as required by an Environmental Protection Licence (EPL), administered by the Environmental Protection Authority (EPA).
- Managing water quality during de-watering activities (e.g. treatment plan, flocculation with gypsum, pumping for treatment into a detention/sediment basin).
- Implement measures to control waste water from plant wash down, saw cutting, drilling or other activities that have the potential to release pollutants to water (e.g. water recycling, sediment traps or sand bags).
- Controlling the deposition of mud and soil material onto local roads.
- Dust suppression via water carts, restricting plant and vehicle movements to designated routes and limiting vehicle speeds etc.
- Initiating a water quality monitoring program in the adjacent watercourses with results analysed to determine the efficiency and effectiveness of implemented controls.

6.7 Stabilisation and Revegetation

- Ensuring the success of the later revegetation program by utilising a good topsoil management program.
- Keying of topsoil to batters. Topsoil depth to be 5 to 10 cms.
- Progressively revegetating disturbed areas utilising appropriate species.
- Controlling dust through progressive revegetation techniques.

6.8 Inspection and Maintenance

- Ensuring the progressive and continual implementation and maintenance of temporary erosion and sediment controls (e.g. sediment fences, diversion banks, diversion drains, sediment traps).
- Initiating a program to ensure regular maintenance of all erosion and sediment control measures. Sediment cleaned from structures, including detention/sediment basins to be deposited in a secure location where further pollution will not occur.
- Arranging regular inspections by the project soil conservationist and construction personnel to review and update control measures. Frequency to be determined by stage of works and risk level. Additional inspections will be conducted during and/or immediately following significant rainfall events to monitor the functioning of controls as per the requirement of the Soil and Water Management Plan.
6.9 Documentation and Recording

- Rainfall / climatic records.
- Developing documentation and systems for recording erosion and sediment control activities via:
  - Progressive ESCPs as detailed in Section 3.0;
  - Inspection reports completed by the Project Soil Conservationist.
- Site notes distributed internally between environmental and construction personnel.
- Dewatering procedure and records.
- Construction Air Quality Management Plan.
- Meeting minutes.
- Formal correspondence (e.g. Client, Environment Protection Authority).
- Water quality monitoring results (e.g. detention/sediment basins, upstream and downstream).

6.10 General

- Monitoring weather forecasts for planning and site ‘securing’ purposes.
- Ensuring erosion and sediment controls are installed at all sites associated with construction activities including:
  - Access roads and tracks;
  - Office and compound sites;
  - Workshop areas;
  - Stockpile sites.
- Liaising with the relevant government authorities in relation to construction and control measures.
- Leaving temporary erosion and sediment controls in place until the disturbed catchments have over 70% vegetation cover (i.e. beyond pavements).

7.0 CONCLUSION

The strategies presented in this Plan / Strategy are considered to appropriately address all issues relevant to erosion and sediment control and to minimise potential impact.

Forward planning, adherence to a system of documentation and training will be key elements to ensure sound performance in the field.

8.0 ACKNOWLEDGEMENTS

- T.R.E.E.S. P/L (November 2010), Hunter Expressway, Kurri Kurri to Branxton Section, Primary / Generic Erosion and Sedimentation Control Plan / Strategy.
- T.R.E.E.S. P/L (July 2012), Construction of Majura Parkway, Primary/Generic Erosion and Sediment Control Plan/Strategy.
- Department of Environmental and Climate Change (2008), Management Urban Stormwater: Soils and Construction, Vol 2D, Main Road Construction.
9.0 ATTACHMENTS

1 Example Progressive Erosion and Sediment Control Plan
2 Soil Properties and Design Parameters
Attachment 1: Example Progressive Erosion and Sediment Control Plan
GENERAL CONSTRUCTION NOTES

1. This plan to be read together with relevant Environmental Documentation (Construction Soil and water Management Plan and Relevant EWMS).
2. Weather forecasts to be regularly monitored.
3. Numbering indicates ‘order’ of works where relevant (e.g. 1, 2, 3).
4. The principle of minimum disturbance to existing vegetation to be implemented with ‘no-go’ zones isolated with flagging etc.
5. ‘Clean’ and ‘dirty’ or construction runoff to be separated.
6. Where required, sediment basins and ‘clean’ and ‘dirty’ water drains to be constructed immediately as permitted.
7. Temporary erosion and sediment controls to be installed prior to site disturbance where reasonable and feasible.
8. Crossings to be constructed as per ‘Blue Book’ guidelines and in accordance with CoA B11 prior to any plant/vehicle movement over watercourses.
9. Stockpile locations are indicated on Plan where relevant with temporary revegetation as necessary (e.g. topsoil, unsuitable).
10. Runoff control from formations/tops of fills to sediment basins to be via one or a combination of fill shaping, diversion drains/banks, earth bunds along top edges of fill baffers discharging to batter drains and storm water pits etc.
11. Sediment basins to be managed in accordance with the EWMS (e.g. flocculation, testing & discharge or reuse).
12. Culvert inlet and outlet protection to be constructed immediately after pipe or box unit installation (e.g. head & wing walls, dissipaters)
13. The location of temporary controls on this Plan are indicative only with actual sites to be determined during works.
14. No controls are to be installed outside of the project footprint without first obtaining appropriate approval. The Project Signage and Fencing Protocol is to be adhered to.
15. Erosion controls (e.g. Windrows on contours to reduce slope length and surface flow velocities)
16. Sediment controls (e.g. sediment fences, mulch sediment traps, mulch bund sediment traps)
17. Disturbed areas to be progressively topsoiled and revegetated (e.g. baffers).
18. Mulch will be stored and managed in accordance with the Document - "Environmental Direction Management of Tannins from Vegetation Mulch" (Roads & Maritime Services, 2012 b).
19. The tracking of mud/soil material onto local roads to be monitored and controlled (e.g. shaker ramps).
20. Dust to be controlled on site and along unsealed roads with controls such as water carts and or limiting vehicle speeds.
21. Temporary controls to be inspected regularly with maintenance/repairs undertaken as required.
22. This plan has been prepared as per ‘Blue Book’ guidelines and standard drawings - Volumes 1 & 2D.
23. Controls shown on the Plan are ‘existing’ unless otherwise noted.
24. This Plan to be revised when required (e.g. change in construction methods and/or site conditions).
Clean water from Pennant Hill Road Managed via existing storm water drainage system.

Hording / Noise walls to be constructed

Specific Construction Notes

1. Initial site access via Wilson Road. Install Rumble Grid or wheel wash if required / maintain from demolition phase.
2. Install mulch bund with sed trap / maintain existing from demolition phase. Ensure spill way of sed trap is stabilized.
3. Construct clean water diversion to enable construction of stabilized site access on Pennant Hills Road.
4. Install Rumble Grid or wheel wash if required.
5. Prior to rainfall break up slope every 40 meters.
6. Commence general construction of the tunnel support facilities marked on plan.

Note: Due to space constraints the building of a sediment basin is not considered feasible. Furthermore, the average annual soil loss from the total area of land disturbed is less than 150 cubic meters per year, as such the building of a sediment basin is considered unnecessary.

Site parameters & Soil Loss Calculations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
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Clean water from local roads managed via existing storm water drainage system.
Attachment 2: Soil Properties and Design Parameters
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<td>Common soil constraints</td>
<td>High soil erosion and high mass movement hazard; steep slope, rock outcrop, shallow, stony, highly permeable soils with low fertility.</td>
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<td>High soil erosion hazard; localized impermeable highly plastic subsoil, moderately expansive.</td>
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Appendix B
Unexpected Discovery of Contaminated Land Procedure
## Document Control

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## Revision History

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<td>A</td>
<td>Nov 2014</td>
<td>Issued for internal review</td>
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<tr>
<td>B</td>
<td>Dec 2014</td>
<td>Revised to address internal comments</td>
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<td>C</td>
<td>Jan 2015</td>
<td>Revised the requirement of waste classification for off-site waste disposal. Amended the procedure for unexpected finds to include notification to Roads and Maritimes and Transurban.</td>
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Table of Content:

1. Introduction ............................................................................................................................. 1
2. Purpose ................................................................................................................................... 1
3. Induction / Training ................................................................................................................ 1
4. Scope ....................................................................................................................................... 1
5. Procedure ................................................................................................................................ 1
   5.1. Potential Contaminated Soil / Material or Acid Sulfate Soil ............................................. 1
   5.2. Personal Protective Equipment (PPE) ............................................................................... 1
   5.3. Undertake a Site/Area Contamination Investigation ..................................................... 1
   5.4. Remedial Action ............................................................................................................... 2
   5.5. Recomence Works ........................................................................................................... 2
1. **Introduction**

There are no restrictions on the distribution/circulation of this Procedure within the NorthConnex Project.

2. **Purpose**

This Procedure details the actions to be taken when potential contaminated soil/material is encountered during excavation/construction activities.

3. **Induction / Training**

Relevant personnel will be trained in the identification of potential contaminated soil/material including the requirements of this Procedure during the Project induction and/or regular toolbox talks.

4. **Scope**

This Procedure is applicable to all activities conducted by personnel on the NorthConnex Project that have the potential to uncover/encounter contaminated soil/material.

5. **Procedure**

5.1. **Potential Contaminated Soil / Material or Acid Sulfate Soil Encountered during Construction Activities**

If potential contaminated soil / material or acid sulphate soil is encountered during excavation / construction activities:

- STOP ALL WORK in the immediate/affected area.
- Immediately notify the Environment Manager (EM).
- Recomence works in an alternate area where practicable.
- If material is determined to the Acid Sulfate Soils, then management should be in accordance with the Acid Sulfate Soil management plan (Appendix F).

5.2. **Personal Protective Equipment (PPE)**

Prior to any contamination investigation/management, appropriate personal protective equipment (PPE) is to be worn as per the relevant Material Safety Data Sheet(s) (MSDS). This may include, but not be limited to:

- Eye goggles.
- Face mask.
- Rubber boots.
- Rubber gloves.
- Work clothes (i.e. long sleeve shirt/pants and steel capped boots).

5.3. ** Undertake a Site/Area Contamination Investigation**

The EM or Environmental Officer (EO) shall notify the representatives of Roads and Maritime and Project Co immediately. In consultation with the representatives of Roads and Maritime and Project Co, the EM is to assess the situation and if considered necessary, commission a suitably qualified contamination specialist to undertake a contamination investigation in the area of the find.

All materials which are to be disposed off-site is to be classified in accordance with the NSW Waste Classification Guidelines (EPA, 2014). If necessary, the EM will liaise with the relevant authorities to determine the appropriate management options.
The EM (in consultation with specialists) will determine the appropriate management measures to be implemented. This may include treatment or offsite disposal. If the material is to be disposed of offsite, ensure the waste facility is appropriately licensed.

5.4. Remedial Action

Remedial actions are to be incorporated into specific Environmental Work Method Statements (EWMS) and training provided to site personnel and subcontractors through inductions and toolbox training sessions.

Remedial works are to be undertaken in line with the EWMS.

5.5. Recommence Works

Recommence works once remedial works have been implemented. The EM grants approval once hold point is released.

Figure 5-1 is a summary of the procedure as a flow chart. It details the steps to be taken in the event of the unexpected discovery of contaminated land.

**Figure 5-1: Flow chart for discovery of contaminated land**

```
<table>
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<tr>
<td>Stop work immediately in the area of potential contamination and inform the EM</td>
</tr>
<tr>
<td>Set aside potential contaminated material and recommence works in alternate area</td>
</tr>
<tr>
<td>EM to classify the waste in accordance with the Waste Classification Guidelines (DECCW, 2009)</td>
</tr>
<tr>
<td>If relevant, the EM will notify and consult with authorities to determine a suitable management option</td>
</tr>
<tr>
<td>EM shall determine appropriate management (disposal or treatment) measures, Release Hold Point</td>
</tr>
<tr>
<td>Proceed with construction excavations in accordance with relevant sub plans</td>
</tr>
<tr>
<td>If potential contamination is determined to be acid sulfate soils, then management shall be in accordance with the ASSMP</td>
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Appendix C
Technical Guideline Environmental Management of Construction Site
Dewatering
Technical Guideline

Environmental Management of Construction Site Dewatering

EMS-TG-011

Issue 2 April 2011

Environmental Management System (EMS)
## About this release

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<td>March 2011</td>
<td>Draft</td>
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<td>2</td>
<td>April 2011</td>
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1.0 Purpose

The purpose of this Guideline is to assist RTA and Contractor project management teams to develop work method statements (WMS) for dewatering activities for main road construction and maintenance projects.

2.0 Scope

This Guideline applies to all projects undertaken by the RTA or engaged contractors that will involve the dewatering of ponded stormwater or infiltrated groundwater. It provides guidance on the preparation of WMS for dewatering activities where required under either RTA specification G35 (Environmental Protection - Management Plan) or G36 (Environmental Protection - Management System).

3.0 Introduction

Dewatering, for the purposes of this guideline, is any activity that involves the removal of ponded stormwater or infiltrated groundwater from any location on site and the subsequent reuse or discharge of that water.

Captured stormwater and infiltrating groundwater will fill sedimentation controls and pool in low lying areas of construction formations and excavations. These areas must be dewatered to maintain the effectiveness of sedimentation controls and to ensure formations and excavations are not adversely affected by long periods of inundation.

During construction activities there may be a requirement to dewater numerous locations including:
- Sedimentation controls (eg sedimentation basins and sumps)
- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations.

It is the objective of this guideline to ensure that all site dewatering activities are completed in a manner that does not cause harm to the environment. To achieve this, a site-specific WMS must be developed for all construction and maintenance projects to ensure that dewatering actions are planned, approved and supervised to minimise impacts on the receiving environment.

No construction site dewatering activity should be carried out unless it is in accordance with a WMS.

4.0 Planning Construction Site Dewatering Activities

Every dewatering activity must be planned to achieve satisfactory environmental outcomes. Sections 4.1 to 4.8 describe critical decisions that must be made in preparing dewatering WMS.

4.1 Identify areas of the site that will require dewatering.

Dewatering locations will be identified through detailed design, in development of the CEMP and during construction as earthworks and construction phases result in changing site drainage conditions. These may include:
- Sedimentation controls (eg sedimentation basins and sumps)
- Excavations
- Culvert and drainage constructions
- Low lying areas of road formations.
Under no circumstances should first flush concrete batching water be pumped to sediment basins for treatment. These waters should be reused within the batching process or must be treated in-situ to ensure accidental discharges do not occur.

4.2 Consider dewatering methods to minimise potential environmental impacts

There are various methods available for dewatering sedimentation controls and inundated areas of construction excavations and formations. The Contractor should assess different technologies with a view to providing the highest level of protection against environmental impacts.

Dewatering methods for sedimentation controls such as basins include pumping, low flow pipes and siphon discharges. Consideration should be given to alternatives to pumped discharges in all cases where practical.

Pumped dewatering presents specific risks relating to the pump inlet falling to the level of deposited sediment, resulting in direct discharge of polluted water to the environment. Any pumped discharge should be designed to prevent this scenario. Likewise, deposited sediment in controls such as basins must be maintained (removed) to ensure that inlets to dewatering systems are always above the level of deposited sediment.

There are two general methods for achieving water quality objectives for any site discharge, being:

a) Water quality treatment prior to discharge.

This is required for sedimentation basins and is the preferred method for any construction excavation or inundated area that has a sufficient volume and depth of water to provide flocculation of sediments prior to discharge. All area other than defined sedimentation basins that can be treated prior to discharge should have a designed dewatering method (e.g. a defined pumping point, low flow or siphon discharge).

b) Treatment with best practice controls prior to discharge.

Treatment with best practice erosion sedimentation controls during discharge is applicable for minor stormwater ponding and for activities such as individual culvert extensions where the volume of stormwater captured is minor and the dewatering activity is infrequent.

In these cases a suite of sedimentation controls, and appropriate erosion controls must be designed and implemented to provide on-site treatment of water prior to discharge to the environment. Controls may include sedimentation fences, mulch bunds, sedimentation sumps, geofabric wrapped gravel or mulch bunds, use of onsite grassed areas or a combination of techniques. The discharge from these activities must be managed to prevent erosion of the receiving environment.

4.3 Assess opportunities for reuse

Onsite reuse of stormwater or detained groundwater should be considered as a priority for all dewatering activities. Onsite reuse may include applications such as dust suppression, earthworks compaction, vegetation establishment/rehabilitation, and plant/vehicle wash-down.

Reuse of water on the construction site may reduce the need for imported or extracted water and provide a lower risk to the environment than direct discharge to the environment. Common minimum requirements for any reuse activity are that the reuse should not cause the ponding or runoff of water, which may then cause concentrated runoff and unauthorised discharge.

4.4 Assess limitations for any proposed reuse methods

Any reuse activity may be limited by climatic or site conditions. During heavy rainfall periods when the need is greatest to remove treated stormwater from sedimentation basins, construction sites may be closed and untrafficable due to the wet condition of the site. In these cases, onsite reuse for dust suppression or compaction is not feasible or possible. In these cases, the water must be discharged to meet the sedimentation basin.
maintenance timeframes specified in either the environmental protection licence or the CEMP (for non-licensed sites).

Planning for any reuse activity and the WMS for dewatering must take these limitations into consideration, and a WMS developed for the management of discharge which may be required in high rainfall events.

Discharge water quality objectives (see 4.6) will not apply only in the cases where the reuse activity is designed to be operational under all climatic and construction conditions and discharge to the environment will not be required.

4.5 Select discharge locations and provide adequate energy dissipation

It is important to ensure that dewatering activities do not cause subsequent erosion at the discharge location or in receiving environments. Consideration must be given to the potential for erosion at discharge locations when designing dewatering outlets. Preference should be given to locations with established stable drainage.

Energy dissipation must be provided at all dewatering discharge points. This may include the use of surface protection such as concrete aprons, geofabric, shade cloth, gabions or form ply depending on the condition of the receiving environment.

4.6 Determine and document water quality criteria for discharge and/or reuse

Sites with Environmental Protection Licenses will have defined water quality objectives for discharges from sedimentation basins. Best management practice still applies when discharging water from all other sites. This includes defining representative water quality criteria for the receiving environment and ensuring all discharges comply with these requirements. Standard project water quality objectives criteria are as follows:

- Total suspended solids 50mg/L
- pH 6.5 – 8.5
- Oil and grease no visible trace

Specific water quality criteria may be required for activities that have the potential to impact water quality through a range of pollutants including:

- general earthworks in soils with contamination issues
- earthworks in soils with naturally occurring issues such as acid sulphate soils, saline soils or high levels of other sulphide minerals (which may result in high concentrations of heavy metals in runoff)
- hydrocarbon spills
- concrete works (including batching operations)
- stabilised pavements
- precoat aggregates and spray sealing

Generally a review of environmental assessment and approval conditions and onsite conditions will provide further information on potential pollutants that may be present onsite or in site waters. Other methods to determine water pollutants may include the use of a testing probe, indicator strips, laboratory analysis, local knowledge and consultation with environmental officers and regulatory agencies.

If reuse activities are properly designed and managed then ponded stormwater or groundwater may be able to be reused onsite without specific treatment.

4.7 Assess the treatment techniques required to meet the water quality criteria.

Treatments should be designed to achieve the water quality outcome specified for the project, as well as to cater for the time constraints that may be applicable to the activity (ie 5 day management period for sedimentation basins). Treatments should be applied to waters as soon as the requirement is determined, and should be applied only by experienced and competent personnel. Care needs to be taken to ensure treatment methods do not adversely affect water quality.

Examples of common treatment applicable to RTA projects may include;
Flocculation of turbid waters is used to minimise the settling duration of suspended particles, as well as facilitate the clearing of waters exposed to dispersive soils that are prevalent throughout NSW. Flocculation enables water quality standards to be achieved within an accepted time period. A suitable flocculent should be chosen for sites based on an impact assessment of the receiving environment. In most cases RTA projects would utilise gypsum which is considered to be inert. There are other flocculants available however the use of these must be subject to consultation with relevant stakeholders, including DECCW and NSW Industry & Investment (Fisheries) prior to use.

- pH adjustment using a base such as hydrated lime (for acidic waters) and inversely an acid such as hydrochloric acid (for alkaline waters). Low volume trials for each location will need to be carried out to determine dosage rates. Special care must be taken when adjusting pH to understand the buffer capacity of the waters, ensuring the neutral point is not over-shot. Any personnel involved in the adjustment of pH must be suitably trained and competent in the use of any additives.

- Absorption of oils and grease is used to remove traces of hydrocarbons that may have been mobilised by rainfall. Sources of oil and grease on a project may include spill and leaks from machinery, runoff from precoat aggregate stockpiles, and runoff from adjacent travel lanes. Generally oils and grease will be removed from the surface of water detention structure by the use of floating booms, pads and socks.

4.8 Assess water sampling and testing requirements

Water quality sampling and testing may be required to ensure that the water quality objectives are met prior to either reuse or discharge of the water. Techniques may include sample collection and laboratory testing or in-situ field assessment.

A list of approved testing methods for various analytes can be referenced from “Approved Methods for the Sampling and Analysis of Water Pollutant in New South Wales” (DEC 2004). Licensed premises require approved testing methods as per the conditions of the environmental protection licence (EPL) unless formal agreement has been reached with the relevant agencies. Any such agreement must be documented, and records kept onsite at all times.

Non-licensed sites still require an approach to demonstrate due diligence for the testing of waters prior to discharge. This may include the use laboratory analysis and the approved testing methods, but alternatively can include calibrated comparison samples, turbidity tubes, portable probe analysis, or indicator strips. With the use of any of these alternative methods, their use should be discussed with environmental officers and personnel testing must be trained and competent. Regardless of the type testing utilised, comprehensive records must be kept onsite of all discharges.

5.0 Minimum Requirements for Dewatering Work Method Statements

5.1 WMS format

The format of site-specific WMS is flexible according to the procedures used by each Contractor. This guideline and RTA specifications G35 or G36 do not require an individual WMS for each dewatering location on each site.

Maps should be used to show all identified dewatering locations that the WMS applies to. Coded systems for similar type activities (e.g. pumping from sedimentation basin) can be used. The WMS should provide clear guidance for each dewatering activity on the following:

a) a map showing areas of the Site that will require dewatering
b) detailed description and justification of all selected dewatering methods
c) description of onsite water reuse requirements

d) a map showing proposed discharge locations for any offsite discharge

e) design requirements for each offsite discharge location to prevent erosion at the discharge location or in the receiving environment

f) water quality objectives relevant to the type of dewatering activity

g) description of the water quality treatment techniques to be used

h) water sampling and testing regime to validate water quality prior to and (if required) during dewatering

i) Proposed monitoring and supervision regime.

If changes are proposed to the dewatering method used at any location or new dewatering requirements are identified during construction you must submit either of the following to the Principal before commencing the activity:

a) revised and updated the Site WMS, or

b) a site-specific WMS for the activity.

5.2 Document the site activity approvals process

All sites discharging water must have in force a robust delegation for the approval of all controlled discharges. This process is to be clearly documented in work method statements and must nominate specific personnel who can approve dewatering activities. Delegates responsible for dewatering approval must be suitably trained and experienced in their duties. The approval process for dewatering activities is to be included in the worksite induction and training of onsite personnel to ensure unauthorised discharges are eliminated.

The minimum requirements of this approval are:

- water quality is demonstrated to meet the objectives in the WMS
- inspection of intake and discharge locations, equipment and receiving environment completed
- trained personnel are available to supervise and monitor the activity as specified on the WMS.

5.3 Document training and induction requirements

All staff responsible for approval and/or carrying out dewatering activities must be trained and inducted into use of the WMS. The WMS should include an induction register as a record of staff that are approved to conduct or approve dewatering activities.

5.4 Document the requirements for supervision of dewatering activities

The WMS must provide a clear description of all supervision and monitoring required for each dewatering activity. All dewatering activities must be inspected and monitored by inducted, experienced and competent personnel. Prior to commencing any dewatering activity the entire system, including intake and outlet, pump, and discharge location must be inspected.

All dewatering activities must be directly supervised for the entire duration. To remove the need for direct supervision, sites may carry out risk assessments and implement mitigation measures to ELIMINATE risks of causing environmental harm. Mitigation measures must be demonstrated to eliminate the possibilities of the following incidents:

- Intakes dropping into deposited sediments and discharging sediment laden waters,
- Erosion of the discharge locations and downstream environment,
- Inadvertent or intentional controlled discharge of untreated waters.

5.5 Record keeping for dewatering activities

You must keep the following records:

a) A copy of the dewatering WMS

b) date, time and estimated volume of water released for each discharge location
c) water quality test results for each discharge

d) records indicating who provides approval for each dewatering activity, and

e) evidence of discharge monitoring or risk assessment.
Appendix D
Water Quality Plan and Monitoring Program

(ALL-LLB-01-0001-QA-PL-0062) (to be attached once approved)
Appendix E
Stockpile Management Protocol
## Document Control

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## Revision History

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<td>B</td>
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<td>C</td>
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Table of Content:

1. Introduction ............................................................................................................................. 1
2. Purpose ................................................................................................................................... 1
3. Induction / Training ................................................................................................................ 1
4. Scope ....................................................................................................................................... 1
5. Stockpile Location Criteria .................................................................................................... 1
6. Protocol ................................................................................................................................... 2
7. Compliance ............................................................................................................................. 4

Appendix A: Stockpile Approval Flow Chart
Appendix B: Stockpile Location Assessment
Appendix C: Stockpile Site Register
1. Introduction

This Stockpile Management Protocol has been prepared to comply with the Conditions of Approval for the NorthConnex project. The protocol is referenced in Schedule 1 of the Instrument of Approval, noting that:

“Where a Stockpile Management Protocol has been approved by the Secretary for the SSI, material stockpile areas are not considered to be ancillary facilities”

This protocol will ensure that stockpiles are managed using appropriate mitigation measures. The Stockpile Management Protocol will be utilized to gain approval for all stockpiles that are not already approved within an Ancillary Facility Management Plan.

2. Purpose

This protocol outlines the locational criteria used to guide the placement of temporary stockpiles and provides both standard and site-specific mitigation measures to be implemented to minimise impacts on the environment. Stockpile sites may typically be required to store material including, but not limited to temporary storage of:

- Excavated or delivered materials to be used in fill embankments and other design features.
- ASS subject to treatment prior to reuse (not currently identified on the NorthConnex Project).
- Excavated material unsuitable for reuse on the project.
- Excess concrete, pavement, rock, soils and aggregate stored for potential reuse in the Project or prior to removal from site.
- Imported sands, soils, aggregates, recycled concrete products, topsoils, rock and engineered fills for use in the Project.
- Topsoil, mulch, timber for landscaping and revegetation works.

Temporary stockpiles would be removed for re-use within the project or disposed of off-site.

Stockpiles that are within the construction footprint and are in place for less than 30 days are not subject to this Protocol.

Potential Contaminated Soil / Material will be managed in accordance with the project Unexpected discovery of contaminated land procedure (Appendix B to the CSWMP). Acid Sulfate Soils will also be managed in accordance with the relevant procedure within the wider CSWMP.

The process for monitoring and managing spoil including details of how excavated material would be managed on-site and during offsite transport is detailed within the Construction Waste and Reuse Management Plan.

Where material is taken off-site (such as to a landfill facility), appropriate approvals will be confirmed and/or obtained under the EP&A Act 1979 and POEO Act 1997.

3. Induction / Training

Personnel involved in planning or managing stockpiles will be trained in the requirements of this Procedure. Training will also include inductions, toolbox talks, pre-starts and targeted training as required.

4. Scope

This protocol is relevant to the planning, placement and management of all stockpiles on or related to the NorthConnex Project being delivered by the LLBJV.

5. Stockpile Location Criteria

Stockpiles sites on the Project shall be assessed against the following criteria:
• Located 5 metres away from areas of concentrated water flow; Located at least 10m away from 1st Order Watercourse;
• Have ready access to project or road network;
• Located on relatively level land;
• Located to minimize the need for heavy vehicles to travel on local streets and / or through residential areas;
• Not unreasonably affect the land use of adjacent properties;
• Located so that the appropriate erosion and sediment control measures can be installed and will operate effectively;
• Located on land above the 20 ARI flood level unless a contingency plan to manage flooding is prepared and implemented;
• On land that does not require the removal of threatened species (beyond those already impacted by the project);
• On land that does not require the removal of EECs (beyond those already impacted by the project) or within the tree protection zone (in accordance with AS 4970) of EEC;
• On land that does not require the removal of roosting habitat for listed threatened fauna species (beyond those already impacted by the project);
• Provides sufficient area for the storage of raw materials to minimize, to the greatest extent practical, the number of deliveries required outside of construction hours;
• Positioned in areas were minimal visual and light spill impacts anticipated at the nearest residence.
• Positioned in areas were minimal noise and vibration impacts anticipated at the nearest residence.
• Located in areas that will not impact on heritage sites (beyond those already impacted by the project); and
• Located within the approved Project boundary.

Prior to use, proposed stockpiles will be assessed under the Stockpile Location Permit (Appendix B). The Stockpile Location Permit determines who is to provide approval and considers if a Minor Consistency Review is be undertaken.

Stockpiles that are within the construction footprint and are in place for less than 30 days do not require approval under the Stockpile Location Protocol and Permit.

Approved stockpile locations are to be marked-up on PESCPs or relevant site plans and recorded in the project Stockpile Register (example located in Appendix C).

6. Protocol

Prior to the establishment of any stockpile on site as part of the project, ensure that:

1. The location of the stockpile is to be considered against the site selection criteria contained in Section 5 and requires prior approval via a Stockpile Location Permit (Appendix B). The Stockpile Location Permit determines who is to approve the stockpile and if a Minor Consistency Review is to be undertaken. Appendix A provides a flow chart that illustrates the stockpile establishment process.

2. Site-specific mitigation measures, where they are necessary to further reduced impacts, are identified and detailed in the ‘Stockpile Location Permit’.

3. Mitigation measures for each stockpile site include as a minimum:

   • Materials will not be stockpiled within the tree protection zone (in accordance with AS 4970) of trees or native vegetation to be retained, and never pushed up around the base of trees. Trees are not to be flooded or soils caused to be waterlogged as a result of stockpile development.
   • A PESCPs will be prepared and implemented in advance of stockpiling. The PESCP will be submitted to RMS in order to raise the G38 Hold Point 3.1. PESCPs will be updated as required. The PESCP will include controls such as:
The PESCP will detail soil and water management measures consistent with Managing Urban Stormwater - Soils and Construction Vols 1 and 2, 4th Edition (Landcom, 2004) to minimise soil erosion and the discharge of sediment and other pollutants to land and/or waters. This may include:

- Erosion and sedimentation controls will be erected between the site and any drainage lines or down-slope areas.
- A diversion bund will be installed on the uphill side of the stockpile to divert water around the site, unless run on water is ‘dirty’ construction water. Where this occurs ‘dirty’ run on water shall be diverted to erosion and sediment controls.
- Erosion and sediment control structures shall remain installed and maintained until sufficient stabilisation is achieved as per the Blue Book.
- Separating ‘clean’ run-on water from ‘dirty’ (e.g. turbid) construction area run-off.
- Temporary sediment basins. It is noted that some small and/or flat sites might not warrant construction of a sediment basin. This includes sites with <2,500 square metres of disturbed area, or those with an average annual soil loss from the total area of land disturbance that is less than 150 cubic metres per year. If in doubt the total soil loss can be calculation utilizing the data included within Attachment A to determine if the building of a sediment retention basin is considered necessary or unnecessary.
- Maximising the diversion of turbid construction runoff into detention/sediment basins.
- Controlling run-off during the construction of stockpiles (e.g. fill shaping and the construction of temporary dykes and batter drains).
- Diverting stockpile run-off through sediment traps and into pits and the stormwater drainage system as soon as practical to reduce surface flow lengths and velocities.

Controls will be installed around all stockpiles that are in place for more than 10 days in order to prevent wind and water erosion. These controls will be in accordance with the Erosion and Sediment control plan and may include stabilisation with cover crop or similar appropriate controls as per the site Progressive Erosion and Sediment Control Plan. Stockpile areas will be monitored for odours on a regular basis during inspections. If nuisance odours are generated and are impacting sensitive receivers, odour control measures will be implemented, in accordance with the Construction Air Quality Management Plan. Weed management measure will be undertaken progressively including weed spraying or covering the stockpile to prevent growth as appropriate. Topsoil that is not contaminated by weeds will be located separately to other stockpiles.

- Dust management measures (including for vehicle movements associated with stockpiling activities) will be implemented in accordance with the requirements of the Air Quality Management Plan.
- Stockpile heights will be generally no greater than 2 meters with slopes no steeper than 2:1.
- Mulch stockpiles must be monitored and turned over as required to avoid spontaneous combustion.
- Mulch stockpiles in high tannin generating vegetation should be:
  - Located 50m from water ways for mulch stockpiles that will be in place for duration of more than 1 month.
  - Located 20m from water ways for mulch stockpiles that will be in place for duration of less than 1 month.
  - Located on elevated ground where possible.
  - Be fully bunded to ensure up-gradient water is prevented from entering the stockpile site, and to capture tannin impacted water. Bunds are to be impervious and 300mm high at a minimum. All bunded stockpiles that are in place for a period longer than one month must include a lined discharge point for overflow in extreme rainfall events.
  - Managed in accordance with all other requirements specified in the Environmental Direction: Management of Tannins from Vegetation Mulch.
  - Other relevant mitigation measures that are specified within the CEMP.
• Other mitigations measures that are requiried by an approved Stockpile Location Permit.

4. In accordance with Roads and Maritime Specification R44, topsoil stockpiles must:
   • be free from subsoil, other excavated materials, contaminated materials, refuse, clay lumps and stones, timber or other rubbish;
   • be trimmed to a regular shape to facilitate measuring and batter slopes not steeper than 2H:1V;
   • have their batters track rolled or stabilised by other means; and
   • be seeded with sterile cover crop in accordance with Specification Roads and Maritime D&C R178, to encourage vegetation cover.

5. Following completion of the Project Works, carry out restoration of the stockpile sites in accordance with Specification RMS D&C R178
   • Stockpile that are within the construction footprint and are in place for less than 30 days do not require approval under the Stockpile Location Permit.
   • The Stockpile Management Protocol is not required for stockpiles that are approved within an Ancillary Facility Management Plan.
   • Appendix A provides a flow chart that illustrates the stockpile establishment process.

7. Compliance

Compliance with this Stockpile management protocol will be tracked through the weekly environmental inspection regime, as per the Construction Environmental Management Plan.

Identified non-compliances will be reported to the Environmental Manager and the appropriate management measures will be put in place to ensure ongoing compliance.
Appendix B: Stockpile Location Assessment
# Stockpile Location Permit

**Project:** NorthConnex

<table>
<thead>
<tr>
<th>Date:</th>
<th>Location/Chainage:</th>
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<th>Comments</th>
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<td>Is the site located within the Approved Construction Footprint?</td>
<td>Yes = LBJV EM.</td>
<td>No = Minor Consistency Review to be first approved by RMS and the ER.</td>
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<td>2</td>
<td>Is the site on land that does not require the removal of threatened species (beyond those already impacted by the project)?</td>
<td>Yes = LBJV EM.</td>
<td>No = Minor Consistency Review to be first approved by RMS and the ER.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Is the site on land that does not require the removal of EECs (beyond those already impacted by project) or within the tree protection zone (in accordance with AS 4970) of EEC?</td>
<td>Yes = LBJV EM.</td>
<td>No = Minor Consistency Review to be first approved by RMS and the ER.</td>
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<tr>
<td>4</td>
<td>Is the site on land that does not require the removal of roosting habitat for listed threatened fauna species (beyond those already impacted by the project);</td>
<td>Yes = LBJV EM.</td>
<td>No = Minor Consistency Review to be first approved by RMS and the ER.</td>
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<td>5</td>
<td>Are minimal noise and vibration impacts anticipated at the nearest residence?</td>
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<td>No = Minor Consistency Review to be first approved by RMS and the ER.</td>
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<td>6</td>
<td>Are minimal visual and light spill impacts anticipated at the nearest residence?</td>
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<td></td>
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<tr>
<td>8</td>
<td>Is the site located so that appropriate erosion and sediment control measures can be installed and will operate effectively?</td>
<td>Yes = LBJV EM</td>
<td>No = Amend proposal to facilitate controls.</td>
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<td>9</td>
<td>Is the site located so it does not unreasonably affect the land use of adjacent properties?</td>
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<td>No = Amend proposal.</td>
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<td>10</td>
<td>Is the site located 5 metres away from areas of concentrated water flow?</td>
<td>Yes = LBJV EM</td>
<td>No = LBJV EM to approve only if an ERSED plan is approved by the Project Soil Conservationist.</td>
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<td>11</td>
<td>Is the site located at least 10 metres from a 1st Order Watercourse?</td>
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<td>12</td>
<td>Does the site have ready access to project or road network?</td>
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<td>Is the site located to minimize the need for heavy vehicles to travel on local streets and / or through residential areas?</td>
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<td>Is the site located on land above the 20 ARI flood level?</td>
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<td>Does the site provide sufficient area for the storage of raw materials to minimize, to the greatest extent practical, the number of deliveries required outside of construction hours?</td>
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**Compliant Stockpile Locations:**
If the proposed stockpile site is deemed compliant with the location based criteria (or the relevant approval requirements have been obtained), this form is to be approved prior to establishment of the stockpile site.

*Once approved, the stockpile location must be recorded in the project stockpile register.*

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<td>Environmental Representative Approval (if required):</td>
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Appendix C: Example Stockpile Site Register
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<td>Is the site located to minimize the need for heavy vehicles to travel on local streets and / or through residential areas?</td>
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<td>Is the site located on relatively level land?</td>
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<td>Is the site located so it does not unreasonably affect the land use of adjacent properties?</td>
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<td>Is the site located on land above the 20 ARI flood level?</td>
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<td>Is the site on land that does not require the removal of threatened species (beyond those already impacted by the project)?</td>
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<td>Is the site on land that does not require the removal of EECs (beyond those already impacted by the project) or within the tree protection zone (in accordance with AS 4970) of EEC?</td>
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<td>Is the site on land that does not require the removal of roosting habitat for listed threatened fauna species (beyond those already impacted by the project);</td>
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<tr>
<td>Does the site provides sufficient area for the storage of raw materials to minimize, to the greatest extent practical, the number of deliveries required outside of construction hours?</td>
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<tr>
<td>Are minimal noise and vibration impacts anticipated at the nearest residence?</td>
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<td>Are minimal visual and light spill impacts anticipated at the nearest residence?</td>
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<td>Is the site located in an area that does not impact on heritage sites beyond those already impacted by the project?</td>
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<td>Is the site located within the Project boundary?</td>
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<td>Comment: additional mitigation measures etc.</td>
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Appendix F
Acid Sulfate Soil Procedure
Acid Sulfate Soil Procedure

NorthConnex & M2 Integration Project
Lend Lease Bouygues Joint Venture

Document Number:  
Revision: 1
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Table of Content:

1. Introduction ............................................................................................................................. 1
2. Purpose ................................................................................................................................... 1
3. Induction / Training ................................................................................................................ 1
4. Scope ....................................................................................................................................... 1
5. Background ............................................................................................................................. 1
   5.1. Types of ASS .............................................................................................................................. 1
   5.2. Occurrence of PASS and ASS .................................................................................................. 2
   5.3. Monosulfidic Black Ooze .......................................................................................................... 2
   5.4. Acid Sulfate Rock ...................................................................................................................... 2
6. Aspects and impacts .............................................................................................................. 4
   6.1. Aspects ....................................................................................................................................... 4
   6.2. Impacts ....................................................................................................................................... 4
7. ASS Management ................................................................................................................... 5
   7.1. Roles ........................................................................................................................................... 5
   7.2. Process ....................................................................................................................................... 5
   7.3. On site identification of ASS ..................................................................................................... 5
   7.4. Management of ASS and MBO ................................................................................................. 6
8. Monitoring ............................................................................................................................. 10
9. Acid sulfate rock management ........................................................................................... 11
10. Contingency Planning .......................................................................................................... 12
    10.1. Unexpected finds ..................................................................................................................... 12
    10.2. Stormwater and sediment retention features of treatment pads ......................................... 12
    10.3. Treatment of excavated ASS .................................................................................................. 12
    10.4. Dewatering ............................................................................................................................... 12
    10.5. Surcharging ............................................................................................................................. 12
1. Introduction

There are no restrictions on the distribution/circulation of this Procedure within the NorthConnex Project.

2. Purpose

This procedure has been prepared to reduce the potential for risk of environmental damage caused by acidic leachate from actual acid sulfate soil (ASS), potential acid sulfate soil (PASS), Monosulfidic Black Ooze (MBO) and acid sulfate rock (ASR) disturbance, if encountered.

A key objective of this procedure is to provide a framework outlining appropriate environmental controls and procedures to be implemented during construction activities to avoid or reduce potential adverse environmental impacts associated with ASS, PASS and ASR disturbance, handling, treatment or disposal.

3. Induction / Training

Personnel involved in acid sulfate soil management will be trained in the requirements of this Procedure. Training will include inductions, toolbox talks, pre-starts and targeted training as required.

4. Scope

This procedure is applicable to all activities relating to acid sulfate soil management on the NorthConnex Project. The procedure applies to subsurface construction activities and has been prepared in general accordance with the RMS Guidelines for the Management of Acid Sulfate Materials, April 2005. The procedure also addresses EPA requirements and the ASSMAC Manual 1998.

5. Background

5.1. Types of ASS

There are two main types of acid sulfate soils:

**Potential Acid Sulfate Soils (PASS)**

PASS contain iron sulfides or sulfidic material which has not been exposed to air and oxidised. These soils are located in an oxygen deficient environment, typically below the water table. The field pH of these soils is typically 4 or higher, sometimes ranging into the alkaline. The sulfides/sulfidic materials oxidise once exposed to air with the potential to generate sulfuric acid, and hence pose risks to the surrounding environment through acid run-off.

**Actual Acid Sulfate Soils (ASS)**

ASS are soils that contain highly acidic layers, this high acidity is a result of the oxidation of soil materials that are rich in iron sulfides. ASS soils can have field pH measurements of 4 or less in dry conditions, and are typically characterised as possessing pale yellow mottling. This mottling is caused by the presence of the mineral Jarosite, a product of the oxidation of iron sulfides which generally requires a pH <3.7 to form. ASS may also contain dissolved metals such as aluminium, which can be toxic to aquatic animals and plants.

Where ASS is stockpiled there is potential that rain events could result in impact to surface waters if runoff is not managed.
5.2. Occurrence of PASS and ASS

ASS occurs predominantly on coastal lowlands, with elevations generally below 5m Australian Height Datum (AHD). The NSW Acid Sulfate Soils Manual (ASSMAC, 1998) notes that ASS are generally associated with the Holocene age (last 10,000 years) sediments.

These sediments were deposited in specific conditions such as within mangrove areas, saltmarsh, floodplain backswamps, coastal flats, seasonal or permanent freshwater swamps that were once saline or brackish and open tidal waters such as the beds of coastal rivers or lakes existed.

The acid sulfate soil analyses in the EIS indicated that both actual and potential acid sulfate soils are unlikely to occur within the Project. This is due to the Project being situated on inland ridgelines and well away from coastal environments. This is illustrated in Figure 1 below which shows a low probability of Acid Sulfate Soils within and surrounding the Project (Australian Soils Resource Information System, 2013).

**Figure 1. Acid Sulfate Soil Probability**

5.3. Monosulfidic Black Ooze

Monosulfides and Monosulfidic Black Ooze (MBO) are characterised by their black and often oily appearance, and when disturbed the release of hydrogen sulfide (rotten egg gas). They generally accumulate in low energy ASS environments such as waterways and lagoons and form thick ‘blankets’ of organic rich, gel like materials. When disturbed in significant quantities they can cause acidification of waterways and deoxygenation of waters. Where drains and wetlands are constructed MBO can continue to accumulate where favourable conditions exist, and present an ongoing management issue.

5.4. Acid Sulfate Rock

Acid Sulfate Rock (ASR) includes geological rock units that contain sulfide and sulfate minerals (pyrite). All rock has the potential to contain varying quantities of sulfide / sulfate minerals. Elevated concentrations are generally associated with metalliferous ore deposits and coal units but can also occur in other forms such as uplifted marine sedimentary rocks and wind driven sediments containing pyrite.

Pyrite can either be present as a fine (microscopic/framboidal) or primary mineral (macroscopic). The particle size range will determine the rate and severity of reaction, with finer particles offering a higher proportional surface area to mass ratio and hence quicker oxidation rate (Bannerman, 2005). ASR much like ASS, is generally not a hazard when left in anaerobic conditions (below water table or deep within fine grained units with
low oxygen diffusion rates). When fresh pyrite containing rock is disturbed during road construction such as in deep cuttings, oxidisation can occur through exposure to air and water.

The oxidisation and weathering process can lead to the generation of acidity, which in turn increases the solubility of sulfates. The leaching of sulfates and increase in acidity can degrade construction materials such as steel and concrete and potentially pollute water resources (surface and groundwater).

Where rock units contain naturally elevated heavy metals concentrations, additional acidity may leach the currently bound metals into solution.
6. Aspects and impacts

6.1. Aspects

Construction activities can cause the exposure of ASR, ASS or oxidation of PASS material which in turn may result in environmental impacts. Some of the causes of exposure and/or oxidation are:

- Excavation and exposure of ASR, PASS and ASS material.
- Exposure of subsurface PASS material due to dewatering activities.
- Discharge of sub-surface water as a result of settlement and reduction in available pore space (during settlement water is 'squeezed' out of the soil material), producing acidic leachate where it flows through oxidised ASS.
- Embankment settlement can depress the underlying material with respect to the water table. In some circumstances heave at the toe of the embankment by displacement may raise PASS material above the water table.
- Oxidation of pyrite in site won (rock from cuttings) or imported fill material.

It is noted that the acid sulfate soil analyses in the EIS indicated that both actual and potential acid sulfate soils are unlikely to occur within the Project. This is due to the Project being situated inland and well away from coastal environments.

6.2. Impacts

Should any of the above causes eventuate, the following impacts may result:

- Release of aluminium, nutrients and heavy metals (particularly arsenic) stored within the soil matrix;
- Death or stunted growth of aquatic flora and fauna;
- Deoxygenation of waterways leading to suffocation of fish and other aquatic animals;
- Mass mortalities of microscopic organisms;
- Increased light penetration due to water clarity;
- Loss of habitat;
- Persistent iron coatings; and
- Damage to infrastructure e.g. Corrosion of concrete, limestone.
7. ASS Management

7.1. Roles

The identification, assessment and management of potential impacts relating to acid sulfate soils is the responsibility of the Environmental Manager, Environmental Coordinators/Advisors, Site Foreman and Project Engineers.

7.2. Process

Where analysis has not already been undertaken on risk areas such as creek crossings, they should be sampled and tested a minimum of 5 days prior to work commencing in the area. Any areas identified as containing PASS will be managed in accordance with this Plan. Following identification, ASS management will occur as described in Section 7.4.

7.3. On site identification of ASS

The following field procedures have been developed to determine whether the soils may contain acid generating potential to levels requiring treatment. It has been developed based on information in the NSW ASSMAC guidelines (1998).

The following flow chart should be used to assist in the initial identification process of soils which have not already been assessed as being ASS or PASS. Detailed ASS identification protocol and collection methodologies can be found in Appendix A and Appendix B respectively.

Figure 2. New Find ASS Identification Process

Identification of PASS or ASS
- Refer to acid sulfate soil risk maps
- Conduct visual assessment of excavations and excavated soils
- Note the colour and any odour of the soil which may indicate the presence of ASS
- If field indicators and risk mapping show potential signs of ASS / PASS conduct field pH test.

pH Field Test

pH > 5.5
No Actual Acid Sulfate Soil (ASS).
Could still contain PASS

pH < 5.5
Maybe Acid Sulfate Soil. Place half the sample in a freezer bag, label and place in freezer. Conduct an Indicator test on the other half of the sample.

Conduct Indicator Test (Appendix A)
Trained environmental staff to undertake indicator test to confirm presence of PASS or ASS

No response to indicator test
No further action required

Reaction to indicator test
Send frozen sample to lab for verification of ASS and required liming rate (Appendix B)
7.4. Management of ASS and MBO

Introduction / Resources

For management or neutralisation of MBO, ASS and PASS soils, medium-fine Aglime will be used. LLBJV may also use liquid lime to treat collected acid run-off and ASS throughout the project due to the extremely fine particle size (5 micron).

MBO will be managed in accordance with the ASS management checklist. If required specialist advice will be sought from the project Soil Conservationist and external laboratory.

The Aglime purity should preferably be 90% or better, (that is, Neutralising Value [NV] > 90), unless there is a significant savings to be made by use of less pure Aglime. In the latter case, however, the individual lime dosing rates will need to be increased accordingly. The requirement for greater amounts of Aglime of lower purity should be borne in mind when assessing the supplies of this material, as the cost savings from less pure material may be offset by the need for more, and correspondingly higher total transport costs.

An aglime store will be established at the compound or treatment site/s. Aglime is non-corrosive, and requires no special handling – it will be necessary to cover the stockpile with a tarpaulin or cover the stockpile with plastic, to minimise dust generation and prevent wetting, since it is then more difficult to spread.

Lime storage shall be managed such that any runoff generated is captured, and treated to correct pH if necessary, to prevent alkaline runoff to waterways.

Availability of liquid lime and Aglime from local suppliers will be confirmed prior to ASS disturbance and lead time for deliveries established.

ASS management will be recorded on an ASS checklist which is provided below as Figure 5.

Immediate Reuse

In the case of immediate reuse on site (e.g. trenching and backfilling within a day), there is a reduced likelihood that PASS will be exposed long enough to oxidise and become ASS. Immediate reuse (same day) may be appropriate if PASS are of low to moderate strength. It is recommended that lime application occur prior to backfilling as a precautionary measure.

Further, the soil material will require backfilling in the reverse order of excavation (i.e. last out first in).

Note: the majority of situations are not conducive for immediate reuse and as such the decision for immediate reuse can ONLY be made by the Environment Manager.

Treatment of ASS onsite

- The ASS Treatment Area (ASSTA) should be established prior to works that are likely to encounter ASS or PASS. ASS treatment area is to be located in accordance with the Stockpile management protocol. Generally the treatment area will be:
  - As close as possible to the source of the material
  - Located at a suitable elevation to be unlikely impacted by flooding
  - Away from identified sensitive receivers
- Where possible, prior to soil disturbance, add required amounts of lime over the area to be disturbed to ensure mixing occurs as early as possible
Note - Figure 4 provides further guidance on the amount of lime required
Note - Any laboratory analysis undertaken as per Appendix B will provide specific liming rates.

- Transfer soil to treatment area.
- Soil shall be laid in 150mm to 300mm layers on a treatment pad (and lime added in accordance with the calculated liming rates if not already added during excavation). See Appendix D for typical treatment pad design.
- If sufficient mixing did not occur during excavation and initial in situ lime addition, the soil shall be turned over/ mixed in a manner such that lime will be distributed throughout the soil matrix.
- The material is then left on the treatment pad for approximately 4-5 days to allow neutralisation to occur (or less if neutralisation can be achieved sooner), turning the soils when the surface dries out, and so increasing the rate of oxidation. Effective drying and mixing of lime with clay is often very difficult. The drying rate is dependent on the temperature and in cooler climates the methods may be too slow to be practicable.
- Water contained within the collection sumps will need to be sampled to assess requirements for treatment prior to discharge (Appendix C).
- This material shall remain bunded until validation results are available and return concentrations less than the respective criteria (detailed in Appendix B). Should the stockpile validation results exceed the criteria, additional lime will be added as required and further validation samples collected.

Figure 3. ASS neutralisation rates

The tonnes (t) of pure fine aglime, CaCO₃, required to fully treat the total weight/volume of Acid Sulfate Soils (ASS) can be read from the table at the intersection of the weight of disturbed soil [row] with the existing plus potential acidity [column]. Where the exact weight or soil analysis figure does not appear in the heading of the row or column, use the next highest value.

Reuse of ASS on site

Once stockpile validation results confirm the criteria described above has been complied with, reuse of the material on site is permitted.

If material cannot be reused onsite and off-site disposal is required, procedures outlined within the document Waste Classification Guidelines, Part 4: Acid Sulfate Soils shall be implemented, as detailed in the following sections.

Disposal of potential ASS offsite

- Keep PASS wet at all times during excavation and subsequent handling, transport and storage until they can be disposed of safely.
• Material must be received at the disposal point within 16 hours of being dug up.
• PASS may be disposed of in water below the permanent water table, provided:
  o this occurs before they have had a chance to oxidise, i.e. within 24 hours of excavation
  o they meet the definition of ‘virgin excavated natural material’ (VENM) under the Protection of the Environment Operations Act 1997, even though they contain sulfidic ores or soils.
• Documentation shall be provided to the occupier of the landfill for each truckload of material received, indicating that the soil's excavation, transport and handling have been in accordance with the Acid Sulfate Soil Manual, thus preventing the generation of acid.
• Soil that has dried out, undergone any oxidation of its sulfidic minerals, or which has a pH of less than 5.5 must be treated by neutralisation (as per below ASS disposal requirements) and disposed of at a landfill that can lawfully accept it.
• The disposal site's licence will outline what documentation needs to be kept and for how long.
• For any transport of PASS:
  o Lime the bottom of the truck;
  o Load PASS and coat top layer with lime; and
  o Cover spoil load.

Disposal of actual acid sulfate soils

• ASS must be treated by the generator of the waste before it can be disposed offsite. Treatment should be in accordance with the neutralising techniques outlined above in Section 7.4.3.
• A review of the analytical results will be undertaken on a range of parameters (not AASS or PASS) that may impact on the waste classification for offsite disposal.
• Once classified, the waste must be taken to a landfill licensed to accept that class of waste.
• The landfill should be informed that the ASS has been treated in accordance with the neutralising techniques outlined in the NSW Acid Sulfate Soil Manual and that the waste has also been classified in accordance with Waste Classification Guidelines: Part 1 – Classifying waste (DECCW, 2008). A copy of the analytical results will be required by the Landfill prior to disposal.
## NorthConnex – ASS Management Checklist

<table>
<thead>
<tr>
<th>#</th>
<th>Control Measure</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Comments / Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Have adequate stockpile and treatment areas been constructed to contain excavated materials?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Have neutralisation rates been calculated based on the ‘Net Acidity’ of the materials being disturbed?</td>
<td></td>
<td></td>
<td></td>
<td>Liming Rate =</td>
</tr>
<tr>
<td>3</td>
<td>Is there sufficient neutralising agent stored on site to apply to materials?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Is there sufficient neutralising agent ready to be applied to any ‘open excavation’ faces that require treatment?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Will there be any immediate water treatment required and is there sufficient containment and neutralising agents on site?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Will the mixing process be adequate to neutralise all acidity present? Does a higher safety factor need to be introduced?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Was the mixing process and containment adequate?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>How many verification samples are required?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Have verification samples been sent to a laboratory for the correct testing suite?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Have verification samples passed?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Have materials been reused and where?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Has the original disturbance site and containment area been inspected for any acidity issues?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional Comments:

Completed By: ____________________  Role: ____________________  
Signature: ____________________  Company: ____________________
8. Monitoring

Where surface water and/or leachate collects within bunded treatment areas or excavations in ASS or PASS areas, the water shall be tested.

Regular visual monitoring of PASS/ASS areas and surrounds shall be undertaken to identify signs of ASS oxidation. This monitoring should include detecting:

- Unexplained scalding, degradation or death of surrounding vegetation.
- Unexplained death or disease in aquatic organisms.
- Formation of the mineral jarosite and other acidic salts in exposed or excavated soils.
- Areas of green-blue water or extremely clear water indicating high concentrations of aluminium.
- Rust coloured deposits on plants and on the banks of drains, water bodies and watercourses indicating iron precipitates.
- Black to very dark coloured waters indicating de-oxygenation.
- Area of black ooze (potentially indicating monosulfidic black oozes) typically in drains and low lying areas.
9. Acid sulfate rock management

The risk of acid rock material impacting the local environment is assessed to be low due to the variable nature and distribution of sulphide within the cuts. A strategy for the management of ASR has been developed and is described in the flow chart below:

When there is seepage from ASR rocks in a cut or from a stockpile, the water will be collected in a sedimentation pond or designated sump and where required, treated to neutralise the pH of the water prior to release. (See Appendix C for water treatment requirements).

ASR rocks will not be used for drainage blankets or in waterways.
10. Contingency Planning

10.1. Unexpected finds

If ASS or PASS is suspected in unexpected areas, appropriate actions must be taken to ensure potential environmental damage is minimised. This shall include:

- Works potentially affecting the material are to cease and environmental staff notified immediately.
- If field test results indicate that PASS / ASS may be present then collect a sample for submission to a NATA accredited Laboratory for confirmation of PASS / ASS and to calculate the applicable liming rate.
- If PASS is believed or shown to occur in the vicinity of the work area, investigate an alternate construction method that avoids the need to disturb PASS.
- If avoidance is not possible, manage in accordance with Section 7.4

**Note:** Until ASS is confirmed do not stockpile with confirmed ASS. Stockpile on impervious pad area separately.

10.2. Stormwater and sediment retention features of treatment pads

If monitoring indicates that the storm water retention features around the treatment or stockpile areas are being breached or have the potential to be breached, a re-assessment of the construction and dimensions of the features will be made that includes:

- The height of the bunds
- The area and depths of the ponds
- The grade and drainage characteristics of the area surrounding the treatment areas

Based on this review, the appropriate changes to the design of the site stormwater retention features should be implemented.

10.3. Treatment of excavated ASS

If treatment of excavated ASS regularly fails to meet the verification target, then a review of the treatment approach should be conducted. This may include a re-assessment of:

- The concentration of the total potential acidity in the soils
- The type and source of neutralising agent used
- The method of mixing the neutralising agent into the ASS.

The aspect considered to be causing the poor treatment results would then be amended accordingly. Treated soils should not be reused on or off site until the verification targets have been achieved.

10.4. Dewatering

Where dewatering is found to be exposing PASS to an extent greater than necessary or desired and potentially having an adverse effect on groundwater quality, a review of the necessity and approach to dewatering activities should be undertaken. This may include:

- Use of a greater number of well points with lower extraction rates to minimise drawdown
- Use of hydraulic barriers
- Re-design of the structure to minimise or remove the need for dewatering

10.5. Surcharging

If surcharging is causing adverse effects on water quality, then excavation, treatment and reinstatement of the relevant material may be necessary as a last resort. Alternatively, a shallow groundwater treatment trench (containing neutralising agent) could be installed between the surcharge area and the down gradient receptors to prevent groundwater impacts.
Appendix A – Acid Sulfate Soils & Rock Field Identification Protocol

A1. Visual Assessment

If working in an area of ASS and PASS, it is important to be able to recognise indicators of actual acid sulfate soils to prevent further acidification of land and waterways. These indicators include:

- cloudy green-blue water
- excessively clear water
- iron stains
- poor pasture
- scalded soil
- yellow jarosite
- ‘rotten egg’ smell
- waterlogged soil
- corrosion of concrete and/or steel structures
- oily-looking surface iron bacterial scum
- dark grey soils

Should these conditions be encountered the Environmental Coordinator and the site foreman should immediately be alerted to the material and area of concern.

A2. Taking the sample

Visually assess the soil for colour, texture, vegetation, porosity etc. Write down the description along with the soil location, depth, date, time and sample number onto results sheet, and onto the sampling container.

Soil samples should include yellow jarosite (if observed) or be a representative sample either in an airtight plastic bag or soil jar.

Note: freezing the sample prevents oxidisation but it is best to use samples which have been thawed; therefore if testing is not to be undertaken immediately, freeze samples.

A3. Equipment set up and calibration

The instruments and field equipment used on site to measure water quality or pH values should be maintained, operated and calibrated on site, according to the operating manuals supplied by the manufacturer.

A3.1. Step Two: pH Field Test

1) Place a small amount of soil (approx. 5-15 grams) in a beaker
2) Add distilled water to make up a soil: water paste
3) Use either a soil pH test kit or pH meter to ascertain pH value.

Field pH readings of 4 or less, indicate that actual acid sulfate soils are present with sulfides having been oxidised in the past, resulting in acid soils and acidic soil pore water. Readings greater than 4 but less than 5.5 are considered acidic and may be the result of some previous or limited oxidation of sulfides, but is not confirmatory of actual acid sulfate soils. Therefore an indicator test is required. Other factors such as excessive fertilizer use, organic acids or strong leaching can cause pH values greater than 4 but less than 5.5 so further testing may be required. The sample collection methodology is explained in more detail in Appendix B.
A3.2. Indicator Test

The Indicator Test provides a preliminary assessment of the potential of the soil sample to produce acidity and thus gives an indication on the presence of potential acid sulfate soils. Further laboratory testing would normally be required to obtain a quantitative value for the amount of sulfur present.

1) Place a small amount of soil (approx. 15 grams) in two heat resistant beakers (one shall be used as a control)
   **Note:** The control and test samples should be subsets of the same sample and be as similar in constitution as possible.

2) Cover the control sample in distilled water and the test sample with 50% hydrogen peroxide (H$_2$O$_2$) and observe the reactions, make notes on reaction intensity, speed and temperature changes. To increase reaction, place test sample in the sun/near heat.
   **Note:** Please undertake this in a very well-ventilated area.

3) The reaction should be observed and rated. Continue to observe the reaction until it is complete; from 20 mins to 24 hours. Greater reaction indicates that the soil sample was more likely to have a lower pH, i.e.; super foamy reaction expects a pH of about 2.

4) While the Test sample is reacting, take the pH reading for the Control sample.

5) When reaction of test sample is complete, take pH of the solution. If required add distilled water to increase volume of solution in order to cover the pH probe.
   **Note:** The handling and storage of H$_2$O$_2$ is an OH&S issue and must be managed in accordance with relevant regulations and the MSDS. Conduct this test in a well-ventilated area.

A5. Finalising the results

Write all observations and results onto a results sheet. Potentially positive reactions include one or more of the following:

- change in colour of the soil from grey tones to brown tones;
- a substantial reduction in pH less than that of “actual” acid sulfate soils (pH 4 or less);
- the release of sulfurous odours; and
- pH of less than 3.

The strength of the reaction is a useful indicator. The test is most useful and reliable with clays and loams containing low levels of organic matter. It is least useful on coffee rock, sands, or gravels, particularly dredged sands with low levels of sulfidic material (<0.05 percent). With soils containing high organic matter (e.g. surface soils, peat, mangrove/estuarine mud and marine clays), care must be taken when interpreting the reaction as high levels of organic matter and other soil constituents particularly manganese oxides can also cause a reaction.

**Table A1** below provides common results and can be used for the general interpretation of pH$_{10\text{min}}$ results.

**Note:** Send off all samples with a significant pH drop between control and test samples, a very low pH, or a very strong/fast reaction with the Hydrogen peroxide. All soil samples must remain frozen until Indicator Test, and if required subsequent lab analysis, is performed.
### Table A1. Results and Interpretations of Field Testing ASS

<table>
<thead>
<tr>
<th>$\text{pH}_{\text{r}}$</th>
<th>$\text{pH}_{\text{FOX}}$ (at completion of reaction)</th>
<th>$\Delta$ pH</th>
<th>Reaction rate</th>
<th>Result (e.g. **PASS or ***AASS))</th>
<th>Comments / Possible explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>3.3</td>
<td>0.2</td>
<td>L</td>
<td>AASS present</td>
<td>Oxidation has occurred and sulfuric acid has formed in the past. This soil may not have much more potential to oxidise further as the pH$<em>{r}$ and pH$</em>{FOX}$ are similar.</td>
</tr>
<tr>
<td>3.7</td>
<td>1.4</td>
<td>2.3</td>
<td>X or V</td>
<td>AASS present; PASS - strong indication</td>
<td>Oxidation has occurred in the past. This soil has the potential to oxidise further indicated by the strong reaction, appreciable pH unit difference (pH$<em>{FOX}$ is significantly lower than the pH$</em>{r}$) and the very low final pH$_{FOX}$.</td>
</tr>
<tr>
<td>6.5</td>
<td>2.1 (1.9)*</td>
<td>4.4</td>
<td>X or V</td>
<td>No AASS; PASS - strong indication</td>
<td>This soil is not yet oxidised but has the ability to produce sulfuric acid if exposed. Little buffering capacity in the soil. Laboratory analysis using SPOCAS could confirm this.</td>
</tr>
<tr>
<td>8.5</td>
<td>3.0 (3.2)*</td>
<td>5.5</td>
<td>H</td>
<td>No AASS; PASS - likely</td>
<td>The initial pH may be reflecting a strong seawater influence (pH 8.2) or some form of dissolved carbonates. The large $\Delta$ pH indicates a strong likelihood of PASS even though the pH$<em>{FOX}$ is borderline. Here, the $\Delta$ pH and the reaction gives strength to the argument. Laboratory analysis using SPOCAS and reacted calcium (Ca$</em>{r}$) could confirm this (see Ahern &amp; McElnea (1999)).</td>
</tr>
<tr>
<td>8.0</td>
<td>2.0 (6.0)*</td>
<td>?</td>
<td>H</td>
<td>No AASS; PASS - strong indication; Considerable buffering capacity</td>
<td>The initial alkaline pH$<em>{r}$ indicates a seawater influence. The initial large decrease in pH indicates the soil is likely to contain sulfides. The pH measured after 20 minutes may indicate a large % of shell dissolving into solution as the acid contacts it (a small amount of HCl added to a sample of soil could confirm its presence). Laboratory analysis using SPOCAS and Ca$</em>{r}$ could confirm this (see Ahern &amp; McElnea (1999)).</td>
</tr>
<tr>
<td>5.5</td>
<td>5.4 (5.3)*</td>
<td>0.2</td>
<td>X or V</td>
<td>No AASS; PASS - unlikely</td>
<td>The reaction is probably due to the presence of manganese in the soil sample.</td>
</tr>
<tr>
<td>5.5</td>
<td>3.6 (3.5)*</td>
<td>2.0</td>
<td>H (slow froth)</td>
<td>No AASS; PASS - possible</td>
<td>The strength of the reaction indicates possible organic matter. There may be some sulfides present also. Laboratory analysis using the S$_{CF}$ could confirm this.</td>
</tr>
</tbody>
</table>

* $\text{pH}_{FOX}$ after 20 minutes (or overnight)
** PASS – Potential Acid Sulfate Soils
*** AASS – Actual Acid Sulfate Soils

L = Low reaction,  
M = Medium reaction,  
H = High reaction,  
V = volcanic reaction,  
X = Extreme reaction (very vigorous, gas evolution and heat generation)

**IDENTIFICATION AND INVESTIGATION OF ACID SULFATE SOILS AND ACIDIC LANDSCAPES** (*WA DEC May 2009*)
Appendix B – ASS Sampling and Criteria

B1. In situ soil sampling for laboratory analysis (for field analysis see Appendix A)

If indicator tests (Appendix A) indicate a positive reaction, the following will occur.

- In situ soil samples will be collected by a person trained or experienced in the collection of acid sulfate soil including knowledge of sample handling.
- Care will be taken to remove as much air as possible from each sample prior to placing in an esky with ice. The soil samples will then be placed in a freezer as soon as possible and as a minimum at the end of each day of sampling.
- Samples are then to be rebatched the following morning, with ice in eskies for dispatch to the laboratory. The soil samples will be sent express to the NATA accredited laboratory such that samples will be received by the laboratory within 24 hours of dispatch. Soil sample collected on a Friday or over the weekend will be retained frozen for dispatch on the following Monday.
- Samples will be tested for Equivalent Sulphur and Equivalent Acid. (Note - The action criteria for the management of soils as ASS/PASS will be an Equivalent Sulphur (%S) of >0.03 and Equivalent Acid (mol H+/tonne) of >18).
- (Note – laboratory results will also indicate neutralisation requirements to be followed in Section 7.4)

B2. Soil Validation sampling

For treated ASS, one soil sample should be collected per 250m³ of treated soil and analysed for the suite of analytes used to calculate the total potential acidity by acid based accounting methods.

The objective of ameliorating ASS materials is to ensure that there is no chance that net acidity will be produced. Validation testing only occurs when soils have been treated (with a neutralising agent) to prevent any future acidification.

If results of the validation testing indicate a failure to comply with the performance criteria, soil may need to be re-treated. When submitting samples for validation to a laboratory, it will be made clear that they require validation testing to ensure the correct methods are used. For validation testing both the Suspension Peroxide Oxidisable Combined Acidity Sulphur (SPOCAS) and Chromium Reducible Sulphur (SCR) suites can be used. The validation assessment will use the following equation:

\[
\text{Net Acidity} = \text{Potential Sulphidic Acidity} - \frac{\text{measured Acid Neutralising Capacity (ANC)/Fineness Factor (FF)}}{
\]

The final net acidity calculation must be either zero or preferably a negative value (having applied the appropriate fineness factor to the ANC). The soil pH must be greater than 5.5 after neutralisation and not above 8.5 (ASSMAC, 1998; QASSIT, 2004).
Appendix C – Water Sampling and Treatment

C1. Initial water sampling

Water collected in the sump of the treatment pad or excavation will initially be tested using a water quality monitoring probe to test pH and turbidity.

If this initial testing (prior to any neutralisation) shows pH of 6.5 to 8.5 and other parameters within EPL criteria, then no further testing is required and discharge may occur if required with approval from environmental personnel.

C2. Water treatment

If the water in the sumps has not been pre-treated (i.e. addition of a neutralising agent) and the pH is within the range of 6.5 – 8.5, the water is considered suitable for both discharge and reuse on site (provided other water quality parameters in the EPL are complied with).

If discharge is proposed and initial water sampling indicates pH below that allowed to discharge, neutralisation will occur in accordance with Figure C1.

If initial water sampling indicates pH above that allowed to discharge, then neutralisation will occur through pool acid or other suitable methods.

Water which has had a pre-treatment should also be tested for those parameters detailed in Appendix C3, and those parameters must be below relevant EPL or ANZECC guidelines prior to discharge or reuse on site.

C3. Neutralised water sampling

If the water in the sump of the treatment pad has been neutralised from a low pH (i.e. to treat acidity caused by ASS), then prior to discharge of the treatment pad sump water, samples will be collected and analysed to ensure EPL and ANZECC water quality guidelines are complied with and shall include the following suite of parameters:

- Total Suspended Solids (TSS).
- pH.
- Conductivity.
- Dissolved Iron.

Water samples to be sent for laboratory testing are to be collected using laboratory supplied bottles and immediately placed in an esky with ice. Water samples are to be collected in the morning so that they can be dispatched to the laboratory to arrive on the day of sampling. Water samples are to be collected by suitable trained and experience personnel.
**Figure C1 – Acidic water neutralisation guide**

<table>
<thead>
<tr>
<th>Current Water pH</th>
<th>([H^+]) (mol/L)</th>
<th>(\text{H}^+) in 1 Megalitre (mol)</th>
<th>Lime to neutralise 1 Megalitre (kg pure CaCO₃)</th>
<th>Hydr. time to neutralise 1 Megalitre (kg pure Ca(OH)₂)</th>
<th>Pure NaHCO₃/1 Megalitre (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.316</td>
<td>316.228</td>
<td>15.824</td>
<td>11.716</td>
<td>26.563</td>
</tr>
<tr>
<td>1.0</td>
<td>0.1</td>
<td>100.000</td>
<td>5.004</td>
<td>3705</td>
<td>8390</td>
</tr>
<tr>
<td>1.5</td>
<td>0.032</td>
<td>32.000</td>
<td>1.600</td>
<td>1185</td>
<td>2686</td>
</tr>
<tr>
<td>2.0</td>
<td>0.01</td>
<td>10.000</td>
<td>0.500</td>
<td>370</td>
<td>839</td>
</tr>
<tr>
<td>2.5</td>
<td>0.0032</td>
<td>3.200</td>
<td>0.160</td>
<td>118</td>
<td>269</td>
</tr>
<tr>
<td>3.0</td>
<td>0.001</td>
<td>1.000</td>
<td>0.050</td>
<td>37</td>
<td>84</td>
</tr>
<tr>
<td>3.5</td>
<td>0.00032</td>
<td>0.320</td>
<td>0.016</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>4.0</td>
<td>0.0001</td>
<td>0.100</td>
<td>0.005</td>
<td>4</td>
<td>8.4</td>
</tr>
<tr>
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<td>0.032</td>
<td>0.001</td>
<td>1.18</td>
<td>0.269</td>
</tr>
<tr>
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<td>0.010</td>
<td>0.005</td>
<td>0.37</td>
<td>0.84</td>
</tr>
<tr>
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<td>0.0032</td>
<td>0.005</td>
<td>0.12</td>
<td>0.27</td>
</tr>
<tr>
<td>6.0</td>
<td>0.000001</td>
<td>0.001</td>
<td>0.005</td>
<td>0.037</td>
<td>0.08</td>
</tr>
<tr>
<td>6.5</td>
<td>0.00000032</td>
<td>0.00032</td>
<td>0.001</td>
<td>0.12</td>
<td>0.027</td>
</tr>
</tbody>
</table>

Notes: 1 m³ = 1,000 litre = 1 Kilolitre = 0.001 Megalitre

- Agricultural lime has very low solubility and may take considerable time to even partially react.
- Hydrated lime is more soluble than aglime and hence more suited to water treatment. However, as Ca(OH)₂ has a high water pH, incremental addition and thorough mixing is needed to prevent overshooting the desired pH. The water pH should be checked regularly after thorough mixing and time for equilibration before further addition of neutralising product.
- Weights of lime or hydrated lime are based on theoretical pure material and hence use of such amounts of commercial product will generally result in under treatment.
- To more accurately calculate the amount of commercial product required, the weight of lime from the table should be multiplied by a purity factor (100/ Neutralising Value for aglime) or (148/ Neutralising Value for hydrated lime).
- Calculations are based on low salinity water acidified by hydrogen ion, H⁺ (acid) and do not take into account the considerable buffering capacity or acid producing reactions of some acid salts and soluble species of aluminium and iron. For example, as the pH increases towards 4, the precipitation of soluble ferric ion occurs, liberating more acid:

\[
\text{Fe}^{3+} + 3\text{H}_2\text{O} \rightleftharpoons \text{Fe(OH)}_3 + 3\text{H}^+
\]

- If neutralising substantial quantities of acid sulfate soil leachate, full laboratory analysis of the water will be necessary to adequately estimate the amount of neutralising material required.
Appendix D - Treatment Pad Construction

D1. Design

Treatment pad locations will be located in areas approved for operation as ancillary facilities or on the road alignment if necessary. Treatment pads will be constructed as follows:

- The base of the pad is to be graded such that all surface water flows to one or multiple collection sumps. The treatment pad can be divided into cells (this may be required to minimise construction works to achieve adequate grade for water management (likely storm water and seepage water management from the material undergoing treatment);
- Appropriate sedimentation controls are to be constructed around each collection sump (if more than one).
- The base of the treatment pad will be constructed with a low permeable base.
- Crushed limestone will be placed over the low permeable material.
- A bund wall is to be constructed surrounding the treatment pad such the storm water flow outside the treatment pad is restricted from flowing into the treatment pad and storm water within the treatment pad is restricted from flowing beyond the collection sump/s.
- An example treatment pad design is provided below.

D2. Treatment pad dimensions

For each treatment pad, the estimated in-situ volume of ASS material will need to be calculated, the program of excavation/treatment determined; and the treatment pad designed to accommodate this volume/rate of material.

Following excavation of the ASS some bulking will occur. From this volume (including a bulking factor), and the rate expected to be excavated, the dimensions of the treatment pad can be calculated.

The treatment area dimensions are also dependent on the thickness of the treatment layer and whether multiple layers will be placed atop one another. Due to space constraints in the Project, it is likely that multiple layers will be used.
Figure D1 – Example treatment Pad Design