Appendix B4
Soil and Water Quality Management Sub Plan
Northern Beaches Hospital- Connectivity and Network Enhancement Project
Roads and Maritime Services | November 2017
## Document control

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**Plan approved by:**

- **Manuel de Miguel**  
  Project Director  
  FerrovialYork JV

- **Mark Sabolch**  
  Environmental Manager  
  FerrovialYork JV

- **Con Lambous**  
  Environment Manager Greater Sydney  
  Roads & Maritime

- **Sada Sadadcharan**  
  Project Manager  
  Roads & Maritime

## Revision history

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<td>Update</td>
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Appendix G  RMS Environmental Direction No: 19 Use of Reclaimed Water (RTA 2006)
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## Glossary / Abbreviations

<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ANZECC</td>
<td>The Australian and New Zealand Environment Conservation Council</td>
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<td>ASS</td>
<td>Acid sulfate soils</td>
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<tr>
<td>CEMP</td>
<td>Construction Environmental Management Plan</td>
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<td>CoA</td>
<td>Condition of Approval</td>
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<tr>
<td>Council</td>
<td>Warringah Council</td>
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<td>DEC</td>
<td>Department of Environment and Conservation</td>
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<td>DECCW</td>
<td>Department of Environment, Climate Change and Water</td>
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<td>DLWC</td>
<td>Department of Land and Water Conservation</td>
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<td>DNR</td>
<td>Department of Natural Resources</td>
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<td>DPI Water</td>
<td>Department of Primary Industries - Water</td>
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<td>DP&amp;E</td>
<td>Department of Planning and Environment</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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<td>EPA</td>
<td>Environment Protection Authority</td>
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<td>EP&amp;A Act</td>
<td><em>Environmental Planning and Assessment Act 1979</em></td>
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<td>EPL</td>
<td>Environmental Protection Licence</td>
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<td>EPBC Act</td>
<td>Commonwealth <em>Environment Protection and Biodiversity Conservation Act 1999</em></td>
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<td>EWMS</td>
<td>Environmental Work Method Statements</td>
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<td>FM Act</td>
<td><em>Fisheries Management Act 1994</em></td>
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<td>FYJV</td>
<td>Ferrovial York Joint Venture</td>
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<td>OEH</td>
<td>Office of Environment and Heritage</td>
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<td>PASS</td>
<td>Potential acid sulfate soils</td>
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<td>PESCP</td>
<td>Progressive Erosion and Sediment Control Plan</td>
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<tr>
<td>POEO Act</td>
<td><em>Protection of the Environment Operations Act 1997</em></td>
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</table>
| Project, the | Northern Beaches Hospital – Connectivity and Network Enhancements:  
|              | - Stage 1 – Hospital Connectivity Enhancement Works; and  
|              | - Stage 2 – Network Enhancement Works. |
| RMS          | Roads and Maritime Services |
| RSMM         | Revised Safeguards and Management Measures |
| Secretary    | Secretary of the NSW Department of Planning and Environment (or delegate) |
| Soil         | Party engaged by the Project to develop coordinated practices for soil erosion  
| Conservationist| control and soil or water conservation as per PESCP’s. |
| SPIR         | Submissions and Preferred Infrastructure Report |
| SWQMP        | Soil and Water Quality Management Plan |
| Water Act    | *Water Act 1912* |
| WM Act       | *Water Management Act 2000* |
1 Introduction

1.1 Context

This Soil and Water Quality Management Sub Plan (SWQMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the Northern Beaches Hospital – Connectivity and Network Enhancements Project (the Project).

This Plan has been prepared to address the requirements of:
- the Concept Proposal Approval;
- Stage 1 Project Approval;
- Stage 2 Project Approval;
- the environmental management measures listed in the Northern Beaches Hospital – Road Connectivity and Network Enhancements Stage 1 EIS (SMEC, 2014);
- the revised safeguards and management measures listed in the Northern Beaches Hospital – Connectivity and Network Enhancements Stage 1 Submissions and Preferred Project Report (SPIR) (SMEC, 2015);
- the environmental management measures listed in the Northern Beaches Hospital – Road Connectivity and Network Enhancements Stage 2 EIS (SMEC, 2015);
- the revised safeguards and management measures listed in the Northern Beaches Hospital – Road Connectivity and Network Enhancements Project Stage 2 Submissions Report (SMEC, 2015); and
- all applicable legislation.

1.2 Background

Chapters 15 and 16 of the Stage 1 EIS (SMEC, 2014) assessed the construction impacts of the Stage 1 Project on geology, soils and contamination, and hydrology, water quality and flooding.

As part of the development of the Stage 1 EIS, detailed contamination and surface water management assessments were prepared to address the Director General’s Requirements for Stage 1. These assessments were included in the EIS as:
- Stage 1 Volume 3 Appendix L Phase 1 Contamination Assessment; and
- Stage 1 Volume 3 Appendix M Surface Water Management Strategy.

Chapters 15 and 16 of the Stage 2 EIS (SMEC, 2015) further assessed and identified the environmental conditions and the potential construction impacts of the Stage 2 Project on geology, soils and contamination, and hydrology, water quality and flooding were undertaken. Chapter 17 of the Stage 2 EIS also assessed the potential impacts on groundwater associated with construction works, in particular, the slot construction works during Stage 2.

Environmental management measures were considered in the Stage 1 and Stage 2 EISs to mitigate the potential constriction impacts. Following consultation on the EISs, revised safeguards and management measures were prescribed in the Stage 1 SPIR and Stage 2 Submissions Report.

1.3 Environmental management systems overview

The Project Environmental Management document system is described in the Construction Environmental Management Plan (CEMP).
This Plan is part of FYJV’s environmental management framework for Stage 1 and Stage 2 of the Project. In accordance with the requirements of Stage 1 CoA C28(d) and Stage 2 CoA D28(d), this Plan has been developed in consultation with the NSW Office of Environment and Heritage (OEH), Department of Primary Industries, Water, and Council. Further details of the consultation are provided in Chapter 4 of this Plan.

Management measures identified in this Plan will be incorporated into the Contractor’s site or activity specific Environmental Work Method Statements (EWMS) and Progressive Erosion and Sediment Control Plans (PESCP).

EWMSs will be developed for high risk activities and signed off by environment and management representatives prior to the commencement of the associated works. Construction personnel will be required to undertake works in accordance with the safeguards identified in the EWMSs.

PESCPs provide detailed site-specific erosion and sediment control measures. PESCPs will be developed by the Contractor’s environment team in consultation with construction personnel and the Project Soil Conservationist. See Appendix J for an example.

PESCPs will be updated or modified as required when there are changes in site conditions, flow paths or construction activities that affect ground conditions.

Updates and modifications to the PESCPs will be made by the Contractor’s Environment Manager or by the Project Soil Conservationist. Following this, the PESCP register will be updated and the amended PESCP made available to the wider construction team.

The combination of the CEMP, sub plans, strategies, procedures, EWMS and PESCPs identify the required environmental management actions for implementation by FYJV’s personnel and sub-contractors.

The review and document control processes for this Plan are described in Chapter 9 and 10 of the CEMP.
2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how FYJV proposes to manage and protect soil and water quality during the 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 this Plan is to ensure that impacts on soil and water quality during construction are minimised and within the scope permitted by Stage 1 and Stage 2.

To achieve this objective, FYJV 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 Stage 1 CoA and SPIR management measures outlined in Table 3.1 of this Plan;
- ensure appropriate measures are implemented to address the relevant Stage 2 CoA and Submissions Report management measures outlined in Table 3.2 of this Plan;
- ensure compliance with the Project’s Environment Protection License (EPL); and
- 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.

2.3 Targets

The following targets have been established for the management of soil and water impacts during the construction of the Project:

- ensure full compliance with the relevant legislative requirements and the Stage 1 and Stage 2 Project Approvals;
- meet environmental protection license water quality discharge parameters for all planned basin discharges (i.e. those within design capacity);
- manage downstream water quality impacts attributable to the Project (i.e. maintain waterway health by avoiding the introduction of nutrients, sediment and chemicals outside of that permitted by the environmental protection licence and ANZECC guidelines);
- ensure training on best practice soil and water management is provided to all construction personnel through site introductions; and
- minimise the intake of groundwater within the Project footprint where reasonable and feasible.
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 (EP&A Act);
- Environmental Planning and Assessment Regulation 2000;
- Protection of the Environment Operations Act 1997 (POEO Act);
- Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);
- Water Management Act (2000);
- Water Act 1912 (Water Act); and

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);
- National Water Quality Management Strategy (NWQMS) (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), 1994);
- Northern Beaches Stormwater Management Plan (PBP, 1999);
- NSW Water Quality and River Flow Objectives (DECCW, 2006);
- NSW Aquifer Interference Policy (DPI Water, 2012);
- Managing Urban Stormwater: Council Handbook (EPA, 1998a);
- Managing Urban Stormwater: Source Control (EPA, 1998b);
- Managing Urban Stormwater: Treatment Techniques (EPA, 1998c);
- Volume 2A Installation of Services (DECCW 2008);
- Volume 2C Unsealed Roads (DECCW 2008);
- Volume 2D Main Roads Construction (DECCW 2008);
- DIPNR Roads and Salinity Guideline, 2003;
- NSW Fisheries, November 2003. Fishnote – Policy and Guidelines for Fish Friendly Waterway Crossings (Ref: NSWF – 1181);
- Environmental Management of Construction Site Dewatering (RTA, 2011);
- RMS Pacific Highway Practice Note for Dewatering;
- RTA’s Code of Practice for Water Management – Road Development and Management (1999);
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA, March 2004);
- Guidelines for the Management of Acid Sulphate materials: Acid Sulphate Soils, Acid Sulphate Rock and Monosulphidic Black Ooze (RTA 2005);
- RMS Environment Direction Management of Tannins from Vegetation Mulch;
- Stockpile Site Management Guideline, RMS 2011;
- Environmental Best Management Practice Guideline for Concreting Contractors (DEC, 2004);
- RMS Road Design Guideline: Section 8 Erosion and Sedimentation (RTA, 2003);
- RMS Guideline for Construction Phase Water Quality Monitoring (RTA, n.d.);
- RMS Erosion and Sedimentation Management Procedure (RTA, 2009);
- Procedures for Selecting Treatment Strategies to Control Road Runoff (RTA, 2003a);
- RMS Water Policy (RTA, 1997);
- RMS QA Specification G38 (RMS, 2011);
- Road Runoff and Drainage: Environmental Impacts and Management Options, AP-R180 (Austroads, 2001);
- Floodplain Development Manual (NSW Government, 2005);
- RMS Technical Guideline: Environmental Management of Construction Site Dewatering (RTA, 2011);
- Coastal Lakes: Independent Inquiry into Coastal Lakes and Statement of Joint Intent (Healthy Rivers Commission of NSW, 2002);
- The relevant targets within the State Water Management Outcomes Plan (DPI Water, 2003);
- State Groundwater Policy Framework Document (Department of Land and Water Conservation (DLWC), 1997);
- The NSW State Groundwater Quality Protection Policy (DLWC, 1998);
- (Draft) NSW State Groundwater Quantity Management Policy (DLWC, n.d.);
- NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2002);
- National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and ANZECC, 1995);
- Guidelines for Treatment of Stormwater Runoff from Road Infrastructure, AP-R232 (Austroads, 2003); and
- Guidelines for the Assessment and Management of Groundwater Contamination (NSW DEC, 2007);
- Guidelines for Riparian Corridors on Waterfront Land (DPI 2012)
- Warringah Council Water Management Policy (2015); and
- Warringah Council Creek Management Study (2004).
3.2 Minister’s Conditions of Approval

3.2.1 Stage 1 CoAs

The Stage 1 CoAs relevant to this Plan are listed in 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 3-1: Conditions of Approval relevant to the SWQMP

<table>
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<tr>
<th>Stage 1 CoA No.</th>
<th>Stage 1 Condition Requirements</th>
<th>Document Reference</th>
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<tr>
<td>CoA B1</td>
<td>Except as may be expressly provided by an EPL, the Proponent must not cause or permit any waters to be pollutants, as defined under Section 120 of the Protection of the Environment Operations Act 1997.</td>
<td>Table 7-1 SW4</td>
</tr>
<tr>
<td>CoA B2</td>
<td>All surface water and groundwater shall be adequately treated to meet the requirements of condition B1 prior to entering the storm water system, drainage lines or riparian corridors. Where the requirements of condition B1 cannot be met, surface water and groundwater shall not be discharged to drainage lines or riparian corridors.</td>
<td>Table 7-1 SW5</td>
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| CoA B6          | The Proponent shall develop a Water Management Plan (WMP) to ensure that the Stage 1 Project is designed and constructed to meet condition B1. The WMP shall address operational water quality management, monitoring and response arrangements in relation to surface water impacts. The Plan shall include but not be limited to:  
   a) identification of surface water quality objectives and pollution reduction targets of receiving waters relevant to the proposal including consideration of: 
      i. Northern Beaches Stormwater Management Plan, PBP, 1999; and 
      ii. The Interim Water Quality Objectives Design Guidelines in Appendix F of the Warringah Council Creek Management Study 2004;  
   b) identification and estimation of the type and quantity of pollutants that may be introduced into the water catchment by source and discharge point;  
   c) identification of the impacts of discharges on receiving surface waters, including but not limited to the consideration of: 
      i. baseline data on current water quality in any receiving waters that could be affected by the project; 
      ii. surface water quality objectives and pollution reduction targets; 
      iii. trigger values and the appropriate level of protection for each contaminant; and 
      iv. how the SSI will be designed to contribute towards achievement of the water quality objectives over time where they are not currently being achieved;  
   d) consideration of water sensitive urban design principles consistent with DPI Water’s Guidelines for Riparian Corridors on Waterfront Land and the Warringah Council Creek Management Study 2004;  
   e) identification of measures to ensure natural flows are maintained, where feasible and reasonable, within local watercourses potentially affected by the Stage 1 Project; and  
   f) contingency and ameliorative measures in the event that adverse impacts to surface water quality are identified (refer to condition B7).  
   The WMP is to be prepared in consultation with EPA and the Council and approved by the Secretary prior to the commencement of construction, unless otherwise agreed by the Secretary. The WMP is to be ongoing for three years following commencement of operation, unless agreed by the Secretary. | Appendix B Water Management Plan |
| CoA B7          | A Surface Water Quality Monitoring Program (SWQMP) shall be prepared and implemented to monitor impacts on surface water quality and resources during construction and operation. The SWQMP shall be prepared by a suitably qualified and experienced person(s) and include, but not be limited to: | Appendix B Water Management Plan |
a) a surface water quality monitoring program including the identification of monitoring locations which are representative of the potential extent of impacts from the SSI, including the relevant analytes and frequency and sampling distribution of modelling;

b) identification of works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways;

c) representative background monitoring of surface water quality parameters prior to the commencement of construction, to establish baseline water conditions, unless otherwise agreed by the Secretary;

d) the presentation of water quality standards and parameters having regard to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (Australia and New Zealand Environment Conservation Council, 2000) and a statement of the indicators and associated trigger values or criteria for the identified environmental values;

e) a statement of the surface water quality objectives and pollution reduction targets of receiving waters relevant to the proposal for the receiving waters relevant to the proposal;

f) trigger values for action and associated actions or mitigation measures if trigger values are exceeded; and

g) reporting of the monitoring results to the Secretary, EPA, and the Council.

The SWMP is to be prepared in consultation with EPA, DPI Water and the Council and approved by the Secretary prior to the commencement of construction, unless otherwise agreed by the Secretary. The SWMP is to be ongoing for a minimum of three years following the commencement of operation or until the affected waterways are certified by an independent expert as being rehabilitated to an acceptable condition, unless otherwise agreed by the Secretary. A copy of the SWMP is to be supplied to the EPA and the Council upon its implementation. The results of all monitoring are to be made publicly available upon completion of each monitoring period.

**CoA C28(c)**

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 DPI Water and the Council and include, but not necessarily be limited to:

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;

ii. soil erosion and sediment control measures that comply with the practices and principles as required under Condition C3;

iii. details of the staging of construction activities to minimise and manage potential sediment loads discharging to receiving drainage lines as a result of soil loss from disturbed areas;

iv. impacts on watercourse bank stability and the development of appropriate mitigation measures as required;

v. a contingency plan to be implemented in the case of unanticipated discovery of contaminated material during construction;

vi. an Asbestos Management Plan, to be developed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999, and to include measures for the safe removal and disposal of known and undiscovered asbestos within the SSI footprint and related construction ancillary facilities, stockpile sites and site access;

vii. a description of how the effectiveness of these actions and measures would be monitored and maintained during the proposed works, clearly indicating how often this monitoring and maintenance 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

viii. mechanisms for the monitoring, review and amendment of this plan.

**This Plan**

Appendix H

Unexpected Discovery of Contaminated Land Procedure

Appendix K – Asbestos Management Plan
The Construction Soil and Water Management Plan shall be prepared to generally reflect, where feasible and reasonable, the recommendations made in the "Construction Phase Surface Water Management Strategy" as outlined in Section 7 of the EIS technical paper - Proposed Construction and Operational Phase Surface Water Management Strategy.

**CoA B8** Prior to the commencement of site preparation and excavation activities, or as otherwise agreed by the Secretary, in areas identified as having a medium to high risk and as presented in Chapter 7 of Phase I Contamination Assessment: Northern Beaches Hospital Connectivity and Network Enhancements Project, Frenchs Forest NSW, SMEC, October 2014, 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 Stage 1 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 and materials and groundwater shall be identified in the Report and incorporated into the Construction Environmental Management Plan required under conditions C27 and C28. 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 Council prior to operation of the site.

**CoA C3** Soil and water management measures consistent with Managing Urban Stormwater - So/s 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.

**CoA C4** 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.
3.2.2 Stage 2 CoAs

The Stage 2 CoAs relevant to this Plan are listed in Table 3-2 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 3-2: Conditions of Approval relevant to the SWQMP

<table>
<thead>
<tr>
<th>Stage 2 CoA No.</th>
<th>Stage 2 Condition Requirements</th>
<th>Document Reference</th>
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<tr>
<td>CoA B5</td>
<td>The Proponent must prepare and implement a Water Management Plan (WMP) for the SSI to ensure that the SSI is designed, constructed and operated to achieve the water quality and flow objectives of this approval. The WMP must include, but not be limited to:</td>
<td>Appendix B Water Management Plan Table 7-2 SW52</td>
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<td>(a) the identification of works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality and flows of potentially affected waterways and intercept groundwater;</td>
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<td>(b) a description of the detailed designs and/or design principles for the SSI taking into consideration the water quality objectives of the WMP, and water sensitive urban design principles consistent with the Guidelines for Riparian Corridors on Waterfront Land (DPI 2012), Warringah Council Water Management Policy (2015) and the Warringah Council Creek Management Study 2004;</td>
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<td>(c) the identification and estimation of the type and quantity of pollutants that may be introduced into the water catchment by source and discharge point;</td>
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<td>(d) a detailed description of the watercourses and groundwater systems that could potentially be affected by the SSI, including:</td>
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<td>(i) currently available data on existing water quality and flows in receiving waters, groundwater levels, yield and quality in the region, and privately-owned groundwater bores, that could be affected by the project; and/or</td>
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<td>(ii) a description of the procedures to obtain this information prior to the commencement of the relevant activities identified in condition B5(a);</td>
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<td></td>
<td>(e) surface water and groundwater assessment criteria, including water quality objectives and trigger levels for investigating any potentially adverse impacts of the SSI, including consideration of:</td>
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<td>(i) Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (Australia and New Zealand Environment Conservation Council, 2000);</td>
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<td></td>
<td>(ii) Warringah Council's PL850 - Water Management Policy (2015); and</td>
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<td>(iii) the interim Water Quality Objectives Design Guidelines in Appendix F of the Warringah Council Creek Management Study 2004;</td>
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<td>(f) a program to monitor and report on the potential surface water and groundwater impacts of the SSI, which includes a description of:</td>
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<td>(i) representative monitoring locations;</td>
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<td>(ii) the relevant analytes and parameters to monitor;</td>
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<td>(iii) duration and frequency of monitoring; and</td>
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<td></td>
<td>(iv) sampling distribution;</td>
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<td>(g) identification of measures to ensure natural flows are maintained, where feasible and reasonable, within local watercourses potentially affected by the project;</td>
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<td>(h) a plan to respond to any exceedances of the performance criteria, and monitor and/or mitigate any adverse surface water and/or groundwater impacts of the SSI;</td>
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<td>(i) a protocol for the periodic review of the plan, including the criteria to determine the need for ongoing monitoring; and</td>
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<td>(j) procedures for reporting monitoring results to the Secretary, EPA, DPI Water and Council.</td>
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<tr>
<td>CoA No.</td>
<td>Stage 2 Condition Requirements</td>
<td>Document Reference</td>
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<td>The WMP must be prepared or reviewed by a suitably qualified expert in consultation with DPI Water and Council, and approved by the Secretary prior to the commencement of construction, unless otherwise agreed by the Secretary. The WMP must be implemented for a minimum of three years following the commencement of operation, unless otherwise agreed by the Secretary. Any request to discontinue the implementation of the WMP must be supported by advice from an independent expert confirming that the criteria established by condition B5(i) are met. The Proponent must provide a copy of the approved WMP, and any approved revisions to the plan, to the EPA, DPI Water and Council once approved. The results of all monitoring are to be made publicly available within 4 weeks of the completion of each monitoring period.</td>
<td>Section 6.6 Table 7-2 SW65, SW66, SW67, SW68, SW69</td>
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<td>Prior to the commencement of site preparation and excavation activities, or as otherwise agreed by the Secretary, in areas identified with contamination above investigation levels as described in the Phase 2 Contamination Assessment: Northern Beaches Hospital - Stage 2 Network Enhancement Works, URS, June 2015, the Proponent must prepare and implement a Soil Contamination Report. The report must be prepared by a suitably qualified person(s) in accordance with the requirements of the Contaminated Land Management Act 1997 and associated guidelines. The report must 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 and materials and groundwater must be identified in the report and incorporated into the Construction Environmental Management Plan required under conditions D27 and D28. Should a remediation strategy be required, the report must 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 must 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, must 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 must be submitted to the Secretary and Council prior to operation of the site.</td>
<td>Section 6.3 Section 6.5 Table 7-2 SW51</td>
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<td>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.</td>
<td>Table 7-2 SW63</td>
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<td>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.</td>
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<td>Unless approved by the Secretary, the location of Ancillary Facilities not identified in the documents listed in condition A1 must comply with the following locational criteria: (a) be located more than 50 metres from a waterway; (j) be above the 20 ARI flood level unless a contingency plan to manage flooding is prepared and implemented</td>
<td>Construction Compound and Ancillary Facilities Management Plan – Appendix B8 (CEMP)</td>
</tr>
<tr>
<td>Stage 2 CoA No.</td>
<td>Stage 2 Condition Requirements</td>
<td>Document Reference</td>
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<td>CoA D27(e)(ii)</td>
<td>The CEMP must include, but not necessarily be limited to:</td>
<td>Table 7-2 SW70 Appendix K – Asbestos Management Plan</td>
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<td>(e) details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the SSI). These should include consideration of cumulative impacts in relation to staging of other major potential construction activities in the project area (including the NBH project and Stage 1 Project). In particular, the following environmental performance issues must be addressed in the CEMP:</td>
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<td>(ii) measures for the handling, treatment and management of hazardous and contaminated materials (including asbestos);</td>
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<td>CoA D28(d)</td>
<td>A Construction Soil and Water Management Plan to manage surface and groundwater impacts during construction of the SSI. The plan must be developed in consultation with DPI Water and Council and include, but not necessarily be limited to:</td>
<td>This Plan Table 7-2 SW51 Appendix B Water Management Plan</td>
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<td>(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;</td>
<td>Water Quality Monitoring Program undertaken for Stage 1 incorporated into the Water Management Plan, Appendix H Unexpected Discovery of Contaminated Land Procedure Appendix K – Asbestos Management Plan</td>
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<td>(ii) soil erosion and sediment control measures that comply with the practices and principles as required under condition D3;</td>
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<td>(iii) details of the staging of construction activities to minimise and manage potential sediment loads discharging to receiving drainage lines as a result of soil loss from disturbed areas;</td>
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<td>(iv) impacts on watercourse bank stability and the development of appropriate mitigation measures as required by condition B5;</td>
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<td>(v) relevant management, monitoring and response measures described in the Water Management Plan prepared in accordance with condition B5;</td>
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<td>(vi) a contingency plan to be implemented in the case of unanticipated discovery of contaminated material during construction;</td>
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<td>(vii) an Asbestos Management Plan, to be developed in accordance with the National Environment Protection (Assessment of Site Contamination) Measure 1999, and to include measures for the safe removal and disposal of known and undiscovered asbestos within the SSI footprint and related construction ancillary facilities, stockpile sites and site access;</td>
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<td>(viii) a description of how the effectiveness of these actions and measures would be monitored and maintained during the proposed works, clearly indicating how often this monitoring and maintenance 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</td>
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<td>(ix) mechanisms for the monitoring, review and amendment of this plan.</td>
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<td>The Construction Soil and Water Management Plan must be prepared to generally reflect, where feasible and reasonable, the recommendations made in the &quot;Construction Phase Surface Water Management Strategy&quot; as outlined in Section 7 of the EIS Appendix L.</td>
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</tbody>
</table>
### 3.3 Revised Safeguards and Management Measures

#### 3.2.3 Stage 1 RSMM

The revised safeguards and management measures (RSMM) from the Stage 1 SPIR relevant to this Plan are listed in Table 3-3 below. A cross reference is also included to indicate where the RSMM is addressed in this Plan. Where RSMMs are not specifically addressed in this Plan, justification is provided. The timing of when the commitment applies has also been included.

<table>
<thead>
<tr>
<th>Stage 1 RSMM</th>
<th>Impact</th>
<th>Stage 1 Requirements</th>
<th>Document Reference</th>
</tr>
</thead>
</table>
| SWMM 1 | Managing impacts on soil in general Erosion and sediment control (construction) | A Soil and Water Management Plan will be prepared for each construction stage of the Concept Proposal in accordance with the principles and guidelines set out Soils and Construction – Managing Urban Stormwater series, comprising Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008), including:  
  - Consideration of soil erodibility.  
  - Management strategies to be used to minimise surface and groundwater impacts, including identification of water treatment measures, discharge points and erosion and sediment control measures.  
  - Sedimentation basin construction and management.  
  - Measures to monitor and manage spoil, fill and materials stockpile sites.  
  - Dewatering procedure.  
  - Water quality monitoring and checklists. | This Plan  
Table 7-1 SW7 |
| SWMM 2 | Disturbance of contaminated or potentially contaminated land | A Contaminated Land Management Plan will be prepared in accordance with the Contaminated Land Management Act 1997, relevant EPA Guidelines and Roads and Maritime Guideline for Management of Contamination (RMS 2013) and will include at a minimum:  
  - Contaminated land legislation and guidelines including any relevant licenses and approvals to be obtained.  
  - Identification of locations of known or potential contamination and preparation of a map showing these locations.  
  - Identification of rehabilitation requirements, classification, and transport and disposal requirements of any contaminated land within the construction footprint.  
  - Contamination management measures including waste classification and reuse procedures and unexpected finds procedures for unanticipated discovery of contaminated material during construction. | Section 6.6  
Table 7-1 SW26, SW27, SW28, SW29 |
| SWMM 3 | Inappropriate disposal of excavated material that cannot be | Excavated material that is not suitable for on-site reuse or recycling will be transported to a site that may legally accept that material for reuse or disposal.  
Excavated material leaving the site will be classified in accordance with the Waste Classification Guidelines so that correct resource recovery and or off-site disposal occur. | Table 7-1 SW31, SW32  
Waste and Energy Management Sub Plan (Appendix B7 – CEMP) |
<table>
<thead>
<tr>
<th>Stage 1 RSMM</th>
<th>Impact</th>
<th>Stage 1 Requirements</th>
<th>Document Reference</th>
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</thead>
</table>
|             | Construction accidental spills | • An emergency spill response procedure will be prepared to minimise the impact of spills including details on the requirements for managing, cleaning up and reporting.  
• Spill kits and adequate quantities of suitable material to counteract spillage would be kept readily available.  
• Any potential hazardous or contaminant materials (for example, fuels, curing compounds, and oils) would not be stored within 50 meters of any waterways or drainage lines, flood prone areas, or on slopes steeper than 1:10. Storage areas would be impervious and adequately bunded.  
• The refueling of plant and maintenance of machinery would be undertaken in impervious bunded areas. Refueling would be attended at all times.  
• Vehicle wash-downs and/or concrete truck washouts would be undertaken within a designated bunded area of an impervious surface or undertaken off-site.  
• Machinery would be checked daily to ensure that there are no oil, fuel, or other liquid leaks. | Table 7-1 SW33, SW34, SW35, SW36, SW37, SW38 |
| SWMM 4      | Impact on Council storm water infrastructure | • Where council’s stormwater infrastructure is impacted, FYJV will consult with council prior to carry out works.  
• Health Infrastructure would be consulted during detailed design with regard to allowing for runoff from the developed hospital site. | Detailed Design reports |
| SWMM 5      | Sedimentation of surrounding watercourses and drainage lines | • A Soil and Water Management Plan will be prepared for each construction stage of the Concept Proposal in accordance with the principles and guidelines set out Soils and Construction – Managing Urban Storm water series, comprising Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008). This would also consider and address the matters noted by the EPA in its submission (Issue 11). | Table 7-1 SW7 |
| SWMM 6      | Contamination of surrounding watercourses and/or groundwater | • An emergency spill response procedure will be prepared to minimise the impact of spills including details on the requirements for managing, cleaning up and reporting. The requirements of the plan are detailed in Section 15.5 of the EIS. | CEMP (Chapter 7)  
Table 7-1 SW33  
Appendix A Environmental Incident and Spill Response Procedure |
| SWMM 7      | Management of groundwater quantity and quality | • Consultation with the EPA and DPI Water would be undertaken prior to construction, regarding monitoring and the management of groundwater quality from contamination sources. Parameters to be monitored would be agreed with the EPA and DPI Water.  
• Pre-construction monitoring of groundwater quality, groundwater flows and groundwater levels would continue to be undertaken to establish existing groundwater quality, flow paths and levels of the Concept Proposal. | Chapter 4 and Chapter 6  
Appendix B Water Management Plan  
NB: The Stage 1 EIS and SPIR identified Stage 1 works are unlikely to impact on groundwater. |
| SWMM 8      | Groundwater flow impacts | • Monitoring of the Red-crowned Toadlet habitat would be undertaken prior to and during construction to determine any groundwater impacts on the habitat. | Flora and Fauna Management Sub Plan (Appendix B2 CEMP) |
3.2.4 Stage 2 RSMM

The revised safeguards and management measures (RSMM) from the Stage 2 Submissions report relevant to this Plan are listed in Table 3-4 below. A cross reference is also included to indicate where the RSMM is addressed in this Plan. Where RSMMs are not specifically addressed in this Plan, justification is provided. The timing of when the commitment applies has also been included.

<table>
<thead>
<tr>
<th>Stage 2 RSMM</th>
<th>Impact</th>
<th>Stage 2 Requirements</th>
<th>Document Reference</th>
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</thead>
<tbody>
<tr>
<td>SWMM 1</td>
<td>Managing impacts on soil in general</td>
<td>A Soil and Water Management Plan will be prepared for each construction stage of the Concept Proposal in accordance with the principles and guidelines set out Soils and Construction – Managing Urban Stormwater series, comprising Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008), including:</td>
<td>This Plan Table 7-2 SW51</td>
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<td>Erosion and sediment control (construction)</td>
<td>- Consideration of soil erodibility.</td>
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<td></td>
<td>Erosion, sediment and water quality impacts</td>
<td>- Management strategies to be used to minimise surface and groundwater impacts, including identification of water treatment measures, discharge points and erosion and sediment control measures.</td>
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<td>- Measures to monitor and manage spoil, fill and materials stockpile sites.</td>
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<td>- Dewatering procedure.</td>
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<td>- Water quality monitoring and checklists.</td>
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A Contaminated Land Management Plan will be prepared in accordance with the Contaminated Land Management Act 1997, relevant EPA Guidelines and Roads and Maritime Guideline for Management of Contamination (RMS 2013) and will include at a minimum:

Chapter 7 Table 7-2
<table>
<thead>
<tr>
<th>Stage 2 RSMM</th>
<th>Impact</th>
<th>Stage 2 Requirements</th>
<th>Document Reference</th>
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| potentially contaminated land | • Contaminated land legislation and guidelines including any relevant licenses and approvals to be obtained.  
• Identification of locations of known or potential contamination and preparation of a map showing these locations.  
• Identification of rehabilitation requirements, classification, and transport and disposal requirements of any contaminated land within the construction footprint.  
• Measures to manage stockpiled potentially contaminated soil in accordance with the requirements of NSW EPA Waste Guidelines.  
• Contamination management measures including waste classification and reuse procedures and unexpected finds procedures for unanticipated discovery of contaminated material during construction. | Appendix D Stockpile Management Protocol  
Waste and Energy Management Sub Plan (Appendix B7 CEMP) |
| SWMM 3 | Inappropriate disposal of excavated material that cannot be reused in the Project | • Potentially contaminated groundwater encountered during the work would be managed in accordance with a Groundwater and Dewatering Management Plan. This would include the proposed method for capture, treatment and/or in accordance with the requirements of NSW EPA (2014) Waste Guidelines.  
• A remediation validation report will be developed to ensure that all identified contamination has been remediated, removed from site and/or managed sufficiently once construction work has ceased and the site is in operation. | Section 6.4  
Table 7-2 SW61  
Table 7-2 SW66, SW67, SW68, SW69  
Table 7-2 SW70  
Appendix K Asbestos Management Plan |
| SWMM 4 | Construction accidental spills  
Water quality impacts during construction | • An emergency spill response procedure will be prepared to minimise the impact of spills including details on the requirements for managing, cleaning up and reporting.  
• Spill kits and adequate quantities of suitable material to counteract spillage would be kept readily available.  
• The refueling of plant and maintenance of machinery would be undertaken in impervious bunded areas. Refueling would be attended at all times.  
• Vehicle wash-downs and/or concrete truck washouts would be undertaken within a designated bunded area of an imperious surface or undertaken off-site.  
• Machinery would be checked daily to ensure that there are no oil, fuel, or other liquid leaks. | Table 7-2 SW74, SW75, SW76, SW77, SW78, SW79, SW80  
Appendix A Environmental Incident and Spill Response Procedure CEMP (Chapter 7) |
<table>
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<tr>
<th>Stage 2 RSMM</th>
<th>Impact</th>
<th>Stage 2 Requirements</th>
<th>Document Reference</th>
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<tbody>
<tr>
<td>SWMM 5</td>
<td>Erosion, sediment and water quality impacts</td>
<td>• Where space allows, construction work should consider the potential for locating sediment retention basins or sumps along the southern side of Warringah Road, where widening of the existing westbound carriageway will require land clearing and excavation work, if possible. These basins or sumps would reduce the volume of sediment and turbidity levels in runoff potentially discharging to Catchments 4, 5 and 6.</td>
<td>Detailed Design reports</td>
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</table>
| SWMM 6      | Management of groundwater quantity and quality | • Pre-construction monitoring of surface water and groundwater quality, groundwater flows and groundwater levels will continue to be carried out to establish existing baseline conditions for Stage 2.  
• Groundwater monitoring as part of a broader water quality monitoring program will be developed and implemented for construction and operation in consultation with EPA and DPI Water. As a minimum the water quality monitoring will include the following analytes:  
  - Total dissolved solids and other inorganic constituents including chloride, sodium and sulphate  
  - pH  
  - Metals including cadmium, iron, lead, nickel, manganese and zinc  
  - Nitrate and phosphorus  
  - Petroleum hydrocarbon related compounds (such as benzene, toluene, ethylbenzene and xylene and poly-aromatic hydrocarbons).  
• The monitoring program will include objectives and parameters to determine the effectiveness of mitigation measures and will also include contingency measures. | Chapter 4  
Chapter 6  
Appendix B Water Management Plan (including the Groundwater and Dewatering Management Plan). Note: Appendix B Water Management Plan |
| SWMM 7      | Management of groundwater drawdown due to seepage into the slot during construction | • A Groundwater and Dewatering Management Plan would be prepared to manage the impacts of groundwater drawdown due to seepage into the slot during construction. The Plan would ensure that the proposed method for managing groundwater impacts during construction, including dewatering operations, does not impact on the quality of the receiving surface waters. The Plan would also provide groundwater quality objectives and discharge requirements, the scope of dewatering (including volumes, levels, method and draw down effects) and would be prepared in consultation with the EPA and DPI Water. | Section 6.4  
Table 7-2 SW60  
Appendix B Water Management Plan (including the Groundwater and Dewatering Management Plan) |
| SWMM 8      | Treatment of captured groundwater during construction | • Groundwater seepage quality would be treated to background surface water quality to be protective of overall instream environmental values, and then in consideration of ANZECC (2000) freshwater criteria prior to discharge to surface water. | Section 6.4  
Appendix B Water Management Plan |
4 Consultation

4.1 Consultation requirements under the Stage 1 Project Approval

**Stage 1 CoA B6**: Water Management Plan to be prepared in consultation with EPA and Council.

**Stage 1 CoA B7**: Surface Water Quality Management Plan to be developed in consultation with DPI Water, EPA and Council.

Prior to the submission of the Stage 1 Soil and Water Quality Management Plan to DP&E, DPI Water and Council were engaged in consultation for review. A summary of consultation undertaken with these authorities is provided in Appendix A2 – Stakeholder and Agency CEMP Consultation within the CEMP.

Areas identified within the Plan for comment included water quality discharge, potential for groundwater impacts, which resulted in the inclusion of a groundwater assessment, and disposal of excavated materials.

All matters raised in consultation with these authorities were addressed in the revision of the Plan for submission to DP&E for approval.

4.2 Consultation requirements under the Stage 1 EIS

**SWMM 8**: Roads and Maritime met with DPI (Water) on 13 October 2015 to discuss impacts to groundwater from the Stage 2 underpass. Groundwater monitoring locations, groundwater parameters, and potential impacts were identified in the Stage 2 Groundwater Assessment (Appendix M to this plan) and discussed at the meeting. Additional information in relation to background monitoring data and long term monitoring locations were provided to DPI (Water) on 14 October 2015. The focus of the meeting was on Stage 2 as the Stage 1 is not expected to intercept groundwater during construction due to the distances between existing groundwater levels and proposed final road levels.

The EPA advised a meeting to discuss groundwater monitoring parameters, monitoring locations and groundwater quality should be deferred until Stage 2 is approved. A meeting was not considered necessary for Stage 1 given groundwater is unlikely to be intercepted.

**SWMM10**: Stage 1 is not anticipated to intercept groundwater therefore a groundwater extraction license or approval is not required. Consultation would be carried out with DPI (Water) in relation to relevant water sharing plans and the need to obtain a groundwater licenses prior to construction of Stage 2, should it be approved.

**SWMM 7**: Stage 1 is not anticipated to intercept groundwater during construction. An area of potential groundwater contamination has been identified in the Stage 2 area. RMS would consult with EPA and DPI Water prior to construction, subject to approval, to discuss groundwater quality in areas of contamination.

4.3 Consultation requirements under the Stage 2 Project Approval

**Stage 2 CoA B5**: Water Management Plan to be prepared or reviewed by a suitably qualified expert in consultation with DPI Water and Council.

**Stage 2 CoA D28(d)**: Construction Soil and Water Management Plan must be developed in consultation with DPI Water and Council.

Prior to the submission of this revised Plan to DP&E, which incorporates the requirements of the Stage 2 Project Approval, DPI Water and Council will be engaged on the specific
requirements covered by this Plan for Stage 2 construction. Similarly, DPI Water and Council will be consulted on the Water Management Plan (Appendix B).

A summary of consultation on this Plan and the Water Management Plan, and areas addressed as outcomes of this consultation will be documented within Appendix A2 – Stakeholder and Agency CEMP Consultation within the CEMP.

4.4 Consultation requirements under the Stage 2 EIS

**SWMM 1, 4 and 5:** In response to the DPI Water’s and the EPA’s submissions on the EIS in regards to surface water quality, Roads and Maritime has started pre-construction monitoring of surface water and groundwater quality, groundwater flows and groundwater levels, and this information (spanning 12 months) would assist in defining baseline conditions for the Water Management Plan, with erosion and sediment control measures and a monitoring program included within the Soil and Water Quality Management Plan.

**SWMM 6, 7 and 8:** Roads and Maritime met with DPI (Water) on 13 October 2015 to discuss impacts to groundwater from the Stage 2 underpass during construction of Stage 2. Groundwater monitoring locations, groundwater parameters, and potential impacts were identified in the Stage 2 Groundwater Assessment (Appendix M to this Plan). A more detailed assessment of water quality has been carried out throughout the detailed design stage as more water monitoring data becomes available.

In further response to DPI Water submission on the EIS in regards to groundwater quality, it was concluded that the selected monitoring sites and accumulation of 12 months of baseline data should be appropriate for comparison against the monitoring to be undertaken during construction. A groundwater monitoring program during construction and operation of the Stage 2 Project would form part of the Water Management Plan, developed in consultation with relevant stakeholders.
5 Existing environment

The following sections summarise the factors influencing soil and water within and adjacent to the Project corridor based on the information provided in the Stage 1 EIS and SPIR and Stage 2 EIS and Submissions Report.

5.1 Landscape and soil characteristics

5.1.1 Topography

The Project is located in an undulating area with the major roads generally following ridgelines. Warringah Road follows an east-west ridgeline and is generally flat. The road rises to its highest point adjacent to the Forest High School. The prevailing grade along Warringah Road is moderate in slope east of the Wakehurst Parkway, becoming steeper further to the west. Warringah Road has a grade of about 7% immediately west of its intersection with Forest Way. The Wakehurst Parkway has a grade of about 3% immediately south of Warringah Road.

Naree Road and Frenchs Forest Road West are steep in grade between Forest Way and Rabbett Street. Frenchs Forest Road falls to a low point at Rabbett Street before rising to its highest point adjacent to the Forest High School before falling again to the east towards the intersection with the Wakehurst Parkway. Frenchs Forest Road East then continues to rise gradually towards the intersection with Warringah Road.

The Wakehurst Parkway follows a north-south ridgeline that descends into a valley north of Frenchs Forest Road that is associated with Deep Creek and Narrabeen Lagoon. To the south of Warringah Road, the Wakehurst Parkway descends into a valley associated with Curl Curl Creek, a tributary of Manly Dam.

5.1.2 Geology and soils

The area is underlain by Hawkesbury Sandstone, and Triassic Wianamatta Group Shales, which comprise the Liverpool Sub-Group of Minchinbury Sandstone and Bringelly and Ashfield Shales (1:250,000 Geological Series Sheet S1 56-5 Sydney). The sandstone geology has weathered to leave exposed stone outcroppings, while the shale geology consists of shale with sandstone lenses. Many locations have been disturbed by development.

The area is located within the Lucas Heights soil landscape, overlying shale at 3 – 5 m thick and Hawkesbury Sandstone at about 10 - 11 m deep. Pockets of clay are common, while bands of iron-rich sands and ironstone gravels can also be found. The main soil types expected within the area are sandstone derived soils associated with ridgelines, as well as pockets or ironstone gravels and shaly clays.

5.1.3 Soil Erodibility

The soil erodibility is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. The soil erodibility factor (K) is used within the Revised Universal Soil Loss Equitation (RUSLE) to estimate the soil loss, expressed as tonnes per hectare per year. This estimate is used when sizing construction sediment basins.

A soil erodibility factor of 0.042 for the Project has been used, taken from table C20 in Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom, 2004).

5.1.4 Acid sulfate soil

Acid sulfate soils are are soils rich in iron sulphides which have the potential to oxidise following exposure to air and generate highly acid leachate (e.g. from stormwater runoff or wetting). Acid sulfate soils generally occur within:
- marine or estuarine sediments deposited during the Holocene period;
- soils less than 5 m above sea level; and
- marine or estuarine settings/environments.

Review of ASS Risk Maps from the NSW Natural Resource Atlas database and the Warringah Council Local Environment Plan 2011 - Acid Sulfate Soil Map–Sheet ASS_008 and Landslip Risk Map – Sheet LSR008 carried out for the Stage 1 and Stage 2 EISs indicate that the Project is not within an acid sulfate soil prone area. Accordingly ASS are not identified as a risk within the Project Footprint, nonetheless an Acid Sulfate Soil Management Procedure is available in Appendix E and will be applied in the event of encountering potential acid sulfate soils.

### 5.1.5 Potential sources of contamination

The Project is largely confined to the existing road network within the Northern Beaches Hospital precinct. There is a potential that contaminated land will be detected during Project construction due to a number of pre-existing land uses in proximity of the Project including current and historical industrial complexes, uncontrolled fill sites, service stations and historic brickworks.

Table 5-1 summarises the findings of the Phase 1 preliminary site assessment (SMEC, 2013) identifying potential Areas of Environmental Concern (AECs) in regards to land contamination. These locations are shown in Figure 5-1.

<table>
<thead>
<tr>
<th>Potential AECs</th>
<th>Location</th>
<th>Potential Contaminants of Concern</th>
<th>Stage 1</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every Day Carwash –</td>
<td>Russell Avenue</td>
<td>Metals (lead), PAHs, TPH, BTEX,</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Forest Way Dry Cleaners</td>
<td>Forest Way Shopping Centre</td>
<td>Tetrachloroethene (PCE) and other chemical cleaning products</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Frenchs Forest Police Station</td>
<td>137-139 Frenchs Forest Road West</td>
<td>Metals (lead), PAHs, TPH, BTEX,</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>RTA Storage Facility</td>
<td>Corner of Warringah Road and Wakehurst Parkway</td>
<td>Metals, Coal Tar and PAHs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Former Service Station(^{Note1})</td>
<td>310-314 Warringah Rd</td>
<td>Metals (lead), PAHs, TPH, BTEX,</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Potential uncontrolled fill material</td>
<td>Numerous locations within Project footprint</td>
<td>Metals, PAHs, TPH, BTEX, PCB, OCP, OPP and asbestos</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Historical brickworks site (3)</td>
<td>Between Warringah Rd and Rodborough Rd</td>
<td>Metals, PAHs, TPH, BTEX, PCB, OCP, OPP and asbestos</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Historical brickworks site (1)</td>
<td>Warringah Road and Bantry Bay Road</td>
<td>Metals, PAHs, TPH, BTEX, PCB, OCP, OPP and asbestos</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Former orchard</td>
<td>The Forest High School</td>
<td>OCP and OPP pesticides</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>7 Eleven Service Station</td>
<td>Warringah Rd &amp; Hilmer St</td>
<td>Metals, PAHs, TPH, BTEX,</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

\(^{Note1}\): Former service station is located outside of project area and is undergoing remediation
Figure 5-1: Phase 1 - Identified potential sources of contamination
Further investigation of potential contamination was undertaken during the Stage 2 EIS and documented findings within the Phase 2 contamination assessment report (URS, 2015). Table 5-2 summarises the findings of the Phase 2 Environmental site assessment and the potential contaminants of concern with each identified AEC. The location of each AEC is shown in Figure 5-2.

**Table 5-2: Phase 2 Identified areas of environmental concern in Stage 2 area**

<table>
<thead>
<tr>
<th>Potential AECs</th>
<th>Location</th>
<th>Potential Contaminants of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>All AEC’s (1 – 5) – Potential uncontrolled fill material</td>
<td>Numerous locations within the project footprint</td>
<td>Metals, PAHs, TPH, BTEX, PCB, OCP, OPP and asbestos</td>
</tr>
<tr>
<td>AEC4 – Historical brickworks site</td>
<td>Between Warringah Road and Rodborough Road</td>
<td>Metals, PAHs, TPH, BTEX, PCB, OCP, OPP and asbestos</td>
</tr>
<tr>
<td>AEC4 – Historical brickworks site</td>
<td>Brick Pit Reserve – Warringah Road and Bantry Bay Road</td>
<td>Metals, PAHs, TPH, BTEX, PCB, OCP, OPP and asbestos</td>
</tr>
<tr>
<td>AEC5 – 7Eleven Service Station</td>
<td>Warringah Road and Hilmer Street</td>
<td>Metals, PAHs, TPH, BTEX</td>
</tr>
</tbody>
</table>

Soil impacts were identified by the Phase 2 screening analytical samples against the adopted Investigation Levels. These impacts were identified within shallow fill material and include:

- Concentrations of lead were recorded as exceeding the adopted soil Health Investigation Levels for recreational ‘C’ land use within areas of AEC4 (location AEC4_2, at 0.1 to 0.2 mbgl and 0.5 to 0.6 mbgl) and AEC5 (location AEC5_4, at 0.1 to 0.2 mbgl). The extent of impacted fill at these locations is considered to extend from surface level to 0.6 mbgl (AEC4_2) and from surface level to 0.2 mbgl (AEC5_4).
- Fill material containing asbestos was recorded to be present within areas of AEC2 (location AEC2_26, at 0.1 to 0.2 mbgl) and AEC4 (location AEC4_2, at 0.5 to 0.6 mbgl). The extent of impacted fill at these locations is considered to extend from surface level to 0.3 mbgl (AEC2_26) and from surface level to 0.6 mbgl (AEC4_2).
- Volatile hydrocarbons were reported within the AEC5 at location AEC5, at 0.7 to 1.3 metres below ground level (mbgl). As these hydrocarbons are likely to be attributed to petroleum products associated with the 7Eleven service station, the depth of impact is not anticipated to extend significantly beyond the depth to groundwater. The static water level was recorded at approximately 0.65 mbgl in AEC5 considered to be representative of perched groundwater within the fill layer, as groundwater ingress was not observed during sampling at less than 1.6 mbgl in any boreholes tested within AEC5.

Groundwater quality was identified by screening analytical samples against the adopted investigation levels. Known localised groundwater conditions are as follows:

- Concentrations of cadmium, chromium, copper, lead, nickel and/or zinc in groundwater were recorded as exceeding the adopted ecological investigation level within all AECs.
- Concentrations of arsenic, chromium, lead and/or nickel in groundwater were recorded as exceeding the adopted health-based (i.e. drinking water) investigation levels within all AECs.
- Light non-aqueous phase liquid (LNAPL) was identified at a thickness of 2 mm in the groundwater monitoring well within AEC5.
Figure 5-2: within Stage 2

Phase 2 – Identified potential sources of contamination and AECs
5.2 Surface water

The Stage 1 works are located within the headwaters of the Middle Creek catchment, runoff from which eventually discharges into the western side of Narrabeen Lagoon. The Stage 2 area lies on a ridge at the top of three catchments: Middle Creek to the north; Bantry Bay to the southwest and Curl Curl Creek to the south.

Figure 5-3 shows the indicative location and extent of the Middle Creek, Bantry Bay and Curl Curl Creek catchments that encompass the Project. Figure 5-4 further illustrates the existing road drainage system and subcatchment locations feeding into the three main catchments.

Land use within the Project area consists residential, commercial and industrial development and includes the Forest High School, Skyline Shops and Forestway Shopping Centre. Stormwater runoff is predominantly generated by roads, roofs and pavements, which discharges into the major drainage lines.

The prevailing terrain within the road corridor is moderate to steep, with maximum longitudinal grades of up to about 5%, except for the area in the vicinity of Wakehurst Parkway where grades of up to about 8% occur.

5.2.1 Middle Creek catchment

The roads to be upgraded as part of the Stage 1 works contribute to runoff in three drainage lines, referred to as Drainage Lines 1, 2 and 3 on Figure 5-4. Drainage Line 1 forms the main arm of Middle Creek and drains the section of road corridor between Adams Street and Gladys Avenue. The section of the road corridor between Gladys Avenue and Romford Road drains to Drainage Line 2, which is referred to as Trefoil Creek and is a tributary Middle Creek. Drainage Line 3 is a tributary to Middle Creek that drains the section of Project corridor between Romford Road and Courtley Road.

Under existing conditions, about 4.2 hectares (24 per cent) of the Stage 2 Project site drains north to Middle Creek via Catchment 1 and Catchment 3, which have total surface areas of about 92.6 hectares and 60.8 hectares, respectively. This differs to the Stage 1 Project, which in part drains Catchment 1, Catchment 2 (Trefoil Creek) and Catchment 3 to the north. Trefoil Creek is a tributary of Middle Creek with headwaters to the northeast of Wakehurst Parkway and Frenchs Forest Road East. The Stage 2 Project does not impact surface water flows received by Trefoil Creek.

5.2.2 Bantry Bay and Curl Curl Creek catchments

The Stage 2 works are located principally within the headwaters of an unnamed watercourse which drains south into Bantry Bay in Middle Harbour and Manly Creek, and then drains south into Manly Dam. Runoff from two sections of Warringah Road and a section of Allambie Road, both of which would be upgraded as part of Stage 2, currently discharge north into the Middle Creek catchment.

The catchment draining to Bantry Bay includes Bates Creek and an unnamed tributary to which about 4.2 hectares (24 per cent) of the Stage 2 Project site drains. The unnamed tributary is split into Catchments 4 and 5, which have total catchment areas of 34.2 hectares and 26.7 hectares, respectively. Under existing conditions, about 9.5 hectares (53 per cent) of the Stage 2 Project site drains south to Curl Curl Creek via Catchment 6, which has a total surface area of about 135 hectares. Six catchments draining in a southerly direction contribute to flow in the existing road drainage systems of the Stage 2 Project area (refer to Figure 5-4). Land use within these catchments comprises residential development, the Frenchs Forest Public School west of Forest Way, a portion of the Northern Beaches Hospital site and Skyline Business Park. Runoff from vacant land located on the western side of the Wakehurst Parkway also discharges south into the road drainage system.

Surface flows to the drainage network proposed to be upgraded as part of Stage 2 contribute to runoff in three drainage lines, described as Drainage Lines 4, 5 and 6 (refer to Figure 5-4).
Drainage Lines 4 and 5 form part of the unnamed watercourse which drains south into Bantry Bay in Middle Harbour, while Drainage Line 6 is tributary of Curl Curl Creek, itself a tributary of Manly Creek.

5.2.3 Catchment biodiversity

The portion of the Middle Creek, Bantry Bay and Curl Curl Creek catchments impacted by the Project is assessed in the Stage 1 and Stage 2 EIIs as having high biodiversity value, with Duffys Forest Ecological Community (DFEC) scattered throughout the area. The Project also traverses a Priority 1 Wildlife Corridor as mapped by Warringah Council and contains habitat for a number of threatened flora and fauna species (refer to the Flora and Fauna Management Sub Plan in Appendix B2 of the CEMP).

Red-crowned Toadlet habitat has been identified on the northern side of Frenchs Forest Road East in the headwaters of the Trefoil Creek sub-catchment and on the southern side of Warringah Road in the upper reaches of the Curl Curl Creek catchment.

5.2.4 Water quality in local waterways

Pre-construction surface water monitoring has been conducted as part of Surface Water Quality Monitoring Program since November 2014 (SMEC, 2015). As there are no up-gradient background monitoring locations the monitoring locations detailed in Table 5-3 and shown in Figure 5-4 have been selected to identify potential water quality impacts on:

- creeks and tributaries;
- existing users; and
- Manly Dam (Curl Curl Creek) and Middle Harbour.

Table 5-3: Surface water quality monitoring locations

<table>
<thead>
<tr>
<th>ID</th>
<th>Surface RL (mAH)</th>
<th>Catchment</th>
<th>Location Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>100.6</td>
<td>Middle Creek</td>
<td>Located to the North of the project footprint. Accessed from Jindabyne Reserve (Epping Drive). Sample point just below confluence of 2nd creek line entering from Greendale Reserve No.2</td>
</tr>
<tr>
<td>SW2</td>
<td>82.5</td>
<td>Middle Creek</td>
<td>Located to the North of the Project. Accessed from Energy Australia access road that runs parallel to Wakehurst Parkway (Oxford Falls traffic lights). Trefoil Creek sample point located approximately 300 north-east of overhead power lines.</td>
</tr>
<tr>
<td>SW3</td>
<td>84.1</td>
<td>Middle Creek</td>
<td>Located to the North of the project footprint. Accessed from Wearden Road. Sample point immediately downstream from road bridge</td>
</tr>
<tr>
<td>SW4</td>
<td>TBC</td>
<td>Curl Curl Creek</td>
<td>Located to the South of the project footprint. Accessed from Warringah Aquatic Centre carpark on the eastern side of Aquatic Drive entry point. Sampled from immediately above culvert.</td>
</tr>
<tr>
<td>SW5*</td>
<td>TBC</td>
<td>Curl Curl Creek</td>
<td>Located to the South of the project footprint. Accessed from the north side of the end of Aquatic Drive. Sampled from drainage line on the northern side of the fence line adjacent to the business park.</td>
</tr>
<tr>
<td>SW6</td>
<td>TBC</td>
<td>Bantry Bay</td>
<td>Located to the South of the project footprint. Accessed from the road bridge at the end of Currie Road. Sampled from creek line upstream of bridge.</td>
</tr>
<tr>
<td>SW7</td>
<td>122</td>
<td>Middle Creek</td>
<td>Wet weather sampling point. Located off Nandi Avenue street reserve. Access from the drainage easement that accesses the creek.</td>
</tr>
</tbody>
</table>

# approximate from GPS, TBC - to be confirmed.

* creek line not located water body at the end of Aquatic Drive sampled
Figure 5-3: Project surface
water catchments
Figure 5-4: Surface Water sampling points and drainage lines traversing the Project
A combination of field and laboratory surface quality indicators pH, Electrical Conductivity (EC), Redox, Dissolved Oxygen (DO), Turbidity, Temperature (°C) and Total Dissolved Solids (TDS) were measured during each monitoring round (outlined in the SWMP) and has shown the following range of physical parameters:

**Table 5-4: Existing Catchment Conditions**

<table>
<thead>
<tr>
<th>Climate Parameter</th>
<th>Middle Creek Catchment (SW1, SW2 and SW3)</th>
<th>Bantry Bay Catchment (SW6)</th>
<th>Curl Curl Creek Catchment (SW4 and 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>from 6.4 to 7.3</td>
<td>ranges from 7.0 to 7.7</td>
<td>ranges from 6.2 to 7.6</td>
</tr>
<tr>
<td>EC</td>
<td>from 260μS/cm to 1,200μS/cm</td>
<td>ranges from 230μS/cm to 360μS/cm</td>
<td>ranges from 230μS/cm to 500μS/cm</td>
</tr>
<tr>
<td>Turbidity</td>
<td>from 0.1NTU to 13.4NTU</td>
<td>ranges from 2.1NTU to 12.0NTU</td>
<td>ranges from 0.1NTU to 140NTU</td>
</tr>
<tr>
<td>TSS</td>
<td>ranges from &lt;5mg/L to 18mg/L</td>
<td>ranges from &lt;5mg/L to 16mg/L</td>
<td>ranges from &lt;5mg/L to 230mg/L</td>
</tr>
<tr>
<td>TDS</td>
<td>ranges from 130mg/L to 690mg/L</td>
<td>from 140mg/L to 230mg/L</td>
<td>ranges from 130mg/L to 300mg/L</td>
</tr>
</tbody>
</table>

The Warringah Council’s GIS stormwater data shows no existing water quality control measures within the road corridor. However, a sediment pond is located on Drainage Line 1 in Rabbett Reserve, approximately 140 m downstream of the road corridor.

There are no existing water quality measures controlling runoff from the urban catchments discharging into Drainage Lines 2 and 3 in the immediate vicinity of the road corridor.

### 5.3 Groundwater

#### 5.3.1 Groundwater conditions

Groundwater level observations were obtained during geotechnical investigations carried out for the Stage 1 EIS and Stage 2 EIS. There are nine groundwater monitoring wells that were used for water elevation monitoring for the Concept Proposal geotechnical investigations. The monitoring data suggests that the average depth to groundwater is between 2.9 and 6.2 metres below ground level across the Project, and that there is an average fluctuation in the groundwater levels of about one metre over a nine-month monitoring period from December 2013 to September 2014.

Groundwater for both the local and regional water tables flows generally to the south and south east towards Middle Harbour and Manly Dam (SMEC 2013, Parsons Brinckerhoff 2013).

Figure 5-5 presents groundwater contours of the estimated existing conditions during the Stage 2 EIS investigations. These were estimated using the average groundwater level at the nine key monitoring wells across the site. The groundwater contours suggest that groundwater typically flows southward across and toward the gully systems located in the Bantry Bay catchment and Curl Curl Creek catchment, to the south and south-east of the Stage 2 Project area. Details on current groundwater conditions will be reviewed based on updated information from groundwater monitoring to be undertaken in accordance with Water Management Plan (Appendix B) including groundwater monitoring and reporting requirements.

#### 5.3.2 Baseline Groundwater Quality Monitoring

The overall objective of the baseline groundwater quality monitoring is to observe and assess the local groundwater to inform the Water Management Plan required under CoA B6.
The WMP outlines ongoing monitoring requirements for the project. Groundwater monitoring is conducted on a monthly basis, generally within the first week of each month. Groundwater monitoring is undertaken at 10 locations near the project site (Figure 5-5).
Figure 5.5: Sampling location for surface water and groundwater monitoring
Table 5.5 and Table 5.6 outlines the baseline groundwater monitoring, changes to the monitoring criteria may occur after the approval of the WMP.

The baseline groundwater criterion uses the relevant information from the following:

- The parameters includes in earlier monitoring programs within the region (e.g. by SEMC for the Northern Beaches Hospital proposed site).
- Drinking Water (Australian Drinking Water guidelines (NHMRC & NRMMC, 2004).
- Aquatic ecosystems (ANZECC &ARMCANZ, 2000).

### Table 5.5: Groundwater quality monitoring parameters

<table>
<thead>
<tr>
<th>Parameters Type</th>
<th>Parameter</th>
<th>Analysis Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of groundwater</td>
<td>Depth (meters below the top of casing)</td>
<td>In field</td>
</tr>
<tr>
<td></td>
<td>pH</td>
<td>In field and laboratory analysis</td>
</tr>
<tr>
<td></td>
<td>Dissolved Oxygen (DO)</td>
<td>In field</td>
</tr>
<tr>
<td></td>
<td>Electrical conductivity</td>
<td>In field and laboratory analysis</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>In field</td>
</tr>
<tr>
<td></td>
<td>Total Dissolved Solids (TDS)</td>
<td>Laboratory analysis</td>
</tr>
<tr>
<td>Hydrocarbons (TPH/BTEX/PHAs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Metals (Arsenic, cadmium, Chromium, Copper, Lead, Nickle, Zinc, Iron, Mercury)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Metals (Aluminum, Iron, Manganese)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ion Balance (Alkalinity, Bicarbonate, Calcium, Carbonate, Chloride, Hydroxide, Magnesium, Potassium, Sodium, Sulphate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrients</td>
<td>Total Nitrogen, Total Phosphorous, Nitrite, Nitrate, Ammonia</td>
<td>Laboratory analysis</td>
</tr>
</tbody>
</table>
Table 56: Adopted site assessment criteria for groundwater (ug/L)

<table>
<thead>
<tr>
<th>Contaminant: (ANZECC (2000) 95% and 90% freshwater criteria)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic V</td>
</tr>
<tr>
<td>Cadmium</td>
</tr>
<tr>
<td>Chromium (III)</td>
</tr>
<tr>
<td>Chromium (VI)</td>
</tr>
<tr>
<td>Copper</td>
</tr>
<tr>
<td>Lead</td>
</tr>
<tr>
<td>Mercury (inorganic)</td>
</tr>
<tr>
<td>Manganese</td>
</tr>
<tr>
<td>Nickel</td>
</tr>
<tr>
<td>Zinc</td>
</tr>
<tr>
<td>Total recoverable Hydrocarbons</td>
</tr>
<tr>
<td>TRH C6-C10</td>
</tr>
<tr>
<td>TRH C10-C16</td>
</tr>
<tr>
<td>TRH C6-C9</td>
</tr>
<tr>
<td>TRH C10-C36</td>
</tr>
<tr>
<td>Benzene</td>
</tr>
<tr>
<td>Ethylbenzene</td>
</tr>
<tr>
<td>Toluene</td>
</tr>
<tr>
<td>Xylenes (o)</td>
</tr>
<tr>
<td>Xylenes (p)</td>
</tr>
<tr>
<td>Xylenes (total)</td>
</tr>
<tr>
<td>Polycyclic Aromatic Hydrocarbons</td>
</tr>
<tr>
<td>Total PAH</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
</tr>
<tr>
<td>Naphthalene</td>
</tr>
<tr>
<td>Ammonia</td>
</tr>
<tr>
<td>Nitrate</td>
</tr>
</tbody>
</table>

Note: Groundwater criteria would be finalised as part of the development of the Stage 2 WMP. This document is yet to be submitted to DP&E as it will form a staged approach to the Stage 2 Project.

5.3.3 Groundwater dependent ecosystems

Communities of potential groundwater dependent ecosystems are identified within the Australian Bureau of Meteorology (BoM) groundwater dependent ecosystems (GDE) Atlas. The atlas suggests that the nearest GDEs are likely to be located more than 2 kilometres to the north and south in low lying areas that are not expected to have a strong hydraulic connection to the site.

Localised ecological studies carried out for the Stage 1 Project and the Stage 2 Project have identified the presence of Red-crowned Toadlet habitats that rely on the presence of water and pools for foraging and breeding. The locations of the Red-crowned Toadlet foraging and breeding areas located in the upper reaches of Trefoil Creek and the upper reaches of Curl Curl Creek (north of the sports fields at Aquatic Drive).

The biodiversity assessment conducted for the Stage 1 EIS also identified flora communities of coastal enriched sandstone dry forest, Sydney Ironstone Bloodwood – Silvertop Ash Forest (DFEC) of varying degrees of condition, which has been considered to be partially dependent on groundwater.
Figure 5-6: Groundwater contours and location of groundwater monitoring bores
Note: Groundwater contours based on monitoring investigations taken for Stage 2 EIS investigations and may be subject to change - To be reviewed as part of WMP for Stage 2 groundwater monitoring.
5.4 Climate

Based on Bureau of Meteorology data, Frenchs Forest has a total mean annual rainfall of 1,348.8 mm, with the highest mean monthly rainfall occurring in January to April (129.5 to 155.5 mm per month).

Frenchs Forest has a mean average annual temperature of 21.6 °C, with the warmest months being December to February (about 28°C) and the coldest months of June to August (about 15 to 16°C).

Climate data obtained from the Bureau of Meteorology for the nearest monitoring station at Macquarie Park is summarised in Table 5-. Data from the Bureau of Meteorology indicate that the windiest months are between September and January.

### Table 5-7: Summary of BoM climate data for BoM Macquarie Park monitoring station

<table>
<thead>
<tr>
<th>Climate Parameter</th>
<th>Average monthly minimum</th>
<th>Average monthly maximum</th>
<th>Average annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall (mm)</td>
<td>144 (February)</td>
<td>1140</td>
<td></td>
</tr>
<tr>
<td>Maximum temperature (°C)</td>
<td>17.1 (July)</td>
<td>27.7 (January)</td>
<td>22.8</td>
</tr>
<tr>
<td>Minimum temperature (°C)</td>
<td>4.9 (July)</td>
<td>16.9 (January)</td>
<td>11.2</td>
</tr>
<tr>
<td>Wind speed (km/h)</td>
<td>9.3 (May)</td>
<td>18.5 (December)</td>
<td>13.4</td>
</tr>
</tbody>
</table>

5.4.1 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 Equation RUSLE). The rainfall erosivity factor is used to determine the soil loss in tonnes per hectare per year, and is used in calculations when sizing construction sediment basins.

For the purpose of designing sediment basins and managing erosion a Rainfall Erosivity Factor erosion index (EI) of 4300 EI for the Project has been used, based on the Rainfall Erosivity maps in the Soils and Construction – Managing Urban Stormwater series, comprising Volume 1 (Landcom, 2004). Specific R values for specific sites are listed within Appendix A of Volume 1.
6 Environmental aspects and impacts

6.1 Construction activities

In general, aspects of the Stage 1 Project and Stage 2 Project that could result in adverse impacts to soils and water include:

- vegetation clearing and topsoil stripping;
- demolition works;
- bulk earthworks;
- construction of cuttings, retaining walls and embankments;
- temporary and permanent culvert and drainage works;
- material stockpiles and handling for onsite reuse and offsite disposal;
- handling of contaminated soils and hazardous materials (e.g. asbestos);
- removal/ modification of existing built features (e.g. paved surfaces);
- water use;
- compound operation including fuel and chemical storage, refuelling and chemical handling; and
- noxious weed treatment including herbicide spraying.

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.

The location of key activities in relation to potential impacts during Stage 1 and Stage 2 construction works in regards to surface water, groundwater, soils and contamination are shown in Figure 6-1 and summarized in Table 6-1. These potential impacts are discussed in sections 6.3, 6.4, 6.5 and 6.6 as follows, based on information provided in the Stage 1 EIS and SPIR and the Stage 2 EIS and Submissions Report.

Chapter 7 of this Plan provides mitigation measures that will be implemented in Stage 1 and Stage 2 to avoid or minimise the impacts identified.
Figure 6-1: Location of key construction activities for Stage 1 and Stage 2
### Table 6-1: Summary of potential surface water groundwater and soil/contamination impacts

<table>
<thead>
<tr>
<th>CONSTRUCTION ACTIVITY</th>
<th>POTENTIAL IMPACTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acid-Sulfate Soils</td>
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<tr>
<td>Stage 1 Works</td>
<td></td>
</tr>
<tr>
<td>Utility potholing</td>
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</tr>
<tr>
<td>Main compound - clearing, mobile plant and vehicles, chemical storages, laydown, water discharge (sed basin)</td>
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<tr>
<td>Vegetation clearing and grubbing</td>
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</tr>
<tr>
<td>Vegetation stockpiles</td>
<td>X</td>
</tr>
<tr>
<td>Trenching, underboring and installations</td>
<td>X</td>
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<tr>
<td>Removal of drilling muds</td>
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<tr>
<td>Road widening cut and fill</td>
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<tr>
<td>Stockpiling</td>
<td>X</td>
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<tr>
<td>Removal of spoil</td>
<td>X</td>
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<tr>
<td>Compaction, pavement layering and surfacing</td>
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<tr>
<td>Fuels, chemicals and hazardous materials</td>
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<tr>
<td>Drainage works</td>
<td>Roadside drainage upgrades and Wakehurst Parkway (north) drainage line</td>
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<tr>
<td>Finishing works</td>
<td>Landscaping, Lighting, Signalling, Linemarking</td>
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<tr>
<td>Stage 2 Works</td>
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<tr>
<td>Utility potholing, Initial environmental safeguards</td>
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<tr>
<td>Establishment of additional site compounds - Laydown areas</td>
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</table>

Northern Beaches Hospital – Connectivity and Network Enhancements Project
Soil and Water Quality Management Sub Plan

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### CONSTRUCTION ACTIVITY

<table>
<thead>
<tr>
<th>Acid Sulfate Soils</th>
<th>Contamination</th>
<th>Asbestos</th>
<th>Tanning generation</th>
<th>Sedimentation</th>
<th>Increased Runoff</th>
<th>Impacts to waterway flows</th>
<th>Increased turbidity in Surface water</th>
<th>Hydrocarbons release in Surface water</th>
<th>Changes to pH in Surface water</th>
<th>Other impacts to Surface water</th>
<th>Groundwater drawdown</th>
<th>Groundwater contamination</th>
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<td>Demolition works (including 7-Eleven site)</td>
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<td>Vegetation clearing and grubbing</td>
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<td>Karingal noise wall installation</td>
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<td>Removal of spoil</td>
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<td>Construction of road drainage structures, including culvert extensions and detention storages.</td>
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<td>Construction and installation of bridge segments for pedestrian bridges at Forest Way and Hilmer Street.</td>
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<td>Construction of overpasses at Hilmer Street, Wakehurst Parkway and Forest Way intersections.</td>
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<td>Fuels, chemicals and hazardous materials</td>
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<td>Pavements and preparation of widened road sections (eastbound and westbound), shared paths</td>
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<td>Slot construction, pavement layering</td>
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</table>
6.2 Staging of construction activities

Staging of construction activities during Stage 1 and Stage 2 is detailed in Chapter 2 of the CEMP covering the planned Project program and the specific construction activities and sequencing of activities for Stage 1 works and Stage 2 works.

Staging will be planned with consideration to the objectives stated in section 3.1 Erosion and Sediment Control of the Roads and Maritime Services Specification G38 - Soil and Water Management (September 2014) prepared for this project.

Site compounds and ancillary areas will be planned, staged and managed as a separate exercise with site specific erosion and sediment controls. The main compound located at Warringah Road and Wakehurst Parkway serving Stage 1 and Stage 2 construction works, and additional supporting facilities within the Project area (as shown in Figure 6-1) will be organised and managed in accordance the Construction Compound and Ancillary Facilities Management Plan (Appendix B8 of the CEMP).

Work programs will be developed which minimise the extent of clearing to areas which can be readily managed in regard to provision of sediment control and also works at elevated or extended shut down to provide increased erosion control.

Where possible, programing will include new stormwater works prior to commencement of bulk earthworks or removal of the existing curb and gutter and pavements. This will maintain access to a functional storm water system throughout the project areas.

Prior to commencement of works in each area a Progressive Erosion and Sediment Control Plan (PESCP) will be prepared. This PESCP will include:

- how and where non-site water is managed around work areas;
- location of high risk areas which may require temporary stabilization or similar protection during works;
- nomination of progressive stabilisation of areas as works are completed to minimize duration and extent of work areas exposed with particular consideration of high risk areas; and
- immediate stabilisation of drainage lines or other high risk areas with fabric or other non-erodible material.

Prior to commencement of earthworks, diversion of non-site water will be achieved wherever practical in accordance with the blue book with advice from the Project soil conservationist. Such diversions are expected to include:

- provision of temporary drainage - lined drains, diversion banks or temporary pipes around or through work areas;
- temporary curbs and gutters - concrete /hot mix berms, sand bag diversions or similar will be used to direct road water to the storm water system; and
- appropriate erosion controls as required within and at outlet of diversions.

Diversions may not be practical in all situations such as where stormwater falls directly into construction working areas or if gradients of construction areas or constraints of working areas prevent installation of bunds etc. to effectively divert stormwater from flowing into construction areas. Further measures to manage stormwater entering into construction sites will comply with the blue book, with advice from the Project soil conservationist.

Earthworks and pavement works will be planned with consideration to catchment sizes and length and grade of slope so that site water is maintained at volumes and velocities appropriate to the sediment controls available to each work area. As works progress, open work areas will be progressively completed to a level where surfaces are either stable or protected with select materials or suitable surface treatments.
6.3 Surface Water Impacts

6.3.1 Potential Stage 1 Surface Water Impacts

Construction activities have the potential to impact water quality within surrounding surface water features, both in the immediate area of the Stage 1 Project and within local receiving waters. Construction will involve the removal of existing vegetation, removal/modification of existing built features (e.g. paved surfaces) which would expose bare ground to erosion. Construction activities have the potential to increase the volume of sediment generated and deposited in the receiving drainage lines and the level of turbidity present in stormwater discharging to the downstream waterways of Narrabeen Lagoon, Manly Dam and Bantry Bay.

Vegetation removal, cut and fill operations, the widening of roads and upgrades to drainage systems represent a risk to surface water quality during construction. Pollutants such as sediment, soil nutrients and construction waste have the potential to mobilise and enter drainage lines, particularly during high rainfall events, resulting in sedimentation of surrounding waterways. Increased volumes or velocity of runoff can result in scouring of drainage lines and creek beds. A reduction in water quality can occur due to the influx of man-made substances, increased sediment load from erosion in the catchment and organic matter.

Potential pollutants which could be introduced into the water cycle from the Stage 1 Project include:

- exposure of soils during vegetation clearing and earthworks, creating the potential for off-site transport of eroded sediments and pollutants;
- production of tannins from mulch during clearing;
- alteration of surface and subsurface flows that could cause disturbances to hydrology and hydraulics;
- contamination of soils, surface water and groundwater from accidental spills or oil leaks. This may include grease or fuel from machinery and vehicles, construction sites or compounds, or spills of other chemicals that may be used during the course of construction;
- disturbance of unidentified contaminated land or other pesticide/chemical concentrations in soil from historical land use practices, and subsequent generation of contaminated runoff; and
- inadvertent release of rinse water from plant and washing concrete slurries and untreated water captured within sediment basins.

The installation of sediment retention basins for Stage 1 is not considered feasible due to the confined nature of the works, the proximity of existing development and the steep topography in work areas where the local stormwater system discharges to Drainage Lines 1, 2 and 3.

In dealing with constrained areas which impact on the ability to install conventional sediment basins, the provisions of the Blue Book recommends increased application of local erosion and sediment control techniques aimed to achieve coarse sediment removal.

The implementation of effective erosion and sediment control measures detailed within the PESCPs for Stage 1 construction will minimise the volume of sediment transported from individual disturbed areas.

Stormwater collected during potholing and trenching works will be pumped out via sucker trucks and deposited into the sediment control basin located within the main site compound for treatment prior to discharge.
In order to minimise the impact on watercourse bank stability as a result of permanent works, outlet scour protection, such as a rock rip rap apron with an energy dissipation structure will be considered as part of detailed design for pipe outlets discharging into receiving waters. Permanent scour protection where provided, will be designed for a 50 year ARI storm event in accordance with RMS D&C G38.

6.3.2 Potential Stage 2 Surface Water Impacts

Construction activities during Stage 2 involves demolition and clearing of existing infrastructure including a former service station and other commercial and residential properties, and removal of sections of road and existing drainage infrastructure. Significant vegetation clearing and excavation works along Warringah Road has been undertaken for slot construction and erection of noise walls, service installations and new shared pathways.

Potential pollutants which could be introduced into the water cycle from the Stage 2 Project include:

- exposure of soils during vegetation clearing and major earthworks, creating the potential for off-site transport of eroded sediments and pollutants;
- production of tannins from mulch during clearing;
- alteration of surface and subsurface flows that could cause disturbances to hydrology and hydraulics;
- contamination of soils, surface water and groundwater from accidental spills or oil leaks. This may include grease or fuel from machinery and vehicles, construction sites or compounds, or spills of other chemicals that may be used during the course of construction;
- handling of contaminated or hazardous materials such as asbestos removed during demolition or excavation works;
- disturbance of unidentified contaminated land or other pesticide/chemical concentrations in soil from historical land use practices, and subsequent generation of contaminated runoff; and
- inadvertent release of rinse water from plant and washing concrete slurries and untreated water captured within sediment basins.

These clearing, removal and excavation works, particularly along Warringah Road, have the potential to lead to erosion if uncontrolled which may lead to scouring and sediment loads leaving the Project area and deposited in the receiving drainage lines impacting waterways within the Bantry Bay and Curl Curl Creek (Manly Dam) catchments to the south of the project area including the Aurora Business Park drainage system.

The implementation of effective erosion and sediment control measures during Stage 2 construction will minimise the volume of sediment transported from individual disturbed areas. Sediment retention basins will be established at:

- southeast corner of Fitzpatrick Avenue East and Warringah Road intersection.

This basin provides temporary sediment retention and treatment solutions for Stage 2 construction during initial earthworks.

In order to minimise watercourse bank stability as a result of permanent works, outlet scour protection, such as a rock rip rap apron with an energy dissipation structure will be considered as part of detailed design for pipe outlets discharging into receiving waters. Permanent scour protection where provided, will be designed for a 50 year ARI storm event in accordance with RMS D&C G38.
In addition to sediment retention basins, erosion and sedimentation controls and smaller retention traps will be progressively implemented within the road corridor during construction.

6.4 Groundwater Impacts

6.4.1 Potential Stage 1 Groundwater impacts

Impacts on groundwater were assessed in the EIS as minor during construction of Stage 1 Project, as the works would mainly be constructed at or near ground surface.

The exception to this is the proposed cuttings near the intersection of the Wakehurst Parkway and Frenchs Forest Road where there is potential for the cutting to intercept and connect with the shallow groundwater adjacent to the hospital site. Further investigations as part of the Stage 1 SPIR identified groundwater impacts would be minor in this area as intersection improvements would result in the road being lowered 1.5m. The known groundwater table is located 3m under existing road levels at this location. Due to distances between existing groundwater and proposed final levels, impacts are not anticipated.

Similarly, it is unlikely that the regional water table would be intercepted. Impacts on groundwater supply are not predicted as there are no identified groundwater bores for domestic or industrial use in the vicinity and groundwater will not be extracted for use during construction.

In the event groundwater is intercepted during construction, it would be monitored as required and engineering methods employed where reasonable and feasible.

Impacts on Red-crowned Toadlet habitat from construction activities upstream of Trefoil Creek was identified in the EIS as a possibility. The Red-crowned Toadlet population associated with Trefoil Creek is unlikely to be affected by works associated with the Stage 1 Project as the area to be cleared along Frenchs Forest Road and Wakehurst Parkway in the north of the study area is minimal. Surface water management and drainage for Stage 1 has been specifically designed to ensure the hydrologic regime is not altered in areas identified as Red-crowned Toadlet habitat in the Trefoil Creek sub-catchment.

Terrestrial vegetation within the Stage 1 Project area has low or only partial dependence on groundwater during low flow or drought periods. The potential for subsurface works on Warringah Road to result in groundwater drawdown or intercepting of groundwater flows would have a minor impact to the Terrestrial Vegetation groundwater dependent ecosystem.

Groundwater pollution may potentially occur due to accidental spills during construction of the Stage 1 Project. However by implementing appropriate mitigation and monitoring measures (as presented in Chapter 7), it is expected that the risk posed by construction activities contaminating the underlying groundwater would be low.

Migration of contaminants to deeper soils or to areas of perched groundwater may occur during construction as a result of leaching of contaminated soils if stockpiled for lengthy periods, or from infiltration of spills on the surface. Given the low permeability of the surrounding soils, the significant depth to regional groundwater, the safeguards and management measures identified for the proposal regarding stockpiling and emergency spill response the potential migration for contaminants (if any) from the construction impact area to groundwater is considered low.

6.4.2 Potential Stage 2 Groundwater impacts

Impacts on groundwater were assessed in the Stage 2 EIS identifying a number of potential impacts as a result of construction work intercepting groundwater when working at depth. Key impacts identified include:
- reduction in groundwater recharge can result as a consequence of a number of factors such as compaction of shallow soils, stockpiling, removal of vegetated surfaces while increasing sealed surfaces;
- drawdown from groundwater inflows during construction of the slot (at depth) could be significant if left unmitigated, requiring measures to minimise seepage where practicable and feasible;
- potential for groundwater quality impacts resulting from the interception of potentially contaminated groundwater, and/or from the potential for construction activities to migrate contaminants to the underlying groundwater; and
- dewatering would be required particularly during the construction of the slot with anticipated inflows into the slot during construction at depth. Groundwater seepage into the slot during construction would require management and treatment before discharge to surface water;

Drawdown impacts on sensitive groundwater receptors including registered groundwater users and groundwater dependent ecosystems (in particular the Red-crowned Toadlet habitat was identified in the Stage 2 EIS as a possibility.

Three groundwater wells are interpreted to be within the zone of drawdown influence associated with the Stage 2 construction work (refer to Figure 17.1). This includes two wells within about 200 metres of the Stage 2 Project (GW031758 and GW106757) which are simulated to have drawdowns of less than one metre under construction, and one well within about 600 metres of the Stage 2 Project with drawdown less than 0.2 metres (GW029663). This is less than the minimal impact criteria listed in the NSW AIP for the groundwater table, which stipulates that less than two metre of cumulative drawdown at any water supply work (water bore) is considered to represent a minimal impact. As such no groundwater wells in the surrounding area are expected to be negatively impacted.

From biodiversity assessments conducted in the Stage 2 EIS, potential groundwater changes resulting from Stage 2 construction works on groundwater drawdown are unlikely to result in a reduction in surface water flows that would adversely impact Red-crowned Toadlet habitats. The Duffys Forest Ecological Community vegetation within the vicinity of the Stage 2 Project would potentially use groundwater opportunistically during low rainfall or drought periods however the EIS concludes that the DFEC vegetation areas are not sensitive to groundwater table depth and therefore that they have a low groundwater dependence.

During construction potential groundwater quality risks include:
- infiltration of isolated spills or leaked chemicals and accidents occurring during construction;
- contamination through the ground surface through dirty water retention facilities (such as temporary sediment basins) to the underlying groundwater systems; and
- contaminated groundwater seeping into the slot that has been impacted by surrounding urban activities such as surrounding land use activities (e.g. 7 Eleven service station) or naturally occurring changes in groundwater due to oxidation or elevated metals, total dissolved solids or nitrate levels.

As a result of potential groundwater quality risks, the offsite discharge of collected groundwater seepage during construction to surface waters can present a potential impact for receiving surface water quality.

Findings from the Stage 2 EIS were that with the implementation of appropriate mitigation and monitoring measures (as presented in Chapter 7), it is expected that the risk posed by construction activities contaminating the underlying groundwater would be low.
Based on material contained in the Water Management plan, treatment of groundwater captured during construction, including seepage into the slot, will need to be managed at or below the background surface water quality levels and/or the ANZECC (2000) freshwater quality guidelines prior to the discharge to catchment in order to be protective of instream environmental values. An Environmental Work method Statement, as described in the CEMP, will be prepared and implemented for the management of groundwater management.

When working at depth resulting in groundwater inflows, drawdown wells (as groundwater basins will be established as a means to lowering and diverting groundwater away from the trafficable construction work area allowing the extracted groundwater to be reused on-site wherever feasible, or discharged into the local stormwater system following treatment (if required).

Discharge of captured groundwater seepage during construction would need to meet the EPL criteria for water quality, followed by background surface water quality and then ANZECC (2000) freshwater criteria prior to discharge to surface water. Discharge quality requirements during construction would be further developed during detailed design when more surface water and groundwater monitoring data becomes available (a monitoring program is currently being carried out to establish baseline water quality).

In the event that discharge quality requirements cannot be achieved, alternative disposal methods would be investigated including applying for a Sydney Water trade waste permit to allow extracted groundwater to be discharged to sewer.

A Water Management Plan has been prepared during detailed design in consultation with the EPA and DPI Water, covering the proposed methods for managing groundwater impacts during construction, including dewatering operations, does not impact on the quality of the receiving surface waters.

6.5 Soil Impacts

6.5.1 Potential Stage 1 Soil Impacts

A preliminary erosion and sedimentation assessment was undertaken for the Project and reported in the Stage 1 EIS, in accordance with the Erosion and Sedimentation Risk Assessment Procedure (RTA, 2004). The identified construction works for Stage 1 are assessed to be low risk with reference to the following considerations:

- the size of the Stage 1 Project and area required for maintenance and installation of controls;
- soils being exposed are generally within the existing road formation and adjacent to operational drainage networks; and
- there are no SEPP 14 wetlands are located within the Stage 1 Project boundary.

Acid sulfate soils are not expected to impact the Stage 1 Project as it is located well above known acid sulfate soil locations as identified in the Stage 1 EIS. In the event that acid sulfate impacted soils are identified, the Acid Sulfate Soil Management Procedure provided in Appendix E will be applied.

Tannin leachate from cleared or mulched vegetation may move beyond the construction impact area if not appropriately managed. However, this impact would likely be minor as any cleared vegetation would be removed from site as soon as practicable after clearing. These works will be subject to the RMS Environmental Direction: Management of Tannins from Vegetable Mulch (Appendix F to this Plan).

More broadly, all clearing works will be subject to controls specified within the EWMS 0004 – Clearing and Grubbing covering the management vegetation, potential erosion and
sedimentation impacts and controlling potential pollution impacts to waterways and sensitive land uses.

Excavation works will involve the stockpiling of spoil prior to reuse or removal from site, which could lead to the potential for erosion of unconsolidated material and entrainment by runoff and transport off site. Soils transported into local waterways could have a number of impacts including:

- reduced hydraulic capacity due to deposition of material within the channel;
- degraded water quality including lower DO levels, increased nutrients (N, P), increased turbidity, and altered pH;
- increased levels of nutrients, metals and other pollutants, transported via sediment and runoff to receiving waterways; and
- bulk sedimentation smothering aquatic life and affecting aquatic ecosystems.

Eroded material transported from construction sites and deposited in terrestrial environments may result in smothering of terrestrial vegetation and reduced visual amenity. This material could form a source of dust emissions which could also impact on local amenity, particularly where deposition occurs in the vicinity of residential areas and sensitive land uses such as schools.

Stockpiling and management of spoil generated from excavated materials are to be undertaken in accordance with Appendix C – Spoil and Fill Management Procedure, and Appendix D – Stockpile Management Protocol.

Due to limited road corridor widths, existing vegetation and the objective of minimising the footprint, retaining walls will be provided to stabilise the Stage 1 cut and fill batters. Where retaining walls are not required, embankments will be stabilised through re-vegetation using indigenous species.

The intersection of Frenchs Forest Road and Wakehurst Parkway will be widened as part of Stage 1, resulting in cuttings on the south west corner (Hospital site) and western verge of the Wakehurst Parkway, the North-West corner next to an existing residence and along the south eastern corner and eastern verge of the Wakehurst Parkway. In addition, the intersection is to be partly raised to improve vertical alignment, which will require fill embankments at the north eastern corner. Retaining walls for the cuttings and fill embankments at this intersection are predicted to be 2 to 4 m high.

These works may encroach into the Trefoil Creek catchment creating the risk of soil erosion and could result in the transportation of eroded material into the catchment.

Cutting and filling in other sections of the Stage 1 Project, including sections of Forest Way, Naree Road, Frenchs Forest Road West and Allambie Road will be of a small scale. Due to the small and confined nature of these works, and with the implementation of SWQMP measures (refer Section 7), the potential for soil erosion or sedimentation is considered negligible.

### 6.5.2 Potential Stage 2 Soil Impacts

A preliminary erosion and sedimentation assessment was undertaken for the Project and reported in the Stage 2 EIS, in accordance with the *Erosion and Sedimentation Risk Assessment Procedure* (RTA, 2004). This identified construction works for Stage 2 are assessed to be low risk with reference to the following considerations:

- the size of the Stage 2 Project and area required for maintenance and installation of controls;
- soils being exposed are generally within the existing road formation and adjacent to operational drainage networks; and
there are no SEPP 14 wetlands are located within the Stage 2 Project boundary.

Acid sulfate soils are not expected to impact the Stage 2 Project as it is located well above known acid sulfate soil locations as identified in the Stage 2 EIS. In the event that acid sulfate impacted soils are identified, the Acid Sulfate Soil Management Procedure provided in Appendix E will be applied.

Major vegetation clearing works are planned for the southern side of Warringah Road to allow for road widening. Erosion of cleared areas and tannin leachate from cleared or mulched vegetation may move beyond the construction impact area if not appropriately managed. However, these impacts would likely be minor with planned erosion and sedimentation controls implemented prior to commencement of works, and cleared vegetation would be removed from site as soon as practicable after clearing.

These clearing works will be subject to the RMS Environmental Direction: Management of Tannins from Vegetable Mulch (Appendix F to this Plan). More broadly, all clearing works will be subject to controls specified within the EWMS 0004 – Clearing and Grubbing covering the management vegetation, potential erosion and sedimentation impacts and controlling potential pollution impacts to waterways and sensitive land uses.

Major excavation works will be required principally for slot construction along Warringah Road. These works will involve the stockpiling of spoil prior to reuse or removal from site, which could lead to the potential for erosion of unconsolidated material and entrainment by runoff and transport off site. Soils transported into local waterways could have a number of impacts including:

- reduced hydraulic capacity due to deposition of material within the channel;
- degraded water quality including lower DO levels, increased nutrients (N, P), increased turbidity, and altered pH;
- increased levels of nutrients, metals and other pollutants, transported via sediment and runoff to receiving waterways; and
- bulk sedimentation smothering aquatic life and affecting aquatic ecosystems.

Eroded material transported from construction sites and deposited in terrestrial environments may result in smothering of terrestrial vegetation and reduced visual amenity. This material could form a source of dust emissions which could also impact on local amenity, particularly where deposition occurs in the vicinity of residential areas and sensitive land uses such as schools.

Stockpiling and management of spoil generated from excavated materials are to be undertaken in accordance with Appendix C – Spoil and Fill Management Procedure, and Appendix D – Stockpile Management Protocol.

Retaining walls will be provided to stabilise the Stage 2 cut and fill batters. Where retaining walls are not required, such as along Wakehurst Parkway south of Warringah Road, embankments would be stabilised through re-vegetation using indigenous species.

Stabilisation methods will also be developed during detailed design for the major cutting of the Warringah Road slot with up to 10 metres of near-vertical cut face at its deepest point, to mitigate the potential for erosion and slope stability impacts.

6.6 Contamination impacts

6.6.1 Stage 1 Contamination impacts

Stage 1 construction activities identified as having the potential to impact on contaminated land or release contamination to underlying soils, include:
• major compound site and other ancillary site preparations and operation including:
  – storage of chemicals;
  – vehicle wash-down areas;
  – vehicle refuelling areas;
  – material storage and stockpile areas; and
  – generation of construction waste and general waste.
• excavation works particularly in areas of detected fill material and identified Areas of Environmental Concern (AECs);
• pavement removal;
• underground service relocation and installation;
• high frequency of vehicle movements;
• importing, handling, stockpiling and transporting material resources;
• accidental spills and leaks (e.g. hydraulic cable breaks);
• potholing and geotechnical investigations through the entire project footprint, particularly in areas of detected fill material and identified AECs.

Potential environmental impacts associated with these construction activities include:
• inappropriate handling or disposal of contaminated or hazardous excavated materials;
• adverse effects on human health (construction personnel, travelling public or nearby communities) via direct contact, release of odours or dust deposition;
• release of contaminants into underlying soils;
• release of contaminants infiltrating into groundwater;
• movement of contaminated sediments into stormwater systems; and
• adverse effects on flora and fauna.

The potential for latent contaminants being encountered during Stage 1 works is low, however Appendix H Unexpected Discovery of Contaminated Land Procedure will be applied in all instances of detected contamination to address potential environmental and human health impacts.

The Asbestos Management Plan (Appendix K) will apply in all instances where asbestos material is suspected.

All contaminated soils requiring to be disposed offsite will be undertaken in accordance with the requirements of soil classification and disposal specified within the Waste and Energy Management Plan (Appendix B7 of the CEMP).

6.6.2 Stage 2 Contamination impacts

The Stage 2 EIS, Phase 2 contamination assessment report identified five AECs within the Stage 2 Project Area as described in Table 5-2 and shown in Figure 5-2 of this Plan.

Potential contaminants of concern included heavy metals, hydrocarbons and asbestos. Three AECs of particular note are:
• asbestos impacted fill material detected within the shallow subsurface strata of AEC 2 – a public space and walkway extending from Fitzpatrick Avenue to Hilmer St;
• asbestos and lead impacted fill material detected within the shallow subsurface strata of AEC 4 – a historical brickworks site located at the southwest corner of the intersection of Wakehurst Parkway and Warringah Rd; and
• volatile hydrocarbons and lead were reported within the AEC5 immediately adjacent to the former 7Eleven service station (corner of Warringah Road and Hilmer Street).
Stage 2 construction activities identified as having the potential to impact on contaminated land or release contamination to underlying soils, include:

- ancillary site preparations and operation including:
  - storage of chemicals;
  - vehicle wash-down areas;
  - vehicle refuelling areas;
  - material storage and stockpile areas; and
  - generation of construction waste and general waste.
- excavation works particularly in areas of detected fill material and identified Areas of Environmental Concern (AECs);
- pavement removal;
- high frequency of vehicle movements;
- importing, handling, stockpiling and transporting material resources; and
- accidental spills and leaks (e.g. hydraulic cable breaks);

Potential environmental impacts associated with these construction activities include:

- inappropriate handling or disposal of contaminated or hazardous excavated materials;
- adverse effects on human health (construction personnel, travelling public or nearby communities) via direct contact, release of odours or dust deposition;
- release of contaminants into underlying soils;
- release of contaminants infiltrating into groundwater;
- movement of contaminated sediments into stormwater systems; and
- adverse effects on flora and fauna.

The potential for latent contaminants being encountered during Stage 2 works exists. In accordance with Stage 2 CoA B6, prior to the commencement of site preparation and excavation activities in areas identified with contamination above investigation levels as described in the Phase 2 Contamination Assessment reported in the Stage 2 EIS, a Soil Contamination Report will be prepared and implemented. The locations subject to CoA B6 are:

- AEC2 (location AEC2_26) from surface level to 0.3 mbgl - fill material containing asbestos;
- AEC4 (location AEC4_2) from surface extending down to 0.6 mbgl - concentrations of lead exceeding the adopted soil Health Investigation Levels for recreational ‘C’ land use; and fill material containing asbestos;
- AEC5 (location AEC5_4) from surface extending down to 0.2 mbgl - concentrations of lead exceeding the adopted soil Health Investigation Levels for recreational ‘C’ land use; and
- AEC5 (location AEC5_2) vertical extent mbgl not determined - volatile hydrocarbons.

For all other locations where excavation work will be conducted, Appendix H Unexpected Discovery of Contaminated Land Procedure will be applied in all instances of detected contamination to address potential environmental and human health impacts.

The Asbestos Management Plan (Appendix K) will apply in all instances where asbestos material is suspected.

All contaminated soils requiring to be disposed offsite will be undertaken in accordance with the requirements of soil classification and disposal specified within the Waste and Energy Management Plan (Appendix B7 of the CEMP).
6.7 Cumulative soil and water impacts

6.7.1 Cumulative surface water impacts

Construction activities for Stage 1 and Stage 2 works would be carried out concurrently with the Northern Beaches Hospital construction, potentially leaving multiple areas of exposed soil and materials. During periods of rainfall, there is potential for erosion to occur due to runoff from exposed areas, and sedimentation of receiving aquatic environments causing deterioration in water quality if left uncontrolled.

The directional stormwater flows during Stage 1 and Stage 2 construction works will be predominantly segregated. Stormwater flows in Stage 1 will lead toward the north into the Middle Creek catchment, while Stage 2 flows are directed predominantly towards the south with captured stormwater directed to sediment basins located at Fitzpatrick Avenue East and at Aquatic Drive (west), further dispersing stormwater (and residual sediment loads) discharging from the Project area. The cumulative surface water impact between Stage 1 and Stage 2 is therefore considered low.

Potential exists for cumulative impacts between the NBH project with the Stage 1 project, and the NBH project with Stage 2 project respectively.

Appropriate erosion and sedimentation control measures as outlined in Chapter 7 would be applied to minimise this risk for Stage 1 and Stage 2. The Stage 2 hospital EIS includes a Soil and Water Management Plan (Appendix P) that outlines the measures that would be put in place during construction of the hospital to manage the risk of soil and water impacts.

Regular and ongoing consultation between contractors would be carried out during overlapping construction periods to ensure erosion and sedimentation controls are in place and being implemented effectively.

As works progress in Stage 1 and Stage 2 which impact on the drainage discharge points of the NBH, arrangements will be made in redirection and management of discharge waters from the NBH project until permanent drainage infrastructure is constructed.

6.7.2 Cumulative groundwater impacts

As discussed in section 6.4.1, the impacts on groundwater as assessed in the Stage 1 EIS were determined to be minor during construction of Stage 1, as the works would mainly be constructed at or near ground surface. Consequently the impact of groundwater towards the north is considered largely to be a factor of basement works within the NBH project during construction.

The cumulative impact assessment undertaken in the Stage 2 EIS addressed the interaction and potential cumulative impact of the NBH basement works and the slot construction of the Stage 2 Project works (refer to Chapter 17.5 of the Stage 2 EIS). The findings of the EIS assessment indicated that during construction of the slot, when the hospital basement has already been constructed and there is seepage into both the hospital and the slot, the seepage into the hospital basement will tend to zero cubic metres per day.

On this basis, the slot inflows (during construction and operation) would dominate seepage and that the overall drawdown and creek inflow impacts would tend toward those of an unlined slot in its operational phase. The EIS determined that there may be a slight increase in drawdown and flow impacts associated with recharge reduction for the catchment area however this is expected to be minor compared with seepage impacts. As such, it is expected that the overall cumulative operational impacts associated with the hospital and an unlined slot would be similar to that of the unlined slot alone. These impacts have been assessed to be acceptable.
6.7.3 Cumulative soil impacts

Cumulative soil impacts associated between the Stage 1 and Stage 2 Projects and the NBH project is considered to be:

- potential erosion and sedimentation in offsite discharges;
- air quality impacts arising from potential cumulative dust emissions; and
- construction traffic movement of soils.

As discussed in section 6.7.1, the cumulative surface water impact and consequently sediment load discharge between Stage 1 and Stage 2 is considered low.

Appropriate erosion and sedimentation control measures of the Stage 1 and the Stage 2 Projects and the NBH project would mitigate potential cumulative impacts of these projects. Potential soil impact risk is further reduced given the differing stages of site clearing and excavation works between these projects.

The cumulative air quality impacts arising from dust from soils (e.g. cleared areas and excavation and stockpiling works) from overlapping construction activities are discussed in the Air Quality Management Sub Plan (AQMP)(Appendix B6 of the CEMP). The findings of the air quality assessment in the Stage 2 EIS, reported that the majority of dust generating activities at the hospital site will be complete before excavation works of the Stage 2 Project begins in the vicinity of the hospital, such that the cumulative impact is not likely to be significant.

Similarly, Stage 1 and Stage 2 works will be in differing stages of excavation works. Albeit it is planned that the potential for cumulative impacts would be appropriately mitigated through the implementation of safeguards and management measures for Stage 1 and Stage 2 as outlined in Chapter 7 of the AQMP.

The differing stages of excavation works between all three project further mitigates that potential cumulative impact associated with the transport of soils within the Project area and disposal offsite. The Traffic and Access Management Sub Plan (TAMP) (Appendix B1 of the CEMP) further addresses more broadly the mitigation measures to be undertaken to overcome potential cumulative traffic impacts (refer to section 6.11 of the TAMP).
7 Environmental management measures

A range of environmental requirements and management measures are identified in the Stage 1 EIS and SPIR and the Stage 2 EIS and Submissions Report, Stage 1 and Stage 2 Conditions of Approvals, RMS documents and from recent experience on similar road projects.

These requirements and environmental management measures that address potential impacts on soil and water during construction are provided in Table 7-1 for Stage 1, and Table 7-2 for Stage 2 respectively.
### Table 7-1: Stage 1 Soil and water management measures

<table>
<thead>
<tr>
<th>Stage 1 ID</th>
<th>Stage 1 Measure / Requirement</th>
<th>Reference</th>
<th>When to implement</th>
<th>Responsibility</th>
<th>Where Addressed/Further Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL</td>
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<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>G38/G36 SPIR</td>
<td>Pre-construction Construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Section 8.2 Training - Inductions, toolboxes and targeted training</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>G36</td>
<td>Pre-construction Construction</td>
<td>Environment Manager</td>
<td>N/A</td>
</tr>
<tr>
<td>SW3</td>
<td>PESCPs will be prepared and implemented in advance of construction, including earthworks and stockpiling.</td>
<td>G36 G38</td>
<td>Pre-construction Construction</td>
<td>Environment Manager</td>
<td>Section 6.3 and 6.5 CEMP (Section 4.1)</td>
</tr>
<tr>
<td>SW4</td>
<td>Except as may be expressly provided by an EPL, the Applicant shall comply with section 120 of the Protection of the Environment Operations Act 1997.</td>
<td>CoA B1</td>
<td>Construction</td>
<td>Environment officer/Foreman</td>
<td>Environmental Protection Licence Section 8.4.1</td>
</tr>
<tr>
<td>SW5</td>
<td>Surface water and groundwater generated during construction of the Project shall be adequately treated to meet the requirements of condition B1 (SW4) prior to entering the stormwater system, drainage lines or riparian corridors. In the event they cannot be met, the Project shall find other measures to manage surface water and groundwater.</td>
<td>CoA B2</td>
<td>Construction</td>
<td>Environment officer/Foreman</td>
<td>Section 6.3 Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)</td>
</tr>
<tr>
<td>SW6</td>
<td>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:</td>
<td>G38/G36</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>CEMP (Section 4.1)</td>
</tr>
<tr>
<td></td>
<td>• Working in waterways.</td>
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<td></td>
<td>• Sediment basin design, construction and management.</td>
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<td></td>
<td>• Dewatering.</td>
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<td>• Working in environmentally Sensitive Areas.</td>
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<tr>
<td></td>
<td>• Clearing and grubbing.</td>
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<tr>
<td></td>
<td>• Concrete paving.</td>
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</tbody>
</table>
- Refuelling or maintenance and cleaning of plant and equipment including concrete agitators, bitumen spray bars and asphalt pavers.

**MANAGING IMPACTS ON SOIL IN GENERAL & SEDIMENTATION OF SURROUNDING WATERCOURSES AND DRAINAGE LINES**

**SW7** A Soil and Water Management Plan will be prepared for each construction stage of the Proposal in accordance with the principles and guidelines set out Soils and Construction – Managing Urban Stormwater series, comprising Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008), including:

- Consideration of soil erodibility
- Management strategies to be used to minimise surface and groundwater impacts, including identification of water treatment measures, discharge points and erosion and sediment control measures
- Sedimentation basin construction and management
- Measures to monitor and manage spoil, fill and materials stockpile sites
- Dewatering procedure
- Water quality monitoring and checklists.

**Reference**

<table>
<thead>
<tr>
<th>ID</th>
<th>Stage 1 Measure / Requirement</th>
<th>Reference</th>
<th>When to implement</th>
<th>Responsibility</th>
<th>Where Addressed/Further Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPIR</td>
<td>A Soil and Water Management Plan will be prepared for each construction stage of the Proposal in accordance with the principles and guidelines set out Soils and Construction – Managing Urban Stormwater series, comprising Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008), including:</td>
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<tr>
<td>G36</td>
<td>Pre-construction</td>
<td>Environment Manager</td>
<td>This Plan</td>
<td></td>
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</tr>
<tr>
<td>G38</td>
<td></td>
<td></td>
<td>Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)</td>
<td></td>
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</tr>
<tr>
<td>SPIR</td>
<td>Erosion and sediment control structures to be installed prior to the commencement of works and shall remain installed and maintained until sufficient stabilisation is achieved as per the Blue Book.</td>
<td>Construction</td>
<td>Environmental Manager / Foreman</td>
<td>Section 6.3 and 6.5 Appendix J Example PESCP</td>
<td></td>
</tr>
<tr>
<td>SPIR</td>
<td>Works will be designed and programmed to minimise the extent and duration of disturbance to vegetation.</td>
<td>Pre-construction Construction</td>
<td>Environmental Manager</td>
<td>Detailed Design Drawings EWMS0004 – Clearing and Grubbing</td>
<td></td>
</tr>
<tr>
<td>SPIR</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 or large aggregate at entry/exit points,</td>
<td>Pre-construction Construction</td>
<td>Environment officer/Foreman</td>
<td>Air Quality Management Plan (Appendix B6 CEMP) PESCP</td>
<td></td>
</tr>
<tr>
<td>Stage 1 ID</td>
<td>Stage 1 Measure / Requirement</td>
<td>Reference</td>
<td>When to implement</td>
<td>Responsibility</td>
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</tr>
<tr>
<td>SW11</td>
<td>Hardstand areas and surrounding public roads will be cleaned as required, using methods which may include brooms, bobcat attachments or street sweepers.</td>
<td>SPIR</td>
<td>Pre-construction Construction</td>
<td>Environment officer/Foreman</td>
<td>EWMS</td>
</tr>
<tr>
<td>SW12</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>G40</td>
<td>Construction</td>
<td>Environment officer/Foreman</td>
<td>Section 6.5 Appendix F RMS Environmental Direction Management of Tannins from Vegetation Mulch</td>
</tr>
</tbody>
</table>
| SW13      | Where feasible and reasonable in order to effectively manage erosion the typical controls that will be utilised through the Stage 1 Project will include:  
  - Appropriate location and treatment of site access and stockpile sites;  
  - Conservation of existing topsoil for later site rehabilitation;  
  - Minimisation of disturbed areas, and stabilisation using batter blanketing, surface mulching or vegetation  
  - Scour protection along temporary drainage lines through the site;  
  - Separation of clean and dirty water wherever possible  
  - Diversion of clean water from upslope areas through the construction corridor  
  - Site maintenance requirements; and  
  - Progressive site rehabilitation                                                                                                                                                                                                                                                                                                                                                       | Section 7 of EIS technical paper – Proposed construction and operational phase water management strategy | Construction | Environment officer/Foreman | Appendix D Stockpile Management Protocol  
Appendix J – Example PESCP |
| SW14      | Where feasible and reasonable in order to effectively manage loose sediment the typical controls that will be utilised through the Stage 1 Project will include:  
  - Sediment retention basins and sumps  
  - Sediment barriers  
  - Kerbside filter rolls  
  - Earth banking, sandbagging and rock check dams                                                                                                                                                                                                                                                                                                                                                                                                      | Section 7 of EIS technical paper – Proposed construction and operational phase water management strategy | Construction | Environment officer/Foreman | Section 6.3 and 6.5 PESCP |
<table>
<thead>
<tr>
<th>Stage 1 ID</th>
<th>Stage 1 Measure / Requirement</th>
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<th>When to implement</th>
<th>Responsibility</th>
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</tr>
</thead>
</table>
| SW15      | Where feasible and reasonable works will be staged to break up catchment areas (and within work zones where appropriate) to ensure that disturbed areas generate an annual soil loss of less than 150m³. This negates the requirement for large scale sediment retention basins. Accordingly management measures may include:  
  • Temporary stabilisation or revegetation/management works to reduce the extent of disturbed surfaces  
  • Application of temporary surface treatments or blanketing on exposed earth surfaces  
  • Sediment barriers  
  • Stabilised drainage lines incorporating rock check dams at regular intervals | Section 7 of EIS technical paper – Proposed construction and operational phase water management strategy  
G36  
G38 | Pre-construction  
Construction | Design Manager  
Environment Officer | Detailed Design  
Section 6.3 and 6.5  
PESCP |
| SW16      | Temporary stockpile locations for both site establishment and earthworks shall be managed in accordance with the Stockpile Management Protocol, and their locations defined within the relevant PESCP. | G38  
SPIR | Construction | Environment officer/Foreman | Appendix D Stockpile Management Protocol  
PESCP |
|           | **IMPACT ON COUNCIL STORMWATER INFRASTRUCTURE** |                                                                 |                  |                                |                               |
| SW17      | • Council would be consulted with regard to matters related to its stormwater drainage infrastructure  
• Health Infrastructure would be consulted during detailed design with regard to allowing for runoff from the developed hospital site. | SPIR  
Consultation with Council | Pre-construction  
Construction | Design Manager  
Construction Manager  
Environment Manager | Detailed Design |
|           | **MANAGEMENT OF GROUNDWATER QUANTITY AND QUALITY** |                                                                 |                  |                                |                               |
| SW18      | Consultation with EPA and DPI Water would be undertaken prior to construction, regarding monitoring and the management of groundwater quality from known contamination sources. Parameters to be monitored would be agreed with the EPA and DPI Water. | Concept Proposal  
Consultation with EPA and DPI Water | Pre-construction | RMS | Chapter 4  
Appendix B Water Management Plan |
<p>| SW19      | Pre-construction monitoring of groundwater quality, groundwater flows and groundwater levels would continue to be undertaken to | Concept Proposal | Pre-construction | RMS | Section 6.4 |</p>
<table>
<thead>
<tr>
<th>Stage 1 ID</th>
<th>Stage 1 Measure / Requirement</th>
<th>Reference</th>
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<th>Responsibility</th>
<th>Where Addressed/Further Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>establish existing groundwater quality, flow paths and levels of the Concept Proposal.</td>
<td>safeguards and mitigation measures</td>
<td></td>
<td></td>
<td>Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)</td>
</tr>
</tbody>
</table>

**GROUNDWATER FLOW IMPACTS**

| SW20 | Monitoring of the Red-crowned Toadlet habitat would be undertaken prior to and during construction to determine the potential for, or realisation of, any groundwater impacts on the habitat. | Concept Proposal safeguards and mitigation measures | Pre-construction Construction | RMS | Flora and Fauna Management Sub Plan incorporating the Ecological Monitoring Program (Appendix B2 CEMP) |

**INTERCEPTION OF GROUNDWATER DURING CONSTRUCTION**

| SW21 | Groundwater flows intercepted by project structures (cuttings) would be collected, treated as necessary and recharged into watercourses or stormwater. | Concept Proposal safeguards and mitigation measures | Construction | Foreman/ Environmental Officer | Section 6.4 Appendix B Water Management Plan (including the Groundwater and Dewatering Plan) |

| SW22 | Engineering methods, such as cross drains, would be used to capture and manage groundwater flows during construction where required. | Concept Proposal safeguards and mitigation measures | Construction | Design Manager | Detailed design |

**ONSITE WATER USAGE**

<p>| SW23 | 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. | ISCA Requirements | Construction | Environment Manager Construction Manager | Construction Compound and Ancillary Facilities Management Plan (Appendix B8 CEMP) |</p>
<table>
<thead>
<tr>
<th>Stage 1 ID</th>
<th>Stage 1 Measure / Requirement</th>
<th>Reference</th>
<th>When to implement</th>
<th>Responsibility</th>
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</tr>
</thead>
<tbody>
<tr>
<td>SW24</td>
<td>All mains drinking water (potable water) shall be metered to allow site mains water use to be monitored and recorded.</td>
<td>ISCA Requirements</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>Construction Compound and Ancillary Facilities Management Plan (Appendix B8 CEMP)</td>
</tr>
</tbody>
</table>

**DISTURBANCE OF CONTAMINATED OR POTENTIALLY CONTAMINATED LAND**

<p>| SW25      | Unanticipated discovery of contaminated material will be managed in accordance with Appendix A. Works in the vicinity will be stopped or modified and will not recommence until the material has been analysed and management measures developed. | Concept design safeguards and mitigation measures within SPIR | Construction | Contractor | Section 6.6 Appendix H Unexpected Discovery of Contaminated Land Procedure |
| SW26      | 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 Stage 1 Project to human health and receiving waterways. | CoA B8 | Pre-construction | Construction Manager / Environment Manager | Section 6.6 Soil Contamination report – when required Appendix L – Remedial Action Plan |</p>
<table>
<thead>
<tr>
<th>Stage 1 ID</th>
<th>Stage 1 Measure / Requirement</th>
<th>Reference</th>
<th>When to implement</th>
<th>Responsibility</th>
<th>Where Addressed/Further Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW27</td>
<td>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 SWQMP.</td>
<td>CoA B8</td>
<td>Pre-construction Construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Section 6.6 Soil Contamination report – when required.</td>
</tr>
<tr>
<td>SW28</td>
<td>If the Soil Contamination Report identifies that remediation is required, the Report shall include a remediation plan that will be implemented on the Stage 1 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.</td>
<td>CoA B8</td>
<td>Pre-construction Construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Section 6.6 Soil Contamination report – when required Appendix L – Remedial Action Plan</td>
</tr>
<tr>
<td>SW29</td>
<td>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.</td>
<td>CoA B8</td>
<td>Pre-construction Construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Section 6.6 Soil Contamination report – when required Appendix L – Remedial Action Plan (if required)</td>
</tr>
<tr>
<td>SW30</td>
<td>It is unlikely that Acid Sulfate Soils will occur within the Stage 1 Project, however in the unlikely event that they are encountered, works will be managed in accordance with Appendix E.</td>
<td>G38</td>
<td>Construction</td>
<td>Environment Manager / Foreman</td>
<td>Appendix E – Acid Sulfate Soil Management Procedure</td>
</tr>
</tbody>
</table>

**DISPOSAL OF EXCAVATED MATERIAL**

<p>| SW31      | Excavated material that is not suitable for on-site reuse or recycling will be transported to a site that may legally accept that material for reuse or disposal. | Stage 1 safeguards and mitigation measures/SPIR | Construction | Environment Manager/Foreman | Waste and Energy Management Sub Plan (Appendix B7 CEMP) Appendix C Spoil and Fill Management Procedure |
| SW32      | Excavated material leaving the site will be classified in accordance with the Waste Classification Guidelines so that correct resource recovery and or off-site disposal occur. | Stage 1 safeguards and mitigation measures/SPIR | Construction | Environment Manager/Foreman | Waste and Energy Management Sub Plan (Appendix B7 CEMP) |</p>
<table>
<thead>
<tr>
<th>Stage 1 ID</th>
<th>Stage 1 Measure / Requirement</th>
<th>Reference</th>
<th>When to implement</th>
<th>Responsibility</th>
<th>Where Addressed/Further Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SW33</strong></td>
<td>In the event of an environmental incident or emergency, the environmental incident and emergency response procedures will be implemented. These procedures include the initial actions required to be undertaken to avoid or minimise environmental harm and notify relevant project personnel.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td><strong>SW34</strong></td>
<td>Spill kits and adequate quantities of suitable material to counteract spillage would be kept readily available.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td><strong>SW35</strong></td>
<td>Any potential hazardous or contaminant materials (for example fuels, curing compounds, and oils) will not be stored within 50 m of any waterway, drainage line, flood prone areas, or on slopes steeper than 1:10. Storage areas would be impervious and adequately bunded.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td><strong>SW36</strong></td>
<td>The refuelling of plant and maintenance of machinery will be undertaken in impervious bunded areas where possible. Refuelling will be attended at all times.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td><strong>SW37</strong></td>
<td>Vehicle wash downs and/or concrete truck washouts will be undertaken within a designated bunded area of an impervious surface or undertaken off-site.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Construction</td>
<td>Foreman/Environment Officer</td>
<td>SWQMP</td>
</tr>
<tr>
<td><strong>SW38</strong></td>
<td>Plant will be checked regularly to ensure that there are no oil, fuel or other liquids leaks.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Construction</td>
<td>Safety Manager</td>
<td>WHS Management Plan</td>
</tr>
<tr>
<td><strong>SW39</strong></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>Good Practice</td>
<td>Construction</td>
<td>Foreman</td>
<td>PESCP</td>
</tr>
<tr>
<td>Stage 1 ID</td>
<td>Stage 1 Measure / Requirement</td>
<td>Reference</td>
<td>When to implement</td>
<td>Responsibility</td>
<td>Where Addressed/Further Detail</td>
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</tr>
<tr>
<td>SW40</td>
<td>Outlet scour protection, such as a rock rip rap apron with an energy dissipation structure, will be considered as part of the detailed design at the pipe outlet in the permanent drainage line downstream (west) of Wakehurst Parkway.</td>
<td>Stage 1 safeguards and mitigation measures/SPIR</td>
<td>Pre-construction</td>
<td>Design Manager/Environment Manager</td>
<td>Detailed design</td>
</tr>
<tr>
<td>SW41</td>
<td>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.</td>
<td>G36</td>
<td>Construction</td>
<td>Foreman/Environment Officer</td>
<td>CEMP – Section 8.1</td>
</tr>
<tr>
<td>SW42</td>
<td>All water quality monitoring will be undertaken in accordance with this SWMP and Appendix B of this plan.</td>
<td>CoA B7</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>Appendix B Water Management Plan Environment Protection Licence</td>
</tr>
<tr>
<td>SW43</td>
<td>Records of monitoring, dewatering activities will be maintained</td>
<td>G38</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>CEMP – Section 10.1</td>
</tr>
<tr>
<td>SW44</td>
<td>Records of all ESCP/PESCPs would be maintained</td>
<td>G38</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>CEMP – Section 10.1</td>
</tr>
</tbody>
</table>
### Table 7-2: Stage 2 Soil and water management measures

<table>
<thead>
<tr>
<th>Stage 2 ID</th>
<th>Stage 2 Measure / Requirement</th>
<th>Reference</th>
<th>When to implement</th>
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</thead>
<tbody>
<tr>
<td><strong>GENERAL</strong></td>
<td></td>
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</tr>
<tr>
<td>SW45</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>G38/G36</td>
<td>Pre-construction Construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Section 8.2 Training - Inductions, toolboxes and targeted training</td>
</tr>
<tr>
<td>SW46</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>G36</td>
<td>Pre-construction Construction</td>
<td>Environment Manager</td>
<td>N/A</td>
</tr>
<tr>
<td>SW47</td>
<td>PESCPs will be prepared and implemented in advance of construction, including earthworks and stockpiling.</td>
<td>G36, G38</td>
<td>Pre-construction Construction</td>
<td>Environment Manager</td>
<td>Section 6.3 and 6.5 CEMP (Section 4.1)</td>
</tr>
<tr>
<td>SW48</td>
<td>Except as may be expressly provided by an EPL, the Applicant shall comply with section 120 of the Protection of the Environment Operations Act 1997.</td>
<td>EPL</td>
<td>Construction</td>
<td>Environment officer/Foreman</td>
<td>Environmental Protection Licence Section 8.4.1</td>
</tr>
<tr>
<td>SW49</td>
<td>Surface water and groundwater generated during construction of the Project shall be adequately treated to meet the requirements of SW4 prior to entering the stormwater system.</td>
<td>EPL</td>
<td>Construction</td>
<td>Environment officer/Foreman</td>
<td>Section 6.3 Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)</td>
</tr>
<tr>
<td>SW50</td>
<td>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:</td>
<td>G38, G36</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>CEMP (Section 4.1)</td>
</tr>
<tr>
<td></td>
<td>• Working in waterways.</td>
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<td></td>
<td>• Sediment basin design, construction and management.</td>
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<td></td>
<td>• Dewatering.</td>
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<td></td>
<td>• Working in environmentally Sensitive Areas.</td>
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<td></td>
<td>• Clearing and grubbing.</td>
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</tbody>
</table>
### Stage 2 Measure / Requirement

<table>
<thead>
<tr>
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<tr>
<td></td>
<td>• Concrete paving.</td>
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<tr>
<td></td>
<td>• Refuelling or maintenance and cleaning of plant and equipment including concrete agitators, bitumen spray bars and asphalt pavers.</td>
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</tbody>
</table>

#### MANAGING IMPACTS ON SOIL IN GENERAL & SEDIMENTATION OF SURROUNDING WATERCOURSES AND DRAINAGE LINES

**SW51** A Soil and Water Management Plan will be prepared for each construction stage of the Concept Proposal in accordance with the principles and guidelines set out Soils and Construction – Managing Urban Stormwater series, comprising Volume 1 (Landcom, 2004) and Volume 2D – Main Roads (DECC, 2008), including:
- Consideration of soil erodibility.
- Management strategies to be used to minimise surface and groundwater impacts, including identification of water treatment measures, discharge points and erosion and sediment control measures.
- Measures to monitor and manage spoil, fill and materials stockpile sites.
- Dewatering procedure.
- Water quality monitoring and checklists.

**Reference**
- CoA D28(d)
- G36
- G38

**Responsibility**
- Environment Manager

**When to implement**
- Pre-construction

**Where Addressed/Further Detail**
- This Plan
- Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)
- Appendix C Spoil and Fill Management Procedure
- Appendix D Stockpile Management Protocol

**SW52** A Water Management Plan (WMP) will be prepared for the Project to ensure that the Project is designed and constructed to achieve the water quality and flow objectives of this Project approval. All requirements of Stage 2 CoA B5 must be addressed within the WMP.

**Reference**
- CoA B5

**Responsibility**
- Environment Manager

**When to implement**
- Pre-construction

**Where Addressed/Further Detail**
- This Plan
- Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)

**SW53** Erosion and sediment control structures to be installed prior to the commencement of works and shall remain installed and maintained until sufficient stabilisation is achieved as per the Blue Book.

**Reference**
- G38
- CoA D3

**Responsibility**
- Environmental Manager / Foreman

**When to implement**
- Construction

**Where Addressed/Further Detail**
- Section 6.3 and 6.5
- Appendix J Example PESCP

**SW54** Where space allows, construction work should consider the potential for locating sediment retention basins or sumps along the southern side of Warringah Road, where widening of the existing westbound carriageway will require land clearing and excavation work, if possible. These basins or sumps would reduce the

**Reference**
- Stage 2 safeguards and mitigation measures/Submissions Report

**Responsibility**
- Environmental Manager

**When to implement**
- Pre-construction

**Where Addressed/Further Detail**
- Section 6.3
- Detailed Design Drawings
<table>
<thead>
<tr>
<th>Stage 2 ID</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>volume of sediment and turbidity levels in runoff potentially discharging to Catchments 4, 5 and 6.</td>
<td>G36, G38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW55</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 or large aggregate at entry/exit points,</td>
<td>G38</td>
<td>Pre-construction Construction</td>
<td>Environment officer/Foreman</td>
<td>Air Quality Management Plan (Appendix B6 CEMP) PESCP</td>
</tr>
<tr>
<td>SW56</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>G40</td>
<td>Construction</td>
<td>Environment officer/Foreman</td>
<td>Section 6.5 Appendix F RMS Environmental Direction Management of Tannins from Vegetation Mulch</td>
</tr>
</tbody>
</table>
| SW57      | Where feasible and reasonable in order to effectively manage erosion the typical controls that will be utilised through the Stage 2 Project will include:  
  • Appropriate location and treatment of site access and stockpile sites;  
  • Conservation of existing topsoil for later site rehabilitation;  
  • Minimisation of disturbed areas, and stabilisation using batter blanketing, surface mulching or vegetation  
  • Scour protection along temporary drainage lines through the site;  
  • Separation of clean and dirty water wherever possible  
  • Diversion of clean water from upslope areas through the construction corridor  
  • Site maintenance requirements; and  
  • Progressive site rehabilitation | G36, G38  | Construction       | Environment officer/Foreman | Appendix D Stockpile Management Protocol Appendix J – Example PESCP |
| SW58      | Temporary stockpile locations for both site establishment and earthworks shall be managed in accordance with the Stockpile Management Protocol, and their locations defined within the relevant PESCP. | G38       | Construction       | Environment officer/Foreman | Appendix D Stockpile Management Protocol PESCP |
### MANAGEMENT OF GROUNDWATER QUANTITY AND QUALITY

<table>
<thead>
<tr>
<th>Stage 2 ID</th>
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<th>Where Addressed/Further Detail</th>
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</thead>
<tbody>
<tr>
<td>SW59</td>
<td>Consultation with EPA and DPI Water would be undertaken prior to construction, regarding monitoring and the management of groundwater quality from known contamination sources. Parameters to be monitored would be agreed with the EPA and DPI Water.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report</td>
<td>Pre-construction</td>
<td>RMS</td>
<td>Chapter 4 Appendix B Water Management Plan</td>
</tr>
</tbody>
</table>

**Stage 2 safeguards and mitigation measures/Submissions Report**
Pre-construction RMS Chapter 4 Appendix B Water Management Plan (including the Groundwater and Dewatering Plan)

**Appendix M Stage 2 – Groundwater Assessment**

| SW60       | Pre-construction monitoring of surface water and groundwater quality, groundwater flows and groundwater levels will continue to be carried out to establish existing baseline conditions for Stage 2. | Stage 2 safeguards and mitigation measures/Submissions Report | Pre-construction | RMS | Chapter 4 Section 6.4 Appendix B Water Management Plan (including the Groundwater and Dewatering Strategy) Appendix M Stage 2 – Groundwater Assessment |

### GROUNDWATER DRAWDOWN

| SW61       | A Groundwater and Dewatering Management Plan would be prepared to manage the impacts of groundwater drawdown due to seepage into the slot during construction. | Stage 2 safeguards and mitigation measures/Submissions Report | Pre-construction | RMS | Section 6.4 Appendix B Water Management Plan (including the Groundwater and Dewatering Plan) Appendix M Stage 2 – Groundwater Assessment |

### TREATMENT OF CAPTURED GROUNDWATER

| SW62       | Groundwater seepage quality would be treated to background surface water quality to be protective of overall instream environmental values, and then in consideration of ANZECC (2000) freshwater criteria prior to discharge to surface water. | Stage 2 safeguards and mitigation measures/Submissions Report | Construction | Environment Manager | Appendix B Water Management Plan (including the Groundwater and Dewatering Plan) |

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<table>
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<tr>
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</thead>
</table>
| SW63       | 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. | ISCA Requirements | Construction | Environment Manager | Construction Compound and Ancillary Facilities Management Plan (Appendix B8 CEMP) |
<p>| SW64       | All mains drinking water (potable water) shall be metered to allow site mains water use to be monitored and recorded. | ISCA Requirements | Construction | Environment Manager | Construction Compound and Ancillary Facilities Management Plan (Appendix B8 CEMP) |
| SW65       | A Contaminated Land Management Plan will be prepared in accordance with the Contaminated Land Management Act 1997, relevant EPA Guidelines and Roads and Maritime Guideline for Management of Contamination (RMS 2013). | Submissions Report | Pre-construction Construction | Construction Manager / Environment Manager | Soil Contamination Report – when required |
| SW66       | Prior to the commencement of site preparation and excavation activities, or as otherwise agreed by the Secretary, in areas identified with contamination above investigation levels as described in the Phase 2 Contamination Assessment: Northern | CoA B6 | Pre-construction Construction | Construction Manager / Environment Manager | Soil Contamination Report – when required |</p>
<table>
<thead>
<tr>
<th>Stage 2 ID</th>
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<tbody>
<tr>
<td>SW67</td>
<td>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 SWQMP.</td>
<td>CoA B6</td>
<td>Pre-construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Soil Contamination Report – when required</td>
</tr>
<tr>
<td>SW68</td>
<td>If the Soil Contamination Report identifies that remediation is required, the Report shall include a remediation plan that will be implemented on the Stage 2 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.</td>
<td>CoA B6</td>
<td>Pre-construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Soil Contamination report (when required) Appendix L – Remedial Action Plan (when required)</td>
</tr>
<tr>
<td>SW69</td>
<td>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.</td>
<td>CoA B6</td>
<td>Pre-construction</td>
<td>Construction Manager / Environment Manager</td>
<td>Soil Contamination report (when required) Appendix L – Remedial Action Plan (when required) Site Audit Statement – if required</td>
</tr>
</tbody>
</table>
| SW70      | An Asbestos Management Plan will be developed prior to work commencing and include:  
  • The locations of asbestos impacted areas within each AEC; and  
  CoA D27(e)(ii) CoA D28(d)(vii) Stage 2 safeguards and mitigation | CoA D27(e)(ii) CoA D28(d)(vii) Stage 2 safeguards and mitigation | Pre-construction  | Environment Manager | Appendix K Asbestos Management Plan                                |
<table>
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</thead>
<tbody>
<tr>
<td>SW71</td>
<td>The requirements including mitigation measures for asbestos management, asbestos handling and asbestos disposal in accordance with NSW EPA and NSW WorkCover guidelines.</td>
<td>measures/Submissions Report</td>
<td></td>
<td></td>
<td>Appendix E – Acid Sulfate Soil Management Procedure</td>
</tr>
<tr>
<td>SW72</td>
<td>It is unlikely that Acid Sulfate Soils will occur within the Stage 2 Project, however in the unlikely event that they are encountered, works will be managed in accordance with Appendix E.</td>
<td>G38 Construction Environment Manager / Foreman</td>
<td></td>
<td></td>
<td>Waste and Energy Management Sub Plan (appendix B7 CEMP) Appendix C Spoil and Fill Management Procedure</td>
</tr>
<tr>
<td>SW73</td>
<td>Excavated material that is not suitable for on-site reuse or recycling will be transported to a site that may legally accept that material for reuse or disposal.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report Construction Environment Manager / Foreman</td>
<td></td>
<td></td>
<td>Waste and Energy Management Sub Plan (appendix B7 CEMP) Appendix C Spoil and Fill Management Procedure</td>
</tr>
<tr>
<td>SW74</td>
<td>Excavated material leaving the site will be classified in accordance with the Waste Classification Guidelines so that correct resource recovery and or off-site disposal occur.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report Construction Environment Manager / Foreman</td>
<td></td>
<td></td>
<td>Waste and Energy Management Sub Plan (appendix B7 CEMP) Appendix C Spoil and Fill Management Procedure</td>
</tr>
<tr>
<td>SW75</td>
<td>In the event of an environmental incident or emergency, the environmental incident and emergency response procedures will be implemented. These procedures include the initial actions required to be undertaken to avoid or minimise environmental harm and notify relevant project personnel.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report Construction Environment Manager / Foreman</td>
<td></td>
<td></td>
<td>Waste and Energy Management Sub Plan (appendix B7 CEMP) Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td>SW76</td>
<td>Spill kits and adequate quantities of suitable material to counteract spillage would be kept readily available.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report Construction Environment Manager / Foreman</td>
<td></td>
<td></td>
<td>Waste and Energy Management Sub Plan (appendix B7 CEMP) Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td>SW77</td>
<td>Any potential hazardous or contaminant materials (for example fuels, curing compounds, and oils) will not be stored within 50 m of any waterway, drainage line, flood prone areas, or on slopes steeper than 1:10. Storage areas would be impervious and adequately bunded.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report Construction Environment Manager / Foreman</td>
<td></td>
<td></td>
<td>Waste and Energy Management Sub Plan (appendix B7 CEMP) Appendix A Environmental Incident and Spill Response Procedure</td>
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<thead>
<tr>
<th>Stage 2 ID</th>
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<tr>
<td>SW77</td>
<td>The refuelling of plant and maintenance of machinery will be undertaken in impervious bunded areas where possible. Refuelling will be attended at all times.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report</td>
<td>Construction</td>
<td>Environment Manager</td>
<td>Appendix A Environmental Incident and Spill Response Procedure</td>
</tr>
<tr>
<td>SW78</td>
<td>Vehicle wash downs and/or concrete truck washouts will be undertaken within a designated bunded area of an impervious surface or undertaken off-site.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report</td>
<td>Construction</td>
<td>Foreman/Environment Officer</td>
<td>SWQMP</td>
</tr>
<tr>
<td>SW79</td>
<td>Plant will be checked regularly to ensure that there are no oil, fuel or other liquids leaks.</td>
<td>Stage 2 safeguards and mitigation measures/Submissions Report</td>
<td>Construction</td>
<td>Safety Manager</td>
<td>Safety Management Plan</td>
</tr>
<tr>
<td>SW80</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>Good Practice</td>
<td>Construction</td>
<td>Foreman</td>
<td>PESCP</td>
</tr>
<tr>
<td>MONITORING</td>
<td></td>
<td>G36</td>
<td>Construction</td>
<td>Foreman/Environment Officer</td>
<td>CEMP – Section 8.1</td>
</tr>
<tr>
<td>SW81</td>
<td>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.</td>
<td>CoA B5(f)</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>Appendix B Water Management Plan</td>
</tr>
<tr>
<td>SW82</td>
<td>Undertake a program to monitor and report on the potential surface water and groundwater impacts</td>
<td>Environment Officer</td>
<td>Construction</td>
<td>Appendix B Water Management Plan</td>
<td>Environment Protection Licence</td>
</tr>
<tr>
<td>RECORDS</td>
<td></td>
<td>G38</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>Section 10.1 CEMP</td>
</tr>
<tr>
<td>SW83</td>
<td>Records of monitoring, dewatering activities will be maintained</td>
<td>G38</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>Section 10.1 CEMP</td>
</tr>
<tr>
<td>SW84</td>
<td>Records of all ESCP/PESCPs would be maintained</td>
<td>G38</td>
<td>Construction</td>
<td>Environment Officer</td>
<td>Section 10.1 CEMP</td>
</tr>
</tbody>
</table>
8 Compliance management

8.1 Roles and responsibilities

FYJV’s Project Team organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 7 of this Plan.

8.2 Training

All 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 quality management including:

- existence and requirements of this sub-plan;
- relevant legislation;
- roles and responsibilities for soil and water management;
- the location of ASS or PASS;
- water quality management and protection measures;
- groundwater issues; and
- 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 control installation methodology;
- sediment basin construction, operation and maintenance;
- working near or in drainage lines and creeks;
- preparedness for high rainfall events;
- emergency response measures in high rainfall events;
- lessons learnt from incidents and other events e.g. high rainfall / flooding;
- mulch and tannin management;
- spill response;
- stockpile location criteria; and
- identification of potentially contaminated spoil and fill material.

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

8.3 Monitoring and inspection

Regular monitoring and inspections will be undertaken prior to, during and following construction. The following monitoring and inspections will be undertaken:

- in accordance with the construction related requirements of the Water Management Plan (provided in Appendix B) in accordance with Stage 1 CoA B7 and Stage 2 CoA B5;
- monitoring and management of spoil, fill and materials stockpile sites including details of how spoil, fill or material would be handled, stockpiled, reused and disposed;
- 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 >10mm 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;
- inspections with the Project Soil Conservationist;
- fortnightly site inspections with RMS, ER and PV to evaluate all aspects of onsite environmental compliance;
- regular ERG site inspections;
- if applicable, construction sediment basin water will be tested, treated, discharged, recorded and reported to meet the requirements of the Project EPL;
- groundwater captured during construction will be tested, treated, discharged recorded and reported to meet the requirements of the Project EPL;
- monitoring water quality of areas downstream of PASS risk;
- monitoring of water quality upstream and downstream of the Project site, including performance of erosion and scouring management measures for potential impacts of watercourse stability, before and during construction; and
- monitoring of groundwater levels and quality.

Monitoring of water quality would be recorded using various methods dependent on the element studied. This could include field analysis data sheet, laboratory analysis report, download from automatic recorder or a combination of devices.

Modifications to monitoring may be initiated pending results of monitoring of soil and water quality conditions, new information on water and soil conditions or unexpected findings, performance of management measures or changes to construction program and staging.

Changes to monitoring frequency and location, parameters to be monitored, and any required modifications to management measures as given in Tables 7-1 and 7-2 will be incorporated into the WMP (Appendix B) and this Plan in accordance with the review process detailed in Chapter 9.

8.3.1 Weather monitoring

Rainfall will be measured and recorded in millimetres per 24-hour period at the same time each day from the time that the site office associated with the activities is established. An automatic rainfall intensity / weather device is installed within the major compound for Stage 1 and Stage 2 Project monitoring.

The weather station will be specifically located, operated and maintained in accordance with relevant guidelines and manufacturer’s specifications.

Additional requirements and responsibilities in relation to inspections are documented in Section 8.2 and Section 8.5 of the CEMP.

8.4 Licences and permits

The project works are subject to an EPL (Licence No. 20673, 19 October 2015) as a scheduled activity “Extractive Activities, Road Construction”.

The EPL prescribes water quality parameters to be measured and associated discharge criteria. The EPL also details the monitoring and analytical requirements by reference to authority publications, e.g. Approved Methods for Sampling and Analysis of Water Pollutants in NSW (2004). The water quality discharge criteria for the Project is listed in Table 8.1. As
noted in Table 8.1, these criteria are correlated with the surface water quality monitoring program.

**Table 8-1: 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>Turbidity</td>
<td>TBA following correlation with TSS results</td>
<td>Grab Sample</td>
<td>Field analysis and confirmed as required with laboratory assessment, regularly updating correlations and having a factor of conservatism.</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>No visible</td>
<td>Grab Sample</td>
<td>Field analysis and confirmed as required with laboratory assessment</td>
</tr>
</tbody>
</table>

These requirements will be managed by the planned management measures specified in Table 7-1 (Stage 1) and in Table 7-2 (Stage 2).

The EPL also prescribes requirements for complaints handling, reporting and record keeping. These requirements will be implemented in accordance with the incident and complaints reporting outlined in section 8.6.

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

### 8.4.1 Water Discharge

The Project EPL outlines the location of licensed discharge points. Throughout the project a licensed discharge point register will be maintained.

Prior to any water being discharged offsite at licensed discharge points it will meet the criteria outlined in Table 8-1 (as amended). Surface water and groundwater captured and managed during construction must adhere to the dewatering requirements specified in the Dewatering Guidelines and Practice Notes (Appendix I), and the Groundwater and Dewatering Management Plan contained within the Water Management Plan (Appendix B).

Note, as part of the EPL, there is potential for a correlation to be established between turbidity and suspended solids. The correlation will allow turbidity to replace suspended solids as the water clarity criteria. This approach 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.
8.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this Plan, CoA and other relevant approvals, licenses and guidelines. Audit requirements are detailed in Section 8.4 of the CEMP.

8.6 Reporting

Reporting requirements and responsibilities are documented in the Water Management Plan, and Section 8.2 and Section 8.5 of the CEMP.

Data would be made publicly available 4 weeks after it is undertaken as per the requirements of the Water Management Plan (CoA B5 of Stage 2 Approval) following the document’s approval. Data would be provided where applicable as part of any incident reporting under CoA A12-A14 of both Stage 1 and Stage 2 Projects.
9 Review and improvement

9.1 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.

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; and
- make comparisons with objectives and targets.

9.2 SWQMP update and amendment

The processes described in Chapter 8 and Chapter 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed. This may include:
- In response to Reportable Incidents and adoption of additional mitigation measures due to non-compliances and/or findings from incident investigation.
- Unexpected ground conditions where contaminated material has been identified and not already detailed in this document (Asbestos Management for example is detailed in Appendix K).
- Following updates/revisions to the Water Management Plan for Stage 2.
- In the event new information and additional recommended mitigation measures for the Project generally are identified following assessment of unexpected contaminated sites.

Any revisions to this Plan will be in accordance with the process outlined in Section 1.6 of the CEMP and as required, be provided to relevant stakeholders for review and comment and forwarded to the Secretary of DP&E for approval.

A copy of the updated SWQMP 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
Environmental Incident and Spill Response Procedure
Appendix A

Environmental Incident & Spill Response Protocol

Document No: NBHRDC-EN-SWMP-APPA_PLN

<table>
<thead>
<tr>
<th>Revision</th>
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<th>Prepared by (Name and Title)</th>
<th>Reviewed by (Name and Title)</th>
<th>Authorisation (Name and Title)</th>
<th>Authorisation Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>July 15</td>
<td>Steve Fermio Environment</td>
<td>Paul Farris Construction Manager</td>
<td>Mark Turner</td>
<td>Environmental Manager</td>
</tr>
<tr>
<td>0</td>
<td>Nov 15</td>
<td>Tim Faiz Environment Co-ordinator</td>
<td>Paul Farris Construction Manager</td>
<td>Mark Turner</td>
<td>Environmental Manager</td>
</tr>
<tr>
<td>1</td>
<td>Feb 16</td>
<td>Tim Faiz Environment Co-ordinator</td>
<td>Claudio Senese Environmental Approvals</td>
<td>Mark Turner</td>
<td>Environmental Manager</td>
</tr>
<tr>
<td>2</td>
<td>Mar 16</td>
<td>Tim Faiz Environment Co-ordinator</td>
<td>Claudio Senese Environmental Approvals</td>
<td>Mark Turner</td>
<td>Environmental Manager</td>
</tr>
<tr>
<td>3</td>
<td>Aug 16</td>
<td>Jared Lipton Environment Co-ordinator</td>
<td>Claudio Senese Environmental Approvals</td>
<td>Mark Turner</td>
<td>Environmental Manager</td>
</tr>
<tr>
<td>4</td>
<td>Nov 17</td>
<td>Mark Sabolch Environment Manager</td>
<td>Mark Sabolch Environment Manager</td>
<td>Mark Sabolch</td>
<td>Environment Manager</td>
</tr>
</tbody>
</table>
1. FYJV Emergency Contacts for Environmental Incidents/Emergencies

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Name</th>
<th>Position</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHD</td>
<td>Maurice Pignatelli</td>
<td>Environmental Representative (ER)</td>
<td>1800 014 307</td>
</tr>
<tr>
<td>Police, Fire, Ambulance</td>
<td>-</td>
<td>-</td>
<td>000</td>
</tr>
<tr>
<td>SES</td>
<td>-</td>
<td>-</td>
<td>132 500</td>
</tr>
</tbody>
</table>

2. Environmental Incident /Emergency Response Protocol

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incident Occurs - Contact the area Supervisor or Superintendent immediately and advise</td>
<td>All</td>
</tr>
<tr>
<td>2</td>
<td>STOP WORKS in the vicinity of the incident</td>
<td>Supervisor</td>
</tr>
<tr>
<td>3</td>
<td>Advise Environmental Co-ordinator and/or Environmental Manager</td>
<td>Supervisor</td>
</tr>
<tr>
<td>4</td>
<td>If safe to do so, implement measures to contain incident or prevent any / further environmental harm</td>
<td>All</td>
</tr>
<tr>
<td>5a</td>
<td>If minor (a Category 2) incident, Environmental Co-ordinator prepare an incident report and submit to RMS representative within 3 days</td>
<td>EC</td>
</tr>
<tr>
<td>5b</td>
<td>If serious (a Category 1) incident, Environmental Manager to verbally notify Construction Manager, Ferrovial Corporate and the RMS environment representative verbally as soon as possible</td>
<td>EM</td>
</tr>
<tr>
<td>6</td>
<td>Notify ER, and regulatory agencies if legally required.</td>
<td>EM</td>
</tr>
<tr>
<td>7</td>
<td>Implement further containment or protection strategies as directed by the EM or delegated senior FYJV Manager</td>
<td>All/Superintendent</td>
</tr>
<tr>
<td>8</td>
<td>Implement Roads and Maritime Environmental Incident Classification and Reporting Procedure, September 2017 (see Attachment A). Save copy of report in FYJV incident folder</td>
<td>EM/EC</td>
</tr>
<tr>
<td>9</td>
<td>Implement any additional measures if directed by FYJV delegated senior management, Roads and Maritime, ER or agencies</td>
<td>EC/ Superintendent</td>
</tr>
<tr>
<td>10</td>
<td>Undertake incident investigation and reporting as per process detailed in the CEMP Chapter 7 (ensuring Roads and Maritime and FYJV procedures are complied with)</td>
<td>EM</td>
</tr>
<tr>
<td>11</td>
<td>Toolbox relevant personnel on incident to ensure similar incidents are prevented in future</td>
<td>EC/ Supervisor</td>
</tr>
<tr>
<td>12</td>
<td>Update CEMP, EWMSs or relevant procedures if required</td>
<td>EM</td>
</tr>
</tbody>
</table>
### 3. **Protocol for Minor Spills**

**PRIOR TO ANY ACTION, IDENTIFY MATERIALS INVOLVED & OBTAIN PERSONAL PROTECTIVE EQUIPMENT**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Responsibilities</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incident Occurs - Contact the area Supervisor or Superintendent immediately and advise</td>
<td>All</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>STOP WORKS in the vicinity of the incident</td>
<td>Supervisor</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Make safe and stop further pollution by containing the leak/spill</td>
<td>All/Supervisor</td>
<td>Create a bund using either the absorbent boom or from spill absorbent granules. Use soil or sand if spill kit isn’t available in immediate area</td>
</tr>
<tr>
<td></td>
<td>If required, Put barriers around drains and outlets</td>
<td></td>
<td>Seal drain grates by putting sand bags etc. around them.</td>
</tr>
<tr>
<td>4</td>
<td>Stop leak/spill from its source</td>
<td>Supervisor</td>
<td>For major leaks notify Superintendent. If spill has escaped offsite/ into waterway contact Environmental Manager immediately.</td>
</tr>
<tr>
<td>5</td>
<td>Apply spill kit contents to spill affected area.</td>
<td>Supervisor / Superintendent</td>
<td>Use absorbent granules or equivalent.</td>
</tr>
<tr>
<td>6</td>
<td>Clean up / remove absorbent material to designated contaminated waste bin</td>
<td>Supervisor / Superintendent</td>
<td>Use broom or dustpan and brush</td>
</tr>
<tr>
<td>7</td>
<td>Clean up soft surface by excavating contaminated soil</td>
<td>Supervisor / Superintendent</td>
<td>Stockpile contaminated material in designated area.</td>
</tr>
<tr>
<td>8</td>
<td>Inform Environmental Manager and complete incident log form</td>
<td>Supervisor / Superintendent</td>
<td>Record incident and investigate.</td>
</tr>
<tr>
<td>9</td>
<td>Appropriately remove and dispose contaminated material from site.</td>
<td>Supervisor / Superintendent</td>
<td>Ensure transporter and waste facility are appropriately licenced and material tracked.</td>
</tr>
<tr>
<td>10</td>
<td>Report incidents as per incident reporting procedures</td>
<td>Environmental Manager</td>
<td>Ensure incident reporting procedures for RMS, FYJV are followed</td>
</tr>
</tbody>
</table>
Appendix B
Water Management Plan
Prepared by SMEC, dated 16 March 2017
Approved by DPE, dated 19 July 2017
Appendix C
Spoil and Fill Management Procedure
# Appendix C

## Spoil and Fill Management Procedure

Document No: NBHRDC-EN-SWMP-APPC.PLN

<table>
<thead>
<tr>
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</table>
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1 Purpose

This Spoil and Fill Management Procedure (the Procedure) forms Appendix C to the Ferrovial York Joint Venture Soil and Water Quality Management Sub Plan (SWQMP), as part of the Construction Environmental Management Plan (CEMP).

The Procedure details the actions that will be taken by FYJV to identify the types of materials expected to be encountered and ensure effective controls are established and maintained to manage potential environmental impacts during the construction of the project. In particular, the Procedure prescribes the measures to monitor and manage spoil and fill including details of how excavated material will be handled, transported, stockpiled, reused and disposed.

For specific requirements on the location of stockpiles and minimum management measures that would be implemented to avoid/minimise amenity impacts to surrounding residents and environmental risks, refer to the Stockpile Management Protocol.

2 Scope

This Procedure is applicable to all activities conducted by personnel on the Project that involve spoil and fill management.

Relevant management measures identified in this Procedure will be incorporated into site or activity specific Environmental Work Method Statements (EWMS), Progressive Erosion and Sediment Control Plans (PESCPs) and the Earthworks Management Plan.

The objectives of this Procedure are to:

- Identify spoil and fill issues potentially arising from the Project;
- Identify and describe measures to be implemented relating to spoil and fill activities that may impact on the environment and local amenity; and
- Ensure all Project personnel are aware of the requirements for spoil and fill material handling, transportation and movement, stockpiling, reuse and disposal to protect the environment and maximise the reuse of earthen materials generated on site.

3 Roles and Responsibilities

3.1 Organisational Chart

An updated version of the organisational chart shall be maintained and available on the Project site, displayed in clear accessible locations and available upon request. The organisational chart is available on the Electronic Document Management System (EDMS) – TeamBinder.
3.2 Key Staff

The overall roles and responsibilities for environmental management are outlined in Section 4.2 of the CEMP. The responsibilities and accountabilities for key Project staff in the implementation of this Procedure include:

3.2.1 Project Director

- Approve this Procedure for implementation and all subsequent revisions;
- Instruct all Project personnel on adherence to this Procedure.

3.2.2 Construction Manager

- Ensure the requirements of this procedure are referenced within earthworks requirements for all construction packages;
- Liaise with the Environmental Manager for each package of work involving spoil and fill generation and handling.

3.2.3 Environmental Manager

- Ensure the Procedure remains current and is reviewed and consulted with RMS and the Environmental Representative (ER);
- Assist the Construction team.

3.2.4 All Other Managers, Superintendents and Workers

- Be familiar with this Procedure and comply with the requirements incorporated within construction management plans and procedures, including Environmental Works Method Statements (EWMS) that are imposed in relation to spoil and fill where applicable.

4 Procedure

4.1 Classification of Spoil

Construction of the project will involve clearing and significant excavation of materials along the alignment. Throughout Stage 1 works approximately 35,850 cubic metres of cut produced, with the potential to reuse 4,300 cubic metres required fill material for this Stage. The Stage 2 works will generate approximately 180,000 cubic metres of cut produced with approximately 15,000 cubic metres for reuse as fill material.

It is noted that these cut and fill volumes are estimates and will be further evaluated during detailed design to reduce the overall volumes of surplus material.

Classification of spoil of the Project shall be referred to as following:

4.1.1 Topsoil and Mulch

Topsoil and vegetation mulch are important resources for the final rehabilitation and landscaping of the project. To achieve a successful landscape and revegetated outcome relies upon the proper management of topsoil and mulch during the construction phase.
Given the particular sensitivity of topsoil and mulch, the composition and handling of topsoils and mulch requires:

- Planning of topsoil stripping operations to ensure the material is not mixed with sub-soil layers;
- Identifying areas where a topsoil/mulch mix may be used in permanent landscaping to add organic matter to the soil profile and stabilise the soil structure;
- Clearing and grubbing of unwanted materials (weeds and roots) and conserving and chipping good quality vegetation for mulch;
- Identifying good quality topsoil for finishing, avoiding and removing poorer soils, and other excavated materials and wastes; and
- Correct stockpiling procedures for topsoil to maintain the soil structure and integrity throughout the duration of the project, stockpile’s are to be managed in accordance with the Stockpile Management Protocol (Appendix D of the SWQMP).

4.1.2 Virgin excavated natural material (VENM)

VENM will be encountered in areas that have not in any way been impacted by development or industry (e.g. natural clay road embankments). During the Project VENM will be confirmed as clean through required sampling and testing procedures.

4.1.3 Fill material (classified as Excavated Natural Material – ENM)

ENM Fill material’s will be encountered in areas typically associated with previously developed lands (e.g. private property lands that may have been previously disturbed by development, road embankments etc.).

4.1.4 Recovered Materials

The Project may seek to reuse materials recovered from the alignment during construction. This may include:

- recovered aggregates;
- reclaimed asphalt pavement; and
- Excavated public road material (EPRM).

Recovered resource use must comply with the relevant resource recovery exemptions discussed in the Waste and Energy Management Sub-plan (WEMP) located as Appendix B7 to the CEMP. EPRM can only be reused within the road corridor.

4.1.5 Acid Sulphate Material

Acid Sulfate Soils are not expected to be encountered on this project. An Acid Sulfate Soils Management Procedure is provided in Appendix E to the SWQMP in the event that potential acid sulfate soils are encountered during excavations.

4.1.6 Potentially contaminated material

Environmental studies of the project area did identify a number of potentially contaminating land uses including current and historical industrial complexes, uncontrolled fill sites, service stations and historic brickworks. There is potential for contaminated land to occur within the vicinity of the Project due to old industrial areas and numerous contaminated sites located within the construction impact area.
If required, additional investigations will aim to determine extent, level and options for remediation, prior to the commencement of clearing and excavation works in the vicinity of these areas.

In addition to these areas, other unexpected contamination finds may arise during the course of construction works. Potentially contaminated material identified during the course of the Project will be handled in accordance with the Unexpected Discovery of Contaminated Land Procedure (Appendix H of the SWQMP).

### 4.2 Reuse on-site

#### Topsoil

Topsoil assessed as clean, and fertile will be stockpiled for reuse on site during revegetation and rehabilitation works. Mulch is to be used for the purposes of erosion and sediment control, soil conditioning or composting on site.

The Urban Design and Landscape Plan will potentially identify key areas within the Project where a topsoil/mulch mix will be used and applied to batters during revegetation. This will allow native vegetation species to regenerate from the seed bank stored within the mulch and topsoil and provide additional organic matter to the soil which will improve soil structure and integrity.

Surplus topsoil that is considered to be poor quality or contaminated with weed species may be reused on site and buried in noise mounds or visual barriers.

Additional surplus topsoil that cannot be reused on site will follow the reuse strategy outlined in Section 4.3.

#### VENM

The Project can reuse material on-site that has been classified as VENM. No sampling or testing is required if the material is being re-used, unless there is evidence that potentially contaminating activities previously took place on or adjacent to the excavation site (e.g. former landfill, waste dump).

If there is a potential that the material is contaminated, it is must be tested and classified according to the Waste Classification Guidelines, DECCW 2014.

#### Fill Material

Fill materials including ENM and recovered resources can be reused within the road corridor for construction. If surplus material occurs, the reuse of these materials must conform with the Resource Recovery Exemptions of the Protection of the Environment Operations (Waste) Regulation 2005. Refer to the WEMP on waste exemptions for reuse on site.

There will be a surplus of fill material generated from the Project earthworks. Where practical The Project will seek to reuse this material within the road corridor in the following scenarios:

1) Adjust the design of the fill embankments to allow for use of surplus materials;
2) Use as fill in noise mounds and visual barriers; and
3) Use to reduce the slope of batters and noise mounds prior to topsoiling;

#### Acid Sulfate Soils

Acid Sulfate Soils are not expected to be discovered on this project.

#### Contaminated Material
In accordance with the remedial actions of the Unexpected Discovery of Contaminated Land Procedure, potentially contaminated materials should be stockpiled on site separately and resultant excavations validated to confirm removal of contaminated materials from the excavated area. If contaminated soils are intended for reuse, these stockpiled soils must be remediated and validated for suitable re-use on site. In most cases, the contaminated spoil will be disposed of off-site at a suitably licenced waste disposal facility.

4.3 Reuse and Disposal off-site

Reuse off-site will only occur for material surplus to project needs (i.e. spoil) or if the material is unsuitable for on-site placement (e.g. fill that is not considered suitable for engineered road embankments). Preference for uncontaminated surplus spoil will be for offsite reuse purposes in accordance with the principles of the Resource Recovery Exemptions.

Prior to transporting spoil material off-site, suitable reuse locations must be determined. The locations can be:

- Land on which the land developer holds a current Development Approval that allows for the importation of earth/mulch materials;
- Land on which the land owner wishes to develop the land and allows FYJV to obtain a development approval from Council on their behalf;
- Permanent land re-shaping works on RMS residual land which are approved by RMS and the Secretary, Department of Planning and Environment (DP&E); and
- Provision of small quantities of earth/mulch material to landholders covered under the Resource Recovery Exemptions that meet the Local Council requirements for exempt development (or development without consent).

Reuse and disposal of all spoil from the site must be classified in accordance with the NSW OEH Waste Classification Guidelines, Part 1: Classifying Waste (NSW DECCW 2014) and be managed in accordance with the requirements specified in the WEMP.

In general top soils, VENM, ENM and mulch may be reused offsite subject to site classification being carried out, and where necessary, based on soil tests to verify the quality of the material.

Reuse of ENM off-site to a private or publically owned site requires the landholder to be issued a written statement of compliance to the ENM exemptions and a Section 143 Notice, and where necessary it is confirmed that the landowner has an appropriate development approval from the relevant planning authority (Council).

Permanent placement of spoil on RMS residual land will be determined with RMS. Any proposals will demonstrate beneficial re-use of the spoil material. The placement of the material will be incorporated into the landscape to ensure visual amenity is not impacted and the future value of the land is not compromised. Permanent placement of spoil on RMS residual land will be agreed with RMS and approved by the DP&E prior to the permanent placement of the spoil.

For all spoil unsuitable for reuse and requires disposal to a landfill, the landfill facility must be appropriately licenced to receive waste to be disposed. Refer to the WEMP for further details on disposal.
4.4 Spoil and fill storage

Stockpiles will be established in the locations identified in the Stockpile Management Protocol (Appendix D), and be managed in accordance with the Protocol and the Progressive Erosion and Sediment Control Plan (an example of a PESCP is provided as Appendix J in the SWQMP). Where possible, topsoil, mulch and fill to be used for construction will be placed in the location it is required to prevent double handling.

4.5 Spoil and fill transportation

Transport and haulage of earthwork materials will be undertaken in accordance with the construction Traffic and Access Management Sub Plan (refer to CEMP Appendix B1). In accordance with the Traffic and Access Management Sub Plan, the following controls will be implemented:

- Minimise exposure to noise sensitive areas: transportation only within the approved construction hours (between 7:00 am and 6:00 pm Mon.- Fri and 8am-1pm Saturdays, unless otherwise approved.) and on approved traffic routes to minimise the passage of material through nearby towns.
- Avoid identified protected areas and no-go zones to minimise potential for impact on biodiversity and heritage values. This includes:
  - minimum impact to local wildlife measures included in the Flora and Fauna Management Sub-plan.
  - temporary works designed to avoid or minimise removal of vegetation;
  - Use rumble pads or stabilised exit points for all access ways to public roads.
- The minimal use of existing roads and tracks: using the Project alignment as the main material transport route to avoid negative community outcomes.
- Reduction of dust generated: loads of earthen materials are to be covered when entering public roads and roads are to remain swept clean and free of mud/debris.

4.6 Record Keeping

Section 143 certificates are required for any material to be reused outside the Project boundary and landfill disposal tickets for material disposed of to landfill will be completed/obtained by engineers and/or the site foreman. Records of any laboratory analysis required to determine compliance with waste exemptions will also be retained.

A spoil tracking register is to be maintained which includes details of each truck load of material sent for reuse outside of the Project Boundary. The truck load register will record where the material is coming from on site and where it is placed on the receiving site. The register will record the classification of the material which will correspond with the Section 143 and waste classification certificate provided to the landholder/developer for the material by the generator (FYJV).

The Project Waste Register will also be maintained which will track the quantities of material being reused/disposed of off-site.
5 Training and Awareness

Personnel involved in Spoil and Fill management will be trained in the requirements of this Procedure during the Project induction and/or regular toolbox talks. This will be provided by the Environmental Manager and Environmental Coordinator.

6 Stakeholder Consultation

Relevant stakeholders include the RMS and ER, EPA and local council. These organisations will be consulted with throughout the project via the regular ERG meeting.

7 Procedure Review

The Environmental Manager in consultation with RMS and the ER, will modify the Procedure where improvements are identified.

8 References

8.1 Legislative and other Requirements

The key legislation relevant to materials management includes:

- Environmental Planning and Assessment Act, 1979 (EP&A Act)
- Protection of the Environment Operations Act, 1997 (PoEO Act)
- Contaminated Land Management Act, 1997
- Resource Recovery Exemptions of the PoEO (Waste) Regulation 2005

8.2 AS/NZS Standards

Guidelines and Standards relevant to this Procedure include:

2) Australian and New Zealand Guidelines for Assessment and Management of Contaminated Sites, ANZECC/NHMRC, 1992
4) Guidelines for the Management of Acid Sulfate Material Acid Sulfate soils, Acid Sulfate Rock and Monosulfidic Black Ooze, RTA 2005
5) RMS Specification D&C R44

8.3 RMS Specification(s)

RMS G36, G38, G40 and R44
Appendix D
Stockpile Management Protocol
# Appendix D

Stockpile Management Protocol

Document No: NBHRDC-EN-SWMP-APPD_PLN

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1 Purpose

This Protocol describes the requirements for the monitoring and managing spoil and fill including details of how excavated material would be handled, stockpiled, reused and disposed is detailed. This Protocol outlines the locational criteria used to guide the placement of 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:

- Excavated material to be used in fill embankments and other design features.
- Acid sulphate soils subject to treatment prior to reuse.
- Excavated material unsuitable for reuse in the formation.
- Excess concrete, pavement, rock, steel and other material stored for either future use 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, excess timber for landscaping and revegetation works.

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

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

Note, the process for monitoring and managing spoil and fill including instructions of how excavated material would be handled, stockpiled, reused and disposed is detailed in Appendix C of the Soil and Water Quality Management Sub Plan, and in the Waste and Energy Management Sub Plan (Appendix B7 of the CEMP). This includes:

- the process by which offsite disposal of materials is to be sent to an appropriately licensed facility or in accordance with the waste exemptions prescribed in the WEMP; and
- records including section 143 certificates to be completed and retained for any material to be disposed of outside of the project boundary.

2 Scope

This Protocol is relevant to the siting and placement of all stockpiles on/related to the Project. The Protocol is consistent with the RMS Stockpile Site Management Guideline.

3 Roles and Responsibilities

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

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

1. The location of the stockpile is considered against the following site selection criteria:
   a. Is the site located within the Approved Construction Footprint?
   b. On land that does not require the removal of threatened species, EECs or roosting habitat for listed threatened fauna species?
   c. Located in areas of low heritage conservation significance?
   d. Located at least 5 metres clear of all areas of possible concentrated water flow?
   e. Located at least 50 m from a waterway?
   f. Located on land with a slope less than 10%?
   g. Ready access to the road network or direct access to the construction corridor?
   h. Located so that appropriate erosion and sediment control measures can be installed and will operate effectively?
   i. Located on land above the 20 ARI flood level?

2. Mitigation measures for each stockpile site include as a minimum:
   - Materials will not be stockpiled under the drip line of trees or native vegetation to be retained, and never pushed up around the base of trees.
   - 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 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.
   - 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 ESCP and may include stabilisation with cover crop or similar appropriate controls as per the site PESCP.
   - Dust management measures (including for vehicle movements associated with stockpiling activities) will be implemented in accordance with the requirements of the Project Air Quality Management Sub-Plan (Appendix A6 to the CEMP).
   - ASS management, including leachate containment, will be in accordance with Appendix G of the SWQMP.
   - Mulch stockpiles must be monitored and turned over as required to avoid spontaneous combustion.
   - Mulch stockpiles in high tannin generating vegetation should be:
     o Located 50m from water ways for mulch stockpiles that will be in place for duration of more than 1 month.
     o Located 20m from water ways for mulch stockpiles that will be in place for duration of less than 1 month.
     o Located on elevated ground where possible.
     o 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.
     o Managed in accordance with all other requirements specified in the Environmental Direction: Management of Tannins from Vegetation Mulch.
   - All exit points from the stockpile area to public roads are to be stabilised

4. In accordance with RMS 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 with a height not exceeding 2.5m and batter slopes not steeper than 2H:1V;
- have their batters track rolled or stabilized by other means; and
- be sealed in accordance with Specification Roads and maritime D&C R178, to encourage vegetation cover.

5 Training and Awareness

Personnel involved in Spoil and Fill management will be trained in the requirements of this Protocol during the Project induction and/or regular toolbox talks. This will be provided by the Environmental Manager and Environmental Coordinator.

6 Stakeholder Consultation

Relevant stakeholders include the RMS and ER, EPA and local council. These organisations will be consulted with throughout the project via the regular ERG meeting.

7 Protocol Review

The Environmental Manager in consultation with RMS and the ER, will modify the Protocol where improvements are identified.
Appendix E
Acid Sulfate Soil Management Procedure
Appendix E

Acid Sulphate Soil Management Procedure

Document No: NBHRDC-EN-SWMP-APPE_PLN

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Appendices

Appendix A – Field pH testing procedure
Appendix B – Estimating ASS treatment levels and aglime rates
Appendix C – Estimating ASR treatment levels and aglime rates
Appendix D – ASM treatment area layout
1 Purpose and Scope

The purpose of this Acid Sulfate Soil Management Procedure (this ASSMP and Procedure) is to describe how the FYJV proposes to manage the potential discovery and disturbance of ASM during the construction of the Project.

This Procedure addresses the requirements of the Minister’s Conditions of Approval (CoA), the RMS Statement of Commitments (SoC), applicable legislation and relevant standards.

The Procedure details the actions that will be taken by FYJV to identify the types of materials expected to be encountered and ensure effective controls are established and maintained to manage potential environmental impacts during the construction of the project.

This Procedure is applicable to all design and construction activities conducted by personnel on the Project that involve earthworks. The Procedure forms Appendix G of the Soil and Water Management Subplan (SWQMP) within the Construction Environmental Management Plan (CEMP) for the Project.

Relevant management measures identified in this Procedure will be incorporated into site or activity specific construction plans, procedures and Environmental Work Method Statements (EWMS), involving earthworks.

1.1 Objectives

The key objective of this Procedure is to provide instruction on potential Acid Sulfate Material (ASM) during design and construction to protect the environment. To achieve this objective, FYJV will undertake the following:

- Ensure all activities which may potentially expose, impact on, or handle ASM include procedures and controls into relevant EWMS;
- Ensure all Project personnel involved in activities which may potentially expose, impact on, or handle ASM are aware of the requirements for ASM management;
- Maximise the reuse of earthen materials generated on site.

2 Roles and Responsibilities

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.

3 Description of ASM Aspects and Impacts

Acid Sulfate Soils are generally distributed in estuaries and coastal floodplains, back swamps and coastal areas in elevations <5m AHD. Monosulfidic Black Ooze potentially exists in drains and waterways in acid sulfate areas and saline areas. Acid Sulfate Soil risk
maps were reviewed and indicated a low potential for the presence of Potential Acid Sulfate Soils (PASS) in the project area as shown in Figure 1.

Based on the Environmental Assessment, Potential Acid Sulfate Soils or potentially acid forming rock are unlikely to be present within the Project boundary and site ancillary facilities. However precautionary measures are being taken to mitigate the potential for impacts resulting from ASM in accordance with this procedure. During the project the following relevant construction activities have been identified for cautionary measures:

- Excavations (shallow and deep);
- Piling;
- Dewatering.

Potential causes during construction activities that can result in ASM impacts include:

- Uncontrolled surface runoff in areas of exposed ASM, causing the release of acid into the environment;
- Changes to surface run-off patterns promoting the release of acid into the environment;
- Leaching of acid into the environment at treatment sites;
- Exposing ASM at/near new drains or creeks, thus causing the release of acid into the environment in the short and long term;
- Exposure of ASM to the air, in new drains or creeks, thus causing increased oxidisation and increased release of acid into the environment;
- Inadequate treatment of ASR reused for construction material;
- Potential ASR affects on concrete structures, road surfaces and road railings and potential destabilisation of fill.

To mitigate the effects of ASM, measures will be implemented into management plans and EWMS in accordance with this Procedure. ASM treatment areas will be located, designed, constructed and operated in accordance with the requirements of this Procedure, the Spoil and Fill Management Procedure and the Stockpile Management Protocol.
Figure 1  Acid Sulfate Soils Risk Map

Class 1 – High Probability of Occurrence
Class 2
Class 3
Class 4
Class 5 – Low Probability of Occurrence
4 Procedures for Managing and Treating ASM

4.1 Assessment of Potential Source

Material source (ie. generated in a cut) will be assessed on the basis of data obtained prior to excavation, enabling classification of material prior to excavation, improving predictability of material handling. Sampling will be undertaken by the drilling of air track holes to create rock dust for sampling purposes.

4.1.1 ASM Avoidance and Mitigation

The following steps must be considered in design and construction planning:

- Avoid the disturbance of ASM where practical to do so by locating temporary facilities, temporary inground services etc away from identified potential areas;
- Risk of disturbance to potential ASM should be reduced to as low as reasonably practicable taking into account engineering and economic constraints;
- Avoid or minimise excavation and lowering of the water table in areas known to potentially contain ASM;
- Acid resistant construction materials to be applied in areas known to contain high risk ASM.

Where impacts to areas containing ASM is unavoidable, the excavation, stockpiling and containment, treatment and reuse or disposal of ASM will be pre-planned in accordance with the requirements of this Procedure to minimise environmental impacts to acceptable levels.
4.2 Unexpected Discovery of Acid Sulfate Soils

The potential risk for unexpected discovery of ASM can arise, particularly in working within the low-lying flood plain areas. 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 Field pH Testing Procedure.

![Workflow Diagram]

Suspected ASS/PASS material encountered during excavation / construction activities

Stop work immediately and notify the environmental coordinator

Environmental Coordinator to conduct indicator test

Negative results obtained

Continue Works

Positive or inconclusive results obtained

Apply management measures
4.3 ASM Treatment methodology

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
- Transfer soil to treatment area.
- Soil shall be laid in 150mm to 300mm layers on a treatment pad, see appendix D for typical treatment pad design.
  - An estimation on treatment levels and aglime required to treat the total weight of disturbed Acid Sulfate Soil is provided in Appendix B.
- 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.
Treatment of ASR onsite

A simple indicator for determining liming rates for Acid Sulfate Rock is provided in Appendix D to this Procedure. The indicator is extracted from the RMS Specification R44: Earthworks.

The pH testing procedure for ASR will be undertaken in accordance with the Field pH and Peroxide test applied to powdered rock material as conventionally applied to soils (refer to Appendix A). Sampling and testing protocols need to be implemented in a manner that accounts for mixing of ‘hot spots’, in order to provide an averaged basis for managing potential acid forming rock.

Validation of Treated material

Final validation sampling of treated soils will be conducted at the completion of treatment to determine if the neutralisation process has been successful.

Soils that have been mixed with aglime will be analysed (by laboratory analysis eg SPOCAS or Chromium Suite testing method) at a rate of one sample per 250 m³.

The following performance criteria must be attained for soil that has been treated using neutralisation:

- The neutralising capacity of the treated soil must exceed the existing plus potential acidity of the soil
- Soil pH > 5.5
- Soil has no further capacity to generate acidity.

Samples of the treated soil should be taken and laboratory tested to demonstrate compliance with the performance criteria. All validation samples are to be recorded by the Environmental Coordinator.

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 actual acid sulfate soils

If off-site disposal is required, procedures outlined within the document Waste Classification Guidelines, Part 4: Acid Sulfate Soils (DECCW 2008) shall be implemented.

ASS must be treated before the material can be considered for disposal. Treatment should be in accordance with the neutralising techniques outlined in this procedure.
Following neutralisation, the waste must chemically assess the soil in accordance with Step 5 of the Waste Classification Guidelines: Part 1 – Classifying waste (available at www.environment.nsw.gov.au/waste/envguidlns). This will determine whether there are any other contaminants that may affect how the waste is classified for disposal.

Once classified, the waste must be taken to a landfill licensed to accept that class of waste. (Refer to the Environmental Coordinator to confirm FYJV approved location for offsite landfill for disposal).

Prior arrangements should be made with the occupier of the landfill to ensure that it is licensed to accept the waste. The landfill must be informed that the actual ASS has been treated in accordance with the neutralising techniques and classified in accordance with the Waste Classification Guidelines.

Further details on the Waste Classification guidelines and disposal requirements is detailed in the Waste and Energy Management sub plan (Refer to Appendix B7 of the CEMP).

4.4 Monitoring

Where surface water and/or leachate collects within the bunded treatment area, the water shall be tested for pH, turbidity and TSS values prior to discharge or pumped directly to a sedimentation basin.

- Any runoff or fines collected in the settlement pond/sump will require assessment prior to decommissioning of the stockpile area.
- Regular visual monitoring of 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 coloured waters indicating de-oxygenation
## 5 Contingency Measures

The following contingency measures outlined in Table 7-1 will be undertaken in the event of failure of proposed ASM management and treatment. The project soil conservationist will be involved in advisory support to implementing any contingency measures as required.

### Table 5-1 Contingencies for potential failures in ASM management and treatment

<table>
<thead>
<tr>
<th>Potential failure</th>
<th>Potential impact</th>
<th>Contingency measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unexpected find of ASM</td>
<td>Lack of preparedness in managing excavated ASM.</td>
<td>• Apply Unexpected Finds Procedure</td>
</tr>
<tr>
<td></td>
<td>Release of acidity into immediate surrounds including waterways.</td>
<td>• Provisioning of neutralising agent (aglime) when working in high risk ASM areas.</td>
</tr>
<tr>
<td>Failure of batch treatment (neutralisation)</td>
<td>Constrain on stockpile treatment area capacity.</td>
<td>• Prepare for temporary stockpile area when working in high risk ASM areas.</td>
</tr>
<tr>
<td></td>
<td>Potential release of acidic material to environment.</td>
<td>• Monitoring by Environmental Coordinator and soil conservationist.</td>
</tr>
<tr>
<td>Local flooding of stockpile treatment area or temporary stockpile area, causing overflow of sump collection.</td>
<td>Release of acidic ‘leachate’ water to land and waterways.</td>
<td>• Follow treatment procedure.</td>
</tr>
<tr>
<td>Inflow of groundwater into soil and rock excavations subject to acidic conditions</td>
<td>Impact on groundwater quality and consequential impacts to aquatic environment.</td>
<td>• Verification of stockpile prior to reuse.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Creation of additional temporary stockpile site to be organised under coordination with Environmental Coordinator and soil conservationist for re-treatment.</td>
</tr>
<tr>
<td>Spillage of ASM during transport</td>
<td>Release of acidity into immediate surrounds including waterways.</td>
<td>• Treating stockpiles within 24 hours. Location of temporary stockpiles away from waterways and provide sufficient stormwater diversion around stockpiles (monitor short term weather information).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Liming of drainage lines.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Collect washed out sediments, test area and neutralise area if required.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provisioning of neutralising agent (aglime) when working in high risk ASM areas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pump out acid drainage into temporary storage tanks or basins for treatment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Install lime curtain in work area where appropriate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Monitoring of groundwater conditions</td>
</tr>
</tbody>
</table>
6 Training and Awareness

All relevant staff, workers and contractors will be trained in this Procedure. This will be provided during Site Inductions as well as on going toolbox training. The following issues will be addressed by training.

7 Stakeholder Consultation

Relevant stakeholders include the RMS, ER EPA, DPI (Fisheries), DPE and Warringah Council. These organisations will be consulted with throughout the project via the regular ERG meeting. The procedure will be modified if where improvements are identified.

8 Procedure Review

The Environmental Manager will undertake an assessment of the effectiveness of ASM treatment and management measures and implications that these Procedures may have for other projects.

The Environmental Manager, in consultation with the construction team and with RMS and the ER, will modify this Procedure where improvements are identified.
Appendix A - Field pH Testing Procedure

1. 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.

2. Field Testing – Field pH and the 30% Peroxide Test

Field testing provides rapid insitu techniques for assessing the likelihood of ASM. The test involves measuring soil pH before and after oxidation using the following parameters:

\[ \text{pH}_F \] — measure of soil pH of a soil:water paste

\[ \text{pH}_{FOX} \] — measure of soil pH after rapid oxidation with hydrogen peroxide (H₂O₂)

Field testing cannot be used as a substitute for laboratory analysis in the identification of acid sulfate soils for assessment purposes.

The techniques for field pH (pHₕ) and field peroxide pH (pHₐₚₙₐₜₑ) are detailed as follows:
2.1 Field pH Test (pHF)

The pHF readings should be taken at regular intervals down the soil profile. It is recommended this test be done every 0.25m down the profile but at least every 0.5m interval or horizon whichever is the lesser.

<table>
<thead>
<tr>
<th>Notes on pH equipment and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>- A battery powered, field pH meter with a robust, spear point, double reference pH electrode should be used</td>
</tr>
<tr>
<td>- Calibrate the field pH meter in accordance with the manufacturer’s instructions</td>
</tr>
<tr>
<td>- The probe can be inserted directly into soft wet soils or soil mixed up into a paste with deionised water. (Care must be exercised not to scratch the electrode on sandy or gravely soils)</td>
</tr>
<tr>
<td>- Use of the meter and testing should be only undertaken by trained personnel</td>
</tr>
</tbody>
</table>

Field Peroxide pH Test (pHFOX)

To test for the presence of unoxidised sulfides and therefore PASS, the oxidation of the soil with 30% (100 volume) hydrogen peroxide can be performed in the field. The most common method is:

- A small sample of soil (approx. 5 g) is placed in a small glass container (e.g. short clear centrifuge tubes, clear tissue culture clusters or sample jar) and a small volume (20 mL) of peroxide is dropped onto the soil

(Note: Allow the digested solution to cool after the reaction. A pH probe will only measure to 60°C.)

- The reaction should be observed and rated. In some cases, the reaction may be instantaneous; in others, it may take 10 minutes or more. Heating over hot water or in the sun may be necessary to start the reaction on cool days, particularly if the peroxide is cold.

- Potentially positive reactions for ASS include one or more of the following:
  - change in colour of the soil from grey tones to brown tones;
  - effervescence;
  - the release of sulfurous odours;
  - final pH of <3.5 and preferably < 3;
  - lowering of soil pH by at least one pH unit.

The strength of the reaction is a useful indicator. Effervescence (or reaction rate) — a visual measure of the vigorousness of the oxidation reaction where: 1 = slight; 2 = moderate; 3 = high; and 4 = extreme.
When effervescence (sometimes violent) has ceased, a few additional mL of peroxide should be added until the reaction appears complete. If the reaction is violent, it is recommended that deionised water be added to cool and dilute the reaction. The test may have to be repeated with a small amount of water added to the soil prior to peroxide addition. The pHFOX of the resultant mixture is then measured. The peroxide 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 sulfuric material (e.g. <0.05 % S).

With soils containing high organic matter (such as surface soils, peats, mangrove / estuarine muds, and marine clays), care must be exercised when interpreting the reaction as high levels of organic matter and other soil constituents particularly manganese oxides can also cause a reaction.

**Note of caution with the use of peroxide**

30 % hydrogen peroxide is a strong oxidising agent and should be handled carefully with appropriate eye and skin protection. This test should be only undertaken by trained personnel.

The pH of analytical grade peroxide may be as low as 3 as manufacturers stabilise technical grade peroxide with acid. The peroxide pH should be checked on every new container and regularly before taking to the field and adjusted to 4.5 - 5.5 with a few drops of 0.1M NaOH if necessary. False field pHFOX readings could result if this step is not undertaken.

1. **pH After Oxidation**

   The measurement of the change in the pHFOX following oxidation can give a useful indication of the presence of sulfuric material and can give an early indication of the distribution of sulfide down a core/ profile or across the site. The following table provides an interpretation of the change in pH.

   If one positive result is obtained, the required action should be followed. The ‘pH after oxidation’ test is not a substitute for analytical test results.
### pH Reaction Rate

<table>
<thead>
<tr>
<th>pH&lt;sub&gt;f&lt;/sub&gt;</th>
<th>pH&lt;sub&gt;fox&lt;/sub&gt;</th>
<th>ΔpH</th>
<th>Reaction Rate</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 5.0</td>
<td>≤ 5.0</td>
<td>≤ 2</td>
<td>1—2</td>
<td>If no other field indicators or acid sulfate soil risk indicators are present, no further action is required</td>
</tr>
<tr>
<td>&gt; 4.0 and ≤ 5.0</td>
<td>&gt; 3.0 and &lt; 5.0</td>
<td>&gt; 2</td>
<td>≥ 2</td>
<td>PASS may be present, further assessment is required (laboratory analysis)</td>
</tr>
<tr>
<td>≤ 4.0</td>
<td>≤ 3.0</td>
<td>&gt; 2</td>
<td>≥ 2</td>
<td>AASS or PASS are likely to be present, further assessment is required (laboratory analysis)</td>
</tr>
</tbody>
</table>

Care is needed with interpretation of the result on highly reactive soils. Some soil minerals other than pyrite react vigorously with peroxide, particularly manganese but may only show small pH changes.

**Note of caution with testing of soil with high organic content**

When selecting soil for testing it is advisable to avoid material high in organic matter as the oxidation of organic matter can lead to the generation of acid. However pH of soils containing organic matter and no pyrite do not generally stay below 4 on extended oxidation. In general positive tests on ‘apparently well drained’ surface soils should always be treated with caution and followed up with laboratory confirmation.

The field peroxide tests can be made more consistent if a fixed volume of soil (using a small scoop) is used, a consistent volume of peroxide is added and left to react for an hour, and the sample is made up to a fixed volume with deionised water before reading. However, such procedures take time in the field and are more suited to a ‘field shed’ situation.
Appendix B – Estimating ASS treatment levels and Aglime rates

The following extract is taken from “Guidelines for the Management of Acid Sulfate Material Acid Sulfate soils, Acid Sulfate Rock and Monosulfidic Black Ooze, RTA 2005” (refer to ASM Procedure No. 4 – Attachment 2 of RTA Guidelines)
Appendix C - Estimating ASR treatment levels and Aglime rates

Figure C1 provides an example flowchart for the treatment of Acid Sulfate Rock, based on pH and liming rates. The requirements for reuse of treated ASR will be undertaken in accordance with the Earthworks Management Plan to conform with RMS Specification R44: Earthworks.

Management of stockpiles and monitoring will be undertaken in accordance with the requirements prescribed in section 6 and 7 of this Procedure.

Figure C1: ASR pH and liming rates for treatment flowchart
Appendix D - ASM Treatment Area Layout

Estimate the potential amount of ASM that may be disturbed and determine a treatment area large enough to contain all, or the progressive treatment loads, of excavated ASM. The Environmental Coordinator and Project soil conservationist should be involved to advise on the establishment of a treatment area. Example set up shown below.

Treatment areas shall meet the following requirements:

- Be located at least 50m from waterways;
- Be located above the 1 in 20 year ARI flood levels;
- Be constructed with impervious material (eg clay) bunds to prevent leachate runoff;
- Be lined with agricultural lime on the floor of the treatment area at a rate capable of neutralising all acid waters that might infiltrate through ASS, prior to placing ASS in the treatment areas;
- Be clearly signposted.

The treatment area will require a settlement pond or sump to collect any runoff. The pond or sump must be designed to capture the ASM treatment area runoff a 1 in 10 year (1 hour) storm event.
Appendix F
RMS Environmental Direction:
Management of Tannins from Vegetable Mulch
ENVIRONMENTAL DIRECTION
Management of Tannins from Vegetation Mulch

JANUARY 2012
# ABOUT THIS RELEASE

| Environmental Direction number | 25 |
| Environmental Direction title | Management of Tannins from Vegetation Mulch |
| Author | Environment Branch (Environmental Policy) |

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Revision description</th>
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<tr>
<td>1</td>
<td>December 2011</td>
<td>Final draft</td>
</tr>
<tr>
<td>2</td>
<td>January 2012</td>
<td>Final</td>
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1 PURPOSE

The purpose of this environmental direction is to set RMS’s minimum management measures to minimise the generation and discharge of tannins from vegetation mulch on Roads and Maritime Services (RMS) construction projects. Additional background information on tannins and the use of mulch on construction sites is included in section 3 of this direction.

2 MANAGEMENT MEASURES

The primary focus must be to minimise tannin generation on construction sites.

2.1 General mulch management measures

These general mulch management measures are to be followed for all RMS construction projects.

2.1.1 Planning and works staging

The first step in planning and works staging is to identify the amount of mulch to be generated. With this information, a strategy can be prepared to manage mulch on site. Staging of chipping, tub grinding and/or mulching activities should be planned to reduce the volume of mulch to be managed at any one time. The volume of excess mulch can then be assessed and plans made to dispose of this off site.

Other general considerations at the planning and works staging phase are as follows:
- Mulch stockpile sites should be established with appropriate controls in place before the main site clearing activities commence. Limited clearing may be required earlier for establishment of stockpile areas and access.
- Stage the mulching of cleared vegetation to ensure that mulch can be progressively moved to elevated, or otherwise suitable, stockpile locations. It is preferred that mulch should be transferred to a stockpile or reused on the day of mulching.
- Plan to efficiently reuse mulch in progressive works to reduce the time that mulch is concentrated in stockpile locations.
- Excess mulch can be managed by community giveaway. This takes considerable time and mulch needs to be suitably located and managed as this occurs. The conditions for community giveaway of mulch are included as Appendix 3.
- Any other form of bulk offsite mulch disposal (eg to Council parkland or a development site) must be assessed to ensure waste management provisions are adhered to for off site disposal.

2.1.2 Stockpile location and management

- Mulch stockpile sites should be established on elevated ground where possible.
- Stockpile sites with a duration of not more than 1 month should be constructed not less than 20 metres from a watercourse, including floodplains.
- Stockpile sites with a duration of more than 1 month should be constructed not less than 50 metres from a watercourse, including floodplains.
- Mulch stockpiles should be designed and constructed to divert upgradient water to prevent it from entering the stockpile site.
2.1.3 Management measures for the use of mulch on site

- Do not use mulch for surface cover or sedimentation controls in any low lying areas of the site that remain consistently wet. Alternative controls such as geofabric (for surface protection) or sediment fence will be required in these areas.
- Do not spread surface mulch in thicker than 100mm layers. Mixing mulch with topsoil is encouraged for batters to prevent loss of topsoil during initial stabilisation. It should be noted that mulch will generally cause nitrogen draw down which may inhibit plant growth, unless mulch has been composted first.
- Care is to be taken to ensure that excessive mulch is not applied for sedimentation controls such as perimeter bunds or catch dams.

2.1.4 Monitoring and response

- Monitor the site for generation of tannins. Tannin impacts can be readily identified visually as dark coloured ponded water. Site staff should be trained to identify and report potential impacts to the site project management or environment staff.
- Review management practices where required to prevent the generation of tannins in identified problem areas.

2.2 Mulch management methods for high risk sites

2.2.1 High risk sites

High risk sites, where additional management measures may be required, include:
- where large quantities of mulch will be generated and stockpiled.
- where high tannin generating vegetation types are to be mulched (see 3.1).
- where the receiving environment is identified as sensitive (eg Marine Park, threatened aquatic species habitat).
- where tannins have been observed to be generated or discharged from an operating site with standard management controls.

2.2.2 Stockpile management measures for high risk sites

- Mulch stockpiles for high tannin generating vegetation types should incorporate an impermeable bund to capture stockpile leachate or tannin impacted water. Impervious bunds must be a minimum of 300 mm high, preferably higher to capture tannin impacted water. 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.
- Stockpiles established on sloping sites must be designed to provide temporary stormwater containment equivalent to a 300 mm minimum height bund on a flat site.
- Tannin impacted water should be pumped out of bunded stockpiles within 5 days of the end of a rainfall event to maintain the storage capacity. This water should be used for on site purposes including dust suppression and landscape watering. These activities must be managed to prevent any pooling or runoff of tannin impacted water.
- Bunded stockpiles must be inspected within 24 hours of cessation of any rainfall event greater than 10mm to ensure tannin impacted water does not overflow.

2.3 Site management procedures

Site management procedures must be prepared for all sites where tannins are identified as a potential issue. Site management procedures should be based on the management measures provided in this Environmental Direction.
3 BACKGROUND

3.1 Tannin generation from vegetation mulch

See Plates 1 – 3 in Appendix 1.

Tannins are naturally occurring plant compounds. Tannin generation from vegetation mulch is likely to be highest from low-lying coastal floodplain areas. The species of vegetation (eg *Melaleuca*) will have a major impact on the likelihood of tannin generation.

Tannin generation is generally highest from mulched vegetation that is stockpiled in areas that are subject to inundation. Placement in wet areas will result in accelerated leaching of tannins into water, concentration of tannins in pooled water, and greater impacts on water quality.

3.2 Tannin impacts on water quality

See Plates 4 – 5 in Appendix 1.

The main concern with the discharge of water that is high in tannins is that it may increase the biological oxygen demand (BOD) of the receiving environment. Increases in BOD may result in a decrease in available dissolved oxygen. A lack of dissolved oxygen is identified as the main cause of about 80 percent of fish kills in NSW rivers and estuaries.

Tannin impacts may result in dark coloured water discharge from construction sites. This impact can be obvious and may raise the concern of the community and other stakeholders including regulatory authorities. Once discharged to the environment, tannins may reduce visibility and light penetration and change the pH of receiving waters. These impacts may affect aquatic ecosystems in receiving environments.

Tannins cannot be readily treated with standard construction site water quality controls. Once water on site is impacted with tannins it is not possible to treat effectively with currently approved flocculants. Minimisation of tannin generation in the first place is the management strategy that must be applied.

3.3 Use of mulch on construction sites

See Plates 10 – 16 in Appendix 2.

The RMS Biodiversity Guidelines provide guidance on the benefits of reusing various sizes of vegetation for different purposes. Mulch is a readily available and cheap source of material for temporary site stabilisation and sedimentation control. The re-use of mulch reduces the need to transport this material off-site and reduces handling and disposal costs for construction contracts.

Unprotected mulch sedimentation controls should not be placed in concentrated flow lines where mulch may be washed away. Mulch may be protected by wrapping it with geofabric or other materials to provide a stable control. All temporary catch dams constructed from mulch must have a stable outlet to minimise the washing away of mulch in high rainfall events, and the possible failure of the control.
4 ADDITIONAL RESOURCES

- RTA Biodiversity Guidelines- Protecting and Managing Biodiversity on RTA Projects, 2011
- Pacific Highway Mulch Protocol 2011
5 APPENDICES
Appendix 1: Plates showing tannin generation & water quality impacts

Plate 1: Melaleuca vegetation community – mulch from this vegetation type will generally produce high amounts of tannins.

Plate 2: Vegetation mulching activity – mulch should be progressively moved into prepared stockpile areas.
Plate 3: Tannin generation from recently felled and partially mulched vegetation in an area subject to localised inundation. Mulched vegetation should be progressively moved to prepared stockpiles to manage tannin impacted water.

Plate 4: Tannin impact in stormwater at the discharge point from a road construction site. The discharge of impacted water may be obvious to community and other stakeholders.
Plate 5: Tannins in a drainage line generated from very thickly applied mulch on the batter above. Note that the sedimentation fence is not effective in treating the tannins.
Appendix 2: Plates showing the use of mulch for erosion & sedimentation controls

Plate 6: Mulched vegetation stockpiled in a low-lying area subject to inundation. This is not an appropriate stockpile location and may increase the generation of tannins from stockpiled mulch.

Plate 7: Mulch being placed as batter erosion control. Mulch should not be applied in layers more than 100 mm thick for surface stabilisation.
Plate 8: Site showing recent application of a mulch/topsoil mix on batters (40% mulch to 60% topsoil). Mulch mixes are used to provide temporary stabilisation to prevent the loss of topsoil from batters in heavy rainfall events. Mulch use is also shown as a mounded sedimentation control to prevent sediment entering the median drain.

Plate 9: A mulch/topsoil mix used to provide temporary batter stabilisation and to assist cover crop establishment.
Plate 10: Successful establishment of cover crops on batters where mulch has been used with topsoil to assist temporary stabilisation.

Plate 11: Geofabric wrapped mulch bunds used for sedimentation control
Plate 12: Mulch used as a bund for a temporary sedimentation catch dam. Mulch is effective as it can provide both containment and filtering of site water. Mulch should not be used as a control in areas of concentrated flow where it may be washed away. Any mulch containment control should have a defined and lined outlet that allows discharge from the control without washing mulch away. Note that this control does not have a defined discharge outlet which should be installed to prevent failure of the control in heavy rainfall events.
Appendix 3: Minimum requirements for community mulch giveaways

The purpose of community mulch giveaways is to provide mulch for residential landscaping purposes.

The activities of a community mulch giveaway are permissible under the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A (the Raw Mulch Exemption 2008). However, the activities remain subject to other relevant environmental regulations within the Act and Regulations. The Raw Mulch Exemption 2008 is subject to the following conditions:

- The raw mulch can only be applied to land for the purposes of filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process.
- The consumer must land apply the raw mulch within a reasonable period of time.


It is the mulch generators responsibility to ensure that the mulch is reused in an environmentally responsible manner.

A safe work method statement (SWMS) must be prepared that identifies potential OHS risks and all prevention and mitigation measures. The SWMS must apply to both the community and site workers involved in the mulch giveaway.

Each member of the community who participates in the mulch giveaway must read and understand a site specific information sheet. A template information sheet is attached as Appendix 4.

The site occupier must maintain written records for each load of mulch that is taken away and to ensure that each community participant understands the conditions of the community mulch giveaway information sheet. A suggested template to record this information is attached as Appendix 5.
Appendix 4: Community mulch giveaway information sheet

The following community mulch giveaway information sheet must be populated with site specific information.
### Community Mulch Giveaway

**Information Sheet**

<table>
<thead>
<tr>
<th>Details of Mulch Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site Occupier</strong></td>
</tr>
<tr>
<td><strong>Project Name</strong></td>
</tr>
<tr>
<td><strong>Location</strong></td>
</tr>
<tr>
<td><strong>Mulch stockpile access directions</strong></td>
</tr>
</tbody>
</table>

### Background

- This information sheet supports the non-commercial giveaway of mulch for local residents.
- The product is raw vegetation mulch from <insert project location / name>.

### Conditions

- Any one individual may only take a maximum of 5 trailer loads from this project.
- The mulch may only be used for residential landscaping purposes.
- Mulch must not be placed in or immediately adjacent to waterways.
- The raw mulch can only be applied to land for the purposes of filtration or as a soil amendment material or used either singularly or in any combination as input material(s) to a composting process.
- The consumer must apply the raw mulch to land within a reasonable period of time.

### Community Safety Requirements

- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
- <add in any safety requirements or mitigation measures from the SWMS that apply to the community>
Appendix 5: Records template for community mulch giveaway

The records in the following suggested template must be kept as a minimum.
## Community Mulch Giveaway

**Record Sheet**

<table>
<thead>
<tr>
<th>Date</th>
<th>Car Registration</th>
<th>I have read and understand the 'Community Mulch Giveaway Information Sheet'</th>
<th>Name</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>☐ Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ Yes</td>
<td></td>
<td></td>
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Appendix G
RMS Environmental Direction No: 19
Use of Reclaimed Water (RTA 2006)
Environmental Directions

Date: 8 December 2006

Use of Reclaimed Water

Purpose

To provide requirements for reclaimed water use for the protection of RTA and Contractor staff and the environment.

Definition of Reclaimed Water

Reclaimed water is sewage effluent that has been treated and disinfected to a standard that is suitable for reuse for non-potable purposes (non-drinking water purposes).

Background

Sewerage treatment plants (STP's) in NSW use a range of methods of sewage treatment and the quality of effluent from different plants is variable. For this reason, the reclaimed water that can be used by RTA for different activities is specifically by treated water quality criteria, not the treatment method.

RTA encourages the use of reclaimed water. However, in order to protect site staff and the environment, certain requirements need to be followed. Specifically, reclaimed water must only be used for construction purposes and only on sites where access is restricted to inducted personnel. Reclaimed water is not to be used for drinking water, cooking or used in potable bathrooms.

Actions Required

Quality of Reclaimed Water that can be used for RTA works

The National Water Quality Management Strategy (NWQMS) 2000 provides guidance on the appropriate uses of reclaimed water of different quality in the Guidelines for Sewage Systems – Use of Reclaimed Water, Nov 2000. For construction activities undertaken by the RTA the Guideline recommends a maximum concentration of 1,000 thermotolerant coliforms/100ml (tc/100ml) in reclaimed water to protect human health. This water quality can be achieved by secondary effluent treatment with disinfection and by tertiary treatment. Reclaimed water for various activities must meet the standards for each activity in Table 1.

Quality Control of Reclaimed Water Quality for water Provider

RTA will receive water from sewage treatment plants where it can be demonstrated that the reclaimed water meets the requirements of Table 1 of this Direction. Regular monitoring of reclaimed water by the Water Authority is required to demonstrate compliance with RTA requirements for use. Additional information is included in the “Minimum System Requirements”, below.
Environmental Directions (continued)

Excluded Activities

This Direction refers to requirements for the use of reclaimed water for construction purposes only. Due primarily to the potential creation of concentrated flows, and subsequent direct runoff to waterways, reclaimed water is not to be used for the following activities:
- Subsoil drainage flushing.
- Pavement or structure washdown.
- Saw cutting.
- Drilling (water may contaminate groundwater and drinking water resources)

Table 1 – Reclaimed Water Standards Required for Specific Activities

Key:
√ = Water of this quality can be used for this activity in accordance with all minimum requirements
X = Water of this quality must not be used for this activity

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<tr>
<td>Watering Vegetation with vehicle-operated equipment (a 4 hour exclusion period may apply prior to site entry)</td>
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<td>High Pressure Water Blasting for Pavement Re-texturing</td>
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*1 – Thermotolerant Coliforms are a group of bacteria whose presence is used as an indicator of effective treatment and the residual risk of treated wastewater.
*2 – Workers potentially exposed to spray drift from dust suppression and earthworks activities include both ground-based staff and plant operators. The SWMS for dust suppression must identify the risks for all site staff. Temporary exclusion of entry to the sprayed area, where possible, is an effective management control.

Minimum Procedural Requirements

RTA’s minimum system requirements for the management of recycled water on any RTA project site are:
1. That written information is provided to the water provider (e.g. the Council operating the STP) that:
   - Clearly states the proposed use of the reclaimed water.
   - Makes reference to the specified water quality required (from Table 1).
   - Requests written confirmation from the water provider that their reclaimed water meets the specified water quality and that regular sampling is undertaken that provides quality assurance to the requirements of the NWQMS, 2000. A minimum of weekly sampling and National Association of Testing Authorities (NATA)
Environmental Directions (continued)

accredited analysis that demonstrates compliance is the minimum standard. Records of long term monitoring results (6 months or more) should be made available by the Water Provider to demonstrate that STP consistently meets the requirements.

2. That the driver of the water cart keeps a log book or other record of information in each registered water cart to record information of deliveries that is available for audit. Details must include the following:
   - All dates of reclaimed water receipt and delivery.
   - Source of reclaimed water.
   - Customers name and delivery address.
   - Volume delivered.
   - The time of application on the site.
   - Method of delivery (i.e. was the water sprayed for dust suppression, used for watering landscaped areas).

3. That the organisation contracted to undertake services for RTA prepares appropriate safe work method statements (SWMS) for its use. Risk assessments and SWMS must identify the use of reclaimed water as a hazard and institute appropriate controls and signage commensurate with the level of risk.

4. That all site staff are made aware of the SWMS and safety controls and environmental controls required for using reclaimed water on each site prior to use.

5. That any water cart used for transporting reclaimed water is preferably not be used to transport potable water. If any water cart previously used for reclaimed water is to be used for potable water then it must be disinfected in accordance with the NSW Health Guidelines for Water Carters, 2002.

6. This Environmental Direction should be read in conjunction with the RTA OHS Tip Sheet on Reclaimed Water Use. The OHS Tip Sheet provides additional guidance on the risk assessment for use of reclaimed water and the procedures for managing exposure outside the requirements of the SWMS.

Minimum Environmental Requirements

Minimum environmental requirements for the use of reclaimed water are:

- That use of the reclaimed water does not result in any runoff from the defined work area. Application will be undertaken to prevent ponding of water on the work site.
- That water carts are fitted with sprays that do not cause spray drift of the effluent.
- That spraying activities are undertaken, with consideration of the weather conditions, so no observable spray or mist from the activity is blown from the site to adjacent properties.

Contact Officer: Chris Blake – (02) 8588 5738

General Manager Environment

Chief Executive
Supersedes: Nil
Appendix H
Unexpected Discovery of Contaminated Land Procedure
APPENDIX H

Unexpected discovery of contaminated land procedure

AUGUST 2016
## Document control

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Plan approved by:

- **Ignacio Chicharro**
  - Project Director
  - FerrovialYork JV
- **Mark Turner**
  - Environmental Manager
  - FerrovialYork JV
- **Nick Francesconi**
  - Environment Branch representative
  - Roads & Maritime
- **Sada Sadadcharan**
  - Project Manager
  - Roads & Maritime

## Revision history

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1 Distribution

There are no restrictions on the distribution/circulation of this Procedure within the Northern Beaches Connectivity and Network Enhancements Project covering Stage 1 and Stage 2 Project works.

2 Purpose

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

3 Induction / Training

Where required, personnel will be trained in the identification of potential contaminated soil / material including the requirements of this Procedure during the Stage 1 Project and Stage 2 Project inductions and / or regular toolbox talks.

4 Scope

This Procedure is applicable to all activities conducted by personnel on Stage 1 and Stage 2 of the Northern Beaches Connectivity and Network Enhancements Project that have the potential to uncover/encounter contaminated soil/material.

5 Procedure

1. Potential Contaminated Soil / Material Encountered during Construction Activities

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

- STOP ALL WORK in the immediate / affected area.
- Immediately notify the Environment Manager (EM).
- Recommence works in an alternate area where practicable.

2. Personal Protective Equipment (PPE)

Prior to any contamination investigation/management, appropriate personal protective equipment (PPE) is to be worn as per the relevant Safety Data Sheet(s) (SDS).

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).
3. **Undertake a Site / Area Contamination Investigation**

The G36 Hold Point Contaminated Land must be implemented.

The EM or Environmental Officer (EO) 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.

The material is to be classified in accordance with the *Waste Classification Guidelines* (DECCW, 2009).

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.

If the material is determined to be acid sulfate soil or potential acid sulfate soil, the Acid Sulfate Soil Management Procedure (Appendix E of this SWQMP) is to be followed.

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. **Recommence Works**

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

Figure 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 1 Unexpected discovery of contaminated land procedure flow chart

Unexpected discovery of potentially contaminated material

Stop work immediately in the area of potential contamination and inform the Environmental Manager

Set aside potential contaminated material and recommence works in alternate area

Environmental Manager to classify the waste in accordance with the Waste Classification Guidelines (DECCW, 2009)

If relevant, the Environmental Manager will notify and consult with authorities to determine a suitable management option

If relevant, the Environmental Manager will notify and consult with authorities to determine a suitable management option

Environmental Manager shall determine appropriate management (disposal or treatment) measures. Release Hold Point

Proceed with construction excavations in accordance with relevant sub plans

If potential contamination is determined to be acid sulphate soils, then management shall be in accordance with the Acid Sulfate Soil Management Procedure
Appendix I
Dewatering Guidelines and Practice Notes
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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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 (eg 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 minimize 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 utilize 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 (eg 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
cause 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 J
Example PESCP
Appendix J

Example PESCP
Appendix K
Not Used
(the Asbestos Management Plan is now a stand-alone management plan, no longer a CEMP sub-plan)
Appendix L
Remedial Action Plan
Remediation Action Plan

461 Warringah Road, Frenchs Forest NSW

Prepared for: Ferrovial York Joint Venture
Remediation Action Plan

Prepared for:

Ferrovial York Joint Venture (FYJV)

461 Warringah Road, Frenchs Forest
NSW

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<td>7th June 2016</td>
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Report No: FYJV-01-10217 / RAP / v1final

Date: 10th June 2016

Written by: Kyle McClintock
B.Sc. Hons. (Enviro)
Environmental Consultant

Reviewed by: Thomas Lobsey
B.L&W. Sci
Senior Environmental Consultant

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<table>
<thead>
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</thead>
<tbody>
<tr>
<td>ADE</td>
<td>A.D. Envirotech Australia Pty Ltd</td>
</tr>
<tr>
<td>BGL</td>
<td>Below ground level (following excavation works)</td>
</tr>
<tr>
<td>BR</td>
<td>Blind Replicate</td>
</tr>
<tr>
<td>BTEX</td>
<td>Benzene, toluene, ethyl-benzene, xylene</td>
</tr>
<tr>
<td>COC</td>
<td>Chain of Custody</td>
</tr>
<tr>
<td>DEC</td>
<td>Department of Environment and Conservation</td>
</tr>
<tr>
<td>DQI</td>
<td>Data Quality Indicators</td>
</tr>
<tr>
<td>DQO</td>
<td>Data Quality Objectives</td>
</tr>
<tr>
<td>EILs</td>
<td>Ecological Investigation Levels</td>
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<tr>
<td>ESLs</td>
<td>Ecological Screening Levels</td>
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<td>GILs</td>
<td>Groundwater Investigation Levels</td>
</tr>
<tr>
<td>HILs</td>
<td>Health Investigation Levels</td>
</tr>
<tr>
<td>HLSs</td>
<td>Health Screening Levels</td>
</tr>
<tr>
<td>LPI</td>
<td>Land Property Information</td>
</tr>
<tr>
<td>LTO</td>
<td>Land Titles Office</td>
</tr>
<tr>
<td>NATA</td>
<td>National Association of Testing Authorities</td>
</tr>
<tr>
<td>NEPC</td>
<td>National Environmental Protection Council</td>
</tr>
<tr>
<td>NEPM</td>
<td>National Environmental Protection Measure</td>
</tr>
<tr>
<td>NSW EPA</td>
<td>New South Wales Environmental Protection Authority</td>
</tr>
<tr>
<td>OEH</td>
<td>Office of Environment and Heritage</td>
</tr>
<tr>
<td>OPPs</td>
<td>Organophosphorous Pesticides</td>
</tr>
<tr>
<td>OCPs</td>
<td>Organochlorine Pesticides</td>
</tr>
<tr>
<td>PAHs</td>
<td>Polycyclic Aromatic Hydrocarbons</td>
</tr>
<tr>
<td>PSI</td>
<td>Preliminary Site Investigation</td>
</tr>
<tr>
<td>QA/QC</td>
<td>Quality Assurance/Quality Control</td>
</tr>
<tr>
<td>RPD</td>
<td>Relative Percent Difference</td>
</tr>
<tr>
<td>SCID</td>
<td>Stored Chemical Information Database</td>
</tr>
<tr>
<td>SWL</td>
<td>Standing Water Level</td>
</tr>
<tr>
<td>SH&amp;EWMS</td>
<td>Safety Health and Environmental Works Method Statement</td>
</tr>
<tr>
<td>TPH</td>
<td>Total Petroleum Hydrocarbons</td>
</tr>
<tr>
<td>TRH</td>
<td>Total Recoverable Hydrocarbons</td>
</tr>
<tr>
<td>UCL</td>
<td>Upper Confidence Limit</td>
</tr>
<tr>
<td>VAL</td>
<td>Validation Report</td>
</tr>
</tbody>
</table>
Definitions

Whenever the following terms occur in the Remedial Action Plan (RAP), they shall have the meanings defined below:

“Principal” means the Client.

“Contractor” means the company / person hired by the Principal that is responsible for the construction / remediation works.

“Consultant” means the person appointed by the Principal who shall inspect the compliance of the remediation procedures with the guidelines assigned by the NSW EPA.

“Works” means any process or activity carried out by the contractor during the construction works.
EXECUTIVE SUMMARY

General

A.D. Envirotech Australia Pty Ltd (ADE) was commissioned by Ferrovial York Joint Venture (FYJV) to prepare a Remediation Action Plan (RAP) for the Site at 461 Warringah Road, Frenchs Forest NSW (hereafter referred to as ‘the Site’). The primary objective of the RAP is to serve as a guidance document for future remediation works and to provide Remediation Assessment Criteria (RAC) as part of the remediation phase. The RAP has been developed based on previous Site assessments/investigations and should be read in conjunction with the following reports:

- Parsons Brinckerhoff, UPSS Validation, 7-Eleven Service Station 461 Warringah Road, Frenchs Forest, NSW (Store ID: 2220), Document No: 2201503A-CLM-RPT-1557 RevB, dated 1st of August 2014;
- SMEC, Phase 1 Contamination Assessment: Northern Beaches Hospital Connectivity and Network Enhancement Project, Frenchs Forest NSW, Document No: 30011560 FINAL, dated October 2014;
- Ventia, 2220-Frenchs Forest-GME Report, dated October 2015; and

Remediation Action Plan

The remediation action plan has been developed to remediate the following areas (refer to Appendix I – Site Plans and Areas of Concern):

Area of Concern 1 – TRH Hotspots

- The TRH hotspots are to be removed off-site in accordance with the EPA Waste Classification Guidelines Part 1: Classifying Waste (2014); and
- Following the removal of the TRH Hot Spots, validation sampling from the excavation walls and base must be undertaken.

Area of Concern 2 – Underground Storage Tanks

- At least six (6) USTs still remain on Site; and
- This RAP outlines the requirements for the removal of the USTs, including a validation sampling program to validate the surrounding soils

Area of Concern 3 – Groundwater

- A TRH hotspot was observed in fill materials within the central portion of the Site (sample location BH05). ADE considers that removal of UST’s throughout the site and the TRH hotspot will remove the source of the contamination observed in soil within the Site and render the Site suitable for its proposed development. The elevated levels of Naphthalene and Ethylbenzene in groundwater would be expected to attenuate once the source areas have been removed; and
- Following the remediation of the site, further groundwater monitoring may be required.
Unknown Potential Area of Concern

The defined extent of remedial works will not be ascertained until remediation works begin. The following aspects of the remediation works can be considered unknown:

- Location of potentially unknown USTs throughout the Site;
- Extent of soil contamination surrounding USTs; and
- The lateral and vertical extent of the contamination beneath TRH Hotspots.

Conclusions and Recommendations

The Site in its current state is not suitable for the proposed future land use and remediation strategies have been designed to protect human and environmental health. ADE considers that the removal of the USTs and TRH hotspot will remove the source of contamination within the soil and render the site suitable for the proposed development. The elevated levels of Naphthalene and Ethylbenzene in groundwater would be expected to attenuate once the source areas have been removed.

It is considered that conformance with this RAP will reduce the potential for environmental impacts during the remedial and excavation works at the subject Site. By following the RAP and demonstrating compliance with the requirement of the “Planning Guidelines SEPP 55 – Remediation of Land”, a validation report will be prepared by a qualified environmental consultant in accordance with the NSW EPA Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites (1997) and other appropriate documentation.

The validation investigation shall confirm whether the Site has been remediated to a suitable standard for the proposed development and that no adverse human health and environmental effects have occurred as a result of the works.

Subject to proper implementation of the RAP it is considered that the Site can be rendered suitable for the proposed public open space and commercial / industrial land-use.
1 INTRODUCTION

1.2 General Information

A.D. Envirotech Australia Pty Ltd (ADE) was commissioned by Ferrovial York Joint Venture (FYJV) to prepare a Remediation Action Plan (RAP) for the Site at 461 Warringah Road, Frenchs Forest NSW (hereafter referred to as ‘the Site’). The primary objective of the RAP is to serve as a guidance document for future remediation works and to provide Remediation Assessment Criteria (RAC) as part of the remediation phase. The RAP has been developed based on previous Site assessments/investigations and should be read in conjunction with the following reports:

- Parsons Brinckerhoff, UPSS Validation, 7-Eleven Service Station 461 Warringah Road, Frenchs Forest, NSW (Store ID: 2220), Document No: 2201503A-CLM-RPT-1557 RevB, dated 1st of August 2014;
- SMEC, Phase 1 Contamination Assessment: Northern Beaches Hospital Connectivity and Network Enhancement Project, Frenchs Forest NSW, Document No: 30011560 FINAL, dated October 2014;
- Ventia, 2220-Frenchs Forest-GME Report, dated October 2015; and

1.3 Purpose of Remediation Action Plan

The purpose of the RAP is to provide a strategy to mitigate the potential for unacceptable risks to human health and the environment. The RAP will seek to address the remediation and subsequent management plans required to render the Site suitable for future land use as public open space and commercial/industrial, specifically as a major road infrastructure (refer to Appendix VI – Development Plans).

1.4 Proposed Development

After consultation with the client and reviewing design drawings for the area (refer to Appendix VI – Development Plans), the Site is to be redeveloped as part of enhancement works of the Warringah Road network.

1.5 Remediation Objectives

The proposed remediation strategy aims to reduce / remove contaminated soils within the Site to acceptable levels to prevent exposure during construction works and future use of the Site.

The objectives of the RAP are to:

- Set remediation goals to such an extent that enables the Environmental Consultant to ensure that the remediated Site is suitable for the proposed future land use and will pose no unacceptable risk to human health or the environment with regards to the contaminants of concern;
- Evaluate the range of remediation options available to address the existing contamination on Site, enabling a cost effective and practical soil remediation strategy;
- To describe the methods required for the excavation and removal of the six (6) underground storage tanks (USTs) still existing within the site, two (2) located along the eastern boundary of the Site, one (1) within the central portion of the Site and three (3) located along the western boundary of the Site;
To remove identified areas of concerns i.e. TRH hotspots located within the central portion of the Site, as a consequence remediation of groundwater will also be achieved;

- Document in detail all procedures and plans to be implemented to reduce risks to acceptable levels for the proposed future land use;
- Establish environmental safeguards required to complete the remediation in an environmentally acceptable matter; and
- Comply with the relevant regulatory guidelines.

### 1.6 Scope of Work

The scope of work required to achieve the objectives of the RAP involves the following:

- Summarise Site conditions and surrounding environment;
- Summarise the current contamination status for the Site;
- Determine areas requiring soil / groundwater remediation;
- Determine relevant clean up levels;
- Outline the methodology and procedures for the remediation strategy;
- Briefly discuss Site management and health & safety issues pertaining to the remedial activities; and
- Preparation of Remediation Action Plan incorporating the above.

### 1.7 Roles and Responsibilities

The roles and responsibilities of the various parties involved in the remediation and subsequent validation of the Site are outlined below:

**FYJV Manager**

Responsible for overall direction of civil and environmental works associated with the remediation works.

**Remediation Contractor (TBC)**

Responsible for required civil works (i.e. any physical remediation and excavation works).

**Environmental Consultant**

Responsible for providing technical guidance to the remediation contractor in order to successfully implement the requirements set out in the RAP. Supervision of remediation works, collection and analysis of validation samples and advising FYJV of appropriate actions necessary based on observations, sampling and analysis. Responsible for preparing the RAP and Validation Report.

### 1.8 Legislative Requirements

The RAP was written in accordance with standard ADE methods and in accordance with:

• National Environmental Protection (Assessment of Site Contamination) Measure (NEPM), Amendment 2013.
• Guidelines for the NSW Site Auditor Scheme (2nd Ed.) 2006, NSW DEC.
• UPSS Technical Note: Decommissioning, Abandonment and Removal of UPSS (NSW DECCW 2010).
• UPSS Technical Note: Site Validation Reporting (DECCW, 2010).
• Planning and Development Process for Sites with UPSS (DECCW 2010).
• Australian Standard AS1940-2004: The Storage and Handling of Flammable and Combustible Liquids.
• Australian Standard AS4967-2008: The Removal and Disposal of USTs.

1.9 Whole Report

No one section or part of a section, of this plan should be taken as giving an overall idea of this plan. Each section must be read in conjunction with the whole of this plan, including its appendices and attachments.
2 SUMMARY OF PREVIOUS REPORTS AND AUDITS

The following provides a summary of previous investigations undertaken by external parties within the Site.

2.1 Parsons Brinckerhoff, UPSS Validation, 7-Eleven Service Station 461 Warringah Road, Frenchs Forest, NSW (Store ID: 2220), Document No: 2201503A-CLM-RPT-1557 RevB, dated 1st of August 2014.

The PB (2014) report was prepared to meet the requirements of the NSW Environment Protection Authority ‘Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008’ for the decommissioning of an underground petroleum storage system (UPSS) at 461 Warringah Road, Frenchs Forest NSW. The aim of the investigation was to validate the site’s suitability for continued use as a service station upon removal of the UPSS.

The investigation would involve the sampling of soil from around the UPSS, sampling of groundwater and evaluating of residual contamination in soil/groundwater precludes the Site’s suitability for on-going use as a service station.

The validation report concluded that residual hydrocarbon contamination existed both within the soil and groundwater after the removal of the UPSS. PB concludes that “The residual impacts, however, are not considered to pose unacceptable risks to the commercial users of the site under the site’s current configuration. The validation soil results also showed no unacceptable risks to the shallow trench worker undertaking intrusive works in the vicinity of the site. Therefore, the site is considered suitable for continued use as a service station. If the site’s layout is to be changed in the future, assessment of potential vapour intrusion risks would be necessary to confirm the site’s suitability under the layout of the new development.”

It should be noted that three USTs remain in-situ, a liquefied petroleum gas UST (located central portion) and two USTs (located in the eastern portion).

2.2 SMEC, Phase 1 Contamination Assessment: Northern Beaches Hospital Connectivity and Network Enhancement Project, Frenchs Forest NSW, Document No: 30011560 FINAL, dated October 2014.

The SMEC (2014) report was prepared to on behalf of Roads and Maritime Services (RMS) in seeking approval for the Northern Beaches – Connectivity and Network Enhancements Project. The Phase 1 contamination assessment was developed to identify potential sources of contamination associated with multiple sites, including the current and historical land use. The redevelopment of the Site will occur as part of the Stage 2 Network Enhancement Works, which will include upgrading of the Warringah Road where it intersects with Hilmer Street.

The SMEC (2014) report acknowledges the conclusions derived within the PB (2014) report that residual hydrocarbon contamination remains within the soil and groundwater. The report goes on to identify potential sources, pathways and receptors associated with the impacted soil and groundwater.

- Source – Impacted Soil and Groundwater;
- Pathways – Direct contact/inhalation of soils/groundwater and ingestion; and
- Receptors – Human and Environment.
The Site is highlighted for further detailed investigation work in order to define the spatial extent of residual contamination.

2.3 Ventia, 2220-Frenchs Forest-GME Report, dated October 2015.

The GME report was prepared to provide a summary of all GME to date.

2.4 ADE Report No. FYJV-01-10217 / DSI / v1 final, Phase II – Detailed Site Investigation for 461 Warringah Road, French’s Forest NSW, dated 15th April 2016.

The detailed site investigation can be summarised as follows.

Contamination Status of the Site

Area of Concern 1 - TRH Contamination in Soil

The elevated TRH concentrations were identified above the SAC in BH05, located in the central portion of the Site; Appendix I – Sample Map outlines the TRH area of concern. As formerly discussed, the fill material will be removed off Site as part of bulk excavation works. The removal of AOC-1 will be included in the excavation works and is to be included in the RAP.

Area of Concern 2 – Underground Storage Tanks (USTs), Fuel Transfer Lines (FTLs) and Associated Soils

The desktop study identified six (6) abandoned USTs remaining within the Site. As formerly discussed, the USTs; associated FTLs and surrounding fill material will be removed off Site as part of bulk excavation works. The removal of AOC-2 will be included in the excavation works and is to be included in the RAP.

Area of Concern 3 - Groundwater

The direction of groundwater within the Site is considered to flow in a south easterly direction based on previous investigation. Exceedances of the groundwater SAC (Chromium, Naphthalene and Ethylbenzene) were observed within the most hydraulically up-gradient groundwater well (GWMW-3) at the Site. It should be noted that the aforementioned contaminants of concern were not detected above the SAC at GWMW-1 and GWMW-2 which are located down gradient. ADE believes that the removal of AOC -1 and AOC-2 will as part of the bulk excavation works will achieve the remediation of the groundwater and is to be included in the RAP.

Based on the findings, a Remediation Action Plan (RAP) for the Site should be developed, detailing the actions required to render the Site suitable its future land use as the extended Warringah Road.
3 REVIEW OF SITE CONDITION AND HISTORY

3.1 Site Location

The Site is located at 461 Warringah Road, Frenchs Forest NSW, identified as within Lot 1 in Deposited Plan 805245, as depicted in Figure 1 and Figure 2 below.

Figure 1. Aerial photograph of the site (photograph from http://maps.au.nearmap.com/; accessed on 11.04.2016).

Figure 2. Aerial photograph of the site (photograph from http://maps.au.nearmap.com/; accessed on 11.04.2016).
Bearings provided in this report are approximate only. For ease of representing locations in the report, the Site is considered to be off Warringah Road with a nominal east-west direction assumed. All references to points of the compass within the report are based on these approximate bearings.

### 3.2 Site Identification and Description

#### Table 1. Summary of Site Identification Details

<table>
<thead>
<tr>
<th>Site Details</th>
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<tbody>
<tr>
<td>Site address</td>
<td>461 Warringah Road, Frenchs Forest NSW</td>
</tr>
<tr>
<td>Title identification</td>
<td>Lot 1, Deposit Plan 805245</td>
</tr>
<tr>
<td>Current zoning</td>
<td>B1 Neighbourhood Centre</td>
</tr>
<tr>
<td>Current property</td>
<td>Ferrovial York Joint Venture (FYJV)</td>
</tr>
<tr>
<td>lessee / owner</td>
<td></td>
</tr>
<tr>
<td>Current Site use</td>
<td>Vacant Site (previously vacated 7-Eleven service station and fishing shop)</td>
</tr>
<tr>
<td>Proposed Site use</td>
<td>Enhancement of the Warringah Road</td>
</tr>
<tr>
<td>Investigation area</td>
<td>Approximately 1,885 m²</td>
</tr>
</tbody>
</table>

### 3.3 Current Land Use

At the time of writing this report, the Site was currently vacant lot having been previously used as a 7-Eleven Service Station and fishing shop (commercial property).

### 3.4 Surrounding Land Use

At the time of investigative works (refer to Figure 1 & Figure 2), the primary surrounding land-uses were observed as follows:

- The northern boundary of the Site lies adjacent to the Warringah Road, a high density main road. To the north of Warringah road is the CPB Contractors construction site (Northern Beaches Hospital);
- The eastern boundary of the Site lies adjacent to an unnamed secondary road which separates the Site from vacant commercial properties; and
- The southern and western boundaries of the Site lie adjacent to Hilmer Street and an unnamed secondary road respectively. Both roads separate the Site from low density residential properties.

### 3.5 Key Features Observed on Site

Upon reviewing the previous reports for the Site, a number of Areas of Environmental Concern (AEC) were identified to exist on the Site. They have been listed below as well as marked on Figure 3 below:

1. Current UST farm;
2. Refuelling bowsers;
3. Previously removed UST;
4. Abandoned UST;
5. Previously removed UST; and
6. Abandoned USTs.

The following information was used as part of the sampling strategy devised for the Site.
3.6 Groundcover and Vegetation

As per PB (2014):

“The majority of the site is concrete paved. Nature strips are located along the northern, western and southern boundaries. A building which consists of a retail shop is located towards the south-western corner. The fuel canopy extends north from the retail building. The eastern portion, which had a car wash facility, was redeveloped recently. The new building in the eastern portion comprised a commercial business selling fishing equipment.”

3.7 Site Topography, Hydrology and Drainage

As per PB (2014):

“The site is situated at approximately 150 metres Australian Height Datum (m AHD). The regional topography is generally flat with some gentle slopes towards reserves located to the north-east, east and south-east of the site (ranging from 100 m to approximately 450 m from the site). Surface water was anticipated to follow the site slope and drain to the north-east towards Warringah Road.”

3.8 Sensitive Receptors

As per SMEC (2014):

“Surface runoff from the area will discharge into the stormwater systems located within the area. Stormwater systems to the north of Warringah Road will discharge into Trefoil Creek and its tributary which
are located immediately north-west of the Warringah Road / Wakehurst Parkway intersection and Rabbett Reserve respectively. Trefoil Creek flows to the north-east and is a tributary of Middle Creek which eventually connect to Narabeen Lakes. Stormwater systems to the south of Warringah Road will discharge into Curl Curl Creek immediately south of Aquatic Drive. Curl Curl Creek flows to the south and is a tributary of Manly Lagoon and Middle Harbour.”

3.9 Regional Geology
As per SMEC (2014):

“Reference to the Sydney 1:100 000 Series Geological Sheet indicates that the site is underlain by thick shale and laminate beds within Hawkesbury Sandstone. These rock features generally weather to form residual clays and can include ironstone bands.”

3.10 Regional Lithology
As per SMEC (2014):

“A description of the various soil landscape profiles that are mapped within the Concept Proposal Footprint are provided below:

Hawkesbury

- **Soils** - shallow soils associated with rock outcrop. Earthy sands, yellow earths and some podzolic soils on inside of benches and along joint and fractures. Localised yellow and red podzolic soils associated with shale lenses and siliceous sands and secondary yellow earths along drainage lines.
- **Limitations** - extreme soil erosion hazard, mass movement (rock fall) hazard, steep slope, rock outcrop, shallow, stony, highly permeable, low soil fertility.

Lucas Heights

- **Soils** - moderately deep, hardsetting yellow podzolic and yellow soloth soils, yellow earths on outer edges of crests.
- **Limitations** - stony soil, low soil fertility, low available water capacity.

Disturbed

- **Soils** - turfed fill areas commonly capped with up to 40cm of sandy loam or up to 60cm of compacted clay over fill or waste materials
- **Limitations** - dependent on the nature of fill material. Mass movement hazard, unconsolidated low wet-strength materials, impermeable soil, poor drainage, localised very low fertility and potential toxic materials.

Lambert

- **Soils** - shallow, discontinuous earthy sands and yellow earths on crest and inside benches. Shallow siliceous sands on leading edges; shallow to moderately deep leached sands, grey earths and gleyed podzolic soils in poorly drained areas; localised yellow podzolic soils associated with shale lenses.
• *Limitations* – very high soil erosion hazard, rock outcrop, seasonally perched water table, shallow, highly permeable soil, very low soil fertility.”

3.11 Regional and Local Hydrogeology

As per SMEC (2014):

“SMEC completed a search of the Department of Water and Energy Online Database on the 25th March 2014 to identify groundwater bores within the vicinity of the site. The search indicated that there are twelve (12) boreholes registered under the database within the Concept Proposal Footprint. The search identified the following:

- Two bores (GW020067 and GW020065) located within the industrial estate east of Skyline Place.
- Three bores (GW104973, GW104974 and GW104975) located within the industrial estate west of Allambie Road on the southern side of Warringah Road.
- One bore (GW106757) located at the Everyday Carwash Café – Forest Way Shopping Centre.
- Six Bores (GW073573, GW073572, GW072997, GW073569, GW073570, and GW073571) located around the 7Eleven Service Station – 461 Warringah Road.

Other than the standing water level in GW106757 (2m below ground level) no other information was provided within the logs that could be used to determine regional or local hydrogeological conditions. However, groundwater studies by SMEC at the proposed hospital site (SMEC, 2 September 2013) identified two water tables on site from 1.6 to 2 meters and that the flow direction of both aquifers was to the south-east.”

3.12 Acid Sulphate Soils

As per SMEC (2014):

“Acid sulfate soils are acidic soil horizons (layers) resulting from the aeration of soil materials rich in iron sulfides. Acid sulphate soils generally occur within the following locations:

- Marine or estuarine sediments deposited during the Holocene period.
- Soils >5m above sea level.
- Marine or estuarine settings/environments.

The Warringah Council Local Environment Plan 2011 - Acid Sulfate Soil Map–Sheet ASS_008 and Landslip Risk Map – Sheet LSR008 indicates that the Concept Proposal Footprint is not within an acid sulfate soil prone area.”
4 POLICY AND APPROVALS

4.1 State Environmental Planning Policy 55

The object of the State Environmental Planning Policy No. 55 – Remediation of Land is to provide a statewide planning approach to the remediation of contaminated land in order to mitigate the risk to human health and to the environment.

Remediation work can be designated into two categories:

4.2 Category 1 Remediation Work

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

a) Designated development; or
b) Being carried out or to be carried out on land declared to be critical habitat: or
c) Likely to have significant effect on a critical habitat or a threatened species, population or ecological community; or
d) Development for which another State environmental policy or regional environmental plan requires development consent; or
e) Carried out or to be carried out in an area or zone to which any classifications to the following effect apply under an environmental planning instrument:
   o coastal protection;
   o conservation or heritage conservation;
   o habitat area, habitat protection area, habitat or wildlife corridor;
   o environment protection;
   o escarpment, escarpment protection or escarpment preservation;
   o floodway;
   o littoral rainforest;
   o nature reserve;
   o scenic area or scenic protection; and
   o wetland
   o is “carried out or to be carried out on any land in a manner that does not comply with a policy made under the contaminated land planning guidelines by the council for any local government area in which the land is situated”

4.3 Category 2 Remediation Work

Clause 14 of the SEPP 55 defines Category 2 remediation works as:

a) a remediation work that is not a work of a kind described in clause 9 (a)-(f), or
b) a remediation work (whether or not it is a work of a kind described in clause 9 (a)-(f)) that:
   i. by the terms of the remediation order, is required to be commenced before the expiry of the usual period under the Contaminated Land Management Act 1997 for lodgement of an appeal against the order, or
   ii. may be carried out without consent under another State environmental planning policy or a regional environmental plan (as referred to in clause 19 (4) and (5)), or
   iii. is carried out or to be carried out by or on behalf of the Director-General of the Department of Agriculture on land contaminated by the use of a cattle dip under the program
implemented in accordance with the recommendations or advice of the Board of Tick Control under Part 2 of the Stock Diseases Act 1923, or

iv. is carried out or to be carried out under the Public Land Remediation Program administered by the Broken Hill Environmental Lead Centre

Remediation works to be carried out at 461 Warringah Road, Frenchs Forest NSW are to be considered as Category 2 Remediation Works. As stipulated within Clause 16 of the SEPP 55, at least 30 days notice must be given before the commencement of the remediation works.

4.4 Warringah DCP (2011)

There is no reference permitting to remediation works within the Warringah DCP (2011).
5 SITE CONTAMINATION CHARACTERISATION

Based on previous site assessment reports (PB 2014; SMEC 2014; Ventia 2014 and ADE 2016), several areas of concern have been identified that will require remediation in order to render the site suitable for the proposed future land as the enhanced Warringah Road. Soil analytical results indicate that contamination exists predominantly within certain sections of the fill material (Appendix I – Site Plans and Areas of Concern), specifically TRHs. Groundwater analytical results indicate that areas of groundwater have been impacted with PAHs, BTEX and Heavy Metals. The areas of concern are discussed below:

5.1 Area of Concern 1 – TRH Hotspot

As detailed in ADE DSI (2016):

“Sample 10217-BH05B collected by ADE on the 23rd of March 2016 was found to contain TPH C_{10}-C_{16} at 13,000 mg/kg & C_{16}-C_{34} at 15,000 mg/kg, 12,000 mg/kg and 10,000 mg/kg greater than the Management Limits – Commercial/Industrial of 1000 mg/kg and 5,000 mg/kg respectively. The concentrations were greater than two and half times the SAC, as such the 95% UCL could not be calculated.

In summary, the sample 10217-BH05B has concentration of hydrocarbons exceeding the Management Limits for Commercial/Industrial. However, the potential risk identified is not considered to be high as the sample location will be excavated as part of future civil works at the Site. The excavation plan for the Site will involve approximately 0.75 m – 9.0 m BGL of soil being removed off Site and should be addressed in a Site specific remediation action plan (RAP).”

The TRH hotspot as mentioned above is noted to be within the fill material within the central portion of the Site, where the existing refuelling points where located (refer to Appendix I – Site Plans and Areas of Concern). The fill material will therefore be considered as an area of concern (AOC-1) and will be required to be removed off Site in accordance with the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).

Following execution of the remediation of the TRH hotspot, a validation report will be prepared in accordance with the Guidelines for Consultants reporting on Contaminated Sites (NSW OEH 2011).

5.2 Area of Concern 2 – Underground Storage Tanks (USTs), Fuel Transfer Lines (FTLs) and Associated Soils

As outlined in ADE DSI (2016), six (6) abandoned USTs are identified as still existing within the Site, two (2) located along the eastern boundary of the Site; one (1) within the central portion of the Site and three (3) located along the western boundary of the Site. The proposed development of the Site requires the removal of the USTs, and as such all locations observed to contain USTs are listed as an area of concern (AOC-2).

Following execution of the remediation of the USTs, a validation report will be prepared in accordance with the UPSS Technical Note: Site Validation Reporting (DECCW 2010) and the Guidelines for Consultants reporting on Contaminated Sites (NSW OEH 2011).
5.3 Area of Concern 3 – Groundwater

A hotspot of TRH has been observed in fill materials within the central portion of the Site and six (6) abandoned USTs including associated fuel transfer lines and soil (refer to Appendix I – Site Plans and Areas of Concern). Concentrations of BTEX, Naphthalene and Chromium have been observed historically and in current groundwater monitoring events above the site assessment criteria (SAC) for groundwater (ADE DSI 2016). It should be noted that concentrations of samples collected from GWMW-1 and GWMW-2 (down gradient) demonstrated concentrations below the SAC. The exceedance of Ethylbenzene, Naphthalene and Chromium is localised to the Site within the western boundary and central portion of the Site and demonstrates no significant evidence of migrating off-site. The monitoring wells (GWMW-1 and GWMW-2) along the eastern boundary (down gradient) will be utilised to validate potential offsite migration of contaminants of concern and assess the trends in groundwater within the Site following removal/remediation of Areas of Concern 1 and 2.

ADE believes the targeted remediation/removal of known USTs and TRH hotspot will reduce the contamination levels within groundwater to an acceptable level. Validation program will involve the sampling of two of the current installed wells following remediation works as per validation program (Section 11).
6 REMEDIATION ACTION PLAN

6.1 Conceptual Site Contamination Model

Figure 4. below shows the potential contamination sources, their pathways and receptors.
<table>
<thead>
<tr>
<th>Primary Sources</th>
<th>Secondary Sources</th>
<th>Transport Mechanisms</th>
<th>Exposure Pathways</th>
<th>Exposed Population Characterisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported fill material</td>
<td>Impacted surface soils (&lt;0.6 m BGL)</td>
<td>Leaching and groundwater transport</td>
<td>Soil, Dust and Vapour - Ingestion/absorption, dermal contact</td>
<td>• Construction workers and Site visitors during excavation works</td>
</tr>
<tr>
<td>Impacted Soils – Residual Hydrocarbon contamination</td>
<td>Impacted subsurface soils (&gt;0.6 m BGL)</td>
<td>Volatilisation and atmospheric dispersion</td>
<td>Groundwater - Ingestion/absorption, dermal contact</td>
<td>• Manly Lagoon</td>
</tr>
<tr>
<td>Impacted Groundwater – Residual Hydrocarbon contamination</td>
<td>Dissolved groundwater plume</td>
<td>Stormwater/surface water transport</td>
<td></td>
<td>• Adjacent property owners, residents and workers</td>
</tr>
<tr>
<td>Imported fill material</td>
<td>Impacting surface soils (&lt;0.6 m BGL)</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 4.** Conceptual Site Model – 461 Warringah Road, Frenchs Forest NSW
6.2 Remediation Goals

The goals of the remediation process for the Site 2 are to:

- Render the soils at the Site suitable for the intended land use in accordance with National Environmental Protection Measure (Assessment of Site Contamination) 1999, 2013 Amendment (NEPM 2013 Amendment) through excavation and offsite disposal. The following have been adopted as the Tier 1 screening criteria:
  - ‘Health-Based Investigation Levels’ (HIL-D) Commercial/Industrial Land Use;
  - ‘Health Screening Levels’ (HSL-D) Commercial/Industrial (0 – 4m+);
  - ‘Health Screening Levels’ (HSL-D) Intrusive Maintenance Worker (Shallow Trench);
  - ‘Health Screening Levels’ (HSL-D) Direct Contact Commercial/Industrial;
  - Management Limits assigned for Commercial/Industrial;
  - ‘Health-Based Investigation Levels’ (HIL-C) Public open space Land Use;
  - ‘Health Screening Levels’ (HSL-C) Public open space (0 – 4m+);
  - ‘Health Screening Levels’ (HSL-C) Intrusive Maintenance Worker (Shallow Trench);
  - ‘Health Screening Levels’ (HSL-C) Direct Contact Public open space; and
  - Management Limits assigned for Public open space and Commercial/Industrial.

- Removal of the contaminated TRH hotspot (confirmed to contain elevated fractions of C₆-C₁₆);

- Removal of the six (6) USTs, associated FTLs and surrounding tank sands/gravels;

- Render the groundwater at the Site suitable for the intended land use in accordance with the National Environmental Protection Measure (Assessment of Site Contamination) 1999, 2013 Amendment (NEPM 2013 Amendment) through excavation and offsite disposal of impacted soil materials and USTS. The following have been adopted as the Tier 1 screening criteria:
  - Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000);
  - Groundwater Investigation Levels (GILs) for marine water and fresh water; and
  - Groundwater HSLs for Vapour Intrusion;

- Eliminate any unacceptable risk to human health and environment associated with contaminated material;

- Monitor natural attenuation of groundwater; and

- Protect Site workers, visitors, the environment and the community throughout the remediation works.

6.3 Extent of Remediation Required

6.3.1 Known Extent

Former environmental investigations undertaken by ADE DSI (2016) have indicated the presence of Contaminants of Concern within the soils and groundwater at the Site. The COCs identified were TRHs (C₁₀-C₃₄) within the fill material located at sample location BH05 at 0.5 m BGL.

ADE considers that removal of the TRH hotspot and the UST’s throughout the Site will remove the source of the contamination observed in soil within the Site and render the Site suitable for its proposed future land use. The elevated levels of Naphthalene and Ethylbenzene in groundwater would be expected to attenuate with time once the source areas have been removed.

6.3.2 Unknown Extent

The defined extent of remedial works will not be ascertained until remediation works begin. The following aspects of the remediation works can be considered unknown:
- Location of potentially unknown USTs throughout the Site;
- Extent of soil contamination (if any) surrounding USTs; and
- Lateral and vertical extent of soil contamination surrounding the TRH hotspot.

6.4 Consideration of Possible Remediation Options

In assessing and determining the optimal remedial options available to the Site, the following factors have been considered:

- The source, types and level of contamination present;
- The vertical and lateral extent of soil contamination;
- The leachate potential of contaminants;
- Permeability and heterogeneity of the soil hydrology;
- The future land use proposed for the remediation area;
- Proven remediation methods and technologies that are available;
- Time, budgetary, engineering, environmental constraints; and
- Regulatory requirements.

6.5 Assessment of Remediation Option for Soil

The preferred order of options for Site remediation and management as stated in the NSW DECCW (2006) ‘Guidelines for the NSW Site Auditor Scheme’ is:

1. On-Site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level.
2. Off-Site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to Site.

If the above options cannot be implemented, then other options that should be considered include:

3. Removal of contaminated soil to an approved Site or facility, followed, where necessary, by replacement with clean fill.
4. Consolidation and isolation of the soil on-Site by containing with a properly designed barrier.

It should be noted that if the remediation is likely to cause a greater adverse effect than would occur were the Site left undisturbed, then remediation should not proceed.

6.5.1 Review of Soil Remediation Options

After considering the type of contamination, proposed land use, construction design, development constraints and costs, the following conclusions have been made when reviewing the remediation options:

Remediation Option 1 - On-Site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level

- The TRH impacted materials, including USTs within the fill material is required to be excavated and removed off Site as per the construction design.

Remediation Option 2 - Off-Site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the Site
- The TRH impacted materials, including USTs within the fill material is required to be excavated and removed off Site as per the construction design.

**Remediation Option 3** - Removal of contaminated soil to an approved Site or facility, followed where necessary by replacement with clean fill

- As the TRH hotspot within the fill material is required to be removed off Site to allow for the construction works, this would be the most appropriate option

**Remediation Option 4** - Consolidation and isolation of the soil on-Site by containment within a properly designed barrier

- The TRH impacted materials, including USTs within the fill material is required to be excavated and removed off Site as per the construction design.

### 6.6 Assessment of Remedial Options for Groundwater

#### Regulatory Requirements

The preferred order of options for site remediation and management as stated in the NSW DECCW (2007) *Assessment and Management of Groundwater Contamination*:

1. Clean up so natural background water quality is restored;
2. Clean up to protect the relevant environmental values of groundwater, and human and ecological health; and
3. Clean up to the extent practicable.

### 6.7 Preferred Remediation Options

With consideration to DECC’s preferred hierarchies for soil remediation options and groundwater cleanup objectives the preferred remediation options are outlined below;

- *Removal of contaminated soil to an approved site or facility* be employed as the Remediation Strategy for contaminated soil; and
- *Clean up to protect the relevant environmental values of groundwater, and human and ecological health.*

### 6.8 Recommended remediation option

Based on soil and groundwater data collected in the ADE DSI (2016) and previous investigations by PB 2014; SMEC 2014 and Ventia 2014, ADE can conclude the following:

- Results from former investigative works have indicated that concentrations of TRHs, PAHs, BTEX and Heavy metals in soil are generally below the SAC with the exception of a TRH hotspot located at the sample location BH05 (refer to Appendix I – Site Plans and Areas of Concern);
- Results from former investigative works (both current and historical) have indicated that the concentrations of BTEX and the heavy metal Chromium are consistently elevated and above the adopted SAC for groundwater; and
ADE considers that removal of the TRH hotspot and the UST’s throughout the Site will remove the source of the contamination observed in soil within the Site and render the Site suitable for its proposed future land use. The elevated levels of Naphthalene and Ethylbenzene in groundwater would be expected to naturally attenuate with time once the source areas have been removed.

Given the information outlined in the previous sub-sections for soil and groundwater remediation options. It is considered that the preferred remediation strategy for the purpose of rendering the Site suitable for the proposed future land use is off-site disposal of contaminated soil and removal of USTs at an approved landfill facility.
7 REMEDIATION WORKS PLAN

In general, the remediation will include the removal and validation of impacted fill material (TRH hotspot) and the removal and validation of the six (6) abandoned USTs remaining on Site including identification and safe removal of associated fuel transfer lines and/or pipes.

7.1 Remediation Process

The proposed development (enhancement of the Warringah Road) at the Site requires the cut and excavation of material to an approximate depth ranging between 0.75 m – 9.0 m BGL (refer to Appendix I – Site Plans and Areas of Concern for exact depths and further detail). As a result of the bulk excavation works, the remediation and subsequent validation of the TRH hotspot and removal of USTs will occur within the Site.

All remediation works undertaken within the Site shall be conducted under the supervision of an Environmental Consultant to ensure that the USTs and the TRH impacted fill material layer are removed and objectives of the RAP are fulfilled.

The presence of the Environmental Consultant will minimise any cross contamination during the removal of the TRH hotspot including unnecessary removal of uncontaminated or underlying natural material. The presence of the Environmental Consultant will also ensure that any unexpected finds as outlined in Section 8 are adequately handled and addressed. Once remediation works are completed, visual inspections and sampling can take place in order to validate the remediation in accordance with Section 11.

The following sequence should be applied (changes may occur during remediation works):

- Appointment of an appropriately qualified and experienced Remediation Contractor;
- Site mobilisation and installation of all required environmental and WH&S controls, in accordance with an approved safe work method statement (SWMS) / works program;
- The identification and marking of the initial areas of concern will be determined from co-ordinates via the estimated remediation zones outlined in Site plans (refer to Appendix I – Site Plans and Areas of Concern);
- Excavation of the fill materials to the extents determined in this RAP (refer to section 11) and as directed by the Environmental Consultant;
- During remediation of contaminated areas PPE regulations should be adhered to (as outlined in Sections 13). However, if during excavation of TRH hotspots PID readings are greater than 30 ppm, A1 Filter Masks should be used for all persons working in the immediate vicinity of the excavation;
- Direct loading of excavated soils onto removal trucks is the preferred option, however if material cannot be directly removed offsite, stockpiling of the excavated soils within the boundaries of the source remediation area, or on a designated hardstand or area covered with plastic to minimise the potential for contaminating soils beneath will suffice;
- Disposal of the contaminated soils to an appropriately licensed land fill facility, under the waste classification assigned by the Environmental Consultant;
- Validation of the resultant excavations through the process of on-site visual observations and screening, soil sampling and testing as per Section 11;
- Expanding of the excavations under the direction of the Environmental Consultant, should the validation testing show that the Remediation Acceptance Criteria (RAC) have not been achieved, followed by additional waste classification of the excavated spoil and validation sampling of the expanded excavation; and

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New South Wales Office: A. D. Envirotech Australia Pty Ltd
Unit 6/7 Millennium Court
Silverwater, NSW 2128

Queensland Office: A. D. Envirotech Australia Pty Ltd
P.O. Box 288
Upper Coomera, QLD 4209

Telephone: NSW: (02) 9648 6669
QLD: (07) 5519 4610

Internet: Site: www.ADenvirotech.com.au
E-mail: info@ADenvirotech.com.au

ABN: 520 934 529 50
• Continue the process until the RAC has been achieved as per Section 9.

Prior to commencement of the remediation works, the appointed contractor will be required to have in place a safe work method statement (SWMS) and works program approved by the FYJV Project Manager, the Environmental Consultant and any relevant regulatory authority.

The following contingencies relating to the soil remediation will be enacted if and when required:

• Should remediation excavations continue to the Site boundary, the excavation will cease at that point and will be validated to the “extent practicable”. Notification to the adjoining property owner (i.e. Council for public road reserves) may be an action deemed appropriate by the Environmental Consultant;
• If unusual odours are generated by the remediation works, the Environmental Consultant will make an assessment and provide management recommendations; and
• If during excavations there are visual or olfactory indicators of potential contamination not anticipated based on previous investigations, the “unexpected finds” protocol outlined in Section 11 will be enacted.

The following remediation works are recommended to be undertaken within the Site:

1) Removal of the six (6) abandoned USTs, FTLs and associated soil materials (Areas of Concern 2) including potentially impacted underlying natural materials (where present) and validation inspection and sampling by Environmental Consultant; and
2) Removal of TRH hotspots (Area of Concern 1) including impacted underlying natural materials (where present) and validation inspection and sampling by Environmental Consultant.

The following outlines the requirements and recommendations for the remediation of the above areas of concern within the Site.

7.2 Area of Concern 1 – TRH Hotspots

As previously discussed, a TRH hotspot identified in fill material (potentially underlying natural materials) within the central portion of the Site (refer to Appendix I – Site Plans and Areas of Concern) is required to be removed off site as part of the main civil works to be undertaken at the Site. The remediation of the TRH hotspot should be conducted as follows (it should be noted that there are areas of underlying natural materials that may also be have been impacted with TRHs, as such this should be addressed by the Environmental Consultant during the remediation works):

• Appointment of an appropriately qualified and experienced Remediation Contractor;
• Site mobilisation and installation of all required environmental and OH&S controls, in accordance with an approved safe work method statement (SWMS) / works program;
• The identification and marking of Area of Concern 1;
• Excavation of the identified contaminated fill material to approximately 1.0 m BGL (potentially including underlying natural materials as identified above) and as directed by the Environmental Consultant. Please note that the lateral and vertical extent of the TRH hotspot is unknown, as such depth of material requiring excavation may need extending;
• Stockpiling of the excavated soils from BH05 should occur within the boundaries of the source remediation area either on a designated hardstand or area covered with plastic (2mm) to minimise the potential for contaminating soils beneath;
• Waste classification assessment of all stockpiled material should be undertaken by the Environmental Consultant;
- Disposal of the contaminated soils (once classified) to an appropriately licensed landfill facility, under the waste classification assigned by the Environmental Consultant – Tipping receipts to be presented to the Environmental Consultant for the validation report;
- Validation of the resultant excavations through the process of on-site observations, PID screening and soil sampling/testing, as discussed in Section 11;
- Expanding of the excavations under the direction of the Environmental Consultant, should the validation testing show that the adopted Remediation Assessment Criteria (RAC) have not been achieved, followed by additional waste classification of the excavated spoil and validation sampling of the expanded excavation; and
- Continue the process until the RAC have been achieved.

7.3 Areas of Concern 2 - Underground Storage Tanks (USTs)

During the course of previous desktop studies and investigations, six (6) USTs were identified on the Site – two (2) located along the eastern boundary of the Site; one (1) within the central portion of the Site and three (3) located along the western boundary of the Site. The identified USTs, FTLs and any additional unexpected USTs that may be encountered including all associated FTLs should be managed, removed and validated as below:

- Appointment of an appropriately qualified and experienced Remediation Contractor;
- Site mobilisation and installation of all required environmental and OH&S controls, in accordance with an approved safe work method statement (SWMS) / works program;
- The identification and marking of the initial estimated UST remediation areas will be determined by the Environmental Consultant;
- Expose the total widths and lengths of all USTs within the subject areas;
- Identify if residual liquids or sand are contained within the USTs, if so appropriate removal, stockpiling of tank sands/gravel and disposal procedures should be followed;
- Stockpiling of excavated soils within the Site should occur on a hard standing area or on 0.2 mm plastic;
- Removal and appropriate onsite demolishing of the UST and if necessary any associated infrastructure (possible vent pipe work or fuel transfer lines);
- Dewatering of excavation may be required;
- PID screening of the walls and base of the excavation for residual contamination should occur; any traces of hydrocarbon contamination should be excavated to the existing stockpile. Process should be repeated until <30 ppm is reached;
- Waste classification assessment of all stockpiled material should be undertaken by the Environmental Consultant;
- Disposal of the contaminated soils (once classified) to an appropriately licensed landfill facility, under the waste classification assigned by the Environmental Consultant – Tipping receipts to be presented to the Environmental Consultant for the validation report. This will include proof of UST disposal;
- Validation of the resultant excavations through the process of on-site observations, PID screening and soil sampling/testing, as discussed in Section 11;
- Expanding of the excavations under the direction of the Environmental Consultant, should the validation testing show that the adopted Remediation Assessment Criteria (RAC) have not been achieved, followed by additional waste classification of the excavated spoil and validation sampling of the expanded excavation; and
- Continue the processes until the RAC have been achieved.
7.3.1 Tank Pump Out

If residual liquids are discovered with any of the USTs, this will be removed by a licensed liquid waste contractor. The procedure outlined below should be adopted (in general accordance with AS4976-2008):

- The principal, or supervisor, shall ensure that documented work instructions and all the relevant work permits including hot work permits are issued to the contractor prior to decommissioning works proceeding;
- Remove all possible product from the tank and pipe work using the normal pumping system;
- Disconnect and isolate dispensers and other above-ground pumping equipment;
- Withdraw the residual product via the dip or other suitable fitting, using an air operated pump or other equipment suitable for a hazardous area and suction hose, or spear, reaching the bottom of the tank. Transfer residual product to sealed drums or licensed tankers for safe off-Site disposal;
- Prior to excavating, locate and isolate all electrical cables and product pipelines, in the vicinity; and
- Seal off all ground level connections to the tank, but leave the vent intact, and excavate to expose all the tank top fittings.

7.3.2 Removal of UST and associated Infrastructure

The USTs identified within the Site are to be decommissioned and demolished of on-site (refer to Appendix I - Site Plans and Areas of Concern) and or removed intact. The decommissioning and disposing of the USTs and associated infrastructure should be undertaken by an experienced remediation contractor that specialises in UPSS removals. As such, the following steps are considered a general outline and may be overruled by the specialist remediation contractor on-site during the works:

- Documented work instructions and all relevant work permits shall be prepared and issued prior to decommissioning works proceeding;
- All possible products shall be removed from the tanks using the normal pumping system;
- If sands are found within the USTs, they will be appropriately removed, stockpiled in separate designated areas, sampled and classified in accordance with EPA waste classification guidelines;
- Dispensers and other above ground pumping equipment shall be disconnected and isolated;
- Any residual product shall be withdrawn via the dip or other suitable fitting, using an air operated pump or other equipment suitable for a hazardous area and a suction hose, or spear, reaching to the tank bottom. All transfer equipment shall be electrically bonded to the tanks. Transfer residual product to sealed drums or appropriate tanker for safe disposal;
- All ground level connections to the tanks shall be sealed off, leaving the vent intact. All tank top fittings shall be exposed by excavation. Prior to excavating, locate and isolate electrical cables, product pipelines and gas lines, including LP Gas lines, in the vicinity;
- Tanks should then be inspected by the experienced remediation contractor. Based on the risk assessment and subsequent conclusion of the remediation contractor, the tanks may be demolished of on-site under careful observation;
- Careful consideration should be given when dismantling the tanks. During this phase, it is prudent that all liquids and materials have been removed so as not to allow any potential contaminants to spill on the remaining soil materials; and
- A permanent record shall be kept of the tanks removal for disposal off-Site. Details of the Site of origin, date of removal, size of the tank, destination or name of the contractor to whom the tank has been transferred should be noted.
7.4 Waste Classification of Stockpile Material

Material excavated (including potential sands from within the USTs) will be stockpiled separately on 0.2 mm plastic or hard standing for waste classification prior to offsite disposal. For waste classification purposes, soil / filling materials have been assessed against:


Waste classification would take into account all previous “in situ” testing results. However, for materials that are to be disposed off site, an ex situ waste classification assessments would be conducted to confirm the appropriate waste classification and to allow for segregation of materials, if and when appropriate (refer to section 9).

7.5 Aesthetics

NEPM (2013) *Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater* specifies that there are no numeric Aesthetic Guidelines but the fundamental principle is that the soils should not be discoloured, malodorous (including when dug over or wet) nor of abnormal consistency. The natural state of the soil should also be considered.

*Guidelines for the NSW Site Auditor Scheme (2006)* specifies that aesthetic issues include the generation of odours from the Site and any discolouration of the soil as a result of contamination.

Excavated material should be initially assessed using visual, PID and olfactory indications of contamination to provisionally assess contamination of material.
8 Unexpected Finds

This unexpected finds protocol has been developed to provide guidance on processes to follow if an unexpected find is encountered during the remediation or future civil and construction works. The following sub-sections outline the procedures to be implemented for various unexpected finds scenarios.

8.1 Underground Storage Tanks (USTs)

As discussed previously, there are six (6) known USTs currently existing on the Site. In the event that more USTs are encountered including all associated fuel line and pipes, the processes outlined in Section 7.6 should be followed and repeated.

8.2 Soil and Groundwater Contamination

Although the Site has been investigated in compliance with relevant NSW EPA endorsed guidelines, there remains a potential for soil and groundwater contamination to be present between sampled locations. In the event that further areas of environmental concern (AEC) or potential contamination are found during remediation, civil or construction works, the following protocols will ensue:

- Upon discovery of further AEC, the FYJV Project Manager is to be notified and the area barricaded;
- Visual identification of the nature of the issue and the likely extent of the AEC by the Environmental Consultant;
- The Environmental Consultant is to conduct appropriate investigations with a view to identifying the nature and extent of the contamination;
- If contamination is found and remediation action or management is considered necessary, an addendum or supplement to the RAP will be prepared by the Environmental Consultant; and
- The additional remediation will be implemented by the Remediation Contractor and validated by the Environmental Consultant.

8.3 Underground Structures

In the event that other underground features are discovered which may have implications on the Site remediation and validation i.e. pits, the find should be managed / removed as follows:

- Identify the nature of the find and inform the Environmental Consultant;
- Identify the presence of and nature of any contents. This may involve sampling and testing by the Environmental Consultant; and
- Remove and dispose of the structure in accordance with Section 7.
9 Remediation Acceptance Criteria

The proposed future land use at the Site is the enhancement of the Warringah Road, the use of appropriate health investigation levels (refer to Section 9.1 below) for each relevant area can be observed in Appendix I – Site Plans and Areas of Concern. The Remediation Acceptance Criteria (RAC) has been selected in accordance with ‘Assessment of Site Contamination, National Environment Protection (Assessment of Site Contamination) Measure 1999, 2013 Amendment’. The following investigation and screening levels have been selected in order to successfully remediate and validate the Site.

9.1 Health Investigation Levels (HILs)

The NEPM (2013) guidelines stipulate four generic land use settings for assessment used in the first stage (Tier 1 or ‘screening’) of potential risks to human health from a broad range of metals and organic substances. The HILs are applicable for assessing human health risk via all relevant pathways of exposure for the following generic land use settings:

- **HIL A** - Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake, (no poultry), also includes children’s day care centres, preschools and primary schools
- **HIL B** - Residential with minimal opportunities for soil access includes dwellings with fully and permanently paved yard space such as high-rise buildings and flats
- **HIL C** - Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. It does not include undeveloped public open space (such as urban bushland and reserves) which should be subject to a site-specific assessment where appropriate
- **HIL D** - Commercial/industrial such as shops, offices, factories and industrial sites.

The adopted HILs from Table 1A (1), Schedule B1 of the NEPM (2013) are shown in Table 5 below. For visual interpretation of the relevant zones requiring investigation and validation against the HIL C and HIL D RAC, refer to Appendix I – Site Plans and Areas of Concern.

9.2 Health Screening Levels (HSLs)

HSLs have been developed for selected petroleum compounds and fractions and are applicable to assessing human health risk via the inhalation and direct contact pathways. The HSLs depend on specific soil physicochemical properties, land use scenarios, and the characteristics of building structures. Due to the proposed development of a hardstand cover (concrete) across the site, with limited physical access to exposed areas of soil, ADE has adopted the NEPM 2013 Tier 1 screening criteria for BTEX, Naphthalene, TRH fractions C6-C10 and C10-C16 for Vapour Intrusion. Further tier 1 HSL screening criteria as per Friebel and Nadebaum’s Health Screening levels for petroleum hydrocarbons in soil and groundwater, Part 2: Application Document, Technical report No. 10 (2011) have also been adopted to include Vapour Risk to Intrusive Maintenance Workers (Shallow Trench 0.0 to <2.0 m), and HSL levels for direct human contact, outlined in Table 2.

9.3 Management Limits

Petroleum hydrocarbon management limits (‘management limits’) are a set of assessment criteria outlined in NEPM 2013 applicable to petroleum hydrocarbon compounds which aim to avoid or minimise the potential effects of:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosive hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

The Management Limits provide Tier 1 screening levels following evaluation of human health and ecological risks and risks to groundwater resources, and are considered relevant for operating Sites where significant sub-surface leakage of petroleum compounds has occurred and when decommissioning industrial and commercial Sites.

The adopted Management Limits from Table 1B (7), Schedule B1 of NEPM (2013) are shown in **Table 2** below.
Table 2. Remediation Assessment Criteria for soil contamination mg/kg (unless otherwise specified)

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Health Investigation Levels (HILs)</th>
<th>Management Limits</th>
<th>Health Screening Levels (HSLs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIL C (mg/kg)</td>
<td>HIL D (mg/kg)</td>
<td>Vapour Intrusion (0 m to &lt; 1 m) - HSL C&lt;sup&gt;1,2&lt;/sup&gt; (mg/kg)</td>
</tr>
<tr>
<td>Arsenic (total)</td>
<td>300</td>
<td>3000</td>
<td>-</td>
</tr>
<tr>
<td>Aluminium</td>
<td>90</td>
<td>900</td>
<td>-</td>
</tr>
<tr>
<td>Cadmium</td>
<td>360</td>
<td>3600</td>
<td>-</td>
</tr>
<tr>
<td>Copper</td>
<td>17000</td>
<td>240000</td>
<td>-</td>
</tr>
<tr>
<td>Lead</td>
<td>600</td>
<td>1500</td>
<td>-</td>
</tr>
<tr>
<td>Mercury (inorganic)</td>
<td>80</td>
<td>730</td>
<td>-</td>
</tr>
<tr>
<td>Nickel</td>
<td>1200</td>
<td>6000</td>
<td>-</td>
</tr>
<tr>
<td>Zinc</td>
<td>30000</td>
<td>400000</td>
<td>-</td>
</tr>
<tr>
<td>Carcinogenic PAHs (as BaP TEQ)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>3</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Polycyclic aromatic hydrocarbons (PAHs)&lt;sup&gt;7&lt;/sup&gt;</td>
<td>300</td>
<td>4000</td>
<td>-</td>
</tr>
<tr>
<td>Benzene</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Toluene</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Xylene</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TRH: C&lt;sub&gt;1&lt;/sub&gt; - C&lt;sub&gt;4&lt;/sub&gt;[F1]&lt;sup&gt;10&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>800</td>
</tr>
<tr>
<td>TRH: C&lt;sub&gt;3&lt;/sub&gt; - C&lt;sub&gt;4&lt;/sub&gt;[F2]&lt;sup&gt;10&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>1000</td>
</tr>
<tr>
<td>TRH: C&lt;sub&gt;4&lt;/sub&gt; - C&lt;sub&gt;4&lt;/sub&gt;[F3]</td>
<td>-</td>
<td>-</td>
<td>3500</td>
</tr>
<tr>
<td>TRH: C&lt;sub&gt;4&lt;/sub&gt; - C&lt;sub&gt;4&lt;/sub&gt;[F4]</td>
<td>-</td>
<td>-</td>
<td>10000</td>
</tr>
</tbody>
</table>

New South Wales Office: A. D. Envirotech Australia Pty Ltd
Unit 4, 10-11 Millennium Court
Silverwater, NSW 2128
Queensland Office: A. D. Envirotech Australia Pty Ltd
P.O. Box 288
Upper Coomera, QLD 4209
Telephone: NSW: (02) 9648 6669
QLD: (07) 3319 4610
Internet: Site: www.ADenvirotech.com.au
e-mail info@ADenvirotech.com.au
ABN: 520 934 529 50
**Notes to table**

1. Human exposure settings based on land use have been established for HILs (see Taylor and Langley 1998). These are:
   - C. Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space where the potential for exposure is lower and where a site-specific assessment may be more appropriate.
   - D. Commercial/industrial premises such as shops, offices, factories and industrial sites.

   *(For details on derivation of HILs for human exposure settings based on land use see Schedule B(7A) of NEPM 2013.)*

2. Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7).

3. Lead: HIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.

4. Methyl mercury: assessment of methyl mercury should only occur where there is evidence of its potential source. It may be associated with inorganic mercury and anaerobic microorganism activity in aquatic environments. In addition the reliability and quality of sampling/analysis should be considered.

5. Elemental mercury: HIL does not address elemental mercury. A site-specific assessment should be considered if elemental mercury is present, or suspected to be present.

6. Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P) adopted by CCME 2008 (refer Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products.

7. Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (WHO 1998). The application of the total PAH HIL should consider the presence of carcinogenic PAHs and naphthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ HIL. Naphthalene reported in the total PAHs should meet the relevant HSL.

8. Management limits are applied after consideration of relevant ESLs and HSLs. Values adopted for ‘Fine’ soil texture.

9. To obtain F1, subtract the sum of BTEX from the C6-C10 fraction.

10. To obtain F2 subtract naphthalene from the >C10-C16 fraction.

11. Regarding Management Limits - Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.

The Site will be considered successfully remediated if and when the concentrations of any identified contaminants are below the adopted investigation and screening levels provided in Table 5.

---

### New South Wales Office:
A. D. Envirotech Australia Pty Ltd
Unit 4, 10-11 Millennium Court
Silverwater, NSW 2128

### Queensland Office:
A. D. Envirotech Australia Pty Ltd
P.O. Box 288
Upper Coomera, QLD 4209

### Telephone:
- NSW: (02) 9648 6669
- QLD: (07) 5519 4610

### Internet:
e-mail info@ADenvirotech.com.au

### ABN:
520 934 529 50

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9.4 Scope of Ecological Assessment

NEPM 2013 outlines that a pragmatic risk-based approach should be taken in applying Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) in public open space and commercial/industrial land use settings. ADE has been advised by the client that the proposed development will be a main road infrastructure as part of the Warringah Road. Taking this into consideration, further assessment of risk to terrestrial ecosystems by adopting the EILs and ESLs is not warranted.

9.5 Groundwater Investigation Levels

The Groundwater investigation levels (GILs) are based on the *Australian Water Quality Guidelines 2000* (AWQG), *Australian Drinking Water Guidelines 2011* (ADWG) and *Guidelines for Managing Risk in Recreational Waters 2008* (GMRRW). The GILs are adopted in the NEPM as investigation levels in the context of the framework for risk-based assessment of groundwater contamination (refer Schedule B6) i.e. levels above which further assessment is required.

In regards to the contamination identified within the previous investigations, the adopted remediation acceptance criteria for groundwater within the Site are provided in Table 3 below.

The criteria specified in the following publications are to be used for the groundwater remediation assessment:

- Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters, 2000, (ANZECC);
- Assessment of Site Contamination, National Environment Protection (Assessment of Site Contamination) Measure 1999, 2013 Amendment; and
### Table 3. Adopted Groundwater Assessment Criteria, mg/L (unless otherwise specified).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PAHs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naphthalene</td>
<td>-</td>
<td>0.016</td>
<td>0.050^1</td>
</tr>
<tr>
<td>Anthracene</td>
<td>-</td>
<td>0.001^1+^b</td>
<td>0.00001^1+^a</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>-</td>
<td>0.0006^1+^b</td>
<td>0.0006^1+^a</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>-</td>
<td>0.001^1</td>
<td>0.001^1</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>-</td>
<td>0.0001^1+^b</td>
<td>0.0001^1+^a</td>
</tr>
<tr>
<td>Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>-</td>
<td>0.055</td>
<td>0.055^5</td>
</tr>
<tr>
<td>Arsenic</td>
<td>-</td>
<td>0.013^3</td>
<td>0.023^3</td>
</tr>
<tr>
<td>Cadmium</td>
<td>-</td>
<td>0.002</td>
<td>0.007^4</td>
</tr>
<tr>
<td>Chromium (total)</td>
<td>-</td>
<td>0.001^4</td>
<td>0.0044^4</td>
</tr>
<tr>
<td>Copper</td>
<td>-</td>
<td>0.0014</td>
<td>0.0013</td>
</tr>
<tr>
<td>Lead</td>
<td>-</td>
<td>0.0034</td>
<td>0.0044</td>
</tr>
<tr>
<td>Mercury</td>
<td>-</td>
<td>0.0006^6</td>
<td>0.001^5</td>
</tr>
<tr>
<td>Nickel</td>
<td>-</td>
<td>0.011</td>
<td>0.007^9</td>
</tr>
<tr>
<td>Tributyl tin (as Sn)</td>
<td>-</td>
<td>-</td>
<td>0.0000006</td>
</tr>
<tr>
<td>Zinc</td>
<td>-</td>
<td>0.008^4</td>
<td>0.015^7</td>
</tr>
<tr>
<td>BTEX</td>
<td>30</td>
<td>0.95</td>
<td>0.5^5</td>
</tr>
<tr>
<td>Toluene</td>
<td>-</td>
<td>0.18^a</td>
<td>0.18^a</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>-</td>
<td>0.08^a</td>
<td>0.005^a</td>
</tr>
<tr>
<td>o-Xylene</td>
<td>-</td>
<td>0.35^4</td>
<td>0.35^4</td>
</tr>
<tr>
<td>m+p-Xylene(s)</td>
<td>-</td>
<td>0.075^5</td>
<td>0.075^5</td>
</tr>
<tr>
<td>TRH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRH &gt;C6 – C10 (F1)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TRH &gt;C10 – C16 (F2)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TRH &gt;C16 – C34 (F3)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TRH &gt;C34 – C40 (F4)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes to Table:**
   a. In the absence of a high reliability concentration, the moderate or low reliability guideline concentration has been adopted.
   b. Due to the potential for the chemical to bioaccumulate, a 99% percent protection level has been adopted.
   c. As the two isomers m-Xylene and p-Xylene cannot be distinguished analytically, the lower threshold of 75 µg/l has been adopted.
   d. Figure may not protect key species from chronic toxicity, ANZECC 2000.
   e. ADE notes ANZECC (2000) outlines potential for bioaccumulation, 95% percent protection level has been adopted as a screening level.
   f. As total concentration was reported for the analyte, the most stringent valence threshold was adopted.
   g. As total Arsenic is provided in analytical results, the most stringent criteria of As III and As V has been adopted.
   h. Listed as Chromium VI.
   i. Insufficient data to set a guideline value based on health considerations.
3. Insufficient data or assessment criteria not reported. Concentration for Freshwater Criteria adopted for screening purposes.

Where no Australian groundwater guidelines were available, the ANZECC (2000) low, medium, and high reliability trigger values have been compared to the data set to provide a benchmark for determining the significance of the concentrations detected.

As per the ANZECC (2000) guidelines:
“Low reliability guidelines trigger values should not be used as default guidelines, although it is reasonable to use them in the risk-based decision scheme to determine if conditions at the Site increase or decrease the potential risk. It is important to recognize the interim nature of the low reliability figures and the inherent uncertainties in their derivation and to obtain more data where appropriate.”

9.6 Waste Classification

For waste classification purposes, soil materials will be assessed against:


Waste classification would take into account all previous “in situ” testing results. The waste classification criteria for the contaminants of concern are provided in Table 4 below.

Table 4. Leachable Concentrations (TCLP) and Specific Contaminant Concentrations (SCC) Values for Classifying Waste by Chemical Assessment

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>General Solid Waste¹</th>
<th>Restricted Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TCLP₁ (mg/L)</td>
<td>SCC1 (mg/kg)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>5.02</td>
<td>500</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.52</td>
<td>18</td>
</tr>
<tr>
<td>Benzo(a)pyrene²</td>
<td>0.044</td>
<td>10</td>
</tr>
<tr>
<td>Cadmium</td>
<td>1.02</td>
<td>100</td>
</tr>
<tr>
<td>Chromium (IV)³</td>
<td>5.2</td>
<td>1900</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>306</td>
<td>1080</td>
</tr>
<tr>
<td>Lead</td>
<td>5.2</td>
<td>1500</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.22</td>
<td>50</td>
</tr>
<tr>
<td>Nickel</td>
<td>26</td>
<td>1050</td>
</tr>
<tr>
<td>C6-C9 Petroleum</td>
<td>NA ⁷</td>
<td>650</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10-C36 Petroleum</td>
<td>NA ⁷</td>
<td>10000</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenol²</td>
<td>14.48</td>
<td>518</td>
</tr>
<tr>
<td>Polychlorinated</td>
<td>NA ⁷</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Biphenyls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polycyclic Aromatic</td>
<td>NA ⁷</td>
<td>200</td>
</tr>
<tr>
<td>Hydrocarbons (total)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduled Chemicals</td>
<td>NA ⁷</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Toluene</td>
<td>14.48</td>
<td>518</td>
</tr>
<tr>
<td>Xylenes (total)</td>
<td>509</td>
<td>1800</td>
</tr>
</tbody>
</table>

Notes:
1. Values are the same for both general solid waste (putrescible) and general solid waste (non-putrescible)
3. There may be a need for the laboratory to concentrate the sample to achieve the TCLP limit value for benzo(a)pyrene with confidence
5. These limits apply to chromium in the +6 oxidation state only
7. No TCLP Analysis is required

Should any Virgin Excavated Natural Materials (VENM) be required to be removed offsite for beneficial reuse/disposal, it would be assessed against published background concentrations:
• NEPM (2013). *National Environmental Protection (Assessment of Site Contamination) Measure*
  Schedule B(1) Guidelines on the Investigation Levels for Soil and Groundwater, Background Ranges; and/or

The background concentrations for the analytes of concern are provided in Table 5 below.

**Table 5. Published Australian Background Soil Concentrations**

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>ANZEC 1992 (mg/kg)</th>
<th>NEPC 1999 (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>0.2-30</td>
<td>1-50</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.04-2</td>
<td>1</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.5-110</td>
<td>5-1000</td>
</tr>
<tr>
<td>Copper</td>
<td>1-190</td>
<td>2-100</td>
</tr>
<tr>
<td>Lead</td>
<td>&lt;2-200</td>
<td>2-200</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.001-0.1</td>
<td>0.03</td>
</tr>
<tr>
<td>Nickel</td>
<td>2-400</td>
<td>5-500</td>
</tr>
<tr>
<td>Zinc</td>
<td>2-180</td>
<td>10-300</td>
</tr>
<tr>
<td>PAHs</td>
<td>0.95-5</td>
<td>ND</td>
</tr>
</tbody>
</table>

Organic analytes (TPH, BTEX, OCP/OPPs and PCBs) would be assessed against the laboratory reporting limit. In other words, for organic analytes, VENM analysis results must be within the laboratory PQL (practical quantification limit) to be classified as VENM.

### 9.7 Aesthetics

NEPM 2013 requires that aesthetic quality of accessible soils be considered even if analytical testing demonstrates that concentrations of COPCs are within the SAC.

It should be noted that there are no quantifiable guidelines in determining if soils are appropriately aesthetic, however the NEPM 2013 does indicate that professional judgement with regard to quantity, type and distribution of foreign materials and/or odours in relation to the specific land use should be employed.

The following scenarios (but not limited to) would trigger further aesthetic assessment:

- Hydrocarbon sheen on surface water;
- Anthropogenic soil staining;
- Odorous soils i.e. petroleum hydrocarbon odours or hydrogen sulphide in soil.

### 9.8 Statistical Analysis

A contaminant concentration in soil will be deemed acceptable if:

- The maximum concentration of all samples meet the specified acceptance criteria; or
- The 95% UCL average concentration of each contaminant is below the acceptance criteria; and
- No individual exceedance is greater than 2.5 times the acceptance criteria.

If a location is found to have more than two and half times (2.5x) a contaminant’s acceptable limit, then it will be classified as a “hot-spot”, requiring further assessment, remediation, removal or management.

If the calculated 95% UCL of the arithmetic average concentration of the contaminant is above their acceptance criteria, then the soil will be considered contaminated, requiring further assessment, remediation, removal or management.
If the 95% UCL of the arithmetic average concentrations is below the acceptance criteria, and no concentrations are at a “hotspot” level (not two and a half times the health based investigation level criteria), slight elevations above the acceptance criteria may be considered to pose an insignificant human health or environmental risk since most of the site will be covered by concrete and road-base.

9.9 Duty to Report Contamination

In accordance with the Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, for the purposes of s. 60(3)(a) of the CLM Act, a landowner or a person whose activities have contaminated land is required to notify DECC (EPA) that the land is contaminated if a substance contaminating the land (a ‘contaminant’) is present at levels above any of those specified by the guidelines and if certain other factors are met.

Any further results derived from the investigation, validation and remediation of the Site must be compared to the Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, and if required, the client must notify the New South Wales Environmental Protection Authority.
10 GENERAL SITE MANAGEMENT

- When materials are removed off Site, they should be loaded into NSW EPA approved trucks which will not allow escape of material during transportation. Do not overfill;
- Trucks should be clean when leaving the Site and should not carry contaminated soil along the street on their wheels;
- No soil disturbance should be undertaken when adverse weather conditions such as high winds or storms are likely. Adequate precautions such as the soil compaction should be undertaken to ensure that soil loss does not occur;
- Workers should have adequate shower/change facilities available (as required) prior to leaving Site; and
- PPE shall be worn at all times in accordance with Section 13 of this report.

10.1 Plant and Equipment
The Contractor should provide all plant and equipment necessary to carry out the work, including all personal protective equipment for workers, as required by the NSW EPA and WorkCover.

10.2 Supervision and Inspection
The work should be supervised by the Consultant, who may require further work to be carried out, if in his/her opinion Site conditions warrant this.
11 VALIDATION AND MONITORING

11.1 Validation

Upon the completion of the remediation works a qualified Environmental Consultant should undertake the validation sampling and inspection.

As the remediation involves excavation and assessment of contamination, a qualified Environmental Consultant should be involved during the remediation works to ensure compliance with the RAP and the appropriate controls are in place.

A validation (Phase IV) assessment report shall be prepared in accordance with the NSW EPA Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites (2000) and other relevant and appropriate guidelines.

The validation report shall confirm that the Site has been remediated to a suitable standard for the proposed land-use and that no related adverse human health and environmental effects have occurred or likely to occur as a result of the remediation works (refer to Appendix I – Site Plans and Areas of Concern). The validation report shall also include details of the total volume of contaminated materials removed, disposal receipts once materials are transported to an EPA licensed landfill, any relevant information regarding future or on-going management requirements, notification mechanisms and management plans.

The validation program will involve validation sampling in order to provide quantitative analysis of the Site suitability for the proposed development. This will include sampling of the Site’s surface and/or the base and walls of any excavations.

11.2 Sample Collection and Handling

If applicable, ADE’s standard decontamination procedures shall be undertaken prior to sampling events to avoid the possibility of cross-contamination.

The soil sampling equipment and items likely to come into contact with soil samples will be thoroughly washed followed by rinsing with phosphate-free detergent and deionised water before the collection of samples. Due care should be taken with the disposal of any washings and residues from such cleaning operations.

A field observation log will be kept by sampling personnel. Details recorded in the log included:

- Borehole and sample number;
- Soil profile notes;
- Sampling method;
- Sample identification;
- Sample description; and
- Sample point measurements.

A comprehensive master sample register will be maintained. As samples are received, they will be given a unique sequential number from the sample register into which details from the labels will be entered.

Before packing and dispatch of samples for analysis, a Chain of Custody will be completed. This form recorded details of the individual samples being dispatched and the type of analysis required for each sample.
11.3 Quality Assurance Plan

Quality Assurance (QA) and Quality Control (QC) procedures will be adopted throughout the field sampling program. All samples shall be analysed by NATA Accredited Laboratories using tests in accordance with the NEPM (2013) Guidelines.

If the QA/QC samples meet the assigned criteria of valid results for:

- Laboratory duplicate samples 95%
- Laboratory blank samples 100%
- Laboratory spike samples 95%
- Laboratory control samples 95%
- Blind replicate samples 95%
- Rinsate samples 75%
- Spiked VOC trip samples 75%
- Trip blank samples 95%
- Field replicate measurements 75%.

With overall completeness of 95%, then the data collected in the course of the investigation will be considered valid and acceptable.

11.4 Data Quality Objectives

The validating report shall be conducted in accordance with the Data Quality Objectives (DQOs) and QA/QC procedures to ensure the repeatability and reliability of the results. A checklist of Data Quality Indicators (DQI) in accordance with the NSW Site Auditor Scheme (2nd Ed.) will be undertaken as part of the validation assessment.

The validation assessment will be planned in accordance with the following DQOs:

- State the Problem;
- Identify the Decision;
- Identify Inputs to the Decision;
- Define the Boundary of the Assessment;
- Develop a Decision Rule;
- Specify Acceptable limits on Decision Errors; and
- Optimise the Design for Obtaining Data.

11.5 Soil Validation Sampling

11.5.1 Validation Sampling of TRH Hotspots (Area of Concern 1)

Validation samples should be undertaken subject to the completion of remediation works within Areas of Concern 1. The following validation program is to be followed:

- A combination of visual and PID screening should be adopted to ensure that the contaminated soils have been adequately removed;
- A systematic sampling pattern should then be applied to the remediated excavation, with sampling points evenly spaced across the walls and base of the excavated hotspot area;
- A minimum of five (5) soil samples should be collected from the area of the removed TRH hotspot, this comprises one (1) soil sample from each wall of the excavation and an additional sample to be collected from the floor of the excavation;
• Should the lateral distance of the walls of the remediated area exceed 5 linear metres additional validation samples will be required. Lateral validation samples are to be collected at a rate of 1 per 5 linear metres along each wall;
• Additional samples may be required if the excavation exceeds 1 m bgl. Samples should be taken at a sampling rate each 1 m of strata on the walls of the excavation;
• One sample per 5 m x 5 m grid at the base of the excavation is to be employed;
• Blind replicate samples should be collected at a rate of one sample per 20 soil samples collected;
• Split samples should be collected at a rate of one sample per 20 soil samples collected;
• A Trip Blank, VOC spike and rinsate sample should also be collected during sampling operations to ensure that sampling is undertaken in accordance with all relevant QA/QC requirements;
• All samples should be analysed for TRHs by a NATA accredited laboratory; and
• Provided that all samples yield concentrations below the adopted criteria for the Site (HIL C & HIL D) and threshold concentrations for land use, a Phase IV Validation Report can be produced.

11.5.2 Validation Sampling for UST Removal (Area of Concern 2)

Validation sampling should be undertaken subject to the completion of remediation works (as outlined in Section 7) within Area of Concern 2. Validation sampling should be undertaken at the following sampling rate as per the UPSS Technical Note: Site Validation Reporting:

• A combination of visual and PID screening should be adopted to ensure that the contaminated soils have been adequately removed;
• A systematic sampling pattern should then be applied to the area of remediation, with sampling points evenly spaced across the walls and the base of all excavated pits should be used;
• A minimum of five (5) soil samples should be collected from the area of the removed UST, this comprises one (1) soil sample from each wall of the excavation and an additional sample to be collected from the floor of the excavation;
• Should the lateral distance of the walls of the remediated area exceed 5 linear metres additional validation samples will be required. Lateral validation samples are to be collected at a rate of 1 per 5 linear metres along each wall;
• Additional samples may be required if the excavation exceeds 1 m bgl. Samples should be taken at a sampling rate each 1 m of strata on the walls of the excavation;
• One sample per 5 m x 5 m grid at the base of the excavation is to be employed;
• Details record of observations including photographs to taken throughout the removal and validation;
• Blind replicate samples should be collected at a rate of one sample per 20 soil samples collected.
• Split samples should be collected at a rate of one sample per 20 soil samples collected;
• A Trip Blank, VOC spike and rinsate sample should also be collected during sampling operations to ensure that sampling is undertaken in accordance with all relevant QA/QC requirements;
• All samples should be analysed for Metals, TRH and BTEX by a NATA accredited laboratory; and
• Provided that all samples yield concentrations below the adopted remediation assessment criteria, a Phase IV Validation Report can be produced.

11.6 Groundwater Validation Sampling (Area of Concern 3)

Groundwater wells (GWMW 1 and GWMW-2) have been installed within the Site (29th of March 2016) by ADE. The groundwater wells have been established along the eastern boundary of the Site down gradient of the TRH hotspot and UST locations.
The recently installed groundwater wells will be used to assess the current on site condition of groundwater, characterising offsite migration and for the purpose of validation sampling (if results are favourable).

Another round of groundwater monitoring will occur after the main excavation and remediation works and the data collected will be used to validate the site.

Methodology

The low-flow purging method should be adopted for sampling of groundwater for validation. Groundwater wells should be purged prior to sampling, the following outlines the necessary steps when using a low-flow pump to purge:

- Calibrate all equipment;
- Remove well cap and record / monitor head-space if volatile organic compounds (VOCs) are suspected;
- Measure the standing water level (SWL) from ground level (GL);
- Place pump into well with careful consideration not to disturb the water column;
- Begin pumping, adjusting flow to minimise drawdown. Water level needs to be measured continuously until an equilibrium between the flow rate and drawdown level is established;
- Once flow rate is established and stabilised and one well volume has been extracted, groundwater samples can then be collected. Stabilisation parameters can be measured so as to determine when purging is completed. Indicator parameters are considered stable when three (3) consecutive readings fall within the ranges outlined in Table 6 below.

Table 6. Stabilisation Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Electrical Conductivity (EC)</th>
<th>pH</th>
<th>Temperature (°C)</th>
<th>Dissolved Oxygen (DO)</th>
<th>Redox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable Range</td>
<td>5%</td>
<td>+/- 0.1</td>
<td>0.2</td>
<td>10%</td>
<td>+/- 10 mv</td>
</tr>
</tbody>
</table>

- Blind replicate samples should be collected at a rate of one (1) sample per monitoring event;
- Split samples should be collected at a rate of one (1) sample per monitoring event;
- Trip Blank, VOC spike and rinsate sample should also be collected during sampling operations to ensure that sampling is undertaken in accordance with all relevant QA/QC requirements;
- All samples should be analysed for TRHs, BTEX, PAHs and Heavy Metals by a NATA accredited laboratory; and
- Provided that all samples yield concentrations below the RAC (refer to section 9) a Phase IV Validation Report can be produced.

11.7 Failed Remediation Works and/or Aesthetic Criteria

In the event that the remediation works fail to bring the contaminant of concern below the criteria adopted for the Site the following steps should be taken:

- Further excavations and off-site disposal should be undertaken with the areas of concern. Further excavations should remove a minimum of 0.1 m of soil material from the excavation walls and floor. At the conclusion of excavation works validation sampling should be undertaken as per the sampling rate outlined in Section 11 of this report respectively. This process should be repeated until the remaining in situ materials yield concentrations below the adopted criteria for the Site; and
• If further excavations are not possible, further investigations, including an environmental and human health risk assessment will be undertaken by the environmental consultant to determine further remediation options, if required.
12 SITE MANAGEMENT PLAN

12.1 Enquiries
Any enquiries regarding the work required by this document should be referred to:

Principal: Attila Barnacz
Project Site Office cnr Wakehurst Parkway and Warringah Road, Frenchs Forest NSW
0427 454 271
attila.barnacz@ferrovialyork.com.au

Consultant: A. D. Envirotech Australia Pty Ltd.
Ross Nefodov (Managing Director)
4/10-11 Millennium Court, Silverwater NSW
(02) 9648-6669 or 0402 389 911
r.nefodov@adenvirotech.com.au

Contractor: To be advised.

12.2 Site Provisions
Local regulations apply to the Site of the works and the Contractor must ascertain these before commencing the soil remediation.

12.3 Adherence to Codes
The Contractor is advised that all relevant Standards, Codes, Acts and Regulations should be applied to the works and strictly adhered to for the duration of the soil remediation.

12.4 Site
The Contractor should determine in conjunction with the Principal the areas to be set aside for use by the Contractor for location of the service units, soil loading and truck decontamination areas.

On-Site identification of contaminated areas should be carried out by the Consultant. This will be based upon the existing data and information relating to the extent of contamination on the Site. The contaminated areas should be isolated and the materials therein should be disposed of as detailed in the following sections.

If previously unidentified potentially hazardous materials are encountered during the course of bulk earthworks the Consultant should inspect and test the materials as a matter of urgency. The Consultant should subsequently provide strategies for dealing with any newly discovered hazardous materials.

12.5 Programming of the Works
The Contractor should program all work to cause minimum inconvenience to the neighbourhood occupants. Site hours will be determined by the client.

12.6 Works on Site
The Contractor should ensure that all surrounding areas are protected against damage by dust, dirt, shock or contaminated materials.

Any other materials or objects found during the remediation procedures should be inspected and disposed of in accordance with the recommendations of the Consultant.
12.7 Damage to Services
The Contractor should ensure that no damage occurs to existing structures. If damage occurs, the Contractor should immediately give notice of the damage of any water, gas, electric, drainage, sewerage, telephone or other services in the area.

12.8 Dewatering of Excavation Pit
Refer to Dewatering Management Plan.

12.9 Waste Water
The Contractor should determine the locations to which all waste water generated by the work shall be discharged.

12.10 Temporary fire Extinguishers
When work under the Contract warrants the provision of fire fighting appliances, the Contractor should provide such appropriate fully charged, maintained and accessible fire extinguishers as are necessary for the care and safety of the Works.

12.11 Environmental Protection
The Contractor should observe and comply with all environmental requirements that apply to the area in which the work under the Contract is to be carried out.

If in the opinion of the author there is a potential for undue disruption to neighbouring residents the Contractor may be required to take remedial/preventative action as considered necessary.

12.12 Runoff Control
Adequate water quality, sediment and erosion control measures must be in place before and during the remediation works. If in the opinion of the Consultant the measures are inadequate, the Contractor may be required to install the appropriate systems.

This RAP has recommended that removal of contaminated material be undertaken. However if stockpiles of contaminated soil need be present on the Site, they should be bunded with sediment control fences or straw bales to ensure any sediment laden runoff is not discharged into storm water canals or drains.

Visual inspections of the surface water control on the Site should be carried out by the Consultant on a regular basis.

12.13 Noise Control
The Contractor should take all practicable precautions to minimise noise arising out of or resulting from any activity associated with the work under the Contract.

12.14 Site and Dust Control
Except as otherwise provided in the Contract, delivery of materials to the Site, space for storage of such materials and for building sheds, offices and other temporary structures, if required, should be allowed only in accordance with arrangements entered into between the Contractor and Principal and subject to such conditions as are determined by the Principal.
An irrigation system should be in place for the suppression of dust for the duration of the project. This measure will prevent surface materials from becoming airborne. If extremely dry weather persists for a substantial period of time throughout the course of remedial work, a suitable dust emission monitoring program should be implemented. If necessary, approval of the program should be sought from the EPA.

12.15 Nuisance Odour Control

If odours are detected during the works the following protocol would be applied:

- Odour source and type of odour to be investigated. This could include air monitoring or sampling of any suspect media in addition to observations of physical conditions.

- Temporary covering of the source to mitigate odours whilst waiting for monitoring/analytical results. This could include the temporary reinstatement of ground conditions.

- Assessing more permanent ways of dealing with the issue. This could include disposal of odorous material off Site, the use of masking agents or controlled progressive excavation etc.

- The re-use of odorous soils for construction purposes would not be undertaken unless the material has been aerated and the odorous material has been chemically assessed to be suitable and the odours have been adequately attenuated.

12.16 Disposal of Waste

The removal from Site and the disposal of contaminated materials should be in accordance with the EPA regulations. These activities should be monitored and reported upon by the Consultant.

Prior to removing materials from the Site, the EPA or EPA approved landfill should be notified of the nature of the material and should be provided with transportation and tip details.

All contaminated materials should be dampened prior to loading to prevent contaminated dust escaping into the atmosphere.

All materials must be classified in accordance with WH&S requirements.

No vehicle or container should leave the Site laden with any material unless it is loaded in a manner that will prevent the discharge or dropping of any of the materials.

12.17 Publicity

The Contractor should not furnish any information or issue any document concerning the work under the Contract for publication in any medium without the prior written approval from the Principal.

12.18 Approval to Commence Soil Removal Work

The Contractor should not commence the removal of any soil until approval to proceed is given by the Principal.

12.19 Authorities

The Contractor is advised that the EPA, local Council and /or WorkCover Authority, may be called upon to give advice on current work procedures and practices at any stage throughout the Contract without prior notice to the Contractor.
12.20 Work Practice
If at any stage during the works in progress, the work practice is considered to be of a lesser standard than that required by the specification, or the Principal, or where airborne or waterborne contamination levels are excessive - all work should cease.

A complete review of work practice should take place.

A complete clean-up of the area and/or implementation of appropriate control procedures by the Contractor should be undertaken immediately, all to the satisfaction of the Principal.

The specified procedure should be undertaken and repeated until satisfactory work practices and air purity levels are achieved. All costs incurred by the specified procedure should be at the Contractor’s expense.

12.21 Decontamination
The Contractor is to provide adequate washing facilities for all persons engaged in the removal of contaminated soil and/or disposal clothing.

All persons engaged in the removal of contaminated soil should use the washing facilities and should observe the applicable standards of hygiene procedures.

12.22 Safety
All works should be undertaken in accordance with relevant Safe Work Method Statements (SWMS). The Contractor must ensure that the Site is made secure at all times during the course of the Contract. Any unsafe areas are to be adequately fenced off and signposted. All pits which might constitute a hazard are to be covered.

12.23 Contaminated Waste
The Contractor should pay all fees due for the disposal of the contaminated soil and water and all receipts should be provided to the Consultant to ensure that the waste has been disposed of in accordance with the EPA docket disposal system. Please note that the tracking of all waste is required from the ground to the truck to tip. Details required include date of excavation, transport and tipping, type of waste and the lot.

This information needs to be provided to the consultant and included in the validation report.
13 HEALTH AND SAFETY ISSUES

Throughout the course of the remedial work extreme emphasis should be put upon matters relating to the health and safety of Site staff, Site visitors and the public. The Contractor should endeavour to minimise the risk of adverse health effects resulting from potential exposure to hazardous substances during the Site remediation program.

All aspects of Health and Safety should be addressed in the Site specific WH&S plan prepared by the Contractor. ADE recommends in brief a number of Health and Safety aspects relating to the contaminants found at the subject Site:

- Before undertaking works all personnel should be inducted according to the activities conducted on the Site. All personnel should be advised of officer responsible for the implementation of WH&S procedures. All personnel should read and understand the WH&S Plan prior to commencing Site works.

- The Site supervisor is to be aware of the presence of all individuals on Site at all times.

- All gates to the Site should be locked outside of normal working hours to ensure that no members of the public are exposed to any hazardous substances located on Site.

- Delineate and restrict access to the contaminated areas. If access into the delineated areas is gained appropriate PPE must be worn. The following PPE should be considered, depending the nature of the contaminants a P2 mask/P3 mask, disposable coveralls and nitrile works gloves as required in addition to mandatory PPE (Steel Capped Boots, Hi-Vis Vest, Safety Glasses), to ensure that Site personnel do not come into direct contact with contaminated soil.

- Eating, drinking, smoking, taking of medicine, chewing gum or tobacco is prohibited in the immediate vicinity of the remedial operations. Furthermore, hands and if necessary, face will be thoroughly washed by workers before meals.

- Appropriate warning signs should be placed at the affected areas.

- All necessary protective clothing including gloves, suits, dust masks, footwear, eye protection and hearing protection should be available on Site. Site clothing is to be laundered separately.

- All previously confirmed areas of contamination should be identified on Site by the Consultant prior to the beginning of works. These areas should be isolated by pegging and taping.

- The soils in the excavation areas should be inspected continually, by the Site supervisor, for the presence of additional, potentially hazardous waste material. If evidence of such material is found, the suspect area should be isolated immediately and the Environmental Consultant should carry out a full scale inspection and testing. Based upon the inspection, test results and regulations, the Consultant should produce appropriate management/removal plan for dealing effectively with the contaminants.

- In the event that any member of the field crew experiences any adverse exposure symptoms while on Site, the entire crew should immediately stop works and act according to the instructions of the Site supervisor.
• The discovery of any conditions that would suggest the existence of a situation more hazardous than anticipated would result in the evacuation of the field team and re-evaluation of the hazard and the level of protection required.
14 CONCLUSIONS

The Site in its current state is not suitable for the proposed future land use and remediation strategies have been designed to protect human and environmental health. ADE considers that removal of UST’s throughout the site and the TRH hotspot will remove the source of the contamination observed in soil within the Site render the Site suitable for its proposed development. The elevated levels of Naphthalene and Ethylbenzene in groundwater would be expected to attenuate once the source areas have been removed.

It is considered that conformance with this RAP will reduce the potential for environmental impacts during the remedial and excavation works at the subject Site. By following the RAP and demonstrating compliance with the requirement of the “Planning Guidelines SEPP 55 – Remediation of Land”, a validation report will be prepared by a qualified environmental consultant in accordance with the NSW EPA Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites (1997) and other appropriate documentation.

The validation investigation shall confirm whether the Site has been remediated to a suitable standard for the proposed development and that no adverse human health and environmental effects have occurred as a result of the works.

Subject to proper implementation of the RAP it is considered that the Site can be rendered suitable for the proposed public open space and commercial / industrial land-use.
15 LIMITATIONS

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based on information provided by the client. The advice herein relates only to this project and all results, conclusions and recommendations made should be reviewed by a competent and experienced person with experience in environmental investigations, before being used for any other purpose. A.D. Envirotech Australia Pty Ltd (ADE) accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced or amended in any way without prior approval by the client or ADE and should not be relied upon by any other party, who should make their own independent enquiries.

The extent of sampling of soils and subsequent analysis has been necessarily limited and has been targeted towards areas where contamination is considered to be most likely based on the knowledge of the Site history and visual observation. This approach maximises the probability of identifying contaminants, however, it may not identify contamination which occurs in unexpected locations or from unexpected sources.

Further, soils rock and aquifer conditions are often variable, resulting in non-homogenous contaminant distributions across a Site. Contaminant concentrations have been identified at chosen sample locations, however, conditions between samples locations can only be inferred on the basis of the estimated geological and hydrogeological conditions and the nature and extent of indentified contamination. Boundaries between zones of variable contamination are often indistinct and have been interpreted based on available information and the application of professional judgement. The accuracy with which the subsurface conditions have been characterised depends on the frequency and methods of sampling and the uniformity of subsurface conditions and is therefore limited by the scope of works undertaken.

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

ADE’s professional opinions are based upon its professional judgement, experience, training and results from analytical data. In some cases further testing and analysis may be required, thus producing different results and/or opinions. ADE has limited investigation to the scope agreed upon with its client.

ADE has used a degree of care and skill ordinarily exercised in similar investigations by reputable member of the Environmental Industry within Australia. No other warranty, expressed or implied, is made or intended.
16 REFERENCES

- Data Quality Assessment Statistical Toolbox (DataQUEST) (EPA QA/G-9D).
- Department of Natural Resources, Groundwater Bore Search, NRAtlaswebSite, February 2010
- EPA Guidelines for Environmental Management of on-Site remediation.
- EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5).
- Guidance on Quality Assurance Project Plans (EPA QA/G-5).
- Guidance on Data Quality Indicators, EPA QA/G-5I.
- National Environmental Protection (Assessment of Site Contamination) Measure 1999, 2013 Amendment.
- UPSS Technical Note: Site Validation Reporting, Environment Climate Change & Water (2014).
- Work Health and Safety Regulation 2011.
Appendix I – Site Plans and Areas of Concern
Area of Concern 1 – TRH hotspot at sample location BH05

Area of Concern 2 – Abandoned USTs.
Appendix M
Surface Water Monitoring Program
Northern Beaches Hospital Road Connectivity and Network Enhancements Project

Surface Water Quality Monitoring Program

Prepared for: Roads and Maritime Services
Date: 5 August 2015
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APPENDICES

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LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Environment Conservation Council</td>
</tr>
<tr>
<td>ARMCANZ</td>
<td>Agriculture and Resource Management Council of Australia and New Zealand</td>
</tr>
<tr>
<td>BTEX</td>
<td>benzene, toluene, ethylbenzene and xylene</td>
</tr>
<tr>
<td>CEMP</td>
<td>Construction Environmental Management Plan</td>
</tr>
<tr>
<td>CoAs</td>
<td>Minister’s Conditions of Approval</td>
</tr>
<tr>
<td>COC</td>
<td>Chain of custody</td>
</tr>
<tr>
<td>COCs</td>
<td>Contaminants of concern</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved oxygen</td>
</tr>
<tr>
<td>DP&amp;I</td>
<td>Department of Planning and Infrastructure</td>
</tr>
<tr>
<td>DPI</td>
<td>Department of Primary Industries (Fishing and Aquaculture)</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>EEC</td>
<td>Endangered Ecological Community</td>
</tr>
<tr>
<td>EIL</td>
<td>Ecological investigation level</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Authority</td>
</tr>
<tr>
<td>EP&amp;A Act</td>
<td>Environmental Planning and Assessment Act 1979</td>
</tr>
<tr>
<td>GDE</td>
<td>Groundwater Dependant Ecosystem</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
</tr>
<tr>
<td>mAHD</td>
<td>Meters Australian Height Datum</td>
</tr>
<tr>
<td>mBGL</td>
<td>Meters Below Ground Level</td>
</tr>
<tr>
<td>NATA</td>
<td>National Association of Testing Authorities</td>
</tr>
<tr>
<td>NEPM</td>
<td>National environmental protection measure</td>
</tr>
<tr>
<td>NBHS</td>
<td>Northern Beaches Hospital Site</td>
</tr>
<tr>
<td>NOW</td>
<td>NSW Office of Water</td>
</tr>
<tr>
<td>NTU</td>
<td>Nephelometric Turbidity Units (a unit of measurement for the turbidity of water)</td>
</tr>
<tr>
<td>OCP</td>
<td>Organochlorine pesticides</td>
</tr>
<tr>
<td>OPP</td>
<td>Organophosphorus pesticides</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic aromatic hydrocarbons</td>
</tr>
</tbody>
</table>
GLOSSARY OF TERMS

pH
A measure of acidity and alkalinity that uses a number scale from 0 to 14 where 7 is neutral, lower numbers indicate acidity and higher numbers indicate alkalinity.

Dissolved Metal Sample
Requires the field filtering of a groundwater sample through 0.45micron filters to remove suspended solids prior to testing.
1. **INTRODUCTION**

The purpose of this document is to detail a Surface Water Quality Monitoring Program (SWQMP) for Stage 1 of the construction and operation of the Northern Beaches Hospital Road Connectivity and Network Enhancements Project. This document outlines water quality monitoring locations, parameters and frequencies for surface monitoring along the length of the project. The monitoring program covers three key phases (pre-construction, construction and operations) and establishes baseline (pre-construction) water quality data that can be used to track potential changes in surface water over the duration of the Project.

The objective of the monitoring program is to observe and assess the extent of potential impacts from the Project on the water quality in the surrounding environment, including creeks, rivers and wetlands. The information collected as part of the monitoring program will be used to inform Project management responses aimed at managing any significant adverse impacts observed in the monitoring results. The document will guide water quality monitoring during each Project phase and will inform the relevant sections of Conditions of approval B7 and the Construction Environmental Management Plan (CEMP).

1.1 **Project Background**

SMEC Australia Pty Limited (SMEC) has been engaged by the NSW Roads and Maritime Services (RMS) to prepare the Surface Water Quality Monitoring Program for Stage 1 of the Northern Beaches Hospital Road Connectivity and Network Enhancements Project. The site location is shown on Figure 1-1.

The Northern Beaches Hospital Road Connectivity and Network Enhancements Project EIS (2014) identified the Concept Proposal and the detail of the Stage 1 Project. A second EIS is currently under preparation which describes and assesses the Stage 2 Project. Stage 1 (Figure 1-2) is proposed to be carried out generally within the following parts of Frenchs Forest:

- Warringah Road from its intersection with Maxwell Parade to its intersection with Courtley Road.
- Forest Way from around Adams Street to its intersection with Warringah Road.
- Naree Road/Frenchs Forest Road from its intersection with Forest Way to its intersection with Warringah Road.
- Wakehurst Parkway from about 500 metres north of Frenchs Forest Road to about 500 metres south of Warringah Road.
- Allambie Road from its intersection with Frenchs Forest Road East to its intersection with Aquatic Drive.
- Rodborough Road from its intersection with Warringah Road to its intersection with Allambie Road.
- A new connection of Aquatic Drive with Wakehurst Parkway (left in, left out).
In addition Stage 1 will involve utilities relocation and associated excavations. The upgrade of Warringah road (Stage 2) is understood to require a 1.2km long trench excavation (to approximately 10m depth) which is anticipated to intersect the groundwater table.

Figure 1-1: Location of Project

Figure 1-2: Schematic of the Concept Proposal
1.2 Project Conditions of Approval

The Ministers Conditions of Approval relate to a broad range of environmental, social and economic factors. The conditions of approval for this project are:

Table 1.1 - Conditions of Approval B7 addressed in this report.

<table>
<thead>
<tr>
<th>CoA</th>
<th>Condition</th>
<th>Addressed in</th>
</tr>
</thead>
<tbody>
<tr>
<td>B7</td>
<td>A Surface Water Quality Monitoring Program (SWQMP) shall be prepared and implemented to monitor impacts on surface water quality and resources during construction and operation. The SWQMP shall be prepared by a suitably qualified and experienced person(s) and include, but not be limited to: (a) a surface water quality monitoring program including the identification of monitoring locations which are representative of the potential extent of impacts from the SSI, including the relevant analytes and frequency and sampling distribution of modelling; (b) identification of works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways; (c) representative background monitoring of surface water quality parameters prior to the commencement of construction, to establish baseline water conditions, unless otherwise agreed by the Secretary; (d) the presentation of water quality standards and parameters having regard to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (Australia and New Zealand Environment Conservation Council, 2000) and a statement of the indicators and associated trigger values or criteria for the identified environmental values; (e) a statement of the surface water quality objectives and pollution reduction targets of receiving waters relevant to the proposal for the receiving waters relevant to the proposal; (f) trigger values for action and associated actions or mitigation measures if trigger values are exceeded; and (g) reporting of the monitoring results to the Secretary, EPA, and the Council.</td>
<td>This Document</td>
</tr>
<tr>
<td>CoA</td>
<td>Condition</td>
<td>Addressed in</td>
</tr>
<tr>
<td>-----</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>The SWQMP is to be prepared in consultation with EPA, NOW and the Council and approved by the Secretary prior to the commencement of construction, unless otherwise agreed by the Secretary. The SWQMP is to be ongoing for a minimum of three years following the commencement of operation or until the affected waterways are certified by an independent expert as being rehabilitated to an acceptable condition, unless otherwise agreed by the Secretary. A copy of the SWQMP is to be supplied to the EPA and the Council upon its implementation. The results of all monitoring are to be made publicly available upon completion of each monitoring period.</td>
<td></td>
</tr>
</tbody>
</table>
2. EXISTING ENVIRONMENT AND POTENTIAL IMPACTS

This section outlines the existing surface water environment and the potential impacts and risks from construction and operation of the Project. The purpose of this section is to provide context for the SWQMP. The background information contained in this section is primarily based on the Project EIS (Northern Beaches Hospital Road Connectivity and Network Enhancements Project EIS) and results of monitoring undertaken since November 2014. The relevant Interim Water Quality Objective Design Guidelines from the Warringah Council Creek Management Study 2004 are outlined in Section 3, along with consideration of the overall catchment objectives provided in the Northern Beaches Stormwater Management Plan (1998).

2.1 Catchment Overview

The Project is located at the junction of three surface water catchment areas; Middle Creek, Bantry Bay and Curl Curl Creek (Figure 2-1). Middle Creek catchment predominantly consists of low density residential dwellings with some commercial/light industrial dwellings and discharges to Narrabeen Lagoon north-east of the Project. Bantry Bay catchment predominantly consists of low density residential dwellings and discharges to Bantry Bay to the south of the project. Curl Curl Creek catchment predominantly consists of commercial/light industrial dwellings with some native bush and discharges to the south of the Project. Stage 1 falls mainly within the Middle Creek catchment and the eastern section of Curl Curl Creek catchment.

The project footprint falls at the top of the catchments, effectively on the surface water divide. As the project footprint is on the surface water divide there are no up-gradient or upstream background locations for sampling or comparison.

2.2 Site Geology

The site is predominately underlain by siltstone beds overlying the Hawkesbury Sandstone. These rocks generally weather to form residual clays and can include ironstone bands. Basalt dykes occur in the vicinity, but have not been encountered during geotechnical investigations. Ashfield shales (siltstone) have been identified on the Northern Beaches Hospital site and the southern side of Warringah Road opposite the hospital site, and are thought to cover a large portion of the project area.

Soils are typically shallow on the sandstones with depths of between 0.05m and 0.25m below ground level. They are generally sandy, silty clays and sands. The siltstone capping on the hospital site has weathered to stiff clays approximately 1m to 3.5m deep. Areas of colluvium and residual soils exist within the region, along with local deposits of fill material scattered in discrete locations across the project area which is typically associated with previous construction activities.
Figure 4-1

Surface Water Sample Locations
Additional Wet Weather Sample Locations
Stage 1 Construction Impact Area
Stage 2 Construction Impact Area
Drainage flow
Major ridgeline/Catchment boundary
Hospital site
Compound site (Stages 1 and 2)
Streams

Middle Creek Catchment
Bantry Bay Catchment
Curl Curl Creek Catchment

Project Boundaries and Sample Locations
2.3 Surface Water Environment

2.3.1 Summary of Pre-construction Monitoring

Pre-construction surface water (and groundwater) monitoring has been conducted since November 2014. As there are no up gradient background monitoring locations the monitoring locations have been selected to identify potential water quality impacts on:

- creeks and tributaries;
- existing users; and
- Narrabeen Lagoon, Manly Dam (Curl Curl Creek) and Middle Harbour.

2.3.2 Sampling Site Selection

The assessment objective and the nature of the disturbance associated with the construction activity have been taken into consideration in identifying the nominated surface water monitoring locations. Each surface water sampling site location has been selected outside of the construction footprint, down gradient and as close to the corridor as possible without compromising reliable flow during dry periods. The nominated locations provide coverage of all drainage lines engaged by the proposed ground engaging works. Sample locations descriptions are provided in the Table 2-1 and supported by Figure 4-1.
TABLE 2-1 - SURFACE WATER MONITORING LOCATIONS

<table>
<thead>
<tr>
<th>ID</th>
<th>Easting (MGA)</th>
<th>Northing (MGA)</th>
<th>Surface RL* (mAHD)</th>
<th>Creek (sub catchment)</th>
<th>Location Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1</td>
<td>337692.8</td>
<td>6264769.3</td>
<td>100.6</td>
<td>Middle Creek (Middle Creek)</td>
<td>Drainage Line 1 - Located to the North of the project footprint. Accessed from Jindabyne Reserve (Epping Drive). Sample point just below confluence of 2nd creek line entering from Greendale Reserve No.2</td>
</tr>
<tr>
<td>SW2</td>
<td>336922.6</td>
<td>6265053.3</td>
<td>82.5</td>
<td>Trefoil Creek (Middle Creek)</td>
<td>Drainage Line 2 - Located to the North of the project footprint. Accessed from EnergyAustralia access road that runs parallel to Wakehurst Parkway (Oxford Falls traffic lights). Trefoil Creek ample point located approximately 300 north-east of overhead power lines</td>
</tr>
<tr>
<td>SW3</td>
<td>337644.1</td>
<td>6265083.7</td>
<td>84.1</td>
<td>Tributary to Middle Creek (Middle Creek)</td>
<td>Drainage Line 3 - Located to the North of the project footprint. Accessed from Wearden Road. Sample point immediately downstream from road bridge</td>
</tr>
<tr>
<td>SW4</td>
<td>336678.4</td>
<td>6263504.4</td>
<td>TBC</td>
<td>Curl Curl Creek (Manly Creek)</td>
<td>Drainage Line 6 - Located to the South of the project footprint. Accessed from Warringah Aquatic Centre carpark on the eastern side of Aquatic Drive entry point. Sampled from immediately above culvert</td>
</tr>
<tr>
<td>SW5</td>
<td>* 336525.3</td>
<td>6263644.4</td>
<td>TBC</td>
<td>Curl Curl Creek (Manly Creek)</td>
<td>Drainage Line 6 - Located to the South of the project footprint. Accessed from the north side of the end of Aquatic Drive. Sampled from drainage line on the northern side of the fence line adjacent to the business park</td>
</tr>
<tr>
<td>SW6</td>
<td>335628.8</td>
<td>6263047.5</td>
<td>TBC</td>
<td>Middle Harbour Creek (Bantry Bay)</td>
<td>Drainage Line 4 &amp; 5 - Located to the South of the project footprint. Accessed from the road bridge at the end of Currie Road. Sampled from creek line upstream of bridge</td>
</tr>
<tr>
<td>SW7</td>
<td>33748205</td>
<td>6265053.3</td>
<td>122</td>
<td>Trefoil (Middle Creek)</td>
<td>Drainage Line 2 - Located off Nandi Avenue street reserve. Access from the drainage easement that accesses the creek.</td>
</tr>
</tbody>
</table>

1. # approximate from GPS, TBC - to be confirmed, * creek line not located water body at the end of Aquatic Drive sampled
2.3.3 Monitoring Parameters

Monitoring parameters have been selected on assessment of risk to water quality that may occur during the construction and operations phases.

During construction, the highest risk of impacts on water quality would be associated with:

- Exposure of soils during earthworks (including stripping of topsoil, excavation, stockpiling and materials transport), which may result in soil erosion and off-site movement of eroded sediments by wind and/or stormwater to receiving waterways, resulting in increased nutrients, metals and other pollutants.
- Accidental leaks or spills of chemicals, fuels, oils and/or greases from construction plant and machinery, which may result in pollution of receiving waterways.
- Disturbance of contaminated land causing contamination of downstream waterways, impacting on aquatic and riparian habitats.
- Changes to flow regimes, which can change the volumes and flow rates of water, leading to stagnation of a waterway and changes in turbidity, nitrogen and phosphorus levels. Leaching of tannins from stockpiles of cleared vegetation, which may have a number of adverse effects on receiving waters, including:
  - Increased biological oxygen demand, with consequent decreases in dissolved oxygen
  - Reduced water clarity and light penetration
  - Decreased pH.

Once the road upgrade is operating, there would be potential for impacts on soils, water quality and groundwater. However, the likelihood and severity of these potential impacts would be minimised by incorporating management and mitigation measures into the design of the road upgrade, as described in Water Quality Management Plan. These measures would protect soils, receiving waters and groundwater.

During operation, the main potential impact on water quality would be associated with runoff from stormwater and direct deposition of airborne particles, causing acute or chronic contamination of water quality in downstream waterways that receive discharged stormwater during rainfall events.

Pollutants from stormwater runoff include sediments, hydrocarbons, metals, and microbials. These deposits build up on road surfaces and pavement areas during dry weather and get washed off and transported to downstream waterways when it rains. Other pollutants in the atmosphere, derived from local and regional sources, would also be deposited and build up on the widened road pavement and contribute to impacts on water quality.

In addition, accidental spills of petroleum, chemicals and hazardous materials as a result of vehicle leaks or accidents, and waste discarded by motorists, could pollute downstream waterways and groundwater sources.

The potential impacts of reduced water quality on sensitive receiving environments have also been considered in the design. The project includes design measures to minimise the likelihood of impacts on water quality, operation of the project would be unlikely to
have an adverse impact on sensitive receiving environments and high risk areas.

Monitoring Data Summary

2.3.4 Monitoring Data for Background Flow and Wet Weather Flow

Data has been collected monthly at the six nominated surface water monitoring sites and one additional wet weather event sample location SW7. Sampling representing background flow has been conducted for eleven months from November 2014 to October 2015. Sampling for wet weather flow events have been conducted on 21/04/2015, 26/08/2015 and 25/09/2015.

TABLE 2.2 - SAMPLES COLLECTED TO DATE

<table>
<thead>
<tr>
<th>Monitoring Event</th>
<th>Sample Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1 SW2 SW3 SW4 SW5 SW6 SW7</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>11 11 11 11 11 11 --</td>
</tr>
<tr>
<td>Wet weather</td>
<td>3 3 3 3 3 3 1</td>
</tr>
<tr>
<td>Combined</td>
<td>14 14 14 14 14 14 1</td>
</tr>
</tbody>
</table>

A combination of field and laboratory surface water quality indicators including pH, Electrical Conductivity (EC), Redox (MV), Dissolved Oxygen (DO), Turbidity (NTU), Temperature (°C) and Total Dissolved Solids (TDS) were measured during each monitoring round. Tables 2-3 to 2-14 detail the median values of background flow and wet weather flow monitoring events which have occurred for each monitoring location. A combined value is also detailed which represents the median of all monitoring events (background flow and wet weather) which have occurred at each monitoring location.

TABLE 2.2 - LABORATORY MEASUREMENTS OF PH

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1 SW2 SW3 SW4 SW5 SW6 SW7</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>6.84 6.635 6.5 6.85 6.25 7.08 --</td>
</tr>
<tr>
<td>Combined</td>
<td>6.76 6.575 6.5 6.68 6.25 7.01 5.46</td>
</tr>
</tbody>
</table>

TABLE 2.3 - LABORATORY MEASUREMENTS OF ELECTRICAL CONDUCTIVITY (µS/CM)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1 SW2 SW3 SW4 SW5 SW6 SW7</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>413 423.5 312 445 448 313 --</td>
</tr>
<tr>
<td>Wet weather</td>
<td>250.5 273 134 207.5 308.5 220 227.5</td>
</tr>
<tr>
<td>Combined</td>
<td>407 407.5 292 396 424 283 227.5</td>
</tr>
</tbody>
</table>

TABLE 2.4 - FIELD MEASUREMENTS OF REDOX (MV)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1 SW2 SW3 SW4 SW5 SW6 SW7</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>104 84.5 96 101 90 74 --</td>
</tr>
<tr>
<td>Wet weather</td>
<td>91.5 71 123 83 81 42.5 58</td>
</tr>
<tr>
<td>Combined</td>
<td>104 82.5 96 86 88 58 58</td>
</tr>
</tbody>
</table>
### TABLE 2-5 - FIELD MEASUREMENTS OF DISSOLVED OXYGEN (PPM)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td></td>
<td>7.42</td>
<td>7.53</td>
<td>7.92</td>
<td>5.8</td>
<td>5.75</td>
<td>9.36</td>
<td>--</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>8.23</td>
<td>7.64</td>
<td>8.37</td>
<td>5.87</td>
<td>6.49</td>
<td>9.41</td>
<td>10.675</td>
</tr>
</tbody>
</table>

### TABLE 2-6 - FIELD MEASUREMENTS OF TURBIDITY (NTU)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td></td>
<td>1.8</td>
<td>3</td>
<td>4</td>
<td>1.1</td>
<td>24.8</td>
<td>3.3</td>
<td>--</td>
</tr>
<tr>
<td>Wet weather</td>
<td></td>
<td>9.1</td>
<td>7.1</td>
<td>6.85</td>
<td>6.85</td>
<td>26</td>
<td>5.9</td>
<td>61.7</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>2.3</td>
<td>4.2</td>
<td>4.3</td>
<td>1.6</td>
<td>24.8</td>
<td>3.3</td>
<td>61.7</td>
</tr>
</tbody>
</table>

### TABLE 2-7 - LABORATORY MEASUREMENTS OF TOTAL DISOLVED SOLIDS (MG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td></td>
<td>240</td>
<td>240</td>
<td>180</td>
<td>270</td>
<td>260</td>
<td>190</td>
<td>--</td>
</tr>
<tr>
<td>Wet weather</td>
<td></td>
<td>130</td>
<td>170</td>
<td>120</td>
<td>120</td>
<td>160</td>
<td>140</td>
<td>79</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>235</td>
<td>240</td>
<td>175</td>
<td>220</td>
<td>230</td>
<td>180</td>
<td>79</td>
</tr>
</tbody>
</table>

### TABLE 2-8 - LABORATORY MEASUREMENTS OF TSS (MG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
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<tbody>
<tr>
<td>Background</td>
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<td>&lt;10</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
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<tr>
<td>Wet weather</td>
<td></td>
<td>10</td>
<td>11</td>
<td>7</td>
<td>10</td>
<td>32</td>
<td>&lt;5</td>
<td>110</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>&lt;10</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>10.5</td>
<td>&lt;5</td>
<td>110</td>
</tr>
</tbody>
</table>

### TABLE 2-9 - LABORATORY MEASUREMENTS OF COPPER (DISSOLVED) (MG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td></td>
<td>0.002</td>
<td>0.001</td>
<td>&lt;0.001</td>
<td>0.002</td>
<td>0.001</td>
<td>0.001</td>
<td>--</td>
</tr>
<tr>
<td>Wet weather</td>
<td></td>
<td>0.004</td>
<td>0.003</td>
<td>0.004</td>
<td>0.004</td>
<td>0.005</td>
<td>0.005</td>
<td>0.003</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>0.002</td>
<td>0.001</td>
<td>0.001</td>
<td>0.002</td>
<td>0.0015</td>
<td>0.002</td>
<td>0.003</td>
</tr>
</tbody>
</table>

### TABLE 2-10 - LABORATORY MEASUREMENTS OF ZINC (DISSOLVED) (MG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
<th>SW7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td></td>
<td>0.011</td>
<td>0.011</td>
<td>0.016</td>
<td>0.034</td>
<td>0.012</td>
<td>0.011</td>
<td>--</td>
</tr>
<tr>
<td>Wet weather</td>
<td></td>
<td>0.019</td>
<td>0.016</td>
<td>0.021</td>
<td>0.046</td>
<td>0.012</td>
<td>0.024</td>
<td>0.026</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td>0.0125</td>
<td>0.013</td>
<td>0.0175</td>
<td>0.0405</td>
<td>0.0125</td>
<td>0.0125</td>
<td>0.026</td>
</tr>
</tbody>
</table>
TABLE 2-12 - LABORATORY MEASUREMENTS OF PHOSPHORUS (MG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SW1</td>
</tr>
<tr>
<td>Background</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Wet weather</td>
<td>0.06</td>
</tr>
<tr>
<td>Combined</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

TABLE 2-13 - LABORATORY MEASUREMENTS OF NITRATE (MG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SW1</td>
</tr>
<tr>
<td>Background</td>
<td>0.18</td>
</tr>
<tr>
<td>Wet weather</td>
<td>0.4</td>
</tr>
<tr>
<td>Combined</td>
<td>0.185</td>
</tr>
</tbody>
</table>

TABLE 2-124 - LABORATORY MEASUREMENTS OF TOTAL RECOVERABLE HYDROCARBONS (C10-C36 UG/L)

<table>
<thead>
<tr>
<th>Median Data</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SW1</td>
</tr>
<tr>
<td>Background</td>
<td>&lt;100</td>
</tr>
<tr>
<td>Wet weather</td>
<td>0.05</td>
</tr>
<tr>
<td>Combined</td>
<td>0.05</td>
</tr>
</tbody>
</table>

2.4 Assessment of potential construction impacts

Construction activities as part of the Stage 1 Project works, will principally involve widening of roads, which may require excavations below existing road levels. In addition services which run beside roads will need to be relocated; this applies to both Stage 1 and 2. This will involve excavation of the existing services and relocation to a new trench.

Due to extensive urbanisation of the study area and surrounding catchments, a reference site with available historical water quality data has not been established. It is considered that the study area has representative water quality sampling locations to characterise typical preconstruction water quality in a highly urbanised catchment in this area of Sydney.

Construction is due to commence in November 2015. Monitoring will continue up to, during, and post completion for a period of up to 3 years. Trigger values calculated in Section 7.2 are based on water quality data collected over seven months from November 2014 to May 2015. This monitoring is ongoing in dry weather and defined wet weather events. The monitoring methodology will continue until commencement of construction stages, for duration of construction and for the nominated operational monitoring as required by conditions of approval. As outlined in Section 7.2, revisions to trigger values may be required for subsequent stages, (i.e. Stage 2). Where this is required, the monitoring data collected up to that date would be used to recalculate values. These would require approval from the Secretary and relevant agencies.
The seven sampling periods conducted between November and May represent the months with the highest average rainfall for the year in this part of NSW. It is likely that the criteria calculated on this seven month period will generate suitable criteria for identifying contamination or pollution that may occur as a result construction during the higher risk time of the year where flows leaving site are more likely. The collected seven months of data is also the same time of year that the Stage 1 construction works will be commencing and therefore the data is likely to be representative for that time that Stage 1 works are being constructed.

The low risk characteristics of the Stage 1 scope works should be noted. It is not likely that Stage 1 scope of works will require construction basins and groundcover disturbance outside of existing road formation areas are limited. Therefore the Stage 1 scope of works is likely to represent a lower risk to impacting water quality due to limited construction area footprint and lower risk construction activity.

As shown in Figure 4.1 there are 6 drainage lines in the study area that capture drainage from both Stage 1 and Stage 2 projects. Figure 4.1 also shows that surface water monitoring sites capture all 6 drainage lines. Monitoring locations are located to observe and assess the impacts of the project on all drainage lines and have been selected based on getting as close to the construction footprint and having a reliable flow of water to enable monitoring all year round. Due to the construction area being at the top of the catchment, it is likely that some closer drainage features may provide opportunity to monitor during wet weather events.

The data collected in this monitoring program cannot be compared to other baseline data. This program has not established a comparable baseline data source due to extensive urbanisation of this catchment and adjacent catchments.

The condition of approval requires the SWMP be prepared for the Stage 1 Project. Impacts associated with the Stage 2 project in relation to SW4, SW5, and SW6 would be addressed should the Stage 2 project be approved and a similar condition imposed. However, as outlined above, and shown in Figure 4.1, all drainage lines in the study area capture drainage from both Stage 1 and 2 Projects and would continue to be monitored up to, during and post completion of both projects.

Current reference site locations for surface water quality are SW1 to SW6. SW7 is nominated as a wet weather monitoring location on Trefoil Creek. SW7 location is relatively closer to the construction works occurring on Wakehurst parkway and Frenchs Forrest Road East. SW7 will provide an earlier indication of acute water quality impacts that may be occurring before it is identified in SW2. Wet weather monitoring events will incorporate SW7 sampling in September 2015 and future reporting will include data from that location.

2.4.1 **Surface Water Impacts**

Construction activities have the potential to degrade water quality within the surrounding surface water environment, both in the immediate area of Stage 1 and the utility relocations within the Stage 2 construction impact area and within local receiving waters. Large-scale disturbance associated with the construction of Stage 1 has the potential to increase the volume of sediment deposited in the receiving drainage lines and the level
of turbidity present in stormwater discharging to the downstream waterways of Narrabeen Lagoon, Manly Dam and Bantry Bay.

Vegetation removal, cut and fill operations, the widening of roads and upgrades to drainage systems represent a risk to surface water quality during construction. Pollutants such as sediment, soil nutrients and construction waste have the potential to mobilise and subsequently enter drainage lines, particularly during high rainfall events, resulting in impacts to drainage lines and the receiving downstream environment.

Erosion and subsequent sedimentation resulting from the construction of Stage 1, if uncontrolled, could potentially have the following effects:

- Scour of drainage lines and creek beds due to high discharge velocities and increased flows
- Introduction of gross pollutants entering receiving creeks
- Declining water quality from the influx of man-made substances, increased sediment load and organic matter.

Spillage of fuel during refuelling, leakage of hydraulic and lubricating oil from plant and equipment, and release of rinse water from plant and washing concrete slurries can also lead to the pollution of surface water.

### 2.4.2 Identified Construction Activities Which May Have an Impact

Identified works and activities during construction and operation of the SSI, including emergencies and spill events, that have the potential to impact on surface water quality of potentially affected waterways may include:

- excavations for utilities / services relocation;
- excavation, widening and repaving roads;
- vegetation removal;
- fuel spills during refuelling;
- oil spills - broken hydraulic lines, leaking machinery;
- accidents, rollovers, collisions, lost loads;
- damage to services - water mains, gas, electricity;
- over topping sediment dams and erosion controls;
- loading and unloading of chemicals, spoil and liquids; and
- deliberate discharges by contractors and or public.

These activities and incidents may all allow contaminants to enter the surface water environment. Controls to limit or minimise the impact or potential for contamination must include:
- sediment and erosion control measures (sediment dams, grassed swales, silt fencing);
- dedicated bunded refuelling areas;
- dedicated and bunded vehicle / machinery wash down areas;
- regular machinery checks and maintenance;
- Incident response and control plan;
- adequate spill kits on site and training on use;
- personnel training and inductions on environmental responsibility;
- waste removal and disposal to correct receiver - i.e. portaloo to sewage, VENM to licensed receiver, contaminated material to licensed landfill etc.

The Construction Environment Management Plan and relevant sub-plans such as the Surface Water Management Plan shall provide further details on management measures to be implemented.

2.4.3 Potential Operational Impacts on Surface Water

It is anticipated that the Project would result in an increase in peak flows in the receiving drainage lines which drain predominantly to the north for Stage 1, and to the south for Stage 2.

Surface water runoff would increase during operation due to an increase in impervious surfaces and concentration of road runoff through drainage infrastructure. Operation of roads generally leads to the build-up of contaminants such as fuels, rubber, hydrocarbons, heavy metals and oils on road surfaces, median areas and roadside corridors. During rain events, such contaminants, depending on their physical and chemical properties, may be transported by road runoff into surrounding waterways. The risk of these impacts, and the severity of the impacts should they occur, would be dependent on the effectiveness of the pavement drainage and water quality controls developed as part of the drainage design for each Stage.

It should be noted that following the completion of post-construction monitoring period that an independent expert shall certify that affected waterways have been rehabilitated to an acceptable condition.
3. MONITORING PROGRAM OBJECTIVES

The primary objective of this SWQMP is to observe and assess the impact of the Project on surface water quality in the Project Area.

To achieve this objective, this document outlines the proposed monitoring locations, parameters and frequencies for surface water monitoring and reporting and covers the construction and operational phases of the project. The information collected as part of the monitoring program will be used to inform project management responses aimed at reducing or halting any adverse impacts detected.

The Northern Beaches Stormwater Management Plan (1999) provides overall catchment objectives as part of the best practice approach to managing the catchment in the short and long term. The objectives of the Northern Beaches Stormwater Management Plan identify short term and long term objectives. The short term objectives are based on what can be achieved in the five years and the longer term objectives and what can be achievable in twenty five years. The longer term objectives will likely require extensive and substantial change in people and industry’s habits and establishment of cheap technologies for removing pollutants. Northern Beaches Stormwater Management Plan outlines overall catchment stormwater quality management objectives in Table 5.3 of that document and have been consulted establishing this document.

The primary guideline that this WQDMP is based on is the Australian National Water Quality Management Strategy (NWQMS) (ANZECC & ARMCANZ 1994). The objective of the NWQMS (ANZECC & ARMCANZ 1994) is focused on ecologically sustainable development of water resources and is consistent with the objectives of the Northern Beaches Stormwater Management Plan.

The Interim Water Quality Objective Design Guidelines from the Warringah Council Creek Management Study 2004 were developed to establish water quality objectives for Warringah’s creeks. The objective levels relevant to the Project are presented in
Table 3-1. In the absence of information about in-stream ecosystems, the objectives use relevant trigger levels from the Australian and New Zealand guidelines (ANZECC, 2000).
### TABLE 3-1 INTERIM WATER QUALITY OBJECTIVES DESIGN GUIDELINES OF THE WARRINGAH COUNCIL CREEK MANAGEMENT STUDY 2004.

<table>
<thead>
<tr>
<th>Creek Impacted by Project</th>
<th>Interim Water Quality Objective (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total P</td>
</tr>
<tr>
<td>Curl Curl</td>
<td>0.010</td>
</tr>
<tr>
<td>Bantry Bay &amp; Middle</td>
<td>0.010</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creek Impacted by Project</th>
<th>Interim Water Quality Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dissolved Oxygen %</td>
</tr>
<tr>
<td>Curl Curl</td>
<td>90-110</td>
</tr>
<tr>
<td>Bantry Bay &amp; Middle</td>
<td>90-110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creek Impacted by Project</th>
<th>Interim Water Quality Objective (ug/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cadmium</td>
</tr>
<tr>
<td>Curl Curl</td>
<td>0.006</td>
</tr>
<tr>
<td>Bantry Bay &amp; Middle</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### 3.1 Monitoring Study Design

This monitoring program involves repeat sample collection at static locations within the surrounding catchment area. The collection of repeat data over a known time period enables an assessment of changes in water quality that may result from implementation of the project; as such, this program is described by the Australian Guidelines for Water Quality Monitoring and Reporting as a “study that measures change” (2000: 3-3). The basic premise of this methodology is that suitable spatial and temporal monitoring is built into the study design.

#### 3.1.1 Surface Water Study Design

Condition B7 of the Project Approval requires that the time period for data collection include the pre-construction period. Monitoring during the pre-construction project phase enables a “BACI” (before-after/control-impact) monitoring approach which involves the collection of data “before” and “after” a known activity has the potential to impact the environment (ANZECC & ARMCANZ 2000b: 3-3). Pre-construction monitoring has been
undertaken since November 2014 and a summary of the results are presented in Section 2.3.1 with the complete results provided in Appendix A.

This type of monitoring program allows for measurement of trends in water quality and simple correlations between characteristics (e.g. rainfall events and water quality responses, or Total Suspended Solids (mg/L) and Turbidity (NTU) measurements).

The inclusion downstream impact sites outside of the construction footprint means that the study can capture preconstruction water quality parameters to assist in identifying any natural pre-existing variation in water quality in downstream locations. This allows for a causal focus in the monitoring program which avoids inappropriately attributing natural downstream changes in water quality to the Project construction activities or operational activities.
4. **MONITORING PROGRAM**

The monitoring program for surface water for the Project proposes to use 6 dedicated surface monitoring locations Figure 4-1. These locations were specifically chosen to be outside the construction footprint of the project to ensure continuity from pre to post construction.

4.1 **Surface Water Monitoring Locations**

The three sub catchments engaged by the study area include Manly Creek, Bantry Bay and Middle Creek. The study area is at the top of each catchment and monitoring is limited to downstream monitoring site. The monitoring locations have been selected to identify potential water quality impacts on creeks and tributaries and existing users.

While ideally all watercourses selected for inclusion in a SWQMP would be permanent waterways, the nature of the existing environment (including the catchment shape, size and rainfall patterns) and Project location (surface water divide between 3 catchments) means that there are a number of sites that may sometimes be dry. It is important that these sites are included in the SWQMP even if samples can only be taken following rainfall events.

The roads which are to be upgraded as part of the Stage 1 Project contribute to runoff in three drainage lines in the Middle Creek Catchment. Drainage Line 1 forms the main arm of Middle Creek and drains the section of road corridor between Adam Street and Gladys Avenue. The section of the road corridor between Gladys Avenue and Romford Road drains to Drainage Line 2, which is referred to as Trefoil Creek and is a tributary of Middle Creek. Drainage Line 3 is an unnamed tributary to Middle Creek that drains the section of the Project corridor between Romford Road and Courtley Road. The combined system (Middle Creek) then flows East through an alluvial floodplain before eventually discharging into the western side of Narrabeen Lagoon

The utility relocations within the subsequent Stage 2 construction impact area is located principally within the headwaters of Middle Creek, which drains south into Bantry Bay in Middle Harbour Creek. Curl Curl drains south into Manly Dam. Runoff from two short sections of Warringah Road and a short section of Allambie Road presently discharges north into the Middle Creek catchment.

Baseline monitoring that is currently being conducted at SW1 to SW6 will be retained for the duration of requirement as these locations have demonstrated to be reliable through dry weather and wet weather periods.

Additional monitoring locations were considered closer to the study area, however due to locations of the study area being at the top of the catchment, closer sites appeared to be ephemeral and may represent an unreliable source of water to monitor. This is confirmed in the Stage 2 surface water quality working paper which shows Trefoil Creek running almost dry in the upper catchment during dry weather. Access may be a constraint, and in the case of Drainage Lines 1, 3, 4 and 5, the upper reaches are confined to stormwater in residential areas. Based on the constraints outlined above and the reliability of the data, no additional dry weather sites are proposed to supplement the baseline data.
However, an additional wet weather monitoring site in the upper reaches of Trefoil Creek (refer to Figure 4.1), will be added to the monitoring program for the construction phase only. This site will be sampled during wet weather events only.

In addition, the SWMP provides that should any of the monitoring sites exceed the trigger values, further investigation would commence. This may include the requirement of additional monitoring locations, where reasonable and feasible. The requirement for inclusion of additional sites would need to be consultation with relevant agencies as required.

The surface water monitoring locations for the Project are listed in Table 2-1 and shown on Figure 4-1.
Figure 4-1: Location of Groundwater and Surface Water Monitoring Points
4.2 Monitoring Parameters

The water quality monitoring parameters included in the SWQMP have been chosen based on the:

- The parameters included in earlier monitoring programs within the region (e.g. by SMEC for the Northern Beaches Hospital proposed site).

The physical parameters (i.e. pH and EC) and the major anions and cations are sampled in order to assess basic water characteristics as they are the major constituent of water and therefore indicate the water type and quality. Changes in quality resulting from exposure of acid soils or rock would be evident from a change in the major anion and cation ratios. For example, changes to the sulphate, chloride or sodium levels may be observed without a significant change in pH to indicate the presence/exposure of acid soils or acid rock. Nutrients provide an indication of contamination from organic sources and TPH is an indicator for pollution from hydrocarbons e.g. oils and greases. The metals provided are the most common trace constituents of water and generally form a standard metals analysis suite. They provide an indicator for changes over time. The Project is not expected to influence faecal coliform counts and therefore this parameter is not included in the monitoring program. During construction the results will be compared to the pre-construction results and the trigger levels presented in Section 7.2, which will be the maximum (or range) value recorded. The trigger levels have been finalised as part of the pre-construction monitoring undertaken from November 2014 of May 2015.

Table 4-1 outlines the monitoring parameters, the analysis location (i.e. in-field/laboratory), and applicability to surface water monitoring. Monitoring sites may only be removed if project boundaries contract for any reason and relevance of the monitoring location to the revised project boundary is redundant.
### TABLE 4-1 - WATER QUALITY MONITORING PARAMETERS

<table>
<thead>
<tr>
<th>Parameter Type</th>
<th>Parameter</th>
<th>Surface water (SW) Monitoring</th>
<th>Analysis Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Properties</td>
<td>pH</td>
<td>SW</td>
<td>Field and Laboratory Analysis</td>
</tr>
<tr>
<td>Dissolved Oxygen (DO)</td>
<td>SW</td>
<td>In Field</td>
<td></td>
</tr>
<tr>
<td>Physical Properties</td>
<td>Electrical Conductivity</td>
<td>SW</td>
<td>Field and Laboratory Analysis</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>SW</td>
<td>Field</td>
</tr>
<tr>
<td></td>
<td>Turbidity (NTU)</td>
<td>SW</td>
<td>Field</td>
</tr>
<tr>
<td></td>
<td>Total Suspended Solids (TSS)</td>
<td>SW</td>
<td>Laboratory Analysis</td>
</tr>
<tr>
<td></td>
<td>Total Dissolved Solids (TDS)</td>
<td>SW</td>
<td>Laboratory Analysis</td>
</tr>
<tr>
<td>Chemical Properties</td>
<td>Hydrocarbons (TPH/BTEX/PAHs)</td>
<td>SW</td>
<td>Laboratory Analysis</td>
</tr>
<tr>
<td></td>
<td>Dissolved Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Iron, Mercury)</td>
<td>SW</td>
<td>Laboratory Analysis</td>
</tr>
<tr>
<td></td>
<td>Total Metals (Aluminum, Iron, Manganese)</td>
<td>SW</td>
<td>Laboratory Analysis</td>
</tr>
<tr>
<td>Nutrients</td>
<td>Total Nitrogen, Total Phosphorus, Nitrite, Nitrate, Ammonia</td>
<td>SW</td>
<td>Laboratory Analysis</td>
</tr>
</tbody>
</table>

If monitoring locations are to be withdrawn or parameters minimised from the program consultation with the Department of Planning and the Environment, the EPA, the NOW and Warringah Council would be undertaken for proposed alterations to the monitoring program (parameters/sites/frequency).

### 4.3 Rainfall Records

Rainfall within the catchment can influence the water quality detected through the monitoring program. Records of daily rainfall should be obtained from the following station/s to enable interpretation of any rainfall influence as required:

- Belrose (Evelyn Place) Station Number 66188; and
- Frenchs Forest (Frenchs Forest Road) Station Number 66182.

During construction, the use of site established Automatic Weather Stations may supersede the need to rely on the above Bureau of Meteorology weather stations and
would be considered to be more indicative of rainfall experienced on site. Reference to the rainfall data source should be included in reporting.

4.4 Sampling Duration and Frequency

The SWQMP will be ongoing for a minimum of three years following the commencement of operation or until the affected waterways are certified by an independent expert as being rehabilitated to an acceptable condition, unless otherwise agreed by the Secretary, as per CoA B7.

The proposed sampling frequencies for surface water must consider rainfall events. The sampling frequencies for surface water are outlined in Table 4-2. To ensure the program is cost effective a duplicate sample shall be collected each round and a triplicate sample, including trip blank and trip spike, shall be collected every round hydrocarbons are observed during the sampling.

The frequency of sampling has been designed in line with the RMS Guideline for Construction Water Quality Monitoring (RTA undated) and includes sampling following “wet events” when water quality impacts from the project are likely to be most evident (for example, due to erosion and sediment loss). A wet event is defined as "10 millimetres of rain fall within a 24 hour period", sampling must occur within 24 hours of this rainfall event.

The sampling frequency has been designed to ensure a comprehensive set of baseline data is established during the pre-construction period. During the construction and operational phases, if repeated results demonstrate that the site or parts of the site have stabilised, sampling parameters, frequencies and locations should be reviewed in order to reduce or discontinue monitoring (RTA undated: 9).

If sampling frequencies are to be reduced, or individual parameters or sites are to be withdrawn from the program, it should be demonstrated that there is no longer an impact over a minimum period of 6 months and that the corresponding construction site catchment is adequately stabilised and permanent works effectively completed (RTA undated: 10). Any proposed alteration to the sampling frequency would be undertaken in consultation with the EPA, the NOW and Warringah Council.

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>All parameters: one wet event per month and one dry event per month</td>
</tr>
<tr>
<td>Operation / Post Construction</td>
<td>Year One - all parameters: month and one wet event per quarter</td>
</tr>
<tr>
<td></td>
<td>Year Two - reduced to quarterly one wet one dry if no impact is observed</td>
</tr>
<tr>
<td></td>
<td>Year Three - reduced to twice per year, one wet one dry if no impact is observed</td>
</tr>
</tbody>
</table>
The nominated period of monitoring is likely to represent the higher risk period of impact to water quality in connected waterways. It is likely that the catchment area of the project will be effectively stabilised within the first year post construction and therefore the reducing the water quality monitoring program will identify this water quality improvement is appropriate in years 2 and 3. In the event that water quality is not improving or stabilisation of the catchment is not complete, then year 1 monitoring should be repeated and reassessed at the completion of the subsequent 12 months.

In accordance with Blue Book requirements, for large land disturbance activities like the proposed works, consideration should be given to establishing a site-specific relationship between suspended solids concentration (also reported as mg/L non-filtrable residue (NFR) and turbidity (measured in nephelometric turbidity units (NTU)) to allow a more rapid assessment of stormwater quality at the site. Samples collected for this purpose should be taken following a reasonable settling period.

This relationship will need to be calculated during the initial construction phase and the correlation calculation is to be checked periodically throughout the project cycle to confirm representativeness of the correlation calculated remains relevant.

The parameters of this correlation period are to be specified in the Construction Environment Management Plan and in consultation with relevant agencies.
5. FIELD MEASUREMENTS AND OBSERVATIONS

5.1 Field Measurements

Turbidity (NTU), temperature, pH and dissolved oxygen (DO) should be measured in-field as the value of the parameter may change after collection.

All in-field monitoring equipment should be calibrated once per year by a NATA accredited laboratory. At the start of each day of monitoring appropriately trained water quality monitoring personnel shall calibrate in field equipment according to the manufactures instructions. An appropriate calibration solution is to be used and a record of calibration kept on file and provided with reporting. Surface water monitoring locations will be sampled using grab sampling techniques directly into laboratory supplied sample bottles.

Monitoring of parameters such as pH in the field and laboratory is conducted as part of overall monitoring QA/QC. Assessment or comparison of field monitoring data and laboratory data for these parameters provides opportunity to identify potential errors in sampling methodology and or instrumentation error.

5.2 Field Observations

Field record sheets should capture as a minimum the following information, where appropriate, at each site for preconstruction, construction and operational phase monitoring:

- On the first sampling event, the site should be recorded with a GPS and a detailed description of the exact position of each sampling site should be recorded along with the site reference number so that it can be re-visited in subsequent sampling rounds to ensure consistency of data. It is important to use a single coordinate system and to record which coordinate system is used, especially the datum and projection;

- The site number;
- The date and time when samples are taken;
- The name of the person who is taking the sample;
- Detailed description of sample;
- Weather conditions;
- Visual observations of oil / grease in the water;
- Odours;
- Photographic records to be taken at the site during the first sampling event, when there is change in the surrounding landscape and at each event during construction;
- The water depth where samples are collected in shallow water bodies (i.e. less than 250 millimetres);
- Whether the waterbody was moving or still (e.g. in low flow periods only ‘pools’ of water may be available for sampling) and
- Any other observations on site conditions that may assist in interpretation of the data.

The field sheets should be included with reports where appropriate.
6. **SAMPLING PROTOCOL**

The sampling protocols outlined in this section follow the Australian guidelines for water quality monitoring and reporting (ANZECC/ARMCANZ 2000b).

6.1 **Sample Collection**

Samples should be collected by methods that obtain a representative water sample and avoid contamination. Where possible, samples should be collected from moving water. Surface water samples should be collected by immersing a sample bottle just below the surface at a depth of approximately 250 to 500 millimetres. In shallow water bodies (i.e. less than 250 millimetres deep) a sample should still be taken however the depth of water should be noted on the field record sheet. When sampling for oils and grease, contribution from surface films should be avoided. If terrain will not permit the sampler to get within reaching distance of the water an extension pole should be used to reach the water.

The sampling methods employed for both surface and groundwater measurements should observe the following requirements:

- In-filed monitoring equipment should be calibrated once per year by a NATA accredited laboratory and then monthly by appropriately trained water quality monitoring personnel (a calibration record must be kept);
- Use of disposable gloves;
- Field measurements to be made on separate sub-samples of water - each volume of water removed should be kept separate and measured;
- Containers and field equipment must be cleaned before use;
- Sample bottles suitable for each parameter must be used (use of containers supplied by the analytical laboratory is recommended);
- The volumes of water taken should be small and disposal of excess sample water is to be onsite, downhill and way from the relevant stream, river or piezometer;
- Rinse the collection container and field equipment between locations with clean (i.e. non-borehole/river) water;
- Sample bottles are labelled with the date and time and filled according to laboratory instructions (e.g. no headspace for TPH);
- Samples are to be kept chilled whilst in transit to a NATA approved laboratory within holding periods and under chain of custody protocols; and
- Sampling staff should be trained and use standard techniques to avoid contamination when handling sample containers (e.g. avoid touching the sample and the insides of caps or containers).
6.1.1 Sample Preservation

It is usually necessary to preserve water samples to retard chemical and physical changes that can occur after the sample has been removed from the water source (ANZECC/ARMCANZ 2000b). The time between sampling and analysis should be minimised wherever possible. Ideally, the samples should be cooled to 4°C and stored in an esky or vehicle refrigerator for delivery to the laboratory. Laboratory staff should be consulted for advice on the most suitable sample preservation methods, including the selection of appropriate containers and the need for addition of any sample preservatives at time of collection.

6.1.2 Wet Weather Sampling Events

In addition to the monthly sampling events, one ‘wet’ event and one ‘dry’ sampling events of the surface water monitoring locations are proposed.

A wet weather monitoring event would be triggered when a rainfall event of 10mm (or greater) within a 24 hour period is recorded within the Frenchs Forest area.

6.2 Quality Assurance and Quality Control

Fieldwork will be performed by experienced and suitably qualified personnel. Field and laboratory QA/QC requirements compliant with National Environmental Protection Council (1999) requirements are outlined below. Field QA/QC for this project consists of blind replicates (duplicate samples) and trip spikes and trip blanks (if required) and will be implemented during the monitoring program for both surface water samples. Rinsate samples are not required for this project as field sampling equipment will be either dedicated or disposable.

6.2.1 Replicate Samples

Replicate samples are two or more samples collected simultaneously to establish the reproducibility of sampling (ANZECC/ARMCANZ 2000b: 4-16).

Duplicate samples will be collected to assess the variation in analyte concentrations between samples collected at the same sampling point and to assess the repeatability of the NATA accredited laboratories analytical procedure. Duplicate samples will be collected at a rate of 1 per 10 samples and analysed as a “blind” duplicate sample at the NATA accredited primary laboratory. The Field Data Sampling Sheets will identify the parent sample and associated duplicate identifier which shall not bear any association to the parent name.

Duplicate samples are provided by the collection of two samples from the same location. These samples are preserved, stored, transported, prepared and analysed in an identical manner. As a minimum, the results of the analyses on the blind duplicate sample pair are assessed by calculating the Relative Percentage Differences (RPDs) between the results. The RPD is calculated as the difference between the results divided by their mean value and expressed as a percentage. If the RPD exceeds the value adopted for any analytes, additional sampling or retesting (which may be problematic with respect to analyte holding times) of the sample may be required.
Inter-laboratory duplicate samples provide a check on the analytical proficiency of the primary laboratory. Inter-laboratory duplicate samples are collected from the same location as the blind duplicate samples, and therefore can be called a triplicate sample. Inter-laboratory duplicate samples are preserved, sampled, stored, transported, prepared and analysed in a manner identical to the duplicate and parent samples. Inter-laboratory duplicate samples will be collected at a rate of 1 per 20 samples (5%) and analysed at the NATA accredited secondary laboratory.

### 6.2.2 Trip Blanks, Trip Spikes and Rinsate Samples

Trip blanks consisting of pre-washed bottles containing distilled or de-ionised water and appropriate preservatives supplied by the analytical laboratory. The purpose of trip blanks is to detect potential contamination of the sample batch during transport. The samples remain in sample vessels (usually eskies) during sampling activities and are not opened in the field. Trip blanks are analysed at the laboratory as regular samples or only for volatiles as deemed appropriate.

Laboratory prepared VOC (trip) spikes consisting of distilled, de-ionised water or sand spiked with known concentrations of BTEX are included in QA/QC programmes where TPH and BTEX concentrations are being measured. Laboratory prepared VOC spikes should be included at a rate of one per sample batch. These samples should be submitted for BTEX and TPH (C6-C10) analysis with results compared with the known additions. The purpose of these samples is to monitor VOC losses during transit.

Rinsate blanks consist of pre-preserved bottles filled with laboratory prepared water that has been passed over decontaminated field equipment. Rinsate blanks are prepared on site, labelled with a unique sample ID and transported to the primary laboratory for analysis as environmental samples. The purpose of the rinsate blanks is to determine the effectiveness of decontamination procedures.

Rinsate samples are not required for this project as dedicated and/or disposable sampling equipment will used at each sampling location.

### 6.3 Chain of Custody Information

At all points in the sampling process (e.g. in-field, during transport and during laboratory analysis) chain of custody information must be recorded. This enables tracing of any errors during the sampling process and improvement of future protocols where problems are identified. To ensure clear identification of all samples in the laboratory, all sample containers must be indicated in a clear and lasting manner. Blind samples should be submitted to the laboratory as individual samples without any indication of which sample they replicate or that it is a replicate.

### 6.4 Laboratory Analysis

The laboratories selected for the monitoring program must be accredited by the National Association of Testing Authorities (NATA). Analytical methods will comply with NEPM and NSW EPA requirements, with laboratory detection limits used in the laboratory tests to be, where practical, less than the adopted site assessment criteria.
The accuracy and precision of the laboratory analysis is assessed to identify if results of any samples may have been compromised. Laboratory QAQC reports will be assessed for internal laboratory samples outside the acceptable recovery range for spikes.

6.4.1 Laboratory Limits of Reporting

Laboratory non-detectable levels are considered acceptable when the result is less than the lower limit of detection (LLD) for analysis where the lower limit of detection is higher than the site criteria guidelines. Different laboratories have different lower limits of detection and as such some criteria guidelines have been adopted from testing on equipment which may have a lower limit of detection than that which is practically available in Australia.
7. DATA ANALYSIS

7.1 Data Analysis

The use of percentiles (80th and 20th etc.) for assessing impacts or setting trigger values (Australian and New Zealand guidelines for fresh and marine water quality - Volume 1 (ANZECC ARMCANZ, 2000a) and the Australian guidelines for water quality monitoring and reporting (ANZECC ARMCANZ, 2000b) is commonly used based on pre-construction monitoring data. However, in very few instances does pre-construction or baseline monitoring covers a sufficiently long period of time and range of natural climatic conditions to be representative. Using percentiles based on this data can lead to exceedances of triggers which are in fact within the natural range, but not within the observed range of pre-construction monitoring. In addition the site is located at the top of the catchment, dry monitoring events are common and there are NO upstream sampling locations for comparison.

In general terms, an exceedance of the trigger values does not mean a pollution event has occurred and may not mean environmental harm has occurred.

In the event that a water quality parameter is exceeded, it is recommended for specific investigations to commence and a remedial response developed if required. These procedures should be described in construction EMP and are most likely going to engage additional control measures and monitoring locations to close out the issue.

7.2 Trigger Values and Comparison of Sampling Data

During construction the results will be compared to the pre-construction results and the trigger levels presented in this monitoring program, which will be the median, range value (pH) recorded or ANZECC 90% protection (SW1, SW2, SW3 and SW6) and ANZECC 95% protection (SW4 and SW5). The trigger levels have been finalised as part of the pre-construction monitoring undertaken up to the beginning of May 2015.

Trigger values have been developed based on the pre-construction monitoring. The Interim Water Quality Objectives outlined in the Warringah Council Creek Management Study 2004 (refer
Table 3-1) should be considered as objectives rather than trigger values for the Project. The comparison against the criteria set out in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (Australia and New Zealand Environment Conservation Council, 2000) have been determined to not reflect the various analyte variations monitored across the site. The Project is located at the top of the surrounding catchments which does not allow up-gradient monitoring points to be used for comparison for surface waters. The Project is also located within a disturbed urban environment. The water quality analytes monitored during the pre-construction monitoring provide the baseline conditions for the surface waters and therefore the trigger values that will be used to assess the impacts on surface from the Project.

Monitoring will continue up to, during, and post completion for a period of up to 3 years. Trigger values are based on water quality data collected over seven months from November 2014 to May 2015. This monitoring is ongoing in dry weather and defined wet weather events. The monitoring methodology will continue until commencement of construction stages, for duration of construction and for the nominated operational monitoring as required by conditions of approval. As outlined in Section 7.2 of the SWMP, revisions to trigger values may be required for subsequent stages, (ie Stage 2). Where this is required, the monitoring data collected up to that date would be used to recalculate values. These would require approval from the Secretary and relevant agencies.

The seven sampling periods conducted between November and May represent the months with the highest average rainfall for the year in this part of NSW. It is likely that the criteria calculated on this seven month period will generate suitable criteria for identifying contamination or pollution that may occur as a result construction during the higher risk time of the year where flows leaving site are more likely. The collected seven months of data is also the same time of year that the Stage 1 construction works will be commencing and therefore the data is likely to be representative for that time that Stage 1 works are being constructed.

The low risk characteristics of the Stage 1 scope works should be noted. It is not likely that Stage 1 scope of works will require construction basins and groundcover disturbance outside of existing road formation areas are limited. Therefore the Stage 1 scope of works is likely to represent a lower risk to impacting water quality due to limited construction area footprint and lower risk construction activity.

The trigger values for electrical conductivity, turbidity total suspended solids and total dissolved solids have been derived using the median value recorded during pre-construction monitoring undertaken up to and including the beginning of May 2015. The trigger levels for pH are derived as being a value outside of the range that has been ANZECC guidelines for Lowland Rivers of 6.5-8.0. Wet weather event sampling has been incorporated into the development of the trigger levels which are presented in Table 4-2.

SW5 represents a highly disturbed catchment. Adjacent to this location is a council street sweeping clean out and plant yard, Wakehurst Parkway intersection and Warringah Road, NBH Construction site and the former Brickpit reserve. NTU data for this location at 140 NTU may represent a highly disturbed catchment condition already existing.
TABLE 7-1 ADOPTED TRIGGER VALUES FOR WATER QUALITY MONITORING

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SW1</td>
</tr>
<tr>
<td>Middle Creek Catchment</td>
<td>Curl Curl Creek Catchment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyte</th>
<th>SW1</th>
<th>SW2/ SW7</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC (µS)</td>
<td>125-2,200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (pH unit)</td>
<td>6.5-8.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS (mg/L)</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate P (mg/L)</td>
<td>&lt;0.021*</td>
<td>&lt;0.014*/&lt;0.018*</td>
<td>&lt;0.005</td>
<td>&lt;0.006*</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Nitrite as N (mg/L)</td>
<td>&lt;0.0065*</td>
<td>&lt;0.062*/&lt;0.006*</td>
<td>&lt;0.006*</td>
<td>&lt;0.006*</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Nitrate as N (mg/L)</td>
<td>&lt;3.4</td>
<td>&lt;0.7</td>
<td>&lt;3.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Median value derived from water quality data adopted as criteria.

<table>
<thead>
<tr>
<th>Analyte (mg/L)</th>
<th>SW1</th>
<th>SW2/ SW7</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>&lt;0.0042</td>
<td>&lt;0.0013</td>
<td>&lt;0.0042</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>&lt;0.004</td>
<td>&lt;0.0002</td>
<td>&lt;0.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>&lt;6</td>
<td>&lt;1</td>
<td>&lt;6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>&lt;0.002*</td>
<td>&lt;0.0018*/0.003*</td>
<td>&lt;0.0018</td>
<td>&lt;0.002*</td>
<td>&lt;0.0015*</td>
<td>&lt;0.002*</td>
</tr>
<tr>
<td>Lead</td>
<td>&lt;0.0056</td>
<td>&lt;0.0034</td>
<td>&lt;0.0056</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>&lt;0.015</td>
<td>&lt;0.015*/&lt;0.026*</td>
<td>&lt;0.0175*</td>
<td>&lt;0.0405*</td>
<td>&lt;0.0125*</td>
<td>&lt;0.015</td>
</tr>
<tr>
<td>TPH Visable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Median value derived from background water quality data adopted as criteria.
Pre-construction monitoring will continue as construction commences and post construction as required. Should revisions to adopted trigger values be deemed necessary for subsequent project stages and approvals, trigger values may be recalculated based on water quality data collected up to that date and will be provided to the Secretary and relevant agencies for further consultation as necessary.

Refer to Section 9 for adopted site assessment criteria with respect to potential contamination.
7.2.1 **Assessment Procedure**

The procedure for assessing construction monitoring data against pre-construction will be as per Figure 7.1.

![Data assessment flow chart](image_url)

Figure 7.1: Data assessment flow chart
8. REPORTING

The reporting schedule is outlined in Table 8-1 and is based on the reporting requirements outlined in the Australian Guidelines for Water Quality Monitoring and Reporting (2000b). All reports are provided directly to RMS, Department of Planning and Environment, EPA, the NOW and Warringah Council.

Reporting during the construction stage will include annual reports and a final report at the completion of each construction stage. Warringah Council to be notified immediately of any incident detected in Warringah Council creek lines in accordance with water quality monitoring.

The reports will include any relevant discussion of the results to inform the ongoing management of the surface water (and groundwater) management measures and the results will be discussed and minuted at the Environmental Review Group meetings.

Annual reports will be forwarded to RMS, Department of Planning and Environment, EPA, the NOW, Warringah Council and made publically available as required by COA. Annual reports will include:

- introduction and background: description of the program and objectives and defining the extent of the highway upgrade works;
- experimental detail, describing the sampling regime and parameters including detail of the sampling locations so they can be unambiguously identified, e.g. GPS directions and descriptions of methods of sampling and analysis;
- presentation, interpretation and discussion of the results;
- review and recommendations for the monitoring program for the construction and operational stages; and
- appendices, providing:
  - Field sheets;
  - Field water quality;
  - Laboratory results report.

Similarly, the final report at the completion of the construction stage will be of a similar format to that outlined above and will include (if applicable) recommendations and or changes for the operational monitoring program. The final report will also be forwarded to RMS, Department of Planning and Environment, EPA, the NOW and Warringah Council.
### TABLE 8-1 - REPORTING FREQUENCY

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Reporting Timing</th>
<th>Reporting Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Annually</td>
<td>A detailed report on all results obtained during the previous 12 months of the construction monitoring period including discussion of whether the results indicate adverse impacts on water quality or groundwater levels and a need to improve the existing management measures. Report provided to update the WQMP.</td>
</tr>
<tr>
<td>At the Completion of Construction</td>
<td></td>
<td>A detailed report on all results obtained during the construction monitoring period. This report should also provide advice regarding ongoing monitoring (and management) of water quality impacts and groundwater levels during the operational phase of the project. This report to update the WQMP and made publically available as required by COA.</td>
</tr>
<tr>
<td>Triggered Event</td>
<td></td>
<td>A brief report outlining the results leading to a triggered event, results of the un-scheduled monitoring event and assessment of the cause / source of the identified impact / contamination and what action (if any) was taken. Where required, identified impacts would be recorded as environmental incidents in accordance with RMS’s Environmental Incident Classification and Reporting Procedure. Warringah Council to be notified of any incidents immediately as well as a report being produced.</td>
</tr>
<tr>
<td>Post Construction / Operation</td>
<td>Annually</td>
<td>A detailed report on all results obtained during the previous 12 months of the operational monitoring period including discussion of whether the results indicate a need to improve the permanent water quality and (where relevant) groundwater level management measures (e.g. sediment basins and site rehabilitation/stabilisation). This report to update the WQMP and made publically available as required by COA.</td>
</tr>
<tr>
<td>At Completion of 3 years or when independently certified as being rehabilitated to an acceptable condition</td>
<td></td>
<td>A final and detailed report on all results obtained during the operational monitoring period. This report should provide advice regarding the need for any further water quality monitoring and management.</td>
</tr>
</tbody>
</table>
9. MANAGEMENT ACTIONS

The SWQMP will guide water quality monitoring during the pre-construction, construction and operational phases of the project. This document will form part of the Construction Environmental Management Plan.

Where adverse water quality impacts are identified in the monitoring reports, the mitigation and management measures (as well as in the CEMP and SWMP) must be reviewed and adjusted to ameliorate the identified impacts, if required. Where required, identified impacts would be recorded as environmental incidents in accordance with RMS’s Environmental Incident Classification and Reporting Procedure. During the construction phase, the relevant construction contractor will be required to revise and implement the necessary management actions in consultation with EPA, the NOW and Warringah Council.

9.1 Document Review

The SWQMP shall be reviewed on a yearly basis following approval. During the operational phase of the project, this document will be reviewed on an annual basis as part of the RMS environmental management systems.

This review may involve changes to trigger levels and associated actions, changes in monitoring locations and the addition of new monitoring locations. The document should also be reviewed and revised if there is significant change in the design of the Project.

9.2 Site Assessment Criteria

Evaluation against the site assessment criteria is used to identify levels of contamination that may pose ecological or health risks to the construction phase and future users of the site. It is noted that a new, amended National Environment Protection (Assessment of Site Contamination) Measure (NEPM) has been approved by all Australian States:

- National Environment Protection (Assessment of Site Contamination) Measure (NEPM) - Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater. The NEPM was first published in 1999, and updated in 2013 by the National Environment Protection Council (NEPC) and provides national standards for a variety of environmental issues, including the assessment of site contamination.

The 2013 version of the NEPM references:


Table 9-1 outlines the criteria values of contaminants of concern which will be used in the surface water and assessment of potential contamination if required. It is considered important to assess the potential contamination levels that may occur based on the sites known environmental areas of concern, specifically of hydrocarbons, given four service
stations are located in and around the Project area. Specific construction activities within areas of environmental concern may require specific mitigation plans.

Any groundwater that is extracted during excavation works is required to meet the ANZECC (2000) 95% protection level for freshwater before it can be discharged to a surface water system. In addition the EPA may require water that is to be discharged, under the appropriate EPA licence, to meet other quality conditions.

**TABLE 9-1 - ADOPTED ASSESSMENT CRITERIA (µG/L)**

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>ANZECC (2000) 95% Freshwater</th>
<th>ANZECC (2000) 90% Freshwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>METALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>13</td>
<td>42</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Chromium (VI)</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Copper</td>
<td>1.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Lead</td>
<td>3.4</td>
<td>5.6</td>
</tr>
<tr>
<td>Mercury (inorganic)</td>
<td>0.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Nickel</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Zinc</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>PETROLEUM HYDROCARBONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRH C₆-C₁₀</td>
<td>Visually obvious</td>
<td></td>
</tr>
<tr>
<td>TRH C₁₀-C₁₆</td>
<td>Visually obvious</td>
<td></td>
</tr>
<tr>
<td>TRH C₁₀-C₉</td>
<td>Visually obvious</td>
<td></td>
</tr>
<tr>
<td>TRH C₁₀-C₃₆</td>
<td>Visually obvious</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>950</td>
<td>1300</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>80 (low reliability)</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>180 (low reliability)</td>
<td></td>
</tr>
<tr>
<td>Xylenes (o)</td>
<td>350</td>
<td>470</td>
</tr>
<tr>
<td>Xylenes (p)</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>Xylenes (total)</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>PAH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total PAH</td>
<td>EQL</td>
<td></td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>EQL</td>
<td></td>
</tr>
<tr>
<td>Naphthalene</td>
<td>16</td>
<td>37</td>
</tr>
</tbody>
</table>

* EQL - estimated quantitative limits

Exceedance of the assessment criteria in Table 9-1 may require a confirmation sampling round or changes to the monitoring program procedures to ensure safety, in consultation with the RMS.
9.3 Surface Water Management Actions

9.3.1 Construction

The key mitigation measures for the construction stage will be sediment basins and additional erosion and sediment controls to intercept run-off and retain the associated sediments and pollutants. Maintenance and monitoring of these measures by the Contractor will form a key component of the mitigation measures. The measures will address the relevant CoA and the safeguards detailed in the EIS and Submission &/Preferred Infrastructure Report. The measures will be formulated at the detailed design stage as part of the Construction Soil and Water Management Plan (CSWMP) within the CEMP which will be submitted for approval by the Department of Planning and Environment.

Management actions will also be triggered by assessment of water surface water quality data collected during the construction phase. If the sampling results indicate a possibility of the Project impacting on surface water quality, the Contractor is to investigate existing water quality control measures and notify agencies such as EPA in appropriate timeframes.

9.3.2 Operation

Permanent water quality management and protection measures would be installed to protect adjacent waterways from pollutants generated by operation of the Project. These would include in-line gross pollutant control devices.

In the event that adverse impacts are identified from the monitoring, the following procedure should be implemented:

- Identify potential pollutant source based on the parameters that were exceeded (e.g. sediment for high TSS reading, or fuel spill / leak for high hydrocarbon reading);
- Inspect and rectify in-line pollutant control devices in area where adverse impacts are identified. This would include inspection of in-line pollutant control devices to assess available storage capacity, water quality, sediment build-up, and structural integrity and debris levels.

Spills and contamination response will be in accordance with Project water quality monitoring and reporting protocols for construction and operation.
10. CONSULTATION

10.1 Regulatory Agencies

The SWQMP has been prepared in consultation with EPA, the NOW and Warringah Council. The SWQMP, containing trigger levels, has been submitted to the Secretary for approval six months prior to the commencement of construction of the Project (or as otherwise agreed by the Secretary).

The SWQMP has been submitted to the Secretary prior to construction and contains the complete baseline monitoring information up to May 2015 and has identified mitigation / remediation measures for the nominated construction phase.

A copy of the SWQMP has been supplied to the EPA, the NOW and Warringah Council upon its implementation. The results of all monitoring are to be made publicly available in accordance with the Conditions of Approval.
11. REFERENCES


Douglas Partners (2013) Report on Standpipe Piezometer Installation, Proposed Northern Beaches Hospital, Corner of Wakehurst Parkway and Warringah Road, Frenchs Forest, report prepared for Health Infrastructure, April 2013.


Northern Beaches Hospital Road Connectivity and Network Enhancements Project EIS 2015 (not completed at time of producing this report).


<table>
<thead>
<tr>
<th>Date</th>
<th>Time (h)</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
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<th>Value 5</th>
<th>Value 6</th>
<th>Value 7</th>
<th>Value 8</th>
<th>Value 9</th>
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<th>Value 15</th>
<th>Value 16</th>
<th>Value 17</th>
<th>Value 18</th>
<th>Value 19</th>
<th>Value 20</th>
</tr>
</thead>
<tbody>
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<td>&lt;1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.05</td>
<td>2/06/2015</td>
<td>&lt;0.0001</td>
<td>0.8</td>
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<td>-0.9</td>
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<td>&lt;0.1</td>
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<td>&lt;1</td>
<td>&lt;0.001</td>
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<td>&lt;2</td>
<td>&lt;2</td>
<td>0.014</td>
<td>370</td>
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<td>&lt;2</td>
<td>-0.003</td>
<td>0.037</td>
<td>&lt;0.01</td>
<td>&lt;0.05</td>
<td>25/09/2015</td>
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<td>&lt;100</td>
<td>&lt;5</td>
<td>&lt;1</td>
<td>&lt;0.005</td>
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<td>2015-05-06</td>
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Table 4.4: Levels of selected substances at background and pre-impact sites. The data are presented as median values.
Table A1-2 Field Measurements of pH

Table A1-3 Field measurements of electrical conductivity (µS)
Sample ID
Date
SW1
SW2
SW3
SW4
SW5

Table A1-4 Field Measurements of Redox (mV)
Sample ID
Date
SW1
SW2
SW3
SW4

SW1

SW2

SW3

Sample ID
SW4

SW5

SW6

SW7

SW6

SW7

SW5

SW6

SW7

12/11/2014
6/01/2015
4/02/2015
11/03/2015
8/04/2015
6/05/2015
3/06/2015
8/07/2015
5/08/2015
9/09/2015
7/10/2015
Median

6.32
6.02
6.94
7
7.11
6.84
7.04
6.74
7.32
6.76
6.79
6.84

*
6.4
7.16
7.37
6.69
6.57
6.58
7.1
7.07
6.54
6.5
6.635

6.03
6.15
6.69
6.77
6.5
6.65
6.5
6.69
6.66
6.19
6.11
6.5

7.03
6.68
7.14
7.47
6.37
6.33
6.85
6.49
7.08
7.02
6.24
6.85

6.13
5.89
7.03
6.74
6.2
6.25
6.1
6.49
6.38
6.61
5.97
6.25

7.15
7.01
7.44
7.57
7.31
6.6
6.45
6.46
7.4
6.55
7.08
7.08

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12/11/2014
6/01/2015
4/02/2015
11/03/2015
8/04/2015
6/05/2015
3/06/2015
8/07/2015
5/08/2015
9/09/2015
7/10/2015
Median

319
474
413
407
418
384
417
465
292
398
425
413

*
560
419
502
415
355
400
310
428
465
460
423.5

342
312
283
324
269
343
285
292
319
311
329
312

415
273
396
445
380
526
451
520
479
332
446
445

453
434
353
448
366
424
476
744
459
735
402
448

283
276
359
309
354
373
242
313
169
356
316
313

#
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#
#
#
#
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#

12/11/2014
6/01/2015
4/02/2015
11/03/2015
8/04/2015
6/05/2015
3/06/2015
8/07/2015
5/08/2015
9/09/2015
7/10/2015
Median

28
118
173
25
60
126
109
116
104
64
58
104

*
98
40
80
83
135
122
82
86
94
69
84.5

62
148
70
84
96
134
133
82
99
112
65
96

64
72
50
72
101
162
142
123
109
123
81
101

84
88
77
82
107
149
164
110
90
94
82
90

20
110
74
106
32
116
114
82
53
41
49
74

#
#
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#
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#
#

Wet Weather
(1) 21/4/15

6.52

5.78

6.05

5.62

5.68

6.43

#

Wet Weather
(1) 21/4/15

270

277

101

266

254

241

#

Wet
Weather (1)
21/4/15

108

201

177

169

128

97

#

Wet Weather
(2) 26/8/15

6.04

6.74

6.6

6.57

6.45

7.13

#

Wet Weather
(2) 26/8/15

688

269

190

187

328

199

#

Wet
Weather (2)
26/8/15

75

62

190

86

78

8

#

Wet Weather
(3) 29/9/15

4.65

3.23

3.82

3.81

6.12

4.36

4.02

Wet Weather
(3) 29/9/15

180

101

93

84

289

159

159

Wet
Weather (3)
29/9/15

72

71

69

80

84

58

61

Wet Weather
(4) 27/10/15

6.4

6.41

6.33

6.96

6.7

6.93

6.9

Wet Weather
(4) 27/10/15

231

288

167

228

374

249

296

Wet
Weather (4)
27/10/15

125

71

63

31

9

27

55

6.22

6.095

6.19

6.095

6.25

6.68

5.46

250.5

273

134

207.5

308.5

220

227.5

91.5

71

123

83

81

42.5

58

6.76

6.575

6.5

6.68

6.25

7.01

5.46

407

407.5

292

396

424

283

227.5

104

82.5

96

86

88

58

58

Date

Median
Combined
Median

Table A1-5 Field Measurements of Dissolved Oxygen (ppm)
Sample ID
Date
SW1
SW2
SW3
SW4
SW5

Median
Combined
Median

Table A1–6 Field Measurements of Turbidity (NTU)
Sample ID
Date
SW1
SW2
SW3
SW4

SW6

SW7

12/11/2014
6/01/2015
4/02/2015
11/03/2015
8/04/2015
6/05/2015
3/06/2015
8/07/2015
5/08/2015
9/09/2015
7/10/2015
Median

7.41
4.5
7.42
4.71
8.39
9.22
8.94
7.15
7.01
8.2
8.43
7.42

*
5.65
6.31
4.73
7.89
8.63
8.29
9.64
7.45
7.61
6.24
7.53

6.39
5.88
6.42
5.47
9.38
9.42
8.18
10.15
9.13
7.16
7.92
7.92

5.43
4.66
5.02
4.01
8.88
6
6.04
6.55
5.8
7.2
2.23
5.8

5.33
3.29
5.1
1.96
6.49
9.42
7.33
7.83
5.75
9.27
5.52
5.75

9.76
7.46
8.13
7.92
8.04
9.35
9.36
9.77
10.15
9.56
9.78
9.36

#
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#
#
#
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#

12/11/2014
6/01/2015
4/02/2015
11/03/2015
8/04/2015
6/05/2015
3/06/2015
8/07/2015
5/08/2015
9/09/2015
7/10/2015
Median

0.1
1.5
1.8
0.6
2.3
3.9
1.9
19
15
1.4
0.1
1.8

Wet Weather
(1) 21/4/15

11.13

10.47

10.52

10.47

9.61

10.62

#

Wet Weather
(1) 21/4/15

Wet Weather
(2) 26/8/15

8.3

7.67

8.75

5.87

7.8

9.41

#

Wet Weather
(3) 29/9/15

10.96

11.07

11.15

10.96

10.43

11.25

Wet Weather
(4) 27/10/15

8.23

6.93

8.37

4.87

5.85

9.63

9.07

9.635

8.17

8.23

7.64

8.37

5.87

Median
Combined
Median

Median
Combined
Median

Table A1-7 Field Measurements of TDS (ppm)
Sample ID
Date
SW1
SW2
SW3
SW4

SW5

SW6

SW7

SW5

SW6

SW7

2.1
4.2
0.9
3.4
13.4
4.2
5.2
2.6
0.3
0.3
3

4.8
2.6
4
1.9
2.3
4.3
8.5
7.4
9.5
2.5
0.5
4

2.3
0
0.6
0.1
1.1
17.4
2.1
8.2
0.8
0.1
1.6
1.1

13
24.8
140
25.6
37.5
54.4
14.8
57.6
15.9
9.6
6.1
24.8

12
2.9
3.2
6.2
2.1
10.5
5
6.2
2.6
3.3
0.5
3.3

#
#
#
#
#
#
#
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#
#
#NUM!

12/11/2014
6/01/2015
4/02/2015
11/03/2015
8/04/2015
6/05/2015
3/06/2015
8/07/2015
5/08/2015
9/09/2015
7/10/2015
Median

754
269
217
265
224
250
220
287
151
259
241
250

*
314
219
326
225
230
216
196
228
302
261
229

185
144
145
211
143
223
152
190
169
202
183
183

226
151
207
289
204
342
247
339
258
216
245
245

248
242
189
291
196
276
260
484
247
478
227
248

150
151
186
200
189
242
134
204
83.4
232
177
186

#
#
#
#
#
#
#
#
#
#
#
#

8.4

7.8

8

7.8

8.2

8.7

#

Wet
Weather (1)
21/4/15

151

151

69

144

127

128

#

Wet Weather
(2) 26/8/15

8.7

6.4

4

1.2

23.8

3.1

#

Wet
Weather (2)
26/8/15

453

175

124

121

208

129

#

11.86

Wet Weather
(3) 29/9/15

40.6

156.7

58

37.4

80.5

23.5

118.6

Wet
Weather (3)
29/9/15

93.5

50

46.6

42.3

153

132

53.7

8.04

9.49

Wet Weather
(4) 27/10/15

9.5

4.9

5.7

5.9

28.2

2.5

4.8

Wet
Weather (4)
27/10/15

119

150

85.6

118

197

129

155

8.705

10.015

10.675

9.1

7.1

6.85

6.85

26

5.9

61.7

135

150.5

77.3

119.5

175

129

104.35

6.49

9.41

10.675

2.3

4.2

4.3

1.6

24.8

3.3

61.7

241

222

152

216

242

151

104.35

Median
Combined
Median

Median
Combined
Median


APPENDIX B: LABORATORY REPORTS
### Chain of Custody Form

**SMEC Office:** North Sydney

**Project:** NBHP - Water Quality Monitoring

**Project Number:** 3011560.08

**Sampled By:** S. Shaw

**Date Sampled:** 12.11.14

**Relinquished By:** S. Shaw

**Date/Time:** 12.11.14 16:00

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<th>Sample ID</th>
<th>Date / Time</th>
<th>Sample Matrix</th>
<th>Container Type &amp; Preservative</th>
<th>Total No. Containers</th>
<th>PH/EC</th>
<th>TDS, TSS</th>
<th>Anions</th>
<th>Cations</th>
<th>SO4</th>
<th>Alkalinity</th>
<th>pH</th>
<th>BTEX</th>
<th>PAH</th>
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<td>Sw2</td>
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<td>Sw5</td>
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</tr>
<tr>
<td>6</td>
<td>Sw6</td>
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<tr>
<td>7</td>
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</tr>
</tbody>
</table>

**Special Laboratory Instructions:**

- Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**Notes:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book.

**Envirolab Services**

12 Ashley St
Chatwood NSW 2077
Ph: (02) 9910 6200

**Job No.:** 119-217

**Date Received:** 12/11/14

**Time Received:** 16:00

**Received by:** LSB

**Temp.:** Cool/Ambient

**Cooling:** Frozen pack

**Security:** Intact/Broken/None
SAMPLE RECEIPT ADVICE

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney  NSW  2060

Attention: D Saunders

Sample log in details:
Your reference: NBHP-Water Quality Monitoring
Envirolab Reference: 119217
Date received: 12/11/2014
Date results expected to be reported: 19/11/14

Samples received in appropriate condition for analysis: YES
No. of samples provided: 6 Waters
Turnaround time requested: Standard
Temperature on receipt (°C): 15.1
Cooling Method: Ice
Sampling Date Provided: YES

Comments:
If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:
Water samples - 1 month
Soil and other solid samples - 2 months
Samples collected in canisters - 1 week. Canisters will then be cleaned.
All other samples are not retained after analysis
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:
Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200    fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200  fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

Page 1 of 1
CERTIFICATE OF ANALYSIS

Client: SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: D Saunders

Sample log in details:
Your Reference: NBHP-Water Quality Monitoring
No. of samples: 6 Waters
Date samples received / completed instructions received: 12/11/2014 / 12/11/2014

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data. Samples were analysed as received from the client. Results relate specifically to the samples as received. Results are reported on a dry weight basis for solids and on an as received basis for other matrices. Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 19/11/14 / 19/11/14
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:

[Signature]
Jacintha Hurst
Laboratory Manager
<table>
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<th>Our Reference:</th>
<th>UNITS</th>
<th>119217-1</th>
<th>119217-2</th>
<th>119217-3</th>
<th>119217-4</th>
<th>119217-5</th>
</tr>
</thead>
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<td>Your Reference:</td>
<td>---------------</td>
<td></td>
<td>SW1</td>
<td>SW3</td>
<td>SW4</td>
<td>SW5</td>
<td>SW6</td>
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<tr>
<td>Type of sample:</td>
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<td>Water</td>
<td>Water</td>
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<td>-----------</td>
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<td>&lt;10</td>
<td>&lt;10</td>
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<td>&lt;10</td>
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<tr>
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<tr>
<td>TRH C6 - C10 less BTEX (F1) µg/L</td>
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<tr>
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#### svTRH (C10-C40) in Water

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#### svTRH (C10-C40) in Water

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# HM in water - dissolved

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**HM in water - dissolved**

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### HM in water - total

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<td>Bicarbonate Alkalinity as CaCO₃</td>
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### Miscellaneous Inorganics

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### Miscellaneous Inorganics

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<td>Total Suspended Solids</td>
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<td>Org-016</td>
<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = ((C6-C10))-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<tr>
<td>Org-013</td>
<td>Water samples are analysed directly by purge and trap GC-MS.</td>
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<tr>
<td>Org-003</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = ((&gt;C10-C16))-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</td>
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<td>Org-012 subset</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</td>
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<td>Metals-022 ICP-MS</td>
<td>Determination of various metals by ICP-MS.</td>
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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<td>Metals-020 ICP-AES</td>
<td>Determination of various metals by ICP-AES.</td>
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<tr>
<td>Inorg-006</td>
<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<tr>
<td>Inorg-081</td>
<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<tr>
<td>Inorg-041</td>
<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<tr>
<td>Inorg-019</td>
<td>Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104 +/- 5oC.</td>
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<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180 +/- 5oC.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.</td>
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#### vTRH(C6-C10)/BTEX in Water

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<th>TRHC&lt;sub&gt;C10&lt;/sub&gt; µg/L</th>
<th>Benzene µg/L</th>
<th>Toluene µg/L</th>
<th>Ethylbenzene µg/L</th>
<th>m+p-xylene µg/L</th>
<th>o-xylene µg/L</th>
<th>Naphthalene µg/L</th>
<th>Surrogate %</th>
<th>Surrogatetoluene-d8 %</th>
<th>Surrogate 4-BFB %</th>
<th>TRH&lt;sub&gt;C10&lt;/sub&gt;-&lt;sub&gt;C14&lt;/sub&gt; µg/L</th>
<th>TRH&lt;sub&gt;C15&lt;/sub&gt;-&lt;sub&gt;C18&lt;/sub&gt; µg/L</th>
<th>TRH&lt;sub&gt;C29&lt;/sub&gt;-&lt;sub&gt;C32&lt;/sub&gt; µg/L</th>
<th>TRH&lt;sub&gt;C34&lt;/sub&gt;-&lt;sub&gt;C36&lt;/sub&gt; µg/L</th>
<th>TRH&lt;sub&gt;C36&lt;/sub&gt;-&lt;sub&gt;C40&lt;/sub&gt; µg/L</th>
<th>Surrogate 0-Terphenyl %</th>
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#### svTRH(C10-C40) in Water

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<th>Surrogatetoluene-d8 %</th>
<th>Surrogate 4-BFB %</th>
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#### PAHs in Water

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#### HM in water - dissolved

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**QUALITY CONTROL**

**UNITS**

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**QUALITY CONTROL**

**HM in water - dissolved**

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<th>Date analysed</th>
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**QUALITY CONTROL**

**HM in water - total**

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<th>Blank</th>
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<th>Spike Sm#</th>
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<table>
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<th>Copper-Total</th>
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<table>
<thead>
<tr>
<th>Lead-Total</th>
<th>µg/L</th>
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<th>Mercury-Total</th>
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<th>Blank</th>
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<th>Spike Sm#</th>
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| Nickel-Total   | µg/L | Metals-020 | Blank | Duplicate Sm# | Duplicate results | Spike Sm# |

| Zinc-Total     | µg/L | Metals-020 | Blank | Duplicate Sm# | Duplicate results | Spike Sm# |
### QUALITY CONTROL

<table>
<thead>
<tr>
<th>Ion Balance</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tbody>
<tr>
<td>Date prepared</td>
<td>-</td>
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<td>Calcium - Dissolved</td>
<td>mg/L</td>
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<td>Potassium - Dissolved</td>
<td>mg/L</td>
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<td>Sodium - Dissolved</td>
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<td>Magnesium - Dissolved</td>
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<td>91%</td>
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<tr>
<td>Hydroxide Alkalinity (OH⁻) as CaCO₃</td>
<td>mg/L</td>
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<td>[NR]</td>
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<tr>
<td>Bicarbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
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<td>[NR]</td>
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<td>Sulphate, SO₄</td>
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<td>[NT]</td>
<td>[NR]</td>
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<td>Chloride, Cl</td>
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<td>[NT]</td>
<td>[NR]</td>
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<td>Ionic Balance</td>
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### QUALITY CONTROL

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<th>Miscellaneous Inorganics</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
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<th>Spike % Recovery</th>
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<tbody>
<tr>
<td>Total Suspended Solids</td>
<td>mg/L</td>
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<tr>
<td>Total Dissolved Solids (grav)</td>
<td>mg/L</td>
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<td>Phosphorus - Total</td>
<td>mg/L</td>
<td>119217-2</td>
<td>&lt;0.05</td>
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<td>[N/T]</td>
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</table>
Report Comments:
ION_BALANCE: # Percent recovery is not possible to report due to the inhomogeneous nature
of the element/s in the sample/s. However an acceptable recovery was
obtained for the LCS.

TRACE METALS: In theory the total metal content should be higher than the dissolved
metal content. However, in some samples this is not the case.
The sample has been re-analysed for both Total and Dissolved
and results have been confirmed.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test       PQL: Practical Quantitation Limit       NT: Not tested
NA: Test not required                    RPD: Relative Percent Difference   NA: Test not required
<: Less than                             >=: Greater than                   LCS: Laboratory Control Sample
Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
# Chain of Custody Form

**SMEC Office:** North Sydney  
**Project:** NBHP - Groundwater Monitoring  
**Project Manager:** Daniel Saunders  
**Sampled by:** S. Shaw  
**Date Sampled:** 15 + 16/12/14  
**Lab Quote No.:** 14SY282  
**COC Sequence Number (Circle):** 0  
**Contact Ph.:** 0414 752 743  
**DISPATCH TO (Address & Phone No.):**  
**Lab:** EnviroLab  
**ATTENTION:**  
**RELIQUISHE BY:**  
**RECEIVED BY:**  
**RELIQUISHE BY:**  
**RECEIVED BY:** LSP  
**DATE/TIME:** 16/12/14  

## Sample Details

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<th>Lab ID</th>
<th>Sample ID</th>
<th>Date / Time</th>
<th>Sample Matrix</th>
<th>Container Type &amp; Preservative</th>
<th>Total No. Containers</th>
<th>Analysis Required</th>
<th>Comments</th>
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<td>Chaos + Plastic Bottles</td>
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**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.  
**Copies:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book.
SAMPLE RECEIPT ADVICE

Client:
SMEC Australia  
Level 5, 20 Berry St  
North Sydney NSW 2060

Attention: D Saunders

Sample log in details:
Your reference: NBHP-Ground Water Monitoring  
Envirolab Reference: 121053  
Date received: 16/12/2014  
Date results expected to be reported: 23/12/14

Samples received in appropriate condition for analysis: YES  
No. of samples provided: 11 Waters  
Turnaround time requested: Standard  
Temperature on receipt (°C): 12.6  
Cooling Method: Ice  
Sampling Date Provided: YES

Comments:
If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:  
Water samples - 1 month  
Soil and other solid samples - 2 months  
Samples collected in canisters - 1 week. Canisters will then be cleaned.  
All other samples are not retained after analysis  
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:
Please direct any queries to Aileen Hie or Jacinta Hurst  
ph: 02 9910 6200  fax: 02 9910 6201  
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au
CERTIFICATE OF ANALYSIS 121053

Client: SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: D Saunders

Sample log in details:
Your Reference: NBHP-Ground Water Monitoring
No. of samples: 11 Waters
Date samples received / completed instructions received 16/12/2014 / 16/12/2014

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 23/12/14 / 23/12/14
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:

[Signature]
Jacinta Hurst
Laboratory Manager
<table>
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<tr>
<th>vTRH(C6-C10)/BTEXN in Water</th>
<th>UNITS</th>
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<th>121053-2</th>
<th>121053-3</th>
<th>121053-4</th>
<th>121053-5</th>
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<td>121053-7</td>
<td>121053-8</td>
<td>121053-9</td>
<td>121053-10</td>
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<td>GW6</td>
<td>GW7</td>
<td>GW8</td>
<td>GW9</td>
<td>GW10</td>
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<td>15/12/14 - 16/12/14</td>
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<th>vTRH(C6-C10)/BTEXN in Water</th>
<th>UNITS</th>
<th>121053-1</th>
<th>121053-2</th>
<th>121053-3</th>
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<tr>
<td>m+p-xylene µg/L µg/L &lt;2 &lt;2 &lt;2 &lt;2 &lt;2</td>
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Revision No: R 00
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**Surrogate o-Terphenyl**

| % | 116 |
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<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-5oC.</td>
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<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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### PAHs in Water

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### HM in Water - dissolved

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<td><strong>Spike % Recovery</strong></td>
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<tr>
<td>HM in water - dissolved</td>
<td>-</td>
<td>121053-1</td>
<td>17/12/2014</td>
<td>17/12/2014</td>
<td>121053-9</td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>121053-1</td>
<td>17/12/2014</td>
<td>17/12/2014</td>
<td>121053-9</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>121053-1</td>
<td>17/12/2014</td>
<td>17/12/2014</td>
<td>121053-9</td>
</tr>
<tr>
<td>Arsenic-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>2</td>
<td></td>
<td>[N/T]</td>
</tr>
<tr>
<td>Cadmium-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>0.7</td>
<td></td>
<td>[N/T]</td>
</tr>
<tr>
<td>Chromium-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>2</td>
<td></td>
<td>[N/T]</td>
</tr>
<tr>
<td>Copper-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>7</td>
<td></td>
<td>[N/T]</td>
</tr>
<tr>
<td>Lead-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>&lt;1</td>
<td></td>
<td>[N/T]</td>
</tr>
<tr>
<td>Mercury-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>&lt;0.05</td>
<td></td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Nickel-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>24</td>
<td></td>
<td>[N/T]</td>
</tr>
<tr>
<td>Zinc-Dissolved</td>
<td>µg/L</td>
<td>121053-1</td>
<td>140</td>
<td></td>
<td>[N/T]</td>
</tr>
</tbody>
</table>

<p>| QUALITY CONTROL | <strong>UNITS</strong> | <strong>Dup. Sm#</strong> | <strong>Duplicate</strong> | <strong>Spike Sm#</strong> | <strong>Spike % Recovery</strong> |
| Ion Balance | - | 121053-11 | 17/12/2014 | 17/12/2014 | 121053-2 | 17/12/2014 |
| Date prepared | - | 121053-11 | 17/12/2014 | 17/12/2014 | 121053-2 | 17/12/2014 |
| Date analysed | - | 121053-11 | 17/12/2014 | 17/12/2014 | 121053-2 | 17/12/2014 |
| Calcium - Dissolved | mg/L | 121053-11 | 15 || 16 || RPD:6 | 121053-2 | 93% |
| Potassium - Dissolved | mg/L | 121053-11 | 5.0 || 5.1 || RPD:2 | 121053-2 | 108% |
| Sodium - Dissolved | mg/L | 121053-11 | 28 || 28 || RPD:0 | 121053-2 | # |
| Magnesium - Dissolved | mg/L | 121053-11 | 2.3 || 2.3 || RPD:0 | 121053-2 | # |
| Hydroxide Alkalinity (OH⁻) as CaCO₃ | mg/L | 121053-11 | &lt;5 || &lt;5 | [NR] | [NR] |
| Bicarbonate Alkalinity as CaCO₃ | mg/L | 121053-11 | 36 || 37 || RPD:3 | [NR] | [NR] |
| Carbonate Alkalinity as CaCO₃ | mg/L | 121053-11 | &lt;5 || &lt;5 | [NR] | [NR] |
| Total Alkalinity as CaCO₃ | mg/L | 121053-11 | 36 || 37 || RPD:3 | [NR] | [NR] |
| Sulphate, SO₄ | mg/L | 121053-11 | 10 || 10 || RPD:0 | 121053-2 | 100% |
| Chloride, Cl | mg/L | 121053-11 | 42 || 41 || RPD:2 | 121053-2 | # |
| Ionic Balance | % | 121053-11 | 4.9 || 4.6 || RPD:6 | [NR] | [NR] |</p>
<table>
<thead>
<tr>
<th>QUALITY CONTROL</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate</th>
<th>Spike</th>
<th>Spike % Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous Inorganics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>121053-11</td>
<td>17/12/2014</td>
<td></td>
<td>17/12/2014</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>121053-11</td>
<td>17/12/2014</td>
<td></td>
<td>17/12/2014</td>
</tr>
<tr>
<td>pH</td>
<td>pH Units</td>
<td>121053-11</td>
<td>6.1</td>
<td></td>
<td>6.1</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>µS/cm</td>
<td>121053-11</td>
<td>250</td>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/L</td>
<td>121053-11</td>
<td>130</td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>pH</td>
<td>pH Units</td>
<td>121053-11</td>
<td>6.1</td>
<td></td>
<td>6.1</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>µS/cm</td>
<td>121053-11</td>
<td>250</td>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/L</td>
<td>121053-11</td>
<td>130</td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Ammonia as N in water</td>
<td>mg/L</td>
<td>121053-11</td>
<td>0.065</td>
<td></td>
<td>0.063</td>
</tr>
<tr>
<td>Nitrate as N in water</td>
<td>mg/L</td>
<td>121053-11</td>
<td>0.34</td>
<td></td>
<td>0.34</td>
</tr>
<tr>
<td>Nitrite as N in water</td>
<td>mg/L</td>
<td>121053-11</td>
<td>0.017</td>
<td></td>
<td>0.018</td>
</tr>
<tr>
<td>Phosphate as P in water</td>
<td>mg/L</td>
<td>121053-11</td>
<td>&lt;0.005</td>
<td></td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>QUALITY CONTROL</td>
<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate</td>
<td>Spike</td>
<td>Spike % Recovery</td>
</tr>
<tr>
<td>HM in water - dissolved</td>
<td>µg/L</td>
<td>121053-7</td>
<td>&lt;0.05</td>
<td></td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>121053-7</td>
<td>17/12/2014</td>
<td></td>
<td>17/12/2014</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>121053-7</td>
<td>17/12/2014</td>
<td></td>
<td>17/12/2014</td>
</tr>
<tr>
<td>Mercury-Dissolved</td>
<td>µg/L</td>
<td>121053-7</td>
<td>&lt;0.05</td>
<td></td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>QUALITY CONTROL</td>
<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate</td>
<td>Spike</td>
<td>Spike % Recovery</td>
</tr>
<tr>
<td>Miscellaneous Inorganics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>121053-7</td>
<td>17/12/2014</td>
<td></td>
<td>17/12/2014</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>121053-7</td>
<td>17/12/2014</td>
<td></td>
<td>17/12/2014</td>
</tr>
<tr>
<td>Phosphorus - Total</td>
<td>mg/L</td>
<td>121053-7</td>
<td>0.2</td>
<td></td>
<td>0.2</td>
</tr>
</tbody>
</table>
Report Comments:
METALS_WLL_8_D: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

ION_BALANCE: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test  PQL: Practical Quantitation Limit  NT: Not tested
NA: Test not required  RPD: Relative Percent Difference  NA: Test not required
<: Less than  >: Greater than  LCS: Laboratory Control Sample
Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
Environmental Division

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive Report

Work Order: ES1428217

Client: SMEC AUSTRALIA PTY LTD
Contact: DANIEL SAUNDERS
Address: P O BOX 1654
        FYSHWICK ACT, AUSTRALIA 2609

Laboratory: Environmental Division Sydney
Contact: Client Services
Address: 277-289 Woodpark Road Smithfield
        NSW Australia 2164

E-mail: daniel.saunders@smec.com
Telephone: +61 02 61261959
Facsimile: +61 61261966

Project: 30011560 NBHP - GROUNDWATER MONITORING

Order number: ----
C-O-C number: 2098
Site: ----
Sampler: S.SHAW

Quote number: ES2014SMEAUS0366 (EN/025/14)
Page: 1 of 2

Date Samples Received: 17-DEC-2014
Client Requested Due Date: 29-DEC-2014
Issue Date: 17-DEC-2014 19:50
Scheduled Reporting Date: 29-DEC-2014

Mode of Delivery: Carrier
Temperature: 6.3°C - Ice bricks present
No. of coolers/boxes: 1 FOAM ESKY
No. of samples received: 1
Security Seal: Intact.
No. of samples analysed: 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables

- Samples received in appropriately pretreated and preserved containers.
- Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.
- Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- No sample container / preservation non-compliance exists.

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sampling date / time</th>
<th>Client sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1428217-001</td>
<td>15-DEC-2014 15:00</td>
<td>TRIP 1</td>
</tr>
</tbody>
</table>

- **EA005P:** pH by PC Titrator
- **EA010P:** Conductivity (PC)
- **EA015H:** Total Dissolved Solids - High Level
- **EK055G-NH4:** Ammonium as N
- **EK067G:** Total Phosphorus as P By Discrete Analyser
- **EK071G:** Reactive Phosphorus by Discrete analyser
- **NT-01 & 02:** Major Cations & Anions (Ca, Mg, Na, K, Cl, SO4
- **NT-04:** Nitrite and Nitrate

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

**Matrix:** WATER

<table>
<thead>
<tr>
<th>Client Sample ID (s)</th>
<th>Due for extraction</th>
<th>Due for analysis</th>
<th>Samples Received</th>
<th>Instructions Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIP 1</td>
<td></td>
<td></td>
<td>Date</td>
<td>Date</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15-DEC-2014</td>
<td>17-DEC-2014</td>
</tr>
</tbody>
</table>

Requested Deliverables

**DANIEL SAUNDERS**

- *AU Certificate of Analysis - NATA ( COA ) Email daniel.saunders@smec.com
- *AU Interpretive QC Report - DEFAULT (Anon QCi Rep) ( QCi ) Email daniel.saunders@smec.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA ( QC ) Email daniel.saunders@smec.com
- A4 - AU Sample Receipt Notification - Environmental HT ( SRN Email daniel.saunders@smec.com
- A4 - AU Tax Invoice ( INV ) Email daniel.saunders@smec.com
- Chain of Custody (CoC) ( COC ) Email daniel.saunders@smec.com
- EDI Format - ENMRG ( ENMRG ) Email daniel.saunders@smec.com
- EDI Format - ESDAT ( ESDAT ) Email daniel.saunders@smec.com
# CERTIFICATE OF ANALYSIS

**Work Order:** ES1428217  
**Client:** SMEC AUSTRALIA PTY LTD  
**Contact:** DANIEL SAUNDERS  
**Address:** P O BOX 1854 FYSHWICK ACT, AUSTRALIA 2609  
**E-mail:** daniel.saunders@sme.com  
**Telephone:** +61 02 61261959  
**Facsimile:** +61 61261966

**Project:** 30011560 NBHP - GROUNDWATER MONITORING  
**Order number:** ----  
**C-O-C number:** 2098  
**Sampler:** S.SHAW  
**Site:** ----  
**Quote number:** EN/025/14

**Date Samples Received:** 17-DEC-2014  
**Issue Date:** 30-DEC-2014  
**No. of samples received:** 1  
**No. of samples analysed:** 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:
- General Comments
- Analytical Results
- Surrogate Control Limits

---

**Signatories**

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<table>
<thead>
<tr>
<th>Signatories</th>
<th>Position</th>
<th>Accreditation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankit Joshi</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Dian Dao</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Hoa Nguyen</td>
<td>Senior Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Phalak Inthakesone</td>
<td>Laboratory Manager - Organics</td>
<td>Sydney Organics</td>
</tr>
<tr>
<td>Shobhna Chandra</td>
<td>Metals Coordinator</td>
<td>Sydney Inorganics</td>
</tr>
</tbody>
</table>

---

**NATA Accredited Laboratory 825**

 Accredited for compliance with ISO/IEC 17025.
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key:

- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- ^ = This result is computed from individual analyte detections at or above the level of reporting

- **Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ)** is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benzo(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a,h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
## Analytical Results

### Sub-Matrix: WATER (Matrix: WATER)

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Client sampling date / time</th>
<th>Client sample ID</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRIP 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH Value</td>
<td><em><strong>0.01</strong></em></td>
<td><strong>pH Unit</strong></td>
<td><strong>6.75</strong></td>
<td>15-DEC-2014 15:00</td>
<td><strong>ES1428217-001</strong></td>
</tr>
<tr>
<td><strong>EA101P: Conductivity by PC Titrator</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Conductivity @ 25°C</td>
<td><em><strong>1</strong></em></td>
<td><strong>µS/cm</strong></td>
<td><strong>289</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>EA105P: pH by PC Titrator</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroxide Alkalinity as CaCO3</td>
<td><strong>DMO-210-001</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td>Carbonate Alkalinity as CaCO3</td>
<td><strong>3812-32-6</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td>Bicarbonate Alkalinity as CaCO3</td>
<td><strong>71-52-3</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td><strong>48</strong></td>
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<tr>
<td><strong>Total Alkalinity as CaCO3</strong></td>
<td></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td><strong>48</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ED037P: Alkalinity by PC Titrator</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroxide Alkalinity as CaCO3</td>
<td><strong>DMO-210-001</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td><strong>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate as SO4 - Turbidimetric</td>
<td><strong>14808-79-8</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td><strong>12</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ED045G: Chloride Discrete analyser</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Chloride</td>
<td><strong>16887-00-6</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
<td><strong>46</strong></td>
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<tr>
<td><strong>ED095F: Dissolved Major Cations</strong></td>
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<tr>
<td>Calcium</td>
<td><strong>7440-70-2</strong></td>
<td><strong>1</strong></td>
<td><strong>mg/L</strong></td>
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<td>Arsenic</td>
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<td>Copper</td>
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## Analytical Results

### Sub-Matrix: WATER (Matrix: WATER)

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### Project Analytical Results

**TRIP 1**

15-DEC-2014 15:00

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### Analytical Results

**Sub-Matrix:** WATER (Matrix: WATER)  

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## Surrogate Control Limits

**Sub-Matrix:** WATER

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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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<tr>
<td>Contact</td>
<td>DANIEL SAUNDERS</td>
</tr>
<tr>
<td>Address</td>
<td>P O BOX 1654</td>
</tr>
<tr>
<td></td>
<td>FYSHWICK ACT, AUSTRALIA 2609</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:daniel.saunders@smec.com">daniel.saunders@smec.com</a></td>
</tr>
<tr>
<td>Telephone</td>
<td>+61 02 61261959</td>
</tr>
<tr>
<td>Facsimile</td>
<td>+61 61261966</td>
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<td>Address</td>
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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.
Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key:
- Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- RPD = Relative Percentage Difference
- # = Indicates failed QC

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<table>
<thead>
<tr>
<th>Signatories</th>
<th>Position</th>
<th>Accreditation Category</th>
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</thead>
<tbody>
<tr>
<td>Ankit Joshi</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Dian Dao</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Hoa Nguyen</td>
<td>Senior Inorganic Chemist</td>
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<td>Phalak Inthakesone</td>
<td>Laboratory Manager - Organics</td>
<td>Sydney Organics</td>
</tr>
<tr>
<td>Shobhna Chandra</td>
<td>Metals Coordinator</td>
<td>Sydney Inorganics</td>
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</table>
Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<tbody>
<tr>
<td>EA005P: pH by PC Titrator (QC Lot: 3764821)</td>
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<tr>
<td>ES1428171-001</td>
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<td>EA005-P: pH Value</td>
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<td>pH Unit</td>
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<td>ES1428171-002</td>
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<td>EA005-P: pH Value</td>
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<td>EA010P: Conductivity by PC Titrator (QC Lot: 3764823)</td>
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<td>EA015: Total Dissolved Solids (QC Lot: 3765968)</td>
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<td>ES1428026-001</td>
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<td>mg/L</td>
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<td>ED037P: Alkalinity by PC Titrator (QC Lot: 3764818)</td>
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<td>ES1427878-013</td>
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<td>ED037-P: Hydroxide Alkalinity as CaCO3</td>
<td>DMO-210-001</td>
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<td>mg/L</td>
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<td>3812-32-6</td>
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<td>&lt;1</td>
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<td>No Limit</td>
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<td></td>
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<td>ED037-P: Bicarbonate Alkalinity as CaCO3</td>
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<td>ED037-P: Carbonate Alkalinity as CaCO3</td>
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<td>mg/L</td>
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<td>&lt;1</td>
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<td>No Limit</td>
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<td>ED037-P: Bicarbonate Alkalinity as CaCO3</td>
<td>71-52-3</td>
<td>1</td>
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<td>816</td>
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<td>ED037-P: Total Alkalinity as CaCO3</td>
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<td>1</td>
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<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3763252)</td>
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<td>14808-79-8</td>
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<td>mg/L</td>
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<td>24</td>
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<tr>
<td>ES1428217-001</td>
<td>TRIP 1</td>
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<td>16887-00-6</td>
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<td>ED093F: Dissolved Major Cations (QC Lot: 3764723)</td>
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<td>ED093F: Magnesium</td>
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<td>113</td>
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<td>mg/L</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QC Lot: 3764722)</td>
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<td>ES1428237-001</td>
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<td>EG020A-F: Arsenic</td>
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<td>mg/L</td>
<td>&lt;0.001</td>
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<td>0.0</td>
<td>No Limit</td>
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</tbody>
</table>
### Laboratory Duplicate (DUP) Report

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium</td>
<td>7440-47-3</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.0</td>
<td>No Limit</td>
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<tr>
<td>Copper</td>
<td>7440-50-8</td>
<td>0.001</td>
<td>mg/L</td>
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<td>0.001</td>
<td>0.0</td>
<td>No Limit</td>
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<tr>
<td>Lead</td>
<td>7439-92-1</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.0</td>
<td>No Limit</td>
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<td>Nickel</td>
<td>7440-02-0</td>
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<td>mg/L</td>
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<td>Zinc</td>
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<td>0.005</td>
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<td>&lt;0.001</td>
<td>0.0</td>
<td>No Limit</td>
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<td>mg/L</td>
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<td>&lt;0.010</td>
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<td>No Limit</td>
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<tr>
<td>Lead</td>
<td>7439-92-1</td>
<td>0.001</td>
<td>mg/L</td>
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<td>&lt;0.010</td>
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<td>Zinc</td>
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<td>mg/L</td>
<td>0.053</td>
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**EG035F: Dissolved Mercury by FIMS (QC Lot: 3764721)**

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<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<tbody>
<tr>
<td>Mercury</td>
<td>7439-97-6</td>
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<td>mg/L</td>
<td>&lt;0.0001</td>
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<td>0.0</td>
<td>No Limit</td>
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<tr>
<td>Mercury</td>
<td>7439-97-6</td>
<td>0.0001</td>
<td>mg/L</td>
<td>&lt;0.0001</td>
<td>&lt;0.0001</td>
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**EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3766203)**

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<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<tbody>
<tr>
<td>Ammonia</td>
<td>7664-41-7</td>
<td>0.01</td>
<td>mg/L</td>
<td>0.05</td>
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<td>Ammonia</td>
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**EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3763251)**

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<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<td>&lt;0.01</td>
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<td>No Limit</td>
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<td>Nitrite</td>
<td>14265-44-2</td>
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<td>mg/L</td>
<td>0.88</td>
<td>0.90</td>
<td>3.1</td>
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<td>Nitrite</td>
<td>14265-44-2</td>
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<td>0.18</td>
<td>0.18</td>
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**EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3766200)**

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<th>LOR</th>
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<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<tr>
<td>Total Phosphorus</td>
<td>14265-44-2</td>
<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
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**EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3768432)**

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<th>LOR</th>
<th>Unit</th>
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<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<tbody>
<tr>
<td>C6 - C9 Fraction</td>
<td>71-43-2</td>
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<td>µg/L</td>
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<td>No Limit</td>
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<tr>
<td>C6 - C10 Fraction</td>
<td>108-88-3</td>
<td>2</td>
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<td>&lt;2</td>
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<td>No Limit</td>
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<tr>
<td>C6 - C10 Fraction</td>
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<td>&lt;2</td>
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<td>No Limit</td>
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<tr>
<td>Laboratory sample ID</td>
<td>Client sample ID</td>
<td>Method: Compound</td>
<td>CAS Number</td>
<td>LOR</td>
<td>Unit</td>
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<td>ES1428142-001</td>
<td>Anonymous</td>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3</td>
<td>2</td>
<td>µg/L</td>
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<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
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<td>EP080: Naphthalene</td>
<td>91-20-3</td>
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<td>ES1428163-001</td>
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<td>EP080: Benzene</td>
<td>71-43-2</td>
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<td>EP080: Ethylbenzene</td>
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<td>EP080: meta- &amp; para-Xylene</td>
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<td>µg/L</td>
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Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Method Blank (MB) Report</th>
<th>Laboratory Control Spike (LCS) Report</th>
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<tr>
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<td>Result</td>
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<td>EA010P: Conductivity by PC Titrator (QCLot: 3764823)</td>
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<td>EA010-P: Electrical Conductivity @ 25°C</td>
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<td>µS/cm</td>
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<td>EA015: Total Dissolved Solids (QCLot: 3765968)</td>
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<td>EA015H: Total Dissolved Solids @180°C</td>
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<td>10</td>
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<td>ED037-P: Total Alkalinity as CaCO3</td>
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<td>1</td>
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<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3763252)</td>
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<td>ED041G: Sulfate as SO4 - Turbidimetric</td>
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<td>mg/L</td>
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<td>ED0450: Chloride Discrete analyser (QCLot: 3763254)</td>
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<td>ED045G: Chloride</td>
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<td>mg/L</td>
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<td>ED093F: Dissolved Major Cations (QCLot: 3764723)</td>
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<td>ED093F: Calcium</td>
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<td>ED093F: Magnesium</td>
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<td>ED093F: Sodium</td>
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<td>ED093F: Potassium</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QCLot: 3764722)</td>
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<td>EG020A-F: Arsenic</td>
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<td>0.001</td>
<td>mg/L</td>
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<td>EG020A-F: Cadmium</td>
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<td>&lt;0.0001</td>
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<td>EG020A-F: Chromium</td>
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<td>mg/L</td>
<td>&lt;0.001</td>
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<tr>
<td>EG020A-F: Copper</td>
<td>7440-50-8</td>
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<td>&lt;0.001</td>
<td>0.1 mg/L</td>
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<tr>
<td>EG020A-F: Lead</td>
<td>7439-92-1</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
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<td>EG020A-F: Nickel</td>
<td>7440-02-0</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
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<td>EG020A-F: Zinc</td>
<td>7440-66-6</td>
<td>0.005</td>
<td>mg/L</td>
<td>&lt;0.005</td>
<td>0.1 mg/L</td>
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<td>EG035F: Dissolved Mercury by FIMS (QCLot: 3764721)</td>
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<tr>
<td>EG035F: Mercury</td>
<td>7439-97-6</td>
<td>0.0001</td>
<td>mg/L</td>
<td>&lt;0.0001</td>
<td>0.010 mg/L</td>
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<td>EK055G: Ammonia as N by Discrete Analyser (QCLot: 3766203)</td>
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<tr>
<td>EK055G: Ammonia as N</td>
<td>7664-41-7</td>
<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
<td>1.0 mg/L</td>
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<td>EK057G: Nitrite as N by Discrete Analyser (QCLot: 3763251)</td>
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<td>EK057G: Nitrite as N</td>
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<td>0.01</td>
<td>mg/L</td>
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<td>EK059G: Nitrate plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 376204)</td>
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<td>EK059G: Nitrate as N</td>
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<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
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<td>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3766200)</td>
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### Method Blank (MB) Report

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<th>Compound</th>
<th>CAS Number</th>
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<th>Unit</th>
<th>Result Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
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<tbody>
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<td>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3766200) - continued</td>
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<td>EK0716: Reactive Phosphorus as P by discrete analyser (QCLot: 3753253)</td>
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<td>EP075(SIM): Polynuclear Aromatic Hydrocarbons (QCLot: 3762401)</td>
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<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3762400)</td>
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<td>EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3736432)</td>
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<td>EP080: BTEXN (QCLot: 3768432)</td>
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Sub-Matrix: WATER

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<th>Method: Compound</th>
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<th>Unit</th>
<th>Result</th>
<th>Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
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<td>EP080: Ethylbenzene</td>
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<td>µg/L</td>
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<td>EP080: meta- &amp; para-Xylene</td>
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<td>µg/L</td>
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<td>EP080: ortho-Xylene</td>
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<td>µg/L</td>
<td>&lt;2</td>
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<td>72 122</td>
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<td>EP080: Naphthalene</td>
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<td>µg/L</td>
<td>&lt;5</td>
<td>10 µg/L</td>
<td>93.5</td>
<td>70 124</td>
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Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: WATER

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<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
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<tr>
<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3763252)</td>
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<td>ED041G: Sulfate as SO4 - Turbidimetric</td>
<td>14808-79-8</td>
<td>10 mg/L</td>
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<td>70 130</td>
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<td>ES1428171-001</td>
<td>Anonymous</td>
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<td>ED045G: Chloride Discrete analyser (QCLot: 3763254)</td>
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<td>ED045G: Chloride</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QCLot: 3764722)</td>
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<td>EG020F: Metals by ICP-MS</td>
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<td>EK055G: Ammonia as N</td>
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<td>70 130</td>
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<td>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3766204)</td>
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<td>EK059G: Nitrite + Nitrate as N</td>
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<td>EK067G: Total Phosphorus as P</td>
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<td>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3763253)</td>
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<td>EK071G: Reactive Phosphorus as P</td>
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### Sub-Matrix: WATER

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<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Concen.</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
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<td><strong>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3763253)</strong> - continued</td>
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<td><strong>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3768432)</strong></td>
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<td>EP080: Naphthalene</td>
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<td>91-20-3</td>
<td>25 µg/L</td>
<td>108</td>
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**Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report**

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

### Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Concen.</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
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<tbody>
<tr>
<td><strong>EK057G: Nitrite as N by Discrete Analyser (QCLot: 3763251)</strong></td>
<td></td>
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<td>Anonymous</td>
<td>ES142817-001</td>
<td>EK057G: Nitrite as N</td>
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<tr>
<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3763252)</td>
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<td></td>
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<td>Anonymous</td>
<td>ES1428217-001</td>
<td>EP041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3763252)</td>
<td>14808-79-8</td>
<td>10 mg/L</td>
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</tr>
<tr>
<td>Anonymous</td>
<td>ES1428217-001</td>
<td>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3763253)</td>
<td>14265-44-2</td>
<td>0.5 mg/L</td>
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<td>ED045G: Chloride Discrete analyser (QCLot: 3763254)</td>
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<td><strong>EG035F: Dissolved Mercury by FIMS (QCLot: 3764721)</strong></td>
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<td>93.3</td>
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</table>

---

**RPD (%)**

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.
## Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
<th>RPDs (%)</th>
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<tbody>
<tr>
<td>EG020F</td>
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<td>EG020A-F: Dissolved Metals by ICP-MS (QCLot: 3764722)</td>
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<td>EK067G</td>
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<td>EK055G</td>
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<td>ES1428212-003</td>
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<tr>
<td>EP080/071</td>
<td>Total Petroleum Hydrocarbons (QCLot: 3768432)</td>
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<td>(QCLot: 3768432)</td>
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<td>Anonymous</td>
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<td>98.9</td>
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<td>EP080: ortho-Xylene</td>
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<td>EP080: Naphthalene</td>
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<td>25 µg/L</td>
<td>108</td>
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## INTERPRETIVE QUALITY CONTROL REPORT

<table>
<thead>
<tr>
<th>Work Order</th>
<th>ES1428217</th>
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<tbody>
<tr>
<td>Client</td>
<td>SMEC AUSTRALIA PTY LTD</td>
</tr>
<tr>
<td>Contact</td>
<td>DANIEL SAUNDERS</td>
</tr>
<tr>
<td>Address</td>
<td>P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:daniel.saunders@smec.com">daniel.saunders@smec.com</a></td>
</tr>
<tr>
<td>Telephone</td>
<td>+61 02 61261959</td>
</tr>
<tr>
<td>Facsimile</td>
<td>+61 61261966</td>
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<tr>
<td>Project</td>
<td>30011560 NBHP - GROUNDWATER MONITORING</td>
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<td>Site</td>
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<td>Sampler</td>
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<td>Quote number</td>
<td>EN/025/14</td>
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</table>

### Laboratory Information
- Address: 277-289 Woodpark Road Smithfield NSW Australia 2164
- E-mail: sydney@alsglobal.com
- Telephone: +61-2-8784 8555
- Facsimile: +61-2-8784 8500

### Site Information
- QC Level: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- Date Samples Received: 17-DEC-2014
- Issue Date: 30-DEC-2014
- No. of samples received: 1
- No. of samples analysed: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:
- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers
Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: WATER

<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Sample Date</th>
<th>Extraction / Preparation</th>
<th>Analysis</th>
<th>Evaluation</th>
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<td>Date extracted</td>
<td>Due for extraction</td>
<td>Evaluation</td>
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Work Order: ES1428217
Client: SMEC AUSTRALIA PTY LTD
Project: 30011560 NBHP - GROUNDWATER MONITORING

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<th>Analysis</th>
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<td>TRIP 1</td>
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</table>

Evaluation: ✗ = Holding time breach; ✓ = Within holding time.
## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

### Matrix: WATER

<table>
<thead>
<tr>
<th>Quality Control Sample Type</th>
<th>Analytical Methods</th>
<th>QC</th>
<th>Regular</th>
<th>Actual</th>
<th>Expected</th>
<th>Evaluation</th>
<th>Quality Control Specification</th>
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<td><strong>Laboratory Duplicates (DUP)</strong></td>
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</tr>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>2</td>
<td>19</td>
<td>10.0</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
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<td>Chloride by Discrete Analyser</td>
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<tr>
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<td>16</td>
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<td>10.0</td>
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<td>18</td>
<td>11.1</td>
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<td>14.3</td>
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<tr>
<td>Nitrate and Nitrite as N (NOx) by Discrete Analyser</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
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<td>Nitrate as N by Discrete Analyser</td>
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<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
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<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
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<tr>
<td><strong>Laboratory Control Samples (LCS)</strong></td>
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<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
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<td>16</td>
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<td>EG020A-F</td>
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<tr>
<td>Major Cations - Dissolved</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
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<tr>
<td>Nitrate and Nitrite as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
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<tr>
<td>Nitrate as N by Discrete Analyser</td>
<td>EK057G</td>
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<td>20</td>
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<td>5.0</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
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<tr>
<td>PAH/Phenols (GCMS - SIM)</td>
<td>EP075(SIM)</td>
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<td>12</td>
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<tr>
<td>Reactive Phosphorus as P-By Discrete Analyser</td>
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<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
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<td>20</td>
<td>5.0</td>
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<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
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<td>20</td>
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<td>10.0</td>
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<td>Total Phosphorus as P By Discrete Analyser</td>
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<tr>
<td>TRH - Semivolatile Fraction</td>
<td>EK071G</td>
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<td>19</td>
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<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>1</td>
<td>20</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
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### Method Blanks (MB)

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<th>Analytical Methods</th>
<th>QC</th>
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<th>Actual</th>
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<th>Evaluation</th>
<th>Quality Control Specification</th>
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<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>1</td>
<td>19</td>
<td>5.3</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
</tr>
<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
<td>5.0</td>
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<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
<td>1</td>
<td>18</td>
<td>5.6</td>
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<td></td>
<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
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</tbody>
</table>

NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Quality Control frequency not within specification: ✗

Quality Control frequency within specification: ✓
### Evaluation: 
- ✗ = Quality Control frequency not within specification
- ✔ = Quality Control frequency within specification

<table>
<thead>
<tr>
<th>Analytical Methods</th>
<th>Method</th>
<th>Count</th>
<th>Rate (%)</th>
<th>Quality Control Specification</th>
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<tbody>
<tr>
<td><strong>Method Blanks (MB) - Continued</strong></td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>16</td>
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<td>5.0</td>
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<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>18</td>
<td>5.6</td>
<td>5.0</td>
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<tr>
<td>Major Cations - Dissolved</td>
<td>ED093F</td>
<td>14</td>
<td>7.1</td>
<td>5.0</td>
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<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>10</td>
<td>10.0</td>
<td>5.0</td>
</tr>
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<td>Reactive Phosphorus as P By Discrete Analyser</td>
<td>EK071G</td>
<td>4</td>
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</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>20</td>
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<td>5.0</td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
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<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
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<tr>
<td>TRH - Semivolatile Fraction</td>
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<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
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### Matrix Spikes (MS) |
<table>
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<th>Method</th>
<th>Count</th>
<th>Rate (%)</th>
<th>Quality Control Specification</th>
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<tbody>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>19</td>
<td>5.3</td>
<td>5.0</td>
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<td>Chloride by Discrete Analyser</td>
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<td>5.0</td>
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<tr>
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<td>EG035F</td>
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<td>6.3</td>
<td>5.0</td>
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<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
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<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
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<td>10.0</td>
<td>5.0</td>
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<tr>
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<td>5.0</td>
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<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EA067G</td>
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<td>5.9</td>
<td>5.0</td>
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<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>20</td>
<td>5.0</td>
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</tbody>
</table>
**Brief Method Summaries**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

<table>
<thead>
<tr>
<th>Analytical Methods</th>
<th>Method</th>
<th>Matrix</th>
<th>Method Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH by PC Titrator</strong></td>
<td>EA005-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed. 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>Conductivity by PC Titrator</strong></td>
<td>EA010-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>Total Dissolved Solids (High Level)</strong></td>
<td>EA015H</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2540C. A gravimetric procedure that determines the amount of ‘filterable’ residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>Alkalinity by PC Titrator</strong></td>
<td>ED037-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)</td>
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<tr>
<td><strong>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</strong></td>
<td>ED041G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>Chloride by Discrete Analyser</strong></td>
<td>ED045G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003</td>
</tr>
<tr>
<td><strong>Major Cations - Dissolved</strong></td>
<td>ED093F</td>
<td>WATER</td>
<td>In house: Referenced to APHA 3120 and 3125; USEPA SW846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>Dissolved Metals by ICP-MS - Suite A</strong></td>
<td>EG020A-F</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.</td>
</tr>
<tr>
<td><strong>Dissolved Mercury by FIMS</strong></td>
<td>EG035F</td>
<td>WATER</td>
<td>In house: Referenced to AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
</tbody>
</table>
### Analytical Methods

<table>
<thead>
<tr>
<th>Method Descriptions</th>
<th>Method</th>
<th>Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia as N by Discrete Analyser</td>
<td>EK055G</td>
<td>WATER</td>
</tr>
<tr>
<td>In house: Referenced to APHA 21st ed., 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
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<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
<td>WATER</td>
</tr>
<tr>
<td>In house: Referenced to APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
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<tr>
<td>Nitrate as N by Discrete Analyser</td>
<td>EK058G</td>
<td>WATER</td>
</tr>
<tr>
<td>In house: Referenced to APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>WATER</td>
</tr>
<tr>
<td>In house: Referenced to APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
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<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
<td>WATER</td>
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<td>In house: Referenced to APHA 21st ed., 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
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<tr>
<td>Reactive Phosphorus as P By Discrete Analyser</td>
<td>EK071G</td>
<td>WATER</td>
</tr>
<tr>
<td>In house: Referenced to APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate react in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ionic Balance by PCT DA and Turbi SO4 DA</td>
<td>EN055 - PG</td>
<td>WATER</td>
</tr>
<tr>
<td>In house: Referenced to APHA 21st Ed. 1030F. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
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<tr>
<td>TRH - Semivolatile Fraction</td>
<td>EP071</td>
<td>WATER</td>
</tr>
<tr>
<td>USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)</td>
<td></td>
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<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
<td>EP075(SIM)</td>
<td>WATER</td>
</tr>
<tr>
<td>USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
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</tr>
<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>WATER</td>
</tr>
<tr>
<td>USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Preparation Methods

<table>
<thead>
<tr>
<th>Method Descriptions</th>
<th>Method</th>
<th>Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKN/TP Digestion</td>
<td>EK061/EK067</td>
<td>WATER</td>
</tr>
<tr>
<td>Separatory Funnel Extraction of Liquids</td>
<td>ORG14</td>
<td>WATER</td>
</tr>
<tr>
<td>USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3). ALS default excludes sediment which may be resident in the container.</td>
<td></td>
<td></td>
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</tbody>
</table>
Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.
- For all matrices, no Matrix Spike outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

<table>
<thead>
<tr>
<th>Matrix: WATER</th>
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<tr>
<td>Method</td>
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<tr>
<td>Container / Client Sample ID(s)</td>
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Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.
### Chain of Custody Form

**SMEC Office:** North Sydney  
**Project:** NBHP - Groundwater Monitoring  
**Project Manager:** D. Saunders  
**Sampled By:** S. Shaw  
**Date Sampled:** 6/7/15

<table>
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<tr>
<th>LAB ID</th>
<th>Sample ID</th>
<th>Date / Time</th>
<th>Sample Matrix</th>
<th>Container Type &amp; Preservative</th>
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<th>Comments</th>
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**Analysis Required:**
- NO3, NO2, NH4, Ca, Mg, SO4, PO4
- BOD, COD
- pH, TDS
- TPH, TOT
- N and P
- Metals

**Special Laboratory Instructions:**
- GW1 - GW5, GW9, GW10 need to be filtered by lab for dissolved metals.
- GW11 was taken from 50cm plastic bottle.

**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**Copies:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book.
SAMPLE RECEIPT ADVICE

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney NSW 2060
ph: 02 9925 5555
Fax: 02 9925 5566
Attention: D Saunders

Sample log in details:
Your reference: NBHP-Ground Water Monitoring
Envirolab Reference: 121694
Date received: 7/1/2015
Date results expected to be reported: 14/01/15

Samples received in appropriate condition for analysis: YES
No. of samples provided: 11 Waters
Turnaround time requested: Standard
Temperature on receipt (°C): 15.1
Cooling Method: Ice
Sampling Date Provided: YES

Comments:
If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:
Water samples - 1 month
Soil and other solid samples - 2 months
Samples collected in canisters - 1 week. Canisters will then be cleaned.
All other samples are not retained after analysis
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:
Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200 fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au
CERTIFICATE OF ANALYSIS 121694

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: D Saunders

Sample log in details:
Your Reference: NBHP-Ground Water Monitoring
No. of samples: 11 Waters
Date samples received / completed instructions received 7/1/2015 / 7/1/2015

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 14/01/15 / 14/01/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinth Hurst
Laboratory Manager
### vTRH(C6-C10)/BTEX in Water

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<tr>
<th>Date Sampled</th>
<th>Type of sample</th>
<th>Date Sampled</th>
<th>Date extracted</th>
<th>Date analysed</th>
<th>TRH C6-C9 µg/L</th>
<th>TRH C6-C10 µg/L</th>
<th>TRH C6-C10 less BTEX (F1) µg/L</th>
<th>Benzene µg/L</th>
<th>Toluene µg/L</th>
<th>Ethylbenzene µg/L</th>
<th>m+p-xylene µg/L</th>
<th>o-xylene µg/L</th>
<th>Naphthalene µg/L</th>
<th>Surrogate Dibromofluoromethane %</th>
<th>Surrogate toluene-d8 %</th>
<th>Surrogate 4-BFB %</th>
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### vTRH(C6-C10)/BTEX in Water

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<th>TRH C6-C9 µg/L</th>
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### svTRH (C10-C40) in Water

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### Metals in Waters - Total

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<tr>
<td>Org-016</td>
<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<tr>
<td>Org-013</td>
<td>Water samples are analysed directly by purge and trap GC-MS.</td>
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<td>Org-003</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (&gt;C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</td>
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<td>Org-012 subset</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</td>
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<td>Metals-022 ICP-MS</td>
<td>Determination of various metals by ICP-MS.</td>
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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<td>Inorg-006</td>
<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<td>Inorg-041</td>
<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180°C/5oC.</td>
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<td>Inorg-057</td>
<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.</td>
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<td>Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.</td>
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<td>Surrogate p-Terphenyl-d14</td>
<td>%</td>
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### HM in water - dissolved

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<tr>
<th>Compound</th>
<th>Units</th>
<th>PQL</th>
<th>Method</th>
<th>Blank</th>
<th>Duplicate Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tbody>
<tr>
<td>Date prepared</td>
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<td>121694-1</td>
<td>08/01/2014</td>
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</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
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<td>08/01/2014</td>
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<tr>
<td>Arsenic-Dissolved</td>
<td>µg/L</td>
<td>1</td>
<td>Metals-022 ICP-MS</td>
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<td>Cadmium-Dissolved</td>
<td>µg/L</td>
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<tr>
<td>Copper-Dissolved</td>
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<td>Lead-Dissolved</td>
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<td>Mercury-Dissolved</td>
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<td>Nickel-Dissolved</td>
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<td>Zinc-Dissolved</td>
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### QUALITY CONTROL

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<th>METHOD</th>
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<th>Duplicate Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tbody>
<tr>
<td>Date prepared</td>
<td>-</td>
<td></td>
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<td>[NT]</td>
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<td>08/01/2015</td>
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<td>Calcium - Dissolved</td>
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<td>Hydroxide Alkalinity (OH⁻) as CaCO₃</td>
<td>mg/L</td>
<td>5</td>
<td>Inorg-006</td>
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<td>121694-6</td>
<td>&lt;5</td>
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<tr>
<td>Bicarbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>5</td>
<td>Inorg-006</td>
<td>&lt;5</td>
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<tr>
<td>Carbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
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<td>Inorg-006</td>
<td>&lt;5</td>
<td>121694-6</td>
<td>&lt;5</td>
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<tr>
<td>Total Alkalinity as CaCO₃</td>
<td>mg/L</td>
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<td>Inorg-006</td>
<td>&lt;5</td>
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<tr>
<td>Sulphate, SO₄</td>
<td>mg/L</td>
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<td>Chloride, Cl</td>
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### QUALITY CONTROL

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<th>PQL</th>
<th>METHOD</th>
<th>Blank</th>
<th>Duplicate Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tr>
<td>Date prepared</td>
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<td></td>
<td>08/01/2</td>
<td>08/01/2015</td>
<td>LCS-W1</td>
<td>08/01/2015</td>
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<td>08/01/2015</td>
<td>LCS-W1</td>
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<tr>
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<td>pH Units</td>
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<td>Total Dissolved Solids</td>
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<td>Inorg-018</td>
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<td>Ammonia as N in water</td>
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<td>Inorg-057</td>
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<td>Inorg-055</td>
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<td>Nitrite as N in water</td>
<td>mg/L</td>
<td>0.005</td>
<td>Inorg-055</td>
<td>&lt;0.005</td>
<td>121694-1</td>
<td>&lt;0.005</td>
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<td>&lt;0.005</td>
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<tr>
<td>Phosphate as P in water</td>
<td>mg/L</td>
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<td>Inorg-060</td>
<td>&lt;0.005</td>
<td>121694-1</td>
<td>&lt;0.005</td>
<td></td>
<td>&lt;0.005</td>
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</tbody>
</table>
### Metal in Waters - Total

| Date prepared | - | | | 09/01/2015 | 09/01/2015 | LCS-W1 | 09/01/2015 |
| Date analysed | - | | | 09/01/2015 | 09/01/2015 | LCS-W1 | 09/01/2015 |
| Phosphorus - Total | mg/L | 0.05 | Metals-020 ICP-AES | <0.05 | 121694-1 | <0.05 | <0.05 | LCS-W1 | 107% |

### vTRH(C6-C10)/BTEX in Water

| Date extracted | - | | | 08/01/2015 | 09/01/2015 | RPD:4 |
| Date analysed | - | | | 08/01/2015 | 10/01/2015 | RPD:15 |
| TRHC6 - C6 | µg/L | 121694-7 | 121694-7 | 121694-7 | 25 | 24 |
| TRHC6 - C10 | µg/L | 121694-7 | 121694-7 | 121694-7 | 28 | 24 |
| Benzene | µg/L | 121694-7 | 121694-7 | 121694-7 | 15 | 13 |
| Toluene | µg/L | 121694-7 | 121694-7 | 121694-7 | <1 | <1 |
| Ethylbenzene | µg/L | 121694-7 | 121694-7 | 121694-7 | <1 | <1 |
| m+p-xylene | µg/L | 121694-7 | 121694-7 | 121694-7 | <2 | <2 |
| o-xylene | µg/L | 121694-7 | 121694-7 | 121694-7 | <1 | <1 |
| Naphthalene | µg/L | 121694-7 | 121694-7 | 121694-7 | <1 | <1 |

### Surrogate

- **Dibromofluoromethane** (%): 121694-7 | 106 | 102 | RPD:4
- **toluene-d8** (%): 121694-7 | 101 | 100 | RPD:1
- **4-BFB** (%): 121694-7 | 99 | 98 | RPD:1

### svTRH (C10-C40) in Water

| Date extracted | - | | | 12/01/2015 | 12/01/2015 | RPD:3 |
| Date analysed | - | | | 12/01/2015 | 12/01/2015 | RPD:2 |
| TRHC10 - C10 | µg/L | 121694-7 | 121694-7 | 121694-7 | <50 | <50 |
| TRHC15 - C15 | µg/L | 121694-7 | 121694-7 | 121694-7 | <100 | <100 |
| TRHC20 - C20 | µg/L | 121694-7 | 121694-7 | 121694-7 | <100 | <100 |
| TRHC25 - C25 | µg/L | 121694-7 | 121694-7 | 121694-7 | <50 | <50 |
| TRHC30 - C30 | µg/L | 121694-7 | 121694-7 | 121694-7 | <100 | <100 |
| TRHC35 - C35 | µg/L | 121694-7 | 121694-7 | 121694-7 | <100 | <100 |
| TRHC40 - C40 | µg/L | 121694-7 | 121694-7 | 121694-7 | <100 | <100 |
| **Surrogate o-Terphenyl** (%): 121694-7 | 83 | 95 | RPD:13

### Client Reference: NBHP-Ground Water Monitoring

**Envirolab Reference:** 121694

**Revision No:** R 00
### PAHs in Water

| Date extracted | 12/01/2015 | 12/01/2015 | 12/01/2015 | 12/01/2015 |
| Date analysed  | 12/01/2015 | 12/01/2015 | 12/01/2015 | 12/01/2015 |
| Naphthalene    | <1 | <1 | [NR] | [NR] |
| Acenaphthylene | <1 | <1 | [NR] | [NR] |
| Acenaphthene   | <1 | <1 | [NR] | [NR] |
| Fluorene       | <1 | <1 | [NR] | [NR] |
| Phenanthrene   | <1 | <1 | [NR] | [NR] |
| Anthracene     | <1 | <1 | 121694-2 | 73% |
| Fluoranthe     | <1 | <1 | 121694-2 | 74% |
| Pyrene         | <1 | <1 | 121694-2 | 85% |
| Benzo(a)anthracene | <1 | <1 | [NR] | [NR] |
| Chrysene       | <1 | <1 | 121694-2 | 70% |
| Benzo(b,j+k)fluoranthe | <2 | <2 | [NR] | [NR] |
| Benzo(a)pyrene | <1 | <1 | 121694-2 | 82% |
| Indeno(1,2,3-c,d)pyrene | <1 | <1 | [NR] | [NR] |
| Dibenzo(a,h)anthracene | <1 | <1 | [NR] | [NR] |
| Benzo(g,h,i)perylene | <1 | <1 | [NR] | [NR] |
| **Surrogate p-Terphenyl-d14** | 75 | 82 | RPD: 9 | 121694-2 | 81% |

### HM in Water - dissolved

| Date prepared | 08/01/2014 | 08/01/2014 | 08/01/2015 | 08/01/2015 |
| Mercury-Dissolved | <0.05 | <0.05 | 121694-2 | 92% |

### Ion Balance

<p>| Date prepared | 08/01/2015 | 08/01/2015 | 08/01/2015 | 08/01/2015 |
| Hydroxide Alkalinity (OH⁻) as CaCO₃ | &lt;5 | &lt;5 | [NR] | [NR] |
| Bicarbonate Alkalinity as CaCO₃ | 9 | 9 | RPD: 0 | [NR] | [NR] |
| Carbonate Alkalinity as CaCO₃ | &lt;5 | &lt;5 | [NR] | [NR] |
| Total Alkalinity as CaCO₃ | 9 | 9 | RPD: 0 | [NR] | [NR] |
| Sulphate, SO₄²⁻ | 36 | 35 | RPD: 3 | 121694-2 | # |
| Chloride, Cl⁻ | 230 | 230 | RPD: 0 | 121694-2 | # |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Date prepared</th>
<th>Date analysed</th>
<th>Spike % Recovery</th>
</tr>
</thead>
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<tr>
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<tr>
<td>pH</td>
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<td>08/01/2015</td>
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<tr>
<td>Electrical Conductivity (µS/cm)</td>
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<td>Total Dissolved Solids (grav)</td>
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<td>Ammonia as N in water (mg/L)</td>
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<td>0.019</td>
<td>103%</td>
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<tr>
<td>Nitrate as N in water (mg/L)</td>
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<td>0.38</td>
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<tr>
<td>Nitrite as N in water (mg/L)</td>
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<td>0.040</td>
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<tr>
<td>Phosphate as P in water (mg/L)</td>
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<td>&lt;0.005</td>
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<tr>
<td><strong>Metals in Waters - Total</strong></td>
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<td>Phosphorus - Total (mg/L)</td>
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<td><strong>HM in water - dissolved</strong></td>
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<tr>
<td>Arsenic-Dissolved (µg/L)</td>
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<td>&lt;1</td>
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<td>Cadmium-Dissolved (µg/L)</td>
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<td>Copper-Dissolved (µg/L)</td>
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<td>Manganese-Dissolved (µg/L)</td>
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<td>Lead-Dissolved (µg/L)</td>
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<td>&lt;1</td>
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<tr>
<td>Mercury-Dissolved (µg/L)</td>
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<tr>
<td>Nickel-Dissolved (µg/L)</td>
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<td>&lt;1</td>
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<tr>
<td>Zinc-Dissolved (µg/L)</td>
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<td>&lt;5</td>
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<tr>
<td>Bicarbonate Alkalinity as CaCO₃ (mg/L)</td>
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<td>&lt;5</td>
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<td>Total Alkalinity as CaCO₃ (mg/L)</td>
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<td>QUALITY CONTROL</td>
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<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
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</tr>
<tr>
<td>Ion Balance</td>
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<td>Sulphate, SO4</td>
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<td>Chloride, Cl</td>
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<tr>
<td>Ionic Balance</td>
<td>%</td>
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<td>5.7</td>
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</tbody>
</table>
Report Comments:
SO4# Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.
Cl # Percent recovery not available due to matrix interference, however an acceptable recovery was achieved for the LCS.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test  PQL: Practical Quantitation Limit  NT: Not tested
NA: Test not required  RPD: Relative Percent Difference  NA: Test not required
<: Less than  >: Greater than  LCS: Laboratory Control Sample
Quality Control Definitions
Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria
Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: ≤5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metallics; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT NUMBER:** 30011560  
**PROJECT MANAGER:** D. Saunders  
**SAMPLED BY:** S. Shaw  
**DATE SAMPLED:** 6.1.15

**LAB:** Enviro Lab  
**ATTENTION:** Chatswood  
**DISPATCH TO:**

**TURNAROUND REQUIREMENTS:**  
- Standard - 5 day TAT

**PROJECT:** NSW HPR - Surface Water Monitoring  
**LAB QUOTE NO.:** 14 SY282  
**CONTACT PH:** 0414 752 743  
**COC SEQUENCE NUMBER (Circle):**

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**COMMENTS:**

Notes: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

Copies: WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book
SAMPLE RECEIPT ADVICE

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney  NSW  2060

Attention:  D Saunders

Sample log in details:
Your reference: NBHP-Water Quality Monitoring
Envirolab Reference: 121693
Date received: 7/1/2015
Date results expected to be reported: 14/01/15

Samples received in appropriate condition for analysis: YES
No. of samples provided 7 Waters
Turnaround time requested: Standard
Temperature on receipt (°C) 15.3
Cooling Method: Ice
Sampling Date Provided: YES

Comments:
If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:
Water samples - 1 month
Soil and other solid samples - 2 months
Samples collected in canisters - 1 week. Canisters will then be cleaned.
All other samples are not retained after analysis
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:
Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200  fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au
CERTIFICATE OF ANALYSIS

Client: SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: D Saunders

Sample log in details:
Your Reference: NBHP-Water Quality Monitoring
No. of samples: 7 Waters
Date samples received / completed instructions received 7/1/2015 / 7/1/2015

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 14/01/15 / 14/01/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:
### vTRH(C6-C10)/BTEXN in Water

| Date Sampled | Type of sample | Date extracted | Date analysed | TRH C6 - C9 µg/L | TRH C6 - C10 µg/L | TRH C6 - C10 less BTEX (F1) µg/L | Benzene µg/L | Toluene µg/L | Ethylbenzene µg/L | m+p-xylene µg/L | o-xylene µg/L | Naphthalene µg/L | Surrogate Dibromofluoromethane % | Surrogate toluene-d8 % | Surrogate 4-BFB % |
|--------------|----------------|----------------|---------------|------------------|------------------|--------------------------------|----------------|-------------|------------------|-----------------|-------------|----------------|-------------------------------|----------------------|----------------|-------------------|
| 6/01/2015    | Water          | 8/01/2015      | 8/01/2015     | <10              | <10              | <10                           | <1             | <1          | <1               | <2              | <1          | <1              | 106                           | 102                  | 100            | 101                |
| 6/01/2015    | Water          | 8/01/2015      | 8/01/2015     | <10              | <10              | <10                           | <1             | <1          | <1               | <2              | <1          | <1              | 106                           | 102                  | 100            | 101                |
| 6/01/2015    | Water          | 8/01/2015      | 8/01/2015     | <10              | <10              | <10                           | <1             | <1          | <1               | <2              | <1          | <1              | 106                           | 102                  | 100            | 101                |
| 6/01/2015    | Water          | 8/01/2015      | 8/01/2015     | <10              | <10              | <10                           | <1             | <1          | <1               | <2              | <1          | <1              | 106                           | 102                  | 100            | 101                |
### svTRH (C10-C40) in Water

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| Date extracted | 08/01/2015 | 08/01/2015 | 08/01/2015 | 08/01/2015 | 08/01/2015 |
| Date analysed  | 08/01/2015 | 08/01/2015 | 08/01/2015 | 08/01/2015 | 08/01/2015 |

| TRH C<sub>10</sub> - C<sub>14</sub> | µg/L | <50 | <50 | <50 | <50 | <50 |
| TRH C<sub>15</sub> - C<sub>28</sub> | µg/L | <100 | <100 | <100 | <100 | <100 |
| TRH C<sub>29</sub> - C<sub>40</sub> | µg/L | <100 | <100 | <100 | <100 | <100 |
| TRH >C<sub>10</sub> - C<sub>16</sub> | µg/L | <50 | <50 | <50 | <50 | <50 |
| TRH >C<sub>16</sub> - C<sub>34</sub> | µg/L | <100 | <100 | <100 | <100 | <100 |
| TRH >C<sub>34</sub> - C<sub>40</sub> | µg/L | <100 | <100 | <100 | <100 | <100 |

*Surrogate o-Terphenyl %* 79 94 76 97 78

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### svTRH (C10-C40) in Water

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| Date extracted | 08/01/2015 | 08/01/2015 |
| Date analysed  | 08/01/2015 | 08/01/2015 |

| TRH C<sub>10</sub> - C<sub>14</sub> | µg/L | <50 | <50 |
| TRH C<sub>15</sub> - C<sub>28</sub> | µg/L | <100 | <100 |
| TRH C<sub>29</sub> - C<sub>40</sub> | µg/L | <100 | <100 |
| TRH >C<sub>10</sub> - C<sub>16</sub> | µg/L | <50 | <50 |
| TRH >C<sub>16</sub> - C<sub>34</sub> | µg/L | <100 | <100 |
| TRH >C<sub>34</sub> - C<sub>40</sub> | µg/L | <100 | <100 |

*Surrogate o-Terphenyl %* 82 82

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| Phosphorus - Total | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |

### Metals in Waters - Total

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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<td>Metals-020 ICP-AES</td>
<td>Determination of various metals by ICP-AES.</td>
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<tr>
<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180°C.</td>
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<td>Inorg-019</td>
<td>Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104°C.</td>
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<td>Inorg-055</td>
<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Inorg-055</td>
<td>Nitrite - determined colourimetrically based on APHA latest edition NO2-B. Soils are analysed following a water extraction.</td>
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<td>Inorg-057</td>
<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<td>Inorg-060</td>
<td>Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.</td>
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<td>Inorg-081</td>
<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<td><strong>Date analysed</strong></td>
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<td>TRHCs - C10</td>
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<td>Phenanthrene</td>
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## QUALITY CONTROL

### PAHs in Water

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<th>Duplicate</th>
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<th>Spike % Recovery</th>
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### HM in water - dissolved

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<th>Spike % Recovery</th>
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<td>Copper-Dissolved</td>
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<td>Lead-Dissolved</td>
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<td>Mercury-Dissolved</td>
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### Quality Control Units: PQL Method

#### HM in Water - Total

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<th>Arsenic-Total (µg/L)</th>
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<th>Mercury-Total (µg/L)</th>
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<th>Zinc-Total (µg/L)</th>
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### Quality Control Units: PQL Method

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<th>Lead-Total (µg/L)</th>
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### Quality Control Units: PQL Method

#### Miscellaneous Inorganics

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<th>Total Suspended Solids (grav) (mg/L)</th>
<th>Nitrate as N in water (mg/L)</th>
<th>Nitrite as N in water (mg/L)</th>
<th>Ammonia as N in water (mg/L)</th>
<th>Phosphate as P in water (mg/L)</th>
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**Envirolab Reference:** 121693

**Revision No:** R 00
## QUALITY CONTROL

**svTRH (C10-C40) in Water**

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<td>TRH C10 - C14</td>
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**Surrogate o-Terphenyl**

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## QUALITY CONTROL

**PAHs in Water**

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<td>Naphthalene</td>
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<td>Phenanthrene</td>
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**Surrogate p-Terphenyl-d14**

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<td>HM in water - dissolved</td>
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<td>Arsenic-Dissolved</td>
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<td>Iron-Dissolved</td>
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<td>Sulphate, SO4</td>
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Report Comments:

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test
NA: Test not required
<: Less than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Envirolab Reference: 121693
Revision No: R 00
Quality Control Definitions

**Blank**: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

**Duplicate**: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

**Matrix Spike**: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

**LCS (Laboratory Control Sample)**: This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

**Surrogate Spike**: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT:** NBHP - Water Quality Monitoring  
**PROJECT NUMBER:** 30011560  
**PROJECT MANAGER:** D. Saunders  
**SAMPLED BY:** S. Shaw  
**DATE SAMPLED:** 3 + 4th 2/1/2015

**LAB:** Envirolab

**COC SEQUENCE NUMBER:** 14 SY282  
**LAB QUOTE NO.:** 14 SY282  
**COC:** 2 2 4 5 6 7

**RELEASING SITE:** Chatswood

**RELINQUISHED BY:** S. Shaw  
**RECEIVED BY:** Envirolab  
**DATE/TIME:** 4/2/15

**REMARKS:** Disolved Metals to be filtered by lab

**SAMPLE DETAILS**

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<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>SAMPLE MATRIX</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO. CONTAINERS</th>
<th>PH / EC</th>
<th>TDS</th>
<th>ANIONS</th>
<th>CATIONS</th>
<th>TRNa, TRCl, SO4, HCO3</th>
<th>NHI4, NH3, NO3, PO4, TotalP</th>
<th>Brix, PAA</th>
<th>Dissolved Metals</th>
<th>COMMENTS</th>
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**TOTAL:** 11

**NOTES:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**COPIES:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in COC book
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT:** NBHP - Water Quality Monitoring

<table>
<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>SAMPLE MATRIX</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>PH/EC</th>
<th>TDS, TSS</th>
<th>Anions</th>
<th>Cations</th>
<th>NH4, NO3-</th>
<th>Nitrates</th>
<th>PO4, NP2-</th>
<th>Silicate</th>
<th>BTEX, PAH</th>
<th>Disolved Metals (8)</th>
<th>Total Metals (8)</th>
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<td>17</td>
<td>SW6</td>
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</tbody>
</table>

**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**Copies:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book
SAMPLE RECEIPT ADVICE

Client:
SMEC Australia  ph: 02 9925 5555
Level 5, 20 Berry St  Fax: 02 9925 5566
North Sydney  NSW  2060

Attention:  Daniel Saunders

Sample log in details:
Your reference:  30011560, NBHP - Water Quality Monitoring
Envirolab Reference:  122964
Date received:  04/02/15
Date results expected to be reported:  11/02/15

Samples received in appropriate condition for analysis:  YES
No. of samples provided  17 waters
Turnaround time requested:  Standard
Temperature on receipt (°C)  1.1
Cooling Method:  Ice
Sampling Date Provided:  YES

Comments:
If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:
Water samples - 1 month
Soil and other solid samples - 2 months
Samples collected in canisters - 1 week. Canisters will then be cleaned.
All other samples are not retained after analysis
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:
Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200  fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au
Client: SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: Daniel Saunders

Sample log in details:
Your Reference: 30011560, NBHP - Water Quality Monitoring
No. of samples: 17 waters
Date samples received / completed instructions received 04/02/15 / 04/02/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 11/02/15 / 11/02/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:
### vTRH(C6-C10)/BTEXN in Water

<table>
<thead>
<tr>
<th>Date Sampled</th>
<th>Type of sample</th>
<th>Date extracted</th>
<th>Date analysed</th>
</tr>
</thead>
<tbody>
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<td>water</td>
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#### vTRH(C6-C10)/BTEXN in Water

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<th>UNITS 122964-4</th>
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<td><strong>TRH C6 - C9</strong></td>
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<td><strong>o-xylene</strong></td>
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<tr>
<td><strong>Surrogate Dibromofluoromethane</strong></td>
<td>83</td>
<td>124</td>
<td>113</td>
<td>130</td>
<td>83</td>
</tr>
<tr>
<td><strong>Surrogate toluene-d8</strong></td>
<td>86</td>
<td>92</td>
<td>122</td>
<td>93</td>
<td>91</td>
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<tr>
<td><strong>Surrogate 4-BFB</strong></td>
<td>86</td>
<td>104</td>
<td>101</td>
<td>102</td>
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### vTRH(C6-C10)/BTEXN in Water

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<th>122964-14</th>
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<td>SW1</td>
<td>SW2</td>
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<td>04/02/2015</td>
<td>04/02/2015</td>
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<td>water</td>
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</tbody>
</table>

<p>| Date Sampled | 03/02/2015 | 04/02/2015 | 04/02/2015 | 04/02/2015 | 04/02/2015 |</p>
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<tr>
<th>Type of sample</th>
<th>water</th>
<th>water</th>
<th>water</th>
<th>water</th>
<th>water</th>
</tr>
</thead>
</table>

| TRHC<sub>C6-C9</sub> | µg/L | 18 | <10 | <10 | <10 | <10 |
| TRHC<sub>C6-C10</sub> | µg/L | 20 | <10 | <10 | <10 | <10 |
| TRHC<sub>C6-C10</sub> less BTEX (F1) | µg/L | <10 | <10 | <10 | <10 | <10 |
| Benzene | µg/L | 11 | <1 | <1 | <1 | <1 |
| Toluene | µg/L | <1 | <1 | <1 | <1 | <1 |
| Ethylbenzene | µg/L | <1 | <1 | <1 | <1 | <1 |
| m+p-xylene | µg/L | <2 | <2 | <2 | <2 | <2 |
| o-xylene | µg/L | <1 | <1 | <1 | <1 | <1 |
| Naphthalene | µg/L | <1 | <1 | <1 | <1 | <1 |

**Surrogate** Dibromofluoromethane<br>% | 81 | 127 | 125 | 106 | 135 |
**Surrogate** toluene-d8<br>% | 91 | 93 | 92 | 73 | 94 |
**Surrogate** 4-BFB<br>% | 84 | 101 | 110 | 99 | 108 |

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### vTRH(C6-C10)/BTEXN in Water

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<th>UNITS</th>
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<tbody>
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<td>SW5</td>
<td>SW6</td>
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<tr>
<td>Date Sampled</td>
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<td>04/02/2015</td>
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<tr>
<td>Type of sample</td>
<td>-------</td>
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<td>water</td>
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</tbody>
</table>

<p>| Date Sampled | 04/02/2015 | 04/02/2015 |</p>
<table>
<thead>
<tr>
<th>Type of sample</th>
<th>water</th>
<th>water</th>
</tr>
</thead>
</table>

| TRHC<sub>C6-C9</sub> | µg/L | <10 | <10 |
| TRHC<sub>C6-C10</sub> | µg/L | <10 | <10 |
| TRHC<sub>C6-C10</sub> less BTEX (F1) | µg/L | <10 | <10 |
| Benzene | µg/L | <1 | <1 |
| Toluene | µg/L | <1 | <1 |
| Ethylbenzene | µg/L | <1 | <1 |
| m+p-xylene | µg/L | <2 | <2 |
| o-xylene | µg/L | <1 | <1 |
| Naphthalene | µg/L | <1 | <1 |

**Surrogate** Dibromofluoromethane<br>% | 117 | 77 |
**Surrogate** toluene-d8<br>% | 78 | 89 |
**Surrogate** 4-BFB<br>% | 107 | 85 |
### svTRH (C10-C40) in Water

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<tbody>
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<td>svTRH (C10-C40) in Water</td>
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<tr>
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<tr>
<td>Your Reference ------------- GW1-10</td>
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<tr>
<td>Date Sampled ------------- 03/02/2015-04/02/2015</td>
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<td>Type of sample water</td>
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| Date extracted - 05/02/2015-05/02/2015 | 05/02/2015-05/02/2015 |
| Date analysed - 08/02/2015-08/02/2015 | 08/02/2015-08/02/2015 |
| TRH C10 - C14 µg/L | <50-<50 | <50-<50 | <50-<50 | <50-<50 | <50-<50 |
| TRH C15 - C28 µg/L | <100-110 | <100-100 | <100-100 | <100-100 | <100-100 |
| TRH C29 - C36 µg/L | <100-<100 | <100-<100 | <100-<100 | <100-<100 | <100-<100 |
| TRH >C10 - C16 µg/L | [NA]-<50 | <50-<50 | <50-<50 | <50-<50 | <50-<50 |
| TRH >C10 - C16 less Naphthalene (F2) µg/L | <50-<100 | <100-110 | <100-<100 | <100-<100 | <100-<100 |
| TRH >C16 - C34 µg/L | <100-<100 | <100-<100 | <100-<100 | <100-<100 | <100-<100 |
| TRH >C34 - C40 µg/L | <100-<100 | <100-<100 | <100-<100 | <100-<100 | <100-<100 |

**Surrogate o-Terphenyl %**
- GW1: 89-103%
- GW2: 94-101%
- GW3: 104-115%
- GW4: 107-114%
- GW5: 106-109%
- GW6: 103-101%
- GW7: 115-113%
- GW8: 113-114%
- GW9: 114-109%
- GW10: 106-109%
- DUP1: 103-101%
- SW1: 115-113%
- SW2: 113-114%
- SW3: 114-109%
- SW4: 106-109%

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**svTRH (C10-C40) in Water**

| Client Reference: 30011560, NBHP - Water Quality Monitoring |

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**svTRH (C10-C40) in Water**

| Client Reference: 30011560, NBHP - Water Quality Monitoring |

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**svTRH (C10-C40) in Water**

| Client Reference: 30011560, NBHP - Water Quality Monitoring |
svTRH (C10-C40) in Water

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<td>Date analysed</td>
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<td>TRH C10 - C14</td>
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<td>&lt;50</td>
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<tr>
<td>TRH C15 - C28</td>
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<td>&lt;100</td>
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<tr>
<td>TRH C29 - C36</td>
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<tr>
<td>TRH &gt;C10 - C16</td>
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<td>TRH &gt;C10 - C16 less Naphthalene (F2)</td>
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<td>TRH &gt;C16 - C36</td>
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<td>TRH &gt;C34 - C40</td>
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<td>Surrogate o-Terphenyl</td>
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### PAHs in Water

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# Client Reference: 30011560, NBHP - Water Quality Monitoring

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### Client Reference: 30011560, NBHP - Water Quality Monitoring

#### Ion Balance

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#### Ion Balance

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### Ion Balance

| Date Sampled | Type of sample | Date prepared | Date analysed | Calcium - Dissolved (mg/L) | Potassium - Dissolved (mg/L) | Sodium - Dissolved (mg/L) | Magnesium - Dissolved (mg/L) | Hydroxide Alkalinity (OH⁻ as CaCO₃) (mg/L) | Bicarbonate Alkalinity as CaCO₃ (mg/L) | Carbonate Alkalinity as CaCO₃ (mg/L) | Total Alkalinity as CaCO₃ (mg/L) | Sulphate, SO₄ (mg/L) | Chloride, Cl (mg/L) | Ionic Balance (%) |
|--------------|----------------|---------------|---------------|-----------------------------|-------------------------------|--------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------|----------------|-----------------|
| 03/02/2015   | water          | 04/02/2015    | 04/02/2015    | 2.3                         | 0.8                           | 38                        | 1.4                           | <5                            | 9                             | <5                          | 9                           | 15              | 47              | 2.4             |
| 04/02/2015   | water          | 04/02/2015    | 04/02/2015    | [NA]                        | [NA]                          | [NA]                     | [NA]                          | [NA]                          | [NA]                        | [NA]                        | [NA]                        | 25              | 82              | [NA]            |
| 04/02/2015   | water          | 04/02/2015    | 04/02/2015    | [NA]                        | [NA]                          | [NA]                     | [NA]                          | [NA]                          | [NA]                        | [NA]                        | [NA]                        | 19              | 92              | [NA]            |
| 04/02/2015   | water          | 04/02/2015    | 04/02/2015    | [NA]                        | [NA]                          | [NA]                     | [NA]                          | [NA]                          | [NA]                        | [NA]                        | [NA]                        | 16              | 48              | [NA]            |
| 04/02/2015   | water          | 04/02/2015    | 04/02/2015    | [NA]                        | [NA]                          | [NA]                     | [NA]                          | [NA]                          | [NA]                        | [NA]                        | [NA]                        | 29              | 43              | [NA]            |

### Ion Balance

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<tr>
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<th>Date analysed</th>
<th>Sulphate, SO₄ (mg/L)</th>
<th>Chloride, Cl (mg/L)</th>
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<td>Org-016</td>
<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. $F_1 = (C_6-C_{10})$-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Inorg-018</td>
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<td>Inorg-057</td>
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### vTRH(C6-C10)/BTEX in Water

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<th>TRHC&lt;sub&gt;C10&lt;/sub&gt; µg/L</th>
<th>Benzene µg/L</th>
<th>Toluene µg/L</th>
<th>Ethylbenzene µg/L</th>
<th>m+p-xylene µg/L</th>
<th>o-xylene µg/L</th>
<th>Naphthalene µg/L</th>
<th>Surrogate</th>
<th>Surrogate toluene-d8 %</th>
<th>Surrogate 4-BFB %</th>
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### svTRH (C10-C40) in Water

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<th>TRH&lt;sub&gt;C29&lt;/sub&gt; µg/L</th>
<th>TRH&lt;sub&gt;C16&lt;/sub&gt; µg/L</th>
<th>TRH&lt;sub&gt;C34&lt;/sub&gt; µg/L</th>
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### PAHs in Water

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***Quality Control Units PQL METHOD Blank Duplicate Sm# Duplicate results Spike Sm# Spike % Recovery***

- **Date extracted**
  - 06/02/2015
  - 09/02/2015
- **Date analysed**
  - 06/02/2015
  - 09/02/2015


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### QUALITY CONTROL

#### Ion Balance

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#### Metals in Waters - Acid extractable

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#### vTRH(C6-C10)/BTEX in Water

<table>
<thead>
<tr>
<th>Date extracted</th>
<th>Date analysed</th>
<th>TRH-C6 - C9</th>
<th>TRH-C6 - C10</th>
<th>Benzene</th>
<th>Toluene</th>
<th>Ethylbenzene</th>
<th>m+p-xylene</th>
<th>o-xylene</th>
<th>Naphthalene</th>
<th>Surrogate</th>
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<tbody>
<tr>
<td></td>
<td>-</td>
<td>µg/L</td>
<td>µg/L</td>
<td>µg/L</td>
<td>µg/L</td>
<td>µg/L</td>
<td>µg/L</td>
<td>µg/L</td>
<td>µg/L</td>
<td>%</td>
</tr>
<tr>
<td>06/02/2015</td>
<td>06/02/2015</td>
<td>122964-11</td>
<td>122964-11</td>
<td>122964-11</td>
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<tr>
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<td>09/02/2015</td>
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<td>20</td>
<td>11</td>
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<td>&lt;1</td>
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### Quality Control Units

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<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
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<td>Toluene-d8</td>
<td>%</td>
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<tr>
<td>4-BFB</td>
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<td>122964-11</td>
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### vTRH (C6-C10)/BTEXN in Water

| Date extracted | -     | 122964-11 | 05/02/2015 || 05/02/2015 122964-2 05/02/2015 |
| Date analysed  | -     | 122964-11 | 08/02/2015 || 08/02/2015 122964-2 08/02/2015 |
| TRH C6 - C14    | µg/L  | 122964-11 | <50 || <50 122964-2 #             |
| TRH C15 - C28   | µg/L  | 122964-11 | <100 || <100 122964-2 126%       |
| TRH C29 - C36   | µg/L  | 122964-11 | <100 || <100 122964-2 80%        |
| TRH C10 - C16   | µg/L  | 122964-11 | <50 || <50 122964-2 #             |
| TRH C16 - C28   | µg/L  | 122964-11 | <100 || <100 122964-2 126%       |
| TRH C15 - C36   | µg/L  | 122964-11 | <100 || <100 122964-2 80%        |
| Surrogate o-Terphenyl | %     | 122964-11 | 103 || 86 || RPD: 18 122964-2 93% |

### Quality Control Units

| Date extracted | -     | 122964-11 | 06/02/2015 || 06/02/2015 122964-2 06/02/2015 |
| Date analysed  | -     | 122964-11 | 06/02/2015 || 06/02/2015 122964-2 06/02/2015 |
| Naphthalene    | µg/L  | 122964-11 | <1 || <1 122964-2 84%             |
| Acenaphthylene | µg/L  | 122964-11 | <1 || <1 [NR] [NR]                |
| Acenaphthene   | µg/L  | 122964-11 | <1 || <1 [NR] [NR]                |
| Fluorene       | µg/L  | 122964-11 | <1 || <1 122964-2 91%             |
| Phenanthrene   | µg/L  | 122964-11 | <1 || <1 122964-2 88%             |
| Anthracene     | µg/L  | 122964-11 | <1 || <1 [NR] [NR]                |
| Fluoranthene   | µg/L  | 122964-11 | <1 || <1 122964-2 89%             |
| Pyrene         | µg/L  | 122964-11 | <1 || <1 122964-2 104%            |
| Benzo(a)anthracene | µg/L | 122964-11 | <1 || <1 [NR] [NR]                |
| Chrysene       | µg/L  | 122964-11 | <1 || <1 122964-2 81%             |
| Benzo(b,j+k)fluoranthene | µg/L | 122964-11 | <2 || <2 [NR] [NR]                |
| Benzo(a)pyrene | µg/L  | 122964-11 | <1 || <1 122964-2 91%             |
| Indeno(1,2,3-c,d)pyrene | µg/L | 122964-11 | <1 || <1 [NR] [NR]                |
| Dibenzo(a,h)anthracene | µg/L | 122964-11 | <1 || <1 [NR] [NR]                |
| Benzo(g,h,i)perylene | µg/L | 122964-11 | <1 || <1 [NR] [NR]                |
| Surrogate p-Terphenyl-d14 | %     | 122964-11 | 78 || 69 || RPD: 12 122964-2 90% |

**Revision No:** R 00
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<tr>
<th>Parameter</th>
<th>Units</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tbody>
<tr>
<td><strong>HM in water - dissolved</strong></td>
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<tr>
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<td></td>
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<td>05/02/2015</td>
<td>05/02/2015</td>
<td>122964-4</td>
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<td>Date analysed</td>
<td></td>
<td>122964-8</td>
<td>05/02/2015</td>
<td>05/02/2015</td>
<td>122964-4</td>
</tr>
<tr>
<td>Arsenic-Dissolved</td>
<td>µg/L</td>
<td>&lt;1 &lt;1</td>
<td>[NR] [NR]</td>
<td>[NR] [NR]</td>
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<tr>
<td>Copper-Dissolved</td>
<td>µg/L</td>
<td>17 15</td>
<td>[NR] [NR]</td>
<td>[NR] [NR]</td>
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</tr>
<tr>
<td>Lead-Dissolved</td>
<td>µg/L</td>
<td>1 1</td>
<td>[NR] [NR]</td>
<td>[NR] [NR]</td>
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</tr>
<tr>
<td>Zinc-Dissolved</td>
<td>µg/L</td>
<td>31 29</td>
<td>[NR] [NR]</td>
<td>[NR] [NR]</td>
<td></td>
</tr>
<tr>
<td>Nickel-Dissolved</td>
<td>µg/L</td>
<td>11 11</td>
<td>[NR] [NR]</td>
<td>[NR] [NR]</td>
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<tr>
<td>Mercury-Dissolved</td>
<td>µg/L</td>
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<tr>
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<td>[NR] [NR]</td>
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<tr>
<td>Iron-Dissolved</td>
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<td>1400 1400</td>
<td>[NR] [NR]</td>
<td>[NR] [NR]</td>
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<tr>
<td>Manganese-Dissolved</td>
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<td>[NR] [NR]</td>
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<td>122964-12</td>
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<tr>
<td>Date analysed</td>
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<td>05/02/2015</td>
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</tr>
<tr>
<td>Arsenic-Total</td>
<td>µg/L</td>
<td>[NT] [NT]</td>
<td>122964-12</td>
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<tr>
<td>Copper-Total</td>
<td>µg/L</td>
<td>[NT] [NT]</td>
<td>122964-12</td>
<td>88%</td>
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<tr>
<td>Lead-Total</td>
<td>µg/L</td>
<td>[NT] [NT]</td>
<td>122964-12</td>
<td>99%</td>
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<tr>
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<td>µg/L</td>
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<tr>
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<td>[NR] [NR]</td>
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<td>µg/L</td>
<td>[NT] [NT]</td>
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<tr>
<td>Iron-Total</td>
<td>µg/L</td>
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<tr>
<td>Manganese-Total</td>
<td>µg/L</td>
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<td>04/02/2015</td>
<td>122964-2</td>
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<td>µS/cm</td>
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<td>200 190</td>
<td>[NR] [NR]</td>
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<tr>
<td>Ammonia as N in water</td>
<td>mg/L</td>
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<td>0.015 0.015</td>
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<tr>
<td>Nitrate as N in water</td>
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<td>0.043 0.043</td>
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<td>Nitrite as N in water</td>
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<td>&lt;0.005 &lt;0.005</td>
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<td>112%</td>
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<td>Phosphate as P in water</td>
<td>mg/L</td>
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<td>&lt;0.005 &lt;0.005</td>
<td>122964-2</td>
<td>96%</td>
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<tr>
<td>Total Suspended Solids</td>
<td>mg/L</td>
<td>[NT] [NT]</td>
<td>[NR] [NR]</td>
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### Quality Control

**UNITS** | **Dup. Sm#** | **Duplicate Spike Sm#** | **Spike % Recovery**
--- | --- | --- | ---
**Ion Balance** | | | |
Date prepared | - | 122964-11 | 04/02/2015 | 04/02/2015
Date analysed | - | 122964-11 | 04/02/2015 | 04/02/2015
Hydroxide Alkalinity (OH⁻) as CaCO₃ | mg/L | 122964-11 | <5 | [NR]
Bicarbonate Alkalinity as CaCO₃ | mg/L | 122964-11 | 9 | 7 | RPD: 25 | [NR]
Carbonate Alkalinity as CaCO₃ | mg/L | 122964-11 | <5 | [NR]
Total Alkalinity as CaCO₃ | mg/L | 122964-11 | 9 | 7 | RPD: 25 | [NR]
Sulphate, SO₄ | mg/L | 122964-11 | 15 | 15 | RPD: 0 | 91%
Chloride, Cl⁻ | mg/L | 122964-11 | 47 | 48 | RPD: 2 | 95%
**Metals in Waters - Acid extractable** | | | |
Date prepared | - | 122964-16 | 05/02/2015 | 05/02/2015
Date analysed | - | 122964-16 | 05/02/2015 | 05/02/2015
Phosphorus - Total | mg/L | 122964-16 | <0.05 | <0.05 | 122964-17 | 104%
**HM in water - dissolved** | | | |
Date prepared | - | 122964-15 | 05/02/2015 | 05/02/2015
Date analysed | - | 122964-15 | 05/02/2015 | 05/02/2015
Arsenic-Dissolved | µg/L | 122964-15 | <1 | <1 | 122964-2 | 98%
Copper-Dissolved | µg/L | 122964-15 | 2 | 2 | RPD: 0 | 84%
Lead-Dissolved | µg/L | 122964-15 | <1 | <1 | 122964-2 | 96%
Zinc-Dissolved | µg/L | 122964-15 | 44 | 44 | RPD: 0 | 95%
Nickel-Dissolved | µg/L | 122964-15 | <1 | <1 | 122964-2 | 90%
Cadmium-Dissolved | µg/L | 122964-15 | <0.1 | <0.1 | 122964-2 | 98%
Iron-Dissolved | µg/L | 122964-15 | 130 | 130 | RPD: 0 | #
Manganese-Dissolved | µg/L | 122964-15 | 21 | 21 | RPD: 0 | 94%
**HM in water - total** | | | |
Date prepared | - | [NT] | [NT] | 122964-17 | 05/02/2015
Date analysed | - | [NT] | [NT] | 122964-17 | 05/02/2015
Arsenic-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Copper-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Lead-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Zinc-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Nickel-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Mercury-Total | µg/L | [NT] | [NT] | 122964-17 | 108%
Cadmium-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Iron-Total | µg/L | [NT] | [NT] | [NR] | [NR]
Manganese-Total | µg/L | [NT] | [NT] | [NR] | [NR]
### Client Reference: 30011560, NBHP - Water Quality Monitoring

#### QUALITY CONTROL

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<tr>
<th>Miscellaneous Inorganics</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
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<td>Date analysed</td>
<td>-</td>
<td>122964-12</td>
<td>04/02/2015</td>
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<tr>
<td>Total Dissolved Solids (grav)</td>
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#### QUALITY CONTROL

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<td>Calcium - Dissolved</td>
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<td>Potassium - Dissolved</td>
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<td>Sodium - Dissolved</td>
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<td>Magnesium - Dissolved</td>
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#### QUALITY CONTROL

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<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tr>
<td>Date analysed</td>
<td>-</td>
<td>122964-12</td>
<td>05/02/2015</td>
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<td>05/02/2015</td>
</tr>
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<td>Arsenic-Dissolved</td>
<td>µg/L</td>
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<td>[N/T]</td>
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<td>Cadmium-Dissolved</td>
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<td>20</td>
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<td>[N/T]</td>
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Report Comments:
METALS_WLL_8_D: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Total Recoverable Hydrocarbons in water:
# Percent recovery is not possible to report due to interference from analytes (other than those being tested) in the sample/s.

Total Recoverable Hydrocarbons (BTEX) in water:PQL has been raised due to the sample matrix requiring dilution.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test PQL: Practical Quantitation Limit NT: Not tested
NA: Test not required RPD: Relative Percent Difference NA: Test not required
<: Less than >: Greater than LCS: Laboratory Control Sample
Quality Control Definitions

**Blank**: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

**Duplicate**: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

**Matrix Spike**: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

**LCS (Laboratory Control Sample)**: This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

**Surrogate Spike**: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and specified phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT:** NBHP - Water Quality Monitoring

**PROJECT NUMBER:** 30011560  
**LAB QUOTE NO.:** 14 SY282

**LAB:** Enviro Lab  
**PROJECT MANAGER:** D. Saunders  
**SAMPED BY:** S. Shaw  
**DATE SAMPLED:** 3 + 4 H 12/2/2015

**DURATION:** 6 H  
**RELIQUISHMENT:** 11/2/15  
**RECEIVED BY:** Enviro Lab  
**DATE/TIME:** 11/2/15  
**RELIQUISHMENT:** PT (EW)  
**RECEIVED BY:** PT  
**DATE/TIME:** 12/15  
**DATE/TIME:** 14:30

**SPECIAL LABORATORY INSTRUCTIONS:** Disolved metals to be filtered by lab

**SAMPLE DETAILS**

<table>
<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>SAMPLE MATRIX</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO. TSS</th>
<th>ANALYSIS REQUIRED</th>
<th>COMMENTS</th>
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<tbody>
<tr>
<td>1</td>
<td>Gw1</td>
<td>3/2/15</td>
<td>w</td>
<td>Bottles</td>
<td>6</td>
<td>Pt, Tn, BpH, Bep, Dnp, Total P, Total F</td>
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<tr>
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</table>

**Environmental Division**  
Sydney  
Work Order  
**ES1502759**

**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.  
**Copies:** WHITE to lab, YELLOW to be placed in project lib, FINISH to be retained in COC book.
**Work Order:** ES1502759

**Client:** SMEC AUSTRALIA PTY LTD  
**Contact:** DANIEL SAUNDERS  
**Address:** P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609

**Laboratory:** Environmental Division Sydney  
**Contact:** Client Services  
**Address:** 277-289 Woodpark Road Smithfield NSW Australia 2164

**E-mail:** daniel.saunders@smec.com  
**Telephone:** +61 02 61261959  
**Facsimile:** +61 61261966

**Client:** SMEC AUSTRALIA PTY LTD  
**Contact:** DANIEL SAUNDERS  
**Address:** P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609

**Laboratory:** Environmental Division Sydney  
**Contact:** Client Services  
**Address:** 277-289 Woodpark Road Smithfield NSW Australia 2164

**E-mail:** daniel.saunders@smec.com  
**Telephone:** +61 02 61261959  
**Facsimile:** +61 61261966

**Project:** 30011560 NBHP - WATER QUALITY MONITORING

**Date Samples Received:** 05-FEB-2015  
**Client Requested Due Date:** 12-FEB-2015  
**Issue Date:** 05-FEB-2015 17:54  
**Scheduled Reporting Date:** 12-FEB-2015

**Mode of Delivery:** Carrier  
**Temperature:** 15.2°C - Ice bricks present  
**No. of coolers/boxes:** 1 ESKY  
**No. of samples received:** 1  
**Secuity Seal:** Intact.  
**No. of samples analysed:** 1

**General Comments**

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables

- Sample containers do not comply to pretreatment / preservation standards (AS, APHA, USEPA). Please refer to the Sample Container(s)/Preservation Non-Compliance Log at the end of this report for details.

- Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.

- Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).

- Please direct any queries you have regarding this work order to the above ALS laboratory contact.

- Analytical work for this work order will be conducted at ALS Sydney.

- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

<table>
<thead>
<tr>
<th>Method</th>
<th>Sample Container Received</th>
<th>Preferred Sample Container for Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG020A-F : Dissolved Metals by ICP-MS - Suite A</td>
<td>- Clear Plastic Bottle - Nitric Acid; Unspecified</td>
<td>- Clear Plastic Bottle - Nitric Acid; Filtered</td>
</tr>
<tr>
<td>TRIP1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EG035F : Dissolved Mercury by FIMS</td>
<td>- Clear Plastic Bottle - Natural</td>
<td>- Clear Plastic Bottle - Nitric Acid; Filtered</td>
</tr>
<tr>
<td>TRIP1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

### Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sampling date / time</th>
<th>Client sample ID</th>
<th>Due for extraction</th>
<th>Due for analysis</th>
<th>Samples Received</th>
<th>Instructions Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-FEB-2015 15:00</td>
<td>TRIP1</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sampling date / time</th>
<th>Client sample ID</th>
<th>Due for extraction</th>
<th>Due for analysis</th>
<th>Samples Received</th>
<th>Instructions Received</th>
</tr>
</thead>
<tbody>
<tr>
<td>03-FEB-2015 15:00</td>
<td>TRIP1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Evaluation:
- ✗ = Holding time breach
- ✔ = Within holding time
### Requested Deliverables

**DANIEL SAUNDERS**

- *AU Certificate of Analysis - NATA ( COA )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) ( QCI )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA ( QC )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- A4 - AU Sample Receipt Notification - Environmental HT ( SRN  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- A4 - AU Tax Invoice ( INV )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- Chain of Custody (CoC) ( COC )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- EDI Format - ENMRG ( ENMRG )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
- EDI Format - ESDAT ( ESDAT )  
  Email [daniel.saunders@smec.com](mailto:daniel.saunders@smec.com)
**CERTIFICATE OF ANALYSIS**

**Work Order**: ES1502759

**Client**: SMEC AUSTRALIA PTY LTD

**Contact**: DANIEL SAUNDERS

**Address**: P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609

**E-mail**: daniel.saunders@smec.com

**Telephone**: +61 02 61261959

**Facsimile**: +61 91261966

**Project**: 30011560 NBHP - WATER QUALITY MONITORING

**Order number**: ----

**C-O-C number**: 1070

**Sampler**: SS

**Site**: ----

**Quote number**: EN/025/14

---

**Date Samples Received**: 05-FEB-2015

**Issue Date**: 13-FEB-2015

---

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

---

**Signatories**

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<table>
<thead>
<tr>
<th>Signatories</th>
<th>Position</th>
<th>Accreditation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankit Joshi</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Ashesh Patel</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Pabi Subba</td>
<td>Senior Organic Chemist</td>
<td>Sydney Organics</td>
</tr>
<tr>
<td>Wisam Marassa</td>
<td>Inorganics Coordinator</td>
<td>Sydney Inorganics</td>
</tr>
</tbody>
</table>
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key:
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- ^ = This result is computed from individual analyte detections at or above the level of reporting

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.c.d)pyrene (0.1), Dibenzo(a,h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
## Analytical Results

**Sub-Matrix:** WATER  
**Matrix:** WATER

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>TRIP1</th>
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</thead>
<tbody>
<tr>
<td><strong>EA005P: pH by PC Titrator</strong></td>
<td></td>
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<tr>
<td>pH Value</td>
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<td>0.01</td>
<td>pH Unit</td>
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<tr>
<td><strong>EA010P: Conductivity by PC Titrator</strong></td>
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<tr>
<td>Electrical Conductivity @ 25°C</td>
<td>---</td>
<td>1</td>
<td>µS/cm</td>
<td>206</td>
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<tr>
<td><strong>EA015: Total Dissolved Solids</strong></td>
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<tr>
<td>Total Dissolved Solids @ 180°C</td>
<td>---</td>
<td>10</td>
<td>mg/L</td>
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<tr>
<td><strong>ED037P: Alkalinity by PC Titrator</strong></td>
<td>DMO-210-001</td>
<td>1</td>
<td>mg/L</td>
<td>&lt;1</td>
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<tr>
<td>Hydroxide Alkalinity as CaCO3</td>
<td>3812-32-6</td>
<td>1</td>
<td>mg/L</td>
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<tr>
<td>Carbonate Alkalinity as CaCO3</td>
<td>71-52-3</td>
<td>1</td>
<td>mg/L</td>
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<td>Bicarbonate Alkalinity as CaCO3</td>
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<td>Total Alkalinity as CaCO3</td>
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<tr>
<td><strong>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</strong></td>
<td>14808-79-8</td>
<td>1</td>
<td>mg/L</td>
<td>17</td>
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<tr>
<td>Sulfate as SO4 - Turbidimetric</td>
<td>16887-00-6</td>
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<tr>
<td><strong>ED045G: Chloride Discrete analyser</strong></td>
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<td><strong>ED093F: Dissolved Major Cations</strong></td>
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<td>Calcium</td>
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<td>Magnesium</td>
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<td>mg/L</td>
<td>4</td>
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<tr>
<td>Potassium</td>
<td>7440-09-7</td>
<td>1</td>
<td>mg/L</td>
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<tr>
<td><strong>EG020F: Dissolved Metals by ICP-MS</strong></td>
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<tr>
<td>Arsenic</td>
<td>7440-38-2</td>
<td>0.001</td>
<td>mg/L</td>
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### Analytical Results

**Sub-Matrix: WATER (Matrix: WATER)**

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**EP075(SIM)B: Polynuclear Aromatic Hydrocarbons**

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^ Sum of polycyclic aromatic hydrocarbons | ---- | 0.5 | µg/L | <0.5  | ---- | ---- | ---- | ---- | ---- |

^ Benzo(a)pyrene TEQ (zero) | ---- | 0.5 | µg/L | <0.5  | ---- | ---- | ---- | ---- | ---- |

**EP080/071: Total Petroleum Hydrocarbons**

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<td>C10 - C14 Fraction</td>
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## Analytical Results

### Client sample ID

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<td><strong>EP0808: TPH(V)/BTEX Surrogates</strong></td>
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<td>1,2-Dichloroethane-D4</td>
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<td>%</td>
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<tr>
<td>4-Bromofluorobenzene</td>
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### Surrogate Control Limits

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<th>Sub-Matrix: WATER</th>
<th>Compound</th>
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<td>4-Bromofluorobenzene</td>
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QUALITY CONTROL REPORT

Work Order : ES1502759
Client : SMEC AUSTRALIA PTY LTD
Contact : DANIEL SAUNDERS
Address : P O BOX 1654
          FYSHWICK ACT, AUSTRALIA 2609
E-mail : daniel.saunders@smec.com
Telephone : +61 02 61261959
Facsimile : +61 61261966
Project : 30011560   NBHP - WATER QUALITY MONITORING
Site : ----
C-O-C number : 1070
Sampler : SS
Order number : ----
Quote number : EN/025/14

Laboratory : Environmental Division Sydney
Contact : Client Services
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail : sydney@alsglobal.com
Telephone : +61-2-8784 8555
Facsimile : +61-2-8784 8500

QC Level : NEPM 2013  Schedule B(3) and ALS QCS3 requirement
Date Samples Received : 05-FEB-2015
Issue Date : 13-FEB-2015
No. of samples received : 1
No. of samples analysed : 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:
- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key:
- Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- RPD = Relative Percentage Difference
- # = Indicates failed QC

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<table>
<thead>
<tr>
<th>Signatories</th>
<th>Position</th>
<th>Accreditation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankit Joshi</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Ashesh Patel</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
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<tr>
<td>Pabi Subba</td>
<td>Senior Organic Chemist</td>
<td>Sydney Organics</td>
</tr>
<tr>
<td>Wisam Marassa</td>
<td>Inorganics Coordinator</td>
<td>Sydney Inorganics</td>
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</table>
Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

### Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<td><strong>EA005P: pH by PC Titrator</strong> (QC Lot: 3812369)</td>
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<tr>
<td>ES1502759-001</td>
<td>TRIP1</td>
<td>EA005-P: pH Value</td>
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<td>0.01</td>
<td>mEq/L</td>
<td>5.58</td>
<td>5.53</td>
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<td><strong>EA010P: Conductivity by PC Titrator</strong> (QC Lot: 3812385)</td>
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<td>mS/cm</td>
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<td>253</td>
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<td>EA10-P: Electrical Conductivity @ 25°C</td>
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<td>mS/cm</td>
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<td>ES1502623-003</td>
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<td>EA15H: Total Dissolved Solids @180°C</td>
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<td>mg/L</td>
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<td>ES1502673-006</td>
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<td>&lt;1</td>
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<td>3812-32-6</td>
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<td>&lt;1</td>
<td>0.0</td>
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<tr>
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<td>45</td>
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<tr>
<td>ED037-P: Total Alkalinity as CaCO3</td>
<td>---</td>
<td>1</td>
<td>mg/L</td>
<td>46</td>
<td>45</td>
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<td>TRIP1</td>
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<td>3812-32-6</td>
<td>1</td>
<td>mg/L</td>
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<td><strong>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</strong> (QC Lot: 3812424)</td>
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<td>14808-79-8</td>
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<td>EG020A-F: Cadmium</td>
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<td>Laboratory sample ID</td>
<td>Client sample ID</td>
<td>Method: Compound</td>
<td>CAS Number</td>
<td>LOR</td>
<td>Unit</td>
<td>Original Result</td>
<td>Duplicate Result</td>
<td>RPD (%)</td>
<td>Recovery Limits (%)</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QC Lot: 3817008) - continued</td>
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<td>ES1502561-002</td>
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<td>&lt;0.010</td>
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<td>EG020A-F: Lead</td>
<td>7439-92-1</td>
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<td>mg/L</td>
<td>&lt;0.010</td>
<td>&lt;0.010</td>
<td>0.0</td>
<td>No Limit</td>
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<tr>
<td></td>
<td></td>
<td>EG020A-F: Nickel</td>
<td>7440-02-0</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.010</td>
<td>&lt;0.010</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Zinc</td>
<td>7440-66-6</td>
<td>0.005</td>
<td>mg/L</td>
<td>1.04</td>
<td>1.01</td>
<td>3.0</td>
<td>0% - 20%</td>
</tr>
</tbody>
</table>

| ES1502799-008        | Anonymous            | EG020A-F: Cadmium        | 7440-43-9  | 0.0001 | mg/L | <0.001          | <0.001          | 0.0     | No Limit            |
|                      |                      | EG020A-F: Arsenic        | 7440-38-2  | 0.001 | mg/L | <0.001          | <0.001          | 0.0     | No Limit            |
|                      |                      | EG020A-F: Chromium       | 7440-47-3  | 0.001 | mg/L | <0.001          | <0.001          | 0.0     | No Limit            |
|                      |                      | EG020A-F: Copper         | 7440-50-8  | 0.001 | mg/L | 0.001           | 0.002           | 0.0     | No Limit            |
|                      |                      | EG020A-F: Lead           | 7439-92-1  | 0.001 | mg/L | <0.001          | <0.001          | 0.0     | No Limit            |
|                      |                      | EG020A-F: Nickel         | 7440-02-0  | 0.001 | mg/L | 0.002           | 0.002           | 0.0     | No Limit            |
|                      |                      | EG020A-F: Zinc           | 7440-66-6  | 0.005 | mg/L | 0.018           | 0.017           | 6.7     | No Limit            |

| EG035F: Dissolved Mercury by FIMS (QC Lot: 3817006) |
| ES1502759-001        | TRIP1                | EG035F: Mercury          | 7439-97-6  | 0.0001 | mg/L | <0.0001        | <0.0001        | 0.0     | No Limit            |

| EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3812422) |
| ES1502582-001        | Anonymous            | EK057G: Nitrite as N     | ----       | 0.01  | mg/L | <0.01         | <0.01         | 0.0     | No Limit            |
| ES1502673-001        | Anonymous            | EK057G: Nitrite as N     | ----       | 0.01  | mg/L | <0.01         | <0.01         | 0.0     | No Limit            |

| EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3814695) |
| ES1502746-001        | Anonymous            | EK059G: Nitrite + Nitrate as N | ---- | 0.01 | mg/L | 0.04 | 0.05 | 32.6 | No Limit |
| ES1502759-001        | TRIP1                | EK059G: Nitrite + Nitrate as N | ---- | 0.01 | mg/L | 0.10 | 0.04 | 93.4 | No Limit |

| EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3814692) |
| ES1502734-001        | Anonymous            | EK067G: Total Phosphorus as P | ---- | 0.01 | mg/L | 0.41 | 0.40 | 3.2 | 0% - 20% |
| ES1502640-009        | Anonymous            | EK067G: Total Phosphorus as P | ---- | 0.01 | mg/L | 0.07 | 0.05 | 31.2 | No Limit |

| EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 3812425) |
| ES1502673-001        | Anonymous            | EGK71G: Reactive Phosphorus as P | 14265-44-2 | 0.01 | mg/L | <0.01 | <0.01 | 0.0 | No Limit |
| ES1502716-004        | Anonymous            | EGK71G: Reactive Phosphorus as P | 14265-44-2 | 0.01 | mg/L | 0.03 | 0.03 | 0.0 | No Limit |

| EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3819186) |
| ES1502769-002        | Anonymous            | EP080: C6 - C9 Fraction  | ---- | 20 | µg/L | 440 | 440 | 0.0 | 0% - 20% |
| ES1502771-001        | Anonymous            | EP080: C6 - C9 Fraction  | ---- | 20 | µg/L | <20 | <20 | 0.0 | No Limit |

| EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3819186) |
| ES1502769-002        | Anonymous            | EP080: C6 - C10 Fraction | C6_C10 | 20 | µg/L | 890 | 880 | 1.3 | 0% - 20% |
| ES1502771-001        | Anonymous            | EP080: C6 - C10 Fraction | C6_C10 | 20 | µg/L | <20 | <20 | 0.0 | No Limit |

<p>| EP080: BTEXN (QC Lot: 3819186) |
| ES1502769-002        | Anonymous            | EP080: Benzene           | 71-43-2  | 1 | µg/L | 2 | 2 | 0.0 | No Limit |
|                      |                      | EP080: Toluene           | 108-88-3 | 2 | µg/L | &lt;2 | &lt;2 | 0.0 | No Limit |
|                      |                      | EP080: Ethylbenzene      | 100-41-4 | 2 | µg/L | 16 | 16 | 0.0 | No Limit |
|                      |                      | EP080: meta- &amp; para-Xylene | 108-38-3 | 2 | µg/L | 114 | 112 | 1.8 | 0% - 20% |
|                      |                      | EP080: ortho-Xylene      | 95-47-6  | 2 | µg/L | 106 | 106 | 0.0 | 0% - 20% |
|                      |                      | EP080: Naphthalene       | 91-20-3  | 5 | µg/L | 37 | 34 | 8.2 | No Limit |</p>
<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1502771-001</td>
<td>Anonymous</td>
<td>EP080: Benzene</td>
<td>71-43-2</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Toluene</td>
<td>108-88-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>&lt;2</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Ethylbenzene</td>
<td>100-41-4</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>&lt;2</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3, 106-42-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>&lt;2</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>&lt;2</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>5</td>
<td>µg/L</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>0.0</td>
<td>No Limit</td>
</tr>
</tbody>
</table>
Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method Blank (MB) Report</td>
<td>Laboratory Control Spike (LCS) Report</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| EA010P: Conductivity by PC Titrator (QCLot: 3812365) | ---- | 1 | µS/cm | <1 | 2000 µS/cm | 103 | 95 | 113 |
| EA015: Total Dissolved Solids (QCLot: 3814750) | ---- | 10 | mg/L | ---- | 2000 mg/L | 108 | 87 | 109 |
| ED037P: Alkalinity by PC Titrator (QCLot: 3812366) | ---- | 1 | mg/L | ---- | 200 mg/L | 103 | 81 | 111 |
| ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3812424) | 14808-79-8 | 1 | mg/L | <1 | 25 mg/L | 112 | 86 | 122 |
| ED045G: Chloride Discrete analyser (QCLot: 3812423) | 16887-00-6 | 1 | mg/L | ---- | 1000 mg/L | 104 | 77 | 119 |
| ED093F: Dissolved Major Cations (QCLot: 3817007) | 7440-70-2 | 1 | mg/L | <1 | 50 mg/L | 100 | 90 | 114 |
| EG020A-F: Arsenic (QCLot: 3817008) | 7440-38-2 | 0.001 | mg/L | <0.001 | 0.1 mg/L | 96.9 | 85 | 115 |
| EG020A-F: Cadmium (QCLot: 3817008) | 7440-43-9 | 0.0001 | mg/L | <0.0001 | 0.1 mg/L | 99.6 | 85 | 115 |
| EG020A-F: Lead (QCLot: 3817008) | 7439-92-1 | 0.001 | mg/L | <0.001 | 0.1 mg/L | 102 | 85 | 115 |
| EG020A-F: Nickel (QCLot: 3817008) | 7440-02-0 | 0.001 | mg/L | <0.001 | 0.1 mg/L | 100 | 85 | 115 |
| EG020A-F: Zinc (QCLot: 3817008) | 7440-66-6 | 0.005 | mg/L | <0.005 | 0.1 mg/L | 98.6 | 85 | 115 |
| EG035F: Dissolved Mercury by FIMS (QCLot: 3817006) | 7439-97-6 | 0.0001 | mg/L | <0.0001 | 0.1 mg/L | 96.9 | 85 | 115 |
## Method Blank (MB) Report

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus as P by Discrete Analyser</td>
<td>EK067G: Total Phosphorus as P</td>
<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
<td>0.442 mg/L</td>
<td>87.8</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 mg/L</td>
<td>105</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.42 mg/L</td>
<td>85.6</td>
<td>67</td>
</tr>
<tr>
<td>Reactive Phosphorus as P by Discrete Analyser</td>
<td>EK071G: Reactive Phosphorus as P</td>
<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
<td>0.5 mg/L</td>
<td>100</td>
<td>82</td>
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</table>

## Laboratory Control Spike (LCS) Report

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphthalene</td>
<td>EP075(SIM): Naphthalene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>64.0</td>
<td>58.6</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>EP075(SIM): Acenaphthylene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>77.9</td>
<td>63.6</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>EP075(SIM): Acenaphthene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>72.8</td>
<td>62.2</td>
</tr>
<tr>
<td>Fluorene</td>
<td>EP075(SIM): Fluorene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>77.8</td>
<td>63.9</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>EP075(SIM): Phenanthrene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>85.1</td>
<td>62.6</td>
</tr>
<tr>
<td>Anthracene</td>
<td>EP075(SIM): Anthracene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>87.8</td>
<td>64.3</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>EP075(SIM): Fluoranthene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>96.8</td>
<td>63.6</td>
</tr>
<tr>
<td>Pyrene</td>
<td>EP075(SIM): Pyrene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>91.6</td>
<td>63.1</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>EP075(SIM): Benz(a)anthracene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>81.5</td>
<td>64.1</td>
</tr>
<tr>
<td>Chrysene</td>
<td>EP075(SIM): Chrysene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>90.9</td>
<td>62.5</td>
</tr>
<tr>
<td>Benzo(b+)fluoranthene</td>
<td>EP075(SIM): Benzo(b+)fluoranthene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>78.7</td>
<td>61.7</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>EP075(SIM): Benzo(k)fluoranthene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>83.9</td>
<td>61.7</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>EP075(SIM): Benzo(a)pyrene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;0.5</td>
<td>5 µg/L</td>
<td>91.2</td>
<td>63.3</td>
</tr>
<tr>
<td>Indeno(1,2,3-cd)pyrene</td>
<td>EP075(SIM): Indeno(1,2,3-cd)pyrene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>94.2</td>
<td>59.9</td>
</tr>
<tr>
<td>Dibenzo(a,h)anthracene</td>
<td>EP075(SIM): Dibenzo(a,h)anthracene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>90.3</td>
<td>61.2</td>
</tr>
<tr>
<td>Benzo(g,h,i)perylene</td>
<td>EP075(SIM): Benzo(g,h,i)perylene</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
<td>77.4</td>
<td>59.1</td>
</tr>
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</table>

## Total Petroleum Hydrocarbons (QCLot: 3815091)

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C14 Fraction</td>
<td>EP071: C14 - C14 Fraction</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;50</td>
<td>2000 µg/L</td>
<td>104</td>
<td>59</td>
</tr>
<tr>
<td>C28 Fraction</td>
<td>EP071: C15 - C28 Fraction</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>3000 µg/L</td>
<td>98.7</td>
<td>71</td>
</tr>
<tr>
<td>C36 Fraction</td>
<td>EP071: C29 - C36 Fraction</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;50</td>
<td>2000 µg/L</td>
<td>101</td>
<td>62</td>
</tr>
</tbody>
</table>

## Total Petroleum Hydrocarbons (QCLot: 3819186)

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C9 Fraction</td>
<td>EP080: C6 - C9 Fraction</td>
<td>20</td>
<td>µg/L</td>
<td>&lt;20</td>
<td>260 µg/L</td>
<td>99.2</td>
<td>75</td>
</tr>
</tbody>
</table>

## Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3813091)

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C16 Fraction</td>
<td>EP071: &gt;C10 - C16 Fraction</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>2500 µg/L</td>
<td>98.0</td>
<td>58.9</td>
</tr>
<tr>
<td>C34 Fraction</td>
<td>EP071: &gt;C16 - C34 Fraction</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>3500 µg/L</td>
<td>101</td>
<td>73.9</td>
</tr>
<tr>
<td>C40 Fraction</td>
<td>EP071: &gt;C34 - C40 Fraction</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>1500 µg/L</td>
<td>103</td>
<td>67</td>
</tr>
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</table>

## Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3819186)

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10 Fraction</td>
<td>EP080: C6 - C10 Fraction</td>
<td>20</td>
<td>µg/L</td>
<td>&lt;20</td>
<td>310 µg/L</td>
<td>99.2</td>
<td>75</td>
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## BTEXN (QCLot: 3819186)
Sub-Matrix: WATER

<table>
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<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080: Benzene</td>
<td>71-43-2</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1</td>
<td>10 µg/L</td>
<td>101</td>
<td>70 124</td>
</tr>
<tr>
<td>EP080: Toluene</td>
<td>108-88-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>100</td>
<td>65 129</td>
</tr>
<tr>
<td>EP080: Ethylbenzene</td>
<td>100-41-4</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>102</td>
<td>70 120</td>
</tr>
<tr>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3 108-42-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>103</td>
<td>69 121</td>
</tr>
<tr>
<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>100</td>
<td>72 122</td>
</tr>
<tr>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>5</td>
<td>µg/L</td>
<td>&lt;5</td>
<td>10 µg/L</td>
<td>92.9</td>
<td>70 124</td>
</tr>
</tbody>
</table>

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Concentration</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1502582-001</td>
<td>Anonymous</td>
<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3812424)</td>
<td>14808-79-8</td>
<td>10 mg/L</td>
<td># Not Determined</td>
<td>70 130</td>
<td></td>
</tr>
<tr>
<td>ES1502582-001</td>
<td>Anonymous</td>
<td>ED045G: Chloride Discrete analyser (QCLot: 3812423)</td>
<td>16887-00-6</td>
<td>250 mg/L</td>
<td>70.7</td>
<td>70 130</td>
<td></td>
</tr>
<tr>
<td>ES1502799-003</td>
<td>Anonymous</td>
<td>EG020A-F: Arsenic</td>
<td>7440-38-2</td>
<td>0.2 mg/L</td>
<td>128</td>
<td>70 130</td>
<td></td>
</tr>
<tr>
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<td>Anonymous</td>
<td>EG020A-F: Cadmium</td>
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<td>EG020A-F: Chromium</td>
<td>7440-47-3</td>
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<td>EG020A-F: Copper</td>
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<td>7439-92-1</td>
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<td>70 130</td>
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<td>EG020A-F: Zinc</td>
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<td>70 130</td>
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<tr>
<td>ES1502561-001</td>
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<td>EG035F: Mercury</td>
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<tr>
<td>ES1502582-001</td>
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<tr>
<td>ES1502799-003</td>
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<td>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3814695)</td>
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<td>70 130</td>
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### Sub-Matrix: WATER

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<th>Laboratory sample ID</th>
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<th>Method: Compound</th>
<th>CAS Number</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
<th>Spike Value</th>
<th>Control Limit</th>
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<tbody>
<tr>
<td>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3812425)</td>
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<td>EK071G: Reactive Phosphorus as P</td>
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<td>EP080: Toluene</td>
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<td>130</td>
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<td>EP080: Ethylbenzene</td>
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<td>101</td>
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<td>130</td>
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<tr>
<td></td>
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<td>EP080: meta- &amp; para-Xylene</td>
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<td>106-42-3</td>
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<td>EP080: ortho-Xylene</td>
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<td></td>
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<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>93.7</td>
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### Sub-Matrix: WATER

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<th>CAS Number</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
<th>Spike Value</th>
<th>Control Limit</th>
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<tr>
<td>EK057G: Nitrite as N by Discrete Analyser (QCLot: 3812422)</td>
<td>Anonymous</td>
<td>EK057G: Nitrite as N</td>
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<td>ED045G: Chloride Discrete analyser (QCLot: 3812423)</td>
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<td>ED045G: Chloride</td>
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<tr>
<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3812424)</td>
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<td>ED041G: Sulfate as SO4 - Turbidimetric</td>
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<td>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3812425)</td>
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<td>EK071G: Reactive Phosphorus as P</td>
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<td>94.7</td>
<td>---</td>
<td>70</td>
<td>130</td>
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<tr>
<td>EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3814692)</td>
<td>TRIP1</td>
<td>EK067G: Total Phosphorus as P</td>
<td>---</td>
<td>102</td>
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<tr>
<td>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3814695)</td>
<td>Anonymous</td>
<td>EK059G: Nitrite + Nitrate as N</td>
<td>---</td>
<td>95.5</td>
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<tr>
<td>EG035F: Dissolved Mercury by FIMS (QCLot: 3817006)</td>
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## Sub-Matrix: WATER

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<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
<th>RPDs (%)</th>
<th>Value</th>
<th>Control Limit</th>
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<tr>
<td>EG035F: Dissolved Mercury by FIMS (QCLot: 3817006) - continued</td>
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</tr>
<tr>
<td>ES1502561-001</td>
<td>Anonymous</td>
<td>EG035F: Mercury</td>
<td>7439-97-6</td>
<td>0.0100 mg/L</td>
<td>74.0</td>
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<td>70</td>
<td>130</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QCLot: 3817008)</td>
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<tr>
<td>ES1502799-003</td>
<td>Anonymous</td>
<td>EG020A-F: Arsenic</td>
<td>7440-38-2</td>
<td>0.2 mg/L</td>
<td>128</td>
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<td>70</td>
<td>130</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Cadmium</td>
<td>7440-43-9</td>
<td>0.05 mg/L</td>
<td>103</td>
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<td>EG020A-F: Chromium</td>
<td>7440-47-3</td>
<td>0.2 mg/L</td>
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<tr>
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<td></td>
<td>EG020A-F: Copper</td>
<td>7440-50-8</td>
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<td>70</td>
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<tr>
<td></td>
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<td>EG020A-F: Lead</td>
<td>7439-92-1</td>
<td>0.2 mg/L</td>
<td>112</td>
<td>--</td>
<td>70</td>
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<tr>
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<td>EG020A-F: Nickel</td>
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<td>111</td>
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<td>EG020A-F: Zinc</td>
<td>7440-66-6</td>
<td>0.2 mg/L</td>
<td>129</td>
<td>--</td>
<td>70</td>
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<tr>
<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3819186)</td>
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<tr>
<td>ES1502769-002</td>
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<td>EP080: C6 - C9 Fraction</td>
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<td>325 µg/L</td>
<td>106</td>
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<td>EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3819186)</td>
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<td>Anonymous</td>
<td>EP080: C6 - C10 Fraction</td>
<td>C6_C10</td>
<td>375 µg/L</td>
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<td>EP080: BTEXN (QCLot: 3819186)</td>
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<tr>
<td>ES1502769-002</td>
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<td>EP080: Benzene</td>
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<td>EP080: Toluene</td>
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<td>89.8</td>
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<td>EP080: Ethylbenzene</td>
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<td>25 µg/L</td>
<td>101</td>
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<td>130</td>
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</tr>
<tr>
<td></td>
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<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3</td>
<td>25 µg/L</td>
<td># Not Determined</td>
<td>--</td>
<td>70</td>
<td>130</td>
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<tr>
<td></td>
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<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
<td>25 µg/L</td>
<td># Not Determined</td>
<td>--</td>
<td>70</td>
<td>130</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>25 µg/L</td>
<td>93.7</td>
<td>--</td>
<td>70</td>
<td>130</td>
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</tr>
</tbody>
</table>
This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers
Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: WATER

<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Sample Date</th>
<th>Extraction / Preparation</th>
<th>Analysis</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td></td>
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<td>Date extracted</td>
<td>Due for extraction</td>
<td>Evaluation</td>
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<tr>
<td></td>
<td>(EA005-P)</td>
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<td>(EA010-P)</td>
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<td>(ED093F)</td>
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<td>Acid; Unspecified (EG020A-F)</td>
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<td>(EG035F)</td>
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<td>(EK057G)</td>
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<td></td>
<td>Acid (EK059G)</td>
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### Work Order:
**Client:** SMEC AUSTRALIA PTY LTD
**Project:** 30011560 NBHP - WATER QUALITY MONITORING

### Matrix: WATER

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<th>Method</th>
<th>Sample Date</th>
<th>Extraction/Preparation</th>
<th>Analysis</th>
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<tbody>
<tr>
<td></td>
<td>Date extracted</td>
<td>Due for extraction</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

#### EK067G: Total Phosphorus as P by Discrete Analyser
- **Clear Plastic Bottle - Sulfuric Acid (EK067G)**
  - **TRIP1**: 03-FEB-2015, 08-FEB-2015, 03-MAR-2015
  - **Date Analysed**: 08-FEB-2015
  - **Due for Analysis**: 03-MAR-2015
  - **Evaluation**: ✔️

#### EK071G: Reactive Phosphorus as P by Discrete Analyser
- **Clear Plastic Bottle - Natural (EK071G)**
  - **TRIP1**: 03-FEB-2015, ---
  - **Due for Analysis**: 05-FEB-2015
  - **Evaluation**: ✔️

#### EP080/071: Total Petroleum Hydrocarbons
- **Amber Glass Bottle - Unpreserved (EP071)**
  - **TRIP1**: 03-FEB-2015, 06-FEB-2015, 10-FEB-2015
  - **Analysis Date**: 09-FEB-2015
  - **Due for Analysis**: 18-MAR-2015
  - **Evaluation**: ✔️

#### EP075(SIM)B: Polynuclear Aromatic Hydrocarbons
- **Amber Glass Bottle - Unpreserved (EP075(SIM))**
  - **TRIP1**: 03-FEB-2015, 06-FEB-2015, 10-FEB-2015
  - **Analysis Date**: 09-FEB-2015
  - **Due for Analysis**: 18-MAR-2015
  - **Evaluation**: ✔️

#### EP080: BTEXN
- **Clear glass VOC vial - HCl (EP080)**
  - **TRIP1**: 03-FEB-2015, 11-FEB-2015, 17-FEB-2015
  - **Analysis Date**: 11-FEB-2015
  - **Due for Analysis**: 17-FEB-2015
  - **Evaluation**: ✔️

#### EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions
- **Clear glass VOC vial - HCl (EP080)**
  - **TRIP1**: 03-FEB-2015, 11-FEB-2015, 17-FEB-2015
  - **Analysis Date**: 11-FEB-2015
  - **Due for Analysis**: 17-FEB-2015
  - **Evaluation**: ✔️
# Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

<table>
<thead>
<tr>
<th>Method</th>
<th>Count</th>
<th>Expected Rate (%)</th>
<th>Evaluation</th>
<th>Quality Control Specification</th>
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<tbody>
<tr>
<td><strong>Laboratory Duplicates (DUP)</strong></td>
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<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
<td>2</td>
<td>17</td>
<td>11.8</td>
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<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>2</td>
<td>18</td>
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<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
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<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
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<td>9</td>
<td>11.1</td>
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<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
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<td>18</td>
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<tr>
<td>Major Cations - Dissolved</td>
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<td>10.0</td>
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<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>2</td>
<td>20</td>
<td>10.0</td>
</tr>
<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
<td>2</td>
<td>20</td>
<td>10.0</td>
</tr>
<tr>
<td>pH by PC Titrator</td>
<td>EA005-P</td>
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<td>1</td>
<td>100.0</td>
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<tr>
<td>Reactive Phosphorus as P-By Discrete Analyser</td>
<td>EK071G</td>
<td>2</td>
<td>13</td>
<td>15.4</td>
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<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>2</td>
<td>18</td>
<td>11.1</td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
<td>2</td>
<td>14</td>
<td>14.3</td>
</tr>
<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
<td>2</td>
<td>20</td>
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<tr>
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<td>EP080</td>
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<td><strong>Laboratory Control Samples (LCS)</strong></td>
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<td>Alkalinity by PC Titrator</td>
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<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>2</td>
<td>18</td>
<td>11.1</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
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<td>19</td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
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<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
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<td>5.0</td>
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<tr>
<td>Major Cations - Dissolved</td>
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<tr>
<td>PAH/Phenols (GCMS - SIM)</td>
<td>EP075(SIM)</td>
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<td>Reactive Phosphorus as P-By Discrete Analyser</td>
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<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
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<tr>
<td>Total Dissolved Solids (High Level)</td>
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<td>2</td>
<td>14</td>
<td>14.3</td>
</tr>
<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
<td>3</td>
<td>20</td>
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<tr>
<td>TRH - Semivolatilie Fraction</td>
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<tr>
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<tr>
<td><strong>Method Blanks (MB)</strong></td>
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<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>1</td>
<td>18</td>
<td>5.6</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
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<td>19</td>
<td>5.3</td>
</tr>
<tr>
<td>Dissolved Mercury by FIMS</td>
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<td>11.1</td>
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<td>20</td>
<td>5.0</td>
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**Matrix: WATER**

**Quality Control Example Type**

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<th>Rate (%)</th>
<th>Evaluation</th>
<th>Quality Control Specification</th>
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<td>PAH/Phenols (GC/MS - SIM)</td>
<td>EP075(SIM)</td>
<td>1</td>
<td>6</td>
<td>16.7</td>
<td>✔️</td>
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<tr>
<td>Reactive Phosphorus as P-By Discrete Analyser</td>
<td>EK071G</td>
<td>1</td>
<td>13</td>
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<td>✔️</td>
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<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>1</td>
<td>18</td>
<td>5.6</td>
<td>✔️</td>
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<tr>
<td>Total Dissolved Solids (High Level)</td>
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<td>✔️</td>
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<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
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<td>✔️</td>
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<tr>
<td>TRH - Semivolatile Fraction</td>
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<td>9</td>
<td>11.1</td>
<td>✔️</td>
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<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>1</td>
<td>17</td>
<td>5.9</td>
<td>✔️</td>
</tr>
</tbody>
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**Matrix Spikes (MS)**

| Chloride by Discrete Analyser | ED045G | 1 | 18 | 5.6 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Dissolved Mercury by FIMS | EG035F | 1 | 9 | 11.1 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Dissolved Metals by ICP-MS - Suite A | EG020A-F | 1 | 18 | 5.6 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Nitrite and Nitrate as N (NOx) by Discrete Analyser | EK059G | 1 | 20 | 5.0 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Nitrite as N by Discrete Analyser | EK057G | 1 | 20 | 5.0 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Reactive Phosphorus as P-By Discrete Analyser | EK071G | 1 | 13 | 7.7 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser | ED041G | 1 | 18 | 5.6 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Total Phosphorus as P By Discrete Analyser | EK067G | 1 | 20 | 5.0 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| TRH Volatiles/BTEX | EP080 | 1 | 17 | 5.9 | ✔️ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
**Brief Method Summaries**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

<table>
<thead>
<tr>
<th>Analytical Methods</th>
<th>Method</th>
<th>Matrix</th>
<th>Method Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH by PC Titrator</td>
<td>EA005-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed. 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2540C. A gravimetric procedure that determines the amount of ‘filterable’ residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2µm). The filtrate is evaporated to dryness and dried to constant weight at 180±5°C. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-SO4. Dissolved sulfate is determined in a 0.45µm filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride in the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003</td>
</tr>
<tr>
<td>Major Cations - Dissolved</td>
<td>ED093F</td>
<td>WATER</td>
<td>In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>WATER</td>
<td>In house: Referenced to APHA 3120 ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45 µm filtered prior to analysis. The ICPSMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.</td>
</tr>
<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>WATER</td>
<td>In house: Referenced to AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Analytical Methods</td>
<td>Method Descriptions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonium as N</td>
<td>The ammonium in the sample is reported as the ionised / unionised fractions by the use of a nomograph and the initial pH and Temperature. Ammonia is determined by discrete colorimetry by Discrete Analyser according to APHA 21st ed., 4500-NH3 G. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>In house: Referenced to APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
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<tr>
<td>Nitrate as N by Discrete Analyser</td>
<td>In house: Referenced to APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>In house: Referenced to APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
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<td></td>
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<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>In house: Referenced to APHA 21st Ed., 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive Phosphorus as P-By Discrete Analyser</td>
<td>In house: Referenced to APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimony tartrate reacts in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
<td></td>
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<tr>
<td>Ionic Balance by PCT DA and Turbi SO4 DA</td>
<td>In house: Referenced to APHA 21st Ed. 1030F. This method is compliant with NEPM (2013) Schedule B(3)</td>
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<tr>
<td>TRH - Semivolatile Fraction</td>
<td>USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)</td>
<td></td>
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<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
<td>USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
<td></td>
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</tr>
<tr>
<td>TRH Volatiles/BTEX</td>
<td>USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)</td>
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</table>

<table>
<thead>
<tr>
<th>Preparation Methods</th>
<th>Method Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKN/TP Digestion</td>
<td>APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Separatory Funnel Extraction of Liquids</td>
<td>USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3). ALS default excludes sediment which may be resident in the container.</td>
</tr>
</tbody>
</table>
Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: WATER

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<th>Client Sample ID</th>
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<th>CAS Number</th>
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<tr>
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<td>Anonymous</td>
<td>14808-79-8</td>
<td>Sulfate as SO4 - Turbidimetric</td>
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<tr>
<td>ES1502769-002</td>
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<td>108-38-3, 106-42-3</td>
<td>meta- &amp; para-Xylene</td>
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<td>MS recovery not determined, background level greater than or equal to 4x spike level.</td>
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<td></td>
</tr>
</tbody>
</table>

For all matrices, no Method Blank value outliers occur.
For all matrices, no Duplicate outliers occur.
For all matrices, no Laboratory Control outliers occur.

Regular Sample Surrogates

For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: WATER

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<th>Container / Client Sample ID(s)</th>
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<th>Days overdue</th>
<th>Date analysed</th>
<th>Due for analysis</th>
<th>Days overdue</th>
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<tr>
<td>EA005P: pH by PC Titrator</td>
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<td>03-FEB-2015</td>
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<td>ED093F: Dissolved Major Cations</td>
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<td>----</td>
<td>----</td>
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Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

No Quality Control Sample Frequency Outliers exist.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT:** NBHP - Water Quality Monitoring  
**PROJECT NUMBER:** 30011560  
**PROJECT MANAGER:** D. Saunders  
**SAMPLED BY:** S. Shaw  
**DATE SAMPLED:** 10/1/15  
**RELINQUISHED BY:** S. Shaw  
**RECEIVED BY:** Envirolab  
**DATE / TIME:** 1/3/15  
**DATE / TIME:** 11/3/15 14:45  

**SPECIAL LABORATORY INSTRUCTIONS:** Disolved metals to be filtered by Lab.

### SAMPLE DETAILS

<table>
<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>SAMPLE MATRIX</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO. CONTAINERS</th>
<th>PH/EC</th>
<th>TCN</th>
<th>ANIONS</th>
<th>CATIONS</th>
<th>CLO2</th>
<th>CHLOR</th>
<th>anderen</th>
<th>NITRITE</th>
<th>NITRATE</th>
<th>NITRILE</th>
<th>TKN</th>
<th>TRK</th>
<th>BTEX</th>
<th>PAH</th>
<th>SECURITY</th>
<th>COMMENTS</th>
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<td>GW1</td>
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**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**Copies:** White: send to lab, Yellow: to be placed in project file, Pink: to be retained in CoC book.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT:** NGHP - Water Quality Monitoring  
**PROJECT NUMBER:** 3001560  
**LAB QUOTE NO.:** 14 SY282  
**CONTACT PH:**  
**PROJECT MANAGER:** D. Saunders  
**SAMPLED BY:** S. Shaw  
**DATE SAMPLED:** 10/11/15  
**RECALLED BY:** S. Shaw  
**RECEIVED BY:** Envirolab  
**RECALLED BY:**  
**DATE/TIME:** 11/3/15  
**DATE/TIME:** 11/3/15  
**DATE/TIME:**  

**Special Laboratory Instructions:** Dissolved metals to be filtered by Lab.

**SAMPLE DETAILS**

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**COMMENTS:** Analysis As Required

**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**Copies:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book
SAMPLE RECEIPT ADVICE

<table>
<thead>
<tr>
<th>Client Details</th>
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<tbody>
<tr>
<td>Client</td>
<td>SMEC Australia</td>
</tr>
<tr>
<td>Attention</td>
<td>Daniel Saunders</td>
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<td>30011560, NBHP - Water Quality Monitoring</td>
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<td>Date Instructions Received</td>
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<td>Date Results Expected to be Reported</td>
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<th>Sample Condition</th>
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<tr>
<td>Samples received in appropriate condition for analysis</td>
<td>YES</td>
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<td>No. of Samples Provided</td>
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<tr>
<td>Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples</td>
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Please direct any queries to:

<table>
<thead>
<tr>
<th>Aileen Hie</th>
<th>Jacinta Hurst</th>
</tr>
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<td>Phone: 02 9910 6200</td>
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</tr>
<tr>
<td>Email: <a href="mailto:ahie@envirolabservices.com.au">ahie@envirolabservices.com.au</a></td>
<td>Email: <a href="mailto:jhurst@envirolabservices.com.au">jhurst@envirolabservices.com.au</a></td>
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Sample and Testing Details on following page
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<th>Sample Id</th>
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<th>HM in water - dissolved</th>
<th>HM in water - total</th>
<th>Iron Balance</th>
<th>Metals in Waters - Acid extractable</th>
<th>Nitrate as N in water</th>
<th>Nitrite as N in water</th>
<th>PAHs in Water</th>
<th>pH</th>
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<th>Total Suspended Solids</th>
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CERTIFICATE OF ANALYSIS 124942

Client: SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: Daniel Saunders

Sample log in details:
Your Reference: 30011560, NBHP - Water Quality Monitoring
No. of samples: 19 waters
Date samples received / completed instructions received 11/03/15 / 11/03/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 18/03/15 / 18/03/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Jacinth Hurst
Laboratory Manager
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<th>Type of sample</th>
<th>Date extracted</th>
<th>Date analysed</th>
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### vTRH(C6-C10):BTEXN in Water

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svTRH (C10-C40) in Water

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Date Extracted: 13/03/2015
Date Analyzed: 13/03/2015

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TRH >C10 - C16 µg/L

| Surrogate o-Terphenyl % | 87 | 101 | 92 | 97 | 92 |

svTRH (C10-C40) in Water

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TRH >C10 - C16 µg/L

| Surrogate o-Terphenyl % | 104 | 114 | 92 | 81 | 108 |

svTRH (C10-C40) in Water

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TRH >C10 - C16 µg/L

<p>| Surrogate o-Terphenyl % | 78 | 96 | 95 | 98 | 98 |</p>
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| **Date analysed** | 12/03/2015 | 12/03/2015 | 12/03/2015 | 12/03/2015 | 12/03/2015 |

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<th>Calcium - Dissolved</th>
<th>mg/L</th>
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<td>Potassium - Dissolved</td>
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<td>mg/L</td>
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<td>Bicarbonate Alkalinity as CaCO\textsubscript{3}</td>
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<td>Sulphate, SO\textsubscript{4}</td>
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<td>Chloride, Cl</td>
<td>mg/L</td>
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<td>81</td>
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### Ion Balance

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<th>Date analysed</th>
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| Sulphate, SO\textsubscript{4} | mg/L | 16 | 16 |
| Chloride, Cl | mg/L | 93 | 53 |
### Metals in Waters - Acid extractable

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<tr>
<td>Org-016</td>
<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. $F_1 = (C_6-C_{10})$-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<tr>
<td>Org-013</td>
<td>Water samples are analysed directly by purge and trap GC-MS.</td>
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<td>Org-003</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. $F_2 = (&gt;C_{10}-C_{16})$-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</td>
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<tr>
<td>Org-012 subset</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</td>
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<td>Metals-022 ICP-MS</td>
<td>Determination of various metals by ICP-MS.</td>
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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-.5oC.</td>
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<td>Inorg-057</td>
<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<td>Inorg-055</td>
<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.</td>
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<tr>
<td>Inorg-060</td>
<td>Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.</td>
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<td>Inorg-019</td>
<td>Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-.5oC.</td>
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<td>Determination of various metals by ICP-AES.</td>
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<td>Inorg-006</td>
<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<td>Inorg-081</td>
<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<td>Inorg-041</td>
<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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### vTRH(C6-C10)/BTEXN in Water

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<th>Spike % Recovery</th>
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<td>LCS-W4</td>
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<td>13/03/2015</td>
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<td>Benzene µg/L</td>
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<td>&lt;1</td>
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<td>&lt;1</td>
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<td>LCS-W4</td>
<td>90%</td>
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<td>Toluene µg/L</td>
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### svTRH (C10-C40) in Water

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### PAHs in Water

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| QUALITY CONTROL | UNITS | PQL | METHOD | Blank | Duplicate Sm# | Duplicate results | Spike Sm# | Spike % Recovery |
| HM in water - dissolved | | | | | | Base II Duplicate II %RPD | | |
| Date prepared | - | | 13/03/2 015 | 124942-1 | 13/03/2015 || 13/03/2015 | LCS-W2 | 13/03/2015 |
| Date analysed | - | | 13/03/2 015 | 124942-1 | 13/03/2015 || 13/03/2015 | LCS-W2 | 13/03/2015 |
| Arsenic-Dissolved | µg/L | 1 | Metals-022 ICP-MS | <1 | 124942-1 | 1 || 1 || RPD: 0 | LCS-W2 | 95% |
| Copper-Dissolved | µg/L | 1 | Metals-022 ICP-MS | <1 | 124942-1 | 39 || 39 || RPD: 0 | LCS-W2 | 96% |
| Lead-Dissolved | µg/L | 1 | Metals-022 ICP-MS | <1 | 124942-1 | 7 || 7 || RPD: 0 | LCS-W2 | 99% |
| Zinc-Dissolved | µg/L | 1 | Metals-022 ICP-MS | <1 | 124942-1 | 100 || 98 || RPD: 2 | LCS-W2 | 95% |
| Nickel-Dissolved | µg/L | 1 | Metals-022 ICP-MS | <1 | 124942-1 | 24 || 24 || RPD: 0 | LCS-W2 | 94% |
| Mercury-Dissolved | µg/L | 0.05 | Metals-021 CV-AAS | <0.05 | 124942-1 | <0.05 || <0.05 | LCS-W2 | 96% |
| Cadmium-Dissolved | µg/L | 0.1 | Metals-022 ICP-MS | <0.1 | 124942-1 | 1.1 || 1.1 || RPD: 0 | LCS-W2 | 102% |
| Iron-Dissolved | µg/L | 10 | Metals-022 ICP-MS | <10 | 124942-1 | 13 || 12 || RPD: 8 | LCS-W2 | 94% |
| Manganese-Dissolved | µg/L | 5 | Metals-022 ICP-MS | <5 | 124942-1 | 53 || 52 || RPD: 2 | LCS-W2 | 94% |
### QUALITY CONTROL

**HM in water - total**

| Date prepared | - | Metals-022 ICP-MS | 13/03/2015 | [NT] | [NT] | LCS-W4 | 13/03/2015 |
| Date analysed | - | Metals-022 ICP-MS | 13/03/2015 | [NT] | [NT] | LCS-W4 | 13/03/2015 |
| Arsenic-Total | µg/L | Metals-022 ICP-MS | <1 | [NT] | [NT] | LCS-W4 | 92% |
| Copper-Total | µg/L | Metals-022 ICP-MS | <1 | [NT] | [NT] | LCS-W4 | 100% |
| Lead-Total | µg/L | Metals-022 ICP-MS | <1 | [NT] | [NT] | LCS-W4 | 105% |
| Zinc-Total | µg/L | Metals-022 ICP-MS | <1 | [NT] | [NT] | LCS-W4 | 96% |
| Nickel-Total | µg/L | Metals-022 ICP-MS | <1 | [NT] | [NT] | LCS-W4 | 92% |
| Mercury-Total | µg/L | Metals-021 CV-AAS | <0.05 | [NT] | [NT] | LCS-W4 | 96% |
| Cadmium-Total | µg/L | Metals-022 ICP-MS | <0.1 | [NT] | [NT] | LCS-W4 | 101% |
| Iron-Total | µg/L | Metals-022 ICP-MS | <10 | [NT] | [NT] | LCS-W4 | 95% |
| Manganese-Total | µg/L | Metals-022 ICP-MS | <5 | [NT] | [NT] | LCS-W4 | 95% |

**Miscellaneous Inorganics**

| Date prepared | - | Inorg-001 | 12/03/2015 | 124942-1 | 12/03/2015 | LCS-W1 | 12/03/2015 |
| Date analysed | - | Inorg-001 | 12/03/2015 | 124942-1 | 12/03/2015 | LCS-W1 | 12/03/2015 |
| pH | pH Units | Inorg-001 | [NT] | 124942-1 | 4.6 | LCS-W1 | 103% |
| Electrical Conductivity | µS/cm | Inorg-002 | <1 | 124942-1 | 920 | LCS-W1 | 98% |
| Total Dissolved Solids | mg/L | Inorg-018 | <5 | 124942-1 | 540 | LCS-W1 | 98% |
| Ammonia as N in water | mg/L | Inorg-057 | <0.005 | 124942-1 | <0.005 | LCS-W1 | 117% |
| Nitrate as N in water | mg/L | Inorg-055 | <0.005 | 124942-1 | <0.005 | LCS-W1 | 110% |
| Nitrite as N in water | mg/L | Inorg-055 | <0.005 | 124942-1 | <0.005 | LCS-W1 | 114% |
| Phosphate as P in water | mg/L | Inorg-060 | <0.005 | 124942-1 | <0.005 | LCS-W1 | 103% |
| Total Suspended Solids | mg/L | Inorg-019 | <5 | [NT] | [NT] | LCS-W1 | 100% |
### Quality Control

<table>
<thead>
<tr>
<th>Ion Balance</th>
<th>UNITS</th>
<th>PQL</th>
<th>METHOD</th>
<th>Blank</th>
<th>Duplicate Sm#</th>
<th>Duplicate results Base II Duplicate II %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tbody>
<tr>
<td>Date prepared</td>
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<td></td>
<td></td>
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<td>12/03/2 015</td>
<td>12/03/2015</td>
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<td>Calcium - Dissolved</td>
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### Quality Control - Metals in Waters - Acid extractable

| Date prepared | - |     |       | 13/03/2 015 | 13/03/2015 | 13/03/2015 | LCS-W1 | 13/03/2015 |
| Date analysed | - |     |       | 13/03/2 015 | 13/03/2015 | 13/03/2015 | LCS-W1 | 13/03/2015 |
| Phosphorus - Total | mg/L | 0.05 | Metals-020 ICP-AES | <0.05 | 124942-10 | 0.2 | 0.2 | RPD: 0 | LCS-W1 | 113% |

### Quality Control - vTRH(C6-C10)/BTEX in Water

| Date extracted | - | 124942-11 | 13/03/2015 | 16/03/2015 |
| Date analysed | - | 124942-11 | 13/03/2015 | 16/03/2015 |
| TRHC\_6 - C\_6 | µg/L | 124942-11 | 58 | 70 | RPD: 19 |
| TRHC\_6 - C\_10 | µg/L | 124942-11 | 64 | 79 | RPD: 21 |
| Benzene | µg/L | 124942-11 | 35 | 38 | RPD: 8 |
| Toluene | µg/L | 124942-11 | <1 | <1 |
| Ethylbenzene | µg/L | 124942-11 | <1 | <1 |
| m+p-xylene | µg/L | 124942-11 | <2 | <2 |
| o-xylene | µg/L | 124942-11 | <1 | <1 |
| Naphthalene | µg/L | 124942-11 | <1 | <1 |
| Surrogate | % | 124942-11 | 102 | 104 | RPD: 2 |
### Quality Control Units

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### Water Quality Monitoring

#### Surrogate

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#### Surrogate Spike

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### PAHs in Water

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<td>Indeno(1,2,3-c,d)pyrene</td>
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### Surrogate Spike

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### Surrogate Spike % Recovery

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### Surrogate Spike % Recovery

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<tr>
<td>HM in water - dissolved</td>
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<tr>
<td>Date analysed</td>
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<tr>
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<tr>
<td>Copper-Dissolved</td>
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<td>Lead-Dissolved</td>
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<td>Zinc-Dissolved</td>
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<td>Cadmium-Dissolved</td>
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<td>Manganese-Dissolved</td>
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<table>
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<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
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<td>0.060</td>
</tr>
<tr>
<td>Nitrite as N in water</td>
<td>mg/L</td>
<td>124942-11</td>
<td>0.008</td>
<td></td>
<td>0.008</td>
</tr>
<tr>
<td>Phosphate as P in water</td>
<td>mg/L</td>
<td>124942-11</td>
<td>0.005</td>
<td></td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>mg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>[NR]</td>
<td>[NR]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QUALITY CONTROL</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ion Balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>124942-11</td>
<td>12/03/2015</td>
<td></td>
<td>12/03/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>124942-11</td>
<td>12/03/2015</td>
<td></td>
<td>12/03/2015</td>
</tr>
<tr>
<td>Calcium - Dissolved</td>
<td>mg/L</td>
<td>124942-11</td>
<td>1.6</td>
<td></td>
<td>1.7</td>
</tr>
<tr>
<td>Potassium - Dissolved</td>
<td>mg/L</td>
<td>124942-11</td>
<td>&lt;0.5</td>
<td></td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Sodium - Dissolved</td>
<td>mg/L</td>
<td>124942-11</td>
<td>30</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Magnesium - Dissolved</td>
<td>mg/L</td>
<td>124942-11</td>
<td>1.8</td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>Hydroxide Alkalinity (OH⁻) as CaCO₃</td>
<td>mg/L</td>
<td>124942-11</td>
<td>&lt;5</td>
<td></td>
<td>&lt;5</td>
</tr>
<tr>
<td>Bicarbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>124942-11</td>
<td>&lt;5</td>
<td></td>
<td>&lt;5</td>
</tr>
<tr>
<td>Carbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>124942-11</td>
<td>&lt;5</td>
<td></td>
<td>&lt;5</td>
</tr>
<tr>
<td>Total Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>124942-11</td>
<td>&lt;5</td>
<td></td>
<td>&lt;5</td>
</tr>
<tr>
<td>Sulphate, SO₄</td>
<td>mg/L</td>
<td>124942-11</td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Chloride, Cl</td>
<td>mg/L</td>
<td>124942-11</td>
<td>46</td>
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<tr>
<td>Ionic Balance</td>
<td>%</td>
<td>124942-11</td>
<td>4.5</td>
<td></td>
<td>4.4</td>
</tr>
<tr>
<td>QUALITY CONTROL</td>
<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
<td>Spike Sm#</td>
<td>Spike % Recovery</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>----------</td>
<td>-----------------------------------</td>
<td>-----------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Metals in Waters - Acid extractable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>[NT]</td>
<td>[NT]</td>
<td>124942-11</td>
<td>13/03/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>[NT]</td>
<td>[NT]</td>
<td>124942-11</td>
<td>13/03/2015</td>
</tr>
<tr>
<td>Phosphorus - Total</td>
<td>mg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>124942-11</td>
<td>110%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QUALITY CONTROL</td>
<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
<td>Spike Sm#</td>
<td>Spike % Recovery</td>
</tr>
<tr>
<td>Miscellaneous Inorganics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>124942-12</td>
<td>12/03/2015</td>
<td></td>
<td>12/03/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>124942-12</td>
<td>12/03/2015</td>
<td></td>
<td>12/03/2015</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>mg/L</td>
<td>124942-12</td>
<td>&lt;10</td>
<td></td>
<td>&lt;10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QUALITY CONTROL</td>
<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
<td>Spike Sm#</td>
<td>Spike % Recovery</td>
</tr>
<tr>
<td>Metals in Waters - Acid extractable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>[NT]</td>
<td>[NT]</td>
<td>LCS-W2</td>
<td>13/03/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>[NT]</td>
<td>[NT]</td>
<td>LCS-W2</td>
<td>13/03/2015</td>
</tr>
<tr>
<td>Phosphorus - Total</td>
<td>mg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>LCS-W2</td>
<td>113%</td>
</tr>
</tbody>
</table>
Report Comments:
TSS: The PQL has been raised due to the limited amount of sample/s available for testing.

Total Dissolved Solids result for sample no.12 may be exaggerated due to the presence of colloids.

ION_BALANCE: % Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

METALS_WLL_8_D: % Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Ammonia: PQL raised due to negative result produced, the sample was rerun with dilution however the sample negative result was given. This may be caused by the matrix of the sample.

TRACE METALS: In theory the total metal content should be higher than the dissolved metal content. However, in some samples this is not the case.
The sample has been re-analysed for both Total and Dissolved and results have been confirmed.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test
NA: Test not required
<: Less than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample
Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/1/15</td>
<td>01:00</td>
<td>Arrival</td>
<td></td>
</tr>
<tr>
<td>11/1/15</td>
<td>05:00</td>
<td>Departure</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Sample details to be addressed by LOB.
## SAMPLE RECEIPT NOTIFICATION (SRN)

### Comprehensive Report

**Work Order**: ES1505946

**Client**: SMEC AUSTRALIA PTY LTD  
**Contact**: DANIEL SAUNDERS  
**Address**: P O BOX 1654 FYSWICK ACT, AUSTRALIA 2609

**Laboratory**: Environmental Division Sydney  
**Contact**: Client Services  
**Address**: 277-289 Woodpark Road Smithfield NSW Australia 2164

**E-mail**: daniel.saunders@smec.com  
**Telephone**: +61 02 61261959

**Facsimile**: +61 61261966

**Order number**: 1074  
**Quote number**: ES2014SMEAUS0366 (EN/025/14)

**Site**: ----  
**Sampler**: SS  
**QC Level**: NEPM 2013 Schedule B(3) and ALS QCS3 requirement

### Dates

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Samples Received</td>
<td>12-MAR-2015</td>
</tr>
<tr>
<td>Client Requested Due Date</td>
<td>19-MAR-2015</td>
</tr>
<tr>
<td>Issue Date</td>
<td>12-MAR-2015 16:36</td>
</tr>
<tr>
<td>Scheduled Reporting Date</td>
<td>19-MAR-2015</td>
</tr>
</tbody>
</table>

### Delivery Details

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Delivery</td>
<td>Carrier</td>
</tr>
<tr>
<td>No. of coolers/boxes</td>
<td>1 FOAM</td>
</tr>
<tr>
<td>Temperature</td>
<td>17.8°C - Ice bricks present</td>
</tr>
<tr>
<td>No. of samples received</td>
<td>1</td>
</tr>
<tr>
<td>No. of samples analysed</td>
<td>1</td>
</tr>
</tbody>
</table>

### General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables

- Sample containers do not comply to pretreatment / preservation standards (AS, APHA, USEPA). Please refer to the Sample Container(s)/Preservation Non-Compliance Log at the end of this report for details.

- Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.

- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

<table>
<thead>
<tr>
<th>Method</th>
<th>Sample Container Received</th>
<th>Preferred Sample Container for Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG020A-F : Dissolved Metals by ICP-MS - Suite A</td>
<td>- Clear Plastic Bottle - Nitric Acid; Unspecified</td>
<td>- Clear Plastic Bottle - Nitric Acid; Filtered</td>
</tr>
<tr>
<td>TRIP1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EG035F : Dissolved Mercury by FIMS</td>
<td>- Clear Plastic Bottle - Natural</td>
<td>- Clear Plastic Bottle - Nitric Acid; Filtered</td>
</tr>
<tr>
<td>TRIP1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

<table>
<thead>
<tr>
<th>Matrix: WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory sample ID</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>ES1505946-001</td>
</tr>
</tbody>
</table>

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

<table>
<thead>
<tr>
<th>Method</th>
<th>Due for extraction</th>
<th>Due for analysis</th>
<th>Samples Received</th>
<th>Instructions Received</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date</td>
<td>Date</td>
<td>Date</td>
<td>Evaluation</td>
</tr>
<tr>
<td>EA005-P: pH by PC Titrator</td>
<td>10-MAR-2015</td>
<td>----</td>
<td>12-MAR-2015</td>
<td>x</td>
</tr>
</tbody>
</table>
Requested Deliverables

DANIEL SAUNDERS

- *AU Certificate of Analysis - NATA ( COA )
  Email daniel.saunders@smec.com

- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) ( QCI )
  Email daniel.saunders@smec.com

- *AU QC Report - DEFAULT (Anon QC Rep) - NATA ( QC )
  Email daniel.saunders@smec.com

- A4 - AU Sample Receipt Notification - Environmental HT ( SRN
  Email daniel.saunders@smec.com

- A4 - AU Tax Invoice ( INV )
  Email daniel.saunders@smec.com

- Chain of Custody (CoC) ( COC )
  Email daniel.saunders@smec.com

- EDI Format - ENMRG ( ENMRG )
  Email daniel.saunders@smec.com

- EDI Format - ESDAT ( ESDAT )
  Email daniel.saunders@smec.com
CERTIFICATE OF ANALYSIS

Work Order : ES1505946
Client : SMEC AUSTRALIA PTY LTD
Contact : DANIEL SAUNDERS
Address : P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609

E-mail : daniel.saunders@smec.com
Telephone : +61 02 61261959
Faximile : +61 61261966

Project : 30011560 NBHP-WATER QUALITY MONITORING
Order number : ---
C-O-C number : 1074
Sampler : SS
Site : ---

Quote number : EN/025/14

Date Samples Received : 12-MAR-2015
Issue Date : 19-MAR-2015
No. of samples received : 1
No. of samples analysed : 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:
- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

Signatories
This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories
Ankit Joshi
Pabi Subba
Shobhna Chandra

Position
Inorganic Chemist
Senior Organic Chemist
Metals Coordinator

Accreditation Category
Sydney Inorganics
Sydney Organics
Sydney Inorganics

Environmental Division Sydney
ABN 84 009 936 029 Part of the ALS Group An ALS Limited Company
Address 277-289 Woodpark Road Smithfield NSW Australia 2164 | PHONE +61-2-8784 8555 | Facsimile +61-2-8784 8500
www.alsglobal.com
Right Solutions Right Partner
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Where sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key:

- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- ^ = This result is computed from individual analyte detections at or above the level of reporting

- **Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ)** is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.c.d)pyrene (0.1), Dibenzo(a,h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.

- **EP080:** Particular sample required dilution due to sample matrix. LOR values have been adjusted accordingly.
## Analytical Results

**Sub-Matrix:** WATER  
**Matrix:** WATER

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>TRIP1</th>
<th>10-MAR-2015 15:00</th>
<th>ES1505946-001</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA005P: pH by PC Titrator</td>
<td></td>
<td></td>
<td></td>
<td>pH Value</td>
<td>5.20</td>
<td></td>
</tr>
<tr>
<td>EA010P: Conductivity by PC Titrator</td>
<td></td>
<td></td>
<td></td>
<td>Electrical Conductivity @ 25°C</td>
<td>184</td>
<td></td>
</tr>
<tr>
<td>EA015: Total Dissolved Solids</td>
<td></td>
<td></td>
<td></td>
<td>Total Dissolved Solids @180°C</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>ED037P: Alkalinity by PC Titrator</td>
<td>DMO-210-001</td>
<td>1</td>
<td>mg/L</td>
<td>Hydroxide Alkalinity as CaCO3</td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Carbonate Alkalinity as CaCO3</td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bicarbonate Alkalinity as CaCO3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total Alkalinity as CaCO3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</td>
<td>14808-79-8</td>
<td>1</td>
<td>mg/L</td>
<td>Sulfate as SO4 - Turbidimetric</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>ED045G: Chloride Discrete analyser</td>
<td>16887-00-6</td>
<td>1</td>
<td>mg/L</td>
<td>Chloride</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>ED093F: Dissolved Major Cations</td>
<td></td>
<td></td>
<td></td>
<td>Calcium</td>
<td>2</td>
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<td></td>
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<td></td>
<td>Magnesium</td>
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<td>Sodium</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Potassium</td>
<td>&lt;1</td>
<td></td>
</tr>
<tr>
<td>EG020F: Dissolved Metals by ICP-MS</td>
<td></td>
<td></td>
<td></td>
<td>Arsenic</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cadmium</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chromium</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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# Analytical Results

## Sub-Matrix: WATER (Matrix: WATER)

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<th>Unit</th>
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<td>Indeno(1,2,3-cd)pyrene</td>
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<td>Benzo(a)pyrene TEQ (zero)</td>
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Note: All concentrations are reported in mg/L or µg/L as appropriate.
### Analytical Results

#### Sub-Matrix: WATER (Matrix: WATER)

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<th>Compound Description</th>
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### Surrogate Control Limits

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QUALITY CONTROL REPORT

Work Order : ES1505946

Client : SMEC AUSTRALIA PTY LTD
Contact : DANIEL SAUNDERS
Address : P O BOX 1654
          FYSWHICK ACT, AUSTRALIA 2609

Laboratory : Environmental Division Sydney
Contact : Client Services
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164

E-mail : daniel.saunders@smec.com
Telephone : +61 02 61261959
Facsimile : +61 61261966

Project : 30011560 NBHP-WATER QUALITY MONITORING
Site : ----
C-O-C number : 1074
Sampler : SS
Order number : ----
Quote number : EN/025/14

Date Samples Received : 12-MAR-2015
Issue Date : 19-MAR-2015
No. of samples received : 1
No. of samples analysed : 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:
- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories
This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<table>
<thead>
<tr>
<th>Signatories</th>
<th>Position</th>
<th>Accreditation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankit Joshi</td>
<td>Inorganic Chemist</td>
<td>Sydney Inorganics</td>
</tr>
<tr>
<td>Pabi Subba</td>
<td>Senior Organic Chemist</td>
<td>Sydney Organics</td>
</tr>
<tr>
<td>Shobhna Chandra</td>
<td>Metals Coordinator</td>
<td>Sydney Inorganics</td>
</tr>
</tbody>
</table>

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key:
- Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- RPD = Relative Percentage Difference
- # = Indicates failed QC
Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

<table>
<thead>
<tr>
<th>Sub-Matrix: WATER</th>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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<td>EA005P: pH by PC Titrator (QC Lot: 3856831)</td>
<td>ES1505435-001</td>
<td>Anonymous</td>
<td>EA005-P: pH Value</td>
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<td>EA015: Total Dissolved Solids (QC Lot: 3860371)</td>
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<td>EA015H: Total Dissolved Solids @180°C</td>
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<td>ED037-P: Hydroxide Alkalinity as CaCO3</td>
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<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 3856899)</td>
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<td>ED093F: Calcium</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QC Lot: 3859773)</td>
<td>ES1505919-001</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QC Lot: 3859773)</td>
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<td>EG020A-F: Arsenic</td>
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## Sub-Matrix: WATER

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<th>Duplicate Result</th>
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<th>Recovery Limits (%)</th>
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<tr>
<td>ES1505919-001</td>
<td>Anonymous</td>
<td>EG020A-F: Chromium</td>
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<td>&lt;0.010</td>
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<tr>
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<td>EG020A-F: Copper</td>
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<td>EG020A-F: Nickel</td>
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<td>0.001 mg/L</td>
<td>0.001</td>
<td>0.002</td>
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| EG035F: Dissolved Mercury by FIMS (QC Lot: 3859771) |
| ES1505919-002    | Anonymous           | EG035F: Mercury                           | 7439-97-6  | 0.0001 mg/L| <0.0001         | <0.0001          | 0.0     |
| ES1505919-009    | Anonymous           | EG035F: Mercury                           | 7439-97-6  | 0.0001 mg/L| 0.0003         | 0.0003          | 0.0     |

| EK055G: Ammonia as N by Discrete Analyser (QC Lot: 3858535) |
| ES1505872-001    | Anonymous           | EK055G: Ammonia as N                      | 7664-41-7  | 0.01 mg/L   | 7.64           | 7.50            | 1.9     |
| ES1505922-005    | Anonymous           | EK055G: Ammonia as N                      | 7664-41-7  | 0.01 mg/L   | 9.04           | 8.99            | 0.6     |

| EK057G: Nitrite as N by Discrete Analyser (QC Lot: 3858987) |
| ES1505922-007    | Anonymous           | EK057G: Nitrite as N                      | ---        | 0.01 mg/L   | <0.01          | <0.01          | 0.0     |
| ES1505960-001    | Anonymous           | EK057G: Nitrite as N                      | ---        | 0.01 mg/L   | <0.01          | <0.01          | 0.0     |

| EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3858536) |
| ES1505934-001    | Anonymous           | EK059G: Nitrite + Nitrate as N            | ---        | 0.01 mg/L   | 0.04           | 0.04            | 0.0     |
| ES1505989-007    | Anonymous           | EK059G: Nitrite + Nitrate as N            | ---        | 0.01 mg/L   | 57.4           | 57.9           | 1.0     |

| EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3858529) |
| ES1505645-001    | Anonymous           | EK067G: Total Phosphorus as P             | ---        | 0.01 mg/L   | 11.2           | 10.9            | 3.0     |
| ES1505689-001    | Anonymous           | EK067G: Total Phosphorus as P             | ---        | 0.01 mg/L   | 0.05           | 0.01            | 134     |

| EK071G: Reactive Phosphorus as P by Discrete analyser (QC Lot: 3856986) |
| ES1505763-001    | Anonymous           | EK071G: Reactive Phosphorus as P          | 14265-44-2 | 0.01 mg/L   | <0.01          | <0.01          | 0.0     |

| EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3861288) |
| ES1505907-001    | Anonymous           | EP080: C6 - C9 Fraction                   | ---        | 20 µg/L     | <20            | <20            | 0.0     |

| EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3861288) |
| ES1505907-001    | Anonymous           | EP080: C6 - C10 Fraction                  | C6_C10     | 20 µg/L     | <20            | <20            | 0.0     |

<p>| EP080: BTEXN (QC Lot: 3861288) |
| ES1505907-001    | Anonymous           | EP080: Benzene                            | 71-43-2     | 1 µg/L     | &lt;1             | &lt;1             | 0.0     |
| EP080: Toluene    |                     |                                           | 108-88-3    | 2 µg/L     | &lt;2             | &lt;2             | 0.0     |
| EP080: Ethylbenzene|                     |                                            | 100-41-4    | 2 µg/L     | &lt;2             | &lt;2             | 0.0     |
| EP080: meta- &amp; para-Xylene |                     |                                            | 108-38-3 106-42-3 | 2 µg/L     | &lt;2             | &lt;2             | 0.0     |
| EP080: ortho-Xylene|                     |                                            | 95-47-6     | 2 µg/L     | &lt;2             | &lt;2             | 0.0     |</p>
<table>
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<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
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**Sub-Matrix:** WATER

**Project:** 30011560 NBHP-WATER QUALITY MONITORING

**Client:** SMEC AUSTRALIA PTY LTD

**Work Order:** ES1505946
Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

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<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Method Blank (MB) Report</th>
<th>Laboratory Control Spike (LCS) Report</th>
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<td>Result</td>
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<td><strong>EA010P: Conductivity by PC Titrator</strong> (QCLot: 3856830)</td>
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<tr>
<td>EA010P: Electrical Conductivity @ 25°C</td>
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<td>2000 µS/cm</td>
</tr>
<tr>
<td><strong>EA015: Total Dissolved Solids</strong> (QCLot: 3860371)</td>
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<td>EA015H: Total Dissolved Solids @180°C</td>
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<td>2000 mg/L</td>
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<td>ED037P: Total Alkalinity as CaCO3</td>
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<td>100 mg/L</td>
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<td><strong>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</strong> (QCLot: 3856898)</td>
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<td>ED045G: Chloride</td>
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<td>ED093F: Calcium</td>
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<tr>
<td>ED093F: Magnesium</td>
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<td>----</td>
<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
<td>4.42 mg/L</td>
</tr>
<tr>
<td>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3856986)</td>
<td>14265-44-2</td>
<td>0.01</td>
<td>mg/L</td>
<td>&lt;0.01</td>
<td>0.5 mg/L</td>
</tr>
<tr>
<td>EP075(SIM): Polynuclear Aromatic Hydrocarbons (QCLot: 3858060)</td>
<td>91-20-3</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Acenaphthylene</td>
<td>208-96-8</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Acenaphthene</td>
<td>83-32-9</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Fluorene</td>
<td>86-73-7</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Phenanthrene</td>
<td>85-01-8</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Anthracene</td>
<td>120-12-7</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Fluoranthene</td>
<td>206-44-0</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Pyrene</td>
<td>129-00-0</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Benz(a)anthracene</td>
<td>56-55-3</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Chrysene</td>
<td>218-01-9</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Benzo(b+j)fluoranthene</td>
<td>205-99-2</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Benzo(k)fluoranthene</td>
<td>205-09-2</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Benzo(a)pyrene</td>
<td>50-32-8</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;0.5</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Indeno(1.2.3-cd)pyrene</td>
<td>193-39-5</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Dibenzo(a.h)anthracene</td>
<td>53-70-3</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP075(SIM): Benzo(g.h.i)perylene</td>
<td>191-24-2</td>
<td>0.2</td>
<td>µg/L</td>
<td>&lt;1.0</td>
<td>5 µg/L</td>
</tr>
<tr>
<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3858059)</td>
<td>----</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;50</td>
<td>2000 µg/L</td>
</tr>
</tbody>
</table>
Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3858059) - continued</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EP071: C15 - C28 Fraction</td>
<td>---</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>3000 µg/L</td>
<td>98.4</td>
<td>71</td>
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<tr>
<td>EP071: C29 - C36 Fraction</td>
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<td>50</td>
<td>µg/L</td>
<td>&lt;50</td>
<td>2000 µg/L</td>
<td>99.9</td>
<td>62</td>
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<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3861288)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP080: C6 - C9 Fraction</td>
<td>---</td>
<td>20</td>
<td>µg/L</td>
<td>&lt;20</td>
<td>260 µg/L</td>
<td>79.4</td>
<td>75</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3858059)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP071: &gt;C10 - C16 Fraction</td>
<td>&gt;C10_C16</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>2500 µg/L</td>
<td>104</td>
<td>58.9</td>
</tr>
<tr>
<td>EP071: &gt;C16 - C34 Fraction</td>
<td>---</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>3500 µg/L</td>
<td>98.0</td>
<td>73.9</td>
</tr>
<tr>
<td>EP071: &gt;C34 - C40 Fraction</td>
<td>---</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>1500 µg/L</td>
<td>104</td>
<td>67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3861288)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP080: C6 - C10 Fraction</td>
<td>C6_C10</td>
<td>20</td>
<td>µg/L</td>
<td>&lt;20</td>
<td>310 µg/L</td>
<td>77.8</td>
<td>75</td>
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</table>

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080: BTEXN (QCLot: 3861288)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EP080: Benzene</td>
<td>71-43-2</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1</td>
<td>10 µg/L</td>
<td>91.7</td>
<td>70</td>
</tr>
<tr>
<td>EP080: Toluene</td>
<td>108-88-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>84.7</td>
<td>65</td>
</tr>
<tr>
<td>EP080: Ethylbenzene</td>
<td>100-41-4</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>84.3</td>
<td>70</td>
</tr>
<tr>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3 106-42-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>82.1</td>
<td>69</td>
</tr>
<tr>
<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>82.6</td>
<td>72</td>
</tr>
<tr>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>5</td>
<td>µg/L</td>
<td>&lt;5</td>
<td>10 µg/L</td>
<td>86.6</td>
<td>70</td>
</tr>
</tbody>
</table>

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3856989)</td>
<td>Anonymous</td>
<td>ED041G: Sulfate as SO4 - Turbidimetric</td>
<td>14808-79-8</td>
<td>10 mg/L</td>
<td># Not Determined</td>
<td>70</td>
</tr>
<tr>
<td>ED045G: Chloride Discrete analyser (QCLot: 3856988)</td>
<td>Anonymous</td>
<td>ED045G: Chloride</td>
<td>16887-00-6</td>
<td>250 mg/L</td>
<td>96.4</td>
<td>70</td>
</tr>
<tr>
<td>EG020F: Dissolved Metals by ICP-MS (QCLot: 3859773)</td>
<td>Anonymous</td>
<td>EG020A-F: Arsenic</td>
<td>7440-38-2</td>
<td>0.2 mg/L</td>
<td>117</td>
<td>70</td>
</tr>
</tbody>
</table>
### EG020F: Dissolved Metals by ICP-MS (QCLot: 3859773) - continued

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505919-003</td>
<td>Anonymous</td>
<td>EG020A-F: Cadmium</td>
<td>7440-43-9</td>
<td>0.05 mg/L</td>
<td>98.6</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Chromium</td>
<td>7440-47-3</td>
<td>0.2 mg/L</td>
<td>89.4</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Copper</td>
<td>7440-50-8</td>
<td>0.2 mg/L</td>
<td>98.6</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Lead</td>
<td>7439-92-1</td>
<td>0.2 mg/L</td>
<td>99.0</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Nickel</td>
<td>7440-02-0</td>
<td>0.2 mg/L</td>
<td>98.5</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Zinc</td>
<td>7440-66-6</td>
<td>0.2 mg/L</td>
<td>122</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EG035F: Dissolved Mercury by FIMS (QCLot: 3859771)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EG035F: Mercury</td>
<td>7439-97-6</td>
<td>0.0100 mg/L</td>
<td>87.5</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EK055G: Ammonia as N by Discrete Analyser (QCLot: 3858535)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505872-001</td>
<td>Anonymous</td>
<td>EK055G: Ammonia as N</td>
<td>7664-41-7</td>
<td>1 mg/L</td>
<td># Not Determined</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EK057G: Nitrite as N by Discrete Analyser (QCLot: 3856987)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505922-007</td>
<td>Anonymous</td>
<td>EK057G: Nitrite as N</td>
<td>----</td>
<td>0.5 mg/L</td>
<td>98.3</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3858536)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505934-001</td>
<td>Anonymous</td>
<td>EK059G: Nitrite + Nitrate as N</td>
<td>----</td>
<td>0.5 mg/L</td>
<td>107</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 3858529)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505869-001</td>
<td>Anonymous</td>
<td>EK067G: Total Phosphorus as P</td>
<td>----</td>
<td>1.0 mg/L</td>
<td>92.9</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3856986)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505763-001</td>
<td>Anonymous</td>
<td>EK071G: Reactive Phosphorus as P</td>
<td>14265-44-2</td>
<td>0.5 mg/L</td>
<td>107</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EP080/071: Total Petroleum Hydrocarbons (QCLot: 3861288)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EP080: C6 - C9 Fraction</td>
<td>----</td>
<td>325 µg/L</td>
<td>108</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3861288)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EP080: C6 - C10 Fraction</td>
<td>C6_C10</td>
<td>375 µg/L</td>
<td>103</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>

### EP080: BTEXN (QCLot: 3861288)

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method</th>
<th>Compound</th>
<th>CAS Number</th>
<th>Spike</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EP080: Benzene</td>
<td>71-43-2</td>
<td>25 µg/L</td>
<td>76.2</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Toluene</td>
<td>108-88-3</td>
<td>25 µg/L</td>
<td>83.7</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Ethylbenzene</td>
<td>100-41-4</td>
<td>25 µg/L</td>
<td>85.4</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3</td>
<td>25 µg/L</td>
<td>84.7</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: ortho-Xylene</td>
<td>106-42-3</td>
<td>25 µg/L</td>
<td>86.6</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>25 µg/L</td>
<td>89.9</td>
<td>70</td>
<td>130</td>
</tr>
</tbody>
</table>
The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

### Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
<th>RPDs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 3856986)</td>
<td></td>
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</tr>
<tr>
<td>ES1505763-001</td>
<td>Anonymous</td>
<td>EK071G: Reactive Phosphorus as P</td>
<td>14265-44-2</td>
<td>0.5 mg/L</td>
<td>107</td>
<td>70</td>
<td>130</td>
</tr>
<tr>
<td>EK057G: Nitrite as N by Discrete Analyser (QCLot: 3856987)</td>
<td></td>
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</tr>
<tr>
<td>ES1505922-007</td>
<td>Anonymous</td>
<td>EK057G: Nitrite as N</td>
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<td>98.3</td>
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<td>ED045G: Chloride Discrete analyser (QCLot: 3856988)</td>
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<tr>
<td>ES1505922-007</td>
<td>Anonymous</td>
<td>ED045G: Chloride</td>
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<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 3856989)</td>
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<td>ES1505922-007</td>
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<td>ED041G: Sulfate as SO4 - Turbidimetric</td>
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<td>EK055G: Ammonia as N by Discrete Analyser (QCLot: 3858535)</td>
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<td>ES1505872-007</td>
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<td>EK055G: Ammonia as N</td>
<td>7664-41-7</td>
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<td>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 3858536)</td>
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<td>EG035F: Dissolved Mercury by FIMS (QCLot: 3859771)</td>
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<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EG035F: Mercury</td>
<td>7439-97-6</td>
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<td>EG020F: Dissolved Metals by ICP-MS (QCLot: 3859773)</td>
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<td>ES1505919-003</td>
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<td>EG020F: Arsenic</td>
<td>7440-38-2</td>
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<td>EG020F: Cadmium</td>
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<td>EG020F: Chromium</td>
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<td>EG020F: Copper</td>
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<td>7440-50-8</td>
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<td>EG020F: Lead</td>
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<td>EG020F: Nickel</td>
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<td>EG020F: Zinc</td>
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<td>7440-66-6</td>
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<td>EP080/071: Total Petroleum Hydrocarbons (QCLot: 3861288)</td>
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<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EP080: C6 - C9 Fraction</td>
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<td>325 µg/L</td>
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<td>130</td>
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<tr>
<td>EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3861288)</td>
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<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EP080: C6 - C10 Fraction</td>
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<td>EP080: BTEXN (QCLot: 3861288)</td>
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<tr>
<td>ES1505907-001</td>
<td>Anonymous</td>
<td>EP080: Benzene</td>
<td>71-43-2</td>
<td>25 µg/L</td>
<td>76.2</td>
<td>70</td>
<td>130</td>
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<tr>
<td>EP080: Toluene</td>
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<td></td>
<td>108-88-3</td>
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### Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
<th>RPDs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EP080: Ethylbenzene</strong></td>
<td>100-41-4</td>
<td>25 µg/L</td>
<td>85.4</td>
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<tr>
<td><strong>ES1505907-001</strong></td>
<td>Anonymous</td>
<td>100-41-4</td>
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<td>70</td>
</tr>
<tr>
<td><strong>EP080: meta- &amp; para-Xylene</strong></td>
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<td>25 µg/L</td>
<td>86.6</td>
<td>---</td>
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<tr>
<td><strong>EP080: ortho-Xylene</strong></td>
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<td>25 µg/L</td>
<td>89.9</td>
<td>---</td>
<td>70</td>
</tr>
<tr>
<td><strong>EP080: Naphthalene</strong></td>
<td>91-20-3</td>
<td>25 µg/L</td>
<td>85.4</td>
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<td>70</td>
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</table>
## INTERPRETIVE QUALITY CONTROL REPORT

<table>
<thead>
<tr>
<th>Work Order</th>
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<tbody>
<tr>
<td>Client</td>
<td>SMEC AUSTRALIA PTY LTD</td>
</tr>
<tr>
<td>Contact</td>
<td>DANIEL SAUNDERS</td>
</tr>
<tr>
<td>Address</td>
<td>P O BOX 1654 FYSHWICK ACT, AUSTRALIA 2609</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:daniel.saunders@smec.com">daniel.saunders@smec.com</a></td>
</tr>
<tr>
<td>Telephone</td>
<td>+61 02 61261959</td>
</tr>
<tr>
<td>Facsimile</td>
<td>+61 61261966</td>
</tr>
<tr>
<td>Project</td>
<td>30011560 NBHP-WATER QUALITY MONITORING</td>
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<td>Site</td>
<td>C-O-C number 1074</td>
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<td>Sampler</td>
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<tr>
<td>Order number</td>
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<td>Quote number</td>
<td>EN/025/14</td>
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<tr>
<td>Laboratory</td>
<td>Environmental Division Sydney</td>
</tr>
<tr>
<td>Contact</td>
<td>Client Services</td>
</tr>
<tr>
<td>Address</td>
<td>277-289 Woodpark Road Smithfield NSW Australia 2164</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:sydney@alsglobal.com">sydney@alsglobal.com</a></td>
</tr>
<tr>
<td>Telephone</td>
<td>+61-2-8784 8555</td>
</tr>
<tr>
<td>Facsimile</td>
<td>+61-2-8784 8500</td>
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<tr>
<td>QC Level</td>
<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
</tr>
<tr>
<td>Date Samples Received</td>
<td>12-MAR-2015</td>
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<tr>
<td>Issue Date</td>
<td>19-MAR-2015</td>
</tr>
<tr>
<td>No. of samples received</td>
<td>1</td>
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<tr>
<td>No. of samples analysed</td>
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</tbody>
</table>

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers
## Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for **VOC in soils** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

### Matrix: WATER

<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Sample Date</th>
<th>Extraction / Preparation</th>
<th>Analysis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Date extracted</td>
<td>Due for extraction</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.
<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Sample Date</th>
<th>Analysis</th>
<th>Extraction / Preparation</th>
<th>Date analysed</th>
<th>Due for analysis</th>
<th>Evaluation</th>
</tr>
</thead>
</table>
## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

### Matrix: WATER

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<tr>
<th>Quality Control Sample Type</th>
<th>Analytical Methods</th>
<th>QC</th>
<th>Regular</th>
<th>Actual</th>
<th>Expected</th>
<th>Evaluation</th>
<th>Method Blanks</th>
<th>Method Blanks</th>
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<tbody>
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<td>Laboratory Duplicates (DUP)</td>
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<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
<td>2</td>
<td>20</td>
<td>10.0</td>
<td>10.0</td>
<td>✓</td>
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<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>2</td>
<td>20</td>
<td>10.0</td>
<td>10.0</td>
<td>✓</td>
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<td>Chloride by Discrete Analyser</td>
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<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
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<td>20.0</td>
<td>10.0</td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
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<td>EG020A-F</td>
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<td>20</td>
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<td>Major Cations - Dissolved</td>
<td>ED093F</td>
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<td>Nitrate and Nitrite as (NOx) by Discrete Analyser</td>
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<td>20</td>
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<td>10.0</td>
<td>✓</td>
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<td>Nitrite as N by Discrete Analyser</td>
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<td>15.4</td>
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<td>EK071G</td>
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<td>Total Phosphorus as P By Discrete Analyser</td>
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<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
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<td>20</td>
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<td>5.0</td>
<td>✓</td>
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<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
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<td>12</td>
<td>16.7</td>
<td>10.0</td>
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<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
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<td>10</td>
<td>10.0</td>
<td>5.0</td>
<td>✓</td>
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<td></td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
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<td>13</td>
<td>7.9</td>
<td>5.0</td>
<td>✓</td>
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<tr>
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<td>5.9</td>
<td>5.0</td>
<td>✓</td>
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</tr>
<tr>
<td>Nitrate and Nitrite as (NOx) by Discrete Analyser</td>
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<td>20</td>
<td>5.0</td>
<td>5.0</td>
<td>✓</td>
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<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
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<td>13</td>
<td>7.9</td>
<td>5.0</td>
<td>✓</td>
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<td>19</td>
<td>5.3</td>
<td>5.0</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reactive Phosphorus as P-By Discrete Analyser</td>
<td>EK071G</td>
<td>1</td>
<td>5</td>
<td>20.0</td>
<td>5.0</td>
<td>✓</td>
<td></td>
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</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>1</td>
<td>11</td>
<td>9.1</td>
<td>5.0</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
<td>2</td>
<td>20</td>
<td>10.0</td>
<td>10.0</td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
<td>3</td>
<td>20</td>
<td>15.0</td>
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<td>TRH - Semivolatile Fraction</td>
<td>EP071</td>
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<td>19</td>
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<td>5.0</td>
<td>✓</td>
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<td>TRH Volatiles/BTEX</td>
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<td>10</td>
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<td>5.0</td>
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### Method Blanks (MB)

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<tr>
<th>Quality Control Sample Type</th>
<th>Analytical Methods</th>
<th>QC</th>
<th>Regular</th>
<th>Actual</th>
<th>Expected</th>
<th>Evaluation</th>
<th>Method Blanks</th>
<th>Method Blanks</th>
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<tbody>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
<td>5.0</td>
<td>✓</td>
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<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>1</td>
<td>12</td>
<td>8.3</td>
<td>5.0</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
<td>1</td>
<td>10</td>
<td>10.0</td>
<td>5.0</td>
<td>✓</td>
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<td></td>
</tr>
</tbody>
</table>

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Specification

- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
- NEPM 2013 Schedule B(3) and ALS QCS3 requirement
## Quality Control Specification

<table>
<thead>
<tr>
<th>Quality Control Example Type</th>
<th>Method</th>
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<th>Rate (%)</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td><strong>Method Blanks (MB) - Continued</strong></td>
<td></td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>1</td>
<td>13</td>
<td>7.7</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Major Cations - Dissolved</td>
<td>ED093F</td>
<td>1</td>
<td>17</td>
<td>5.9</td>
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<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
<td>1</td>
<td>13</td>
<td>7.7</td>
</tr>
<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
<td>EP075(SIM)</td>
<td>1</td>
<td>19</td>
<td>5.3</td>
</tr>
<tr>
<td>Reactive Phosphorus as P- By Discrete Analyser</td>
<td>EK071G</td>
<td>1</td>
<td>5</td>
<td>20.0</td>
</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>1</td>
<td>11</td>
<td>9.1</td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>TRH - Semivolatile Fraction</td>
<td>EK067G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
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<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP071</td>
<td>1</td>
<td>19</td>
<td>5.3</td>
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### Matrix Spikes (MS)

<table>
<thead>
<tr>
<th>Quality Control Example Type</th>
<th>Method</th>
<th>Count</th>
<th>Rate (%)</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>1</td>
<td>12</td>
<td>8.3</td>
</tr>
<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>1</td>
<td>13</td>
<td>7.7</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
<td>1</td>
<td>13</td>
<td>7.7</td>
</tr>
<tr>
<td>Reactive Phosphorus as P- By Discrete Analyser</td>
<td>EK071G</td>
<td>1</td>
<td>5</td>
<td>20.0</td>
</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>1</td>
<td>11</td>
<td>9.1</td>
</tr>
<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
<td>1</td>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>1</td>
<td>10</td>
<td>10.0</td>
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</tbody>
</table>
**Brief Method Summaries**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

<table>
<thead>
<tr>
<th>Analytical Methods</th>
<th>Method</th>
<th>Matrix</th>
<th>Method Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH by PC Titrator</td>
<td>EA005-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed. 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015SH</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2540C. A gravimetric procedure that determines the amount of ‘filterable’ residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180°+/-5C. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500 Cl - G. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride in the presence of ferric ions the liberated thiocyanate forms highly-coloured ferric thiocyanate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003</td>
</tr>
<tr>
<td>Major Cations - Dissolved</td>
<td>ED093F</td>
<td>WATER</td>
<td>In house: Referenced to APHA 3120 and 3125; USEPA SW846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>WATER</td>
<td>In house: Referenced to AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. The ionized mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td>Analytical Methods</td>
<td>Method</td>
<td>Matrix</td>
<td>Method Descriptions</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------</td>
<td>--------</td>
<td>---------------------</td>
</tr>
<tr>
<td><strong>Ammonia as N by Discrete Analyser</strong>&lt;br&gt;<strong>Nitrite as N by Discrete Analyser</strong>&lt;br&gt;<strong>Nitrate as N by Discrete Analyser</strong>&lt;br&gt;<strong>Nitrite and Nitrate as N (NOx) by Discrete Analyser</strong>&lt;br&gt;<strong>Total Phosphorus as P By Discrete Analyser</strong>&lt;br&gt;<strong>Reactive Phosphorus as P-By Discrete Analyser</strong>&lt;br&gt;<strong>Ionic Balance by PCT DA and Turbi SO4 DA</strong>&lt;br&gt;<strong>TRH - Semivolatile Fraction</strong>&lt;br&gt;<strong>PAH/Phenols (GC/MS - SIM)</strong>&lt;br&gt;<strong>TRH Volatiles/BTEX</strong></td>
<td>EK055G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-NH3 G. Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EK057G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EK058G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EK059G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EK067G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EK071G</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st ed., 4500-P F. Ammonium molybdate and potassium antimonyl tartrate react in acid medium with orthophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EN055 - PG</td>
<td>WATER</td>
<td>In house: Referenced to APHA 21st Ed. 1030F. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EP071</td>
<td>WATER</td>
<td>USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EP075(SIM)</td>
<td>WATER</td>
<td>USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td></td>
<td>EP080</td>
<td>WATER</td>
<td>USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>Preparation Methods</strong></td>
<td>Method</td>
<td>Matrix</td>
<td>Method Descriptions</td>
</tr>
<tr>
<td><strong>TKN/TP Digestion</strong>&lt;br&gt;<strong>Separatory Funnel Extraction of Liquids</strong></td>
<td>EK061/EK067</td>
<td>WATER</td>
<td>APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)</td>
</tr>
<tr>
<td><strong>ORG14</strong></td>
<td>WATER</td>
<td>USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3). ALS default excludes sediment which may be resident in the container.</td>
<td></td>
</tr>
</tbody>
</table>
Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

<table>
<thead>
<tr>
<th>Compound Group Name</th>
<th>Laboratory Sample ID</th>
<th>Client Sample ID</th>
<th>Analyte</th>
<th>CAS Number</th>
<th>Data</th>
<th>Limits</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Matrix Spike (MS) Recoveries</td>
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<tr>
<td>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</td>
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<td></td>
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<tr>
<td>ES1505922-007</td>
<td>Anonymous</td>
<td>Sulfate as SO4 - Turbidimetric</td>
<td>14808-79-8</td>
<td>Not Determined</td>
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<td>MS recovery not determined, background level greater than or equal to 4x spike level.</td>
<td></td>
</tr>
<tr>
<td>EK055G: Ammonia as N by Discrete Analyser</td>
<td></td>
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<td></td>
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<tr>
<td>ES1505872-001</td>
<td>Anonymous</td>
<td>Ammonia as N</td>
<td>7664-41-7</td>
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<td>----</td>
<td>MS recovery not determined, background level greater than or equal to 4x spike level.</td>
<td></td>
</tr>
</tbody>
</table>

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

<table>
<thead>
<tr>
<th>Container / Client Sample ID(s)</th>
<th>Extraction / Preparation</th>
<th>Analysis</th>
<th>Days overdue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date extracted</td>
<td>Due for extraction</td>
<td>Days overdue</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>EA005P: pH by PC Titrator</td>
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<tr>
<td>Clear Plastic Bottle - Natural</td>
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</tr>
<tr>
<td>TRIP1</td>
<td>----</td>
<td>----</td>
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</tr>
</tbody>
</table>

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney  
**PROJECT:** MBHP Water Quality Monitoring  
**PROJECT NUMBER:** 39011560  
**PROJECT MANAGER:** D. Saunders  
**LAB:** Envirolab  
**ATTENTION:** Chatswood  
**DATE SAMPLED:** 7 + 8/4/15  
**DATE/TIME:** 8/4/15  
**RECEIVED BY:** Envirolab  
**DATE/TIME:** 8/4/15  
**REMARKS:** Dissolved Metals to be filtered by lab

### SAMPLE DETAILS

<table>
<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE/TIME</th>
<th>SAMPLE MATRIX</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO. CONTAINERS</th>
<th>PH, EC</th>
<th>TDS</th>
<th>Nitrate</th>
<th>Ammonium</th>
<th>Antimony</th>
<th>Alkalinity</th>
<th>Sulphate</th>
<th>Dissolved Metals (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GW1</td>
<td>7/4/15</td>
<td>w</td>
<td>Bottles</td>
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**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.  
**Copies:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book
**CHAIN OF CUSTODY FORM**

**SMDC OFFICE:** North Sydney  
**PROJECT:** WABIP Water Quality Monitoring  
**PROJECT NUMBER:** 30011560  
**PROJECT MANAGER:** D. Saunders  
**SAMPLED BY:** S. Shaw  
**DATE SAMPLED:** 7/8/15  
**RELINQUISHED BY:** S. Shaw  
**RECEIVED BY:** Enirolab  
**DATE/TIME:** 8/4/15  

**Notes:** Low reporting limits required for groundwater as specified by SMDC Australia Pty Ltd.

**Special Laboratory Instructions:** Dissolved Metals to be filtered by Lab.

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**ATTENTION:** & Chartwood

**DISPATCH TO (ADDRESS & PHONE NO.):**

**LAB:** Enirolab

**LAB QUOTE NO.:** 14 SY282  
**COC SEQUENCE NUMBER (Circle)**

-coc: 1 0 3 4 5 6 7

**TOTAL:**

**COPY:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book
SAMPLE RECEIPT ADVICE

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney NSW 2060
ph: 02 9925 5555
Fax: 02 9925 5566
Attention: Daniel Saunders

Sample log in details:
Your reference: 30011560, NBHP - Water Quality Monitoring
Envirolab Reference: 126243
Date received: 08/04/15
Date results expected to be reported: 15/04/15

Samples received in appropriate condition for analysis: YES
No. of samples provided: 18 waters
Turnaround time requested: Standard
Temperature on receipt (°C): 15.2
Cooling Method: Ice
Sampling Date Provided: YES

Comments:
If there is sufficient sample after testing, samples will be held for the following time frames from date of receipt of samples:
Water samples - 1 month
Soil and other solid samples - 2 months
Samples collected in canisters - 1 week. Canisters will then be cleaned.
All other samples are not retained after analysis
If you require samples to be retained for longer periods then retention fees will apply as per our pricelist.

Contact details:
Please direct any queries to Aileen Hie or Jacinta Hurst
ph: 02 9910 6200  fax: 02 9910 6201
email: ahie@envirolabservices.com.au or jhurst@envirolabservices.com.au
CERTIFICATE OF ANALYSIS

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: Daniel Saunders

Sample log in details:
Your Reference: 30011560, NBHP - Water Quality Monitoring
No. of samples: 18 waters
Date samples received / completed instructions received 08/04/15 / 08/04/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 15/04/15 / 15/04/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:

Envirolab Reference: 126243
Revision No: R 00
## vTRH(C6-C10)/BTEXN in Water

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### vTRH(C6-C10)/BTEX in Water

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### vTRH(C6-C10)/BTEX in Water

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Revision No: R 00
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# HM in water - dissolved

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| Arsenic-Dissolved | <1 | <1 | <1 | <1 | <1 |
| Copper-Dissolved | 18 | <1 | 9 | 3 | <1 |
| Lead-Dissolved | 9 | <1 | 3 | 4 | <1 |
| Zinc-Dissolved | 73 | 21 | 25 | 280 | 23 |
| Nickel-Dissolved | 11 | 5 | 7 | 59 | 1 |
| Mercury-Dissolved | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium-Dissolved | 0.4 | <0.1 | 0.1 | 0.2 | <0.1 |
| Iron-Dissolved | 19 | 390 | 1,200 | 14,000 | <10 |

| Manganese-Dissolved | | | | | | |
| Iron-Dissolved | 19 | 390 | 1,200 | 14,000 | <10 |

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| HM in water - dissolved | | | | | | |
| Arsenic-Dissolved | <1 | <1 | <1 | <1 | <1 |
| Copper-Dissolved | <1 | <1 | 2 | 1 | 1 |
| Lead-Dissolved | <1 | <1 | <1 | <1 | <1 |
| Zinc-Dissolved | 2 | 6 | 26 | 250 | 5 |
| Nickel-Dissolved | <1 | <1 | 6 | 56 | <1 |
| Mercury-Dissolved | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium-Dissolved | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Iron-Dissolved | 11 | 16 | <10 | 20,000 | 39 |

| Manganese-Dissolved | | | | | | |
| Iron-Dissolved | 11 | 16 | <10 | 20,000 | 39 |
### Water Quality Monitoring - HM in water - dissolved

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<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<tr>
<td>Org-013</td>
<td>Water samples are analysed directly by purge and trap GC-MS.</td>
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<td>Org-003</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (&gt;C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</td>
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<tr>
<td>Org-012 subset</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</td>
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<tr>
<td>Metals-022 ICP-MS</td>
<td>Determination of various metals by ICP-MS.</td>
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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<tr>
<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-5oC.</td>
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<td>Inorg-057</td>
<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.</td>
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<tr>
<td>Inorg-060</td>
<td>Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.</td>
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<tr>
<td>Inorg-019</td>
<td>Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5oC.</td>
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<td>Determination of various metals by ICP-AES.</td>
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<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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### QUALITY CONTROL

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<th>Duplicate results Base II Duplicate %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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#### vTRH(C6-C10)/BTEX in Water

| Date extracted | 10/04/2015 | 126243-7 | 10/04/2015 | 13/04/2015 | LCS-W1 | 10/04/2015 |
| Date analysed | 10/04/2015 | 126243-7 | 10/04/2015 | 14/04/2015 | LCS-W1 | 10/04/2015 |
| TRH-C9 | µg/L | 10 | 09-016 | <10 | 126243-7 | 36 | 33 | RPD: 9 | LCS-W1 | 114% |
| TRH-C10 | µg/L | 10 | Org-016 | <10 | 126243-7 | 37 | 34 | RPD: 8 | LCS-W1 | 114% |
| Benzene | µg/L | 1 | Org-016 | <1 | 126243-7 | 20 | 17 | RPD: 16 | LCS-W1 | 120% |
| Toluene | µg/L | 1 | Org-016 | <1 | 126243-7 | <1 | <1 | LCS-W1 | 117% |
| Ethylbenzene | µg/L | 1 | Org-016 | <1 | 126243-7 | <1 | <1 | LCS-W1 | 111% |
| m+p-xylene | µg/L | 2 | Org-016 | <2 | 126243-7 | <2 | <2 | LCS-W1 | 112% |
| o-xylene | µg/L | 1 | Org-016 | <1 | 126243-7 | <1 | <1 | LCS-W1 | 112% |
| Naphthalene | µg/L | 1 | Org-013 | <1 | 126243-7 | <1 | <1 | LCS-W1 | 111% |
| Surrogate | % | Org-016 | 104 | 126243-7 | 110 | 104 | RPD: 6 | LCS-W1 | 104% |
| Surrogate toluene-d8 | % | Org-016 | 96 | 126243-7 | 98 | 98 | RPD: 0 | LCS-W1 | 100% |
| Surrogate 4-BFB | % | Org-016 | 99 | 126243-7 | 97 | 98 | RPD: 1 | LCS-W1 | 97% |

#### svTRH (C10-C40) in Water

| Date extracted | 09/04/2015 | 126243-1 | 09/04/2015 | 09/04/2015 | LCS-W1 | 09/04/2015 |
| Date analysed | 09/04/2015 | 126243-1 | 09/04/2015 | 09/04/2015 | LCS-W1 | 09/04/2015 |
| TRH-C9 | µg/L | 50 | Org-003 | <50 | 126243-1 | <50 | <50 | LCS-W1 | 92% |
| TRH-C10 | µg/L | 100 | Org-003 | <100 | 126243-1 | <100 | <100 | LCS-W1 | 83% |
| TRH-C20 | µg/L | 100 | Org-003 | <100 | 126243-1 | <100 | <100 | LCS-W1 | 80% |
| TRH-C19 | µg/L | 50 | Org-003 | <50 | 126243-1 | <50 | <50 | LCS-W1 | 92% |
| TRH-C30 | µg/L | 100 | Org-003 | <100 | 126243-1 | <100 | <100 | LCS-W1 | 83% |
| TRH-C34 | µg/L | 100 | Org-003 | <100 | 126243-1 | <100 | <100 | LCS-W1 | 80% |
| Surrogate o-Terphenyl | % | Org-003 | 95 | 126243-1 | 106 | 98 | RPD: 8 | LCS-W1 | 74% |

#### PAHs in Water

| Date extracted | 09/04/2015 | 126243-1 | 09/04/2015 | 09/04/2015 | LCS-W1 | 09/04/2015 |
| Date analysed | 09/04/2015 | 126243-1 | 09/04/2015 | 09/04/2015 | LCS-W1 | 09/04/2015 |
| Naphthalene | µg/L | 1 | Org-012 subset | <1 | 126243-1 | <1 | <1 | LCS-W1 | 75% |
| Acenaphthylene | µg/L | 1 | Org-012 subset | <1 | 126243-1 | <1 | <1 | [NR] | [NR] |
| Acenaphthene | µg/L | 1 | Org-012 subset | <1 | 126243-1 | <1 | <1 | [NR] | [NR] |
| Fluorene | µg/L | 1 | Org-012 subset | <1 | 126243-1 | <1 | <1 | LCS-W1 | 70% |
| Phenanthrene | µg/L | 1 | Org-012 subset | <1 | 126243-1 | <1 | <1 | LCS-W1 | 71% |
### PAHs in Water

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<th>Method</th>
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<th>Spike Recovery</th>
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<td>Anthracene</td>
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### HM in Water - dissolved

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<th>Method</th>
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<th>Spike Sm#</th>
<th>Spike Recovery</th>
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<tbody>
<tr>
<td>Arsenic-Dissolved</td>
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<td>LCS-1 96%</td>
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<tr>
<td>Ammonia as N in water</td>
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<td>Inorg-057</td>
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<td>mg/L</td>
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<td>Inorg-055</td>
<td>&lt;0.005</td>
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<td>&lt;0.005 [0.005]</td>
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<td>Phosphate as P in water</td>
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**Client Reference:** 30011560, NBHP - Water Quality Monitoring

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<th>PQL</th>
<th>METHOD</th>
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<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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### QUALITY CONTROL

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<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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### QUALITY CONTROL

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<th>vTRH(C6-C10)/BTEXN in Water</th>
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**Envirolab Reference:** 126243  
**Revision No:** R 00
### QUALITY CONTROL

#### vTRH(C6-C10)/BTEXN in Water

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#### svTRH (C10-C40) in Water

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#### Surrogate o-Terphenyl %

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### QUALITY CONTROL

#### PAHs in Water

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<tr>
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<td>Anthracene µg/L</td>
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<tr>
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<tr>
<td>Pyrene µg/L</td>
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<tr>
<td>Benzo(a)anthracene µg/L</td>
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<td>Chrysene µg/L</td>
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<tr>
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#### Surrogate p-Terphenyl-d14 %

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<td>Lead-Dissolved</td>
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<td>Zinc-Dissolved</td>
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<td>Nickel-Dissolved</td>
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<th>Duplicate Base + Duplicate + %RPD</th>
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<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
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</thead>
<tbody>
<tr>
<td>Ion Balance</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>126243-11</td>
<td>8/04/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>126243-11</td>
<td>8/04/2015</td>
</tr>
<tr>
<td>Calcium - Dissolved</td>
<td>mg/L</td>
<td>126243-11</td>
<td>1.2</td>
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<tr>
<td>Potassium - Dissolved</td>
<td>mg/L</td>
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<tr>
<td>Sodium - Dissolved</td>
<td>mg/L</td>
<td>126243-11</td>
<td>30</td>
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<tr>
<td>Magnesium - Dissolved</td>
<td>mg/L</td>
<td>126243-11</td>
<td>2.0</td>
</tr>
<tr>
<td>Hydroxide Alkalinity (OH⁻) as CaCO₃</td>
<td>mg/L</td>
<td>126243-11</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Bicarbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>126243-11</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Carbonate Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>126243-11</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Total Alkalinity as CaCO₃</td>
<td>mg/L</td>
<td>126243-11</td>
<td>&lt;5</td>
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<tr>
<td>Sulphate, SO₄</td>
<td>mg/L</td>
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<td>6</td>
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<tr>
<td>Chloride, Cl</td>
<td>mg/L</td>
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<td>Ionic Balance</td>
<td>%</td>
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<td>4.1</td>
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Report Comments:
ION_BALANCE # # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

METALS_WLL_8_D: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

TSS: The PQL has been raised due to the limited amount of sample/s available for testing.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test PQL: Practical Quantitation Limit NT: Not tested
NA: Test not required RPD: Relative Percent Difference NA: Test not required
<: Less than >: Greater than LCS: Laboratory Control Sample
**Quality Control Definitions**

**Blank**: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

**Duplicate**: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

**Matrix Spike**: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

**LCS (Laboratory Control Sample)**: This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

**Surrogate Spike**: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

**Laboratory Acceptance Criteria**

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
**CHAIN OF CUSTODY FORM**

**SMEC OFFICE:** North Sydney

**PROJECT:** NBHP Water Quality Monitoring

**PROJECT NUMBER:** 3001560

**PROJECT MANAGER:** D. Saunders

**SAMPLED BY:** S. Shaw

**DATE SAMPLED:** 21/4/15

**LAB:** Envirolab

**ATTENTION:** Chatswood

**LAB QUOTE NO.:** 14 Sy282

**CONTACT PH:** 0414 752 743

**COC SEQUENCE NUMBER (Circle):** 0234567

**DISPATCH TO (ADDRESS & PHONE NO.):**

**RELINQUISHED BY:** S. Shaw

**RELEIVED BY:** Envirolab (carrier)

**DATE/TIME:** 21/4/15

**DATE/TIME:** 21/4/15

**Special Laboratory Instructions:** Dissolved metals to be filtered by Lab

**SAMPLE DETAILS**

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<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>SAMPLE MATRIX</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO CONTAINERS</th>
<th>PH</th>
<th>EC</th>
<th>TDS</th>
<th>TSS</th>
<th>Anions</th>
<th>Cations</th>
<th>Ca, Mg</th>
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<th>NH4</th>
<th>Nitrates</th>
<th>P</th>
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<td>As Required</td>
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</table>

**Notes:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**Copies:** WHITE: send to lab, YELLOW: to be placed in project file, PINK: to be retained in CoC book
### SAMPLE RECEIPT ADVICE

#### Client Details

<table>
<thead>
<tr>
<th>Client</th>
<th>SMEC Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>Daniel Saunders</td>
</tr>
</tbody>
</table>

#### Sample Login Details

<table>
<thead>
<tr>
<th>Your Reference</th>
<th>30011560, NBHP - Water Quality Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envirolab Reference</td>
<td>126831</td>
</tr>
<tr>
<td>Date Sample Received</td>
<td>22/04/2015</td>
</tr>
<tr>
<td>Date Instructions Received</td>
<td>22/04/2015</td>
</tr>
<tr>
<td>Date Results Expected to be Reported</td>
<td>29/04/2015</td>
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#### Sample Condition

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<th>Samples received in appropriate condition for analysis</th>
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<tr>
<td>No. of Samples Provided</td>
<td>9 waters</td>
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<tr>
<td>Turnaround Time Requested</td>
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<tr>
<td>Temperature on receipt (°C)</td>
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<td>Cooling Method</td>
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<td>Sampling Date Provided</td>
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#### Comments

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

<table>
<thead>
<tr>
<th>Aileen Hie</th>
<th>Jacinta Hurst</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone: 02 9910 6200</td>
<td>Phone: 02 9910 6200</td>
</tr>
<tr>
<td>Fax: 02 9910 6201</td>
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</tr>
<tr>
<td>Email: <a href="mailto:ahie@envirolabservices.com.au">ahie@envirolabservices.com.au</a></td>
<td>Email: <a href="mailto:jhurst@envirolabservices.com.au">jhurst@envirolabservices.com.au</a></td>
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Sample and Testing Details on following page
<table>
<thead>
<tr>
<th>Sample Id</th>
<th>Ammonia as N in water</th>
<th>Electrical Conductivity</th>
<th>HM in water - dissolved</th>
<th>HM in water - total</th>
<th>Iron Balance</th>
<th>Metals in Waters - Acid extractable</th>
<th>Nitrate as N in water</th>
<th>Nitrite as N in water</th>
<th>Phosphate as P in water</th>
<th>pH</th>
<th>svTRH(C10-C40) in Water</th>
<th>Total Dissolved Solids (grav)</th>
<th>Total Suspended Solids</th>
<th>svTRH(C6-C10)/BTEXN in Water</th>
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<tbody>
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</tbody>
</table>
CERTIFICATE OF ANALYSIS 126831

Client:
SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: Daniel Saunders

Sample log in details:
Your Reference: 30011560, NBHP - Water Quality Monitoring
No. of samples: 9 waters
Date samples received / completed instructions received 22/04/15 / 22/04/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 29/04/15 / 29/04/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:
<table>
<thead>
<tr>
<th>vTRH(C6-C10)/BTEXN in Water</th>
<th>UNITS</th>
<th>126831-1</th>
<th>126831-2</th>
<th>126831-3</th>
<th>126831-4</th>
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svTRH (C10-C40) in Water

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<tr>
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## Miscellaneous Inorganics

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| Date analysed   | ------| 22/04/2015| 22/04/2015| 22/04/2015| 22/04/2015| 22/04/2015|

| pH              | pH Units | 7.3 | 6.9 | 6.9 | 7.1 | 6.9 |
| Electrical Conductivity | µS/cm | 260 | 270 | 280 | 270 | 230 |
| Total Dissolved Solids (grav) | mg/L | 130 | 170 | 150 | 130 | 160 |
| Ammonia as N in water | mg/L | <0.005 | <0.005 | 0.017 | <0.005 | <0.005 |
| Nitrate as N in water | mg/L | 0.40 | 0.34 | 0.51 | 0.17 | 0.31 |
| Nitrite as N in water | mg/L | 0.006 | <0.005 | <0.005 | 0.006 | 0.012 |
| Phosphate as P in water | mg/L | 0.040 | 0.014 | 0.041 | 0.015 | <0.005 |
| Total Suspended Solids | mg/L | 18 | 11 | 7 | 10 | 230 |

## Miscellaneous Inorganics

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| Date prepared   | ------| 22/04/2015| 22/04/2015|
| Date analysed   | ------| 22/04/2015| 22/04/2015|

| pH              | pH Units | 7.0 | 7.1 |
| Electrical Conductivity | µS/cm | 230 | 260 |
| Total Dissolved Solids (grav) | mg/L | 140 | 140 |
| Ammonia as N in water | mg/L | <0.005 | 0.008 |
| Nitrate as N in water | mg/L | 0.41 | 0.40 |
| Nitrite as N in water | mg/L | <0.005 | 0.006 |
| Phosphate as P in water | mg/L | 0.035 | 0.039 |
| Total Suspended Solids | mg/L | 16 | 21 |
### Ion Balance

**Our Reference:** UNITS 126831-1 126831-2 126831-3 126831-4 126831-5  
**Your Reference:** SW1 SW2 SW3 SW4 SW5  
**Date Sampled:** 21/04/2015 21/04/2015 21/04/2015 21/04/2015 21/04/2015  
**Type of sample:** water water water water water

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<td>21/04/2015</td>
<td>21/04/2015</td>
<td>21/04/2015</td>
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<td>22/04/2015</td>
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<td>19</td>
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<td>&lt;5</td>
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### Ion Balance

**Our Reference:** UNITS 126831-6 126831-7  
**Your Reference:** SW6 DUP1  
**Date Sampled:** 21/04/2015 21/04/2015  
**Type of sample:** water water

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<td>Calcium - Dissolved mg/L</td>
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<td>Carbonate Alkalinity as CaCO₃ mg/L</td>
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<td>Total Alkalinity as CaCO₃ mg/L</td>
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<td>Sulphate, SO₄ mg/L</td>
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<td>Chloride, Cl mg/L</td>
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<td>Ionic Balance %</td>
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<tr>
<td>Org-016</td>
<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<tr>
<td>Org-013</td>
<td>Water samples are analysed directly by purge and trap GC-MS.</td>
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<tr>
<td>Org-003</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (&gt;C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</td>
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<tr>
<td>Org-012 subset</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</td>
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<td>Determination of various metals by ICP-MS.</td>
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<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<tr>
<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<tr>
<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-5oC.</td>
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<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.</td>
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<td>Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5oC.</td>
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<td>Inorg-006</td>
<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<td>Inorg-081</td>
<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<td>Inorg-041</td>
<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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### QUALITY CONTROL

**PAHs in Water**

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**QUALITY CONTROL**

**HM in water - dissolved**

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<td>Total Dissolved Solids (grav)</td>
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<td>Nitrate as N in water</td>
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<td>Nitrite as N in water</td>
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### QUALITY CONTROL

#### Ion Balance

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#### Metals in Waters - Acid extractable

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<tr>
<td>Phosphorus - Total</td>
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<td>&lt;0.05 [0.05]</td>
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#### QUALITY CONTROL

#### HM in water - dissolved

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<td>23/04/2015</td>
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<td>µg/L</td>
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<td>[NT]</td>
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<td>Zinc-Dissolved</td>
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<td>[NT]</td>
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<td>Nickel-Dissolved</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-2</td>
<td>96%</td>
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<tr>
<td>Mercury-Dissolved</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-2</td>
<td>[NR]</td>
</tr>
<tr>
<td>Cadmium-Dissolved</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-2</td>
<td>102%</td>
</tr>
<tr>
<td>Iron-Dissolved</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-2</td>
<td>#</td>
</tr>
<tr>
<td>Manganese-Dissolved</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-2</td>
<td>98%</td>
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### QUALITY CONTROL

<table>
<thead>
<tr>
<th>HM in water - total</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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</thead>
<tbody>
<tr>
<td>Date prepared</td>
<td>-</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-6</td>
<td>23/04/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td>-</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-6</td>
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<tr>
<td>Arsenic-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
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<td>101%</td>
</tr>
<tr>
<td>Copper-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
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<td>94%</td>
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<tr>
<td>Lead-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
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<tr>
<td>Zinc-Total</td>
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<td>[NT]</td>
<td>[NT]</td>
<td>126831-6</td>
<td>101%</td>
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<tr>
<td>Nickel-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-6</td>
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<tr>
<td>Mercury-Total</td>
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<td>[NT]</td>
<td>[NR]</td>
<td>[NR]</td>
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<tr>
<td>Cadmium-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>126831-6</td>
<td>104%</td>
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<tr>
<td>Iron-Total</td>
<td>µg/L</td>
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<td>[NT]</td>
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<td>Manganese-Total</td>
<td>µg/L</td>
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<td>[NT]</td>
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### QUALITY CONTROL

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<tr>
<th>Miscellaneous Inorganics</th>
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<th>Duplicate Base + Duplicate + %RPD</th>
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<tr>
<td>Date prepared</td>
<td>-</td>
<td>126831-2</td>
<td>22/04/2015</td>
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<tr>
<td>Date analysed</td>
<td>-</td>
<td>126831-2</td>
<td>22/04/2015</td>
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<tr>
<td>Total Dissolved Solids</td>
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<td>(grav)</td>
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<tr>
<td>Total Suspended Solids</td>
<td>mg/L</td>
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### QUALITY CONTROL

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<tr>
<th>Ion Balance</th>
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<th>Duplicate Base + Duplicate + %RPD</th>
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</thead>
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<td>-</td>
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<td>22/04/2015</td>
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<tr>
<td>Date analysed</td>
<td>-</td>
<td>126831-7</td>
<td>22/04/2015</td>
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<td>Calcium - Dissolved</td>
<td>mg/L</td>
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<td>Potassium - Dissolved</td>
<td>mg/L</td>
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<tr>
<td>Sodium - Dissolved</td>
<td>mg/L</td>
<td>126831-7</td>
<td>39</td>
</tr>
<tr>
<td>Magnesium - Dissolved</td>
<td>mg/L</td>
<td>126831-7</td>
<td>3.9</td>
</tr>
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</table>
Report Comments:
METALS_WLL_8_D: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test    PQL: Practical Quantitation Limit    NT: Not tested
NA: Test not required    RPD: Relative Percent Difference    NA: Test not required
<: Less than    >: Greater than    LCS: Laboratory Control Sample
Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc., can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
### CHAIN OF CUSTODY FORM

**SMEC OFFICE**: North Sydney  
**PROJECT**: SNHP Water Quality Monitoring  
**PROJECT NUMBER**: 30011/60  
**PROJECT MANAGER**: D. Saunders  
**SAMPLED BY**: S. Shaw  
**DATE SAMPLED**: 5th + 6th May 2015  
**LAB QUOTE NO.**: 14 SY282  
**RELINQUISHED BY**: S. Shaw  
**RECEIVED BY**: Envirolab  
**DATE/TIME**: 6/5/15

#### SAMPLE DETAILS

<table>
<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO. CONTAINERS</th>
<th>ANIONS</th>
<th>METALS</th>
<th>METALS 8</th>
<th>TI</th>
<th>TRH</th>
<th>TPH</th>
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<td>Gw1</td>
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<td>11</td>
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**NOTES**: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.

**COG SEQUENCE NUMBER (Circle)**: 0 2 3 4 5 6 7

<table>
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<th>TOTAL</th>
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<tbody>
<tr>
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</tbody>
</table>

**DATE/TIME OF RECEIPT**: 6/5/15

**LAB**: Envirolab  
**ATTENTION**: Chatswood

---

**Special Laboratory Instructions**: Dissolved metals to be filtered by lab

---

**DISCLAIMER**: All data contained in this form is for internal purposes only and is not to be shared outside of the project unless specified.

---

**Envirolab Services**:  
12 Ashley St  
Chatswood NSW 2067  
Ph: (02) 9510.5200

**Job No:** 127509

**Date Received:** 6/5/15  
**Time Received:** 16.00  
**Received By:** E813  
**Temp:** Cold Ambient  
**Coding:** Unpack  
**Security:** Intact/Broken/None

**ALSO**: please dispatch TRIP to ALS
**CHAIN OF CUSTODY FORM**

- **PROJECT:** NBHP 10 water quality monitoring
- **PROJECT NUMBER:** 30011560
- **PROJECT MANAGER:** O. Saunders
- **SAMPLED BY:** S. Shaw
- **DATE SAMPLED:** 5th-6th May 20x5
- **LAB:** EnviroLab
- **ATTENTION:** chatswood

**Special Laboratory Instructions:**

- Dissolved Metals to be filtered by lab

**SAMPLE DETAILS**

<table>
<thead>
<tr>
<th>LAB ID</th>
<th>SAMPLE ID</th>
<th>DATE / TIME</th>
<th>CONTAINER TYPE &amp; PRESERVATIVE</th>
<th>TOTAL NO CONTAINERS</th>
<th>PH EC</th>
<th>TDS TSS</th>
<th>Anions</th>
<th>Cations Cl, SO4</th>
<th>NH4, NOx, Nitrate, Phosphate, Sulfate, TRA, TPH, BTEX, PAH, Total Metals 8, Dissolved Metals 8</th>
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<tbody>
<tr>
<td>12</td>
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<td>18</td>
<td>Trip blank</td>
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</table>

**NOTES:** Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.
## SAMPLE RECEIPT ADVICE

### Client Details

<table>
<thead>
<tr>
<th>Client</th>
<th>SMEC Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>Daniel Saunders</td>
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### Sample Login Details

<table>
<thead>
<tr>
<th>Your Reference</th>
<th>30011560, NBHP - Water Quality Monitoring</th>
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<tbody>
<tr>
<td>Envirolab Reference</td>
<td>127509</td>
</tr>
<tr>
<td>Date Sample Received</td>
<td>06/05/2015</td>
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<tr>
<td>Date Instructions Received</td>
<td>06/05/2015</td>
</tr>
<tr>
<td>Date Results Expected to be Reported</td>
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### Sample Condition

<table>
<thead>
<tr>
<th>Samples received in appropriate condition for analysis</th>
<th>YES</th>
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</thead>
<tbody>
<tr>
<td>No. of Samples Provided</td>
<td>19 waters</td>
</tr>
<tr>
<td>Turnaround Time Requested</td>
<td>Standard</td>
</tr>
<tr>
<td>Temperature on receipt (°C)</td>
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</tr>
<tr>
<td>Cooling Method</td>
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<tr>
<td>Sampling Date Provided</td>
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</tbody>
</table>

### Comments

Samples will be held for 1 month for water samples and 2 months for soil samples from date of receipt of samples

Please direct any queries to:

<table>
<thead>
<tr>
<th>Aileen Hie</th>
<th>Jacinta Hurst</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone: 02 9910 6200</td>
<td>Phone: 02 9910 6200</td>
</tr>
<tr>
<td>Fax: 02 9910 6201</td>
<td>Fax: 02 9910 6201</td>
</tr>
<tr>
<td>Email: <a href="mailto:ahie@envirolabservices.com.au">ahie@envirolabservices.com.au</a></td>
<td>Email: <a href="mailto:jhurst@envirolabservices.com.au">jhurst@envirolabservices.com.au</a></td>
</tr>
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</table>

Sample and Testing Details on following page
<table>
<thead>
<tr>
<th>Sample Id</th>
<th>Ammonia as N in water</th>
<th>Electrical Conductivity</th>
<th>HM in water - dissolved</th>
<th>HM in water - total</th>
<th>Iron Balance</th>
<th>Metals in Waters - Acid extractable</th>
<th>Ferron as N in water</th>
<th>Nitrite as N in water</th>
<th>Phosphate as P in water</th>
<th>pH</th>
<th>Total Dissolved Solids (grav)</th>
<th>Total Suspended Solids</th>
<th>svTRH(C10-C40) in Water</th>
<th>Total suspended solids</th>
<th>Total N (C10-C40) in Water</th>
</tr>
</thead>
<tbody>
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CERTIFICATE OF ANALYSIS

Client: SMEC Australia
Level 5, 20 Berry St
North Sydney
NSW 2060

Attention: Daniel Saunders

Sample log in details:
Your Reference: 30011560, NBHP - Water Quality Monitoring
No. of samples: 19 waters
Date samples received / completed instructions received 06/05/15 / 06/05/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 13/05/15 / 11/05/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:

[Signature]
Jacinta Hurst
Laboratory Manager
### vTRH(C6-C10)/BTEXN in Water

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### vTRH(C6-C10)/BTEXN in Water

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TRH C10 - C14 µg/L  
- 50  - 50  - 50  - 50  - 50

TRH C15 - C28 µg/L  
- <100  400  <100  <100  <100

TRH C16 - C29 µg/L  
- <100  <100  <100  <100  <100

TRH C10 - C16 µg/L  
- <50  <50  <50  <50  <50

TRH C16 - C34 µg/L  
- <100  440  <100  <100  <100

TRH C34 - C40 µg/L  
- <100  <100  <100  <100  <100

Surrogate o-Terphenyl %  
101  95  95  92  95

svTRH (C10-C40) in Water

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TRH C10 - C14 µg/L  
- 50  - 50  - 50  - 50  - 50

TRH C15 - C28 µg/L  
- <100  <100  <100  <100  <100

TRH C16 - C29 µg/L  
- <100  <100  <100  <100  <100

TRH C10 - C16 µg/L  
- <50  <50  <50  <50  <50

TRH C16 - C34 µg/L  
- <100  <100  <100  <100  <100

TRH C34 - C40 µg/L  
- <100  <100  <100  <100  <100

Surrogate o-Terphenyl %  
94  95  100  82  85

svTRH (C10-C40) in Water

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TRH C10 - C14 µg/L  
- 50  - 50  - 50  - 50  - 50

TRH C15 - C28 µg/L  
- <100  <100  <100  <100  <100

TRH C16 - C29 µg/L  
- <100  <100  <100  <100  <100

TRH C10 - C16 µg/L  
- <50  <50  <50  <50  <50

TRH C16 - C34 µg/L  
- <100  <100  <100  <100  <100

TRH C34 - C40 µg/L  
- <100  <100  <100  <100  <100

Surrogate o-Terphenyl %  
86  98  93  99  83
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## Client Reference: 30011560, NBHP - Water Quality Monitoring

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| Potassium - Dissolved | mg/L  | 0.5  | 0.9  | 1.0  | 3.9  | &lt;0.5  |
| Sodium - Dissolved | mg/L  | 35  | 32  | 33  | 500  | 31  |
| Magnesium - Dissolved | mg/L  | 3.0  | 2.0  | 4.2  | 40  | 2.3  |
| Hydroxide Alkalinity (OH⁻) as ( \text{CaCO}_3 ) | mg/L  | &lt;5  | &lt;5  | &lt;5  | &lt;5  | &lt;5  |
| Bicarbonate Alkalinity as ( \text{CaCO}_3 ) | mg/L  | &lt;5  | 7  | &lt;5  | 28  | &lt;5  |
| Carbonate Alkalinity as ( \text{CaCO}_3 ) | mg/L  | &lt;5  | &lt;5  | &lt;5  | &lt;5  | &lt;5  |
| Total Alkalinity as ( \text{CaCO}_3 ) | mg/L  | &lt;5  | 7  | &lt;5  | 28  | &lt;5  |
| Sulphate, SO₄ | mg/L  | 25  | 7  | 3  | 200  | 3  |
| Chloride, Cl | mg/L  | 50  | 40  | 54  | 570  | 40  |
| Ionic Balance | %  | 0.15  | 9.4  | 8.2  | 11  | 13  |</p>
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<td>Phosphorus - Total</td>
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<tr>
<td>Org-016</td>
<td>Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.</td>
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<tr>
<td>Org-013</td>
<td>Water samples are analysed directly by purge and trap GC-MS.</td>
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<tr>
<td>Org-003</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (&gt;C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.</td>
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<tr>
<td>Org-012 subset</td>
<td>Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.</td>
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<tr>
<td>Metals-022 ICP-MS</td>
<td>Determination of various metals by ICP-MS.</td>
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<tr>
<td>Metals-021 CV-AAS</td>
<td>Determination of Mercury by Cold Vapour AAS.</td>
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<tr>
<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
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<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA latest edition 2510 and Rayment &amp; Lyons.</td>
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<tr>
<td>Inorg-018</td>
<td>Total Dissolved Solids - determined gravimetrically. The solids are dried at 180+/-5oC.</td>
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<tr>
<td>Inorg-057</td>
<td>Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Soils are analysed following a KCl extraction.</td>
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<tr>
<td>Inorg-055</td>
<td>Nitrate - determined colourimetrically. Soils are analysed following a water extraction.</td>
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<td>Inorg-055</td>
<td>Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Soils are analysed following a water extraction.</td>
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<tr>
<td>Inorg-060</td>
<td>Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Soils are analysed following a water extraction.</td>
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<tr>
<td>Inorg-019</td>
<td>Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5oC.</td>
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<td>Metals-020 ICP-AES</td>
<td>Determination of various metals by ICP-AES.</td>
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<tr>
<td>Inorg-006</td>
<td>Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.</td>
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<tr>
<td>Inorg-081</td>
<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
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<tr>
<td>Inorg-041</td>
<td>Gravimetric determination of the total solids content of water based on APHA latest edition 2540B.</td>
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## QUALITY CONTROL

### vTRH (C6-C10)/BTEXN in Water

<table>
<thead>
<tr>
<th>Date extracted</th>
<th>PQL</th>
<th>METHOD</th>
<th>Blank</th>
<th>Duplicate Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<td>015</td>
<td></td>
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<td>127509-7</td>
<td>08/05/2015</td>
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</table>

### Benzene

| TRHC - C9       | µg/L | 10     | Org-016 | <10 | 127509-7 | 20 || 23 || RPD: 14 | LCS-W3 | 103% |

### Ethylbenzene

| TRHC - C10      | µg/L | 10     | Org-016 | <10 | 127509-7 | 20 || 23 || RPD: 14 | LCS-W3 | 103% |

### m+p-xylene

| TRHC - C10      | µg/L | 1      | Org-016 | <1  | 127509-7 | <1 || <1           | LCS-W3 | 105% |

### o-xylene

| TRHC - C10      | µg/L | 1      | Org-016 | <1  | 127509-7 | <1 || <1           | LCS-W3 | 105% |

### Naphthalene

| TRHC - C10      | µg/L | 1      | Org-013 | <1  | 127509-7 | <1 || <1           | [NR]  | [NR]  |

### Surrogate

| Dibromofluoromethane | %    | Org-016 | <10    | 127509-7 | 108 || 109 || RPD: 1 | LCS-W3 | 107% |

| Toluene-d8        | %    | Org-003 | <100   | 127509-7 | 100 || 100 || RPD: 0 | LCS-W3 | 101% |

| 4-BFB             | %    | Org-003 | <100   | 127509-7 | 98 || 98 || RPD: 0 | LCS-W3 | 103% |

## QUALITY CONTROL

### svTRH (C10-C40) in Water

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<th>METHOD</th>
<th>Blank</th>
<th>Duplicate Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tbody>
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<td>08/05/2015</td>
<td>015</td>
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<td>127509-1</td>
<td>08/05/2015</td>
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<td>08/05/2015</td>
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</table>

### TRH

| TRH C10 - C14  | µg/L | 50    | Org-003 | <50 | 127509-1 | <50 || <50           | LCS-W1 | 117% |

### TRH C15 - C28

| TRH C15 - C28  | µg/L | 100   | Org-003 | <100| 127509-1 | <100 || <100          | LCS-W1 | 104% |

### TRH C29 - C36

| TRH C29 - C36  | µg/L | 100   | Org-003 | <100| 127509-1 | <100 || <100          | LCS-W1 | 98%  |

### Surrogate

| o-Terphenyl    | %    | Org-003 | <100   | 127509-1 | 101 || 88 || RPD: 14 | LCS-W1 | 81%  |

## QUALITY CONTROL

### PAHs in Water

<table>
<thead>
<tr>
<th>Date extracted</th>
<th>PQL</th>
<th>METHOD</th>
<th>Blank</th>
<th>Duplicate Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<td>127509-1</td>
<td>08/05/2015</td>
<td></td>
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</tr>
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</table>

### Naphthalene

| Naphthalene    | µg/L | 1      | Org-012 subset | <1 | 127509-1 | <1 || <1           | LCS-W1 | 78%  |

### Acenaphthylene

| Acenaphthylene | µg/L | 1      | Org-012 subset | <1 | 127509-1 | <1 || <1           | [NR]  | [NR]  |

### Acenaphthene

| Acenaphthene   | µg/L | 1      | Org-012 subset | <1 | 127509-1 | <1 || <1           | [NR]  | [NR]  |

### Fluorene

| Fluorene       | µg/L | 1      | Org-012 subset | <1 | 127509-1 | <1 || <1           | LCS-W1 | 75%  |

### Phenanthrene

| Phenanthrene   | µg/L | 1      | Org-012 subset | <1 | 127509-1 | <1 || <1           | LCS-W1 | 80%  |
### QUALITY CONTROL

#### PAHs in Water

| PAHs in Water | UNITS | PQL | METHOD | Blank | Duplicate Sm# | Duplicate results Base || Duplicate II %RPD | Spike Sm# | Spike % Recovery |
|---------------|-------|-----|--------|-------|---------------|--------------------------|----------------|----------------|----------------|
| Anthracene    | µg/L  | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | [NR]          | [NR]           |                |
| Fluoranthene  | µg/L  | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | LCS-W1        | 79%            |                |
| Pyrene        | µg/L  | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | LCS-W1        | 80%            |                |
| Benzo(a)anthracene | µg/L | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | [NR]          | [NR]           |                |
| Chrysene      | µg/L  | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | LCS-W1        | 76%            |                |
| Benzo(b,j+k)fluoranthene | µg/L | 2   | Org-012 subset | <2    | 127509-1      | <2 || 2                | [NR]          | [NR]           |                |
| Benzo(a)pyrene | µg/L | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | LCS-W1        | 89%            |                |
| Indeno(1,2,3-c,d)pyrene | µg/L | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | [NR]          | [NR]           |                |
| Dibenzo(a,h)anthracene | µg/L | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | [NR]          | [NR]           |                |
| Benzo(g,h,i)perylene | µg/L | 1   | Org-012 subset | <1    | 127509-1      | <1 || 1                | [NR]          | [NR]           |                |
| Surrogate p-Terphenyl-d14 | %    | Org-012 subset | 92    | 127509-1 | 104 || 94 || RPD: 10 | LCS-W1        | 112%           |                |

#### HM in water - dissolved

| HM in water - dissolved | UNITS | PQL | METHOD | Blank | Duplicate Sm# | Duplicate results Base || Duplicate II %RPD | Spike Sm# | Spike % Recovery |
|-------------------------|-------|-----|--------|-------|---------------|--------------------------|----------------|----------------|----------------|
| Date prepared           | -     |     |        |       | 07/05/2015    | 07/05/2015 || 07/05/2015 | LCS-W2    | 07/05/2015          |
| Date analysed           | -     |     |        |       | 07/05/2015    | 07/05/2015 || 07/05/2015 | LCS-W2    | 07/05/2015          |
| Arsenic-Dissolved       | µg/L  | 1   | Metals-022 ICP-MS | <1    | 127509-9      | <1 || [N/T]            | LCS-W2    | 98%            |
| Copper-Dissolved        | µg/L  | 1   | Metals-022 ICP-MS | <1    | 127509-9      | <1 || [N/T]            | LCS-W2    | 94%            |
| Lead-Dissolved          | µg/L  | 1   | Metals-022 ICP-MS | <1    | 127509-9      | <1 || [N/T]            | LCS-W2    | 100%           |
| Zinc-Dissolved          | µg/L  | 1   | Metals-022 ICP-MS | <1    | 127509-9      | 250 || [N/T]           | LCS-W2    | 99%            |
| Nickel-Dissolved        | µg/L  | 1   | Metals-022 ICP-MS | <1    | 127509-9      | 55 || [N/T]            | LCS-W2    | 98%            |
| Mercury-Dissolved       | µg/L  | 0.05| Metals-021 CV-AAS | <0.05 | 127509-9      | <0.05 || <0.05          | LCS-W2    | 103%           |
| Cadmium-Dissolved       | µg/L  | 0.1 | Metals-022 ICP-MS | <0.1  | 127509-9      | <0.1 || [N/T]          | LCS-W2    | 104%           |
| Iron-Dissolved          | µg/L  | 10  | Metals-022 ICP-MS | <10   | 127509-9      | 28000 || [N/T]         | LCS-W2    | 97%            |
| Manganese-Dissolved     | µg/L  | 5   | Metals-022 ICP-MS | <5    | 127509-9      | 2300 || [N/T]          | LCS-W2    | 99%            |
### QUALITY CONTROL

#### HM in water - total

| Date prepared | - | Metals-022 ICP-MS | 07/05/2015 | 07/05/2015 | LCS-W2 | 07/05/2015 |
| Date analysed | - | Metals-022 ICP-MS | 07/05/2015 | 07/05/2015 | LCS-W2 | 07/05/2015 |
| Arsenic-Total | µg/L | Metals-022 ICP-MS | <1 | 127509-12 | LCS-W2 | 110% |
| Copper-Total | µg/L | Metals-022 ICP-MS | <1 | 127509-12 | LCS-W2 | 90% |
| Lead-Total | µg/L | Metals-022 ICP-MS | <1 | 127509-12 | LCS-W2 | 100% |
| Zinc-Total | µg/L | Metals-022 ICP-MS | <1 | 127509-12 | LCS-W2 | 107% |
| Nickel-Total | µg/L | Metals-022 ICP-MS | <1 | 127509-12 | LCS-W2 | 96% |
| Mercury-Total | µg/L | Metals-021 CV-AAS | <0.05 | 127509-12 | LCS-W2 | 104% |
| Cadmium-Total | µg/L | Metals-022 ICP-MS | <0.1 | 127509-12 | LCS-W2 | 104% |
| Iron-Total | µg/L | Metals-022 ICP-MS | <10 | 127509-12 | LCS-W2 | 92% |
| Manganese-Total | µg/L | Metals-022 ICP-MS | <5 | 127509-12 | LCS-W2 | 96% |

#### Miscellaneous Inorganics

| pH | pH Units | Inorg-001 | 06/05/2015 | 06/05/2015 | LCS-W1 | 06/05/2015 |
| Electrical Conductivity | µS/cm | Inorg-002 | 06/05/2015 | 06/05/2015 | LCS-W1 | 101% |
| Total Dissolved Solids (grav) | mg/L | Inorg-018 | 06/05/2015 | 06/05/2015 | LCS-W1 | 97% |
| Ammonia as N in water | mg/L | Inorg-057 | 0.005 | 127509-1 | LCS-W1 | 107% |
| Nitrate as N in water | mg/L | Inorg-055 | 0.005 | 127509-1 | LCS-W1 | 105% |
| Nitrite as N in water | mg/L | Inorg-055 | 0.005 | 127509-1 | LCS-W1 | 119% |
| Phosphate as P in water | mg/L | Inorg-060 | 0.005 | 127509-1 | LCS-W1 | 107% |
| Total Suspended Solids | mg/L | Inorg-019 | 0.005 | 127509-1 | LCS-W1 | 113% |
### QUALITY CONTROL

**UNITS** | **PQL** | **METHOD** | **Blank** | **Duplicate Sm#** | **Duplicate results** | **Spike Sm#** | **Spike % Recovery**
---|---|---|---|---|---|---|---

**Ion Balance**

- **Date prepared**
  - Calcium - Dissolved: mg/L<br>  - Potassium - Dissolved: mg/L<br>  - Sodium - Dissolved: mg/L<br>  - Magnesium - Dissolved: mg/L<br>  - Hydroxide Alkalinity: (OH⁻) as CaCO₃ mg/L<br>  - Bicarbonate Alkalinity as CaCO₃ mg/L<br>  - Carbonate Alkalinity as CaCO₃ mg/L<br>  - Total Alkalinity: as CaCO₃ mg/L
  - **Date analysed**
  - **Calcium - Dissolved**: ICP-AES, Metals-020, <0.5 mg/L, Duplicate 127509-1, % Recovery 97%
  - **Potassium - Dissolved**: ICP-AES, Metals-020, <0.5 mg/L, Duplicate 127509-1, % Recovery 95%
  - **Sodium - Dissolved**: ICP-AES, Metals-020, <0.5 mg/L, Duplicate 127509-1, % Recovery 114%
  - **Magnesium - Dissolved**: ICP-AES, Metals-020, <0.5 mg/L, Duplicate 127509-1, % Recovery 99%
  - **Hydroxide Alkalinity**: Inorg-006, <5 mg/L, Duplicate 127509-1, % Recovery [NR]
  - **Bicarbonate Alkalinity**: Inorg-006, <5 mg/L, Duplicate 127509-1, % Recovery [NR]
  - **Carbonate Alkalinity**: Inorg-006, <5 mg/L, Duplicate 127509-1, % Recovery [NR]
  - **Total Alkalinity**: Inorg-006, <5 mg/L, Duplicate 127509-1, % Recovery [NR]

**Metals in Waters - Acid extractable**

- **Date prepared**
  - Phosphorus - Total: mg/L<br>  - **Date analysed**
  - **Phosphorus - Total**: Metals-020, ICP-AES, <0.05 mg/L, Duplicate 127509-1, % Recovery 105%

**vTRH(C₆-C₁₀)/BTEX**

- **Date extracted**
  - **Date analysed**
  - **TRH₆ - C₉**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **TRH₆ - C₁₀**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **Benzene**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **Toluene**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **Ethylbenzene**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **m+p-xylene**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **o-xylene**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **Naphthalene**: µg/L, Duplicate 127509-11, % Recovery 105%
  - **Surrogate**: %, Duplicate 127509-11, % Recovery 105%

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Envirorlab Reference: 127509
Revision No: R 00
<table>
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<tr>
<th>QUALITY CONTROL</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate Base + Duplicate + %RPD</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
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<tr>
<td><strong>svTRH (C10-C40) in Water</strong></td>
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<td>TRH C10 - C14 µg/L</td>
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<td>TRH C29 - C36 µg/L</td>
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<td>TRH &gt;C16 - C19 µg/L</td>
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<td><strong>Surrogate o-Terphenyl</strong></td>
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<td><strong>PAHs in Water</strong></td>
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<td>08/05/2015</td>
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<td>127509-2</td>
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<td>Acenaphthylene µg/L</td>
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<td>Fluorene µg/L</td>
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<td>127509-2</td>
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<tr>
<td>Phenanthrene µg/L</td>
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<td>127509-2</td>
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<td>Pyrene µg/L</td>
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<td>Benzo(a)anthracene µg/L</td>
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<td>[NR]</td>
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<td>Chrysene µg/L</td>
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<tr>
<td>Benzo(b+j+k)fluoranthene µg/L</td>
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<td>Indeno(1,2,3-c,d)pyrene µg/L</td>
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<td>Dibenzo(a,h)anthracene µg/L</td>
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<td>Benzo(g,h,i)perylene µg/L</td>
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<td><strong>Surrogate p-Terphenyl-d14</strong></td>
<td>%</td>
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<td>92</td>
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<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
<td>Spike Sm#</td>
<td>Spike % Recovery</td>
</tr>
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<tr>
<td>HM in water - dissolved</td>
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<td></td>
<td></td>
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<tr>
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<td>07/05/2015</td>
<td>127509-16</td>
<td>07/05/2015</td>
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<td>127509-15</td>
<td>07/05/2015</td>
<td>127509-16</td>
<td>07/05/2015</td>
</tr>
<tr>
<td>Arsenic-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>&lt;1</td>
<td>127509-16</td>
<td>101%</td>
</tr>
<tr>
<td>Copper-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>2</td>
<td>127509-16</td>
<td>92%</td>
</tr>
<tr>
<td>Lead-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>&lt;1</td>
<td>127509-16</td>
<td>102%</td>
</tr>
<tr>
<td>Zinc-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>34</td>
<td>127509-16</td>
<td>102%</td>
</tr>
<tr>
<td>Nickel-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>1</td>
<td>127509-16</td>
<td>98%</td>
</tr>
<tr>
<td>Mercury-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>&lt;0.05</td>
<td>[NR]</td>
<td></td>
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<tr>
<td>Cadmium-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>&lt;0.1</td>
<td>127509-16</td>
<td>105%</td>
</tr>
<tr>
<td>Iron-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>180</td>
<td>127509-16</td>
<td>95%</td>
</tr>
<tr>
<td>Manganese-Dissolved</td>
<td>µg/L</td>
<td>127509-15</td>
<td>30</td>
<td>127509-16</td>
<td>97%</td>
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<td>HM in water - total</td>
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<tr>
<td>Date prepared</td>
<td>-</td>
<td>[NT]</td>
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<td>[NT]</td>
<td>[NT]</td>
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<td>07/05/2015</td>
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<td>Arsenic-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>127509-13</td>
<td>98%</td>
</tr>
<tr>
<td>Copper-Total</td>
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<td>[NT]</td>
<td>127509-13</td>
<td>86%</td>
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<tr>
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<td>100%</td>
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<tr>
<td>Zinc-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
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<td>98%</td>
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<tr>
<td>Nickel-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>127509-13</td>
<td>94%</td>
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<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>[NR]</td>
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<tr>
<td>Cadmium-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>127509-13</td>
<td>103%</td>
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<tr>
<td>Iron-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
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<td>101%</td>
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<td>Manganese-Total</td>
<td>µg/L</td>
<td>[NT]</td>
<td>[NT]</td>
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<td>Electrical Conductivity</td>
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<td>Total Dissolved Solids (grav)</td>
<td>mg/L</td>
<td>127509-11</td>
<td>100</td>
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<tr>
<td>Ammonia as N in water</td>
<td>mg/L</td>
<td>127509-11</td>
<td>0.031</td>
<td>127509-2</td>
<td>104%</td>
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<td>Nitrate as N in water</td>
<td>mg/L</td>
<td>127509-11</td>
<td>0.091</td>
<td>127509-2</td>
<td>101%</td>
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<td>Nitrite as N in water</td>
<td>mg/L</td>
<td>127509-11</td>
<td>0.006</td>
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<td>115%</td>
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<td>Phosphate as P in water</td>
<td>mg/L</td>
<td>127509-11</td>
<td>&lt;0.005</td>
<td>127509-2</td>
<td>100%</td>
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<tr>
<td>Total Suspended Solids</td>
<td>mg/L</td>
<td>[NT]</td>
<td>[NT]</td>
<td>[NR]</td>
<td></td>
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<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
<td>Spike Sm#</td>
<td>Spike % Recovery</td>
</tr>
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<td>Ion Balance</td>
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<tr>
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<td>6/05/2015</td>
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<td>6/05/2015</td>
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<td>6/05/2015</td>
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<td>Hydroxide Alkalinity (OH⁻) as CaCO₃</td>
<td>mg/L</td>
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<td>Carbonate Alkalinity as CaCO₃</td>
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<td>&lt;5</td>
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<tr>
<td>Total Alkalinity as CaCO₃</td>
<td>mg/L</td>
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<td>Sulphate, SO₄</td>
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<td>Chloride, Cl</td>
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<td>Metals in Waters - Acid extractable</td>
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<td>Spike Sm#</td>
<td>Spike % Recovery</td>
</tr>
<tr>
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<td>07/05/2015</td>
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<td>Date analysed</td>
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<td>07/05/2015</td>
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<td>UNITS</td>
<td>Dup. Sm#</td>
<td>Duplicate Base + Duplicate + %RPD</td>
<td>Spike Sm#</td>
<td>Spike % Recovery</td>
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<td>mg/L</td>
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<td>mg/L</td>
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<td>Nitrate as N in water</td>
<td>mg/L</td>
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<td>Nitrite as N in water</td>
<td>mg/L</td>
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<td>&lt;0.005</td>
<td>[N/T]</td>
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<td>mg/L</td>
<td>127509-12</td>
<td>0.018</td>
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<td>mg/L</td>
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<td>&lt;5</td>
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<td>&lt;5</td>
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</table>
Report Comments:
ION_BALANCE: # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test
NA: Test not required
<: Less than
>: Greater than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample
Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.
| LAB ID | SAMPLE ID | DATE / TIME | SAMPLE MATRIX | CONTAINER TYPE & PRESERVATIVE | TOTAL NO CONTAINERS | PH EC | TDS | THM | TPH | TKN | TOC | NO3 | NO2 | BZR | PAN | ALK | \*METALS * | HT |
|--------|-----------|-------------|---------------|-----------------------------|---------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 129507 | GW1       | 5/5/15      | W Bottles     | 6                           |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2      | GW2       | 5/5/15      |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 3      | GW3       | 6/5/15      |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4      | GW4       | 5/5/15      |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5      | GW5       | 5/5/15      |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6      | GW6       | 6/5/15      |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 7      | GW7       | 5/5/15      |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 8      | GW8       |             |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 9      | GW9       |             |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 10     | GW10      |             |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 11     | DUP1      |             |               |                             |                     |      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

Notes: Low reporting limits required for groundwater as specified by SMEC Australia Pty Ltd.
Work Order: ES1521420
Amendment: 1

Client: SMEC AUSTRALIA PTY LTD
Contact: DANIEL SAUNDERS
Address: LEVEL 5, 20 BERRY STREET P O BOX 1052
          NORTH SYDNEY NSW, AUSTRALIA
          2060

Laboratory: Environmental Division Sydney
Contact: 
Address: 277-289 Woodpark Road Smithfield
          NSW Australia 2164

E-mail: daniel.saunders@smec.com
Telephone: +61 02 61261959
Facsimile: +61 61261966

Project: NBHP WATER QUALITY MONITORING 30011560

Order number: ----
C-O-C number: 1082

Site: ----
Sampler: STEVEN SHAW

Date Samples Received: 07-May-2015
Client Requested Due Date: 19-May-2015
Issue Date: 19-May-2015
Scheduled Reporting Date: 19-May-2015

Mode of Delivery: Undefined
No. of coolers/boxes: 1
Receipt Detail: 

Security Seal: Intact.
Temperature: 10.4°C - Ice Bricks present
No. of samples received / analysed: 1 / 1

General Comments
- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables

- Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.

- Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).

- Please direct any queries you have regarding this work order to the above ALS laboratory contact.

- Analytical work for this work order will be conducted at ALS Sydney.

- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

<table>
<thead>
<tr>
<th>Method</th>
<th>Client sample ID</th>
<th>Sample Container Received</th>
<th>Preferred Sample Container for Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved Mercury by FIMS - EG035F</td>
<td>TRIP1</td>
<td>- Clear Plastic Bottle - Natural</td>
<td>- Clear Plastic Bottle - Nitric Acid; Filtered</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A: EG020A-F</td>
<td>TRIP1</td>
<td>- Clear Plastic Bottle - Natural</td>
<td>- Clear Plastic Bottle - Nitric Acid; Filtered</td>
</tr>
</tbody>
</table>

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

<table>
<thead>
<tr>
<th>Matrix: WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory sample ID</td>
</tr>
<tr>
<td>ES1521420-001</td>
</tr>
</tbody>
</table>

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

<table>
<thead>
<tr>
<th>Method</th>
<th>Container</th>
<th>Due for extraction</th>
<th>Due for analysis</th>
<th>Samples Received Date</th>
<th>Instructions Received Date</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIP1</td>
<td>Clear Plastic Bottle - Natural</td>
<td>----</td>
<td>05-May-2015</td>
<td>07-May-2015</td>
<td>(\times)</td>
<td>----</td>
</tr>
</tbody>
</table>

Requested Deliverables

DANIEL SAUNDERS

- "AU Certificate of Analysis - NATA (COA) Email daniel.saunders@smec.com
- "AU Interpretive QC Report - DEFAULT (Anon QC Rep) (QCI) Email daniel.saunders@smec.com
- "AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email daniel.saunders@smec.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email daniel.saunders@smec.com
- A4 - AU Tax Invoice (INV) Email daniel.saunders@smec.com
- Chain of Custody (CoC) (COC) Email daniel.saunders@smec.com
- EDI Format - ENSRGE (ENMRG) Email daniel.saunders@smec.com
- EDI Format - ESDAT (ESDAT) Email daniel.saunders@smec.com
CERTIFICATE OF ANALYSIS

Work Order : ES1521420
Amendment : 1
Client : SMEC AUSTRALIA PTY LTD
Contact : DANIEL SAUNDERS
Address : LEVEL 5, 20 BERRY STREET P O BOX 1052
          NORTH SYDNEY NSW, AUSTRALIA 2060
E-mail : daniel.saunders@smec.com
Telephone : +61 02 61261959
Facsimile : +61 61261966
Project : NBHP WATER QUALITY MONITORING 30011560
Order number : ----
C-O-C number : 1082
Sampler : STEVEN SHAW
Site : ----

Date Samples Received : 07-May-2015 15:00
C-O-C number : 1082
Date Analysis Commenced : 08-May-2015
Issue Date : 19-May-2015 16:05

No. of samples received : 1
No. of samples analysed : 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:
- General Comments
- Analytical Results

NATA Accredited Laboratory 825
Accredited for compliance with
ISO/IEC 17025.

Signatories
This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<table>
<thead>
<tr>
<th>Signatories</th>
<th>Position</th>
<th>Accreditation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shobhna Chandra</td>
<td>Senior Organic Chemist</td>
<td>Sydney Organics</td>
</tr>
<tr>
<td>Pabi Subba</td>
<td>Metals Coordinator</td>
<td>Sydney Inorganics</td>
</tr>
</tbody>
</table>
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key:
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- ^ = This result is computed from individual analyte detections at or above the level of reporting
- ø = ALS is not NATA accredited for these tests.

- This report has been amended following the request to remove unwanted results.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenzo(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for ‘TEQ Zero’ are treated as zero.
## Analytical Results

### Sub-Matrix: WATER  (Matrix: WATER)

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOQ</th>
<th>Unit</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>7440-38-2</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadmium</td>
<td>7440-43-9</td>
<td>0.0001</td>
<td>mg/L</td>
<td>&lt;0.0001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>7440-47-3</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>7440-50-8</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td>7440-02-0</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>7439-92-1</td>
<td>0.001</td>
<td>mg/L</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>7440-66-6</td>
<td>0.005</td>
<td>mg/L</td>
<td>&lt;0.005</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### EG035F: Dissolved Mercury by FIMS

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOQ</th>
<th>Unit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>7439-97-6</td>
<td>0.0001</td>
<td>mg/L</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

### EP075(SIM)B: Polynuclear Aromatic Hydrocarbons

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOQ</th>
<th>Unit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphthalene</td>
<td>91-20-3</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>208-96-8</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>83-32-9</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Fluorene</td>
<td>86-73-7</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>85-01-8</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Anthracene</td>
<td>120-12-7</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Fluoranthen</td>
<td>206-44-0</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Pyrene</td>
<td>129-00-0</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>56-55-3</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Chrysene</td>
<td>218-01-9</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Benzo(b+j)fluoranthene</td>
<td>205-99-2</td>
<td>205-82-3</td>
<td>1</td>
<td>µg/L</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>207-08-9</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>50-32-8</td>
<td>0.5</td>
<td>µg/L</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Indeno(1,2,3-cd)pyrene</td>
<td>193-39-5</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Dibenzo(a,h)anthracene</td>
<td>53-70-3</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Benzo(g,h,i)perylene</td>
<td>191-24-2</td>
<td>1</td>
<td>µg/L</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Sum of polycyclic aromatic hydrocarbons</td>
<td>0.5 µg/L</td>
<td>&lt;0.5 µg/L</td>
<td>&lt;0.5 µg/L</td>
<td></td>
</tr>
<tr>
<td>Benzo(a)pyrene TEQ (zero)</td>
<td>0.5 µg/L</td>
<td>&lt;0.5 µg/L</td>
<td>&lt;0.5 µg/L</td>
<td></td>
</tr>
</tbody>
</table>

### EP080/071: Total Petroleum Hydrocarbons

<table>
<thead>
<tr>
<th>Fraction</th>
<th>LOQ</th>
<th>Unit</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6 - C9</td>
<td>20</td>
<td>µg/L</td>
<td>&lt;20</td>
</tr>
<tr>
<td>C10 - C14</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;50</td>
</tr>
<tr>
<td>C15 - C28</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
</tr>
<tr>
<td>C29 - C36</td>
<td>50</td>
<td>µg/L</td>
<td>&lt;50</td>
</tr>
<tr>
<td>Sum of C10 - C36 Fraction</td>
<td>50 µg/L</td>
<td>&lt;50 µg/L</td>
<td></td>
</tr>
</tbody>
</table>

### EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions
## Analytical Results

### Sub-Matrix: WATER  
(Matrices: WATER)

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6 - C10 Fraction</td>
<td>C6_C10</td>
<td>20 µg/L</td>
<td>&lt;20</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>C6 - C10 Fraction minus BTEX (F1)</td>
<td>C6_C10-BTEX</td>
<td>20 µg/L</td>
<td>&lt;20</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>&gt;C10 - C16 Fraction</td>
<td>&gt;C10_C16</td>
<td>100 µg/L</td>
<td>&lt;100</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>&gt;C16 - C34 Fraction</td>
<td>***</td>
<td>100 µg/L</td>
<td>&lt;100</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>&gt;C34 - C40 Fraction</td>
<td>***</td>
<td>100 µg/L</td>
<td>&lt;100</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>&gt;C10 - C40 Fraction (sum)</td>
<td>***</td>
<td>100 µg/L</td>
<td>&lt;100</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

### EP080: BTEXN

#### Benzene
71-43-2 1 µg/L 10 *** *** *** ***

#### Toluene
108-88-3 2 µg/L <2 *** *** *** ***

#### Ethylbenzene
100-41-4 2 µg/L <2 *** *** *** ***

#### meta- & para-Xylene
108-38-3 106-42-3 2 µg/L <2 *** *** *** ***

#### ortho-Xylene
95-47-6 2 µg/L <2 *** *** *** ***

#### Total Xylenes
1330-20-7 2 µg/L <2 *** *** *** ***

#### Sum of BTEX
*** 1 µg/L 10 *** *** *** ***

#### Naphthalene
91-20-3 5 µg/L <5 *** *** *** ***

### EP075(SIM): Phenolic Compound Surrogates

#### Phenol-d6
13127-88-3 1 % 25.4 *** *** *** ***

#### 2-Chlorophenol-D4
93951-73-6 1 % 54.9 *** *** *** ***

#### 2,4,6-Tribromophenol
118-79-6 1 % 68.0 *** *** *** ***

### EP075(SIM): PAH Surrogates

#### 2-Fluorobiphenyl
321-60-8 1 % 75.8 *** *** *** ***

#### Anthracene-d10
1719-06-8 1 % 72.6 *** *** *** ***

#### 4-Terphenyl-d14
1718-51-0 1 % 68.1 *** *** *** ***

### EP080S: TPH(V)/BTEX Surrogates

#### 1,2-Dichloroethane-D4
17060-07-0 2 % 97.4 *** *** *** ***

#### Toluene-D8
2037-26-5 2 % 106 *** *** *** ***

#### 4-Bromofluorobenzene
460-00-4 2 % 111 *** *** *** ***
QUALITY CONTROL REPORT

Work Order: ES1521420
Amendment: 1

Client: SMEC AUSTRALIA PTY LTD
Contact: DANIEL SAUNDERS
Address: LEVEL 5, 20 BERRY STREET P O BOX 1052 NORTH SYDNEY NSW, AUSTRALIA 2060
E-mail: daniel.saunders@smec.com
Telephone: +61 02 61261959
Facsimile: +61 61261966

Project: NBHP WATER QUALITY MONITORING 30011560
Order number: ----
C-O-C number: 1082
Sampler: STEVEN SHAW
Site: ----
Quote number: ----

Laboratory: Environmental Division Sydney
Contact: DANIEL SAUNDERS
Address: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail: daniel.saunders@smec.com
Telephone: +61-2-8754 8555
Facsimile: +61-2-8754 8500

QC Level: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Date Samples Received: 07-May-2015
Date Analysis Commenced: 08-May-2015
Issue Date: 19-May-2015
No. of samples received: 1
No. of samples analysed: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:
- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories
This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatures
Position
Pabi Subba
Senior Organic Chemist
Shobhna Chandra
Metals Coordinator

Accreditation Category
Sydney Organics
Sydney Inorganics

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

R I G H T   S O L U T I O N S  |  R I G H T   P A R T N E R
General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key:
- Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- RPD = Relative Percentage Difference
- # = Indicates failed QC
Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: WATER

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method, Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Original Result</th>
<th>Duplicate Result</th>
<th>RPD (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG020F: Dissolved Metals by ICP-MS (QC Lot: 95837)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ES1521390-001</td>
<td>Anonymous</td>
<td>EG020A-F: Cadmium</td>
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<td>0.00</td>
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Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER

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<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Method Blank (MB) Report</th>
<th>Laboratory Control Spike (LCS) Report</th>
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<td>EG020A-F: Arsenic</td>
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<td>mg/L</td>
<td>&lt;0.001</td>
<td>0.1 mg/L</td>
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<td>EG020A-F: Cadmium</td>
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<td>mg/L</td>
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<td>0.1 mg/L</td>
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<td>EG020A-F: Copper</td>
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<td>0.1 mg/L</td>
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<td>mg/L</td>
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<td>EP075(SIM): Benzo(b+j)fluoranthene</td>
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### Sub-Matrix: WATER

#### Method Blank (MB) Report

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<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
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<td>10 µg/L</td>
<td>85.5</td>
<td>70</td>
</tr>
<tr>
<td>EP080: Ethylbenzene</td>
<td>100-41-4</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>89.8</td>
<td>70</td>
</tr>
<tr>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3 106-42-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>88.1</td>
<td>69</td>
</tr>
<tr>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>5</td>
<td>µg/L</td>
<td>&lt;5</td>
<td>10 µg/L</td>
<td>82.5</td>
<td>70</td>
</tr>
<tr>
<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>89.6</td>
<td>72</td>
</tr>
<tr>
<td>EP080: Toluene</td>
<td>108-88-3</td>
<td>2</td>
<td>µg/L</td>
<td>&lt;2</td>
<td>10 µg/L</td>
<td>100</td>
<td>65</td>
</tr>
</tbody>
</table>

#### Laboratory Control Spike (LCS) Report

<table>
<thead>
<tr>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>LOR</th>
<th>Unit</th>
<th>Result</th>
<th>Spike Concentration</th>
<th>Spike Recovery (%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 94951)</td>
<td>&gt;C10_C16</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>3500 µg/L</td>
<td>86.5</td>
<td>74</td>
</tr>
<tr>
<td>EP080: C6 - C10 Fraction</td>
<td>C6_C10</td>
<td>100</td>
<td>µg/L</td>
<td>&lt;100</td>
<td>1500 µg/L</td>
<td>78.0</td>
<td>67</td>
</tr>
</tbody>
</table>

#### Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

### Sub-Matrix: WATER

#### Laboratory sample ID | Client sample ID | Method: Compound | CAS Number | Spike Concentration | Spike Recovery (%) | Recovery Limits (%) |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EG020F: Dissolved Metals by ICP-MS (QCLot: 95887)</td>
<td>Anonymous</td>
<td>EG020A-F: Arsenic</td>
<td>7440-38-2</td>
<td>0.2 mg/L</td>
<td>102</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Cadmium</td>
<td>7440-43-9</td>
<td>0.05 mg/L</td>
<td>107</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Chromium</td>
<td>7440-47-3</td>
<td>0.2 mg/L</td>
<td>85.6</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Copper</td>
<td>7440-50-8</td>
<td>0.2 mg/L</td>
<td>91.1</td>
<td>70</td>
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<tr>
<td></td>
<td></td>
<td>EG020A-F: Lead</td>
<td>7439-92-1</td>
<td>0.2 mg/L</td>
<td>93.8</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Nickel</td>
<td>7440-02-0</td>
<td>0.2 mg/L</td>
<td>87.7</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EG020A-F: Zinc</td>
<td>7440-66-6</td>
<td>0.2 mg/L</td>
<td>100</td>
<td>70</td>
</tr>
<tr>
<td>EG035F: Dissolved Mercury by FIMS (QCLot: 95886)</td>
<td>Anonymous</td>
<td>EG035F: Mercury</td>
<td>7439-97-6</td>
<td>0.01 mg/L</td>
<td>82.1</td>
<td>70</td>
</tr>
</tbody>
</table>
## EP080: BTEXN (QCLot: 94951) - continued

<table>
<thead>
<tr>
<th>Laboratory sample ID</th>
<th>Client sample ID</th>
<th>Method: Compound</th>
<th>CAS Number</th>
<th>Spike Concentration</th>
<th>SpikeRecovery(%)</th>
<th>Recovery Limits (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1521324-001</td>
<td>Anonymous</td>
<td>EP080: Ethylbenzene</td>
<td>100-41-4</td>
<td>25 µg/L</td>
<td>96.0</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: meta- &amp; para-Xylene</td>
<td>108-38-3</td>
<td>25 µg/L</td>
<td>96.2</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>108-42-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Naphthalene</td>
<td>91-20-3</td>
<td>25 µg/L</td>
<td>103</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: ortho-Xylene</td>
<td>95-47-6</td>
<td>25 µg/L</td>
<td>96.9</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP080: Toluene</td>
<td>108-88-3</td>
<td>25 µg/L</td>
<td>103</td>
<td>70</td>
</tr>
</tbody>
</table>
This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples
This report highlights outliers flagged in the Quality Control (QC) Report.

- NO Method Blank value outliers occur.
- NO Duplicate outliers occur.
- NO Laboratory Control outliers occur.
- NO Matrix Spike outliers occur.
- For all regular sample matrices, NO surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance
- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples
- Quality Control Sample Frequency Outliers exist - please see following pages for full details.
Outliers : Analysis Holding Time Compliance

Matrix: WATER

<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Date extracted</th>
<th>Due for extraction</th>
<th>Days overdue</th>
<th>Date analysed</th>
<th>Due for analysis</th>
<th>Days overdue</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA005P: pH by PC Titrator</td>
<td>Clear Plastic Bottle - Natural TRIP1</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>08-May-2015</td>
<td>05-May-2015</td>
<td>3</td>
</tr>
<tr>
<td>EK057G: Nitrite as N by Discrete Analyser</td>
<td>Clear Plastic Bottle - Natural TRIP1</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>08-May-2015</td>
<td>07-May-2015</td>
<td>1</td>
</tr>
<tr>
<td>EK071G: Reactive Phosphorus as P by discrete analyser</td>
<td>Clear Plastic Bottle - Natural TRIP1</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>08-May-2015</td>
<td>07-May-2015</td>
<td>1</td>
</tr>
</tbody>
</table>

Outliers : Frequency of Quality Control Samples

Matrix: WATER

<table>
<thead>
<tr>
<th>Quality Control Sample Type</th>
<th>QC</th>
<th>Regular</th>
<th>Actual</th>
<th>Expected</th>
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</thead>
<tbody>
<tr>
<td>Laboratory Duplicates (DUP)</td>
<td>0</td>
<td>2</td>
<td>0.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
<td>0</td>
<td>2</td>
<td>0.00</td>
<td>10.00</td>
</tr>
<tr>
<td>TRH - Semivolatile Fraction</td>
<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matrix Spikes (MS)</td>
<td>0</td>
<td>2</td>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
<td>0</td>
<td>2</td>
<td>0.00</td>
<td>5.00</td>
</tr>
<tr>
<td>TRH - Semivolatile Fraction</td>
<td>NEPM 2013 Schedule B(3) and ALS QCS3 requirement</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referring to USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: WATER

<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Sample Date</th>
<th>Extraction / Preparation</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA005P: pH by PC Titrator</td>
<td>Clear Plastic Bottle - Natural (EA005-P) TRIP1</td>
<td>05-May-2015</td>
<td>----</td>
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</tr>
</tbody>
</table>

Evaluation: × = Holding time breach ; ✓ = Within holding time.
<table>
<thead>
<tr>
<th>Method</th>
<th>Container / Client Sample ID(s)</th>
<th>Sample Date</th>
<th>Extraction / Preparation</th>
<th>Analysis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Date extracted</td>
<td>Due for extraction</td>
<td>Evaluation</td>
</tr>
<tr>
<td><strong>EA010P: Conductivity by PC Titrator</strong></td>
<td>Clear Plastic Bottle - Natural (EA010-P) TRIP1</td>
<td>05-May-2015</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</strong></td>
<td>Clear Plastic Bottle - Sulfuric Acid (EK059G) TRIP1</td>
<td>05-May-2015</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Container / Client Sample ID(s)</td>
<td>Method</td>
<td>Sample Date</td>
<td>Extraction / Preparation</td>
<td>Analysis</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
<td>-------------</td>
<td>--------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Date extracted</td>
<td>Due for extraction</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>
## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: WATER

<table>
<thead>
<tr>
<th>Quality Control Sample Type</th>
<th>Analytical Methods</th>
<th>Method</th>
<th>QC</th>
<th>Regular</th>
<th>Count</th>
<th>Rate (%)</th>
<th>Evaluation</th>
<th>Quality Control Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Duplicates (DUP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
<td>2</td>
<td>10</td>
<td></td>
<td>20.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>0</td>
<td>2</td>
<td></td>
<td>0.00</td>
<td>10.00</td>
<td>✗</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>1</td>
<td>4</td>
<td></td>
<td>25.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
<td>2</td>
<td>14</td>
<td></td>
<td>14.29</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>2</td>
<td>20</td>
<td></td>
<td>10.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>2</td>
<td>19</td>
<td></td>
<td>10.53</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Major Cations - Dissolved</td>
<td>ED093F</td>
<td>2</td>
<td>19</td>
<td></td>
<td>10.53</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>2</td>
<td>8</td>
<td></td>
<td>25.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
<td>2</td>
<td>12</td>
<td></td>
<td>16.67</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>PAH/Phenols (GCMS - SIM)</td>
<td>EP075(SIM)</td>
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<td>2</td>
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<td>10.00</td>
<td>✗</td>
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</tr>
<tr>
<td>pH by PC Titrator</td>
<td>EA005-P</td>
<td>2</td>
<td>16</td>
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<td>10.00</td>
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<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Reactive Phosphorus as P-By Discrete Analyser</td>
<td>EK071G</td>
<td>1</td>
<td>7</td>
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<td>14.29</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
<td>ED041G</td>
<td>1</td>
<td>4</td>
<td></td>
<td>25.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Total Dissolved Solids (High Level)</td>
<td>EA015H</td>
<td>2</td>
<td>14</td>
<td></td>
<td>14.29</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
<td>2</td>
<td>8</td>
<td></td>
<td>25.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>TRH - Semivolatile Fraction</td>
<td>EP071</td>
<td>0</td>
<td>5</td>
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<td>0.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>2</td>
<td>12</td>
<td></td>
<td>16.67</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Laboratory Control Samples (LCS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Alkalinity by PC Titrator</td>
<td>ED037-P</td>
<td>1</td>
<td>10</td>
<td></td>
<td>10.00</td>
<td>5.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Ammonia as N by Discrete analyser</td>
<td>EK055G</td>
<td>1</td>
<td>2</td>
<td></td>
<td>50.00</td>
<td>5.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Chloride by Discrete Analyser</td>
<td>ED045G</td>
<td>2</td>
<td>4</td>
<td></td>
<td>50.00</td>
<td>10.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Conductivity by PC Titrator</td>
<td>EA010-P</td>
<td>1</td>
<td>14</td>
<td></td>
<td>7.14</td>
<td>5.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Dissolved Mercury by FIMS</td>
<td>EG035F</td>
<td>1</td>
<td>20</td>
<td></td>
<td>5.00</td>
<td>5.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
<td>EG020A-F</td>
<td>1</td>
<td>19</td>
<td></td>
<td>5.26</td>
<td>5.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Major Cations - Dissolved</td>
<td>ED093F</td>
<td>1</td>
<td>19</td>
<td></td>
<td>5.26</td>
<td>5.00</td>
<td>✓</td>
<td>NEPM 2013 Schedule B(3) and ALS QC3 requirement</td>
</tr>
<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>1</td>
<td>8</td>
<td></td>
<td>12.50</td>
<td>5.00</td>
<td>✓</td>
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</table>

### Method Blanks (MB)

| Ammonia as N by Discrete analyser | EK055G | 1      | 2  |         | 50.00 | 5.00     | ✓          | NEPM 2013 Schedule B(3) and ALS QC3 requirement |
## Matrix: WATER

**Quality Control Sample Type**

<table>
<thead>
<tr>
<th>Method</th>
<th>Count</th>
<th>QC Rate (%)</th>
<th>Actual Rate (%)</th>
<th>Evaluation</th>
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<tr>
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<td>Major Cations - Dissolved</td>
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<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
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<td>1</td>
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<td>12.50</td>
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<tr>
<td>Nitrite as N by Discrete Analyser</td>
<td>EK057G</td>
<td>1</td>
<td>12</td>
<td>8.33</td>
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<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
<td>EP075(SIM)</td>
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<td>Reactive Phosphorus as P-By Discrete Analyser</td>
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<td>7</td>
<td>14.29</td>
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<tr>
<td>Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser</td>
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<td>Total Phosphorus as P By Discrete Analyser</td>
<td>EK067G</td>
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<td>12.50</td>
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<td>Chloride by Discrete Analyser</td>
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<td>4</td>
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<tr>
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<td>20</td>
<td>5.00</td>
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<tr>
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<td>5.26</td>
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<tr>
<td>Nitrite and Nitrate as N (NOx) by Discrete Analyser</td>
<td>EK059G</td>
<td>1</td>
<td>8</td>
<td>12.50</td>
</tr>
<tr>
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<td>1</td>
<td>12</td>
<td>8.33</td>
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<tr>
<td>PAH/Phenols (GC/MS - SIM)</td>
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<td>TRH Volatiles/BTEX</td>
<td>EP080</td>
<td>1</td>
<td>12</td>
<td>8.33</td>
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</tbody>
</table>

**Evaluation:** ✗ = Quality Control frequency not within specification; ✔ = Quality Control frequency within specification.
**Brief Method Summaries**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

### Analytical Methods

<table>
<thead>
<tr>
<th>Method Descriptions</th>
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<tbody>
<tr>
<td>Dissolved Metals by ICP-MS - Suite A</td>
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<tr>
<td>Dissolved Mercury by FIMS</td>
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<td>TRH - Semivolatile Fraction</td>
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<td>PAH/Phenols (GC/MS - SIM)</td>
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<tr>
<td>TRH Volatiles/BTEX</td>
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</tbody>
</table>

### Method Descriptions

- **Dissolved Metals by ICP-MS - Suite A**
  - EG020A-F
  - WATER
  - In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45 um filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

- **Dissolved Mercury by FIMS**
  - EG035F
  - WATER
  - In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

- **TRH - Semivolatile Fraction**
  - EP071
  - WATER
  - USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

- **PAH/Phenols (GC/MS - SIM)**
  - EP075(SIM)
  - WATER
  - USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

- **TRH Volatiles/BTEX**
  - EP080
  - WATER
  - USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

### Preparation Methods

- **TKN/TP Digestion**
  - EK061/EK067
  - WATER
  - APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)