Prepared for

NSW Office of Water

Groundwater Monitoring Bore Drilling Project at Broke:

Review of Environmental Factors

Final

August 2013

Reference: 475173
NSW Office of Water
Groundwater Monitoring Bore Drilling Project at Broke
Review of Environmental Factors

REPORT DETAILS

Title: Groundwater Monitoring Bore Drilling Project at Broke:
Author(s): Jessica Littlejohn, Suzanne May and Emma Hale
Client: NSW Office of Water
Client Contact: Richard Green
Client Reference: Groundwater Team Leader - Coastal

Synopsis: NSW Office of Water proposes to commence construction of groundwater bores and associated infrastructure to monitor groundwater levels and groundwater quality in three areas of NSW proposed for coal seam gas and large coal mining development. An assessment of environmental impacts is required under Part 5 of the Environmental Planning and Assessment Act 1979. An assessment has been undertaken for the proposed monitoring bores in Broke. The findings of this assessment are presented in this Review of Environmental Factors (REF) report.

REVISION / CHECKING HISTORY

<table>
<thead>
<tr>
<th>REVISION NUMBER</th>
<th>DATE</th>
<th>REVIEWED BY</th>
<th>APPROVED FOR ISSUE</th>
<th>DISTRIBUTION – NUMBER OF COPIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>26 June 2013</td>
<td>Emma Hale</td>
<td>Emma Hale</td>
<td>Client: 1, Council: 1, Other: 1, CH2M File: 1</td>
</tr>
<tr>
<td>1</td>
<td>24 July 2013</td>
<td>Emma Hale</td>
<td>Emma Hale</td>
<td>Client: 1, Council: 1, Other: 1, CH2M File: 1</td>
</tr>
<tr>
<td>2</td>
<td>1 August 2013</td>
<td>Emma Hale</td>
<td>Emma Hale</td>
<td>Client: 1, Council: 1, Other: 1, CH2M File: 1</td>
</tr>
<tr>
<td>3</td>
<td>2 August 2013</td>
<td>Emma Hale</td>
<td>Emma Hale</td>
<td>Client: 1, Council: 1, Other: 1, CH2M File: 1</td>
</tr>
</tbody>
</table>

August 2013
Ref: 475173
Final
Executive Summary

This Review of Environmental Factors (REF) has been prepared by CH2M HILL Australia Pty Ltd (CH2M HILL) on behalf of the New South Wales Office of Water (NOW). The purpose of this REF is to assess potential impacts arising from the Broke-Bulga bore drilling program.

NOW are increasing the spatial coverage of their bore network through the drilling of new groundwater bores in key areas of NSW. The drilling program aims to construct monitoring bores in sedimentary rock and Coal Seams, in order to improve the understanding of the hydrogeologic environment. It is anticipated that by the end of 2013 there will be strategic nests of groundwater monitoring bores established in the Sydney (Hunter Valley) and Gunnedah Basins. The Broke-Bulga drilling program consists of three potential sites located around the towns of Broke and Bulga, NSW.

Statutory Context

A review of legislative, regulatory environmental planning instruments, policy and guideline documents has been undertaken to identify NOW’s statutory obligations. The Environmental Planning and Assessment Act 1979 (EP&A Act) and associated Regulations provide a framework for the assessment of the impact of activities in NSW. This proposal does not require development consent under Part 4 of the EP&A Act as it is considered to be development without consent under the State Environmental Planning Policy (Infrastructure) 2007. A proposal can be assessed under Part 5 of the EP&A Act if it may be carried out without development consent and is carried out, or approved, by a determining authority. The NOW is both the proponent and the determining authority for the proposal under Part 5 of the EP&A Act.

Consultation

Key stakeholders relevant to the proposed drilling program have been identified and includes state regulatory agencies, local government, landholders and occupiers, local community, users of local facilities, business, special interest groups and utility operators. A community consultation database has been established and will be maintained to monitor and address any concerns or issues raised by the local community and/or key stakeholders. Project fact sheets will be distributed as part of a stakeholder and community consultation program.

Environmental Impact Assessment and Conclusions

This REF assesses the potential impacts associated with the proposed drilling works. The existing environment, potential impacts and mitigation measures have been considered for a range of aspects including topography, geology and soils; surface water; groundwater; flora and fauna; heritage; noise and vibration; air quality; traffic and access; waste and social and visual assessment.

For the three sites investigated, the assessment did not identify any significant, adverse environmental impacts as a result of the proposed drilling works, subject to implementation of the mitigation measures outlined in this REF.
Table of Contents

1 Introduction ................................................................................................................................1
  1.1 Background Information ......................................................................................................... 1
  1.2 Scope of this Report ................................................................................................................... 1
  1.3 Location of the Proposed Sites ................................................................................................. 1

2 Statutory Context .......................................................................................................................... 6
  2.1 Environmental Planning and Assessment Act 1979 ................................................................. 6
  2.2 Planning Policies ....................................................................................................................... 6
    2.2.1 State Environmental Planning Policy (Infrastructure) 2007 ................................................ 6
    2.2.2 State Environmental Planning Policy 44, Koala Habitat Protection (SEPP 44) ...................... 7
    2.2.3 State Environmental Planning Policy 19, Bushland in Urban Areas (SEPP 19) ................. 7
    2.2.4 State Environmental Planning Policy 26, Littoral Rainforests (SEPP 26) ............................ 7
    2.2.5 Singleton Local Environmental Plan 1996 ........................................................................ 7
    2.2.6 Draft Singleton Local Environmental Plan 2013 ............................................................... 7
  2.3 State Legislation ....................................................................................................................... 9
    2.3.1 National Parks and Wildlife Act 1974 (NPWS Act) ............................................................. 9
    2.3.2 Heritage Act 1977 ............................................................................................................... 9
    2.3.3 Protection of the Environment Operations Act 1997 .......................................................... 10
    2.3.4 Threatened Species Conservation Act 1995 ...................................................................... 10
    2.3.5 Fisheries Management Act 1994 ....................................................................................... 11
    2.3.6 Noxious Weeds Act 1993 .................................................................................................. 11
    2.3.7 Mine Subsidence Compensation Act 1961 and Regulation 2007 ....................................... 11
    2.3.8 Waste Avoidance and Resource Recovery Act 2001 ........................................................ 11
    2.3.9 Water Act 1912 ................................................................................................................ 11
    2.3.10 Water Act 1912 .............................................................................................................. 11
    2.3.11 Roads Act 1993 ............................................................................................................... 13
  2.4 Commonwealth Legislation ...................................................................................................... 14
    2.4.1 Environmental Protection and Biodiversity Conservation Act 1999 ................................. 14
  2.5 Strategic Considerations ........................................................................................................ 14
    2.5.1 Strategic Regional Land Use Plan – Upper Hunter ........................................................... 14
    2.5.2 NSW Aquifer Interference Policy ..................................................................................... 15
  2.6 Stakeholder Consultation and Community Consultation ...................................................... 16
    2.6.1 State Government Agencies ............................................................................................. 16
    2.6.2 Local Government .......................................................................................................... 17
    2.6.3 Local Community ............................................................................................................. 17

3 Alternatives and Justification for the Proposal ......................................................................... 18
  3.1 Proposal Need ......................................................................................................................... 18
  3.2 Proposal Options .................................................................................................................... 18
    3.2.1 Do Nothing ....................................................................................................................... 18
    3.2.2 Alternative Sites ............................................................................................................... 18
  3.3 Justification of Option .......................................................................................................... 18
Groundwater Monitoring Bore Drilling Project at Broke: 
Review of Environmental Factors

4 Proposal Description

4.1 Scope of Works

4.2 Materials and Equipment

4.3 Worksites, Access and Vehicle Movements

4.4 Workforce and Timeframe

5 Existing Environment, Potential Impacts and Mitigation Measures

5.1 Topography, Geology and Soils

5.2 Surface Water

5.3 Groundwater

5.4 Flora and Fauna

5.5 Heritage

5.6 Noise and Vibration

5.7 Air Quality

5.8 Traffic and Access

5.9 Waste

5.10 Social and Visual Assessment

5.10.1 Existing Environment

5.10.3 Mitigation Measures

5.9.3 Mitigation Measures

5.8.3 Mitigation Measures

5.7.3 Mitigation Measures

5.6.3 Mitigation Measures

5.5.3 Mitigation Measures

5.4.3 Mitigation Measures

5.3.3 Mitigation Measures

5.2.3 Mitigation Measures

5.1.3 Mitigation Measures

5.1.2 Impacts

5.1.1 Existing Environment

5.3.2 Impacts

5.3.1 Existing Environment

5.2.2 Impacts

5.2.1 Existing Environment

5.1.1 Impacts

5.1.0 Existing Environment

5.9.2 Impacts

5.8.2 Impacts

5.6.2 Impacts

5.5.2 Impacts

5.4.2 Impacts

5.3.2 Impacts

5.2.2 Impacts

5.1.0 Impacts

5.1.0 Existing Environment

5.1.0 Impacts

5.1.0 Existing Environment
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.10.2 Impacts</td>
<td>42</td>
</tr>
<tr>
<td>5.10.3 Mitigation Measures</td>
<td>43</td>
</tr>
<tr>
<td>5.11 Cumulative Impacts</td>
<td>43</td>
</tr>
<tr>
<td>6 Summary of Mitigation Measures</td>
<td>44</td>
</tr>
<tr>
<td>7 Ecologically Sustainable Development Principles</td>
<td>51</td>
</tr>
<tr>
<td>8 Conclusions</td>
<td>52</td>
</tr>
<tr>
<td>9 References</td>
<td>53</td>
</tr>
</tbody>
</table>
List of Tables

Table 1-1: Proposed Drill Sites............................................................................................................. 3
Table 2-1: Current Land Zonings in the Area.......................................................................................... 7
Table 2-2: Land Zonings under the Draft LEP ...................................................................................... 8
Table 4-1: Approximate Depth of Each Bore ......................................................................................... 19
Table 5-1: Distances to Watercourses ................................................................................................... 25
Table 5-2 Threatened Flora and Fauna of the Locality ......................................................................... 28
Table 5-3 Vegetation Cover of the Proposed Borehole Sites ................................................................. 30
Table 5-4: Distance to Closest Inhabited Dwelling .............................................................................. 34
Table 5-5: Distance to sensitive receptors ........................................................................................... 34
Table 5-6 Construction Noise Guidelines ............................................................................................. 35
Table 5-7 Management Noise Level for Specific Sensitive Receivers .................................................. 35
Table 5-8 Potential to Exceed Noise Management Levels during Standard Construction Hours ....... 35
Table 5-9: Proposed Drill Site Access .................................................................................................. 38
Table 5-10: Population ........................................................................................................................ 41
Table 7-1: How the Proposal Meets ESD Principles ........................................................................... 51

List of Figures

Figure 1-1: Overview of Proposed Sites (ESRI, 2013) .......................................................................... 2
Figure 1-2: Locations of Boreholes B1a and B1b within Broke (ESRI, 2013) ........................................... 4
Figure 1-3: Location of Borehole B3a within Bulga (ESRI, 2013) .............................................................. 5
Figure 4-1: Drill Site Layout ................................................................................................................ 20
Figure 5-1: Expected drilling rig ......................................................................................................... 42
Figure 5-2: Expected Permanent Footprint ........................................................................................... 43

List of Appendices

Appendix A: Clause 228 Determination
Appendix B: Flora and Fauna Assessment
# Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHIMS</td>
<td>Aboriginal Heritage Information Management System</td>
</tr>
<tr>
<td>AIS</td>
<td>Agricultural Impact Statement</td>
</tr>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Conservation Council</td>
</tr>
<tr>
<td>ASRIS</td>
<td>Australian Soil Resource Information System</td>
</tr>
<tr>
<td>ASS</td>
<td>Acid Sulphate Soils</td>
</tr>
<tr>
<td>BLR</td>
<td>Basic Landholder Right</td>
</tr>
<tr>
<td>BOP</td>
<td>Blow Out Preventer</td>
</tr>
<tr>
<td>CH2M HILL</td>
<td>CH2M HILL Australia Pty Ltd</td>
</tr>
<tr>
<td>CIC</td>
<td>Critical Industry Clusters</td>
</tr>
<tr>
<td>CSG</td>
<td>Coal Seam Gas</td>
</tr>
<tr>
<td>CSIRO</td>
<td>The Commonwealth Scientific and Industrial Research Organisation</td>
</tr>
<tr>
<td>DII</td>
<td>Department of Industry and Investment</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>ENCM</td>
<td>Environmental Noise Control Manual</td>
</tr>
<tr>
<td>EPA</td>
<td>Environment Protection Authority</td>
</tr>
<tr>
<td>EP&amp;A Act</td>
<td>Environmental Planning and Assessment Act 1979</td>
</tr>
<tr>
<td>EPBC Act</td>
<td>Environmental Planning and Biodiversity Conservation Act 1999</td>
</tr>
<tr>
<td>ESD</td>
<td>Ecologically Sustainable Development</td>
</tr>
<tr>
<td>GDE</td>
<td>Groundwater Dependent Ecosystem</td>
</tr>
<tr>
<td>LEP</td>
<td>Local Environmental Plan</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
</tr>
<tr>
<td>ML</td>
<td>Mega-litres</td>
</tr>
<tr>
<td>MSD</td>
<td>Mine Subsidence District</td>
</tr>
<tr>
<td>NES</td>
<td>National Environmental Significance</td>
</tr>
<tr>
<td>NOW</td>
<td>New South Wales Office of Water</td>
</tr>
<tr>
<td>NPWS</td>
<td>National Parks and Wildlife Service</td>
</tr>
<tr>
<td>OEH</td>
<td>Office of Environment and Heritage</td>
</tr>
<tr>
<td>POEO Act</td>
<td>Protection of the Environment Operations Act</td>
</tr>
<tr>
<td>REF</td>
<td>Review of Environmental Factors</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>SEPP</td>
<td>State Environmental Planning Policy</td>
</tr>
<tr>
<td>TSC Act</td>
<td>Threatened Species Conservation Act 1995</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>UHAQMN</td>
<td>Upper Hunter Air Quality Monitoring Network</td>
</tr>
<tr>
<td>Water Act</td>
<td>Water Act 1912</td>
</tr>
<tr>
<td>WM Act</td>
<td>Water Management Act 2000</td>
</tr>
<tr>
<td>WSP</td>
<td>Water Sharing Plan</td>
</tr>
<tr>
<td>Glossary</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Acid Sulphate Soil (ASS)</td>
<td>Soil material which is waterlogged and contains oxidisable sulphur compounds, usually ferrous iron disulphide (pyrite) that has a field pH of 4 or more.</td>
</tr>
<tr>
<td>Bund</td>
<td>A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or the entire perimeter of a compound and provides a barrier to retain liquid.</td>
</tr>
<tr>
<td>BLR</td>
<td>For groundwater, basic landholder rights (BLR) includes water for domestic and stock purposes which is extracted from any aquifer underlying the landholder’s property. It also includes water extracted for native title purposes.</td>
</tr>
<tr>
<td>Catchment</td>
<td>The area drained by a drainage system, stream, or body of water.</td>
</tr>
<tr>
<td>Contamination</td>
<td>Concentration of substances above that naturally present that poses, or is likely to pose, an immediate or long-term risk to human health or the environment.</td>
</tr>
<tr>
<td>Cumulative Impacts</td>
<td>The sum effect on the environment resulting from the successive effects of several different impacts.</td>
</tr>
<tr>
<td>Determining Authority</td>
<td>The Minister or Public Authority by or on whose behalf a proposed development/activity is to be carried out; or whose approval is required in order to allow the activity to be carried out.</td>
</tr>
<tr>
<td>Ecological Sustainable Development</td>
<td>Using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.</td>
</tr>
<tr>
<td>Ecology</td>
<td>Branch of biology dealing with the relations of organisms to one another and to their physical surroundings.</td>
</tr>
<tr>
<td>Hydrology</td>
<td>Study of the properties of the Earth’s water, especially of its movement in relation to land.</td>
</tr>
<tr>
<td>L10</td>
<td>The sound level exceeded 10% of the time</td>
</tr>
<tr>
<td>Mitigation</td>
<td>To become milder, less intense or less severe.</td>
</tr>
<tr>
<td>Topography</td>
<td>Detailed description of the natural and artificial features of the area.</td>
</tr>
</tbody>
</table>
1 Introduction

This Review of Environmental Factors (REF) has been prepared on behalf of New South Wales Office of Water (NOW) to support a proposal for groundwater monitoring bores and fulfill NOW’s requirements under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation). The purpose of this REF is to:

- Provide a detailed description of the proposal;
- Identify the key potential environmental impacts and issues associated with the proposal;
- Assess the key potential environmental impacts associated with the proposal; and
- Outline NOW’s commitment to manage, where possible, any potential impacts outlined.

1.1 Background Information

NOW is responsible for strategic management of the State’s surface water and groundwater resources. NSW is currently experiencing growth in mining and petroleum projects, in particular coal seam gas and large coal mining developments. It is therefore important to gather baseline information on groundwater levels and water quality throughout NSW. NOW are therefore increasing the spatial coverage of their bore network through the drilling of new groundwater bores in key areas of NSW’s coal basins, namely Sydney/Gunnedah.

This project area is located in the Broke and Bulga area. The Bulga Coal operations, operated by Glencore-Xstrata which includes the Bulga open cut, South Bulga underground and Beltana underground is located north of Broke. In addition AGL is exploring for Coal Seam Gas in the vicinity of the townships of Broke and Bulga.

This drilling program to construct monitoring bores is in sedimentary rock of the Sydney Basin and it will increase the knowledge of the aquifer systems of these areas. Bores will be installed at depths ranging between 100 and 300 m below ground surface, depending on the depth of the coal seam. It is anticipated that by the end of 2013 there will be strategic nests of groundwater monitoring bores established in both the Sydney (Hunter Valley) and Gunnedah Basins.

CH2M HILL Australia Pty Ltd (CH2M HILL) has been engaged on behalf of NOW to prepare an REF covering each of the drilling programs. This REF covers the Broke-Bulga drilling program, within the Hunter Valley.

1.2 Scope of this Report

This report outlines the statutory requirements, stakeholder consultation, project justification, existing environment, potential impacts and mitigation measures associated with the Broke-Bulga drilling program.

1.3 Location of the Proposed Sites

The three sites lie within the Wollombi Brook subcatchment (B1b, B3a) and the Monkey Place Creek subcatchment (B1a) within the Upper Hunter Catchment of the Hunter-Central Rivers region. The sites are located around two townships, Broke and Bulga (Figure 1-1). The township of Broke is located approximately 24 km southwest of Singleton, approximately 17 km northwest of Paynes
Crossing and north of the village of Wollombi. The township of Bulga is approximately 18 km northwest of the township of Broke.

Figure 1-1: Overview of Proposed Sites (ESRI, 2013)
Two sites are proposed for the Broke area. Site B1a is located 1.9 km east from the township of Broke on private land (Figure 1-2). Bore B1b would be located on crown reserve land within a Council Caravan Park in Broke township, west of Wollombi Street (Figure 1-2).

One site is proposed for the Bulga area (Figure 1-3). Site B3a is located 800 m southwest and 220 m east of the town of Bulga. This bore would be located on crown reserve adjacent to the Bulga National Parks and Wildlife Service office and information centre. Coordinates of the three sites can be found in Table 1-1.

Table 1-1: Proposed Drill Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Nearest township</th>
<th>Latitude</th>
<th>Longitude</th>
<th>LGA</th>
<th>Land Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Broke</td>
<td>-32.747874</td>
<td>151.122591</td>
<td>Singleton</td>
<td>Private</td>
</tr>
<tr>
<td>B1b</td>
<td>Broke</td>
<td>-32.743956</td>
<td>151.098384</td>
<td>Singleton</td>
<td>Crown Reserve</td>
</tr>
<tr>
<td>B3a</td>
<td>Bulga</td>
<td>-32.658818</td>
<td>151.025336</td>
<td>Singleton</td>
<td>Crown Reserve</td>
</tr>
</tbody>
</table>
Figure 1-2: Locations of Boreholes B1a and B1b within Broke (ESRI, 2013)
Figure 1-3: Location of Borehole B3a within Bulga (ESRI, 2013)
2 Statutory Context

2.1 Environmental Planning and Assessment Act 1979

This proposal has been assessed in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act) and the associated EP&A Regulation 2000. The Act institutes a system for environmental planning and assessment and development approvals. It also establishes environmental planning instruments, such as State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs).

The proposal does not require development consent under Part 4 of the EP&A Act as it is considered to be development without consent under the State Environmental Planning Policy (Infrastructure) 2007. A proposal can be assessed under Part 5 of the EP&A Act if it may be carried out without development consent and is carried out, or approved, by a determining authority. Under Part 5 a determining authority is defined as:

“...a Minister or public authority and, in relation to any activity, the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out...”

NOW is both the proponent and the determining authority for the proposal under Part 5 of the EP&A Act. A REF is required if the determining authority considers that the proposal is unlikely to have a significant impact on the environment. If a determining authority decides the proposal would be likely to significantly affect the environment, it must obtain and consider an environmental impact statement. Furthermore, if the proposal were to be carried out on land that is critical habitat, or if the determining authority decides the proposal would be likely to significantly affect a threatened species, population or ecological community or its habitat, then it must obtain and consider a species impact statement.

Provided the mitigation measures outlined in this REF are implemented, the proposal is unlikely to have a significant impact on the environment and is unlikely to result in a significant impact on threatened species, population or ecological communities (see section 5.4.2).

Factors that need to be taken into account when considering the likely impact of an activity on the environment are outlined in clause 228 of the EP&A Regulation and are discussed in Appendix A.

2.2 Planning Policies

2.2.1 State Environmental Planning Policy (Infrastructure) 2007

A monitoring station is a “facility operated for the principal purpose of monitoring weather, noise, air, water, groundwater or environmental impacts”. The construction of piezometers to monitor groundwater levels and groundwater quality can be considered monitoring stations for the purposes of this SEPP.

Clause 90 of the SEPP states that development for the purpose of a monitoring station may be carried out by or on behalf of a public authority without consent on any land. NOW falls under the definition of a public authority and therefore the proposal is permitted without consent and the proposal can be assessed under Part 5 of the EP&A Act, with NOW the determining authority.
2.2.2 State Environmental Planning Policy 44, Koala Habitat Protection (SEPP 44)

The purpose of SEPP 44 is to encourage the conservation and management of koala habitat to ensure permanent, free living populations are maintained over their present range. Under the policy, consent for a development cannot be issued without an investigation for core koala habitat. SEPP 44 provides a State-wide approach ensuring appropriate development can continue, while protecting koalas and their habitat.

SEPP 44 applies to Singleton LGA. Although NOW does not require Council consent, the provisions of SEPP 44 have been considered within the REF. An Ecological Impact Assessment was undertaken for this proposal and did not identify any potential or core koala habitat, as defined in this SEPP (section 5.4.2).

2.2.3 State Environmental Planning Policy 19, Bushland in Urban Areas (SEPP 19)

The aim of SEPP 19 (Bushland in Urban Areas) is to preserve bushland in urban areas because of its natural heritage, aesthetic and recreational, scientific and educational values. Schedule 1 of SEPP 19 lists LGAs to which the SEPP applies and does not include Singleton LGA. As such, SEPP 19 does not apply to the proposal.

2.2.4 State Environmental Planning Policy 26, Littoral Rainforests (SEPP 26)

The aim of SEPP 26 is to provide an avenue for consideration of development that is likely to affect littoral rainforest areas, with a view to preserve their natural state. The proposal is not situated on land identified in SEPP 26, thus SEPP 26 does not apply.

2.2.5 Singleton Local Environmental Plan 1996

The proposal is located within the Singleton Local Government Area and as such, planning in this area is generally managed by the Singleton Local Environmental Plan 1996 (Singleton LEP). Table 2-1 lists the zonings and permissibility along the proposal.

Table 2-1: Current Land Zonings in the Area

<table>
<thead>
<tr>
<th>Bore Number</th>
<th>Council Area</th>
<th>Zoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Singleton</td>
<td>5 Special Uses</td>
</tr>
<tr>
<td>B1b</td>
<td>Singleton</td>
<td>6a Public Open space or 1d Rural Small Holdings</td>
</tr>
<tr>
<td>B3a</td>
<td>Singleton</td>
<td>Zone 1a Rural</td>
</tr>
</tbody>
</table>

The proposal is permissible without consent within the zones listed in Table 2-1 due to the application of clause 90 of the SEPP Infrastructure. The consent provisions of the LEP do not apply and the proposal will be assessed under Part 5 of the EP&A Act with NOW as the determining authority.

2.2.6 Draft Singleton Local Environmental Plan 2013

The Draft Singleton Local Environmental Plan 2013 has completed the public exhibition period and is estimated to take effect as of June 2013. Table 2-2 lists the zonings and permissibility along the proposal for the draft LEP.
Table 2-2: Land Zonings under the Draft LEP

<table>
<thead>
<tr>
<th>Bore Number</th>
<th>Council Area</th>
<th>Zoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Singleton</td>
<td>RU4, Primary Production, Small Lots</td>
</tr>
<tr>
<td>B1b</td>
<td>Singleton</td>
<td>R5, Village or RE1, Public Recreation</td>
</tr>
<tr>
<td>B3a</td>
<td>Singleton</td>
<td>E4, Environmental Living</td>
</tr>
</tbody>
</table>

B1a is located within the Singleton Military Area buffer area. Although development consent is not required for this proposal, it is important to take into consideration clause 7.8 of the draft LEP. This states:

“development consent must not be granted to any form of development to which this clause applies, including subdivision where additional opportunities for the erection of dwellings or tourist and visitor accommodation will result, unless consideration has been given to:

a) the impacts of any emissions (such as noise, vibration, odour) from the existing operation on the proposed development and any associated activities located within the buffer area,

b) any proposed measures incorporated into the development that limit the impact of such emissions associated with the existing land use,

c) any opportunities to relocate the proposed development outside of the buffer area to which this clause applies, and

d) an assessment of whether the proposed development and any associated activities would adversely affect the operational environment of the existing infrastructure to which the buffer area relates.”

An assessment of noise and air emissions as a result of the proposal has been undertaken in section 5.6 and 5.7. It is expected that the impacts of the proposal will be confined to the immediate construction footprint and therefore it is unlikely that the proposal will impact on the Singleton Military area buffer.

Site B1b is also located within close proximity to the following LEP listed heritage sites:

- St Andrew’s Anglican Church, 36 Wollombi Street (Lot 1, DP 758164); and
- Maria Immaculate Roman Catholic Church, 26-28 Wollombi Street (Lot 1-2, DP 758164)

It is not expected that the proposal will affect either of these sites. Further discussion on heritage is found in Section 5.5.

Clause 5.12 of the draft LEP states that, “this Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007. Due to the application of clause 90 of the SEPP Infrastructure, the proposal is permissible without consent and potential impacts will be assessed under part 5 of the EP&A Act.
2.3 State Legislation

2.3.1 National Parks and Wildlife Act 1974 (NPWS Act)

The NPWS Act is administered by the National Parks and Wildlife Service (NPWS) of the Office of Environment and Heritage (OEH) and provides a basis for the establishment, preservation and management of areas such as national parks, State conservation areas, historic sites, regional parks, karst conservation reserves, nature reserves, and Aboriginal areas. Wollemi National Park sits 1.3km to the south west of B3a and Yengo National Park sits 2km west of B1b. It is not expected that the proposal will impact on these National Parks or any other area established, preserved or managed under this Act. Whilst site B3a is not located on NPWS reserved land, it is located on an area of crown land managed by the NPWS for the siting of the NPWS Bulga office and Information Centre, as well as several ranger cottages. As such, permission would be obtained from NPWS prior to the construction of this bore on this site.

A permit or approval under the NPW Act is required if any protected native flora or fauna (s12), or Aboriginal sites or relics (s87) are to be affected or disturbed (see also Threatened Species Conservation Act 1995).

It is a defense under s80B of the regulations against the unintentional harming of an Aboriginal object (s86(2)) if the act or omission:

i) Was work of the following kind on land that has been disturbed:
   i. Seismic surveying; and
   ii. The construction and maintenance of groundwater monitoring bores.

Disturbed land includes land affected by:

a) Soil ploughing;

b) Construction of rural infrastructure (such as dams and fences);

c) Construction of roads, trails and tracks (including fire trails and tracks and walking tracks);

d) Clearing of vegetation;

e) Construction of buildings and the erection of other structures; and

f) Construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure).

Substantial grazing involving the construction of rural infrastructure, construction of earthworks associated with anything referred to in paragraphs (a)–(g). A search was completed on the Aboriginal Heritage Information Management Database for Aboriginal objects. Further detail on likely impact on any objects is outlined in section 5.5. In addition to this, the proposal will occur on land previously disturbed for agriculture and therefore if an Aboriginal object is uncovered during the works, mitigation measures as outlined in section 5.5.3 will be carried out.

An Ecological Impact Assessment was conducted as part of the REF and identified that no significant impact was likely on any threatened flora and fauna (see section 5.4).

2.3.2 Heritage Act 1977

The Heritage Act 1977 was introduced to conserve the environmental heritage of NSW.
Environmental heritage is defined as including buildings, works, relics or places which are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the State.

Heritage places and items of particular importance to the people of NSW are listed on the NSW State Heritage Register. One item in Bulga, Bulga Bridge over Wollombi Brook, is listed on the NSW State Heritage Register. This item, along with Bulga Police Station is also listed on the s170 Heritage register. The impact on heritage is discussed further in section 5.5. It is not expected that any significant impact on heritage items will occur as a result of the proposal.

Section 139 of the Heritage Act 1977 prohibits a person from disturbing or excavating any land on which the person has discovered or exposed a relic, except in accordance with an excavation permit or a notification granting exception for the permit. There are no known relics within the sites.

2.3.3 Protection of the Environment Operations Act 1997

 Requirement for a licence

The Protection of the Environment Operations Act 1997 (PoEO Act) prohibits the undertaking of scheduled activities and scheduled development work without a licence. The Act also prohibits the undertaking of polluting activities without a licence (both scheduled and unscheduled).

The proposal is not listed as a scheduled activity under the PoEO Act and therefore an EPL is not required.

The Protection of the Environment (Clean Air) Regulation 2002 (POEO (Clean Air) Reg) contains provisions on the emission of air impurities from motor vehicles and the compulsory fitting and maintenance of anti-pollution requirements. All vehicles operating on site will comply with the POEO (Clean Air) Reg.

The Protection of the Environment (Noise) Regulation 2008 (POEO (Noise)) makes provisions for the use of power tools and equipment at residential premises between certain hours and determining noise levels of particular articles. All work on site will comply with the POEO (Noise) Reg. The impact of the proposal on noise is further discussed in section 5.6

The Protection of the Environment (Waste) Regulation 2005 (POEO (Waste) Reg), as amended 28 April 2008, makes provision for, amongst other things, the tracking of waste between generators, transporters and receivers of waste and record keeping associated with such waste movements. Waste tracking and recording will be undertaken on site in accordance with the POE (Waste) Reg requirements.

2.3.4 Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 (TSC Act) is administered by the OEH and provides for the protection of threatened species, populations, ecological communities and their habitat, and critical habitat within NSW. The primary aims of the TSC Act are to protect, conserve and, where applicable, manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities. Schedules 1 and 2 of the Act list threatened species, populations and ecological communities that are classified as endangered or vulnerable.

A Biodiversity Impact Assessment was conducted as part of the REF and identified that no significant impact was likely on any threatened flora and fauna (see section 5.4, Appendix B).
2.3.5 Fisheries Management Act 1994

The *Fisheries Management Act 1994* provides for the conservation of the State’s aquatic resources and is administered by the Department of Industry and Investment (DII). The Act requires that potential impacts on threatened species and aquatic habitat be addressed during the environmental planning and assessment process.

An Ecological Impact Assessment was conducted as part of the REF and identified that no permanent natural water features identified at any of the proposed borehole sites.

2.3.6 Noxious Weeds Act 1993

The purpose of the *Noxious Weeds Act 1993* is to identify noxious weed areas where particular control measures need to be taken, to specify those control measures, and to specify the duties of public and private landholders for the control of noxious weeds. The Act categorises noxious weeds into four divisions according to the requirements for their control. Section 13 of the Act states that:

“a public authority that is an occupier of land must control noxious weeds on the land, as required under the control category or categories specified in relation to the weeds concerned, to the extent necessary to prevent the weeds from spreading to adjoining land”.

The proposal would not require any approvals under the Act. However, where weeds need to be cleared, the drilling contractor would need to identify the noxious weeds and the associated requirements for their removal and disposal.

2.3.7 Mine Subsidence Compensation Act 1961 and Regulation 2007

The purpose of this Act is to ensure that areas at risk of subsidence from mining activities are identified as Mine Subsidence Districts (MSD). Certain colliery owners contribute to a compensation fund used to compensate parties if mine subsidence can be shown to have damaged property.

A portion of the proposal (B3a) is located in the Patrick Plain declared Mine Subsidence area in accordance with section 15 of the Act. NOW would seek approval for the proposal from the Mine Subsidence Board under section 15 of the Act.

2.3.8 Waste Avoidance and Resource Recovery Act 2001

The purpose of this Act is to develop and support the implementation of regional and local programs to meet the outcomes of a state-wide strategy for waste avoidance and resource recovery. It also aims to, “minimise the consumption of natural resources and final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste”.

Waste generation and disposal reporting would be required during the construction of this proposal.

2.3.9 Water Management Act 2000 and Regulation

The *Water Management Act 2000* (WM Act) dictates how both surface and groundwater resources are managed in NSW. Its main objective is to ensure the future and present supply of water sources at a state level, and protect, develop and restore water resources in the region. It controls the extraction of water, how water can be used, the construction of works, such as dams and weirs and the carrying out of activities on or near water sources.

The main tool the Act provides for in managing the State’s water resources are Water Sharing Plans (WSP). The Act will generally apply to surface and groundwater sources in areas where a WSP is in
place (and outlined below). In areas where there is no WSP, the Water Act 1912 applies. The Hunter Unregulated and Alluvial Water Sources WSP applies to the area.

The WM Act details the requirements for licences for the access, use and supply of water (260A, s89 and s90 of the Act), as well as approval to carry out work on waterfront land (s91 Controlled activity approval). Waterfront land includes the bed of any river, together with any land within 40 m of the high water mark of the river.

Monitoring bores, as specified by Part 1 of Schedule 5 of the Regulations, are exempt from water access and water use approvals under clauses 18 and 31 of the Regulations. Exempt monitoring bores includes “a monitoring bore constructed in accordance with the Minimum Construction Requirements for Water Bores in Australia that is...constructed and operated only by the Ministerial Corporation”. As NOW is the Ministerial Corporation, the proposal is therefore exempt from obtaining either a Water Access or Water Use approval under the Act.

Whilst clause 38 of the Regulations exempts public authorities, and thus NOW, from requiring controlled activity approvals, it is an offence to harm waterfront land. Harm is defined as any act or omission that adversely affects the capacity of the waterfront land to hold or carry water. It is a defence under section 345 if the work that caused the harm was essential for the carrying out of an activity by a determining authority within the meaning of Part 5 of the EP&A Act. Whilst several small unnamed tributaries are located around the sites, it is not expected that the proposal will be undertaken on waterfront land.

Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009

The WSP covers the Hunter region and encompasses a variety of water sources, including the Lower Wollombi Brook Water Source, of which Broke is situated. The plan incorporates:

a) All water occurring naturally on or below the surface of the ground shown on the Plan Map for these water sources, and

b) All water in rivers, lakes and wetlands in these water sources, and

c) All water contained within alluvial sediments below the surface of the land shown on the Plan Map for these water sources (hereafter the alluvial sediments in these water sources), including any water contained in those unconsolidated alluvial sediments underlying the waterfront land within 1 metre of works taking water pursuant to licences issued under Part 5 of the Water Act 1912 or their equivalent aquifer access licence issued under the Act, that are not part of the Hunter Regulated River Water Source.

Water contained within the porous and fractured rock aquifers and basement rocks are amongst the exclusions for this plan. As the monitoring bores will be at a depth of no more than 300 m, monitoring water within sedimentary coal basins, the WSP is only relevant to a portion of the groundwater that will be encountered during drilling process.

In accordance with the rules for this source, new bores must not be constructed:

- 400m from an access licence bore;
- 200m from a Basic Landholder Rights (BLR) bore;
- 50m from the boundary (unless negotiated with neighbour);
- 500m from a local or major water utility bore (or as otherwise assessed); or
- 400m from departmental monitoring bore (unless negotiated with the department).
The monitoring bores B1a will be located within 50 m of an existing NOW monitoring bore. As both bores will be NOW operated bores, departmental negotiation is not considered necessary.

Whilst the rules also state that new bores must not be located:

- Within the following distances of high priority Groundwater Dependent Ecosystems (GDEs) (non Karst) as identified within the plan:
  - 100m for bores used for extracting for BLR;
  - 200m for bores used for all other aquifer access licences;
  - Where there is likely to be drawdown at the outside edge of the buffer zones referred to above.

- Bores are not to be located within the following distances from these identified features:
  - 500m of karsts;
  - In the bed of the river, unless assessment indicates that the work will have minimal harm on the river environment or stability.

- Within the 100m of contaminated sites as identified within the plan;

As the proposal is for monitoring bores, these rules do not apply.

No groundwater dependent ecosystems have been identified as occurring near Broke within this plan.

2.3.10 Water Act 1912

Part 5 of the Water Act 1912 (Water Act) stipulates that it is an offence against the act to sink a bore unless:

a) In pursuance of a licence issued under this Part, or
b) The bore is to be sunk, enlarged, deepened, or altered by the Crown.

NOW are a state owned agency and therefore representative of the Crown (in accordance with s13A of the Interpretation Act 1989. As such, a licence is not required for the sinking of the bores covered by this proposal.

‘Bore’ under the Water Act, includes any bore, well or any excavation or other work connected or proposed to be connected with sources of sub-surface water and used or proposed to be used to obtain supplies of such water whether the water flows naturally at all times or has to be raised either wholly or at times by pumping or other artificial means.

Whilst the Hunter Unregulated and Alluvial Water Sources WSP applies to the area, this is only within the alluvials. The hard rock areas do not have a WSP and therefore are covered by the Water Act.

2.3.11 Roads Act 1993

The Roads Act 1993 outlines the processes involved with the opening of roads, road levels, closing of public roads, roadwork, regulation of traffic (both temporary and permanent) by roads authorities, entry onto land and financial assistance to roads authorities.

Under section 138 of the Act, a person must not:
a) Erect a structure or carry out a work in, on or over a public road, or;
b) Dig up or disturb the surface of a public road, or
c) Remove or interfere with a structure, work or tree on a public road, or
d) Pump water into a public road from any land adjoining the road, or
e) Connect a road (whether public or private) to a classified road;
otherwise than with the consent of the appropriate roads authority.

However, in accordance with clause 5 of Schedule 2, public authorities are not required to obtain approval for works on unclassified roads.

RMS is responsible for managing public classified roads, whilst local councils are generally responsible for managing public unclassified roads.

The roads within the study area affected by the proposal are generally considered to be local and regional, unclassified roads and are managed by Singleton Council. NOW would not require approval from Council for work on these roads, but NOW have provided Council written information as to the nature and location of works.

2.4 Commonwealth Legislation

2.4.1 Environmental Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act), activities that are likely to have a significant impact on matters of national environmental significance, Commonwealth lands, or actions undertaken by the Commonwealth, are subject to assessment and approval.

Matters of national environmental significance (NES) are identified in the Act as: World Heritage properties, national heritage properties, Ramsar wetlands, nationally threatened species and communities, migratory species protected under international agreements, Commonwealth marine environment, the Great Barrier Reef Marine Park and nuclear actions. Several nationally threatened species and communities are listed as potentially occurring within the study area. The Ecological Impact Assessment conducted as part of the REF identified that no significant impact was likely on any matters of NES (see section 5.3).

2.5 Strategic Considerations

2.5.1 Strategic Regional Land Use Plan – Upper Hunter

The *Strategic Regional Land Use Plan* (the Plan) has been developed to represent, “the Government’s proposed framework to support growth, protect the environment and respond to competing land uses, whilst preserving key regional values over the next 20 years” (DPI. 2012). In the Upper Hunter area, “it is particularly important to minimise land use conflicts arising from the rapid growth of coal mining activities and the recent emergence of the coal seam gas industry”.

The Upper Hunter region has been described within the plan as having an economy underpinned by coal mining, agriculture and associated service industries (dairy, beef and pasture), horse breeding, electricity production, tourism, viticulture and wine making.

The Plan provides for a range of key challenges facing upper Hunter region and actions to addresses these challenges. Challenges include:
• Balancing Agriculture and Resource Development;
• Infrastructure;
• Economic Development and Employment;
• Housing and Settlement;
• Community Health and Amenity;
• Natural Environment;
• Natural Hazards and Climate Change; and
• Cultural Heritage.

In order to effectively manage growth and competing land uses within the region, the region has been mapped according to areas of high agricultural value, referred to as Strategic Agricultural Land. Strategic Agricultural Land is that defined as being, “highly productive land that has both unique natural resource characteristics...as well as socio-economic value...” Two categories of strategic agricultural land have been developed and include:

• Biophysical Strategic Agricultural Land – land with a rare combination of natural resources highly suitable for agriculture; and

• Critical industry clusters (CIC) – localised concentration of interrelated productive industries based on an agricultural product that provides significant employment opportunities and contributes to the identity of the region. The cluster also needs to be potentially substantially impacted on by coal seam gas (CSG) or mining proposals.

If a state significant mining or CSG proposal is located on strategic environmental land, it must be assessed through a Gateway Process; an independent scientific assessment on the impact of the proposal on the agricultural values of the land. Additionally, all state significant development and infrastructure proposals, including exploration activities determined by Part 5 of the EP& A Act, must prepare an Agricultural Impact Statement (AIS).

The area of Broke is mapped as a CIC Viticulture cluster due to the concentrations of vineyards as well as winery and tourism infrastructure within a rural landscape. The implementation of this proposal will assist in developing a greater understanding of the impact future CSG and mining proposals have on groundwater within this region as it will provide a means to monitor the groundwater within key locations of this CIC. Having a greater understanding of groundwater quality around Broke will also assist with the assessment of future applications.

In addition to this, this REF provides an assessment of a range of environmental issues which may be impacted on as a result of construction and operation of this proposal including; the natural environment, cultural heritage, amenity, and transport (see section 5). As such, the REF is taking into account some of the key challenges for the region as they relate to this specific proposal and managing these issues so they do not result in a greater impact for the region.

2.5.2 NSW Aquifer Interference Policy

The Aquifer Interference Policy has been developed to provide the following objectives:

• Clarify the requirements for obtaining water licences for aquifer interference activities under NSW water legislation; and
Establish and objectively define considerations in assessing and providing advice on whether more than minimal impacts might occur to a key water-dependent asset.

Aquifer interference activities are defined under the *Water Management Act 2000* as those which involve:

- The penetration of an aquifer;
- The interference with water in an aquifer;
- The obstruction of the flow of water in an aquifer;
- The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations; and
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The Policy outlines license requirements for water taken through aquifer interference under both the *Water Management Act 2000* and the *Water Act 1912*.

When a mining or coal seam gas development proposal occurs on strategic agricultural land and is assessed by the Gateway Panel, an assessment must be undertaken on the impacts of the proposal on aquifers against this policy. In addition to this, before granting water access licences or approvals under the *Water Management Act*, NOW must be satisfied that the activity will result in, “no more than minimal harm”. This policy outlines minimal impact considerations of which proposals will be assessed against and provisions by which proponents are to comply to enable appropriate assessment.

The Policy also stipulates several aquifer interference activities that are by their nature defined to be of minimal impact. Monitoring bores and wells that are constructed and operated by the Ministerial Corporation are listed as being of minimal impact. Therefore, as the bores and wells for this proposal will be constructed and operated by NOW, they are considered to be of minimal impact.

### 2.6 Stakeholder Consultation and Community Consultation

Key stakeholders relevant to the proposed drilling program include:

- State regulatory agencies;
- Local government;
- Landholders and occupiers;
- Local community, users of local facilities, business and special interest groups; and
- Utility operators.

A community consultation database has been established and will be maintained to monitor and address any concerns or issues raised by the local community and/or key stakeholders.

#### 2.6.1 State Government Agencies

A proposal fact sheet was developed and sent to relevant stakeholders for the sites including the Local Aboriginal Land Council.
No issues have been raised to date in regards to the works.

As the proposal is located within a Mine Subsidence District, NOW will require the approval of the Mine Subsidence Board prior to commencing drilling works.

The NPWS are the managers of the land for the site of B3a and as such, NOW have undertaken consultation with the area manager of the Bulga NPWS office in regards to the location of B3a on this land. NOW will obtain formal consent from NPWS prior to undertaking the proposal and will issue NPWS a copy of this REF as part of the consent process.

NOW have an existing Memorandum of Understanding (MOU) with the Land and Property Management Authority (LPMA) for the installation of bores on Crown land. As two of the sites are located on Crown land reserve, in accordance with this MOU, NOW have submitted formal notification (Access Notice), dated 8 July 2013, to LPMA in regards to the use of these sites. As per the conditions of the MOU, if LPMA do not respond to the contrary within 21 days of the notification date, NOW is authorised to use and occupy crown land for these boreholes (B3a and B1b).

2.6.2 Local Government

Singleton Council is the local government authority for Broke and Bulga and as such they have been notified of the proposed works. In addition to this, Singleton Council is the land manager for McNamara Park, the location of site B1b and therefore permission has been sought from Singleton Council in regards to the location of the borehole on this site.

2.6.3 Local Community

A proposal fact sheet has been developed and will be distributed to residents in close proximity to each of the proposed boreholes and relevant sensitive receivers prior to work commencing.

Once finalised, a copy of this REF will be placed on the NOW website (www.water.nsw.gov.au) to provide further information on the works to any interested party.

At the time of writing, no issues have been raised by the local community in regards to the proposed works.
3 Alternatives and Justification for the Proposal

3.1 Proposal Need

Given the increase in mining, particularly coal seam gas and large coal mining developments, within the Hunter and Upper Hunter regions of NSW, there has been an increased interest in, and need to further understand, the impact of these activities on groundwater sources. The construction of monitoring bores into the sedimentary coal basin, will aid in further understanding this impact.

3.2 Proposal Options

3.2.1 Do Nothing

If the monitoring bores were not constructed then it would be difficult to ascertain the level of impact of the groundwater within the aquifers of the sedimentary coal basins, and therefore determine the impact of mining and petroleum activities on groundwater levels (quantity) and quality. Whilst groundwater monitoring is undertaken by mining companies, the construction of groundwater monitoring bores by a state authority, such as NOW, provides independent data and analysis that will be publically available.

3.2.2 Alternative Sites

In determining the location of the proposed borehole sites, consideration was given to a variety of factors to minimise potential impacts on the surrounding community and environment. These included:

- Location of sensitive receivers;
- Proximity to threatened flora and fauna;
- Proximity to Aboriginal and non-Aboriginal heritage;
- Proximity to waterways and flood potential;
- Availability of existing access routes; and
- Depth to coal seam.

An additional borehole at Bulga, site B3b, was discounted from this proposal due to the difficulty in accessing the site and it's location within a river bed.

3.3 Justification of Option

The borehole locations within this proposal were selected because they were considered to provide a good representation of groundwater close to mining and coal seam gas activities in both Bulga and Broke. Additionally the sites selected were located close to existing access routes and will have minimal impact on the surrounding community and the environment.
4 Proposal Description

4.1 Scope of Works

Three priority sites for bore drilling have been identified in the Broke-Bulga area. At each of the sites it is expected to drill two boreholes as nested monitoring bores. The deeper bore will be drilled to the nearest overlying porous rock aquifer above the commercial coal seams targeted by mining and petroleum industries. During drilling stage well control using a blow out preventer annular and blind ram will be undertaken. The depth at which each bore is expected to be sunk is outlined in Table 4-1.

<table>
<thead>
<tr>
<th>Bore Number</th>
<th>Approximate Depth of Bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>250m</td>
</tr>
<tr>
<td>B1b</td>
<td>250m</td>
</tr>
<tr>
<td>B3a</td>
<td>250m</td>
</tr>
</tbody>
</table>

Mud rotary drilling will be used which involves a special mix of clay and water being forced down the drill hole turning a rotary bit, with rock chips returning in the "mud" slurry. This method is used for drilling through soft rocks, sand and clay layers.

It is proposed to control all sediment and water above ground using a mud recycling tank with back up reserve tanks for additional drill mud cuttings and water. When developing the bore, it is proposed to use a Blooie line and tank to allow sediment and waste to be transported to an approved off site facility for waste disposal.

The only proposed excavation on site is a 2 m x 2 m deep cellar to allow installation of the Blow Out Preventer (BOP). This will be backfilled and restored upon completion of site.

A small flare pit will be installed 35 m from the well head to mitigate against the event of a gas or fluid leak and to allow flaring of any gas for safety reasons. There will also be a two inch pipeline from the drill site to the flare pit. The flare pit is proposed to be approximately 2 m x 2 m and 0.6m deep. This pit will also be backfilled and rehabilitated upon completion of the drilling.

4.2 Materials and Equipment

The following equipment and associated temporary infrastructure are required for the proposed drilling operations:

- Mobile drilling rig (Bournedrill 350 THD rig), including support vehicles and equipment;
- Site office;
- 15,000 Litre mud recycling system to clean muds and recycle down the borehole;
- Two 15,000 Litre muds and sediment tanks;
- Bunded chemical storage area;
- Top soil and sediment storage area;
- BOP cellar and Flare pit;
• Koomey unit; and
• Temporary toilet.

Figure 4-1 shows the likely drill site layout. Fuel will be located up gradient, remote from the active drilling area in a bunded area and separate to the process water capture and sediment treatment area.

Figure 4-1: Drill Site Layout

4.3 Worksites, Access and Vehicle Movements

The drilling and testing operation will involve the drilling rig, a support truck, service vehicles and other smaller support vehicles. A maximum of four to five support vehicles could be expected on any one site at any one time.

Heavy vehicle traffic and other vehicle movements at each drill site will involve:
• A once only movement onto and off each drill site by the drilling rig;
• Daily movements by the support truck to the site to deliver casing, screens, cement/concrete, protectors, and other drilling consumables;

• Remove drilling water from site and recyle of send to an licensed treatment facility; and

• Crew support vehicles (light 4WD vehicles).

Dedicated parking and turn areas will be established at each site for all vehicles. Traffic management plans will be in force where required. Signage will be placed on the road alerting traffic that trucks are entering and crossing in these areas.

4.4 Workforce and Timeframe

Work will be carried out seven days a week, Monday to Sunday, 7am to 7pm. The work is expected to continue for a maximum of 2-3 weeks at each site.
5 Existing Environment, Potential Impacts and Mitigation Measures

5.1 Topography, Geology and Soils

5.1.1 Existing Environment

The Broke-Bulga area consists of a diverse range of gently undulating landscapes and rich farmland set against a backdrop of rocky outcrops, sandstone cliffs and rugged scrub-covered mountains. The Upper Wollombi Brook catchment, headwaters of the Wollombi Brook, is highly forested and rises to a maximum elevation of 550 m. As the Wollombi Brook moves down the valley, floodplain extents increase with remnant channels in some parts of the floodplain (Umwelt 2013). The townships of Broke and Bulga are located on the alluvial floodplain at the base of the forested areas. Parts of the catchment are heavily forested, including the Yengo National Park, Pokolbin State Forest and Wollemi National Park. The Wollemi and Yengo National Parks are both part of the Greater Blue Mountains World Heritage Area. Further rocky outcrops are located around the township of Broke, with the Yellow Rock Escarpment to the northwest of town.

Monkey Place Creek is an ephemeral tributary of Wollombi Brook with its headwaters originating in the Broken Back Range. The Monkey Place Creek subcatchment consists of hills with grades typically between 3 and 10 per cent with steeper sections associated with the Vere escarpment and the Broken Back range where cliffs and steep terrain are found (Umwelt 2013). Soils within the Monkey Creek catchment (site B1a) are classified as yellow duplex with uniform sands, gravelly loams and clays (Australian Atlas of Mineral Resources, Mine and Processing Centers 2012).

The townships of Broke and Bulga lie within the Sydney Basin, part of the larger Sydney-Gunnedah-Bowen Basin and stand at 84 m above sea level and 69 m respectively. A large open cut and underground coal mine is located north of Broke township, to the east of Bulga and is known as the Bulga Coal Complex. This complex is managed by Xstrata Coal and targets the Redbank, Wambo, Blakefield, Glen Munro and Woodlands Hill seams of the Whittingham coal measures within the Sydney Basin. These coal measures produce both soft coking and thermal coal products (Australian Atlas of Mineral Resources, Mine and Processing Centers 2012).

Triassic intercalated Sandstone and shale outcrops occur through the Wollombi Brook with red duplex soils of well structured, loamy surfaces. Permian to middle Triassic continental sediments can be found, including coal, and mafic to felsic volcanic with a maximum thickness of 5,000 m (New South Wales Mineral Council 2013). The Hunter coalfield, the primary target of the Bulga mine, is the largest coal-producing region in NSW. The Hunter coal seams are mostly at shallow depths of less than 300 meters, enabling open cut mining operations (New South Wales Mineral Council 2013). AGL are currently investigating and exploring for potential coal seam gas reserves in the Broke area (ref: http://agk.com.au/hunter/).

There are no known occurrences of Acid Sulphate Soils (ASS) within the vicinity of the three sites. A search of the Australian Soil Resource Information System (ASRIS) (31 May 2013) CSIRO soil database found that all three drill holes are located in areas where ASS have ‘low probably of occurrence’.

A search of the NSW EPA Contaminated Land record (14 June 2013) database found that there are no known occurrences of contaminated land within the vicinity of the three sites.
5.1.2 Impacts

Any impact on soils is likely to be a result of the use of equipment at each drill site. Potential impacts include:

- Soil contamination as a result of oil, chemical, grease or fuel spillages or leaks associated with operation of machinery;
- Soil compaction in areas immediately surrounding the drill sites. This may have implications for infiltration of rainfall into the soil column and may slightly alter surface drainage characteristics; and
- Sediment runoff from disturbed areas adjacent to the work sites.

One 2 m x 2 m deep cellar will be excavated to allow for installation of the BOP. A small flare pit will also be installed approximately 35 metres from the well head. There will also be a pipeline that runs from the drill site to the flare pit. These small excavations will be backfilled and restored upon completion of works. Therefore, the potential exists for erosion during excavation and other minor site set-up activities. Temporary stockpiles would have the potential to erode due to wind or water exposure and the occurrence of any heavy rainfall could amplify on-site erosion with water draining off disturbed areas and transporting sediment loads into adjacent drainage pathways, local creeks and waterways.

5.1.3 Mitigation Measures

The following mitigation measures have been recommended to reduce or minimise impacts:

- Integrated sediment and erosion control measures would be installed as necessary to control stormwater and pollution and would be in place prior to any earth works commencing.
- Sediment and erosion control measures would be routinely inspected and maintained to ensure they remain effective.
- Wherever possible, excavated soil and sediment accumulated in erosion and sediment control structures would be reused for site restoration unless contaminated or otherwise inappropriate for reuse. The sediment would be checked for reuse ability prior to site restoration.
- Minimal ground disturbance would occur.
- Site watering would be undertaken to suppress dust if required.
- Stormwater controls (bunding) would be used to divert clean water around the site (where required).
- On completion of the drilling, all cuttings would be removed and the site restored to its former contour shape.
- If ASS are suspected, testing would be undertaken. If ASS are found then an ASS Management Plan would be developed and implemented.
- Trucks and machinery would be checked for leaks and appropriate spill kits would be available at all times.
Vehicle and machinery movement would be confined to designated tracks, pathways and work areas.

Vehicle access routes to and within the site(s) would be clearly defined.

Refuelling activities would be undertaken off site, as far as practicable, however most of the stationary equipment would need to be refuelled on site. This would be undertaken with bunded fuel tanks, no tankers would be involved in refuelling.

Topsoil would be stockpiled separately from other spoil for reuse.

Measures would be taken to prevent tracking of soils/sediments from work sites to roadways and footpaths as a result of work vehicle/machinery movement (for example wheel washing may be used or sweeping of roads would occur at completion of work each day).

Compacted soil areas would be ripped on completion to prevent preferential drainage patterns across the site.

Works would not be undertaken during periods of high rainfall.

The sites would be rehabilitated to their existing condition on completion of the work, as far as practicable, and any restoration measures adopted would be monitored for effectiveness, and modified as required.

5.2 Surface Water

5.2.1 Existing Environment

Major rivers of the Upper Hunter Catchment include the Hunter, Goulburn, Pages, Dart Brook and Wollombi Brook. The predominant river within the project area is the Wollombi Brook, starting below Mount Warrawolong at an elevation of 426 m and ending at an elevation of 48 m flowing northward into the Hunter River. The Wollombi Brook drops around 378 m over its 118 km length and passes through rural towns including Broke and Bulga (Lamontage et al. 2003). Wollombi Brook is a sand-bed stream with erosional sand deposits (sand slugs) common in the river channel as well as incised channels from substantial erosion Wollombi Brook is characterised by highly variable flows with prolonged low flow periods and infrequent, short-duration but potentially catastrophic floods (Lamontage et al. 2003). It is recognised that Lower Wollombi Brook has limited surface flows and is a groundwater dominated system (NSW Department of Water and Energy 2009). During significant dry periods, Wollombi Brook’s alluvial aquifer has increased significance as a groundwater resource for ecosystems and water use (Umwelt 2013).

Monkey Place Creek, also known as Yellow Rock Creek, is an ephemeral watercourse and flows into Wollombi Brook to the east of the Broke township. Site B1a is located within the Monkey Place Creek subcatchment. Monkey Place Creek varies from highly confined in the upper reaches to partly confined in the lower reaches. Around Broke the creek is situated on a broad valley floodplain with a sinuosity of around 1.4. The creek has a defined and typical U shaped channel and the sediment matrix is largely made up of fine sand and silt (Umwelt 2013). Monkey Place Creek ceases to flow during dry spells, or in some instances reduces to a series of pools.

Broke and Bulga are located within the Lower Wollombi Brook Management Zone. The total surface water entitlement for this area is 6,663 ML/year (88% used for irrigation purposes, 10% used for industrial purposes) (NSW Department of Water and Energy 2009).
Surface water quality of the Wollombi Brook has been well documented since 2004, in part by the water monitoring requirements of the Bulga mine. In addition, NOW has three monitoring sites on Wollombi Creek. Previous water quality investigations have found that water quality within Wollombi Brook is, on average, within the Australian and New Zealand Conservation Council Guidelines for Fresh and Marine Waters (ANZECC) default trigger values for pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS). Some exceedences of trigger values for TSS have been noted which can be caused by deposition or dilution within the sampled reach.

Water quality data from Monkey Place Creek is, on average, above ANZECC Guideline trigger values for EC and TSS. As no mining activities or infrastructure is located within the Monkey Place Creek catchment, these values are likely to represent background water quality. The cleared nature of the catchment, combined with a depositional environment, suggests that this creek is naturally high in EC and TSS.

Historical water quality data also suggests that TSS within Wollombi Brook and Monkey Place Creek is highly variable. This may be explained by the variable nature of flow in these two creeks, together with the presence of dispersive soils and extensive sediment deposition observed in the area.

There are two surface water systems within close proximity of sites, Wollombi Brook and Monkey Place Creek. Table 5-1 shows the distances to closest watercourses for all three sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Closest watercourse</th>
<th>Distance from watercourse</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Monkey Place Creek</td>
<td>90 meters</td>
</tr>
<tr>
<td>B1b</td>
<td>Wollombi Brook</td>
<td>75 meters</td>
</tr>
<tr>
<td>B3a</td>
<td>Wollombi Brook</td>
<td>800 meters</td>
</tr>
</tbody>
</table>

5.2.2 Impacts

Impacts from the bore program may include:

- Fuel or chemical spills;
- Sediments washed away from disturbed areas;
- Increased soil erosion and sedimentation resulting from localised flooding of construction sites during periods of heavy wet weather; and
- Increased sedimentation from sites if proper controls are not adopted.

However, due to the localised nature and duration of works and provided mitigation measures are implemented, it is not expected that there would be any significant impact on any surface water bodies.

5.2.3 Mitigation Measures

The following mitigation measures have been recommended to reduce or minimise impacts:

- Run-on waters from rainfall events would be diverted from the construction area by the construction of diversion drains and or bunds on the up-gradient side of the site. Clean water would be diverted to roadside swales and natural bushland areas. Water from any diversion tracks constructed would be diverted away from the trail and tracks through sand bags, silt fencing and other control measures so as to direct water into bushland and not erode the track areas.
• Any refuse waters would be treated as contaminated and contained in above ground mud tanks where they would be stored until they are removed off site and disposed of at an EPA licenced facility.

• Sediment fences would be installed to prevent soil loss and runoff into any nearby water course.

• All water and mud would be removed off site at the completion of works and disposed at an EPA licensed facility.

• A periodic “pumpout” of the tanks would occur as required to prevent any surcharge during wet weather events.

• All land disturbed during operations would be restored to pre-operational quality as soon as practicable.

• Trucks and machinery would be checked for leaks and appropriate spill kits would be available on site at all times.

• All refuelling activities would be undertaken off site, as far as practicable.

• All chemicals and fuels would be stored in suitable bunded areas away from drainage lines. The capacity of the bunded area would be at least 110% of the largest chemical container stored within the bunded area.

• Where possible, stockpiles would be placed away from kerbs and drainage lines.

5.3 Groundwater

5.3.1 Existing Environment

Typically, the Bulga – Broke region contains three aquifer systems, as summarised below:

• Quaternary alluvial deposits, which are in hydraulic connection with both the Wollombi Brook and Monkey Place Creek;

• Near surface Permian weathered bedrock; and

• The coal seams of the Permian Jerrys Plains subgroup.

Quaternary

The Wollombi Brook alluvium is up to 20 m thick and recharged by rainfall and runoff and sustains a relatively shallow water table, hence, considered an important groundwater resource for agriculture, irrigation and stock use. The aquifer comprises saturated basal sand and gravels, overlain by fine grained silty and clayey sediments (Rio Tinto 2010). The estimated rainfall recharge to alluvial aquifer is 5,567 ML/year (NSW Department of Water and Energy 2009).

Groundwater quality can range from fresh to saline depending on the predominant source of recharge. During times of no rainfall, the source of recharge is predominantly the underlying coal measures which can lead to poor water quality (salinity). In contrast during times of rainfall and subsequent runoff, groundwater is recharged by fresh quality water, thereby enhancing groundwater quality (McLean et al. 2010).
Permian

The Jerrys Plains subgroup contains coal seams currently mined at Bulga and is a regular layered westerly dipping sedimentary sequence forming the basement rock. The weathered bedrock horizon is comprised of superficial soils between 10 to 20 m thick. This regolith temporarily stores groundwater during wet periods, and provides recharge to the underlying coal measures (Rio Tinto 2010). The coal seams are generally confined above and below by interburden aquitards made of conglomerates, sandstones, siltstones and claystones which have low to very low permeabilities (Mackie Environmental Research, 2013).

The total groundwater entitlement of the Lower Wollombi Brook Water Source within the Hunter Unregulated and Alluvial Water Sources Water Sharing Plan (2009) is 5,071 ML/year, this amounts to 90% of the rainfall recharge documented earlier. Of the groundwater entitlement, 55% is used for irrigation purposes and 44% is used for industrial purposes.

5.3.2 Impacts

All three sites target either the Wollombi Brook alluvium or the Permian coal seams. As drilling works would intersect and transgress through the shallow alluvial groundwater aquifer, there is potential to contaminate groundwater as a result of:

- Surface runoff from any utilised chemicals, fuel, oil and drilling fluids that may be present onsite or associated with operating machinery; and
- Cross-contamination via potential interconnectivity between the alluvial and coal seam aquifers during the drilling process, as a result of poor hydraulic isolation between these groundwater bearing horizons.

5.3.3 Mitigation Measures

The following mitigation measures are recommended to reduce or minimise impacts.

- Where the drill hole intersects with an alluvial aquifer, it would be solid cased to minimise any potential effect on other users of the groundwater and the environment.
- All brackish or refuse water would be treated as contaminated and be contained in appropriately sized tanks and disposed of off site at an EPA licenced facility.
- A silt fence would be installed around the work area and bunding installed where appropriate to mitigate against potential chemical and drilling fluid spills and runoff.
- No refuse water would be released into the surrounding environment.

5.4 Flora and Fauna

5.4.1 Existing Environment

A Biodiversity Impact Assessment was conducted by Niche Environmental as part of this REF (Appendix B). This assessment involved a desktop search of threatened species registers and a site survey undertaken on 14-19 June 2013.

The desktop assessment was for a 10km radius and included searches on the following databases:

- OEH Atlas of NSW Wildlife; and
- EPBC Act Protected Matters Search Tool.
The results of this desktop assessment are recorded in Table 5-2 and can be found in more detail in Appendix B.

### Table 5-2 Threatened Flora and Fauna of the Locality

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Threatened Flora</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lobed Bluegrass</td>
<td>Bothriochloa biloba</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>North Rothbury Geebung</td>
<td>Pedrsoonia pauciflora</td>
<td>CE</td>
<td>CE</td>
</tr>
<tr>
<td></td>
<td>Philotheca ericifolia</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>A leek orchid</td>
<td>Prasophyllum sp. Wybong (C.Phelps ORG 5269)</td>
<td></td>
<td>CE</td>
</tr>
<tr>
<td>Cobar Greenhood Orchid</td>
<td>Pterostylis cobarensis</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Rulingia procumbens</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Austral Toadflax</td>
<td>Thesium australae</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td><strong>Threatened Fauna</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giant Burrowing Frog</td>
<td>Heleioporus australiacus</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Giant Barred Frog</td>
<td>Mixophyes iterates</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Green and Golden Bell Frog</td>
<td>Litoria aurea</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Booroolong Frog</td>
<td>Litoria booroolongensis</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Littlejohn's Tree Frog</td>
<td>Litoria littlejohni</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Broad-headed Snake</td>
<td>Hoplocephalus bungaroidi</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Spotted Harrier</td>
<td>Circus assimilis</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Little Eagle</td>
<td>Hieraaetus morphnoidies</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Australian Painted Snipe</td>
<td>Rostratula australis</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Glossy Black-cockatoo</td>
<td>Calyptorhynchus lathami</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Gang-gang Cockatoo</td>
<td>Callocephalon fimbriatum</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Little Lorikeet</td>
<td>Glossopsitta pusilla</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Turquoise Parrot</td>
<td>Neophema pulchella</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Swift Parrot</td>
<td>Lathamus discolor</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Sooty Owl</td>
<td>Tyto tenebricosa</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Masked Owl</td>
<td>Tyto novaehollandiae</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Powerful Owl</td>
<td>Ninox strenua</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Barking Owl</td>
<td>Ninox connivens</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Brown Treecreeper</td>
<td>Climacteris picumnus victoriae</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Speckled Warbler</td>
<td>Pyrrholaemus saggitatus</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Regent Honeyeater</td>
<td>Xanthomyza Phrygia</td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>

Ref: 475173 August 2013 Final
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painted Honeyeater</td>
<td><em>Grantiella picta</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Hooded Robin</td>
<td><em>Melanodryas cucullata cucullata</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Flame Robin</td>
<td><em>Petroica phoenicea</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Scarlet Robin</td>
<td><em>Petroica boodang</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Grey-crowned Babbler</td>
<td><em>Pomatostomus temporalis temporalis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Varied Sittella</td>
<td><em>Daphoenositta chrysoptera</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Diamond Firetail</td>
<td><em>Stagonoplera guttata</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Spotted-tailed Quoll</td>
<td><em>Dasyurus maculatus maculates</em></td>
<td>V</td>
<td>E</td>
</tr>
<tr>
<td>Brush-tailed Phascogale</td>
<td><em>Phascogale tapoatafa</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Koala</td>
<td><em>Phascolarctos cinereus</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Yellow-bellied Glider</td>
<td><em>Petaurus australis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Squirrel Glider</td>
<td><em>Petaurus norfolkensis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Brush-tailed Rock-wallaby</td>
<td><em>Petrogale penicillata</em></td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Grey-headed Flying-fox</td>
<td><em>Pteropus poliocephalus</em></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Yellow-bellied Sheath-tail-bat</td>
<td><em>Saccolaimus flaviventris</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Eastern Freetail-bat</td>
<td><em>Mormopterus norfolkensis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Little Bent-wing Bat</td>
<td><em>Miniopterus australis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Eastern Bent-wing Bat</td>
<td><em>Miniopterus schreibersii oceanensis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Large-eared Pied Bat</td>
<td><em>Chalinolobus dwyeri</em></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Eastern False Pipistrelle</td>
<td><em>Falsistrellus tasmaniensis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Large-footed Myotis</td>
<td><em>Large-footed Myotis</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Greater Broad-nosed Bat</td>
<td><em>Scoteanax ruepellii</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Eastern Cave Bat</td>
<td><em>Vespadelus troughtoni</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>New Holland Mouse</td>
<td><em>Pseudomys novaehollandiae</em></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Hastings River Mouse</td>
<td><em>Pseudomys oralis</em></td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>

Key: CE = Critically Endangered; E, E1 = Endangered; EP = Endangered Population; V = Vulnerable

The Broke-Bulga locality is home to the following endangered populations:
- Weeping Myall of the Hunter Valley;
- River Redgum of the Hunter Valley; and
- Tiger Orchid of the Hunter Valley.

The Broke-Bulga locality is home to the following endangered populations:
TSC listed *White Box- Yellow Box- Blakely’s Red Gum Woodland EEC;*

EPBC Act listed *White Box- Yellow Box- Blakely’s Red Gum Grassy Woodland and derived native grasslands CEEC;*

TSC Act listed *Hunter Valley Dry Rainforests EEC;*

TSC Act listed *Weeping Myall Woodlands EEC;*

EPBC Act listed *Myall Woodlands EEC;*

TSC Act listed *Central Hunter Spotted Gum Ironbark Box Forest EEC;*

TSC Act listed *Central Hunter Box Ironbark Woodland EEC;* and

TSC Act listed *Hunter Lowland Redgum Forest EEC.*

**Flora**

Native vegetation cover was identified as occurring at all proposed borehole sites. Borehole site B1a is described as a secondary grassland dominated by Common Couch (*Cynodon dactylon*) and exotic species common found in heavily grazed pastures. Table 5-3 identified the vegetation cover at the remaining proposed borehole site including listed status under the TSC Act and/or EPBC Act.

**Table 5-3 Vegetation Cover of the Proposed Borehole Sites**

<table>
<thead>
<tr>
<th>Site</th>
<th>Vegetation Cover</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Yes- secondary grassland dominated by Common Couch</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>B1b</td>
<td>No- exotic grasses and herbs</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>B3a</td>
<td>No- exotic grasses and herbs</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

No threatened flora species were identified at the borehole sites.

**Fauna Habitat**

**Tree hollows and stags**

No hollows or dead trees were identified in the drilling area or associated access pathway. Notwithstanding, avoidance of canopy tree species is required to avoid impacts on threatened bird and mammal species, which can be demonstrated at each of the sites.

**Overstorey composition**

A tree canopy was observed to surround one of the sites (i.e. B1b). Rough-barked Apple dominates the tree canopy around this borehole site, which is capable of supporting foraging by threatened bird and bat species. Avoidance of canopy tree species is required to avoid impacts on threatened bird species, which can be demonstrated at this site.

**Fallen logs**

No fallen logs were identified at the three proposed borehole sites.

**Water availability**
There are no permanent natural water features identified at any of the proposed borehole sites.

Despite the lack of available fauna habitat at each of the sites, the following species were identified as affected fauna species:

- Speckled Warbler (*Pyrrholaemus saggitatus*);
- Hooded Robin (*Melanodryas cucullata cucullata*); and
- Diamond Firetail (*Stagonopleura guttata*).

These species have been identified as affected as they:

- Feed on seed and insects in the groundcover layer; and
- May nest in the groundcover layer (Speckled Warbler).

### 5.4.2 Impacts

Seven part tests were conducted for the Speckled Warbler, Hooded Robin and Diamond Firetail (Appendix B). These tests identified that no significant impact on the species was likely as a result of the works. The proposed impact is considered to be relatively small in scale, impacting approximately 0.3 hectares at each site. As each site will be rehabilitated upon conclusion of the works, any impact experienced is likely to be short-term.

Given the absence of threatened flora at each of the borehole locations, no significant impact is anticipated on threatened species, ecological communities and their habitats.

### 5.4.3 Mitigation Measures

- All occurrences of fallen logs and hollow-bearing trees (including dead trees) would be avoided.
- All clearing of live trees and understory vegetation would be avoided.
- Upon completion of the works, each site will be rehabilitated to condition pre-works.
- If lighting is required during construction, this would be directed away from intact vegetation to avoid disturbance of passing fauna.
- Where practicable, materials, plant, equipment and stockpiles would not be placed in a manner that results in damage to vegetation located adjacent, or within the drip-lines of any trees.
- Managing all weeds removed as part of the proposal in accordance with the requirements of the *Noxious Weeds Act 1993*. All noxious weeds which are cleared as part of the proposal would be disposed of appropriately.
- Inspections/maintenance would take place to reduce the carriage or weed and noxious weed material on machinery.
• Backfilling or covering of any excavations at night to prevent fauna falling in would occur. Open excavations would be checked each morning, prior to the commencement of construction, to salvage any fauna that have fallen in, and move them to a safe (and appropriate) nearby location. This would involve developing protocols to deal with the removal of injured or dangerous animals (e.g. snakes).

• If any threatened species (flora or fauna) are discovered during the work, all work would stop immediately and the environmental representative for the Contractor would be notified. Work would only recommence once the impact on the species has been assessed and appropriate control measures developed.

5.5 Heritage

5.5.1 Existing Environment

Aboriginal Heritage
A search on the Office of Environment and Heritage Aboriginal Heritage Information Management System database (AHIMS) was conducted for the Lot and DP of all three drilling locations. The searches identified the presence of seven Aboriginal objects located within 200 m of the lot but only one of these was located within a 50m buffer of the lot. An advanced search was also conducted to obtain the geographical coordinates of AHIMS sites located within 200 m of the proposed lots in which drilling would occur. From this advanced search, only one Aboriginal site (37-6-1225) was found to be located within close proximity to the proposed bore holes, with an AHIMS site located approximately 280m to the north east of borehole B1b. Given the proximity of the Aboriginal site to this borehole, the AHIMS site card site was obtained and this confirmed that the Aboriginal site was unlikely to be within the construction footprint for the proposed borehole.

Non Aboriginal Heritage
A desktop search of the following heritage registers was conducted on 28 May 2013:

• Australian Heritage Database (National Heritage List, Commonwealth Heritage List and Register of the National Estate;

• NSW State Heritage Register;

• NSW s170 Heritage Register; and

• Singleton Local Environmental Plan 1996.

The results of the desktop search are summarised below:

• No Commonwealth or World Heritage listed items were located in the vicinity of the proposal;

• One item, the Bulga Bridge, is listed on the NSW State Heritage Register. However, this item is not located close to any of the boreholes;

• Two items, the Bulga Bridge and Bulga Police Station, are listed on the s170 heritage register; and
Two locally listed items are located around the proposal. These items, St Andrew’s Anglican Church and Maria Immaculate Catholic Church, are located in the lot opposite B1b. No items are located on the same lot as any of the proposed drill locations.

5.5.2 Impacts

**Aboriginal**

Given the 280 m distance of Aboriginal site 37-6-1225 from B1b, it is unlikely that construction would impact on this item. The three other boreholes are all located on previously disturbed land and therefore it is unlikely that any unknown sites of Aboriginal significance would be accidently disturbed during construction. In addition to this, no trees would be removed as part of this proposal, therefore it is unlikely that any scar-trees would be impacted on as a result of the works.

**Non-Aboriginal**

No Non-Aboriginal heritage sites are located on the same properties as the proposed boreholes. The closest heritage site is St Andrew’s Anglican Church, which is located approximately 200 m to the south east of B1b. Whilst the construction of the boreholes may result in localised vibration impacts, this is not expected to be of significant magnitude to impact on this heritage site. Additionally, the site compound during construction would be contained within each property boundary, therefore it is not expected that the proposal would cause any significant impact on nearby heritage items.

5.5.3 Mitigation Measures

Mitigation measures would be implemented to minimise the impacts on heritage during construction. These would involve:

- If an Aboriginal object (or suspected object) of heritage significance is discovered during the work, all work in that area would cease and the drilling manager would inform NOW’s project manager and the OEH in accordance with section 89A of the NPW Act.

- Construction activities and machinery would be restricted to the designated work areas.

- A CEMP that specifies the measures to be used to minimise impacts on both Aboriginal and non-Aboriginal heritage during construction, including items listed within the LEP, would be prepared and implemented prior to construction.

- During site induction, all work crews would be briefed on nearby heritage items and measures required to avoid potential impacts.

- If an item (or suspected item) of non-Aboriginal heritage is discovered during the work, the drilling manager would inform NOW’s project manager and the OEH as possible to determine the subsequent course of action.

5.6 Noise and Vibration

5.6.1 Existing Environment

The drilling sites are situated around the towns of Broke and Bulga, NSW. Sensitive land uses located in close proximity to the proposed sites include:
- Residences;
- Classrooms;
- Places of Worship; and
- Passive recreation areas.

Neighbouring residents are located around the borehole sites, with varying degrees of distance, as listed in Table 5-4.

### Table 5-4: Distance to Closest Inhabited Dwelling

<table>
<thead>
<tr>
<th>Site</th>
<th>Approximate distance to closest dwelling</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>600 m</td>
<td>224 Cessnock Rd Broke</td>
</tr>
<tr>
<td>B1b</td>
<td>75 m</td>
<td>45-47 Wollombi Street Broke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44 Wollombi Street Broke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42 Wollombi Street Broke</td>
</tr>
<tr>
<td>B3a</td>
<td>110 m</td>
<td>2104 Putty Rd Bulga</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2116 Putty Rd Bulga</td>
</tr>
</tbody>
</table>

Sites B1b and B3a are also located in close proximity to other sensitive receivers, as listed in Table 5-5.

### Table 5-5: Distance to sensitive receptors

<table>
<thead>
<tr>
<th>Site</th>
<th>Sensitive receptor</th>
<th>Distance from drilling location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>St Andrew’s Anglican Church</td>
<td>241 m</td>
</tr>
<tr>
<td>B1b</td>
<td>Maria Immaculate Roman Catholic Church</td>
<td>425 m</td>
</tr>
<tr>
<td></td>
<td>Broke Public School</td>
<td>560 m</td>
</tr>
<tr>
<td></td>
<td>McNamara Reserve Caravan Park (nearest likely caravan site)</td>
<td>50 m</td>
</tr>
</tbody>
</table>
Table 5-6 Construction Noise Guidelines

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Management Level $L_{Aeq}$ (15min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended standard hours:</td>
<td></td>
</tr>
<tr>
<td>Monday to Friday 7 am to 6 pm</td>
<td>Noise affected RBL +10 dB</td>
</tr>
<tr>
<td>Saturday 8 am to 1 pm</td>
<td></td>
</tr>
<tr>
<td>No work on Sundays or public holidays</td>
<td>Highly noise affected 75 dB(A)</td>
</tr>
<tr>
<td>Outside recommended standard hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noise affected RBL + 5dB</td>
</tr>
</tbody>
</table>

The guidelines also provide differing management levels for specific sensitive receivers, as detailed in Table 5-7.

Table 5-7 Management Noise Level for Specific Sensitive Receivers

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Management Level $L_{Aeq}$ (15min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classrooms and schools</td>
<td>Internal noise level 45dB(A)</td>
</tr>
<tr>
<td>Places of worship</td>
<td>Internal noise level 45dB(A)</td>
</tr>
<tr>
<td>Passive recreation areas</td>
<td>External noise level 60dB(A)</td>
</tr>
</tbody>
</table>

Table 5-8 provides an indication as to whether the expected noise level will exceed the Interim Construction Noise management guidelines for receivers within the vicinity of the borehole sites during standard construction hours. This information will be confirmed during the initial stages of drilling.

Table 5-8 Potential to Exceed Noise Management Levels during Standard Construction Hours

<table>
<thead>
<tr>
<th>Borehole</th>
<th>Noise Criteria</th>
<th>Noise Affected</th>
<th>Highly Noise Affected</th>
<th>Sensitive Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Nearest Resident</td>
<td>✓</td>
<td>X</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Nearest Resident</td>
<td>✓</td>
<td>X</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>St Andrew’s Anglican Church</td>
<td>NA</td>
<td>NA</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Maria Immaculate Roman Catholic Church</td>
<td>NA</td>
<td>NA</td>
<td>✓</td>
</tr>
<tr>
<td>B1b</td>
<td>Broke Public School</td>
<td>NA</td>
<td>NA</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>McNamara Reserve Camping</td>
<td>NA</td>
<td>NA</td>
<td>✓</td>
</tr>
<tr>
<td>B3a</td>
<td>NPWS Information Centre</td>
<td>✓</td>
<td>X</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Nearest Resident</td>
<td>✓</td>
<td>X</td>
<td>NA</td>
</tr>
</tbody>
</table>
As illustrated, whilst during standard construction hours noise levels are likely to be above noise affected levels (RBL +10 dB =40 dB), all residents are likely to be within “highly noise affected levels”. However, work undertaken outside of these standard hours will be above the recommended noise guidance of 35dB for all sites.

It is also anticipated that at site B1b, noise levels will be above the construction guidelines for St Andrew’s Anglican Church, Maria Immaculate Roman Catholic Church and McNamara Reserve at all times.

The other three sites are located in rural areas, whereby the density and number of sensitive receivers is significantly reduced. However, it is likely that noise levels at these receivers would exceed the noise criterion for work undertaken between 6pm and 7am Monday to Friday, from 1pm on Saturday and all day Sunday.

The drilling rig will be required to undertake drilling from 7am to 7pm seven days a week to maximise the available daylight hours and reduce the overall length of construction time and therefore drilling will occur outside of the standard construction hours. Additionally, the drilling rig may occasionally be required to undertake drilling beyond these hours to maintain stability and integrity within the borehole, prior to completion of works each day.

Whilst work will occur outside of the standard construction hours, construction work is, by its nature, a relatively short term activity. During construction, occasional exceedances of the above criteria for specific well-defined activities are generally acceptable to the community and the OEH. Drilling on Sundays and outside of normal construction hours will assist in reducing the overall construction time required at each site.

Whilst noise limits may be exceeded, given the expected short duration of the drilling work (two to three weeks), and the number of sensitive receivers likely to be affected, potential noise impacts as a result of the proposal are considered low to moderate. It is also noted that noise monitoring will be undertaken once drilling starts to ascertain the exact impact, if any, on neighbouring properties and/or sensitive receivers. If necessary appropriate sound barriers will be installed.

No noise impacts are likely during operation of the facility.

5.6.3 Mitigation Measures

The following mitigation measures are recommended to reduce or minimise impacts.

- Implementation of ‘Best Practice’ noise management measures and procedures would occur to manage noise impacts during construction activities.
- Noise monitoring will take place at the start of drilling to determine the impact on neighbouring properties and sensitive receivers.
- If monitoring determines that noise is impacting on neighbouring properties or sensitive receivers noise barriers will be installed at the site.
- Noise emissions of the drill rig and other equipment is directional in nature, so it would be oriented in such a way that the noisiest side is directed away from the residents and sensitive receivers where possible.
- Generators would be located away from sensitive receivers and nearest residences. Where possible, generators with low acoustic outputs would be selected.
The noise level objectives outlined in the Interim Construction Noise Guidelines (DECC, 2009) would be adhered to where practicable.

Consultation with potentially affected residents would occur in advance of any site activity to inform the community of the work.

Compression and exhaust braking would be kept to a minimum.

The noisiest activities would be conducted during the least sensitive periods of the day as far as is reasonably practicable.

A journal of activities would be kept, so any complaints received can be checked against the type of activity that was being carried out.

Selection of construction plant and equipment would be undertaken based on acoustic performance, where practical.

Site inductions would include material that raises workers awareness of noise and vibration issues.

Noise emitting machinery would be directed away from residential areas and away from the nearest residents where possible.

Reversing alarms on mobile plant would be oriented towards the ground where it is practical and safe to do so.

Machinery would be switched off when not in use.

### 5.7 Air Quality

#### 5.7.1 Existing Environment

The air quality of the Hunter Valley is well documented with a regional air quality monitoring network in the Upper Hunter Region. The NSW EPA run the Upper Hunter Air Quality Monitoring Network (UHAQMN) which begins at Bulga with the remaining stations located to the north in the area of highest mining activity.

Air quality monitoring results from 2012 showed that particle pollution in the Hunter Valley exceeded national standards during 2012 and indicates that particle levels in the Upper Hunter are higher than those at Beresfield, Newcastle and Wallsend in the Lower Hunter (EPA 2012).

#### 5.7.2 Impacts

Impacts on existing air quality may include emissions from equipment and dust generation. Exhaust emissions from the drilling rig, associated plant as well as vehicle movements to and from the drill sites would intermittently occur during the drilling works. It is estimated that the works would be carried out for a maximum of 21 days at each site. Therefore, air quality impacts are expected to be minor and temporary in nature and unlikely to alter the local and/or regional air quality.

Furthermore, the release of pollutants associated with the drilling program within the catchment is unlikely to impact on ambient air quality of the region or contribute significantly to greenhouse gas emissions. This is due to:

- The nature of the pollutant sources (low volumes and concentrations);
The presence of substantial carbon sinks in the region (i.e. bushland); and
Atmospheric conditions (i.e. wind dispersion).

### 5.7.3 Mitigation Measures

The following mitigation measures have been recommended to reduce or minimise impacts:

- All construction vehicles and equipment would be suitably serviced within a six-month period prior to commencement of construction activities.
- Dust plumes during bore construction would be minimised where possible by removing drilling fines from around the bore head. Furthermore, the use of filter socks and pump filter bags would be also be used if dust persists during drilling.
- Stabilisation, revegetation and landscaping would be carried out as soon as possible after disturbance.
- All work areas and stockpiles would be closely monitored for dust generation and where necessary, a water cart would be utilised for dust suppression.
- A safety imposed site speed limit of 30km/h would be imposed across all sites which should further reduce the potential for vehicle related dust emissions.
- Mud, sand and other debris would be removed from the wheels and bodies of vehicles and equipment prior to leaving the site and before entering public roads or sealed pavements.
- All work vehicles/machinery would be maintained so that they minimise visible particulates in exhaust emissions for a continuous period of more than 10 seconds.
- Work vehicles/machinery/lights would be switched off when not in use.
- No matter of any kind would be burnt on site.

### 5.8 Traffic and Access

#### 5.8.1 Existing Environment

The Broke-Bulga area is serviced by a number of road networks, ranging from two lane highways to small dirt tracks. Existing traffic using road networks may include tourists and local residents. Extensive mining activity within the region means that mine employees and heavy vehicles also use local roads.

Table 5-9 contains site access details for each drill site.

<table>
<thead>
<tr>
<th>Site</th>
<th>Access</th>
<th>Other information</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>South turn off Cessnock Rd (opposite silo and sheds) approximately 1 km from 108 Cessnock Road property onto rough farm track. Drive over causeway and site location in approximately 50 m south of existing monitoring bore.</td>
<td>Private property, therefore land owner would be contacted prior to access.</td>
</tr>
</tbody>
</table>
Access to each of the sites would be undertaken on existing access tracks. Where the terrain of the track is uneven the tracks would be graded, or mown for occupational health and safety reasons. Grading and/or grass mowing may also occur within the footprint of each of the drill sites for additional safety reasons. No permanent access tracks would be constructed for any of the sites.

### 5.8.2 Impacts

Each of the sites would be accessed via existing tracks where available with a maximum of four to five support vehicles expected on any one site at any one time.

Heavy vehicle traffic and other vehicle movements at each drill site would involve:

- A once only movement onto and off each drill site by the drilling rig;
- Daily movements by the support truck to the site to deliver casing, screens, cement/concrete, protectors, and other drilling consumables;
- Movement onto and off each drill site by mud and water tankers; and
- Crew support vehicles (light 4WD vehicles).

Traffic controls may be required during entry and exit of the drill rig into site B1a, given the location of the access road on a bend. Access to each of the drilling construction sites would also be restricted to members of the public for safety reasons.

Given the rural nature of the sites, presence of existing mining traffic on the road network, and temporary and minor nature of the proposed works, traffic impacts during construction are not considered significant.

Operation of each monitoring well would likely only require occasional site visits for maintenance and downloading data approximately once every 3 months, this is anticipated to be insignificant on surrounding traffic volumes.

### 5.8.3 Mitigation Measures

The following mitigation measures have been recommended to reduce or minimise impacts:

- Signage would be placed on the road prior to all access points, alerting traffic that trucks are entering and crossing in these areas.
- Traffic controls would be placed along Cessnock Road for entry and exit of the drill rig to site B1a.
- There would be dedicated parking, entry and exit points beside the fenced drill site area to manage site traffic flow.
Traffic movements would be minimised where possible.

Traffic routes would be determined between sites so as to abide by road and bridge load restrictions.

Dedicated parking areas and turn area would be established at each site for all vehicles.

5.9 Waste

5.9.1 Existing Environment

Broke and Bulga lie within the Singleton Council local government area (LGA) who are responsible for waste disposal throughout the LGA. In the townships Bulga and Broke, all residents receive a weekly domestic waste collection service and a fortnightly recycle service. Recycled material is transported to a material recycling facility at Thornton, NSW.

The closest waste depot to Broke and Bulga is Singleton Council Waste Depot. Wastes that can be accepted for landfilling are general solid waste (non-putrescible), general solid waste (putrescible) and asbestos waste.

Singleton Council provides town sewage services to residential areas which are processed at the waste treatment plant south of Singleton township. However, rural properties around Broke and Bulga rely on on-site septic systems (Sheridan Coakes Consulting 2013).

5.9.2 Impacts

Waste produced during the works may include the following:

- Drilling spoil - drilling would result in the production of bentonite mud;

- Excess water from drilling;

- Incidental waste - construction at all the sites would generate general construction waste such as paper, cardboard, plastic wraps and general off-cuts. Waste stored onsite would be held in appropriate skips, the skips would be emptied regularly and placement of the skips would consider amenity and access requirements;

- Earth Material – spoil would be produced in small quantities during excavation activities for the flare pit and Blow Out Preventer pit. Spoil generated would be used for backfilling during rehabilitation of the sites;

- Topsoil – any topsoil that is removed during excavation would be retained separately and re-used during rehabilitation; and

- Sewage – sewage from the on-site portable toilets would be removed by a licensed contractor.

The Protection of the Environment Operations Act 1997 (POEO Act) makes it an offence to “without lawful authority, wilfully or negligently dispose of waste in a manner which harms or is likely to harm the environment”. Accordingly, the requirement of the POEO Act would be adhered to during the drilling works.

There are potentially six waste streams that will be generated from the drilling program, however, the amount of waste produced would be minimal. Two 15,000 L tanks would allow
for disposal of muds and sediments. A vacuum truck would be used to take and dispose of the muds and sediment at an EPA approved waste facility in Windsor, Sydney.

Due to the minimal amount of waste produced and the composition, waste generated from the works are unlikely to have a significant impact on the environment.

5.9.3 Mitigation Measures
The following mitigation measures have been recommended to reduce or minimise impacts:

- During the works, a portable toilet would be provided at each drill site for the workers. Toilet waste from on site porta-loos would be removed by an appropriately licensed contractor.

- All waste (excluding portable toilet waste) generated would be stored in a suitable container, with a lid (to prevent pollutants from escaping and prevent access by vermin), and transported from site when 80% full and at completion of works.

- Residential bins would not be used to dispose of any waste and all incidental waste generated at the sites would be contained and disposed of appropriately off site.

- All refuse water would be treated as contaminated and stored within site tanks until they would be disposed of offsite at an EPA licenced facility.

- Chemicals temporarily stored at the site would be bunded and the bunds would be at least 120% of the largest chemical container stored within the bunded area.

- Storage of fuels and other hazardous materials would be in accordance with AS1940.

- Spill kits would be on site during the installation and testing of the bores.

- All chemicals, sediments and contaminated water would be taken off site for correct disposal at EPA licenced facilities. Glass, aluminium, paper and other recyclable products would be separated and removed from site for recycling.

- The drilling sites would be left clean and free of weeds, debris and other rubbish at the end of works.

- Documents and records of the transport and fate of all materials removed from the drill sites would be kept and submitted to the project manager as proof of correct disposal and for environmental auditing purposes.

5.10 Social and Visual Assessment

5.10.1 Existing Environment
The Broke-Bulga landscape is dominated by scattered rural and low density urban development. These rural communities include many lifestyle and weekend properties. Populations of Broke and Bulga townships are presented below.

<table>
<thead>
<tr>
<th>Area</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broke</td>
<td>636</td>
</tr>
</tbody>
</table>
Other land uses in the area include extractive industries such as coal mining as well as viticulture, agriculture and tourism. The Broke-Fordwich area was declared a viticultural sub-region in 1994 as the warm climate and fertile soils are ideal for producing many types of wine grapes. Small boutique wine holdings ranging from 2 to over 40 hectares are common around the township of Broke (Economics Consulting Services 2012).

The Wollombi Brook catchment supports a large range of land uses including residential areas, viticulture, agriculture, tourism and recreation (Hunter-Central Rivers Catchment Management Authority 2013). The Bulga Coal Complex is the southern-most mining coal project in the Hunter Valley and located to the north east of Bulga.

5.10.2 Impacts

The drill rig likely to be used during the operation has a 10 m high mast and may impact on the general visual amenity of the area (refer to Figure 5-1). Given this impact would only last for the duration of the drilling works at each site, a maximum of 21 days, it is not expected that this impact would be significant to the local community.

![Expected drilling rig](image)

**Figure 5-1: Expected drilling rig**

Operations would take place on each day of the week (Monday to Sunday) from 7am to 7pm. The use of artificial lighting at the works sites during the night may disturb residents in close proximity to the drilling area, especially given the rural nature of the general area and lack of ambient street lighting. However, as the works would be ceasing at 7pm, it is not expected that this impact would be significant.

It is noted that any visual impact from drill rigs and ancillary equipment would only occur for the duration of the works. Once the works are finished a well head, solar panel and fencing would remain, similar to that depicted in Figure 5-2. The footprint of the remaining infrastructure is small and given the rural locations, visual impacts would be minor.
5.10.3 Mitigation Measures

The following mitigation measures have been recommended to reduce or minimise impacts:

- Flood lights would be minimised at night to reduce light pollution. Necessary lighting would be focused on the worksite to avoid light spill into adjacent areas.

- All work equipment and materials would be contained within the designated boundaries of the work site.

- The spread of stockpiles, waste, and vehicle parking would be minimised.

- Work sites would be restored as close to their original condition as soon as possible following completion of the proposed works.

- Remaining infrastructure would be chosen to be fit for purpose but also have the least visual impact.

- Security fencing to enclose all structures and machinery would be installed.

5.11 Cumulative Impacts

There is the potential that other construction activities would take place during construction of this proposal. Given the short duration of the works proposed to be undertaken, and the confines of construction within the curtilage of each lot, it is unlikely that any significant cumulative impacts would occur as a result of the proposal.
### 6 Summary of Mitigation Measures

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topography, Geology and Soils</td>
<td>• Integrated sediment and erosion control measures would be installed as necessary to control stormwater and pollution and would be in place prior to any earth works commencing.</td>
</tr>
<tr>
<td></td>
<td>• Sediment and erosion control measures would be routinely inspected and maintained to ensure they remain effective.</td>
</tr>
<tr>
<td></td>
<td>• Wherever possible, excavated soil and sediment accumulated in erosion and sediment control structures would be reused for site restoration unless contaminated or otherwise inappropriate for reuse. The sediment would be checked for reuse ability prior to site restoration.</td>
</tr>
<tr>
<td></td>
<td>• Minimal ground disturbance would occur.</td>
</tr>
<tr>
<td></td>
<td>• Site watering would be undertaken to suppress dust if required.</td>
</tr>
<tr>
<td></td>
<td>• Stormwater controls (bunding) would be used to divert clean water around the site (where required).</td>
</tr>
<tr>
<td></td>
<td>• On completion of the drilling, all cuttings would be removed and the site restored to its former contour shape.</td>
</tr>
<tr>
<td></td>
<td>• If ASS are suspected, testing would be undertaken. If ASS are found then an ASS Management Plan would be developed and implemented.</td>
</tr>
<tr>
<td></td>
<td>• Trucks and machinery would be checked for leaks and appropriate spill kits would be available at all times.</td>
</tr>
<tr>
<td></td>
<td>• Vehicle and machinery movement would be confined to designated tracks, pathways and work areas.</td>
</tr>
<tr>
<td></td>
<td>• Vehicle access routes to and within the site(s) would be clearly defined.</td>
</tr>
<tr>
<td></td>
<td>• Refuelling activities would be undertaken off site, as far as practicable, however most of the stationary equipment would need to be refuelled on site. This would be undertaken with bunded fuel tanks, no tankers would be involved in refuelling.</td>
</tr>
<tr>
<td></td>
<td>• Topsoil would be stockpiled separately from other spoil for reuse.</td>
</tr>
</tbody>
</table>
Measures would be taken to prevent tracking of soils/sediments from work sites to roadways and footpaths as a result of work vehicle/machinery movement (for example wheel washing may be used or sweeping of roads would occur at completion of work each day).

Compacted soil areas would be ripped on completion to prevent preferential drainage patterns across the site.

Works would not be undertaken during periods of high rainfall.

The sites would be rehabilitated to their existing condition on completion of the work, as far as practicable, and any restoration measures adopted would be monitored for effectiveness, and modified as required.

Run-on waters from rainfall events would be diverted from the construction area by the construction of diversion drains and or bunds on the up-gradient side of the site. Clean water would be diverted to roadside swales and natural bushland areas. Water from any diversion tracks constructed would be diverted away from the trail and tracks through sand bags, silt fencing and other control measures so as to direct water into bushland and not erode the track areas.

Any refuse waters would be treated as contaminated and contained in above ground mud tanks where they would be stored until they are removed off site and disposed of at an EPA licenced facility.

Sediment fences would be installed to prevent soil loss and runoff into any nearby water course.

All water and mud would be removed off site at the completion of works and disposed at an EPA licensed facility.

A periodic “pumpout” of the tanks would occur as required to prevent any surcharge during wet weather events.

All land disturbed during operations would be restored to pre-operational quality as soon as practicable.

Trucks and machinery would be checked for leaks and appropriate spill kits would be available on site at all times.

All refuelling activities would be undertaken off site, as far as practicable.

All chemicals and fuels would be stored in suitable bunded areas away from drainage lines. The capacity of the bunded area would be at least 110% of the largest chemical container stored within the bunded area.
Where possible, stockpiles would be placed away from kerbs and drainage lines.

Where the drill hole intersects with an alluvial aquifer, it would be solid cased to minimise any potential effect on other users of the groundwater and the environment.

All brackish or refuse water would be treated as contaminated and be contained in appropriately sized tanks and disposed of off site at an EPA licenced facility.

A silt fence would be installed around the work area and bunding installed where appropriate to mitigate against potential chemical and drilling fluid spills and runoff.

No refuse water would be released into the surrounding environment.

- Where practicable, materials, plant, equipment and stockpiles would not be placed in a manner that results in damage to vegetation located adjacent, or within the drip-lines of any trees.

- Managing all weeds removed as part of the proposal in accordance with the requirements of the *Noxious Weeds Act 1993*. All noxious weeds which are cleared as part of the proposal would be disposed of appropriately.

- Inspections/maintenance would take place to reduce the carriage or weed and noxious weed material on machinery

- Backfilling or covering of any excavations at night to prevent fauna falling in would occur. Open excavations would be checked each morning, prior to the commencement of construction, to salvage any fauna that have fallen in, and move them to a safe (and appropriate) nearby location. This would involve developing protocols to deal with the removal of injured or dangerous animals (e.g. snakes).
If any threatened species (flora or fauna) are discovered during the work, all work would stop immediately and the environmental representative for the Contractor would be notified. Work would only recommence once the impact on the species has been assessed and appropriate control measures developed.

### Heritage

- If an Aboriginal object (or suspected object) of heritage significance is discovered during the work, all work in that area would cease and the drilling manager would inform NOW’s project manager and the OEH in accordance with section 89A of the NPW Act.
- Construction activities and machinery would be restricted to the designated work areas.
- A CEMP that specifies the measures to be used to minimise impacts on both Aboriginal and non-Aboriginal heritage during construction, including items listed within the LEP, would be prepared and implemented prior to construction.
- During site induction, all work crews would be briefed on nearby heritage items and measures required to avoid potential impacts.
- If an item (or suspected item) of non-Aboriginal heritage is discovered during the work, the drilling manager would inform NOW’s project manager and the OEH as possible to determine the subsequent course of action.

### Noise and Vibration

- Implementation of ‘Best Practice’ noise management measures and procedures would occur to manage noise impacts during construction activities.
- Noise monitoring will take place at the start of drilling to determine the impact on neighbouring properties and sensitive receivers.
- If monitoring determines that noise is impacting on neighbouring properties or sensitive receivers noise barriers will be installed at the site.
- Noise emissions of the drill rig and other equipment is directional in nature, so it would be oriented in such a way that the noisiest side is directed away from the residents and sensitive receivers where possible.
- Generators would be located away from sensitive receivers and nearest residences. Where possible, generators with low acoustic outputs would be selected.
- The noise level objectives outlined in the Interim Construction Noise Guidelines (DECC, 2009) would be adhered to where practicable.
- Consultation with potentially affected residents would occur in advance of any site activity to inform the community of the work.
- Compression and exhaust braking would be kept to a minimum.
- The noisiest activities would be conducted during the least sensitive periods of the day as far as is reasonably practicable.
- A journal of activities would be kept, so any complaints received can be checked against the type of activity that was being carried out.
- Selection of construction plant and equipment would be undertaken based on acoustic performance, where practical.
- Site inductions would include material that raises workers awareness of noise and vibration issues.
- Noise emitting machinery would be directed away from residential areas and away from the nearest residents where possible.
- Reversing alarms on mobile plant would be oriented towards the ground where it is practical and safe to do so.
- Machinery would be switched off when not in use.

<table>
<thead>
<tr>
<th>Air Quality</th>
<th>All construction vehicles and equipment would be suitably serviced within a six-month period prior to commencement of construction activities.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dust plumes during bore construction would be minimised where possible by removing drilling fines from around the bore head. Furthermore, the use of filter socks and pump filter bags would be also be used if dust persists during drilling.</td>
</tr>
<tr>
<td></td>
<td>Stabilisation, revegetation and landscaping would be carried out as soon as possible after disturbance.</td>
</tr>
<tr>
<td></td>
<td>All work areas and stockpiles would be closely monitored for dust generation and where necessary, a water cart would be utilised for dust suppression.</td>
</tr>
<tr>
<td></td>
<td>A safety imposed site speed limit of 30km/h would be imposed across all sites which should further reduce the potential for vehicle related dust emissions.</td>
</tr>
<tr>
<td></td>
<td>Mud, sand and other debris would be removed from the wheels and bodies of vehicles and equipment prior to leaving the site and before entering public roads or sealed pavements.</td>
</tr>
<tr>
<td></td>
<td>All work vehicles/machinery would be maintained so that they minimise visible particulates in exhaust emissions for a continuous period of more than 10 seconds.</td>
</tr>
</tbody>
</table>
Traffic and Access

- Work vehicles/machinery/lights would be switched off when not in use.
- No matter of any kind would be burnt on site.

- Signage would be placed on the road prior to all access points, alerting traffic that trucks are entering and crossing in these areas.
- Traffic controls would be placed along Cessnock Road for entry and exit of the drill rig to site B1a.
- There would be dedicated parking, entry and exit points beside the fenced drill site area to manage site traffic flow.
- Traffic movements would be minimised where possible.
- Traffic routes would be determined between sites so as to abide by road and bridge load restrictions.
- Dedicated parking areas and turn area would be established at each site for all vehicles.

Waste

- During the works, a portable toilet would be provided at each drill site for the workers. Toilet waste from on site porta-loos would be removed by an appropriately licensed contractor.
- All waste (excluding portable toilet waste) generated would be stored in a suitable container, with a lid (to prevent pollutants from escaping and prevent access by vermin), and transported from site when 80% full and at completion of works.
- Residential bins would not be used to dispose of any waste and all incidental waste generated at the sites would be contained and disposed of appropriately off site.
- All refuse water would be treated as contaminated and stored within site tanks until they would be disposed of offsite at an EPA licenced facility.
- Chemicals temporarily stored at the site would be bunded and the bunds would be at least 120% of the largest chemical container stored within the bunded area.
- Storage of fuels and other hazardous materials would be in accordance with AS1940.
- Spill kits would be on site during the installation and testing of the bores.
Social and Visual Assessment

- All chemicals, sediments and contaminated water would be taken off site for correct disposal at EPA licenced facilities. Glass, aluminium, paper and other recyclable products would be separated and removed from site for recycling.
- The drilling sites would be left clean and free of weeds, debris and other rubbish at the end of works.
- Documents and records of the transport and fate of all materials removed from the drill sites would be kept and submitted to the project manager as proof of correct disposal and for environmental auditing purposes.

- Flood lights would be minimised at night to reduce light pollution. Necessary lighting would be focused on the worksite to avoid light spill into adjacent areas.
- All work equipment and materials would be contained within the designated boundaries of the work site.
- The spread of stockpiles, waste, and vehicle parking would be minimised.
- Work sites would be restored as close to their original condition as soon as possible following completion of the proposed works.
- Remaining infrastructure would be chosen to be fit for purpose but also have the least visual impact.
- Security fencing to enclose all structures and machinery would be installed.
7 Ecologically Sustainable Development Principles

The most common and broadest definition of Ecologically Sustainable Development (ESD) is “development that improves the quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends” (National Strategy for ESD, 1992).

The proposal must be considered in terms of the four principles of ESD which are outlined in section 6(2) of the Protection of the Environment Administration Act 1991 (as amended by the Protection of the Environment Operations Act 1997 and Schedule 2 of the Environmental Planning and Assessment Regulation 2000).

The proposal meets these four principles in the following ways as outlined in Table 7-1.

**Table 7-1: How the Proposal Meets ESD Principles**

<table>
<thead>
<tr>
<th>ESD Principle</th>
<th>Explanation of Principle</th>
<th>Way in Which Proposal Meets Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Precautionary Principle</td>
<td>Minimise the potential risk for serious environmental problems even if we are uncertain they will occur</td>
<td>The REF has been prepared to identify any potential risks for serious environmental problems and to confirm appropriate controls or management strategies to help reduce these impacts.</td>
</tr>
<tr>
<td>Intergenerational Equity</td>
<td>That present generations do not reduce the environment for future generations</td>
<td>The construction of the monitoring bores will enable a greater understanding of the impacts nearby coal seam gas activities and major coal mines are having on the groundwater system and therefore enable appropriate management of groundwater for future generations.</td>
</tr>
<tr>
<td>Conservation of Biological Diversity and Ecological Integrity</td>
<td>These are fundamental to the sustainability of development</td>
<td>Potential impacts of flora and fauna have been examined in this REF. As identified in Section 5.4 it is not anticipated that any significant impact on flora and fauna will occur.</td>
</tr>
<tr>
<td>Improved Valuation, Pricing and Incentive Mechanisms</td>
<td>Users pay for their products or services, including their full cycle impacts</td>
<td>The monitoring bores will provide for a better understanding of the groundwater systems within the sedimentary coal basins and this will enable better future groundwater management.</td>
</tr>
</tbody>
</table>
8 Conclusions

This REF has been prepared in accordance with Part 5 of the EP&A Act and has considered the factors that must be taken into account when assessing the impact of an activity on the environment under Clause 228 of the Environmental Planning and Assessment Regulation 2000 (refer to Appendix A).

The Groundwater Monitoring Bore Drilling Project at Broke has the potential to affect the surrounding environment. Construction could potentially affect:

- Traffic and access;
- Noise and vibration; and
- Visual amenity.

However, construction impacts would be short-term and not considered significant.

Minimal operational impacts are expected.

This REF has identified and assessed the short and long-term impacts of the proposal on the environment and identified mitigation measures to minimise any potential impacts. Potential negative operational impacts associated with the proposal are considered on the whole to be minor. However, some low-moderate impacts have the potential to occur, such as impacts of noise during construction. Given the duration of the construction works, this is not expected to be significant.

Provided the mitigation measures outlined in Section 6 of this REF are implemented, the proposal is unlikely to have a significant adverse environmental impact.

The contractor is to prepare a CEMP prior to the commencement of construction. This CEMP would incorporate the construction phase mitigation measures and requirements outlined in this REF.

If the scope of work, construction methods or site described in this document change during, or prior to construction, NOW will need to determine whether additional environmental assessment is needed.
9 References


Department of Planning and Infrastructure, 2012, *Upper Hunter Strategic Regional Land Use Plan*, NSW Government.


Mackie Environmental Research, 2013, *Assessment of groundwater relations impacts arising from the proposed Bulga Optimisation Project*.


Umwelt, 2013, *Surface Water Assessment, Bulga Optimization Project*.
Appendix A:
Clause 228 Determination
Clause 228 Summary

Clause 228 of the Environmental Planning and Assessment Regulation 2000 lists the factors to be taken into account when consideration is being given to the likely impact on the environment of an activity. Consideration of those factors for the proposed works is summarised below. Also the Department of Planning’s guideline “Is an EIS required?” has been considered as part of this assessment.

<table>
<thead>
<tr>
<th>Clause 228 Factor</th>
<th>REF Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any environmental impact on a community</td>
<td>The proposed works will take place within the confines of each property (a total of three properties) and as such minimal impact is expected on the local community.</td>
</tr>
<tr>
<td>A transformation of a locality</td>
<td>The proposed works will involve the construction of monitoring bores within existing property boundaries. Whilst the monitoring bores will be permanent structures they will be constructed on previously cleared land in and will take up a footprint of approximately 5m². Given the scale of the proposal, it will not be a significant transformation of a locality.</td>
</tr>
<tr>
<td>Any environmental impact on the ecosystem of the locality</td>
<td>The works will take place on previously disturbed land and will not involve the removal of any vegetation. Conversely, the monitoring bores will provide a greater understanding of groundwater quality which may aid future management of groundwater resources and groundwater dependent ecosystem. As such, it is expected that the proposal will have a long term positive impact on the ecosystem of a locality.</td>
</tr>
<tr>
<td>A diminution of the aesthetic, recreational, scientific or other environmental quality or value of the locality</td>
<td>The proposed works will be located within existing property boundaries. As such, minimal impact is expected on recreational, aesthetic, scientific or other environmental quality of the locality. The construction of the monitoring bores will actually improve the scientific use of the area, as they will provide a better understanding on the quality of groundwater over time.</td>
</tr>
<tr>
<td>Any effect upon a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other special value for present or future generations</td>
<td>The proposed works will take place within the confines of existing property boundaries. It is not expected that there will be any negative impact on anthropological, archaeological, architectural, cultural, historic, scientific or social significance of the area. There are no sites of non-aboriginal heritage located within the properties. The construction of the monitoring bores will actually improve the scientific use of the area, as they will provide a better understanding on the quality and quantity of groundwater over time. There may be minor aesthetic impacts during construction as a result of visibility of the drilling rig. However, these impacts are expected to be localised and short term. As such minimal impact on the aesthetic or social significance of the site is expected. Whilst the proposed works may involve excavation, given the previously disturbed nature of the properties, and provided mitigation measures listed in section 5.5.3 are implemented, no significant impact on Aboriginal heritage is anticipated.</td>
</tr>
<tr>
<td>Any impact on the habitat of any protected or endangered fauna</td>
<td>Niche Environmental conducted a Biodiversity Impact Assessment for the proposal and identified that provided mitigation measures as identified in Section 5.4.3 are implemented, no significant impact on the habitat of any protected or endangered fauna should occur.</td>
</tr>
<tr>
<td>Clause 228 Factor</td>
<td>REF Finding</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Any endangering of any species of animal or plant or other form of life, whether</td>
<td>Niche Environmental conducted a Biodiversity Impact Assessment for the proposal and identified that provided mitigation measures as identified in Section 5.4.3 are implemented, no significant impact on flora or fauna as a result of the works should occur.</td>
</tr>
<tr>
<td>living on land, in water or in the air</td>
<td></td>
</tr>
<tr>
<td>Any long-term effects on the environment</td>
<td>The proposed works will assist in providing information on groundwater quality within the Broke-Bulga area, thus assisting with improved management of groundwater and promoting a positive effect on the environment. It is not expected that the proposed works will have a long-term negative effect on the environment.</td>
</tr>
<tr>
<td>Any degradation of the quality of the environment</td>
<td>Construction of the proposal will result in minor impacts on the environment, which include soil disturbance, traffic and noise. However, these impacts would be short term and localised and provided mitigation measures are implemented, unlikely to result in any permanent degradation to the quality of the environment.</td>
</tr>
<tr>
<td>Any risk to the safety of the environment</td>
<td>Provided all mitigation measures are followed, it is not expected that the proposed works will place any additional risk to the safety of the environment.</td>
</tr>
<tr>
<td>Any reduction in the range of beneficial uses of the environment</td>
<td>It is not expected that the proposed works will have any reduction in the range of beneficial uses of the environment. The construction of the monitoring bores will result in some refuse water from the drilling process, but this is not expected to be of significant quantity to affect water availability in the region. The operation of the monitoring bores is not expected to result in loss of any groundwater.</td>
</tr>
<tr>
<td>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply</td>
<td>It is not expected that the proposed works will place any increased demands on resources that are likely to become in short supply.</td>
</tr>
<tr>
<td>Any cumulative environmental effect with other existing or likely future activities</td>
<td>The long-term cumulative impact will aid in improving the existing environment. The construction of the monitoring bores would provide greater understanding of the groundwater dynamics in the immediate region and thus aid future environmental assessment of coal seam gas and mining activities.</td>
</tr>
<tr>
<td>Any impact on coastal processes and coastal hazards, including those under projected climate change conditions</td>
<td>It is not expected that the proposed works will have any impact on coastal processes and coastal hazards</td>
</tr>
</tbody>
</table>
Appendix B:
Flora and Fauna Assessment
BIODIVERSITY IMPACT ASSESSMENT

NSW Office of Water Groundwater Monitoring Project: Bulga

July 2013
**DOCUMENT CONTROL**

<table>
<thead>
<tr>
<th>Business unit</th>
<th>Niche Environment and Heritage, Hunter Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project no.</td>
<td>1531</td>
</tr>
<tr>
<td>Document description</td>
<td>Biodiversity Impact Assessment: Bulga Borefield</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Signed</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervising manager(s)</td>
<td>Frank Lemckert</td>
<td>2/8/2013</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Person managing this document</th>
<th>Person(s) writing this document</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark Aitkens</td>
<td>Mark Aitkens</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Document revision no.</th>
<th>Date prepared</th>
<th>Reviewed by</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev1</td>
<td>09/07/2013</td>
<td>Frank Lemckert</td>
<td>02/08/2013</td>
</tr>
</tbody>
</table>

Prepared for: CH2M HILL Pty Limited
Level 7, 9 Help Street
Chatswood NSW 2067

Front cover photograph: Thick-tailed Gecko (*Nephurus milii*)
EXECUTIVE SUMMARY

Context

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by CH2M HILL Pty Ltd on behalf of the NSW Office of Water to prepare a biodiversity impact assessment for a proposed groundwater monitoring project (the Project) comprising three boreholes (the site) in the Bulga area (the study area).

Aims

This report aims to address the assessment requirements for relevant threatened biodiversity including those listed on the Threatened Species Conservation Act 1995 (TSC Act), as well as matters of national environmental significance (MNES) listed on the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Methods

Targeted flora and fauna surveys were completed on 14-15 June 2013 and 17 June 2013. Methods included the use of BioMetric (Gibbons et al., 2009) to identify and analyse vegetation communities, condition and habitat quality. Fauna surveys were restricted to habitat evaluation conducted as part of the BioMetric plot (i.e. presence of fallen logs, hollow-bearing trees and vegetation structure).

Key Results - flora

No listed threatened species, populations, ecological communities or their habitats were observed within the site.

Key Results - fauna

Low value habitat for the Diamond Firetail, Hooded Robin and Speckled Warbler, all species listed as vulnerable under the NSW TSC Act, was identified within the site and is common within the study area. Habitat for common migratory species such as the Rainbow Bee-eater (Merops ornatus) and Satin Flycatcher (Myiagra cyanoleuca) was also observed.

Impact Assessment - Avoid, Mitigate and Offset

No requirements for impact avoidance were recommended for the three borehole sites investigated as these boreholes do not coincide with the occurrence of a listed threatened plant species and/or threatened ecological community (TEC). Required mitigation includes the protection of trees, hollows and fallen logs.

Assessment conclusions

The Project’s impact on threatened biodiversity is considered to be low and unlikely to have a significant effect on State and/or Commonwealth listed threatened biodiversity.
Table 4. Vegetation cover of the proposed borehole sites ........................................17
Table 5. Summary results for the proposed borehole sites ........................................18

FIGURES

Figure 1: Site locations ...................................................................................22

APPENDICES

Appendix 1 Template - Borehole clearance form
Appendix 2 Impact assessment for complying boreholes
1 INTRODUCTION

1.1 The Project

A groundwater monitoring program (the Project) comprising up to three boreholes (the site) is proposed in the Bulga area (the study area). Borehole establishment would involve the siting of a groundwater piezometer at a specified location using a truck mounted drill rig. Drilling would take a number of days to reach the borehole’s target depth, resulting in a temporary surface disturbance of the drilling pad (i.e. impact area for each borehole). An impact area of 0.3 hectares or 70 metres X 40 metres is anticipated for each borehole resulting in an estimated impact area of 0.9 hectares.

1.2 Project location

The Project is located approximately west south west of Bulga, NSW (Figure 1). The Project comprises areas referred to as the ‘site’ and ‘study area’. These are described as follows:

- The site is the area where direct impacts from the boreholes are expected;
- The study area is the area including direct and indirect impacts and lands where mitigation/offsetting may be proposed.

A summary of the major geophysical features of the study area is presented in Table 1.

Table 1: Geophysical context of the study area

<table>
<thead>
<tr>
<th>Geographical Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioregion</td>
<td>Sydney Basin Bioregion</td>
</tr>
<tr>
<td>Catchment management authority</td>
<td>Hunter Central Rivers</td>
</tr>
<tr>
<td>Sub-catchment</td>
<td>Hunter</td>
</tr>
<tr>
<td>Mitchell Landscape</td>
<td>Central Hunter Foothills</td>
</tr>
<tr>
<td>Local government area</td>
<td>Singleton Council local government area</td>
</tr>
<tr>
<td>Watercourses</td>
<td>Wollumbi Brook</td>
</tr>
<tr>
<td>Nearby conservation areas</td>
<td>Yengo National Park; Wollemi National Park</td>
</tr>
</tbody>
</table>

The site comprises three proposed boreholes each approximately 0.3 hectares in area (total 0.9 hectares). The surrounding study area is used primarily for agriculture (i.e. viticulture), tourism and mining (e.g. coal and coal seam gas).

The landscapes of the study area include open eucalypt grassy woodlands dominated primarily by grey box on elevated ground and rough-barked apple/ forest red gum and yellow box on areas of low relief.

1.3 Legislative context

The following legislative context has been considered in this assessment:

- NSW Environmental Planning and Assessment Act 1979 (EP&A Act);
- NSW Threatened Species Conservation Act 1995 (TSC Act); and

This legislative context is outlined in the following sections.

### 1.3.1 EP&A Act

The EP&A Act provides an assessment framework for the consideration of threatened species, populations, ecological communities and their habitats. Section 5A of the EP&A Act lists seven factors to be considered when projects are deemed to have an impact on the habitat for threatened biodiversity listed on the TSC Act. The Assessment of Significance or Seven Part Test sets the criteria for determining whether a proposal is likely to have a significant impact on threatened biodiversity, which if identified would necessitate the preparation of a Species Impact Statement (SIS).

### 1.3.2 TSC Act

The TSC Act provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia*, ‘conserve biological diversity and promote ecologically sustainable development’. It provides for:

- The listing of ‘threatened species, populations and ecological communities’, with endangered species, populations and communities listed under Schedule 1, ‘critically endangered’ species and communities listed under Schedule 1A, and vulnerable species and communities listed under Schedule 2;
- The listing of ‘Key Threatening Processes’ (under Schedule 3);
- The preparation and implementation of Recovery Plans and Threat Abatement Plans; and
- Requirements, or otherwise, for the preparation of a Species Impact Statement (SIS).

Threatened species, populations and ecological communities listings gazetted under the TSC Act are relevant to this assessment. Listings deemed relevant to the Project are to be assessed under Section 5A of the EP&A Act.

### 1.3.3 EPBC Act

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on ‘matters of national environmental significance’ undergo an assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that ‘has, will have or is likely to have a significant impact on a matter of national environmental significance’ is deemed to be a ‘controlled action’ and may not be undertaken without prior approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (SEWPaC).

The EPBC Act identifies matters of national environmental significance (MNES) as:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (Ramsar wetlands);
- Threatened species and ecological communities;
☐ Migratory species;
☐ Commonwealth marine areas; and
☐ Nuclear actions (including uranium mining).

Listings deemed relevant to the Project are to be assessed in accordance with relevant guidelines available at the time of writing this assessment.

1.3.4 Other relevant regulation

State Environmental Planning Policy No. 44 - Koala Habitat Protection has not been considered in this assessment as the Project is being assessed under Part 5 of the EP&A Act. This species has been independently considered as a listed species under the TSC Act and EPBC Act.

1.4 Purpose of this report

The assessment provided in this report is designed to provide information required to meet the assessment requirements stipulated under Section 5A of the EP&A Act for threatened species, populations and ecological communities listed on the TSC and/ or EPBC Act. No assessments pursuant to these Acts are provided.

1.5 Investigation scope

The preparation of this report involved the following tasks:

☐ Review of relevant data and reports;
☐ Completion of site inspection by experienced and recognised ecologists to identified threatened biodiversity constraints;
☐ The consideration of the avoid, mitigate and offset principles; and
☐ Preparation of impact assessment under Section 5A of the EP&A Act and EPBC Act for threatened biodiversity deemed relevant to the Project.

1.6 Limitations

1.6.1 Survey methods

A limited set of survey methods have been employed in this investigation. The reduced survey effort is matched by the impact avoidance strategy adopted in this investigation. Sites having unavoidable impacts that exceed the assessment criteria impacts may require additional survey effort to support additional impact assessments for the proposed borehole location.

1.6.2 Plant and animal detection

Numerous threatened plant and animal species are cryptic or difficult to detect. Consequently negative survey results, no matter how extensive the survey design and effort, do not necessarily indicate species absence. For instance, some cryptic plant species are more easily detected at certain times of the year, such as during flowering events.
Some fauna can only be detected during certain seasons (e.g. migration patterns or intratorpor periods).

Species that are difficult to detect have been targeted, where possible, using appropriate survey methods, effort and timing. These species have also been considered on the basis of habitat suitability. Habitat assessments are conservative and default to assumed presence where there is insufficient scientific knowledge to determine otherwise. Assumed presence of a species dictates inclusion within the assessment process.

### 1.6.3 Impact assessment

Impact assessments for sites that meet the specified assessment criteria have been limited to selected threatened fauna species that may be affected by the residual impacts of the proposed boreholes. It is assumed that these residual impacts are low and tolerable for the affected threatened fauna species.

Sites that do not meet the assessment criteria and are required to be included in the project would be assessed on an individual basis. Such assessments do not carry the assumed low residual impact that is otherwise accepted for sites that have met the specified assessment criteria.
2 METHODS

2.1 Survey guidelines

Survey methods used in this investigation are based on *An operational method to assess impacts of land clearing on terrestrial biodiversity* (BioMetric) (Gibbons et al, 2009). Not all methods were adopted. Some methods have been varied, where necessary, to suit species, populations and communities identified as relevant to the Project.

2.2 Database review

2.2.1 Databases

Relevant databases were reviewed prior to field survey to identify data gaps and inform survey design. Database searches for a 10 km radius around the study area were conducted in June 2013 to identify threatened biodiversity and migratory species with known occurrences in the locality. The following databases were used for this purpose:

- OEH Atlas of NSW Wildlife (OEH, 2013); and
- EPBC Act Protected Matters Search Tool (SEWPAC, 2013).

2.3 Vegetation and plant surveys

A combination of survey methods including flora plots, BioMetric plots (Gibbons et al 2009) and random meanders were used to sample the native vegetation of the study area. These are discussed as follows.

2.3.1 Flora plots

Flora plots measuring 400 m² (i.e. 20 x 20 metre quadrat) were used to aid vegetation classification and descriptions for vegetation mapped within the study area. Data collections in accord with a modified Braun-Blanquet cover abundance scale; a scale designed to measure plant species relative abundance. The modified Braun-Blanquet cover abundance scale was used in this survey, as follows:

1. 1-5% cover.
2. 6-25% cover.
3. 26-50% cover.
4. 51-75% cover.
5. 76-100% cover.

Modified Braun-Blanquet scores were estimated for each observed plant species within the flora plot, which was nested within the larger BioMetric plot (see below).

2.3.2 BioMetric plots

BioMetric plots measuring 1000 m² (i.e. 20 x 50 metres) were used to sample vegetation structure and habitat in accordance with the method described by Gibbons et al (2009).
The BioMetric plot provides an objective standardised approach to the characterisation of bio-condition and is a method compatible with the NSW BioBanking Methodology.

Bio-condition is assessed by comparing measured site attribute scores (see below) against published ‘vegetation benchmarks’ for each vegetation type:

- Native plant species richness (NPS);
- Native overstorey cover (NOC);
- Native mid-storey cover (NMS);
- Native groundcover stratum grasses (NGSG);
- Native groundcover stratum shrubs (NGSS);
- Native groundcover other (NGSO);
- Exotic plant cover (EPC);
- Number of trees with hollows (NTH);
- Overstorey regeneration (OR); and
- Total length of fallen logs (FL).

Vegetation benchmarks are quantitative measures of the expected variability in vegetation condition that once occurred prior to habitat modification by humans since European settlement (post 1750).

2.3.3 Targeted surveys

Targeted surveys for threatened plant species were conducted at each of the borehole locations.

2.3.4 Vegetation typing

A standardised classification for the vegetation cover of stratification units sampled within the study area was based on comparisons with published descriptions provided in the NSW Vegetation Types database (OEH, 2012). This database was developed for each of the 13 catchment management authority (CMA) areas with most of the vegetation types comprising original vegetation types (i.e. pre-1750).

Each vegetation type is defined for field identification purposes on the basis of the following attributes, where relevant:

- Dominant canopy species;
- Main associated species;
- Landscape position;
- Characteristic mid-storey species;
- Characteristic groundcover species; and
- Other diagnostic features.

Published local and regional vegetation mapping was used where appropriate to assist the classification of native vegetation cover within the study area.
2.3.5 Identification of threatened ecological communities

The following documents were used to assess for the presence of listed threatened ecological communities (TECs) within the study area:

- Commonwealth listing advice and conservation advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland;
- EPBC Act policy statement 3.5 - White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands;
- Species list for the EPBC Act policy statement 3.5 - White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grasslands;
- Commonwealth listing advice on Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions; and
- National Recovery Plan for the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ecological community.

2.4 Fauna habitat assessments

Habitat assessments were conducted at each site. Habitat characteristics and parameters that were assessed included:

- Dominant vegetation, floristic composition and structure;
- Composition of ground layer (bare earth, litter etc.);
- Presence and relative abundance of key habitat features (e.g. tree hollows, large logs, exfoliating rock, flowering resources, aquatic features);
- Condition and disturbance factors; and
- Vegetation age structure.

2.5 Nomenclature

2.5.1 Plant taxonomy

Plant taxonomy used was consistent with the nomenclature of the Flora of NSW (Harden 1990-1993; 2002), except where more recent revisions have been published in recognised scientific journals and accepted by the National Herbarium of New South Wales (as per their PlantNet web site http://plantnet.rbgsyd.nsw.gov.au/).

2.5.2 Vegetation types

The assigning of NSW Vegetation Types to vegetation cover mapped within the study area was in accordance with the NSW Vegetation Types Database (OEH, 2012). Published scientific literature, where available, was used to aid in the interpretation of this database (e.g. referenced source documents).
2.6 Site clearance protocol

A site is considered approved for biodiversity matters if it meets the specified assessment criteria in accordance with the site clearance procedure. These are described in the following sections.

2.6.1 Assessment criteria

The assessment criteria used to clear borehole sites are based on the principles of avoid, mitigate and offset. Impact avoidance is the method for minimising impacts on listed threatened species, populations and ecological communities. Sites must demonstrate a capacity to avoid the following prior to the site being cleared:

- No impacts on threatened ecological communities; and
- No direct impacts on threatened species occurrences and their habitat.

Sites that do not meet the above criteria cannot be cleared. Instead, a second alternative site must be located and suitably cleared using the same criteria. These sites must be within 100 metres of the original proposed site and must also be land owned by the crown.

2.6.2 Site clearance procedure

A dichotomous decision making process was adopted to facilitate the clearance of each proposed borehole. A site approved for borehole drilling that meets the assessment criteria must demonstrate the following attributes:

- Absence of threatened ecological communities or derived forms;
- Absence of threatened flora species occurrences; and
- Avoidance of important fauna habitat values.

The following factors were evaluated at each of the sites:

- Native vegetation cover present? (Yes/ No);
- Native vegetation is a listed threatened ecological community? (Yes/No);
- Threatened plant species is known to occur within borehole area? (Yes/ No); and
- Hollow-bearing trees or fallen logs present in borehole area? (Yes/ No).

The site clearance form used for the site inspections is provided in Appendix 1.

Where a proposed borehole site is identified as containing a threatened ecological community (TEC) and/or known habitat for a threatened plant species then an alternative borehole site must be found prior to the site being cleared for drilling. The above listed factors above are to be reconsidered at the alternative site. It is possible for some sites to not have suitable alternative drilling locations.

2.6.3 Impact Assessments

Impact assessments are to be prepared in accordance with the following:

- Section 5A of the EP&A Act; and
- Significant Impact Guidelines V1.1 Matters of National Environmental Significance.

Sites that abide by the specified assessment criteria (i.e. complying sites) are sites that assume a low residual impact on habitat for affected threatened fauna species. Impact
assessments for complying sites would be restricted to species capable of utilising the available groundcover resources of the borehole site. Assessments would assume no direct or indirect impacts on limiting resources for threatened fauna (e.g. avoidance of fallen logs and hollow-bearing trees) or the occurrence of threatened flora and/or ecological communities.

Sites that have not been cleared in accordance with the site clearance procedure and cannot be suitably relocated are deemed ‘not cleared’. These sites would be made redundant unless they are identified as important to the project. In such circumstance, individual impact assessments would be provided to determine if the project is likely to have a significant impact on threatened species, populations, ecological communities and their habitats.
3 RESULTS

3.1 Database searches

The threatened species listed in Table 2 are known or likely to occur in the locality (OEH 2013, DSEWPaC 2013).

Table 2. Threatened flora of the locality

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobed Bluegrass</td>
<td>Bothriochloa biloba</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Cynanchum elegans</td>
<td></td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Eucalyptus glaucina</td>
<td></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Lasiopetalum longistamineum</td>
<td></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Pomaderris reperta</td>
<td></td>
<td>CE</td>
<td>CE</td>
</tr>
<tr>
<td>Pomaderris queenslandica</td>
<td></td>
<td>E</td>
<td>-</td>
</tr>
<tr>
<td>North Rothbury Geebung</td>
<td>Persoonia pacifica</td>
<td>CE</td>
<td>CE</td>
</tr>
<tr>
<td>Philotheca ericifolia</td>
<td></td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>A leek orchid</td>
<td>Prasophyllum sp. Wybong (C.Phelps ORG 5269)</td>
<td>-</td>
<td>CE</td>
</tr>
<tr>
<td>Rulingia procumbens</td>
<td></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Austral Toadflax</td>
<td>Thesium australe</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>

The threatened fauna species listed in Table 3 are known or likely to occur in the locality (OEH 2013, DSEWPaC 2013).

Table 3. Threatened fauna of the locality

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giant Burrowing Frog</td>
<td>Heleioporus australiacus</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Giant Barred Frog</td>
<td>Mixophyes iteratus</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Green and Golden Bell Frog</td>
<td>Litoria aurea</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Booroolong Frog</td>
<td>Litoria booroolongensis</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Littlejohn's Tree Frog</td>
<td>Litoria littlejohni</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Broad-headed Snake</td>
<td>Hoplocephalus bungaroides</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Spotted Harrier</td>
<td>Circus assimilis</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Little Eagle</td>
<td>Hieraetus morphnoides</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Australian Painted Snipe</td>
<td>Rostratula australis</td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Glossy Black-cockatoo</td>
<td>Calyptorhynchus lathami</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Gang-gang Cockatoo</td>
<td>Callocephalon fimbriatum</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Little Lorikeet</td>
<td>Glossopsitta pusilla</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Turquoise Parrot</td>
<td>Neopoma pulchella</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Swift Parrot</td>
<td>Lathamus discolor</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Sooty Owl</td>
<td>Tyto tenebricosa</td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Masked Owl</td>
<td>Tyto novaehollandiae</td>
<td>V</td>
<td>-</td>
</tr>
</tbody>
</table>
The following endangered populations are known to occur within the locality:

- Weeping Myall of the Hunter Valley;
- River Redgum of the Hunter Valley; and
- Tiger Orchid of the Hunter Valley.

The following threatened ecological communities are known to occur in the locality:

- TSC Act listed *White Box - Yellow Box - Blakely’s Red Gum Woodland* EEC;
- EPBC Act listed *White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland and derived native grasslands* CEEC;
- TSC Act listed *Hunter Valley Dry Rainforests* EEC;
- TSC Act listed *Weeping Myall Woodlands* EEC;
- EPBC Act listed *Myall Woodlands* EEC;

### Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powerful Owl</td>
<td><em>Ninox strenua</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Barking Owl</td>
<td><em>Ninox connivens</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Brown Treecreeper</td>
<td><em>Climacteris picumnus victoriae</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Speckled Warbler</td>
<td><em>Pyrholaemus saggitatus</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Regent Honeyeater</td>
<td><em>Xanthomyza phrygia</em></td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Painted Honeyeater</td>
<td><em>Grantiella picta</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Hooded Robin</td>
<td><em>Melanodyas cucullata cucullata</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Flame Robin</td>
<td><em>Pteroica phoeincea</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Scarlet Robin</td>
<td><em>Pteroica boodang</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Grey-crowned Babbler</td>
<td><em>Pomatostomus temporalis temporalis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Varied Sittella</td>
<td><em>Daphoenositta chrysoptera</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Diamond Firetail</td>
<td><em>Stagonopleura guttata</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Spotted-tailed Quoll</td>
<td><em>Dasyurus maculatus maculatus</em></td>
<td>V</td>
<td>E</td>
</tr>
<tr>
<td>Brush-tailed Phascogale</td>
<td><em>Phascogale tapeotafa</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Koala</td>
<td><em>Phascolarctos cinereus</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Yellow-bellied Glider</td>
<td><em>Petaurus australis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Squirrel Glider</td>
<td><em>Petaurus norfolcensis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Brush-tailed Rock-wallaby</td>
<td><em>Petrogale penicillata</em></td>
<td>E</td>
<td>V</td>
</tr>
<tr>
<td>Grey-headed Flying-fox</td>
<td><em>Pteropus poliocephalus</em></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Yellow-bellied Sheathtail-bat</td>
<td><em>Saccolaimus flaviventris</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Eastern Freetail-bat</td>
<td><em>Mormopterus norfolkensis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Little Bent-wing Bat</td>
<td><em>Miniopterus australis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Eastern Bent-wing Bat</td>
<td><em>Miniopterus schreibersii oceanensis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Large-eared Pied Bat</td>
<td><em>Chalinolobus dwyeri</em></td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Eastern False Pipistrelle</td>
<td><em>Falsistrellus tasmaniensis</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Large-footed Myotis</td>
<td><em>Myotis macropus</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Greater Broad-nosed Bat</td>
<td><em>Scoteanax rueppelli</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>Eastern Cave Bat</td>
<td><em>Vespadelus troughtoni</em></td>
<td>V</td>
<td>-</td>
</tr>
<tr>
<td>New Holland Mouse</td>
<td><em>Pseudomys novaehollandiae</em></td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Hastings River Mouse</td>
<td><em>Pseudomys oralis</em></td>
<td>E</td>
<td>E</td>
</tr>
</tbody>
</table>
TSC Act listed Central Hunter Spotted Gum Ironbark Box Forest EEC;
TSC Act listed Central Hunter Box Ironbark Woodland EEC; and
TSC Act listed Hunter Lowland Redgum Forest EEC;

Targeted surveys focused on these threatened species, populations and ecological communities during site inspections.

### 3.2 Borehole inspections

#### 3.2.1 Vegetation cover and classification

Borehole site B1a is described as a secondary grassland dominated by Common Couch (*Cynodon dactylon*) and exotic species commonly found in heavily grazed pastures. Table 4 identified the vegetation cover at the remaining proposed borehole site including listed status under the TSC Act and/or EPBC Act.

<table>
<thead>
<tr>
<th>Site</th>
<th>Vegetation Cover</th>
<th>TSC Act</th>
<th>EPBC Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Yes - Secondary grassland dominated by Common Couch</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B1b</td>
<td>No – exotic grasses and herbs</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B3a</td>
<td>No – exotic grasses and herbs</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

#### 3.2.2 Threatened flora

No threatened plant species were identified within each of the three borehole sites inspected.

#### 3.2.3 Fauna habitats and observations

Descriptions of the fauna habitat and opportunistic observations are described below.

**Tree hollows and stags**

No hollows or dead trees were identified in the drilling area or associated access pathway. Notwithstanding, avoidance of canopy tree species is required to avoid impacts on threatened bird and mammal species, which can be demonstrated at each of the sites.

**Overstorey composition**

A tree canopy was observed to surround one of the sites (i.e. B1b). Rough-barked Apple dominates the tree canopy around this borehole site, which is capable of supporting foraging by threatened bird and bat species. Avoidance of canopy tree species is required to avoid impacts on threatened bird species, which can be demonstrated at this site.

**Fallen logs**

No fallen logs were identified at the three proposed borehole sites.

**Water availability**

There are no permanent natural water features identified at any of the proposed borehole sites.
3.2.4 Summary observations

The results of the borehole site inspections are summarised Table 5 in accordance with the site clearance method outline in Section 2.

Table 5. Summary results for the proposed borehole sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Native Vegetation</th>
<th>Listed TEC?</th>
<th>Threatened Flora present?</th>
<th>Fauna habitat present?</th>
<th>Primary site cleared</th>
<th>Alternate site cleared</th>
<th>New Easting</th>
<th>New Northing</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1a</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>B1b</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>B3a</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
4 IMPACT ASSESSMENT

4.1 Complying sites

All three proposed sites have been investigated and found to comply with the assessment criteria and assumptions.

4.1.1 Affected fauna

The following have been identified as affected fauna species for complying sites:

- Speckled Warbler;
- Hooded Robin; and
- Diamond Firetail.

These species have been identified as affected species as they:

- Feed on seed and insect in the groundcover layer; and
- May nest in the groundcover layer (i.e. Speckled Warbler).

None of these species were observed within the complying sites with the habitat values of these sites to be considered low.

4.1.2 Impact assessment

Impact assessments are provided in Appendix 2 for these species. Recommended mitigation measures to further limit impacts on these species are as follows:

- Avoid all occurrences of fallen logs and hollow-bearing trees (including dead trees).
- Avoid the clearing of live trees and understory.

On the basis of the above mitigation measures it is considered that the drilling of the identified complying borehole site is unlikely to have a significant impact on threatened species, populations, ecological communities and their habitats.

4.2 Conclusions

The proposed borehole project in the Bulga locality, which comprises three proposed boreholes, is unlikely to have a significant impact on threatened species, populations, ecological communities and their habitats provided the following circumstances prevail:

1. Complying sites are cleared in accordance with the proposal description and also meet the recommended mitigation measures outlined in Section 4.1.2.

Should circumstances change involving infringement of the assessment criteria and assumptions and the recommendations stated in Section 0 then it is recommended that a review of the impact assessment be conducted to validate the conclusions provided in this report.
REFERENCES


DSEWPaC (2013) Protected Matters Search for Bulga, NSW.


FIGURES
Figure 1: Site locations
APPENDICIES
Appendix 1: Template - Borehole Clearance Form

<table>
<thead>
<tr>
<th>Factor</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a Vegetation is classed native vegetation – moderate to good condition (&gt;50% native vegetation cover in the groundcover stratum)</td>
<td>Go to 3a</td>
</tr>
<tr>
<td>1b Vegetation is not classed native vegetation (&lt;50% native vegetation cover in the groundcover stratum)</td>
<td>Go to 4a</td>
</tr>
<tr>
<td>2a Native vegetation is a listed threatened ecological community (TEC) on the Threatened Species Conservation Act 1995 and/or Environment Protection and Biodiversity Conservation Act 1999</td>
<td>Relocate Go to 3a</td>
</tr>
<tr>
<td>2b Native vegetation not listed as a threatened ecological community</td>
<td>Go to 4a Type</td>
</tr>
<tr>
<td>3a Alternative site is NOT a TEC</td>
<td>Go to 4a Native? BioMetric Plot completed? Yes / No</td>
</tr>
<tr>
<td>3b Alternative site is a TEC</td>
<td>Go to 7b Notes:</td>
</tr>
</tbody>
</table>

1531 NOW Borehole Assessment: Gunnedah, Spring Ridge, Merriwa and Bulga (June 2013)
<table>
<thead>
<tr>
<th>Bore Hole Site:</th>
<th>Date:</th>
<th>Recorder: Mark Aitken</th>
</tr>
</thead>
</table>

4a Threatened plant species occur within the bore hole impact area (including access)  
☐ Relocate  
☐ Go to 5a  
☐ Type  

4b Threatened plant species do not occur within the bore hole impact area  
☐ Go to 6a  

5a Alternative site does NOT have threatened plant species  
☐ Go to 6a  
☐ Easting:  
☐ Northing:  

5b Alternative site does have threatened plant species  
☐ Go to 7b  
☐ Type  

6a Hollow bearing trees or fallen logs occur within the bore hole impact area  
☐ Go to 7a  
☐ Identify constraints in field with blue flagging tape and on map.  
☐ Drilling contractor to avoid impacts on mapped habitat features. If cannot avoid then site clearance protocol to be implemented by suitably experienced and licenced ecologist at time of habitat alteration.  

6b No fauna habitat features within impact area  
☐ Go to 7a  
☐ No habitat avoidance requirements.  

7a Site cleared  
☐ Signature:  
☐ Photograph:  

7b Site NOT cleared - requires further assessment  
☐ Signature:  
☐ Photograph:  

1531 NOW Borehole Assessment: Gunnedah, Spring Ridge, Morriwa and Bulga (June 2013)
Appendix 2: Impact Assessments for Complying Boreholes

Assessments of significance (Seven Part Tests) have been conducted below for the following items of threatened biodiversity under the TSC Act:

- Diamond Firetail;
- Hooded Robin; and
- Speckled Warbler.

Note: Unless otherwise stated - the habitat and general ecological information contained in these assessments of significance has been taken from the NSW Office of Environment and Heritage (OEH) Threatened Species Profiles database (DECC 2008) and/or the Commonwealth SPRAT database (SEWPaC 2012):


Definitions

The following definitions are taken from the OEH Threatened Species Assessment Guidelines: The Assessment of Significance (DECC 2007) and have been adopted for this assessment.

Subject site: the area to be directly affected by the proposal.

Study area: the subject site and any additional areas which may potentially be affected by the proposal either directly or indirectly.

Direct impacts: those that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated.

Indirect impacts: those that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated.

Local population: the population of a particular species that occurs in the locality.

Locality: the area within 10 km of the study area.
### Diamond Firetail

#### Assessment of Significance criteria (Seven Part Test)

<table>
<thead>
<tr>
<th>Address of criteria</th>
<th>The following is known about the lifecycle of the Diamond Firetail (DEC 2005):</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands.</td>
</tr>
<tr>
<td></td>
<td>Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.</td>
</tr>
<tr>
<td></td>
<td>Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.</td>
</tr>
<tr>
<td></td>
<td>Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season).</td>
</tr>
<tr>
<td></td>
<td>Usually encountered in flocks of between 5 to 40 birds, occasionally more.</td>
</tr>
<tr>
<td></td>
<td>Groups separate into small colonies to breed, between August and January.</td>
</tr>
<tr>
<td></td>
<td>Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests.</td>
</tr>
<tr>
<td></td>
<td>Birds roost in dense shrubs or in smaller nests built especially for roosting.</td>
</tr>
<tr>
<td></td>
<td>Appears to be sedentary, though some populations move locally, especially those in the south.</td>
</tr>
<tr>
<td></td>
<td>Has been recorded in some towns and near farm houses.</td>
</tr>
<tr>
<td></td>
<td>The proposed development is unlikely to have an adverse affect on the species life cycle due to the following:</td>
</tr>
<tr>
<td></td>
<td>The proposed impact is relatively small in scale and will impact approximately 0.1 hectares of potential habitat in the form of disturbed pasture grasses.</td>
</tr>
<tr>
<td></td>
<td>The proposed borehole location will be rehabilitated upon completion of the project. The impact to potential habitat will therefore be short-term.</td>
</tr>
<tr>
<td></td>
<td>No riparian areas will be impacted by the proposal.</td>
</tr>
<tr>
<td></td>
<td>No known nests will be impacted by the proposal.</td>
</tr>
<tr>
<td></td>
<td>No viable populations have been recorded in the study area.</td>
</tr>
</tbody>
</table>

#### b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

N/A
### Diamond Firetail

<table>
<thead>
<tr>
<th>Assessment of Significance criteria (Seven Part Test)</th>
<th>Address of criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>c)</strong> In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td><strong>d)</strong> In relation to the habitat of a threatened species, population or ecological community:</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</td>
<td><strong>N/A</strong></td>
</tr>
<tr>
<td><strong>e)</strong> Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</td>
<td>No critical habitat will be impacted</td>
</tr>
<tr>
<td><strong>f)</strong> Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP</td>
<td>To date, no recovery plan exists for the Diamond Firetail.</td>
</tr>
<tr>
<td><strong>g)</strong> Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP</td>
<td>The proposal will result in the following Key Threatening Processes:</td>
</tr>
<tr>
<td></td>
<td>• Clearing of native vegetation.</td>
</tr>
<tr>
<td></td>
<td>However, it should be noted that the area of impact would be allowed to regenerate following the completion of the borehole drilling.</td>
</tr>
</tbody>
</table>

**Conclusion:** The proposed action is unlikely to have a significant impact on the Diamond Firetail.
**Hooded Robin**

### Assessment of Significance criteria (Seven Part Test)

<table>
<thead>
<tr>
<th>Address of criteria</th>
<th>The following is known about the lifecycle of the Hooded Robin (DEC 2005):</th>
</tr>
</thead>
</table>
| a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction | - Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.  
- Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.  
- Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.  
- Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season.  
- May breed any time between July and November, often rearing several broods.  
- The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.  
- The nest is defended by both sexes with displays of injury-feigning, tumbling across the ground.  
- A clutch of two to three is laid and incubated for fourteen days by the female. Two females often cooperate in brooding. |
| b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction | The proposed development is unlikely to have an adverse affect on the species life cycle due to the following:  
- The proposed impact is relatively small in scale and will impact approximately 0.1 hectares of potential habitat in the form of disturbed pasture grasses..  
- The proposed borehole location will be rehabilitated upon completion of the project. The impact to potential habitat will therefore be short-term.  
- No known nests will be impacted by the proposal.  
- No viable populations have been recorded in the study area. |
| c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:  
  i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or  
  ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction | N/A |

---

**Biodiversity Impact Assessment: NSW Office of Water Groundwater Monitoring Project - Bulga**

Page 29
<table>
<thead>
<tr>
<th>Assessment of Significance criteria (Seven Part Test)</th>
<th>Address of criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>d) In relation to the habitat of a threatened species, population or ecological community:</td>
<td></td>
</tr>
<tr>
<td>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</td>
<td>i. The proposal will result in a short-term impact to approximately 0.1 hectares of potential habitat. Habitat to be impacted will be rehabilitated upon completion of the project and there is other suitable habitat immediately adjacent to the boreholes.</td>
</tr>
<tr>
<td>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</td>
<td>ii. The proposal will not result in fragmentation or isolation of potential habitat.</td>
</tr>
<tr>
<td>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</td>
<td>iii. The potential habitat to be impacted is a low value given the availability of potential habitat immediately adjacent to the borehole site, and the relatively small size of the area to be impacted.</td>
</tr>
<tr>
<td>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</td>
<td>No critical habitat will be impacted</td>
</tr>
<tr>
<td>f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP</td>
<td>To date, no recovery plan exists for the Hooded Robin.</td>
</tr>
</tbody>
</table>
| g) Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP | The proposal will result in the following Key Threatening Processes:  
  - Clearing of native vegetation.  
However, it should be noted that the area of impact would be allowed to regenerate following the completion of the borehole drilling. |

**Conclusion:** The proposed action is unlikely to have a significant impact on the Hooded Robin.
### Speckled Warbler

**Assessment of Significance criteria (Seven Part Test)**

| Address of criteria |  |
|---------------------|--
<p>| <strong>a)</strong> In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction. | The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Within the site, the Speckled Warbler may forage throughout the groundcover stratum and in in cases were dense enough, may build ground nests for breeding. The impact area of 0.1 hectares is a temporary impact. Following installation, the groundcover would revert back to a condition similar to those observed during the site inspections. Due to the small impact area, the low habitat values contained within the impact area and the temporary nature of the impact, it is considered that any adverse impacts on the lifecycle of this species would be negligible and is unlikely to result in a viable local population being placed at risk of extinction. |
| <strong>b)</strong> In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction. | n/a |
| <strong>c)</strong> In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: | n/a |
| i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or | |
| ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction | |
| <strong>d)</strong> In relation to the habitat of a threatened species, population or ecological community: | |
| i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and | i. Approximately 0.1 hectares of low value foraging and breeding habitat would be temporarily removed from the locality. This represents less than 0.01% of the available habitat for this species within the locality. |
| ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and | ii. The small area to be impacted (0.1 hectares) and the temporary nature of the impacts are unlikely to result in habitat any fragmentation or isolation. |
| iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. | iii. The importance of the habitat to be modified is very low. |
| <strong>e)</strong> Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly). | No areas of critical habitat have been mapped for the Speckled Warbler. No impacts on mapped critical habitat would eventuate as a consequence of the proposal. |
| <strong>f)</strong> Whether the action proposed is consistent with the objectives or actions of a recovery plan or TAP | While there is no recovery plan for the Speckled Warbler, it is considered that the proposal would not be consistent with the objectives or actions of such recovery plan or TAP. With regard to the implementation and/or success of a recovery plan and/or |</p>
<table>
<thead>
<tr>
<th>Speckled Warbler</th>
<th>TAPs it is considered that the extent of any inconsistency brought by the proposal is unlikely to be of any significant consequence for the recover of this species.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>g)</strong> Whether the action proposed constitutes or is part of a KTP or is likely to result in the operation of, or increase the impact of, a KTP</td>
<td></td>
</tr>
<tr>
<td>The proposal may potentially constitute or promote the following KTP under the NSW TSC Act.</td>
<td></td>
</tr>
<tr>
<td>• Clearing of native vegetation</td>
<td></td>
</tr>
<tr>
<td>However, it should be noted that the area of impact would be allowed to regenerate following the completion of the borehole drilling.</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion:** The proposed action is unlikely to have a significant impact on the Speckled Warbler.
**GLOSSARY**

**Direct impacts**
Impacts that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat (DEC 2007).

**Indirect impacts**
Impacts that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas (DECC 2007).

**Local occurrence**
The distribution of an ecological community within the study area and continuous with it.

**Local population**
The population that occurs in the study area and contiguous with it.

**Locality**
The area within 10 km of the study area.

**Study area**
The site and any additional areas which may potentially be affected by the proposal either directly or indirectly.

**Site**
The area directly affected by the proposal.

**Subject species**
List of threatened species considered in the assessment.

**Threatened biodiversity**
Threatened species, populations, ecological communities or their habitats listed on the TSC and/or EPBC Acts.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMA</td>
<td>Catchment management authority</td>
</tr>
<tr>
<td>EEC</td>
<td>Endangered ecological community</td>
</tr>
<tr>
<td>EP&amp;A Act</td>
<td>NSW <em>Environmental Planning and Assessment Act 1979</em></td>
</tr>
<tr>
<td>EPBC Act</td>
<td>Commonwealth <em>Environment Protection and Biodiversity Conservation Act 1999</em></td>
</tr>
<tr>
<td>EPI</td>
<td>Environmental planning instrument</td>
</tr>
<tr>
<td>LGA</td>
<td>Local government area</td>
</tr>
<tr>
<td>Matters of NES</td>
<td>matters of national environmental significance.</td>
</tr>
<tr>
<td>OEH</td>
<td>NSW Office of Environment and Heritage</td>
</tr>
<tr>
<td>RDP</td>
<td>Rapid data point</td>
</tr>
<tr>
<td>SEPP</td>
<td>State environmental planning policy</td>
</tr>
<tr>
<td>SEWPaC</td>
<td>Commonwealth Department of Sustainability, Environment, Water, Population and Communities</td>
</tr>
<tr>
<td>TEC</td>
<td>Threatened ecological community as listed on the TSC and or EPBC Acts. Includes vulnerable, endangered and critically endangered ecological communities.</td>
</tr>
<tr>
<td>TSC Act</td>
<td>NSW <em>Threatened Species Conservation Act 1995</em></td>
</tr>
</tbody>
</table>